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**A Tool for Predicting the Likelihood of Information Systems
Implementation Failure:
Case of Kenya National Highways Authority**

William Okari Masita

**A Dissertation submitted to Strathmore University in partial fulfilment
of the requirements for Master of Science in computer-based
information systems**

**Faculty of Information Technology
Strathmore University
Nairobi, Kenya**

June, 2017

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Declaration

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Approval

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Abstract

Every implementer of information systems would desire to have a successful project implementation. To achieve this, they work towards eliminating causes of failure. Therefore, there is need to know these causes before implementation begins. This study sought to investigate the causes of information systems implementation failure and come up with a tool to predict likelihood of failure. To achieve this objective, relevant literature was reviewed covering approaches used in implementing information systems, ways of measuring success in implementation and techniques used in mitigating failure. Both quantitative and qualitative research design methods were used to study information systems implementation projects at Kenya National Highways Authority (KeNHA). Arising from the findings, it was found that IS implementation projects fail due to inadequate user involvement, changing scope, requirements not well understood, poor estimation techniques, failure to manage expectations of users, failure to manage the implementation plan, failure to adapt to business change, lack of commitment to a systems implementation methodology, poor user commitment, lack of top management support, insufficient staffing, team members lack of requisite knowledge and skills and inadequate people management skills. In order to come up with the proposed solution, the research findings were analysed through use case diagrams and sequence diagrams. Following this analysis, the system was designed using design class diagrams and entity relationship diagrams. Using this design, the system was built using PHP 5.6. MySQL database was also incorporated at the back end. The system incorporates main causes of failure in implementation of information systems. Existence of these factors in any information system implementation project is analysed taking into consideration their relative weights and materiality. Once analysed, a report will be produced to indicate whether there is likelihood of failure. This tool is advantageous in that there will be early warning in case failure is likely and therefore organisations will institute corrective mechanisms prior to commencement of the implementation process.

Table of Contents

Declaration	ii
Abstract.....	iii
List of Figures.....	viii
List of Tables	ix
Abbreviations and Acronyms	x
Acknowledgements	xi
Dedication	xii
Chapter One: Introduction	1
1.1 Background of the Study.....	1
1.2 Problem Statement	3
1.3 Research Objectives	4
1.4 Research Questions	4
1.5 Justification	5
1.6 Scope.....	6
1.7 Limitations of the Study.....	6
Chapter Two: Literature Review	8
2.1 Introduction	8
2.2 Theoretical Framework	8
2.2.1 Socio-technical Approach	8
2.2.2 Social Construction of Technology.....	11
2.2.3 Organizational Information Processing Theory (OIPT).....	13
2.2.4 Activity Theory	15
2.2.5 Related studies on factors that lead to information systems implementation failure	16
2.2.6 Measuring Success of IS Implementation	18
2.2.7 Approaches and techniques used in mitigating information system implementation failures	19
Chapter Three: Research Methodology	24
3.1 Introduction	24
3.2 Research Design.....	24
3.2.1 System Architecture.....	24

3.2.2	System Analysis	25
3.2.3	System Design.....	25
3.2.4	System Development and Implementation.....	26
3.2.5	System Testing	26
3.3	Research Location	26
3.4	Population and Sampling	27
3.5	Data Collection Methods.....	27
3.6	Data Analysis	27
3.7	Research Quality	27
3.7.1	Validity.....	27
3.7.2	Reliability	28
3.7.3	Objectivity.....	28
3.8	Ethical Considerations	28
Chapter Four: System Design and Architecture.....		30
4.1	Introduction	30
4.2	Results of Questionnaire	30
4.2.1	Highest level of education of respondents	30
4.2.2	Role of the respondents.....	31
4.2.3	Categories of information systems implemented	32
4.2.4	Causes of information systems implementation failure	33
4.2.5	Rating the factors that lead to information systems implementation failure.....	34
4.2.6	Methods of predicting information systems implementation failure	35
4.2.7	Ranking the methods of predicting failure of information systems	36
4.2.8	Criteria for determining failure of information systems	37
4.2.9	Reaction of management when failure was predicted.....	37
4.2.10	Approaches used in mitigating information systems implementation failure.....	38
4.2.11	Rating of effectiveness of approaches used in mitigation of IS implementation failure.....	39
4.2.12	Approaches used in implementation of information systems	40
4.2.13	Rating of effectiveness in approaches for information systems implementation.....	41
4.3	Proposed System Architecture	41
4.4	Requirements and System Analysis	42
4.4.1	Requirements Analysis.....	42
4.4.2	System Analysis	43
4.4.3	Sequence Diagram	45

4.5	System Design.....	45
4.5.1	Entity Relationship Diagram	46
4.5.2	Design Class Diagram.....	46
4.5.3	Security Design	47
Chapter Five: System Implementation and Testing.....		48
5.1	Introduction.....	48
5.2	System Development Life Cycle.....	48
5.3	System Implementation.....	49
5.3.1	Front End.....	49
5.3.2	Back End	53
5.4	System Testing	55
5.4.1	Functionality Testing	56
5.4.2	Usability Testing	56
5.4.2.1	Usability Testing Results	57
5.4.2.1.1	Success in Login	57
5.4.2.1.2	Predicting Likelihood of Failure	57
5.4.2.1.3	Qualitative Attributes of the System	58
Chapter Six: Discussion.....		59
6.1	Introduction	59
6.2	Causes of Information Systems Implementation Failure	59
6.3	Approaches for Mitigating Information Systems Implementation Failure	61
6.4	Development of the Tool for Predicting Information Systems Implementation Failure.....	61
6.5	Prototype for Predicting Likelihood of Information Systems Implementation Failure.....	61
6.6	Testing the Tool for Predicting Failure in Implementation of Information Systems	62
6.7	Advantages of the tool for predicting Failure in Implementation of Information Systems	62
Chapter Seven: Conclusions, Recommendations and Future Work		64
7.1	Introduction.....	64
7.2	Conclusion.....	64
7.3	Recommendations	65
7.4	Future Work	65
References.....		67
Appendices.....		71
Appendix A: Questionnaire		71

Section A: Respondent’s Demographic Information..... 71
Section B: Causes of Information Systems Implementation Failure 72
Section C: Approaches Used in Mitigating Information Systems Implementation Failure..... 74
Section D: Development of the Tool for Prediction of Information Systems Implementation Failure... 75
Appendix B: Detailed Description of Use Cases..... 76
Appendix C: Usability Testing Questionnaire..... 79
Appendix D: Turnitin Report..... 80

List of Figures

Figure 4.1: Highest level of education of respondents	30
Figure 4.2: Roles of respondents	31
Figure 4.3: Categories of information systems implemented	32
Figure 4.4: Causes of information systems implementation failure	33
Figure 4.5: Rating for factors causing information systems failure.....	34
Figure 4.6: Methods for predicting information systems implementation failure	35
Figure 4.7: Rating for effectiveness in methods of identifying failure.....	36
Figure 4.8: Ways of determining whether an IS implementation project had failed	37
Figure 4.9: Management reactions when Failure of IS implementation is detected.....	37
Figure 4.10: Approaches used in mitigating IS implementation failure	38
Figure 4.11: Rating of effectiveness of approaches used in mitigation of IS implementation failure.....	39
Figure 4.12: Approaches used in IS implementation.....	40
Figure 4.13: Rating of effectiveness of approaches used in IS implementation.....	41
Figure 4.14: System architecture	42
Figure 4.15: Use-case diagram	44
Figure 4.16: Sequence diagram	45
Figure 4.17: Entity Relationship Diagram.....	46
Figure 4.18: Design Class Diagram.....	47
Figure 5.1: Information System Development Cycle (source: Davies, 2009).....	49
Figure 5.2: Login page wireframe	49
Figure 5.3: Project creation wireframe	50
Figure 5.4: Feedback for password reset wireframe.....	50
Figure 5.5: Assessment of process driven issues wireframe.....	51
Figure 5.6: Assessment of content driven issues wireframe.....	51
Figure 5.7: Assessment of context driven issues wireframe.....	52
Figure 5.8: Results of risk assessment wireframe.....	52
Figure 5.9: New user set-up wireframe	53
Figure 5.10: Editing a user wireframe	54
Figure 5.11: Account lockout policy wireframe	54
Figure 5.12: Restriction settings for file uploads wireframe	54
Figure 5.13: Mail settings wireframe.....	55
Figure 5.14: Audit trail wireframe.....	55
Figure 5.15: Respondents who successfully logged in	57
Figure 5.16: Information systems whose likelihood of failure was successfully predicted.....	57
Figure 5.17: Rating on the qualitative attributes of the application.....	58

List of Tables

Table 2.1: Types of risks as per ERM	20
Table 2.2: Likelihood levels	21
Table 2.3: Impact levels.....	22
Table 4.1: User Requirements	42

Abbreviations and Acronyms

AC	- Actual Cost
DBMS	- Database Management System
DCD	- Design Class Diagram
ERD	- Entity Relationship Diagram
ERP	- Enterprise Resource Planning
ERM	- Enterprise Risk Management
ETHICS	- Effective Technical & Human Implementation of Computer-based Systems
EV	- Earned Value
EVM	- Earned Value Management
EWS	- Early Warning Signs
ICT	- Information and Communication Technology
IS	- Information System
IT	- Information Technology
KeNHA	- Kenya National Highways Authority
MSC	- Master of Science
OIPT	- Organizational Information Processing Theory
OOA	- Object-oriented Analysis
PHP	- Hyper-text Preprocessor
PV	- Planned Value
RAD	- Rapid Applications Development
SCOT	- Social Construction of Technology
SDLC	- System Development Life Cycle
SPSS	- Statistical Package for Social Sciences

Acknowledgements

In completing this dissertation, a lot of assistance was sought from persons and organizations that would provide the necessary input. The dissertation would not have been successful without the cooperative assistance of many unseen hands. First and foremost I owe special thanks to God Almighty for giving me the grace to conduct this exercise.

This research work would not have been complete without the acknowledgements of the personalities and institutions who contributed enormously towards its writing. I first wish to recognize Strathmore University and its entire staff for the facilities, assistance and relentless support they accorded me, all the lecturers for very humbly imparting their knowledge.

Special thanks go to KeNHA who allowed me to use data within their organization for academic purposes. Many thanks to the officers who gave me their time and data without which this research project proposal would not have been feasible.

I wish to express my gratitude and appreciation to my dedicated supervisor, Dr. Vincent Omwenga. His guidance, positive criticism, encouragement and patience was enormous and inspirational, never tired and always at hand to offer professional help in the efforts of guiding me in the development of topic, research proposal and final report.

Dedication

This dissertation is dedicated to my lovely wife Zipporah who offered maximum support during the course of the entire MSC programme and especially during the final dissertation writing period. Special dedication to my dear daughters, Nicole and Chloè who always remained my source of joy, inspiration and desire to excel academically. I am humbled to have you.

Chapter One: Introduction

1.1 Background of the Study

An information system (IS) is a combination of Information and Communication Technologies (ICTs)—hardware, software, and telecommunications, used to collect, create, store, and disseminate information to support decision making, coordination, control, and general management of an organization (Laudon & Laudon, 2012). Spalding (2013) noted that the group of components that together form an information system help organisations to increase competitiveness and gain better information for decision making. Therefore, management of information is critical for the prosperity of every organization (Beynon-Davies, 2009).

Information systems play a very important role in the strategic success of a business by enabling enterprise collaboration and management. The role played by information systems is vital to businesses in ensuring their strategic success (Hevner, March, Park, & Ram, 2014). Investment in information systems will enhance effectiveness of processes, reduce costs, improve decision making and support strategic change (Sullivan & Bozeman, 2010). Therefore, in order to improve efficiency and effectiveness in their procedures and activities, organisations implement information systems (Kornkaew, 2012).

Kornkaew (2012) defined information system implementation as the procedures performed for completing the design in approved system design documents and to test, install and begin to use the new or revised information system. It is an ongoing process which includes the deployment of the business information system through feasibility study, analysis, design, programming, training, conversion and installation of the system. Successful implementation of information systems is important in order to maintain the competitive position of an organisation (Kornkaew, 2012). Al-Sabaawi (2015) noted that IS implementation process is a highly complicated task which may take months to implement but years to realize required benefits from the system. These benefits are not easy to claim as organisations face numerous problems during and after the implementation of the system. Kaur and Aggrawal (2013) found that during the past two decades investments in information technology (IT) have increased significantly. However, the rate of failure remains quite high.

According to research conducted by The Royal Academy of Engineering and British Computing Society (2014), 84% of public sector IS implementation projects end up in failure. Thus, the remaining 16% of the IS Implementation projects were successful. Success in this case was determined by completion within budget, on time and meeting the set objectives. Further, Martineau and Shumway (2009) found that 44% of information systems development and implementation projects ended in failure. This amounts to almost half of all the projects implemented. On the other hand, the proportion of successful projects amounts to 24%, equivalent to approximately one-quarter. The remaining “challenged” projects account for 32%. Thus, the conclusion was that the majority of IS implementation projects result in failure. However, IS/IT failures were covered up, ignored, and/or rationalized by IS/IT personnel (Kaur & Aggrawal, 2013).

Although IS/IT systems can bring competitive advantage to organisations, the high failure rate in implementing such systems is a major concern (Al-Sabaawi, 2015). Nyandiere, Kamuzora, Lukandu and Omwenga (2014) identified the following uncertainties to implementation of information systems: the system specifications, user requirements, budget (cost) estimates, time to be spent in the system implementation and how the system implementation process will affect normal operations of the business. Thus, uncertainties to implementation of information systems need to be addressed at the planning stage (Nyandiere, Kamuzora, Lukandu & Omwenga, 2014). Buruncuk and Gulcer (2014) found that ICT projects fail when organisations fail to determine the factors that affect success of the project at the very beginning. Gattiker and Goodhue (2005) recommended the need to explore uncertainties within an organisation with the aim of finding a way of mitigating challenges before they occur. Therefore, Organisations implementing information systems may adopt varied strategies. Understanding the uncertainties involved in integrating a new information system into the existing system environment is one of such strategies. This strategy aims at minimizing challenges that may arise during implementation (Nyandiere, Kamuzora, Lukandu & Omwenga, 2014). There is therefore need to find a way of mitigating the challenges before the information systems are implemented (Gattiker & Goodhue, 2005).

1.2 Problem Statement

Information systems are implemented by organizations in order to address certain functional weaknesses through reorganization of their business processes (Rajagopal, 2013). The implementation of information systems brings about both positive and negative effects (Kornkaew, 2012). The effects of system implementation are felt much more in Enterprise systems implementation which can be complex, costly and time consuming, and involving management, staff, consultants and vendors with possible conflicting organizational culture and the new information system culture (Basoglu, Daim & Kerimoglu, 2007). The negative effects of information systems mainly occur when the systems fail either during implementation or at the deployment stage. The consequence of failure of information systems implementation should serve as a pointer to an organisation to develop effective strategies aimed at avoiding failure of the system and achieving success (Kornkaew, 2012).

Kornkaew (2012) notes that the strategies aimed at addressing system failures must focus on key aspects like information technology infrastructure and alignment to organizational goals. The key to achieving this is by clearly identifying the factors that may affect system implementation. Unfortunately, many organizations do not have the ability to identify these factors before the system implementation process begins and this leaves these organizations at a risk of experiencing system failure (Al-Sabaawi, 2015). Moreover, organizations face various challenges specific to the different stages of the information system implementation process and therefore it cannot be template (Beaumaster, 2012). As a result, there is need to come up with ways to deal with these challenges by developing a rubric that can be used to identify the likely factors that may affect system implementation for a particular organization (Gichoya, 2005). Gichoya (2005) argues that for the rubric to succeed, action should be taken to increase the chances of project success by reducing the impact of the factors for failure and increasing the strength of the factors for success. Aineruhanga (2010) observes that one way of having a working rubric is to institute effective planning to help in reducing wastage of resources by recognizing the requirements for successful IS implementation rather than going into an IS implementation without first analyzing its chances of success. Therefore, this study endeavours to develop an institutional focused risk factor identification tool for purposes of pre-emptying the likelihood of occurrence of a system failure. This study will

enrich the work done by Aming'a and Omwenga (2016) by using an ERM framework that specifically considers IS risks as opposed to the general project risks. The risk management methodology proposed will identify the possible elements that may affect the project during its lifecycle, thus helping to predict the future performance of a project before it begins. The practicality in implementation of this tool will be tested using information systems implementation projects at Kenya National Highways Authority (KeNHA). This organisation has been selected for study because success in information systems implementations for the roads sector in Kenya has not been studied before. KeNHA is the largest single organisation in the roads sector in Kenya. Thus, findings from studying this organization can be representative of other organisations in the sector.

1.3 Research Objectives

The objectives of this research are the following:

- i. To investigate the causes of information systems implementation failure.
- ii. To assess approaches used in mitigating information system implementation failure.
- iii. To develop an analytical tool for predicting the likelihood of information system implementation failure.
- iv. To develop a system prototype for predicting likelihood of information systems implementation failure.
- v. To carry out testing of the tool using IS implementation projects at KeNHA.

1.4 Research Questions

Arising from the research objectives, the following research questions were identified:

- i. What are the factors whose presence or absence may lead to failure of information systems implementation projects?
- ii. What approaches are available for mitigating failure in information systems implementation projects?
- iii. How can the approaches be used in developing a tool that can predict likelihood of failure in information systems implementation projects?
- iv. How can the tool for predicting likelihood of failure in information systems implementation be converted into a prototype?
- v. How can the tool be tested?

1.5 Justification

Problems encountered by organizations in the process of implementing information systems arise due to lack of awareness of the various challenging issues. To date, research has been scanty in developing models and frameworks to predict initial and ongoing implementation success (Brown & Vessey, 2009). Research has been done for IS/IT implementations in numerous environments but there is a serious gap in the literature regarding implementations in the developing countries contexts (Al-Sabaawi, 2015). Heeks (2012) observes that there is a big difference between ICT implementation and use between developed and developing countries. Milis and Mercken (2012) noted that the rate of failure for enterprise resource planning (ERP) was more than 70 per cent and therefore implementation of information systems is affected by problems which may imply that it may not be easy to succeed.

Heeks (2012) reported that in developing countries, planning and management of IS projects was very poor. Gichoya (2005) concluded that the issue of ICT failure can be analyzed by assuming that learning from IS failures will provide important lessons for formulating successful strategies for the planning, development, implementation and management of information systems. Buruncuk and Gulcer (2014) found that all factors were generally common for many companies but weights and priorities of these factors that affect IT success and failure differ from one company to another based on their culture, region, organization structure and environment.

