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Effects of project complexity on project success: the case of telecom firms in Nairobi

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Effects of Project Complexity on Project Success: The Case of Telecom Firms in Nairobi

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DECLARATION

I declare that this dissertation has not been previously submitted and approved for the award of a degree by this, or any other University. To the best of my knowledge and belief, the proposal contains no material previously published or written by another person except where due reference is made in the thesis itself.

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ABSTRACT

Project complexity is mentioned as one of the factors that both directly and indirectly influences project success and therefore an important factor to be managed along the project lifecycle. Complexity affects cost, time and quality objectives of a project, inhibits clear identification of goals and objectives, as well as influencing project planning and controlling practices. However, different forms of project complexities affect projects in different economic sectors differently. This study focused on investigating the effects of project complexity on project success. The study focused on project success in terms of project efficiency and organizational benefits. The study adopted a cross-sectional survey of telecom operators' base in Nairobi, Kenya. The study used simple random and convenience sampling methods to select respondents from the target population. Data was collected using a structured questionnaire. Descriptive and inferential statistics were used establish the effect of project complexities on project success. Multiple linear regression showed that technological complexity positively influenced project efficiency but not organizational benefits. Organizational and environmental complexities positively influenced organizational benefits but not project efficiency. The study recommends that project implementers should find ways of streamlining technological, organizational and environmental complexities in order to influence project success.

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ABBREVIATIONS

ANP	Analytic Network Process
CA	Communication Authority of Kenya
CAPI	Computer Aided Personal Interviews
CLRM	Classical Linear Regression Model
GDP	Gross Domestic Product
IS	Information Systems
ISDP	Information System Development Projects
KMO	Kaiser-Meyer-Olkin
NACOSTI	National Commission for Science, Technology and Innovation
OLS	Ordinary Least Square
PMO	Project Management Office
SPSS	Statistical Package for Social Sciences
TOE	Technological, Organizational, and Environmental

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DEDICATION

I dedicate this research to my family for the invaluable support during my MBA program.

CHAPTER ONE: INTRODUCTION

Projects and managing projects have become increasingly common in organizations. Indeed, it is estimated that 25 per cent of the global Gross Domestic Product (GDP) is realized through implementation of projects (ICCPM, 2017). Vidal and Marle (2015) defines a project as a temporary and unique endeavour managed to deliver an outcome.

Telecommunication companies are simultaneously running numerous Information Systems (IS) and technology projects. Due to high capital expenditure, uncertainty, and risks involved in many of these projects, there needs a means of enhancing success in their deployment (Munyoki & Njeru, 2014). Managing projects have therefore become a core activity for most companies and in particular in the telecommunication sector (Turki, Al-Karaghouli, & Eldabi, 2013).

Due to the complexity of projects and the environments they are managed in, projects may fail to meet their expectations despite improved delivery methods of delivery. Some of these projects are complex because they have to deal with both technological and organizational factors that are largely beyond the project team's control. Constant changes in both the business and information technology environments make functional requirements and technical specifications difficult to clearly define and manage (Xia & Lee, 2004).

Firms that would like to increase their project's success rate must therefore develop strategies for managing the projects complexity. It is therefore critical for the firms' management to gain knowledge and understanding of the factors that drive complexity and effects of the complexity on project success. Such knowledge would help the project organization focus more on the complexity factors with greatest influence on project success measure important to their objectives (Xia & Lee, 2004)

Managing complexity is in line with contingency theory which opines that organizational performance will improve if there is a proper alignment of internal and external organization factors. Furthermore, for organization's effectiveness, its structure and processes must fit its context - environment, organization culture, technology, size, or task (Drazin, 1985). In addition to contingency theory, adoption and implementation of technological innovations as is the case in telecom industry is influenced by technological context, organizational context, and environmental context as outlined in Tornatzky, Eveland, and Fleischer (1990) TOE theory for innovation adoption, implementation and usage.

This study was motivated by a series of premises: that projects in telecommunication sector are becoming increasingly complex Sherif (2006); that projects are implemented in an increasingly volatile and complex environment IBM (2010); and that traditional drive to measure project success solely on triple constraints - time, cost, and scope are no longer adequate (Kam Jugdev & Müller, 2005; Shenhar, Dvir, Levy, & Maltz, 2001).

The aim of this study was to determine the effects of project complexity factors on success of projects managed by telecom firms. In this study, project success was considered in terms of project efficiency and organizational benefits. This study adopted the independent variable, project complexity, from existing research work by Bosch-rekveldt et al. (2011) in TOE model. The project complexity dimensions adopted by the study were technological complexity, organizational complexity, and environmental complexity. The dependent variable, project success – project efficiency and organization benefits, were adopted from Khan et al. (2013) model.

1.1.1 Project Complexity

Complexity has been mentioned as an important factor that influences planning and controlling practices, hinders identification of goals and objectives, and a factor that affect cost, quality and time objectives of a project, Dao (2016) citing Cicmil et al. (2009). The importance of complexity to project management processes has been highlighted by Hannah and Ashton (2010) to encompass: determination of planning, coordination and control processes; inhibit identification of goals and objectives; criterion in choosing appropriate organization structure; an influencer in selection of project resources; a consideration in choosing project procurement approach; and an influencer of project objectives of cost, time and quality.

Project complexity as a growing research topic has attracted a lot of attention from researchers and has been immensely mentioned in a lot of literature as leading influencer to projects performance (Azim, 2010; Dvir & Shenhar, 2007; Nuottila, Kujala, & Nystén-Haarala, 2015; Xia & Lee, 2004). Despite the immense literature, there is notable lack of consensus on a single concept that explains what complexity really is (Dao, 2016). Lack of an agreed definition has led to complexity being interpreted in many different ways due to different comprehension and perceptions by researchers as to what it really means (Saed, Yong, & Othman, 2016).