At its core, the problem addressed in this study involves the effects and consequences of development and deployment of information systems in an organization and its business processes. This is aimed at developing a tool to predict the likelihood of failure of information systems implementation. This will be important in helping management to determine whether key ingredients are in place to ensure success in implementation and if not, then the organization's resources would not be committed for a process with a likelihood of failure. Thus, information obtained from this tool will assist management in making decisions on how best to proceed with a particular information system implementation.

1.6 Scope

The research addresses real world information systems implementation practices and mirrors these against their consequent successes or failures with the aim of generating an ideal predictive tool for adoption. To achieve this, the study will investigate the causes of failure in implementation of information systems and test its practicality on information systems implementation projects at KeNHA. Within this organisation, primary emphasis will be laid on the ICT Department. In addition, other users of information systems outside of the ICT Department will also be included in the study. Specific practical implementation processes will be studied covering feasibility study, planning, analysis, design and implementation. User involvement in the initiation, design, development, testing, deployment and acceptance of information systems will be a critical element in this study. Further, the effect of organisation culture on system implementation will also be studied.

This study will rely heavily on the available approaches to information systems implementation in order to develop a tool to predict the likelihood of failure. Approaches to be used are; sociotechnical, social construction of technology, organizational information processing theory and activity theory. The researcher will combine key elements of these theories and draw upon their conclusions in developing the tool.

1.7 Limitations of the Study

Organizations regard their IT platforms with high levels of confidentiality and security. In order to enhance this, the organization being studied may be reluctant to release information or respond to some of the questions posed. To counter this, the researcher will present authorization credentials for conducting research. In addition, the respondents and management of KeNHA will be assured that information provided will be kept confidential and their prior authorization sought in case there is need for its release.

Since the study will involve utilization of comprehensive data sets as availed by KeNHA, the researcher may encounter cases of uncooperative respondents thus delaying research data collection process. This will be overcome by consistent and persistent visits to their various departments to remind the non-respondents on the need for that data. In addition, various communication media like email and phone calls will be used to enhance faster

response. Respondents will also be reminded that the findings from this research will be beneficial to them as well.

Additionally, the research may be hampered by time constraints since the research fieldwork will be conducted simultaneously with other course work activities. To mitigate this limitation, the researcher will work over time during lunch break, evenings and weekends.

Chapter Two: Literature Review

2.1 Introduction

This chapter reviews the theoretical frameworks of IS implementation. Four theoretical concepts are reviewed and discussed, that is, sociotechnical approach, social construction of technology (SCOT), organizational information processing theory (OIPT) and activity theory. In addition, ways of measuring IS implementation success are also explored. Finally, tools and techniques of mitigating failure in IS implementation projects are also reviewed. This is intended to identify the factors that influence the process of IS implementation and how lack of these factors may lead to failure. In order to develop an algorithm for the study, an empirical review is also elaborated.

2.2 Theoretical Framework

The theoretical framework is the structure that can hold or support a theory of a research study. It introduces and describes the theory that explains why the research problem under study exists. A theoretical framework consists of concepts and, together with their definitions and reference to relevant scholarly literature, existing theory that is used for the particular study. It is an explicit statement of theoretical assumptions and therefore permits the researcher to evaluate them critically. The theoretical framework connects the researcher to existing knowledge. Guided by a relevant theory, the researcher is given a basis for choice of hypotheses and research methods. Articulating the theoretical assumptions of a research study will enable the researcher to address questions of why and how. A theoretical framework specifies which key variables influence a phenomenon of interest and highlights the need to examine how those key variables might differ and under what circumstances. This study will be guided by the following theories:

- i. Socio-technical theory
- ii. Social construction of technology
- iii. Organizational information processing theory
- iv. Activity theory

2.2.1 Socio-technical Approach

Socio-technical approach can be traced back to researchers at the Tavistock Institute of Human Relations in England (Mumford, 2006). These researchers thought that their findings could be applicable to the cadre of employees whose daily chores entail routine

tasks and who could neither derive job satisfaction nor a clear path and prospect for growth (Mumford, 2006). This theory emphasized the importance of allowing employees to participate in the design and development of new systems and to clearly determine how the new system could result in enhanced productivity of their work. This therefore meant that equal weight should be accorded to both the technical and social aspects of work.

The sociotechnical approach is explained as the nexus between people and technologies, the context within which people and technologies are mutually embedded and the benefits derived from collective action (Sawyer & Jarahi, 2013). As Lee (2007) notes, research in the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomena that emerge when the two interact. Sociotechnical research is premised on the interdependent and inextricably linked relationships among the features of any technological object or system and the social norms, rules of use and participation by a broad range of human stakeholders. Sawyer and Jarahi (2013) concluded that this mutual constitution of social and technological is the basis of the term sociotechnical. The premise of collective action is that joint interests and multiple goals are intertwined with both the context and the technological elements (Kling & Lamb, 2010).

The primary objective of Tavistock researchers was to bring a human face in the design of jobs through restructuring of some practices and technologies in the work place. The focus on interdependency among technology and human organization is done by attending to material triggers, actions of social groups, pressures from contextual influences and the complex processes of development, adoption, adaptation and use of new (digital) technologies in people's social worlds (Jones & Orlikowski, 2007). The sociotechnical premise is that all technology cannot be separated from the social situations existing in its environment. Thus, design, development, deployment and uses of information systems helps to reshape the social structure through mutual adaptation (Sawyer & Jarahi, 2013).

The sociotechnical approach disagrees with the view that organizational or social change is caused by a single or dominant cause (Sawyer & Jarahi, 2013). This approach recognizes the complex and uncertain nature of technological change. Thus,

sociotechnical approaches demand an appreciation of the nature of changes in organizational processes in addition to the people involved and the technological features. Sociotechnical researchers therefore seek to concentrate on the combined effort of institutions, people and technologies and their collective role in the design, development, deployment, take up and uses of information systems (King, 2011). Therefore, any distinction between IS/ICT and society as context is an over simplification which obscures the complex processes where human and technologies jointly construct sociotechnical entities (Sawyer & Jarahi, 2013).

Avgerou, Ciborra and Land (2004) raised concern that a significant majority of research work on information systems was skewed towards engineering approaches which concentrated on the technical aspects of work to the disadvantage of the social aspects. Sawyer and Jarahi (2013) identified the system development methodology called Effective Technical & Human Implementation of Computer-based Systems (ETHICS) as important and applicable in the current environment. ETHICS consolidated sociotechnical principles and entailed two phases in the design of information systems i.e., the design of IT-based systems and the design of work processes around those systems. It aims for a positive interaction of people and technologies. The methodology begins with the design of work prior to the design of systems. Because of its emphasis of work design around information systems, ETHICS aims at the development of information systems that are both technically viable and promote job satisfaction through implementation of effective work practices (Alter, 2006). Consequently, an information system designed for the sole purpose of meeting technical requirements without considering the work practices around it is likely to have unpredictable user consequences (Mumford, 2006).

Participation of users during the stages of system design and implementation of the designed information systems has been widely adopted in practice (Land & Hirschheim, 2013). In its original sense, user participation means that all intended users or a representative majority should be involved in all information systems development tasks and stages i.e., from design to deployment. Involvement of employees in the design and implementation of information systems serves to empower employees to organize their own jobs around information systems (Kaur & Aggrawal, 2013). This thinking indicates a strong orientation towards user-involvement in designing information systems and

encourages quality of working life as well as reflecting a human face of information and communication technologies (ICTs). This is in agreement with the Tavistock findings.

The sociotechnical theory is important in developing a model for predicting the likelihood of failure in implementation of information systems. Singular focus on the technical aspects of information systems implementation may result to a system that may not be accepted by the intended users. Lack of user acceptance is an indication of failure of implemented information systems. This theory enables an understanding of the relationship among ICT and organizational actions, processes, structures and changes. The sociotechnical theory and its underlying premises provides a range of conceptual tools that advance the empirical bases, theoretical understanding, and design interventions relative to IS in organizations and society. In summary, the sociotechnical approaches to studying ICT and IS provides useful guidance on how people's work practices and organizational arrangements are afforded by technological resources and inhibited by technological constraints. This is important in understanding factors that influence IS implementation. Thus, this theory will be of benefit to this study as it will assist the researcher to understand the effect of user involvement or lack of it and how this may influence likelihood of IS implementation failure.

2.2.2 Social Construction of Technology

Social construction of technology (SCOT) asserts that technological advancement does not precede human action, but that rather, human action determines and leads to technological progress (Bartis & Mitev, 2008). According to Bartis and Mitev (2008), social construction theory is both a theory and a methodology. It is a methodology because it clearly points out the procedure to be adhered to in analyzing the factors which lead to technological failure or success.

The social construction theory emphasizes the flexibility with which technological aspects are interpreted by different relevant social groups (Bartis & Mitev, 2008). Different relevant social groups may attribute different meanings and problems to the same technological elements. This will result in flexibility of interpreting their impact. Therefore, depending on how each relevant social group interprets different challenges will give varied solutions to the same technological element. SCOT views technological advancement as a social process. This enables us to understand the effect of social factors

on technology. It also provides a framework for understanding how technologies are replaced by further technological enhancements (Wilson & Howcroft, 2005). The implication here is that in identifying relevant homogenous social groups, it is possible to come up with a combination of different meanings and interpretations of the situation and of the technology. According to social construction theory, therefore, the perception of success or failure for the same technological element can differ between social groups i.e., what one may perceive as successful could be considered a failure by someone else. Wilson and Howcroft (2005) argue that use of the terms 'success' and 'failure' does not clearly indicate the social group for which the technology presents itself as either a failure or a success in line with the same interpretation.

Relevant social groups are members of a social group who share the same general meaning about the technological element being considered (Wilson & Howcroft, 2005). A direct implication of this interpretation is that analysts must identify and define the groups that would take part in the process of designing technological implementations and what their role would be in the whole process. One of the easily identifiable relevant groups is the users and the producers of the technological element. However, some subgroups that could be considered as part of the relevant groups could be excluded, for example, users with different socioeconomic status or even competing producers. Wilson and Howcroft (2005) also noted that some relevant groups may neither be users nor producers of the technology. Examples of these include journalists, politicians and civil groups. Therefore, a distinction between relevant social groups is possible based on the shared or different interpretations of the technology in question i.e., this distinction between relevant social groups is possible based on interpretive flexibility.

An understanding of SCOT is relevant in predicting the likelihood of failure in implementation of information systems. Arising from the fact that technologies have different interpretive meanings amongst the various social groups, there are a variety of ways of coming up with technologies. A design would only be one of the solutions in the large field of technical possibilities, reflecting the interpretive flexibilities of various relevant groups. In this sense, conflict may arise between criteria that are difficult to tackle using technology, or conflicts between the relevant groups. Different groups in different societies may encounter different problems, leading to different designs for information systems. Social construction research methodology starts by reconstructing

alternative interpretations of the technology, analyze the problems and conflicts these interpretations give rise to, and connect them to the design features of the information system under consideration. This theory is important in developing a tool that would predict the likelihood of failure for an IS implementation as it will assist in determining what failure may mean based on the relevant social group for which the information system will serve. Thus, the theory is important in determining how persons who participate in implementation of information systems are selected and how this may have an influence in predicting failure.

2.2.3 Organizational Information Processing Theory (OIPT)

Organizational information processing theory (OIPT) postulates that the main task in organizational design is avoidance of uncertainty (Nyandiere, Kamuzora, Lukandu, & Omwenga, 2014). Uncertainty results from lack of connectivity between organizational functions and processes. Factors that lead to lack of connectivity between function and process include organizational misfit (i.e., data, process, use), organizational resistance, adaptation problems (ERP adaptation, or process adaptation), differentiation among sub-units, and organizational structure (Morton & Qing, 2008). Thus, uncertainty is conceptualized by OIPT as a lack of information about organizational tasks and the environment of operation.

The level of uncertainty may vary from organization to organization or even between departments of the same organization (Nyandiere, Kamuzora, Lukandu & Omwenga, 2014). The level of uncertainty in an organization may dictate the ideal organization structure to be adopted. Therefore, in order to survive in the dynamic market environment, organizations need to align their operating procedures and organization structures with the prevailing uncertainty. Gattiker and Goodhue (2005) recommended adoption of hierarchical structures and standard operating procedure where the level of uncertainty is low while for high uncertainty environments, computerized information systems and lateral organization structures would ideally be adopted.

Gattiker & Goodhue (2005) identified various sources of uncertainty that exist in environments where organizations operate. These are: the characteristics of the self-contained tasks that departments must execute (internal context), instability of the external environment, interdependence with other sub-units and differentiation among

sub-units. In order to achieve success in implementation of information systems, integration and standardization are the most critical factors. These are closely related to the interdependencies and differentiation between sub-units of an organization as the main sources of uncertainties which are internal in context. Greater interdependence among organizational departments is associated with greater benefits from information systems. On the other hand, differentiation among organizational departments can lead to significant likelihood of information systems implementation failure (Karimi, Somers & Gupta, 2004).

Environmental uncertainty can be addressed by studying the complexity of the environment and dynamism or the frequency of changes to various environmental variables affecting systems implementation from the perspective of interdependencies and differentiation. According to Jones, Boushey and Workman (2013), people make choices based on the level of risk and uncertainty existing in the environment that they operate in. Thus, individuals are unaware of the outcomes that will result from strategic choices and uncertain of the procedures of making choices and are also uncertain about their own preferences and procedures for choices they make (Jones, Boushey & Workman, 2013).

Factors affecting implementation of information systems have been differentiated between conducted factors and environmental factors (Chen & Chang, 2009). Conducted factors that influence IS implementation tend to be internal and include, among others, top management support, user support, project team member competence, project manager leadership skills, vendor support, consultants competence, level of system customization and data quality and post-implementation support. On the other hand, environmental factors that influence implementation of IS tend to be external and include, among others: rapid technological changes, global competitors, unpredictability of customer taste, severe regulatory restrictions, shortage of labour or raw materials, relative lack of exploitable opportunities and resources. Conducted factors have the positive influence on coordination improvement and task efficiency while environmental factors have the positive influence on coordination improvement but negative influence on task efficiency.

To achieve success, there is need to remove any uncertainties that relate to IS implementation. These uncertainties include: the system specifications, user requirements, budget (cost) estimates, time to be spent in the system implementation and how the system implementation process will affect normal operations of the business. The uncertainties need to be addressed at the time of systems planning. This theory is therefore important in developing a tool that will predict failure of information systems implementation projects. Understanding the risks and uncertainties that organizations face will assist in understanding the operating environment and therefore enhance prediction of likelihood of failure. This is important in that if failure is predicted, the organization's resources will not be committed.

2.2.4 Activity Theory

Activity theory involves the design of information systems based on actions and processes that an organization can use (Nyandiere, Kamuzora, Lukandu & Omwenga, 2014). According to Mursu, Luukkonen, Toiranen and Korpela (2007), activity theory is the understanding of computer-based artefacts as instruments for work activities and materials for systems design for organizations. It is a philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time.

The description above implies that the design of an information system should consider both the interactions between the human activities and the elements that form the information system. Thus, in information systems designers should consider both social and technical aspects. Activity theory therefore requires designers of information systems to understand the key human actions and practices that are to be considered in the implementation of the information systems. Nyandiere, Kamuzora, Lukandu and Omwenga (2014) noted that human actions and practices are important in informing the technical elements to be used in the design and implementation of information systems. This theory therefore encourages consideration of the views of users in the design of information systems.

Activity theory reinforces the need to have an all-inclusive approach in the design and implementation of information systems (Mursu, Luukkonen, Toiranen & Korpela, 2007). Thus, a need arises for the development of a model that considers what the intended users

do in their daily work environment. Therefore, users of proposed information systems should be given an opportunity to participate in the design and implementation. Mursu, Luukkonen, Toiranen and Korpela (2007) proposed the following stages in the design of user-driven information systems: start with the work activity as a systemic entity; see the technology, including computer-based technology, as a tool to facilitate work, embedded in the work system; take into account both collective and individual aspects of work; and study the work systems in their organizational context.

An information system that is not user-driven may fail even if all the technical aspects are working well. When users are not involved in the design, development, testing and changeover, information systems implemented may not meet the needs of users. This may result in failure as the implemented information system could be rejected by users. Thus, failure may be due to lack of user acceptance of the implemented information system. Lack of user acceptance may arise when users are not effectively involved in the design and implementation of information systems. Activity theory will be useful in predicting the likelihood of failure of information systems as it considers the work activities of users and encourages user-involvement in the design and implementation processes. The proposed model will consider the likelihood that systems may fail as a result of user resistance which may arise when organizations implement systems without considering prevailing circumstances.

2.2.5 Related studies on factors that lead to information systems implementation failure

Success in implementation of projects is determined by the extent to which the cost, schedule and outcomes achieve user expectations (Nwagbogwu, 2011). Thus, cost, schedule and objectives are the major determinants of success in project implementation and therefore challenge in meeting any of these aspects may lead to project failure. In other words, IS implementation projects will have failed where expected benefits are not derived from the implemented system, cost exceeds benefits of the system and the system is abandoned midway through the implementation process (Hwang & Lim, 2013). Further, Sweis (2015) identified three pillars of project success, that is, money, time, and scope. Negative changes in any of these may result in failure.

An alternative categorization of factors that may result in IS project implementation failure is to differentiate between managerial and the technical ones. Managerial factors

include poor leadership, poor communication, lack of adequate competencies, failure to follow through an implementation methodology, complexity of the organization, management support and organizational behaviour and politics. Technical factors that may lead to failure include, inappropriate software requirements definition, use of inappropriate technical designs and tools and inadequate technical (McManus & Harper, 2007). Further, on a balance of the two categories of factors, McManus and Harper (2007) found that managerial factors are most likely to determine project success or failure.

Kappelman, McKeeman and Zhang (2006) also came up with an alternative classification of factors that may lead to IS implementation failure, that is, process driven issues, content driven issues and context driven issues. These were describes as follows:

- 1) Process driven issues are those that relate to planning (both for the corporate and for the project), managing and controlling the project, formulation of corporate and project strategies, and managing the process of change. Thus, under this category, factors that could lead to failure include weak definition of user requirements, failure to properly determine project scope, poor budget and time estimation techniques, lack of or weak project risk assessment, lack of clarity in the vision and business needs, poor determination of resource requirements, lack of a business and operational change management programme, inadequate allocation of responsibility and accountability, and inconsistency between the IS and corporate strategies.
- 2) Content driven issues entail the environment where the project is being developed. It includes existing organizational culture, organization structure in place, the operating style of senior management of the organization, internal communications, user involvement, lack of a change agent, organizational politics, and reactive and not proactive style to deal with problems.
- 3) Context driven issues concern the information system itself, design of the system, and source of knowledge of IT professionals. Factors of failure under this category include choice of software that is not appropriate to address the business need, changes in technological scope, lack of clarity in the IS project deliverables, uncontrolled changes in design, lack of completeness in specifications and poor estimation of project scope.

In order to achieve effectiveness in implementation of information systems, organizations usually follow a well-defined and documented methodology involving top management,

user management, and information systems management participation (Buruncuk & Gulcer, 2014). The common approaches in developing information systems include system development life cycle (SDLC), prototyping, and rapid applications development (RAD). Organizations will therefore elect to use any of these approaches or a reasonable combination in implementation of information systems. However, available research findings suggest that following through such a process has been a difficult task for organizations. Thus, inadequacies in following the established methodology for implementation of information systems may result in failure (Fitzgerald, 2010).

2.2.6 Measuring Success of IS Implementation

The worth of an IS will be determined in the three contexts of functionality, usability and utility (Beynon-Davies, 2009). Projects which are completed on time, within budget and according to the goal of the organisation are declared as successful whereas the projects of IS which are abandoned before finishing point are called failed projects (Kaur & Aggrawal, 2013). According to Buruncuk and Gulcer (2014), an information systems project is unsuccessful if it exceeds its schedule and budget whether it ends or is not concluded. Gichoya (2005) concluded that if the perceived benefits like easier communication, networking and system integration, timely, relevant and useful information are not realized, then the system will be perceived to have failed. In addition to successful and failed projects, a “successful” completion of a project which, however, exceeds set timelines and budget frameworks is a frequent occurrence (Martineau & Shumway, 2009). Buruncuk and Gulcer (2014) stated that companies are generally afraid of IS project failure because they make big investments to a project in terms of money, time and manpower.

Gichoya (2005) acknowledged the difficulty in defining information system success and noted that different researchers address different aspects of success, making comparisons difficult and the prospect of building a cumulative tradition for IS research similarly elusive. Further, uncertainties associated with IS implementation process can be associated with an absence of information, which may lead to acquisition of more data and may result in the inability to confidently assign probabilities about how environments will affect success or failure (Karimi, Somers & Gupta, 2004). Kappelman, McKeeman and Zhang (2013) concluded risk management skills in IS project are yet to reach a

mature level. To cure this, the concept of 'Early Warning Signs' (EWS) was proposed. This is EWS is an incident or sign that provides caution that IS implementation may fail. These are the symptoms that show long before occurrence of a failure, that is, during the early stages of project implementation.

2.2.7 Approaches and techniques used in mitigating information system implementation failures

2.2.7.1 Predictive algorithms

It has been noted that system implementation failures are as a consequence of not getting to know the likely causes of failure. Some researchers have proposed the use of predictive models to map the system implementation based on the likely causes of system failures.

Given the increasing and changing IS project uncertainties, there is need to come up with a tool that will predict the likelihood of failure before commencing the implementation process. It is important to predict likelihood of project failure so that an organization's resources are not committed on a project that is likely to fail. One tool that has been widely used is the Earned Value Management (EVM). EVM aids in measuring project performance and managing projects. This tool is also beneficial in approximating the future performance and progress of projects (Tabriz, Farrokh, Nooshabadi & Nia, 2013). It incorporates scope, time and cost in a single methodology to factually measure the performance and progress of projects. The EVM model rests on its metrics that stems from its fundamental elements; Planned Value (PV), Earned Value (EV) and Actual Cost (AC). Planned Value indicates where the project should be at any given point in time, Earned Value reflects the quantity of work that has been realized after completion of each task, activity and even the entire project and Actual Cost shows the amount of resources that have been put to use to achieve the actual work that has been accomplished to date (Project Management Institute, 2011). However, EVM has a weakness in that it operates under the assumption that future performance of a project can be determined from its past performance. This therefore makes it difficult to apply the tool on a new project which does not have history. Further, it is also instructive to recognize the unique attributes of each project and therefore risks and uncertainty may differ between projects. Thus, the

historical performance of one project cannot be used to accurately measure the future performance of another.

To cure the weakness noted, it is recommended that EVM is combined with another technique that has capability to handle uncertainties that affect IS project performance. Risk Management (RM) is one of such methods that can deal with uncertainties that exist in IS projects. All the risk factors that affect an IS project throughout all the implementation stages from feasibility study to changeover will be identified, assessed and analyzed. For each implementation stage, risk management will involve four stages of planning for the risks, identifying risks that are inherent in the activities of the particular stage of IS project implementation, analyzing the risks and responding to mitigate them. The risk analysis stage is of importance and is done both qualitatively and quantitatively (Hillson, 2009). This therefore deals with the gap that EVM leaves out and therefore making the combined approach better than applying these methods individually.

Aming'a and Omwenga (2016) identified a weakness in the RM technique in that it did not explain how risks were identified and incorporated in the risk management process. It was recommended that an adjustment to the formulae be made to incorporate Enterprise Risk Management (ERM) in place of RM. Razali and Tahir (2011) defined ERM as the integration of all types of risks in a single framework (Razali & Tahir, 2011). This is different from RM which tends to manage risks individually. The framework includes operational, strategic, financial, and hazard risks. Table 2.1 provides a classification of all types of risks that may affect a project with their examples.

Table 2.1: Types of risks as per ERM (Razali & Tahir, 2011)

Type	Hazard	Financial	Strategic	Operational	ERM Formulae
Definition	Poses threat or injury to a project.	Affects project financial resources.	Affects projects objectives, mission, vision, goals etc.	Affects efficient use of project resources.	$+ \\ \text{ErM} = \text{Hr} + \text{Fr} + \text{Sr} \\ \text{Or}$
Example	Climatic Conditions.	Rise/Fall in interest rates.	Delays of disbursement process.	Careless project manager.	
Abbreviation	Hr	Fr	Sr	Or	

2.2.7.2 Proposed tool for predicting the likelihood of information system implementation failure

For the purposes of this study, ERM methodology will be adjusted to come up with a weighted risk score that will be used to determine whether the proposed information system and the structures in place are likely to result in failure. Various risks will be considered at each stage of the information system implementation process. The results of risk assessment will then be used as input to determine the overall risk rating. Through application of the tool, a determination will be made on likelihood of failure. If it is determined that the project is likely to fail, corrective measures will then be instituted prior to commencement of the IS implementation project.

The process will start by developing a risk register i.e., factors which may lead to failure. The factors will be grouped in accordance with the categorization model developed by Kappelman, McKeeman and Zhang (2006) i.e., process driven factors, content driven factors and context driven factors. These are the broad categories for which risks inherent in them will be assessed. Whatever the methodology adopted, key causes of failure in implementation of information systems will be evaluated and the effect of their presence or absence tested through the risk assessment process.

The risk assessment process will begin by determining the likelihood and impact levels. Likelihood level is the frequency value with respect to how easy it is for the failure factor to materialize in the project. Impact level is the rating of the consequence that a failure factor may have in case it materializes. The higher the impact level the higher the score. Risk score for a given factor of failure is the product of the likelihood level and impact level. The levels of likelihood and impact adopted in this study are depicted in Table 2.2 and Table 2.3.

Table 2.2: Likelihood levels

Description	Measure
Factor of failure is unlikely to actualize	1
Factor of failure is likely to partially actualize	2
Factor of failure is likely to fully actualize	3

Table 2.3: Impact levels

Description	Measure
Occurrence of the failure factor will have an insignificant impact on the project	1
Occurrence of the failure factor have an average impact on the project	2
Occurrence of the failure factor will have a significant impact on the project	3

Assuming L_s is the likelihood score while I_s is the impact score, the risk score for a given factor (R_f), can be arrived at using the formula below;

$$R_s = L_s * I_s \dots\dots\dots[2.1]$$

Where;

R_s is the risk score for a given factor;

L_s is the likelihood score for a given factor expressed in nominal values; and

I_s is the impact score for a given factor expressed in nominal values.

However, formula 2.1 has a weakness in that it assumes that all the factors have the same weight in the overall information system implementation process. This may not be necessarily true. To allocate weights, the factors will be ranked based on materiality of their individual effect on the implementation process. Research findings will be used to determine the average rank index using a 5-point Likert scale (with 5 being the most likely cause of failure and 1 being the least likely). The rank index of a given factor will be divided by the total score of all factor indices to arrive at the weight of that factor. This will be applied on formulae 2.1 to arrive at the adjusted risk factor as shown in formulae 2.2 below;

$$AR_s = R_s * C_n/x \dots\dots\dots [2.5]$$

Where

AR_s is the adjusted risk score;

C_n is the index for a given failure factor determined by average scoring of respondents; and

x is the sum of indices of all the factors determined by average scoring of respondents.

The adjusted risk scores of all the factors will be summed up to arrive at the total risk rating, P_r . Thus,

$$P_r = AR_1 + AR_2 + \dots + AR_n \dots\dots\dots [2.6]$$

If the total risk (P_r) is greater than 4.5 (i.e., the midpoint on the P_r scale), then it would be adjudged to have a likelihood of failure.

Chapter Three: Research Methodology

3.1 Introduction

This research is aimed at coming up with a tool to predict the likelihood of failure in information systems implementation. The chapter provides a detailed assessment of the various methods employed during this study. Target population, the sample size to use in the research, data collection procedures and analysis of the results obtained are also discussed. In addition, approaches applied in system analysis, system architecture, system design, system development, and implementation and testing will also be discussed.

3.2 Research Design

The study adopted mixed research design, that is, quantitative and qualitative. Quantitative method was used through analysis of a questionnaire that was designed to find out the factors that are most responsible for information systems failure, approaches used in mitigating implementation failure, methodologies used in implementation of information systems and reactions of management whenever failure of information systems implementations was predicted. Qualitative approach was used to gather information on the experience of users in using the proposed tool for predicting likelihood of failure in implementation of information systems.

3.2.1 System Architecture

System architecture for the tool comprises of three components; a modeling component, a user interface, and a database. The modeling component was implemented using PHP 5.6. PHP is a general-purpose scripting language that is especially suited to server-side web development, in which case PHP generally runs on a web server. The user interface will allow users to access and manipulate the modeling and database components as well as analyze various decision scenarios. The database component will allow users to create, retrieve, update and delete data pertaining to various decision scenarios. The database design will be normalized to eliminate possibilities for data anomalies as well as facilitate the ease of future maintenance and upgrades to the database.

3.2.2 System Analysis

This study used Object-oriented Analysis (OOA). The object-oriented method combines processes and data into single entities called objects. OOA escalates the understanding of problem domains because OOA promotes a smooth transition from the analysis phase to the design phase and offers a more ordinary way of establishing specifications (Mauluko, 2016).

User requirements were analyzed and presented in tabular form. They were modeled into system requirements using a use case diagram and a sequence diagram. Use case diagrams denote a sequence of interrelated activities initiated by an actor to achieve a precise objective. An actor is an external entity that interacts with the system. Use cases help in gaining a good understanding of the functional requirement of the system. Sequence diagrams are used to show interactions between objects. These diagrams depict the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

3.2.3 System Design

The design strategy used was custom system design approach. This approach allows researchers to come up with a tailor-made application that will address the specific problem identified. Object oriented design was used in defining the requirements identified during system analysis.

Design class diagrams (DCD) were used to show software class definitions. DCDs describe systems by illustrating attributes, operations and relationships between classes i.e., they describe how objects interact with each other. This makes it easier to understand the structure of the system.

An Entity Relationship Diagram (ERD) was used to provide a graphical representation of the relationships between objects, places, people concepts or events within a system. ERDs help to outline the processes involved in implementation of information systems procedures and to develop relationships between entities and their attributes.

3.2.4 System Development and Implementation

Hypertext preprocessor (PHP) was used to develop the application. This is a server-side web programming language that is widely used for web development. It was selected because it is platform independent. MySQL was used as the back-end database tool. This database tool was selected because it is open source and interfaces very well with PHP hence its choice.

Direct cutover system implementation approach was used. This approach allows stoppage of the old system and commencement of the new system immediately. Since there was no mechanism in place for predicting the likelihood of failure in implementation of information systems, there was no information system to be stopped. Therefore the proposed tool was implemented immediately as a solution.

3.2.5 System Testing

Actual operation of the system was established and tested. The objective of testing is to assess the effectiveness of the system at mitigating risks to an appropriate level and provide management accountability over the effectiveness of the system in meeting its intended objectives and establishing an appropriate level of internal control.

Functional and usability testing procedures were used. Functional testing is done to ascertain whether the system operates to achieve its intended objectives. Usability testing entails testing; validation of communicating components on each screen e.g., text inputs and buttons, validation of navigation flow, ease of navigation, responsiveness and user friendliness. The questionnaire in Appendix B was used in performing system testing.

3.3 Research Location

The study was conducted at the head offices of KeNHA (Nairobi). This was considered to be the most preferred site as most activities in the implementation of information systems are coordinated from the head office, that is, all information systems for KeNHA are acquired and managed centrally at the head office. Thus, the required data would be collected from persons who have participated in implementation of information systems and these are located at the head office in Nairobi.

3.4 Population and Sampling

The target population for this study consisted of all 32 employees of KeNHA who are at middle and senior management level. Given the population size was small, the entire population was surveyed. This cluster was believed would respond satisfactorily and therefore provide the required survey data necessary to draw conclusions for this study.

3.5 Data Collection Methods

Data was collected using the Questionnaire in Appendix A. This was aimed at collecting information about the need of the tool for predicting likelihood of failure of information systems and user requirements. Use of questionnaires was adopted because one can collect information from a large number of people within a short time.

3.6 Data Analysis

Content analysis was used to analyze data collected. Directed content analysis was used to validate study objectives, user and system requirements. The validated research objectives and user requirements were used to determine the approach used in the initial development of the proposed solution. As guidance for initial codes, a directed data analysis approach begins with relevant research findings or a theory. This method was preferred because primary classification would not introduce biases in identification of important application objectives and needs. The methodology also helps focus the questionnaire on research objectives thus simplifying data analysis.

3.7 Research Quality

Validity, reliability and objectivity are three major components to measure the quality or trustworthiness of the study. Consequently, the following describes the validity, reliability and objectivity of this study.

3.7.1 Validity

Validity determines whether the researcher is studying the phenomenon he/she purports to be studying. There are two kinds of validity, namely internal and external. In terms of internal validity, it evaluates how well there is a match between the empirical findings and theory. In contrast, external validity measures the extent to which results from the measurements are coherent with the reality and whether generalizations can be drawn from the result (Ghuri & Gronhaug, 2005). In order to maintain external validity in this

research, questionnaires were used. In terms of internal validity in this research, focus was on an open approach in order to maintain a high internal validity. The open approach doesn't manipulate the outcome of the questionnaires. There may be a weakness in the internal validity in this research because a few of the respondents may not have dealt directly with implementation of information systems. As a result, this may cause more general answers, not specific to the implementation of information systems.

3.7.2 Reliability

Reliability measures the extent to which the same conclusions drawn can be repeated if the research is done again (Ghauri & Gronhaug, 2005). Reliability in this research was achieved by having a structured research method. In order to construct reliability in this study, all respondents were subjected to the same set of questions. In addition, analysis of data from respondents was done using the same procedure.

3.7.3 Objectivity

Objectivity is a measure of how researchers undertake and carry out their research in that it requires them to be precise, unbiased, open, honest and receptive to criticism. In a similar vein, objectivity means being aware and honest about how one's own beliefs, values, and biases affect the research process. To achieve objectivity all employees at middle and senior management were surveyed. In addition, data collected was analyzed using known measures. Conclusions from this research were strictly based on the findings. Therefore, there was no bias in reporting hence the results of this study would easily pass the objectivity test.

3.8 Ethical Considerations

Ethics refers to the principles of right and wrong that individuals, acting as free moral agents, use to make choices to guide their behaviors (Laudon & Laudon, 2012). Research ethics is critical since it guides the interactions with people, organisations and institutions (Christensen, Johnson & Turner, 2010). Assurance is given that information provided for purposes of this research will be treated with the highest level of confidentiality. The responses provided by the respondents will not be shared with any person or institution without consent. In addition, this research report was subjected to the Turnitin tool and achieved a similarity index of 23%. This is within the maximum threshold of similarity of

30% required by the University. Data collected will be used for academic purposes only and a copy of the final document will be given to KeNHA Management.

Chapter Four: System Design and Architecture

4.1 Introduction

The objective of this study was to develop a tool for predicting the likelihood of failure in implementation of information systems. This chapter details the process of designing and implementing the tool. The analysis part describes the process of identifying and selecting a business process for improvement. Results of the questionnaire in Appendix A have been discussed in this section. The design of the predictive tool is fully detailed in the design section. Further, the chapter takes a look at system analysis based on the data collected and finally the resulting system design/architecture.

4.2 Results of Questionnaire

4.2.1 Highest level of education of respondents

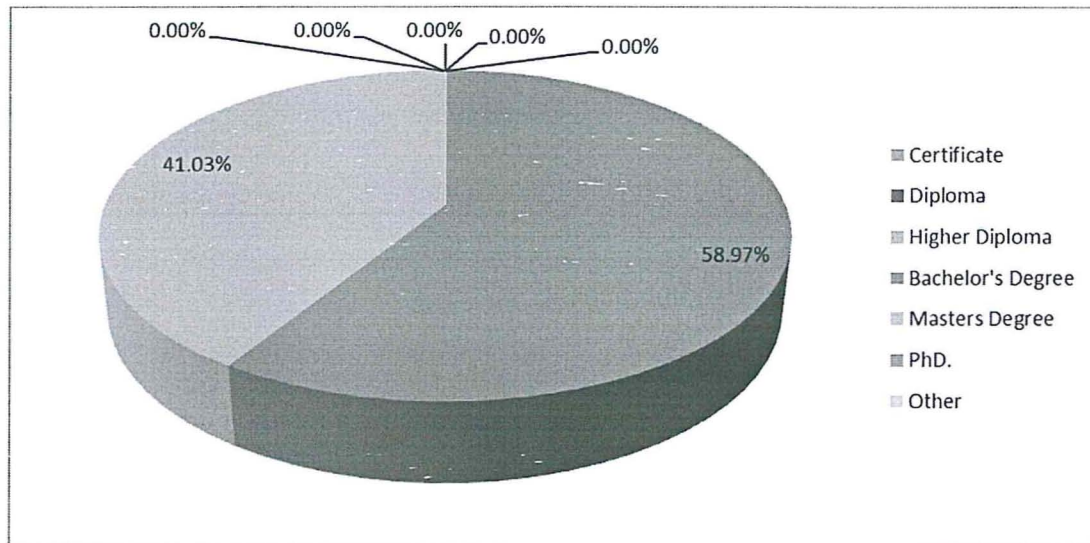


Figure 4.1: Highest level of education of respondents

Respondents were asked to state their highest level of qualification. This would determine whether respondents had the required level of education to effectively comprehend and respond to the questionnaire. Figure 4.1 shows the distribution on highest level of qualification of the respondents. 59% of the respondents had a Bachelor's degree while 41% had a Master's degree as their highest level of qualification. None of the respondents had a certificate, diploma, higher diploma, PhD. or any other as their

highest qualification. Thus, since all the respondents at least had a bachelor's degree, the level of education was sufficient to effectively respond to the questionnaire.