Vidal and Marle (2015) defines complexity in the lens of descriptive complexity as an intrinsic property of a system and also from prescriptive complexity view as subjective where complexity of the system is understood through the perception of an observer. Complexity thus has negative and positive influence on a system. The negative aspect arising in regard to difficulties understand and control whereas the positive influence on the system due to the resultant opportunities (Vidal & Marle, 2015). Due to the importance and relevance of complexity in the project management field, researchers have focussed more on complex projects management, investigation of project complexity drivers, and development of models (Baccarini, 1996; Williams, 1999) and frameworks for project complexity assessment (Bosch-Rekveldt, 2011; Geraldi, Maylor, & Williams, 2011).

Project complexity is defined by Baccarini (1996) as encompassing many varied interrelated parts. Baccarini operationalized complexity in lines of differentiation and interdependency and listed two types of complexity: technological complexity and organizational complexity. An organizational structure is therefore complex if containing differentiated parts. This differentiation has been operationalized in two dimensions namely vertical and horizontal differentiation. Vertical differentiation being concerned with number of levels in the organization hierarchies in the structure. Whereas horizontal differentiation is concerned with number of organizational units and division of tasks.

Building on Baccarini's work, Williams (1999) combined and termed the technology and organizational complexities as structural complexity and added uncertainty as a new complexity dimension. Basing on systematic literature review on project complexities, Geraldi, Maylor, and Williams (2011) developed a project complexity framework comprised of five dimensions: pace, uncertainty, dynamic, structural, and socio-political complexity. Bosch-rekveldt, Jongkind, Mooi, Bakker, and Verbraeck (2011) provides a framework for assessing project complexity and suggests it's applicable in initial phases and throughout the entire lifecycle of a project. The framework gives an indication of where the project complexity would be expected to be and is comprised of three main complexity dimensions: Technological complexity, Organizational complexity, and Environmental complexity. Bosch-rekveldt et al.

(2011) enumerates Technological, Organizational and Environmental complexities as key factors of project complexity. This study adopted these dimensions to operationalize the variable project complexity.

Saed et al. (2016) study on Project complexity influence on project management performance in Malaysia identified five complexity factors: operational complexity ; organizational complexity; technical complexity;; and team complexity.

Technological complexity refers to the diversity and variety of tasks' aspects and also entails interdependencies within: different technologies; tasks; network of tacks; teams; and inputs (Baccarini, 1996).

On the other hand, Bosch-rekveldt et al.(2011) describes organizational complexity in relation to size of the project, and the softer elements such as project team composition, resources availability, skills, experience, and trust.

Environmental complexity includes the factors such as strategic pressure, market competition, political pressures, weather conditions, required local adaptation, disturbance to existing site, etc. (Bosch-rekveldt et al., 2011).

In ranking the factors why Information System (IS) project failures may occur for example, Liebowitz (1999) found complexity underestimation ranked fifth.

Abouzahra (2011) study on causes of failure in healthcare IT (Information Technology) projects in Saudi Arabia recommended careful consideration of the system's complexity as well as integration requirements with other systems when specifying scope. IS projects often fail because they are more complex than anticipated by the project team.

Omonyo (2018) study in Kenya found that all factors of project complexity under investigation had a negative influence on public infrastructural megaprojects success.

From the literature above, project complexity stands out as a key research area. There is need to investigate the effects of project complexity on project success in an industry or sectoral level where projects in the same sector/industry are expected to exhibit common similarities. This study intends to investigate the effects of project complexity on project success focussing on projects executed by companies in Nairobi within the telecommunications sector

1.1.2 Project Success

According to Turner (2009), project success is defined through success criteria and success factors. Project success criteria being the dependent variables used for measuring the successful project outcome, and the project success factors are independent variables that influence the project success.

Joslin (2015); Jugdev and Ralf Müller (2005) suggests that criteria for project success has extended beyond the traditional iron triangle (time, cost, and scope) that is no longer adequate, to a multidimensional construct that include other success indicators which are becoming important such as: safety, quality, stakeholders' satisfaction, knowledge management, and efficient resource utilization.

Rolstadas, Tommelein, Morten Schiefloe, and Ballard (2014) notes that project success can be assessed against different objectives: project objectives (scope, cost, quality and time); business objectives that capture the value project owner derives from project outcomes after handover; and social and environmental objectives which include the benefits created to greater society from the project.

Standish Group International (2013) enumerated number of factors adding to project success to include; top-level management support, user engagement, scope optimization, skill levels of involved resources, project management skills and expertise, flexible process, unambiguous business objectives, project environment emotional state, governing and controlling approaches adopted, and applied tools and infrastructure.

Shenhar and Holzmann (2018) study on the three secrets of mega project success: unambiguous strategic vision, proper alignment, and adapting to complexity observed that successful megaprojects adopted three main elements: alignment of stakeholders; clear strategic vision; and adapted to complexity.

Shenhar, Dvir, Levy, and Maltz (2001) research on Project Success: A multidimensional strategic concept, developed a project success assessment framework with four dimensions: project efficiency, impact on customer, business success, and prepare for future. Their study observed that different success dimensions could only be assessed at different times along and after project completion, and different dimensions were more important at different times with respect to project completion.

In their study on Factors that influence the success of public sector projects in Pakistan, Khan et al. (2013), developed model on project success criteria and success factors. Their framework included eight success factors dimensions and five success criteria dimensions: benefits to organization, stakeholder satisfaction, future potential, project efficiency, and project impact.

This study defines project success in a wider measure of project efficiency (meeting budget, time and scope goals), and realization of organization benefits when the project is implemented. The project efficiency can be measured during implementation and soon after execution while organizational benefits can only be assessed after project is completed and project outcomes are in use (Shenhar et al., 2001). This study will adopt two success criteria from Khan et al. (2013) model which is recent, amalgamates success criteria from prominent researchers on project success topic, and tested in a developing country (Pakistan) which economically closely relates to Kenya.

The two success criteria adopted by the study are project efficiency and organizational benefits. Serrador and Turner (2014) study on the relationship between project success and project efficiency found that project efficiency 56% correlated with overall project success. In this research, project efficiency assesses project success during project execution and at closure stage while organizational benefits will assess project success after completion and handover of outcomes onwards (Shenhar et al., 2001)

1.1.3 Telecommunication Firms in Kenya

In Kenya, telecommunication infrastructure development as part of six priority sectors in Vision 2030's Economic and Macro pillar, is envisaged to enhance GDP growth at the rate of 10 per cent by the year 2030. Under infrastructure development, the Vision 2030 aims at improving country's interconnectivity through roads, railways, ports, airports, water and sanitation facilities, and telecommunication (Government of Republic of Kenya, 2007).

Telecommunication industry falls under Information and communication Technology sector (Kenya National Bureau of Statistics, 2019a). The regulator, Communications Authority of Kenya licenses telecommunication firms under Unified Licensing Framework in 13 broad market segments: International gateway operators; Submarine cable landing rights operators; network facilities providers Tier 1; Network facilities providers Tier 2; Network facilities providers Tier 3; application service providers; content service providers; Dot KE sub-domain name registrar service providers; Business process outsourcing service providers; telecommunications contractors; telecommunications technical personnel; telecommunication equipment providers; and public communication access centres. Some of the firms operate in more than one market segment such that a network facility provider Tier 1 is also an international gateway operator for example. Similarly, some telecommunication equipment providers would also be registered under telecommunications contractors' segment.

According to Kenya National Bureau of Statistics (2019a) and (Kenya National Bureau of Statistics, 2019b), Kenya imported telecommunication equipment worth of KES 25.5 billion in year 2018, a 0.8% of 2018/2019 Kenyan budget. Mobile and fixed network providers are the most publicly notable firms and command majority share of subscribers in Kenya. The major mobile services providers in terms of market share are: Safaricom PLC with 63.3%, Airtel Networks Limited with 23.4%; Telkom Kenya Limited with 9%; Finserve Africa Limited with 4.2%; and Mobile pay limited with 0.2%. In fixed data market, 10 firms dominate in terms of market share: Wananchi companies (Kenya) Limited (38%), Safaricom PLC (29.6%), Jamii Telecommunications Limited (13.8%), Poa internet Kenya Limited (7.5%), Internet Solutions Kenya limited (4.1%), Mawingu Networks Limited (2.9%), Liquid Telecommunications Kenya limited (2.2%), Telkom Kenya (1.0%), Mobile Telephone Business Kenya limited (0.2%), and Frontier Optical Networks limited - 0.1% (Communication Authority of Kenya, 2018).

According to Sherif (2006), telecom projects are characterized by: complex interfaces; diverse users and user requirements; multidisciplinary in nature; international orientation; long planning stages; and lack of mass production. Telecommunication industry and in particular Mobile communication business environment is characterized by stiff competition that has led to price wars in clamour to grow subscribers base. The situation has been aggravated since the introduction of a simplified and converged licensing regime in 2008, that reduced barriers to entry and allowed telco operators to provide any service in a technology neutral regulatory framework. Thus, telecom firms have deployed various strategies to beat competition, become profitable, and achieve low cost advantage. One such strategy is strategic outsourcing of key functions to technology vendors or third parties (Kipkorir, 2014).

1.2 Statement of the Problem

Project complexity has been widely recognized as a crucial factor that may affect project success (Bosch-Rekveldt, 2011; Luo et al., 2016; Omonyo, 2018). Project success is a key priority goal for project management. It is influenced by numerous success factors (Kam Jugdev & Müller, 2005; Pinto & Slevin, 1987). Exploring project complexity can reveal problems hindering project success. The traditional measurements of project success based on project objectives or project efficiency alone (scope, time, and cost) that are short-term in practice, and are no longer adequate (Atkinson, 1999; Kam Jugdev & Müller, 2005). A multidimensional concept that includes short and long term objectives is required (Khan et al., 2013; Shenhar et al., 2001).

Complexity has both negative and positive influence on a system. The negative effects arise from difficulties to understand and control whereas the positive influence on the system arising due to the emergence of opportunities (Vidal & Marle, 2015). Project complexity has been mentioned to hinder clear project goals and objectives identification Dao (2016) and affects project management processes (Hannah & Ashton, 2010). However, different project complexity factors affected different project success dimensions in varying degrees (Saed et al., 2016; Shenhar & Dvir, 1996; Shenhar, Dvir, Lechler, & Poli, 2002). Omonyo (2018) project complexity (system dependency) was associated with improved schedule and cost performance so long as the dependency was not on project's critical path. However, in some cases, technological complexity had insignificant influence on project success (Luo et al., 2016; Xia & Lee, 2004).

Lee, Levendis, and Gutierrez (2012), telecommunication and particularly cellular phone infrastructure contributed to economic growth in sub-Saharan Africa and hence should be supported. Okendo (2011) found positive relationship between telecommunication expenditure and GDP growth in Kenya. Telecom firms are however faced with regulatory and technological changes that have seen an increase in solution offerings as well as potential suppliers making interactions complex among sponsors, suppliers (vendors), and customers. With intense market competition and contending with complex nature of telecom service projects, firms are expected to run successful projects in order to deliver products faster, at lower cost, and with high quality in uncertain and dynamic environment (Sherif, 2006).

Most of the research on project complexity have been carried outside Kenya and focussed on modelling complexity, measures of project complexity and factors driving complexity (Azim, 2010; Baccarini, 1996; Bosch-rekveldt et al., 2011; Floricel, Michela, & Piperca, 2016; Hannah & Ashton, 2010; Rolstadås & Schiefloe, 2017; Williams, 1999). Majority of the studies that investigated effects of project complexity on project success or performance have been carried outside Kenya and focussed more on construction industry (Davies & Mackenzie, 2014; Luo et al., 2016; bo Xia & Chan, 2012) and other areas except telecommunication industry (Bosch-Rekveldt, 2011; Xia & Lee, 2004). In Kenya, Omonyo (2018) conducted study on Moderating Role of Project Leadership on the Influence of Complexity on Success of Public Infrastructural Megaprojects. Mwaro, Omwenga, and Kihonge (2016) carried a study on Effects of project complexity on project implementation: a case of Orange money project at Telkom Kenya Limited.