4.2.2 Role of the respondents

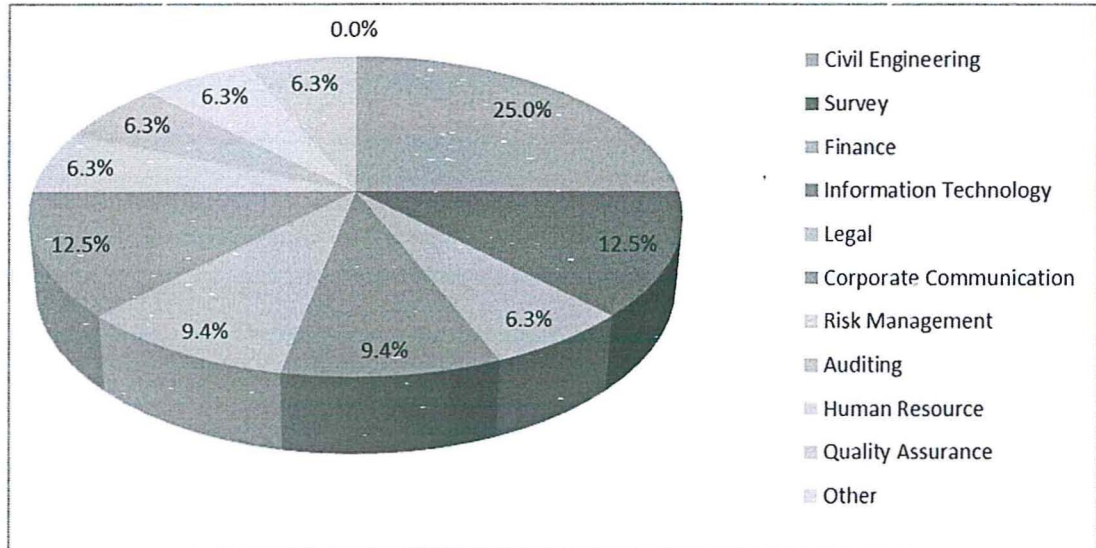


Figure 4.2: Roles of respondents

Respondents were asked to state their role in the organization. This would assist in ensuring that data gathering is fairly distributed amongst the various functions and therefore bias towards one department would be minimized. Figure 4.2 shows the role that respondents play in the organization. 25% of the respondents were from civil engineering (three departments), 12.5% each from survey and corporate communication, 9.4% each from information technology and legal and 6.3% each from finance, risk management, auditing, human resource and quality assurance. Given that these are all the departments of KeNHA, the respondents were evenly distributed across the organization.

4.2.3 Categories of information systems implemented

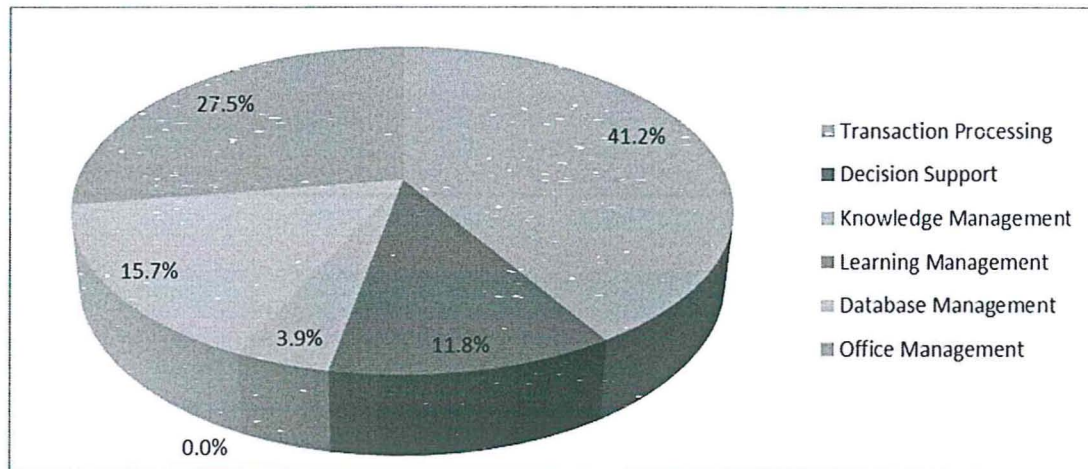


Figure 4.3: Categories of information systems implemented

Respondents were asked to state the categories of information systems they had participated in implementation. Participation by respondents in implementation of information systems would provide assurance that responses given are practical and out of relevant experience in systems implementation. Figure 4.3 shows the type of information system that respondents had been involved in implementing. 41.2% were involved in transaction processing systems, 27.5% in office management systems, 15.7% in database management systems, 11.8% in decision support systems and 3.9% in knowledge management systems. None of the respondents had been involved in implementation of learning management systems. Thus, all the respondents had been involved in implementation of information systems and therefore their responses would be anchored on their experience in actual implementation and not theoretical.

4.2.4 Causes of information systems implementation failure

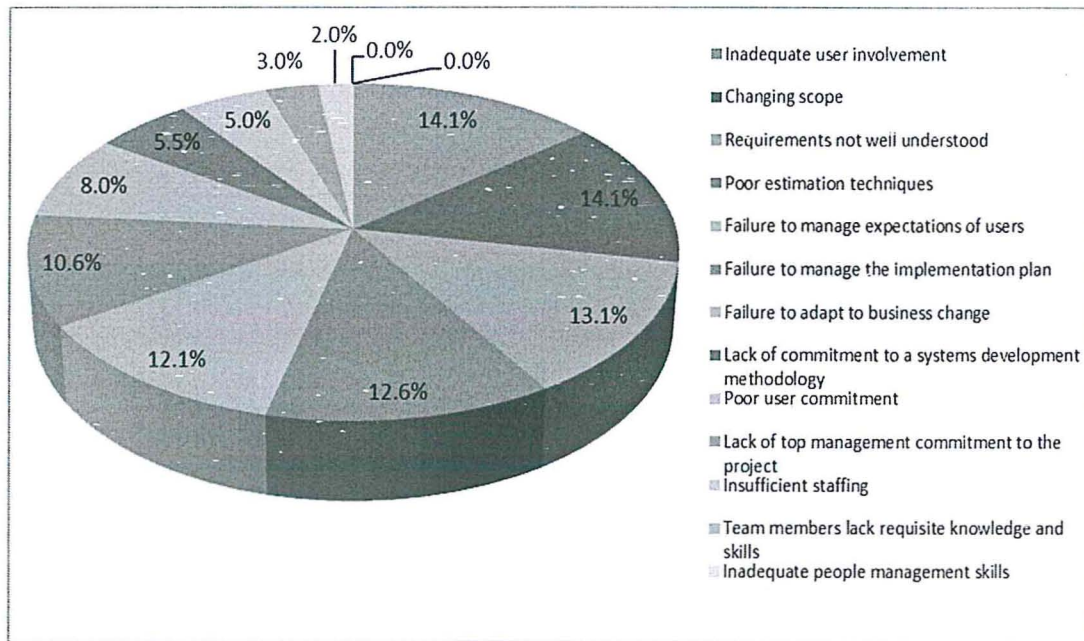


Figure 5.4: Causes of information systems implementation failure

Respondents were presented with a listing of major causes of failure in implementation of information systems and required to indicate if these were the causes of failure at KeNHA. This would assist in determining the actual factors that led to failure of actual information systems implementation projects and therefore provide a basis of coming up with the proposed solution. Figure 4.4 shows the causes of information systems failure at KeNHA. According to the survey results, in order of importance, these are; inadequate user involvement (14.1%), changing scope (14.1%), requirements not well understood (13.1%), poor estimation techniques (12.6%), failure to manage expectations of users (12.1%), failure to manage the implementation plan (10.6%), failure to adapt to business change (8.0%), lack of commitment to a systems development methodology (5.5%), poor user commitment (5.0%), lack of top management commitment to the project (3.0%) and insufficient staffing (2.0%).

4.2.5 Rating the factors that lead to information systems implementation failure

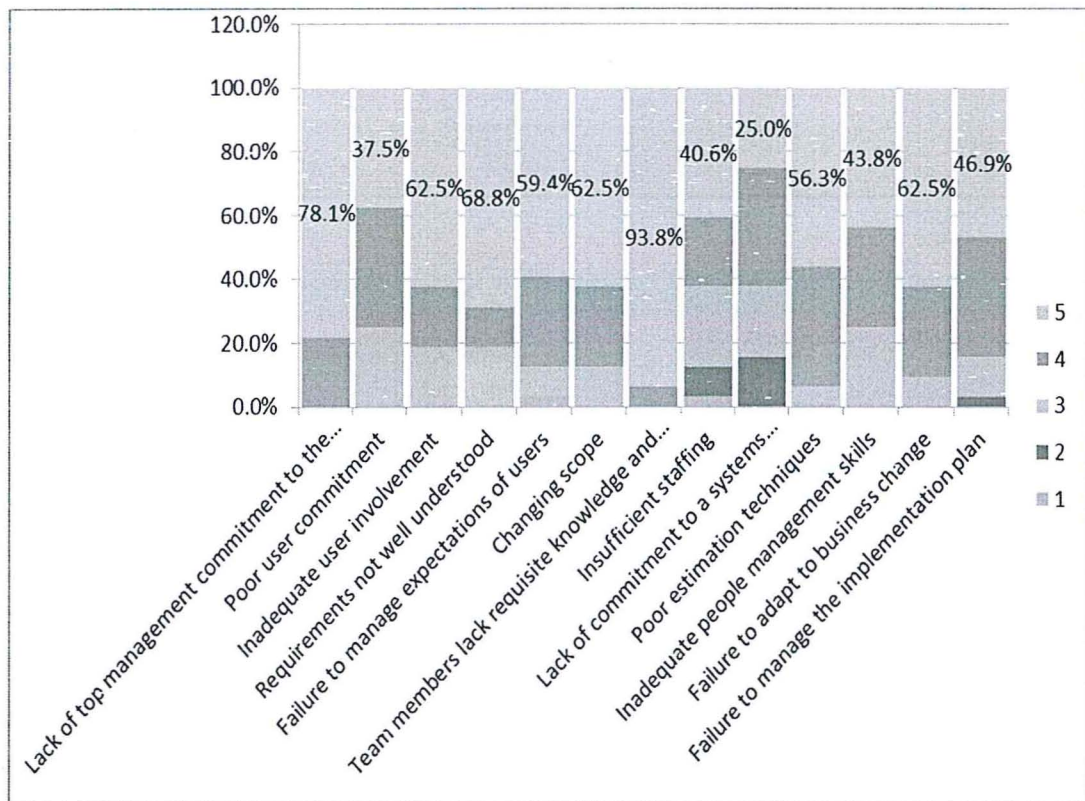


Figure 4.5: Rating for factors causing information systems failure

Respondents were asked to rate each factor of failure based on a five-point Likert scale (with 5 being the most effect while 1 being the least effect). This information is important in determining the order of importance of the factors of failure. Analysis of data provided will help determine the weight index for the various factors of failure. Figure 4.5 shows how the respondents ranked the major causes of failure in implementation of information systems. Respondents were asked to rate the methods on a scale of 1 to 5 (with 5 being the most important or influential factor). In the order of most influential factor, information systems are bound to fail due to team members lack of requisite knowledge and skills, lack of top management commitment to the project, requirements not well understood, inadequate user involvement, changing scope, failure to adapt to business change, failure to manage expectations of users, poor estimation techniques, failure to manage the implementation plan, inadequate people management skills, insufficient staffing, poor user commitment and lack of commitment to a systems implementation methodology.

4.2.6 Methods of predicting information systems implementation failure

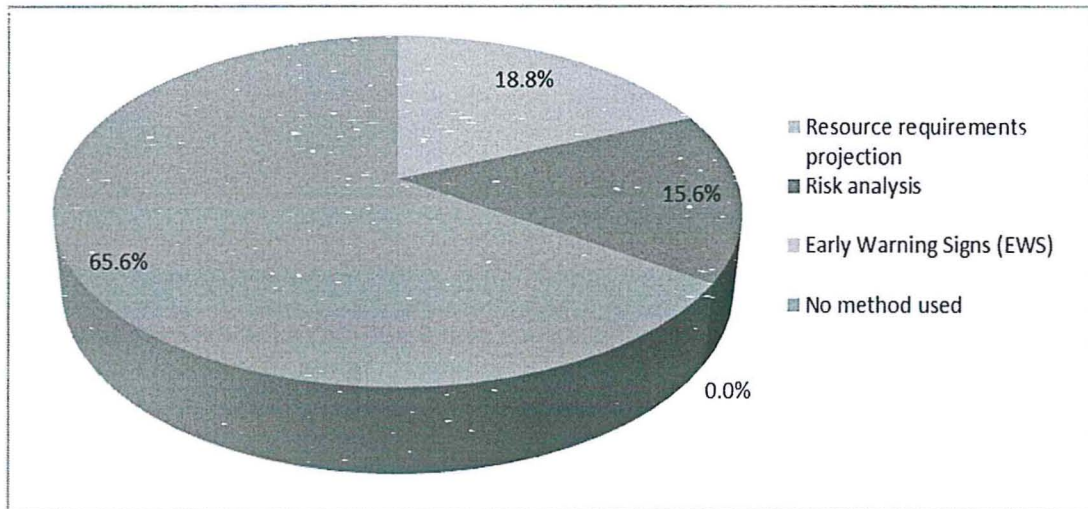


Figure 4.6: Methods for predicting information systems implementation failure

Respondents were asked to select the method used in predicting failure of information systems. This information is important in determining the existing mechanisms for predicting failure of information systems implementation projects. Such information is important in designing the proposed tool for predicting the likelihood of failure in implementation of information systems. Figure 4.6 shows the methods used in identifying failure of information systems at KeNHA. 65.6% of respondents stated that there was no method used in identifying whether information systems implementation projects would fail. 18.8% stated that resource requirements projection was used while 15.6% stated that risk analysis was used. None of the respondents provided feedback on the use of Early Warning Signs (EWS) as a failure projection method.

4.2.7 Ranking the methods of predicting failure of information systems

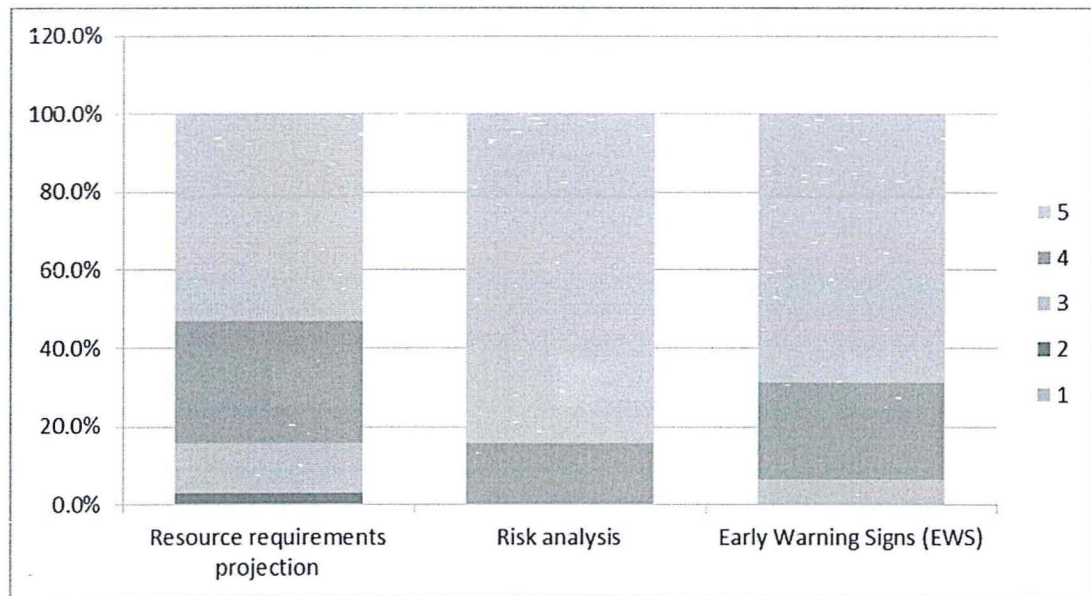


Figure 4.7: Rating for effectiveness in methods of identifying failure

Respondents were required to rank the effectiveness of each of the methods of predicting failure of information systems using a 5-point Likert scale (with 5 being the most effective and 1 the least effective). Information gathered would help indicate how effective each of the methods is in predicting failure and therefore lay ground for the solution to be implemented. Figure 4.7 shows the rating on effectiveness of use of each of the methods for identifying failure of information systems. Respondents were asked to rate the methods on a scale of 1 to 5 (with 5 being the most effective method). In order of effectiveness, these were; risk analysis, early warning signs and resource requirements projection.

4.2.8 Criteria for determining failure of information systems

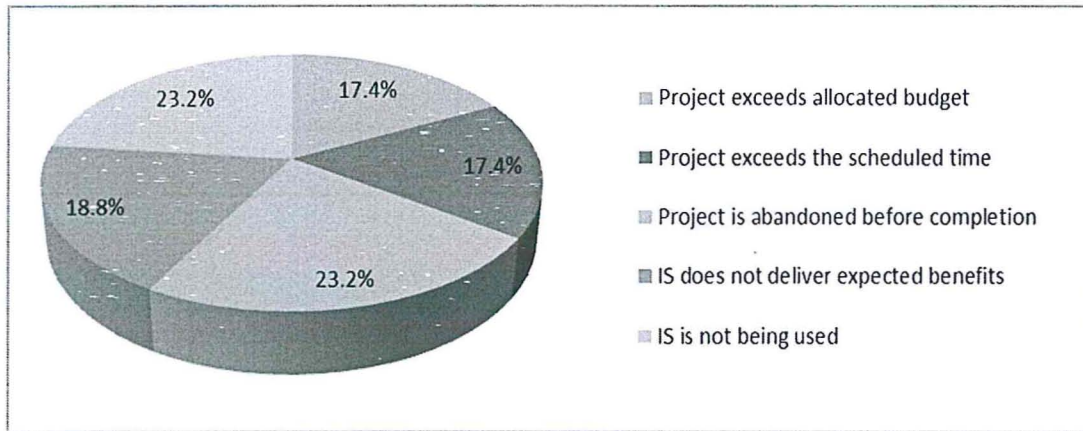


Figure 4.8: Ways of determining whether an IS implementation project had failed

Respondents were required to indicate how they determined whether information systems implementation projects had failed. This information is important in setting the criteria for determining failure of information systems implementation projects. Figure 4.8 shows the ways of determining whether an IS implementation project had failed. According to the respondents, failure is determined when either the implemented information system is not being used (23.2%), the IS implementation project is abandoned (23.2%), the information system does not deliver expected benefits (18.8%), the project exceeds the scheduled time (17.4%) and the project exceeds the budget (17.4%).

4.2.9 Reaction of management when failure was predicted

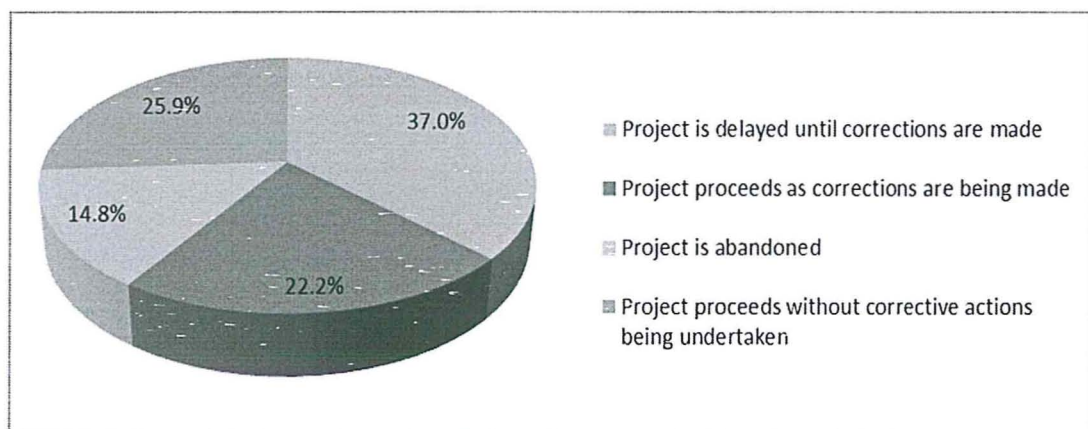


Figure 4.9: Management reactions when Failure of IS implementation is detected

Respondents were required to indicate what action was taken by management whenever failure was predicted. This information will help in determining the procedure for

implementing the mitigation strategies to be incorporated in the proposed solution. Figure 4.9 shows how management reacts when failure is detected. According to the respondents, in most cases (37%), implementation would be delayed until corrective measures are put in place. However, there were cases when the projects proceeded without corrections being made (25.9%) or the project proceeds simultaneously as corrections were being made (22.2%). In other cases, implementation was abandoned altogether (14.8%).

4.2.10 Approaches used in mitigating information systems implementation failure

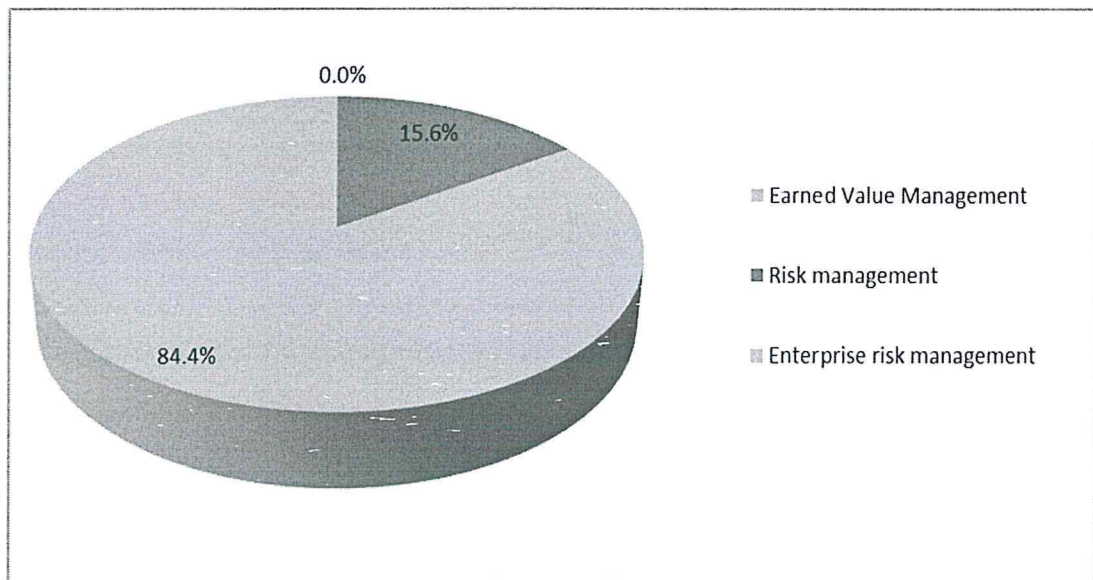


Figure 4.10: Approaches used in mitigating IS implementation failure

Respondents were asked to indicate the approaches used in mitigating information systems implementation failure. This information would assist in determining whether there were procedures in place to ensure that failure is mitigated. Figure 4.10 shows the approaches to mitigating IS implementation failure at KeNHA. 84.4% stated that enterprise risk management was used while 15.6% said risk management was used. Earned value management was not used at all.

4.2.11 Rating of effectiveness of approaches used in mitigation of IS implementation failure

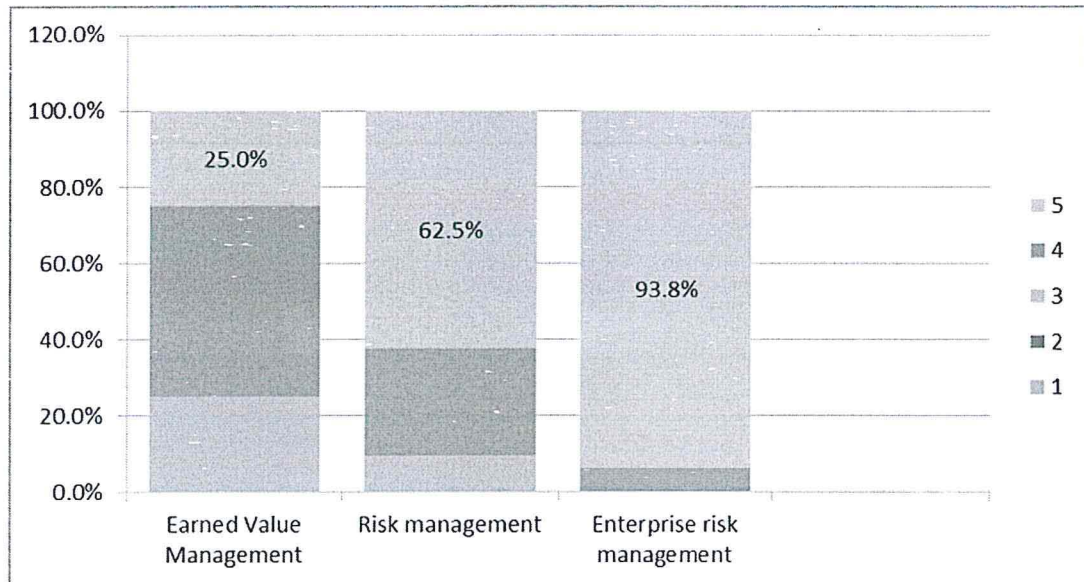


Figure 4.11: Rating of effectiveness of approaches used in mitigation of IS implementation failure

Respondents were required to rate the approaches used in mitigating information systems implementation failure using a 5-point Likert scale (with 5 being the most effective and 1 the least effective). Information gathered would assist in judging the effectiveness in methods used. This would assist in coming up with a solution that considers effectiveness in approach used for mitigating IS implementation failure. Figure 4.11 shows the rating of respondents on effectiveness of the methods used in mitigating IS implementation failure. According to the respondents, enterprise risk management is the most effective followed by risk management and lastly, earned value management.

4.2.12 Approaches used in implementation of information systems

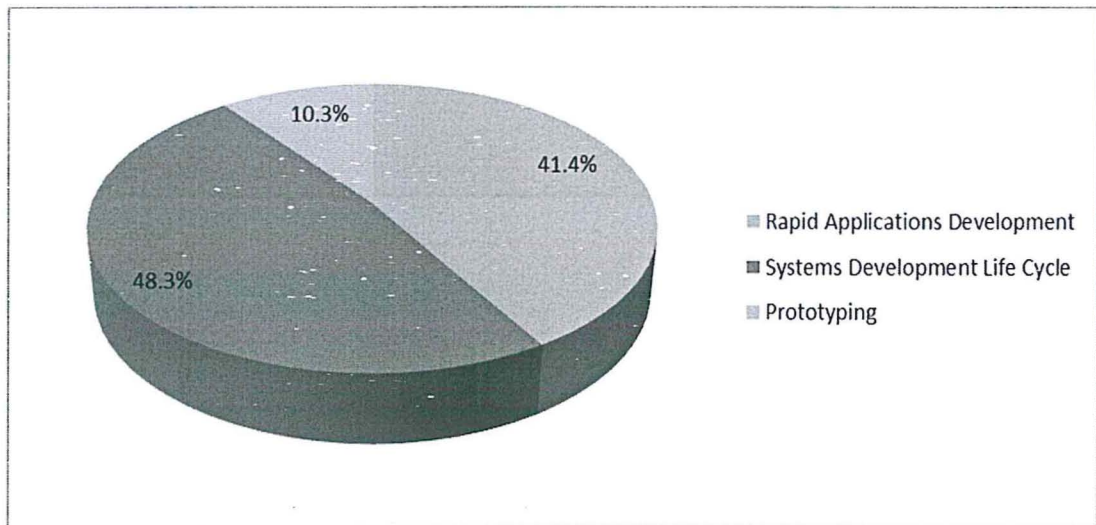


Figure 4.12: Approaches used in IS implementation

Respondents were required to indicate the approaches used in actual implementation of information systems. This information would help determine the most common approach in systems implementation at KeNHA and help in designing the proposed solution. Figure 4.12 shows the approaches used in implementation of information systems. Use of Systems Development Life Cycle (SDLC) approach was the most common (48.3%). This was followed by the Rapid Applications Development (RAD) approach (41.4%) and lastly, the Prototyping approach (10.3%).

4.2.13 Rating of effectiveness in approaches for information systems implementation

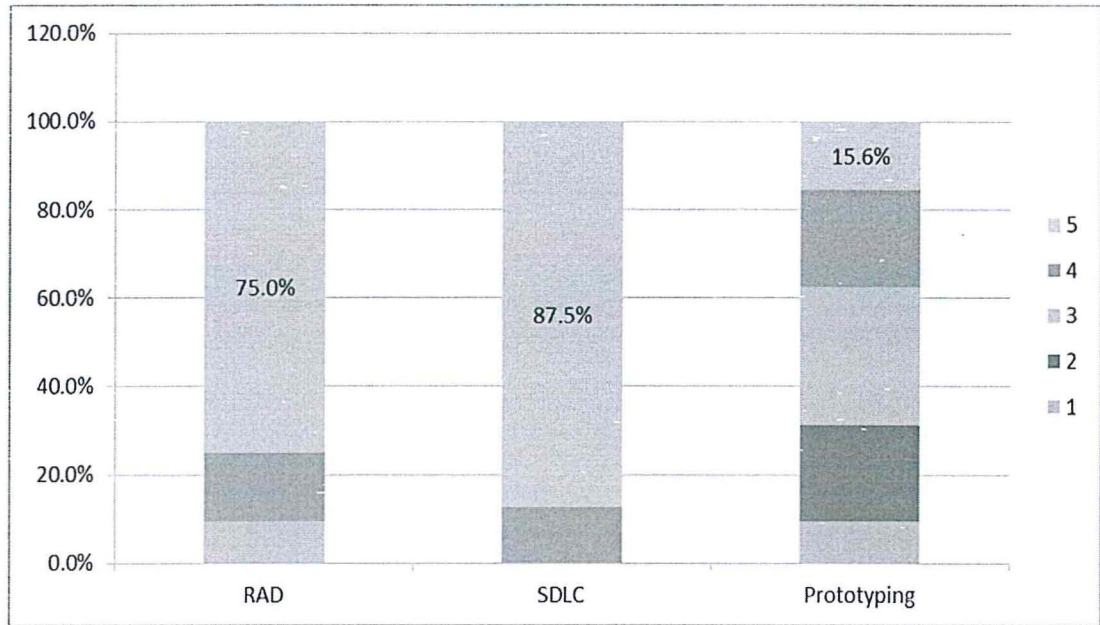


Figure 4.13: Rating of effectiveness of approaches used in IS implementation

Respondents were asked to rate the approaches used in implementation of information systems using a 5-point Likert scale (with 5 being the most effective approach and 1 the least effective). This will help in determining the implementation approach which best works for the respondents and therefore base the proposed tool on this approach. Figure 4.13 shows the rating of effectiveness of the approaches used in implementation of information systems. Resulting from the survey, SDLC was the most effective, followed by RAD and lastly prototyping.

4.3 Proposed System Architecture

The main actors of the system are the users. These may be divide into two categories i.e., end users and the system administrator. End users include the project planners (accesses the system to determine the likelihood of failure) and Director General (makes decisions based on reports from the system). The system administrator will access the system to update the factors of failure and their mitigation strategies, adjust the weights of failure factors and update the list of users. The system is Internet based with XAMPP as the application server and MySQL as the database server.

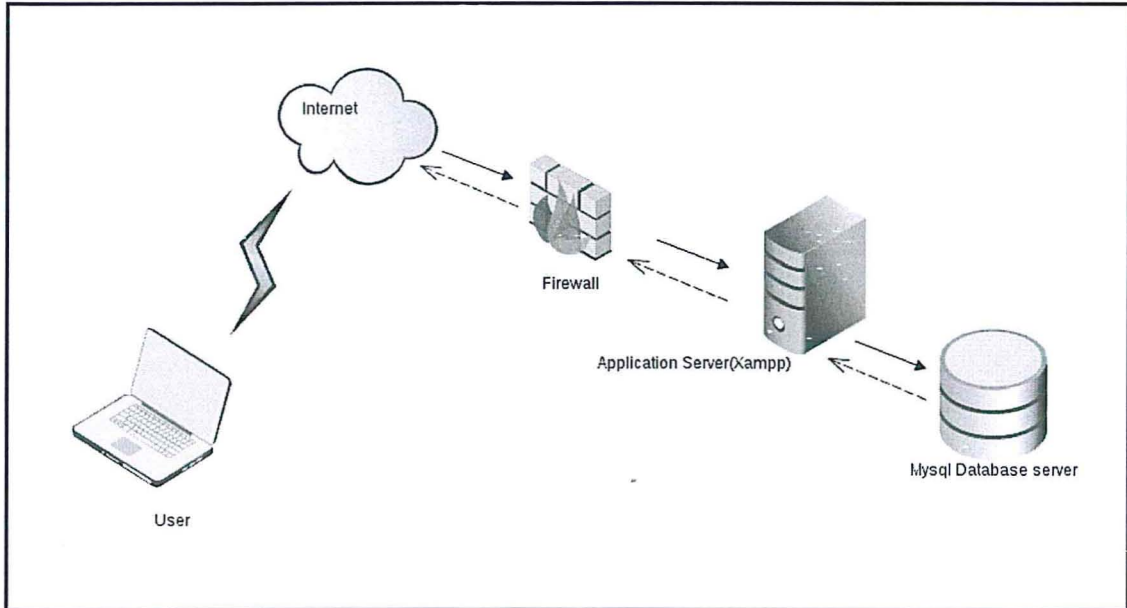


Figure 4.14: System architecture

4.4 Requirements and System Analysis

4.4.1 Requirements Analysis

In this study, requirements analysis will help to determine the services, features and constraints that should be addressed by the tool for predicting information systems implementation failure. These are the functions, basic processes and capabilities that the tool should execute in order to meet its intended objective and user needs. From the research findings, the requirements in Table 4.1 were identified.

Table 4.1: User Requirements

	Action	Description
1.	Create a project	Users will create a project to be assessed
2.	Enter project failure factors	Users will enter the failure factors for the project
3.	Enter risk levels	Users will enter the likelihood and impact levels for each failure factor
4.	Update failure factors	Administrator adds, deletes or edits failure factors
5.	Update list of users	Administrator adds, deletes or updates users with new information received

	Action	Description
6.	Update weights of IS failure factors	Administrator adjusts the weights of factors of failure based on information received.
7.	View reports	User views reports generated by the system

4.4.2 System Analysis

The system was analyzed using a use case diagram and a sequence diagram. The major actors were identified as the system planner and system administrator. Further, the main objects were the users, the application and the database. These are discussed below.

4.4.2.1 Use-case Diagram

The major interactions that will take place between the various actors and the tool for predicting the likelihood for information systems implementation failure are shown in Figure 4.15.

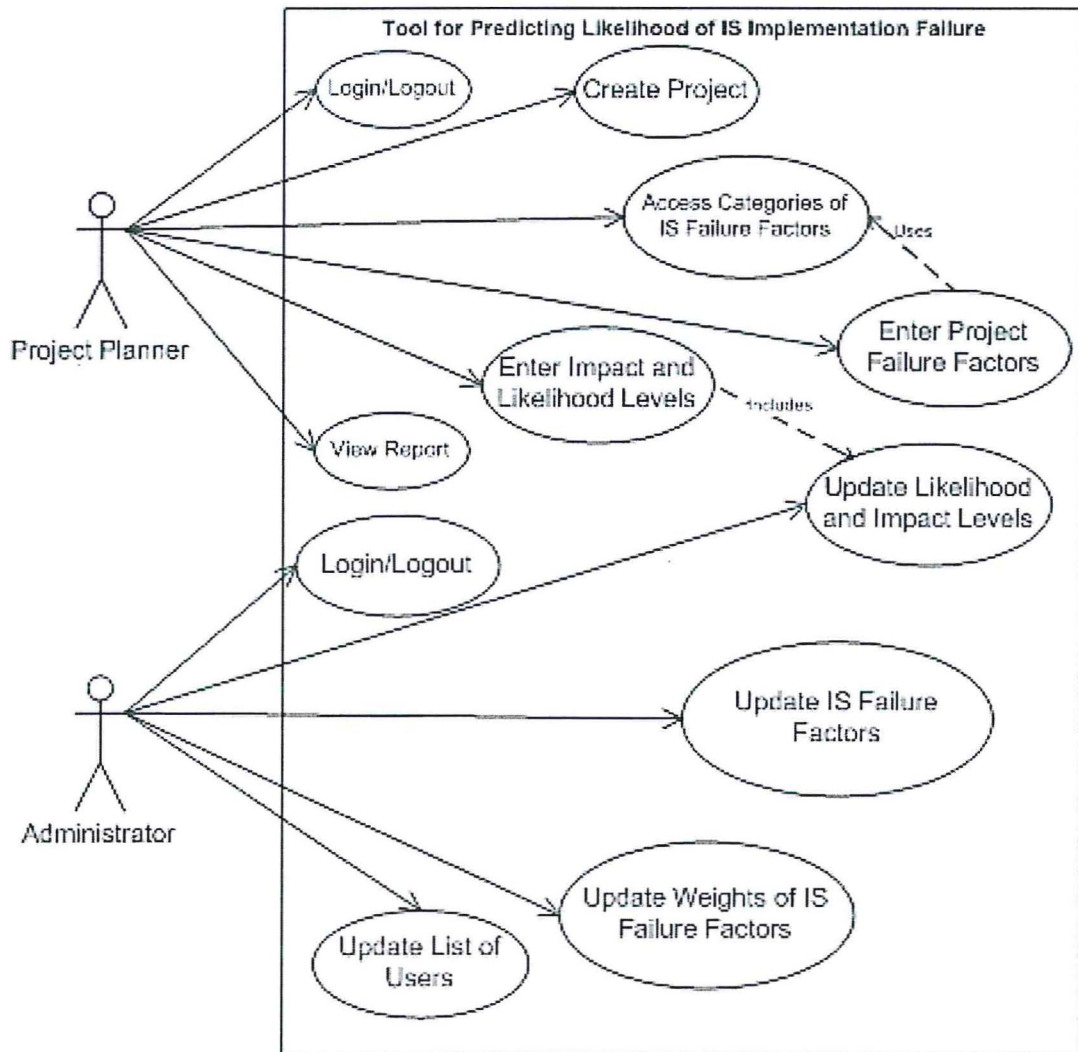


Figure 4.15: Use-case diagram

As shown in Figure 4.15, the main actors are the project planner and the system administrator. The project planner will log into the system and create a project. Once a project is created, the project planner will access the categories of IS failure factors and post the project failure factors and the impact and likelihood levels (nominal values). Finally, once all these actions are executed, the user will be able to view the system generated report that would indicate whether the assessed project will be a success or a failure. On the other hand, the system administrator will log in and update IS failure factors, update weights of IS failure factors and update the list of users. A detailed description of the pre-conditions, post-conditions main success scenarios of the use cases are contained in Appendix B.