This study aimed at adding new knowledge on relationship of project complexity and project success by investigating in Kenyan context how different project complexity factors influence success of projects managed by telecom firms in terms of project efficiency and organization benefits.

1.3 Research Objectives

1.3.1 Main objective

To investigate the effects of project complexity on success of projects deployed by telecom firms in Nairobi.

1.3.2 Specific objectives

i. To establish the effects of technological complexity on success of projects managed by telecom firms in Nairobi.

ii. To determine the effects of organizational complexity on success of projects managed by telecom firms in Nairobi.

iii. To establish the effects of environmental complexity on success of projects managed by telecom firms in Nairobi.

1.4 Research Questions

i. What is effect of technological complexity on success of projects managed by telecom firms in Nairobi?

ii. What is the effect of organizational complexity on success of projects managed by telecom firms in Nairobi?

iii. What is the effect of environmental complexity on success of projects managed by telecom firms in Nairobi?

1.5 Scope of the Study

The study focused on telecom sector since the sector has had in transforming communication, access to information, and access to financial services through increased mobile and internet penetration in Nairobi. The study is confined to establishing the effects of project complexity on success of projects managed by major telecom firms in Nairobi. The study focused on the firms that are registered by Communications Authority of Kenya (2018) as licensees in the register of Unified Licensing Framework and who also submitted compliance returns for the period July-September 2018 (Communication Authority of Kenya, 2018). Communication Authority of Kenya (CA) has registered and licensed telecom firms according to 13 categorizations and a firm can be registered in more than one category. The 13 categorizations are listed as: international gateway operators; submarine cable landing rights operators; Network facilities providers Tier 1 to 3; Application service providers; content service providers; Dot Ke sub-domain name registrar services providers; business process outsourcing service providers; telecommunication contractors; telecommunication technical personnel; telecommunication equipment vendors; and, public communication access centres.

The research was conducted in the months of April and May, 2019 with focus on 592 firms whose postal addresses are registered in Nairobi for data collection convenience. These firms are licensed in one or more of the following 6 categories: international gateway operators; submarine cable landing rights operators; Network facilities providers Tier 1 to 3; and, telecommunication contractors. These target firms command the majority of mobile and fixed user subscription base in Nairobi.

The study target respondents were personnel actively involved in a recently completed project and include: project management office heads, project managers, solution architects, operations and support teams; procurement and contract managers of the target firms. Data collected was limited to descriptive and quantitative analysis.

1.6 Significance of the study

The study provided empirical results on the complexity factors influence on project success. Thus, factors with greatest impact on success of projects were discerned. The study findings provided insights on complexity factors that have greatest impact on success of projects and therefore guide the policy makers towards enhancing the factors that promote project success at the same time controlling the factors that have negative impact on project success. As such, policies could be formulated to encompass project success dimensions and criteria, project governance structure, and project resources allocation in line with prevalent project complexity factor.

The findings enriches the project management practice and equip the project managers in the telecom sector in Nairobi with more knowledge in managing complex telecom projects. This study advanced the management of complex projects by telecom firms by highlighting the project complexity factors effects on project success in telecom industry. Project managers in the sector can therefore: select planning, coordination and controlling practices; adopt project organization structure; allocate project resources; and clearly develop project goals and objectives in line with prevalent project complexity factors. The study also contributed to project management body of knowledge by highlighting the complexity factors that influence project success in telecom projects in Nairobi. Scholarly, the study contributed to the growing research topic on project complexity and add more insights to Contingency and Complexity theories by providing empirical data and results.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter gives a summary of literature from other scholars who have undertaken closely related research to the theme and objectives of this study. The chapter first presents a number of developed theories relating to project complexity and project success. This section is followed by a discussion on findings from related research, conceptual framework, literature and research gap, and ends with a chapter summary.

2.2 Theoretical Review

This section discusses the theories on which this study is anchored on, namely; TOE framework for technological innovation, contingency theory, TOE innovation and adoption theory, and concept of project success which will be presented as a body of knowledge.

2.2.1 Technology-Organization-Environment (TOE) innovation adoption Theory

The theory was developed by Tornatzky et al.(1990) with its central concept being three factors that influence adoption, implementation, and usage of technological innovations by organizations (Hoti, 2015). The three aspects are technological context, organizational context, and environmental context. The technological context encompasses the internal and external technologies already in use and new technologies that are relevant to the firm. The organization context describes the characteristics of the firm such as management structure complexity, size and scope, availability of financial resources and technology. The environment context is the market space or the arena where a firm carries out its business and includes its competitors, industry, engagement with business partners and the government (Hoti, 2015; Oliveira & Martins, 2010). Thong and Yap (1995) added distinguished-decision maker characteristics as the fourth context and an extension to TOE framework. Thong and Yap argued that for organizations with centralized structures such as small and medium enterprises (SMEs), the owners or chief executive officers (CEOs) made the most important and critical decisions. The TOE framework has been used to explain adoption of innovation in numerous empirical researches on information systems (IS): enterprise resource planning (ERP), electronic data interchange, IS, and e-business (Hoti, 2015; Oliveira & Martins, 2010).

From empirical studies, Baker (2011) lists factors that were found to significantly predict adoption and which composed the technological, organizational, and environmental contexts in those studies. The factors of complexity, compatibility, perceived barriers, perceived benefits, relative advantage, trialability, technology readiness, technology competence, and technology integration were to observed the most significant elements for technological context. The significant factors in organizational context for predicting innovation adoption were: size, strategic planning, satisfaction with existing systems, top management support, organizational readiness, infrastructure, championship, perceived financial cost, perceived technical competence, firm scope, global scope, and employees' IS knowledge. Perceived industry pressure, competitive pressure, management risk position, adaptable innovations, perceived government pressure, performance gap, role of information technology, regulatory environment, and regulatory support were the significant predictor factors for innovation adoption under environmental context.

Baker (2011), notes that the TOE has not evolved much since its development and has received scant criticism. Baker highlights that the theory has widely been applied as a framework where various factors are accommodated. TOE theory is also perceived to be in line with other innovation adoption explanation rather than competing with them.