4.4.3 Sequence Diagram

The main feature of this tool is when the user submits the risk assessment and gets back a report detailing the verdict on likelihood of failure. Figure 4.16 shows the sequential flow of information passing through the main entities in the system. This is shown through the messages passed back and forth between the respective components.

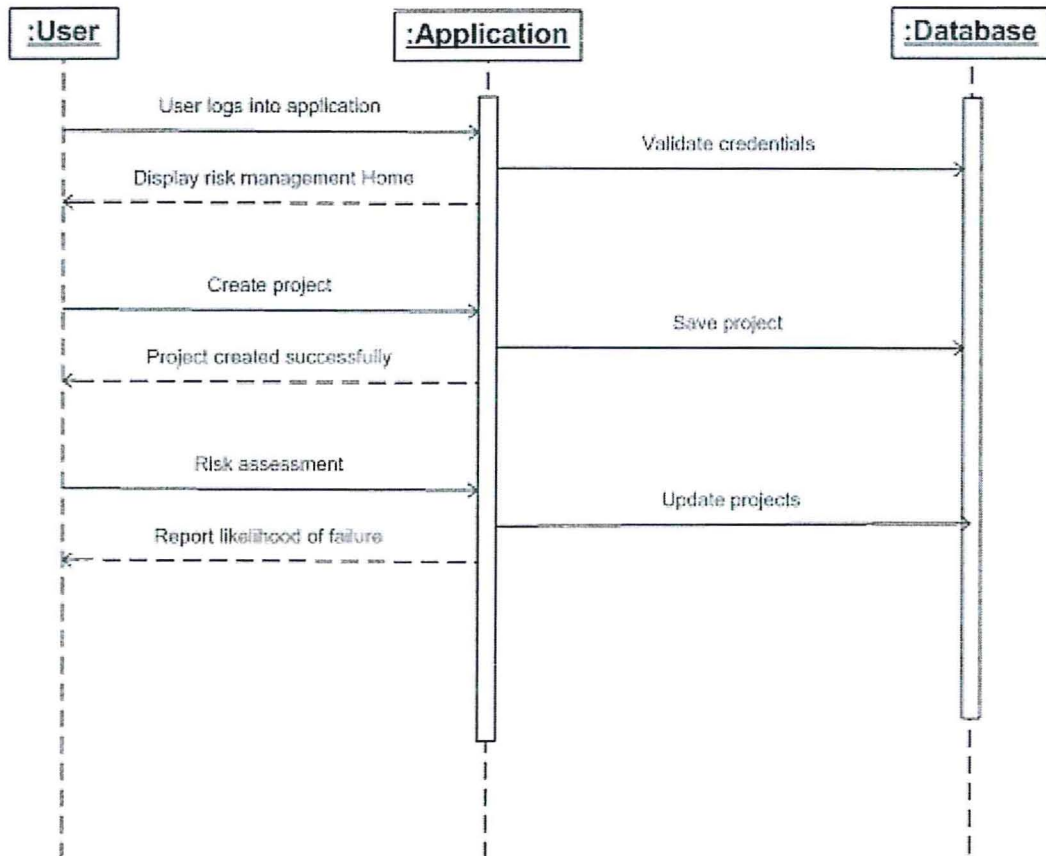


Figure 4.16: Sequence diagram

4.5 System Design

Custom development was used as the design strategy. Object oriented design was used in defining the requirements identified during system analysis. User requirements were obtained from the findings of the survey. These user requirements were summarized into design class diagrams (DCD) and entity relationship diagrams (ERD). This is important to illustrate how objects interact with each other and outline the processes involved in implementation of systems.

4.5.1 Entity Relationship Diagram

Figure 4.17 presents the ERD for the system. It shows the entities used in the database and illustrates the various tables and their relationship with each other.

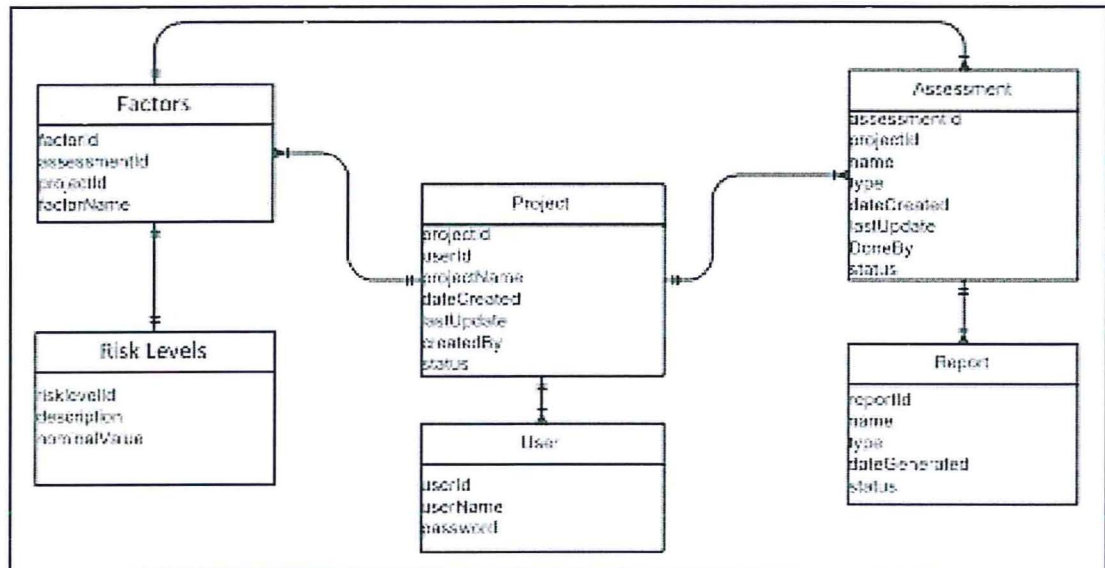


Figure 4.17: Entity Relationship Diagram

One user can have one or many projects (one to many relationship). One project can have one or many assessments (one to many relationship). One assessment can have one or many reports (one to many relationship). One factor can have many assessments (one to many relationship). One factor can only have one risk level (one to one relationship).

4.5.2 Design Class Diagram

Figure 4.18 shows the design class diagram which illustrates the interaction of the classes in the system, their respective attributes and methods.

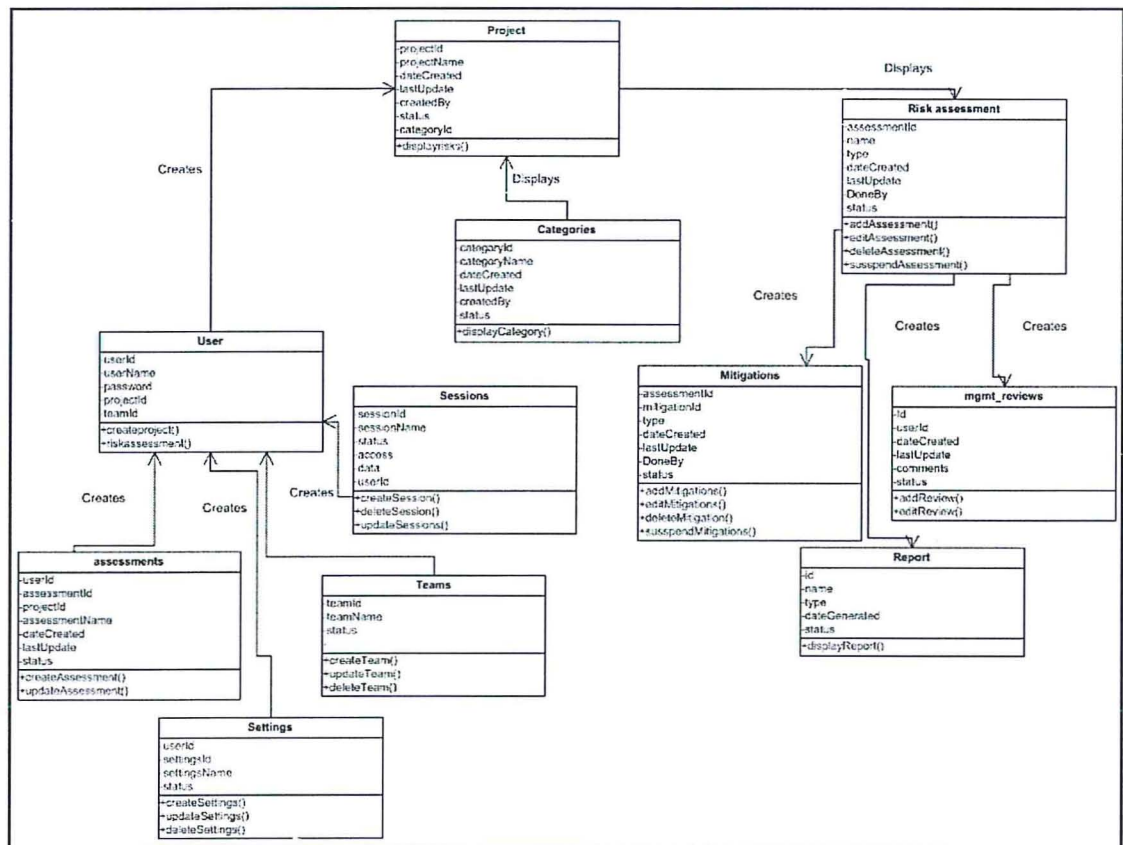


Figure 4.18: Design Class Diagram

4.5.3 Security Design

Both the system approach and data approach were considered in designing the security of the system. Security of data is ensured by requiring access to the system through user name and password. In addition, the characters of the password are masked even in the storage to ensure that even the administrator cannot tell the user password. In addition, there is a password policy which defines the type of characters to be used, minimum number of characters allowed, duration of use of the password and prohibits use of a password that had been used before. Further, a lockout policy is implemented in the system that locks out users after a specified number of unsuccessful login attempts and after a given duration of when the system is idle. To ensure security of the system and data, access to the system is authenticated. Access is only granted in accordance to the privileges accorded to the user.

Chapter Five: System Implementation and Testing

5.1 Introduction

In this chapter, implementation and testing of the tool for prediction of information systems implementation failure are discussed. Implementation of the system will focus on the various parts of the system, how they are implemented and their mode of operation. Finally, usability and functional testing of the tool will be done to ascertain if the tool achieves the objectives of the proposed solution.

5.2 System Development Life Cycle

This study utilized the information systems development methodology developed by Davies (2009). The methodology involves five (5) stages in implementation of information systems. The stages were: investigation, analysis, design, implementation and maintenance (see Figure 5.1). Investigation involved the development of a project management plan. This was followed by systems analysis where the information needs were identified and functional requirements of the system developed. At systems design stage, the technical aspects of the system were planned. This stage also involved building the information system according to the specifications. System implementation involved delivering the developed system. Activities in this phase included, testing the system, training people to use the system, and converting from the old to the new information system. Finally, system maintenance is the process of making necessary changes to the functionality of an information system (Davies, 2009).

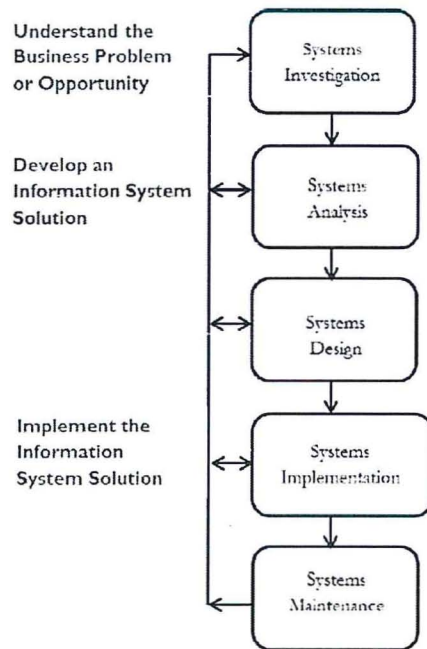


Figure 5.1: Information System Development Cycle (source: Davies, 2009)

5.3 System Implementation

The system has a front end and a back end. In developing the application, PHP and HTML technologies were used. MySQL is the back end database.

5.3.1 Front End

5.3.1.1 Login Page

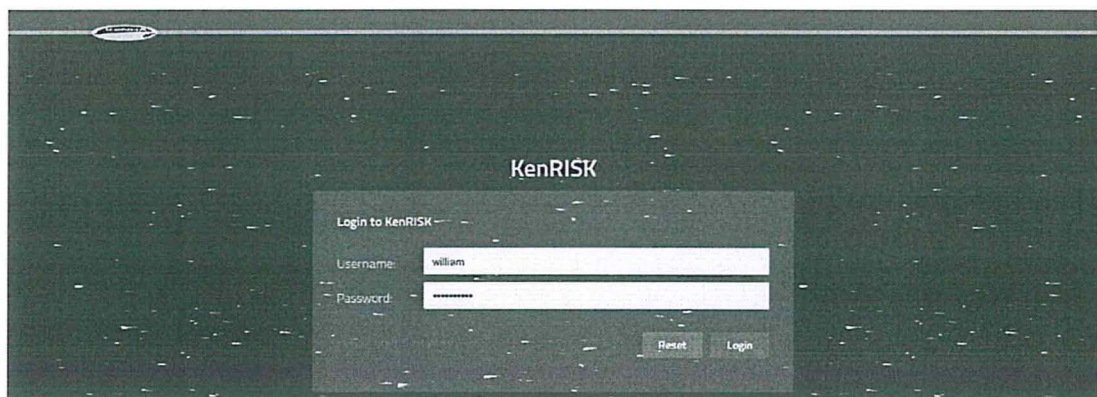
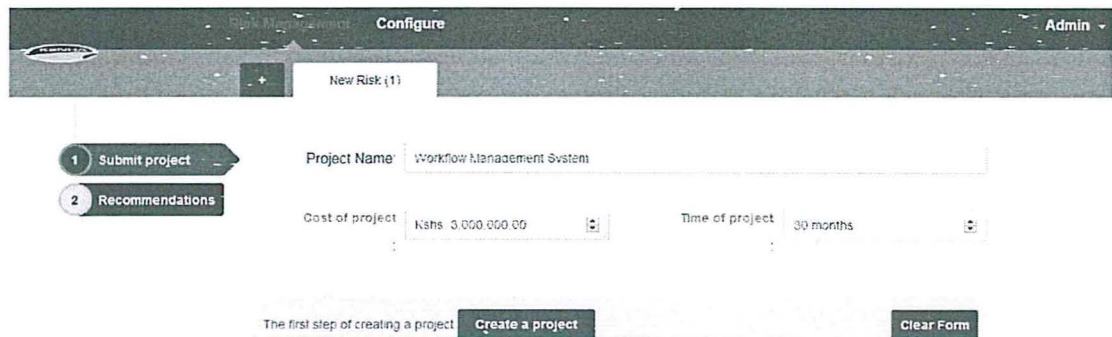


Figure 5.2: Login page wireframe

Figure 5.2 shows the login page. The user will input their user name and password to access the system. When a user enters his/her access credentials and clicks ‘Login’, the

menu in Figure 5.3 appears allowing the user to create a new project. If the user clicks 'Reset', the menu in figure 5.4 appears allowing the user to resent his/her password.

5.3.1.2 Creating a New Project

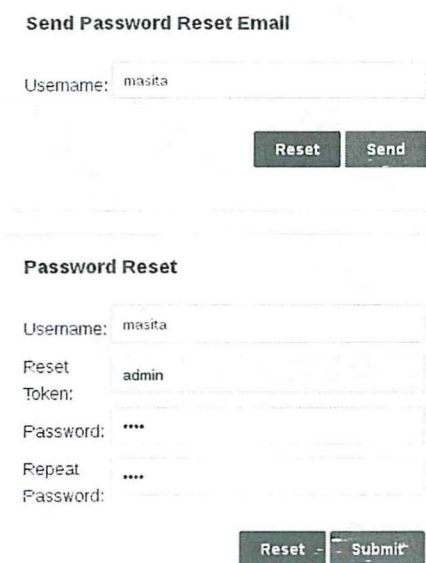


The wireframe shows a top navigation bar with 'Configure' and 'Admin' links. Below it is a 'New Risk (1)' header. The main form area contains two numbered steps: '1 Submit project' and '2 Recommendations'. The 'Submit project' step includes a 'Project Name' field with the value 'Workflow Management System', a 'Cost of project' field with 'Kshs 3,000,000.00', and a 'Time of project' field with '30 months'. At the bottom of the form, there is a 'Create a project' button and a 'Clear Form' button. A small text note reads 'The first step of creating a project'.

Figure 5.3: Project creation wireframe

Figure 5.3 shows the menu for creating a new project. A user will be required to state the project name, cost and time to completion. Once these details are entered, the user will be allowed to create the project. Upon clicking 'Create', the menu in figure 5.5 appears allowing the user to assess the process related factors. If the user clicks 'Clear Form', the details already entered will disappear and allow the user to reenter them.