The TOE framework informs this study in that, firms' adoption and implementation of technological innovations is affected by technological context, organizational context, and environmental context. Within different technological innovation domains, different TOE elements or factors are significant predictors of adoption and implementation of technological innovations. Therefore, firms must assess and map the most significant factors within their technological domain of interest.

2.2.2 Contingency Theory

The theory was developed by Fiedler (1964) and the key concept of the theory is fit. Linton (2014) notes that organizational performance will improve if there is a proper alignment of internal and external organization factors. Contingency theory stemmed from researchers' criticism that challenged the idea of "one best way" and therefore, to efficiently organize and structure an organization, there are contingencies that needed to be taken care of (Linton, 2014). Contingency theory is based on assumption that organizations are unique and therefore no single type of organization structure that is effectively and equally applicable to all organizations (Islam and Hu, 2012).

For an organization's effectiveness, Drazin (1985) proposes that its structure and processes must fit its context (environment, organization culture, technology, size, or task).

Linton (2014) citing Stalker and Burns (1961) highlights mechanistic and organic organizations as an example of break away from "one best way". Linton (2014) suggests mechanistic structures are appropriate for stable conditions and are characterized by hierarchic structure of control (bureaucracy), centralization, differentiation and task specialization. On the other hand, organic structures promotes flexibility and shared responsibility between tasks (Linton, 2014).

Stalker and Burns (1961), suggested that organic structure was appropriate form for organizations faced with changing environment that constantly spawned new challenges (problems) and unpredicted requirements for actions that could not be decomposed or distributed within a hierarchic structure. Whereas, organizations operating in stable environments and technologies would gain from mechanistic structure where tasks remained the same over time ; decision making and instructions are centralized and issued by superiors (Linton, 2014; Stalker and Burns, 1961). Aaltonen (2017), describes the organizational form in agile project management approach as organic structure (flexible and cooperative) and contrasts it with mechanistic structure adopted in traditional project management approach which is bureaucratic and favouring formalization.

The contingency theory informs the study in that, first, organization's effectiveness depends on the fit between its structure and processes, and its context (environment, organization culture, technology, size, or task). Therefore, project context such as project complexity would have influence on project success depending on project structure and processes adopted. Secondly, the theory informs this research that organic structure favoured organizations faced with dynamic environments and unpredicted requirements (similar in complex projects) and whereas mechanistic structure favoured organizations in stable environments. Therefore, in selecting the effective project structure and processes to ensure project success, project complexity context should be determined.

Anchoring to contingency theory and attending to project complexity as contingency factor, this research aims at investigating the effects of project complexity on success of projects managed by telecom firms in Nairobi.

2.2.3 Concept of Project Success

Over time and in the project management history there have been considerable efforts in developing a criterion for measuring project success. The traditional, popular and widely used measures of project success is the triple constraint or "iron triangle" referring to cost, time, and scope goals. However, the measure of project success based on iron triangle and in terms of project objectives- cost, time, scope, and quality goals is narrow in scope and not adequate enough. It is paradoxical that a project that satisfies the project management success (iron triangle criteria) could still be appraised a failure for not satisfying project overall objectives (project success); and conversely a project that meets overall objectives may be considered as failed for not meeting one or all of the iron triangle criteria (Kam Jugdev & Müller, 2005; Pinto & Slevin, 1988; Rolstadas et al., 2014).

Researchers' views on project success criteria have over time evolved from focussing on success during implementation phase only to consideration of success over the overall project or product lifecycle (Shenhar et al., 2001). Therefore, project management that only meets the success criteria of time, cost, and scope offers operational or tactical value but not strategic value. A project is thus said to be efficient if it meets project management success whereas, it's effective (project success) if satisfies overall project objectives (KAM Jugdev & Ralf Müller, 2005).

Project success changes over product and project lifecycle. Different success dimensions are more important and can only be measured at different times of the project and product lifecycle. For example, measuring project efficiency during project execution during or soon after implementation may be prioritized over measuring impact on customer that would only be possible to measure once the project outcomes were handed over and were in use (Shenhar et al., 2001).

There is however no agreed definition and a measure of project success among researchers and project success is dependent on perceptions of the observer. (Ika, 2009). There is strong push and advocacy by researchers for adoption of multidimensional success criteria for assessing project success through inclusion of organizational and other stakeholder benefits (Ika, 2009; Khan et al., 2013; Mathur, Jugdev, & Fung, 2007; Shenhar et al., 2001).

This study considers project success in a broader view as a multidimensional construct with success criteria of project efficiency and organizational benefits.

2.3 Empirical Review

2.3.1 Technological Complexity and Project Success

In a study on Moderating role of project leadership on the influence of complexity on success of public infrastructural megaprojects in Kenya, Omonyo(2018) adopted three dimensions of complexity- human behaviour, ambiguity, and system behaviour as independent variables. Under human behaviour project complexity dimension, three factors of individual behaviour, group behaviour, and organizational design and development were considered. Project context, project emergence, and project uncertainty were the factors considered in the ambiguity project complexity dimension. The study adopted system connectedness, system dependency, and system dynamics as factors under system behaviour project complexity dimension. Project success dimension, the dependent variable, was considered through process success, product success, and organizational success factors. Project leadership was modelled as moderating variable and consisted of goal-oriented leadership, involving leadership, and complexity leadership as the individual constructs. The study found that system behaviour had negative and significant influence on success of infrastructural megaprojects. Individual constructs, however had mixed influence on project success. Under system connectedness dimensions, as the number of connections increased, the lower was schedule and cost performance. The system dependency construct was associated with improved schedule and cost performance so long as the dependency was not on project's critical path. Omonyo did not however elaborate why increased system dependencies improved cost and schedule performance.

Using qualitative and quantitative approach, Shenhar and Dvir (1996), conducted a 3-year study on 152 projects in Israel where 26 were case projects in a research, Toward a typological theory of project management. Their study found that projects had a wide range of variations and technology uncertainty was the most prevalent factor affecting project characteristics. Their study did not however indicate how technology uncertainty would affect project performance or project efficiency.

In a study Investigating the relationship between project complexity and success in complex construction projects, Luo et al. (2016) used a deductive, positivistic approach. Basing on literature review and expert views, study collected data on project complexity and project outcomes using 245 questionnaire surveys in China. Through Delphi interviews, their study came up with six project complexity factors: technological complexity; organizational complexity; informational complexity; task complexity; environmental complexity; and goal complexity. Eight project success dimensions: time; cost; quality; health and safety; environmental performance; participant's satisfaction; user satisfaction; and commercial value. To test hypothesis and investigate influence of different complexity factors on project success, Luo et al. used structural-equation modelling technique. The study found that technological complexity had insignificant influence on project success. The study however did not investigate how different composites for project success were affected by various dimensions of project complexity. This is in backdrop of Serrador and Turner (2014) conclusion that project efficiency 56% correlated with overall project success.

In a study Grasping the complexity of IS development projects, Xia and Lee (2004) conducted four-phase research to develop a taxonomy that would validate and measure Information System Development Projects' (ISDP) complexity. Their study modelled ISDPs complexity in a taxonomy comprising of two dimensions – organizational versus technological, and structural versus dynamic. Four ISDP complexity dimensions were defined: structural organizational; structural Information Technology (IT); dynamic organizational; and Dynamic IT. Xia and Lee (2004) conducted web survey on 541 ISDPs in North America and analysed ISDP complexity influence on project performance constructs of delivery cost, time, functionality, and user satisfaction. Their study observed that, structural IT complexity had insignificant influence on ISDP performance. Xia and Lee study did not include the environmental complexity as part of complexity dimension that would affect the project performance of ISDP projects. Their study measured project performance using factors of project efficiency (delivery cost and time) and organization benefits (functionality and user satisfaction) combined in a single project performance indicator. The authors did not show if different project complexities would have had equal or differing effects on success factors.

Floricel, Michela, & Piperca (2016) study on Complexity, uncertainty-reduction strategies, and project performance used a survey questionnaire on 81 complex projects in three sectors: information and communication; energy and transportation; and biopharmaceutical which were geographically spread in 5 continents: Africa; Australia; Latin America; North America; and Europe. Canonical correlation analysis was used in examining relationship between complexity factors and performance factors. Floricel et al.(2016) found that complexity factors in overall were associated with reduction of project completion performance. The variables, technical and organizational complexities negatively affected completion performance and operation performance whereas market complexity variable was observed to improve innovation performance. Institutional complexity had positive impact on completion performance. Floricel et al. (2016) also observed that some strategies reduced the negative impact of some of complexity factors. Strategies where new knowledge was iteratively produced and where project organization's integrated contributions and fostered collaborations between project stakeholders appear to have interacted with market complexity factor with positive impact on performance. The former strategy impacting completion and later influencing operation performance respectively. The strategies that utilized existing knowledge appeared to interact with technical complexity with positive impact on completion performance. Though their study could have covered project in Africa, a sample size of 81 projects in 5 continents is too small to make inferences about complex about Africa and even more difficult to make inferences about management of complex projects in Kenya.

Based on the study, Project complexity influence on project management performance-the Malaysian perspective, Saed, Yong, and Othman (2016), grouped factors that contributed to project complexity under five complexity dimensions: Environmental; Operational; Organizational; Technical; and Team. Under Environmental complexity dimension they found: clarity of project goals; weather conditions; number of locations; number of different languages; and, interference between existing sites as the variables. Lack of experience in the country, competition level and presence of technical risks were observed as variables in Technical complexity factor. Number of goals, lack of skills & resources, and lack of experience with partners were the variables under Team Complexity. Operational complexity variables were tasks variety, strict quality requirements, project duration and financial sources availability. Variables such as size of the project, uncertainty in methods, different time zones and political influence constituted the Organizational complexity. The Saed et al. (2016) study did not highlight if project complexity factors impacted project performance, neither did it demonstrate if each complexity factor would influence project performance equally or in a varied magnitude.

According to the study on Impact of Project Complexity Factors on Project Cycle Time: A System Dynamics Modelling Approach, Lebcir and Choudrie (2011) found that project complexity factors increased project cycle time. Project uncertainty had strongest influence on time to complete a project. Number of elements and their interconnectivity were observed to have impact on project cycle time. The higher the linkages in the project structure, the longer the project would take to complete. Their study only concentrated on completion time and did not investigate how other critical success criteria would be impacted by project complexity.

Dvir and Shenhar (2007) highlights that project uncertainty is influenced by the mix of new and mature technologies, as well as organization's existing knowledge required to deliver the product. Therefore, technological newness to the market and newness to the organization determines the level of project's technological risk. Thus, superhigh-tech projects are prone to schedule delays, cost overruns and product failure risks. Requirements for low-tech products are thus frozen early in the development process in order to gain efficiency while requirements for high-tech products should stay open for longer to make good use of the knowledge attained during the project. Their study focussed more on technological complexity and have not highlighted the impact of other complexities such as organizational and environmental complexities.

2.3.2 Organizational Complexity and project success

Luo et al. (2016) study on investigating the relationship between project complexity and success in complex construction projects conducted in China found that Organizational complexity had insignificant effect on project success. Their study did not investigate if organizational complexity had impact on composites of the project success.

Xia and Lee (2004) study on Grasping the complexity of IS development projects conducted on 541 ISDPs in North American organizations through a web survey found that of all other three components of ISDP complexity, structural organizational complexity had the strongest influence on all four project performance measures of delivery cost, time, user satisfaction, and functionality. Their study had combined project objectives (delivery cost and time) and business objectives (user satisfaction and functionality) in one construct – project success. Their research did not investigate if complexity dimensions had equal or differing impact on different constructs of project success.