5.3.1.3 Resetting the Password



The wireframe shows a 'Send Password Reset Email' section with a 'Username:' field containing 'masita' and two buttons: 'Reset' and 'Send'. Below this is a 'Password Reset' section with a 'Username:' field containing 'masita', a 'Reset Token:' field containing 'admin', a 'Password:' field with masked characters '****', and a 'Repeat Password:' field with masked characters '****'. At the bottom, there are 'Reset' and 'Submit' buttons.

Figure 5.4: Feedback for password reset wireframe

Figure 5.4 shows the information that the user will provide when they require their password to be reset. Once the user clicks ‘Submit’, the request will be processed and confirmation sent to the user’s email.

5.3.1.4 Assessment of Process Driven Factors of Failure

The wireframe shows a 'Configure' header with 'Admin' on the right. Below is a 'New Risk (1)' tab. A sidebar on the left contains two steps: '1 Submit project' and '2 Recommendations'. The main area is titled 'Process driven issues' and contains a table of factors with dropdown menus for likelihood and impact.

Issue	Likelihood	Impact
Requirements not well understood	Requirements well understood	Average Impact
Lack of commitment to a systems development methodology	Partial adherence to development	Insignificant Impact
Failure to manage the implementation plan	Implementation plan not implem	Insignificant Impact
Poor estimation techniques	Accurate estimation techniques	Average Impact

At the bottom, a message reads: 'Complete the form above to document a risk for consideration in Risk Management Process'. Below this are two buttons: 'Save Process' and 'Clear Form'.

Figure 5.5: Assessment of process driven issues wireframe

Figure 5.5 shows the assessment window for process driven issues. The user will be required to state the likelihood and impact level for each process factor of failure. Once the user clicks ‘Save Process’, the menu in figure 5.6 will appear allowing the user to assess the content driven issues.

5.3.1.5 Assessment of Content Driven Factors of Failure

The wireframe shows a 'Configure' header with 'Admin' on the right. Below is a 'New Risk (1)' tab. A sidebar on the left contains two steps: '1 Submit project' and '2 Recommendations'. The main area is titled 'Content driven issues' and contains a table of factors with dropdown menus for likelihood and impact.

Issue	Likelihood	Impact
Lack of top management commitment to the project	Partially adequate support	Significant Impact
Poor user commitment	Partial user commitment	Average Impact
Inadequate user involvement	Adequate user involvement	Average Impact
Failure to manage expectations of users	User expect, to be partially met	Average Impact
Inadequate people management skills	Adequate people management sk	Insignificant Impact
Failure to adopt in business change	No change management program	Average Impact

At the bottom, a message reads: 'Complete the form above to document a risk for consideration in Risk Management Process'. Below this are two buttons: 'Save Content' and 'Clear Form'.

Figure 5.6: Assessment of content driven issues wireframe

Figure 5.5 shows the assessment window for content driven issues. The user will be required to state the likelihood and impact level for each content factor of failure. Once the user clicks ‘Save Content’, the menu in figure 5.7 will appear allowing the user to assess the context driven issues.

5.3.1.6 Assessment of Context Driven Factors of Failure

Figure 5.7: Assessment of context driven issues wireframe

Figure 5.7 shows the assessment window for context driven issues. The user will be required to state the likelihood and impact level for each context factor of failure. Once the user clicks ‘Save Context’, the menu in figure 5.8 will appear allowing the user to view the assessment results.

5.3.1.7 Project Assessment Report

Project Name	Score	Status
Workflow Management System	4.6	Likely to fail

Figure 5.8: Results of risk assessment wireframe

Figure 5.8 shows the assessment results. It shows the risk score and informs management on the likelihood of failure in the information system being implemented.

5.3.2 Back End

The back end contains information on management of users, file upload settings, mail settings and audit trail. This is illustrated in Figure 5.9 to 5.14.

5.3.2.1 New User Set Up

The screenshot shows the 'Add a New User' form within the Risk Management system. The form is located on the right side of the page, with a navigation menu on the left. The navigation menu includes 'User Management', 'File Upload Settings', 'Mail Settings', and 'Audit Trail'. The 'Add a New User' form contains the following fields and options:

- Type:** SimpleRisk (dropdown)
- Full Name:** William Masika
- E-mail Address:** willmasika@gmail.com
- Username:** admin
- Password:** ****
- Repeat Password:** ****
- Team(s):** Branch Management (dropdown)
- User Responsibilities:**
 - Check All
 - Check All Risk Management
 - Able to Submit New Risks
 - Able to Modify Existing Risks

Figure 5.9: New user set-up wireframe

Figure 5.9 shows how the administrator sets up a new user and defines the privileges for that user. When the administrator clicks 'Add', the user will be added to the system.

5.3.2.2 Editing Details of an Existing User

The screenshot shows the user management interface with the following sections:

- View Details for User:** Details for User: Admin (dropdown) [Select]
- Enable and Disable Users:** Use this feature to enable or disable user logins while maintaining the audit trail of user activities.
 - Disable user: Admin (dropdown) [Disable]
 - Enable user: (dropdown) [Enable]
- Delete an Existing User:** Delete current user: Kevin Masika (dropdown) [Delete]
- Password Reset:** Send password reset email for user: Kevin Masika (dropdown) [Send]

Figure 5.10: Editing a user wireframe

Figure 5.10 shows how the administrator enables, disables or deletes a user from the system.

5.3.2.3 Account Lockout Policy and Password Policy

The wireframe shows two sections: 'Account Lockout Policy' and 'Password Policy'. Under 'Account Lockout Policy', there are two input fields: 'Maximum Attempts Lockout' with a value of '0' and a note '[0 = Lockout Disabled]', and 'Maximum Attempts Lockout Time' with a value of '15' and a note '[0 = Manual Enable Required]'. The 'Password Policy' section includes a checked 'Enabled' checkbox, a 'Minimum Number of Characters' field with a value of '8' and a range '[1-50]', and five checked checkboxes for 'Require Alpha Character', 'Require Upper Case Character', 'Require Lower Case Character', 'Require Numeric Character', and 'Require Special Character'. Below these are two more input fields: 'Minimum Password Age' with a value of '0' and a note '[0 = Min Age Disabled]', and 'Maximum Password Age' with a value of '0' and a note '[0 = Max Age Disabled]'. An 'Update' button is located at the bottom of the form.

Figure 5.11: Account lockout policy wireframe

Figure 5.11 show the security policies in place which include the account lockout and password rules.

5.3.2.4 File Upload Settings

The wireframe shows a navigation bar with 'Risk Management' and 'Admin' links. On the left is a sidebar with 'User Management', 'File Upload Settings', 'Mail Settings', and 'Audit Trail'. The main content area is titled 'Allowed File Types:' and contains a table with two rows. The first row has 'Add new file type of application/vnd' and an 'Add' button. The second row has 'Delete current file type of application/vnd' and a 'Delete' button. Below the table is a 'Maximum Upload File Size:' section with an input field containing '5120000' and the unit 'Bytes', followed by an 'Update' button.

Figure 5.12: Restriction settings for file uploads wireframe

Figure 5.12 shows the set up window for file types which users are allowed to upload and the maximum file size.

5.3.2.5 Mail Settings

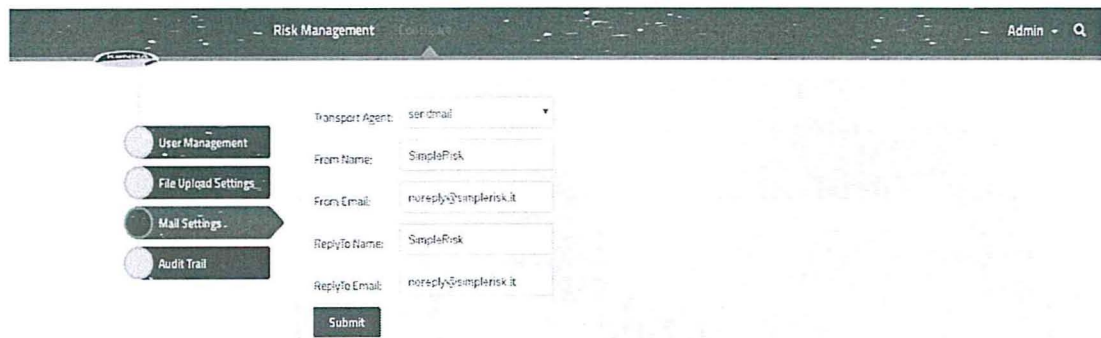


Figure 5.13: Mail settings wireframe

Figure 5.13 shows the mail settings as they currently exist in the system. The administrator can use this window to change the settings.

5.3.2.6 Audit Trail

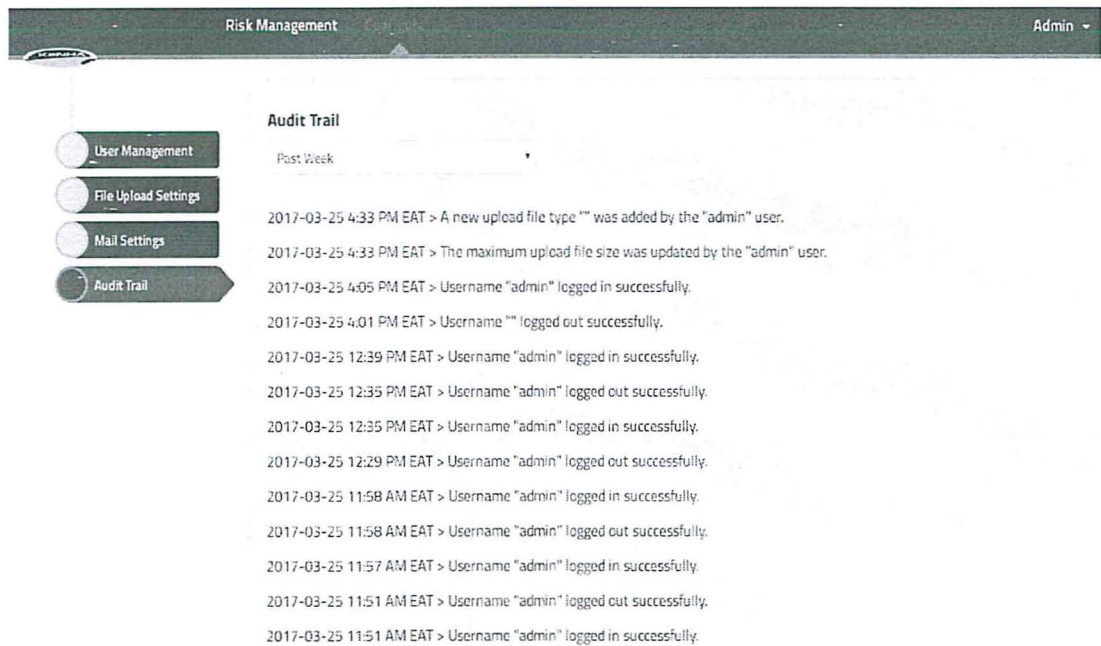


Figure 5.14: Audit trail wireframe

Figure 5.14 shows the audit trail. This indicates a history of the logon activity of the system.

5.4 System Testing

The objective of system testing is to assess the effectiveness of the system at mitigating risks to an appropriate level and provide management accountability over the

effectiveness of the system in meeting its intended objectives and establishing an appropriate level of internal control. Testing is done to verify and validate that a program, subsystem or application performs the functions for which it has been designed. This is also to confirm that the information system units operate without malfunction or adverse effect on other components of the system. Based on the severity of the problem found, the problem may be fixed prior to implementation or may be noted for correction following implementation. Testing of this tool focussed on its functionality and usability.

5.4.1 Functionality Testing

This mode of testing was geared towards assessing the functional parts of the system. The functional parts of this system are: admin login and logout; user login and logout; admin adding, editing and deleting users; admin viewing analytics; and user viewing all the menus.

5.4.2 Usability Testing

This is an assessment of the ease with which users are able to achieve their goals for the application. Usability testing for this system concentrated on the following attributes for all the modules: consistency between the modules, efficiency in using the application, ease of navigating through the application, ease of learning and using the application, ease of finding content in the application, user interface, user-friendliness, usefulness and responsiveness. The respondents were created in the system and issued with access credentials. The questionnaire in Appendix C was used to do usability testing.

5.4.2.1 Usability Testing Results

5.4.2.1.1 Success in Login

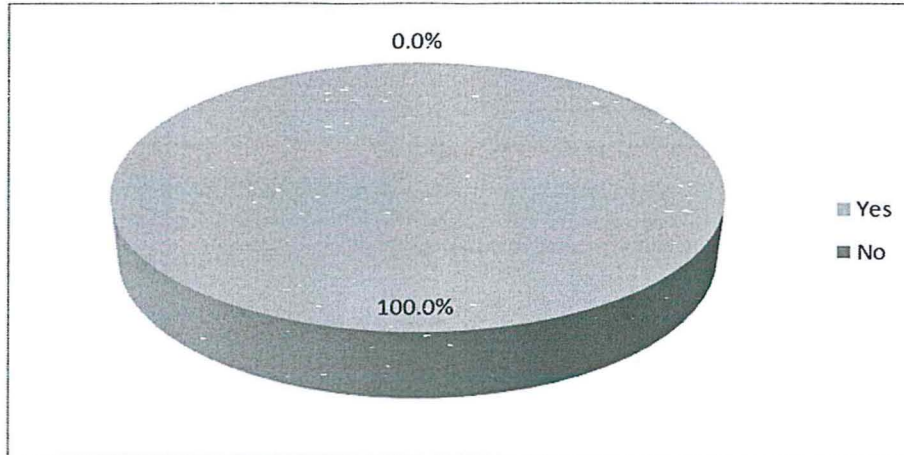


Figure 5.15: Respondents who successfully logged in

Respondents were required to log into the system using the access credentials that had been issued. This was intended to test whether users could easily log in. Figure 5.15 shows that all the respondents successfully logged into the application. Thus, once the user was issued with system access credentials, no other assistance was required to log in and therefore the system was easy to learn and use.

5.4.2.1.2 Predicting Likelihood of Failure

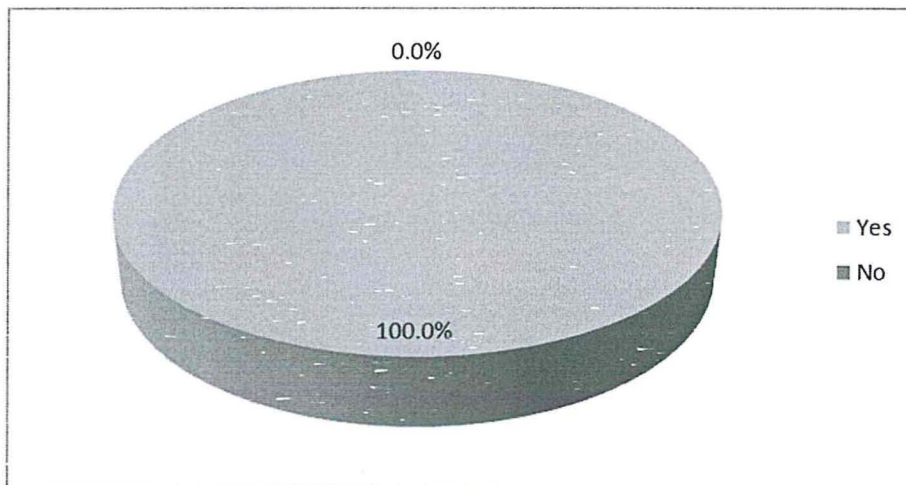


Figure 5.16: Information systems whose likelihood of failure was successfully predicted

Respondents were presented with five IS projects which had been implemented and asked to use the tool to assess the likelihood of failure. This was meant to test the effectiveness

of the tool at predicting the likelihood of failure of information systems. Figure 5.16 shows that all the respondents predicted correctly on the likelihood of failure of information systems using the application. Though the risk scores for various respondents were not the same, the cutoff point for failure was met by all these assessments i.e., for the three failed projects, the risk scores were higher than 4.5 while for the two successful projects, the risk scores were lower than 4.5. This therefore proved that the system effectively predicted likelihood of failure.

5.4.2.1.3 Qualitative Attributes of the System

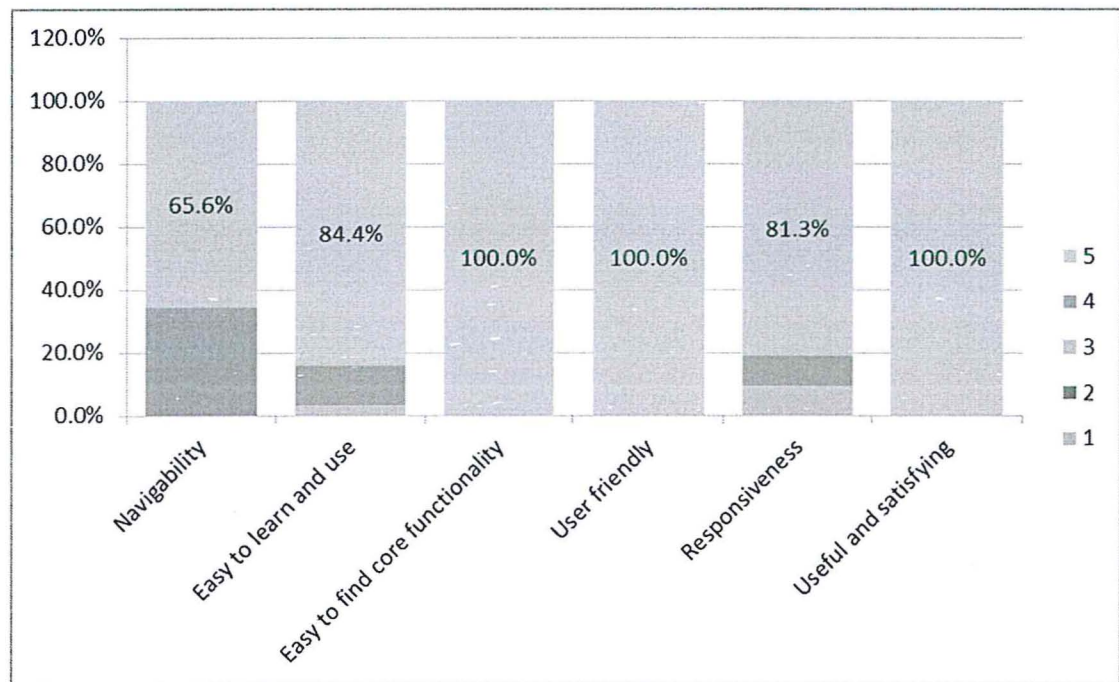


Figure 5.17: Rating on the qualitative attributes of the application

Users were required to rate various quality aspects of the system on a 5-point Likert scale. Figure 5.17 shows that all the respondents stated excellent for the attributes of ease of finding core functionality, user-friendliness of the application and useful and satisfying. A majority of the respondents also stated that the application was easily navigable, responsive and easy to learn and use. Thus, it can be concluded that the system meets the standard quality aspects.