In a study, Complexity, uncertainty-reduction strategies, and project performance, Floricel et al.(2016) investigated 81 complex projects across 5 continents and touching on 3 sectors – biopharmaceutical, energy and transportation; and information and communication. Their study found operation performance was negatively affected by organizational and technical complexity. Organizational complexity was observed to belong to representational category of complexity and interacted with new knowledge production strategy to positively influence completion performance. Though their study could have covered project in Africa, a sample size of 81 projects in 5 continents is too small to make inferences about complex about Africa and even more difficult to make inferences about management of complex projects in Kenya.

In a study Socio-organo complexity and project performance – further thoughts, investigating influence on project performance by socio-organo complexity Antoniadis (2016) conducted 5 case studies in construction projects and found an inverse relationship between complexity of interconnections and project performance. Their investigations are limited to construction industry and hence can not be generalized to other sectors such as telecommunication. The researcher focussed on schedule performance as the only indicator of project performance and hence no investigation on other project success indicators such as user satisfaction and functionality.

In a study Using analytic network process to analyse influencing factors of project complexity, Luo et al.(2016) basing on literature review and through expert review developed 6 dimensions of complexity: Technical complexity; organizational complexity; cultural complexity; environmental complexity; informational complexity; and goal complexity. They used super decision software to conduct

Analytic Network Process (ANP), the study found that organizational complexity ranked first, followed by informational complexity, and technological complexity ranked third. The study didn't however investigate how the different complexity factors would affect project performance or project success.

2.3.3 Environmental complexity and project success

He et al. (2012) study on using analytic network process to analyse influencing factors of project complexity used Analytic Network Process (ANP) to investigate the factors that influenced project complexity. Out of six complexity dimensions, the study ranked cultural complexity, environmental complexity, and goal complexity in positions 4^{th}, 5^{th}, and 6^{th} respectively, in the order of relative importance. The study however didn't investigate the effects of complexity on project success.

In a study Managing project complexity: A study into adapting early project phases to improve project performance in large engineering projects, Bosch-Rekveldt (2011) adopting project complexity dimensions - technological complexity, organizational complexity, and environmental complexity conducted quantitative survey with 67 responses on how project complexity influenced project performance. Bosch-Rekveldt's study found that all the three dimensions had significant correlation with project performance. An increase in each of the three complexity dimensions, decreased project performance. Environmental complexity had the least correlation with project performance, while technological complexity had the strongest followed by organizational complexity.

In a study modelling project complexity, Rolstadås & Schiefloe (2017) conducted a case study on an oil and gas project in Norway in order to validate the project complexity model. The complexity factors were grouped in three categories: system produced, producing system, and project context. Project context is examined through studying the actors (stakeholders) involved. Three levels of stakeholder environments are highlighted: primary, secondary, and tertiary environments. The primary environment is comprised of mother organization, resource owners, project owners, external suppliers, and regulating authorities. Secondary environment includes – customers, local interested groups, unions, local authorities, and finance. The tertiary environment consists of competitors, media, criminal groups, and NGOs. The study however did not empirically test how the different complexity dimensions would affect project success and whether all the complexity factors would have equal impact on project success.

2.4 Research Gap

IBM (2010) highlights that today's world leaders are operating in an environment that is volatile, uncertain, and complex. Linton (2014) highlights that for organizations' effectiveness, it must find a fit between its structures and processes, and its prevailing context (technology, Organization culture, environment, size, or task). Studies have highlighted project complexity as a factor in projects' context that influence project success negatively either directly or indirectly (Luo et al., 2016; Omonyo, 2018; Shenhar and Dori, 2007; Xia & Lee, 2004). Owing to its importance and relevance in recent times, project complexity has received a lot of attention from researchers. It is notable that a lot of research effort has been focussed in development of frameworks for modelling and measurements of project complexity (Baccarini, 1996; Bosch-rekveldt et al., 2011; Rolstadås & Schiefloe, 2017; Williams, 1999). However, these models are based on a different market context and cannot be directly applied in Kenyan context due to cultural, geographical, and socio-political differences.

Most of the studies on effects of project complexity and project success, too have not addressed the Kenyan context and none has focussed on telecommunication industry (Bosch-rekveldt et al., 2011; Floricel et al., 2016; He et al., 2012; Luo et al., 2016; Xia & Lee, 2004). There are limited number of Kenyan studies on project complexity and too have not addressed the telecommunication industry. Omonyo (2018) study on Moderating role of project leadership on the influence of complexity on success of public infrastructural megaprojects in Kenya, found that system behaviour had negative and significant influence on success of infrastructural megaprojects. Study by Mwaro et al. (2016) on Effects of Project Complexity on Project Implementation: a Case of Orange Money Project At Telkom Kenya Limited found IT infrastructure had positive and insignificant relationship with project implementation. Technical team, project planning, and management support had positive and significant relationship with project implementation.

From the reviewed literature there is limited research on the effects of project complexity on project success in Kenyan telecommunication sector. In particular, there exists a gap on how different project complexity factors affects success of projects implemented by telecom firms in Nairobi.