Chapter Six: Discussion

6.1 Introduction

Findings obtained from this research were used to develop the tool for predicting likelihood of failure in implementation of information systems. Functionalities of the application were ascertained through system testing. The application was validated using real system implementation data at KeNHA. In this chapter, research findings will be analysed in relation to research objectives and consistency with literature review.

6.2 Causes of Information Systems Implementation Failure

ICT projects fail when organisations fail to determine the factors that lead to failure from the very beginning. From the research findings, the major causes of failure are lack of requisite knowledge and skills, lack of top management support, inadequate user involvement, changing scope, failure to adapt to business change, poor estimation techniques and lack of commitment to a systems implementation methodology. The proposed solution has incorporated these factors as input in the assessment to determine the likelihood of failure.

Lack of user involvement right from initiation of the project is a key source of failure. Mumford, (2006) emphasized the importance of allowing end users to participate in the design and development of new or modified information systems. Lack of user involvement may lead to changing scope, requirements not well-understood, failure to manage expectations of users and poor user commitment to the project. In turn, weak definition of project scope and requirements may lead to scope creep (Kappelman, McKeeman & Zhang, 2006). Consequently, complex changes that are beyond the project plans may result which could lead to increasing conflicts within the project or between various categories of users. Through use of the proposed tool, this will be foreseen and mitigation measures put in place to ensure users are involved, requirements are well understood and project scope is well defined.

Poor estimation techniques may result in shortage of required resources to complete the project. This may be due to incorrect assumptions regarding resource availability. Resources may include people, skills, equipment, hardware, software, time and all the other requirements for completing the project. As evident from the research findings,

time and budget overrun is a major indicator of project failure. The Organizational Information Processing Theory advocates for avoidance of uncertainty relating to specifications, requirements, cost and time (Nyandiere C. M., Kamuzora, Lukandu, & Omwenga, 2014). This therefore calls for accuracy in determination of required resources. In the proposed solution, resource availability for each IS project implementation will be tested and recommendations made where deficiencies are noted.

When top management commitment to the project is inadequate, information systems implementation projects may fail. This may have an effect on resource allocation for the project. This is among the content driven issues which have an effect on the likelihood of failure of the project (Kappelman, McKeeman & Zhang, 2006). The extent of top management support has been included in the tool as part of the areas to be assessed to determine the likelihood of failure of information systems implementation projects.

Failure to adapt to business change is identified as a cause of failure. The information system may be technically operational but fail on account of the existing culture of the organization (Basoglu, Daim & Kerimoglu, 2007). In implementing information systems, equal weight should be given to both technical and social aspects of an information system. As noted by (Mumford, 2006), an information system designed for the sole purpose of meeting technical requirements without considering the work practices around it is likely to have unpredictable user consequences. Thus, implementing information systems may bring with it a conflict between the existing organizational culture and the new information systems culture. As such, it is recommended that a programme of change management should be in place whenever new information systems are implemented or existing ones are modified to ensure alignment of the culture scenarios. This tool will enable an assessment of the extent of business/ culture change and feed into the overall determination of likelihood of failure.

Lastly, lack of commitment to a systems implementation methodology may also lead to failure. Although respondents stated that SDLC was largely used, this may not have been the case all the time. Fitzgerald (2010) concluded that following through a systems implementation methodology is difficult for organisations and this may result in failure. It is therefore important to assess the effect of this factor on the likelihood of information systems implementation failure.

6.3 Approaches for Mitigating Information Systems Implementation Failure

Approaches for mitigating information systems implementation failure were identified as Earned Value Management (EVM), Risk Management (RM) and Enterprise Risk Management. From research findings, it was apparent that ERM is the most effective in mitigating failure and the most preferred for the respondents. This is also supported by literature review which states that ERM addresses weaknesses of both EVM and RM hence its effectiveness, that is, it integrates all types of risks in a single framework and therefore it is possible to assess all risks throughout the implementation cycle (Aming'a & Omwenga 2016). Arising from the research findings and documented literature, the proposed tool was developed based on an ERM framework.

6.4 Development of the Tool for Predicting Information Systems Implementation Failure

According to the research findings, in most cases, there was no mechanism used in predicting failure of information systems. It was only in a few cases where resource requirements projection and risk analysis were used. Further, the fact that some projects were abandoned midway through the implementation process means that the prediction methods in place were not effective. It is therefore important to develop a tool that would predict the likelihood of failure in implementation of information systems. Kappelman, McKeeman and Zhang (2006) emphasized the importance of predicting, cautioning and alerting one of future implementation problems. The proposed tool will help bring an understanding of uncertainties associated with implementation of any new information system.

6.5 Prototype for Predicting Likelihood of Information Systems Implementation Failure

Use case diagrams and sequence diagrams were used to analyse the system. Following this analysis, the system was designed using entity relationship diagrams and design class diagrams. The proposed solution is a responsive web application (KenRISK). It was built using PHP 5.6 and has both front end and a back end. MySQL database is at the back-end. In developing the application, jQuery was used to enhance user experience. When using the application, credentials are encrypted before being saved to enhance user privacy. For the system to predict the likelihood of IS project failure, input into the

system will be the likelihood and impact levels for the various factors of failure. These factors have been grouped based on the categorization proposed by Kappelman, McKeeman and Zhang (2006), that is, process driven factors, content driven factors and context driven factors. The system computes the overall risk score for the project and outputs a verdict on the likelihood of failure.

6.6 Testing the Tool for Predicting Failure in Implementation of Information Systems

Data from actual IS project implementations projects at KeNHA was used to test whether the application fulfilled its objective of predicting failure. Out of the five projects tested, the system predicted that three would have failed. This was proven to be factual. Thus, the application is reliable. Reliability is an attribute of arriving at the same conclusion when the test is repeated (Ghuri & Gronhaug, 2005). All respondents stated that the application was user friendly, useful and satisfying and that it was easy to find the core functionality. In addition, respondents were satisfied with the navigability in the application, ease of learning and using the system and its responsiveness. This agrees with conclusions reached by Kaur and Aggrawal (2013) that for an information system to be successful, users must accept it.

6.7 Advantages of the tool for predicting Failure in Implementation of Information Systems

From the research findings, it was found that there was no tool in place for predicting failure. Moreover, reactions by management when implementation failure is identified were varied. Most worrying were the cases where management proceeded with implementation even if likelihood of failure was identified i.e., weaknesses noted in the implementation process were not treated. The tool provides feedback on the likelihood of failure of the information system being implemented. The reports generated by the tool will provide management with information on how to proceed with the implementation process in order to increase chances of success. Even in cases where failure is not predicted, the assessment report will still provide recommendations for further improvement. Such information is important for decision making. As such, if management takes the recommended corrective actions, the likelihood of failure would

be reduced. Thus, as noted by Kappelman, McKeeman and Zhang (2006), where systems are likely to fail, management will be notified early before resources are wasted.

Chapter Seven: Conclusions, Recommendations and Future Work

7.1 Introduction

The main objectives of this study were to investigate causes of information systems implementation failure, assess the approaches for mitigating failure and develop a tool for predicting the likelihood of information systems implementation failure. In this chapter, conclusions and recommendations will be discussed based on these objectives and empirical data.

7.2 Conclusion

From the research findings, it was noted that in most cases, there was no mechanism for predicting whether information systems being implemented would fail. About 66% of the respondents stated that there was no mechanism for predicting likelihood of failure of information systems implementation projects. This may lead to going on with implementation to the very end only for the systems to fail. This results in loss of resources as the organization invests heavily in terms of financial, human and time. The research helped identify factors which would lead to failure. From the research findings, the major causes of failure were identified as team members lack of requisite knowledge and skills, lack of top management commitment to the project, requirements not well understood, inadequate user involvement, changing scope, failure to adapt to business change, failure to manage expectations of users, poor estimation techniques, failure to manage the implementation plan, inadequate people management skills, insufficient staffing, poor user commitment and lack of commitment to a systems implementation methodology. However, at KeNHA, respondents stated that knowledge and skills of team members and people management skills were not causes of failure of IS implementation projects as none of the respondents said so. Therefore, the other factors may have been responsible for the failures noted. However, it is worthy to note that the factors do not lead to failure in equal measure. As a result, these factors were weighted based on the responses received. Further, it was revealed that respondents preferred use of ERM as an approach to mitigating information systems implementation failure over EVM and risk management. Thus, the proposed solution was based on ERM because of its advantages over the other two methods elaborated in the literature review and its preference by the respondents. Arising from these findings, a tool was developed for predicting likelihood

of failure in information system implementations. The tool will use the identified factors of failure which will then be assessed and a risk score generated. Based on the score arrived at, the system will determine the likelihood of failure i.e., a score greater than 4.5 would result in a verdict of likelihood of failure. The tool was tested using actual information systems implementations at KeNHA and found to be accurate in its determination of the outcome of IS implementations. Further, through testing of the tool, it was revealed that it was user friendly, easy to learn and use, easily navigable and easy to find core functionality. Adoption of this tool will be useful in helping organizations to mitigate challenges that may arise during and after implementation. With this tool, it will be easier to tell the likelihood of failure of information systems implementations given the organization's existing processes, resources and structures. This will help save resources and ensure that all key ingredients that support successful implementation of information systems are in place prior to commencement of the projects.

7.3 Recommendations

The tool for predicting failure of implementation of information systems is very important as it provides recommendations that will increase likelihood of success. The main beneficiaries are management of organizations as it will add value by enhancing awareness on factors that lead to failure. Organizations will therefore have a reference point in order to enhance their methodologies and therefore better delivery of planned information systems implementations. However, there is need for wide distribution of the tool to help in mitigating the high failure rate noted in the introduction section of this dissertation. In order to increase adoption of the tool, there is need for public awareness campaigns to assist in wide knowledge about its existence.

7.4 Future Work

More research needs to be done on factors that are likely to lead to failure in other sectors. This research used respondents from one organization and therefore one sector of the economy i.e., the roads sector. Further, the subject organization is in the public sector and therefore there is need to obtain input from the private sector. Thus, the tool could be enhanced by incorporating factors of failure that are specific to certain other sectors. Users will then be presented with a menu to select their sector. Upon selection of a given sector, the tool will populate the factors that are specific to that sector. This will result in

higher levels of uptake and therefore prevent resource wastage by organizations implementing information systems that are bound to fail.

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Appendices

Appendix A: Questionnaire

A Tool for Predicting the Likelihood of Information Systems Implementation Failure

Dear Respondent

I am a Masters student in the Faculty of Information Technology, Strathmore University conducting a research entitled A TOOL FOR PREDICTING THE LIKELIHOOD OF INFORMATION SYSTEMS IMPLEMENTATION FAILURE. You have been selected to form part of this study. I kindly request you to complete the questionnaire below. The information requested is needed for academic purposes only and will be treated in strict confidence.

Kind regards

William Okari Masita

SECTION A: RESPONDENT'S DEMOGRAPHIC INFORMATION

1. Indicate your department.....

2. What is your highest level of education?

Select one option

- Certificate
- Diploma
- Higher Diploma
- Bachelor's Degree
- Master's Degree
- PhD
- Other (specify)

3. What is your role in the organization?

Select one option

- Civil engineering
- Survey
- Accounting

- Information Technology
- Legal
- Corporate Communication
- Risk Management
- Auditing
- Human Resource Management
- Quality Assurance
- Other (Specify).....

SECTION B: CAUSES OF INFORMATION SYSTEMS IMPLEMENTATION FAILURE

4. What category of information systems have you participated in implementation?

Select all that apply

- Transaction Processing Systems
- Decision Support Systems
- Knowledge Management Systems
- Learning Management Systems
- Database Management Systems
- Office Management Systems

5. What are the likely causes of information systems implementation failure?

Select all that apply

- Lack of top management commitment to the IS project
- Poor user commitment
- Inadequate user involvement
- Requirements not well understood
- Failure to manage expectations of users
- Changing scope
- Team members lack requisite knowledge and skills
- Insufficient staffing
- Lack of commitment to a systems development methodology
- Poor estimation techniques
- Inadequate people management skills

- Failure to adapt to business change
- Failure to manage the implementation plan

6. On a scale of 1 – 5 (with 5 being the highest and 1 being the lowest), rate the causes of information systems failure *Select one box only in each row*

Cause of Failure		1	2	3	4	5
1.	Lack of top management commitment to the project					
2.	Poor user commitment					
3.	Inadequate user involvement					
4.	Requirements not well understood					
5.	Failure to manage expectations of users					
6.	Changing scope					
7.	Team members lack requisite knowledge and skills					
8.	Insufficient staffing					
9.	Lack of commitment to a systems development methodology					
10.	Poor estimation techniques					
11.	Inadequate people management skills					
12.	Failure to adapt to business change					
13.	Failure to manage the implementation plan					

7. What method(s) do you use to identify the likely causes of failure in implementation of information systems? *Select all that apply*

- Resource requirements projection
- Risk analysis
- Early Warning Signs (EWS)
- No method used
- Other (specify).....

8. For your chosen method(s) in (4.) above, what is the success rate on a scale of 1 -5 (with 5 being the most successful and 1 being the least successful)?

State the rate for method(s) used only

Method of Identifying Failure		1	2	3	4	5
1.	Resource requirements projection					
2.	Risk analysis					
3.	Early Warning Signs (EWS)					
4.	No method used					
5.(specified method)					

9. How do you determine whether an IS implementation project has failed?

Select all that apply

- Project exceeds allocated budget
- Project exceeds the scheduled time
- Project is abandoned before completion
- IS does not deliver expected benefits
- IS is not being used

10. What action is taken when likelihood of failure of information systems implementation is identified?

- Project is delayed until corrections are made
- Project proceeds as corrections are being made
- Project is abandoned
- Project proceeds without corrective actions being undertaken

SECTION C: APPROACHES USED IN MITIGATING INFORMATION SYSTEMS IMPLEMENTATION FAILURE

1. What approach(es) do you use in mitigating information systems implementation failure?

Select all that apply

- Earned Value Management
- Risk management
- Enterprise risk management
-

No method used

Other (Specify.....)

2. On a scale of 1 – 5, (where 5 is the most effective and 1 the least effective), rate the effectiveness of the method used *State the rate for approaches used only*

Method of Identifying Failure		1	2	3	4	5
1.	Earned Value Management					
2.	Risk management					
3.	Enterprise risk management					
4.	No method used					
5.(<i>specified method</i>)					

SECTION D: DEVELOPMENT OF THE TOOL FOR PREDICTION OF INFORMATION SYSTEMS IMPLEMENTATION FAILURE

1. What approach(es) do you use in implementation of information systems?

Select all that apply

- System Development Life Cycle
- Rapid Applications Development
- Prototyping
- Other (Specify).....

2. For your chosen approach(es) in (1.) above, what is the success rate on a scale of 1 -5 (with 5 being the most successful and 1 being the least successful)?

State the rate for approaches used only

Method of Identifying Failure		1	2	3	4	5
1.	System Development Life Cycle					
2.	Rapid Applications Development					
3.	Prototyping					
4.(<i>specified method</i>)					

Appendix B: Detailed Description of Use Cases

Description of Use Case	Preconditions	Post-conditions	Main Success Scenario
Login - reports how a user accesses the system to start a session.	A user is issued with a user name and password.	A user clicks 'login' and enters the user name and password and views the home page	<ol style="list-style-type: none"> 1. User views the 'Home' screen. 2. User views the categories of IS failure factors. 3. User selects the likelihood and impact levels for each factor and submits. 4. User creates and views the report.
Logout - reports how a user ends a session in the system.	User is already logged into the system.	User clicks the 'logout' button.	Current session is ended. User will be required to login to resume using the system.
Create Project - reports how a user creates a new project.	User is logged into the system.	User enters project name, cost and time to completion.	<ol style="list-style-type: none"> 1. User views the categories of IS failure factors. 2. User selects the likelihood and impact levels for each factor and submits. 3. User creates and views the report.
Enter Likelihood and Impact Levels - reports how a user enters likelihood and impact levels.	A project has been created in the system.	User enters likelihood and impact levels for each failure	User creates and views the report.

		factor by selecting from a dropdown list.	
<u>View Report</u> - reports how a user creates and views the assessment report.	User enters the likelihood and impact levels and submits.	User assesses the last category of factors of failure (context driven factors) and saves.	User views the assessment report on the screen.
<u>Update Failure Factors</u> - reports how the system administrator edits (adds or removes) factors of failure.	New information about factors of failure has been received.	System administrator enters new information and deletes unwanted information about factors of failure.	1.Administrator edits the factors of failure with new information. 2.Added factors can be viewed. 3.Deleted factors are not available.
<u>Update Likelihood and Impact Levels</u> - reports how the system administrator edits/adjusts the likelihood and impact levels.	New information about likelihood and impact levels has been received.	System administrator adds new information about impact levels and deletes unwanted information.	1.Entry of factors of failure is based on the adjusted likelihood and impact levels. 2.Deleted information is not available.
<u>Update Weights of IS Failure Factors</u> - reports how the system	New information about weights of factors of failure has been	System administrator enters the new weights of	1.Old weights are not available in the system. 2.Risk scores are

administrator adjusts the weights of factors of failure.	received.	factors of failure.	computed based on the new weights.
Update Users - reports how a user is added, deleted or information about an existing user is updated.	System administrator obtains details of a new user or new information about an existing user.	System administrator adds, deletes or updates information about the user.	<ol style="list-style-type: none"> 1. New user can access the system. 2. Updated user can access the system using the new details. 3. Updated user cannot access the system using old details. 4. Deleted user cannot access the system.

Appendix C: Usability Testing Questionnaire

1. Were you able to log into the system?

Select one only

Yes

No

2. If your answer in (1.) above is 'No', state the response received

Write down the response

3. Use the application to test its predictive ability. Does the application predict failure for the failed systems tested? *Select one only*

Yes

No

4. On a scale of 1 – 5, (where 5 is the excellent and 1 is poor), how would you rate the whole application on the following factors? *Select one only option in each row*

Factor		1	2	3	4	5
1.	Navigability					
2.	Easy to learn and use					
3.	Easy to find core functionality					
4.	User friendly					
5.	Responsiveness					
6.	Useful and satisfying					

Appendix D: Turnitin Report

A Tool for Predicting the
Likelihood of Information
Systems Implementation Failure
A Case of Kenya National
Highways Authority

by William Masita Okari

A Tool for Predicting the Likelihood of Information Systems Implementation Failure: A Case of Kenya National Highways Authority

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