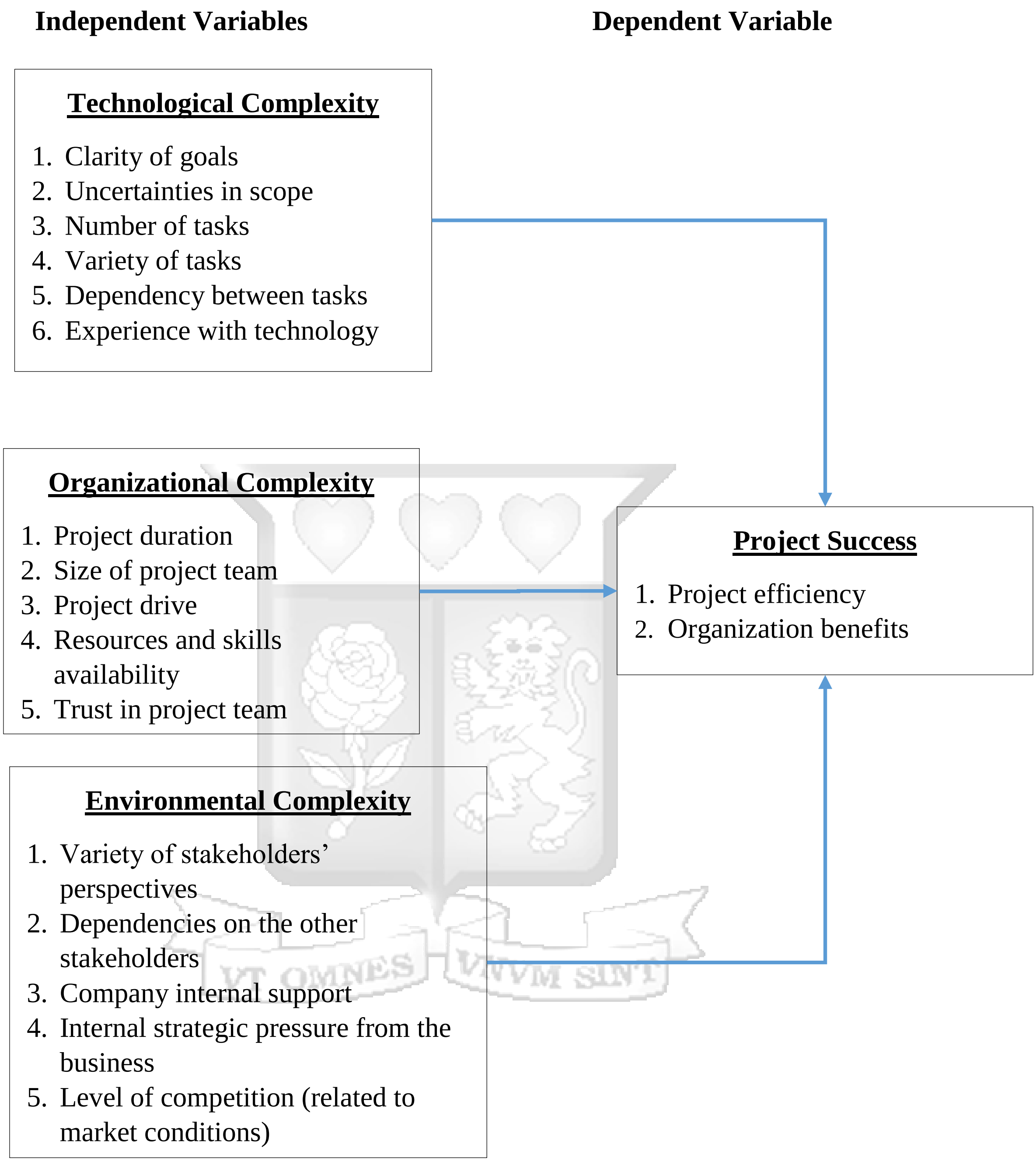
2.5 Conceptual Framework

According to Adom, Hussein, & Joe (2018), conceptual framework is a representation created by researcher which he/she believes provides the best explanation to the phenomenon under study. It is further described as a logical visual presentation of how the ideas being studied relate to one another (Adom et al., 2018). Conceptual framework aids in presentation of research questions, highlights the research variables, and depicts the relationships among the variables (McGaghie, Bordage, & Shea, 2001).

Conceptual framework for this study is presented in Figure 2.1 below. project complexity dimensions (Technological, Organizational, and Environmental) are conceptualized as the independent variables. Project success is taken as the dependent variable. Saunders, Lewis, & Thornhill (2016), defines independent variable as variable causing change on another variable referred as dependent variable.

This study adopted the independent variable, project complexity, from existing research work by Bosch-rekveldt et al. (2011) in TOE model. The dependent variable, project success, has been adopted from Khan et al. (2013) model.

Figure 0.2 Conceptual Framework



Source: (Author, 2019)

2.6 Operationalization of Variables

Project complexity will be measured using indicators developed by Bosch-rekveldt et al. (2011) in TOE model. Project success will be measured using project success assessment model developed by Khan et al. (2013).

Table 0.1 Operationalization of project complexity variables

VARIABLE	INDICATOR	MEASUREMENT
Technological complexity	Clarity of goals, Uncertainties in scope, The number of tasks, The variety of tasks, Dependency between tasks, Experience with technology	Ordinal scale (4point Likert scale) Questionnaire Section V, part 1
Organizational complexity	Project duration, Size of project team, Project drive/ culture, Resource and skills availability, Trust in project team	Ordinal scale (4point Likert Scale) Questionnaire Section V, part 2
Environmental Complexity	Variety of stakeholders' perspectives, Dependencies on the other stakeholders, Company internal support, Internal strategic pressure from the business, Level of competition (related to market conditions)	Ordinal scale (4point Likert Scale) Questionnaire Section V, part 3

Table 0.2 Operationalization of project success variable

VARIABLE	INDICATOR	MEASUREMENT
Project efficiency	Finished on time, Finished within budget, Minimum number of agreed scope changes, Activities carried out as scheduled, Deliverable met planned quality standard, Complied with environmental regulations, Met safety standards	Ordinal scale (5point Likert Scale) Questionnaire Section III, part 1 Questionnaire Section IV, part 1
Organization benefits	Learned from the project/ New understanding/knowledge gained, Adhered to defined procedures, End product used as planned, The project satisfies the needs of users	Ordinal scale (5point Likert Scale) Questionnaire Section III, part 2 Questionnaire Section IV, part 2

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter details the research methodology the researcher adopted in the study. It examined in detail the research design, population and sampling, data collection procedure, and data analysis. It further presents the research quality and ethical considerations observed.

3.2 Research Design

The researcher adopted a cross-sectional study employing survey research method. This study adopted a quantitative research methodology and deductive approach in order to investigate the relationship between the variables, numerically measure, and analyse using statistical and graphical techniques. Specifically, the study utilized descriptive and explanatory research designs to test the hypotheses (Saunders et al., 2016).

3.3 Population and Sampling

Saunders, Lewis, and Thornhill (2016) defines population as a collection elements from which a researcher would like to assess and make deductions from. The study population comprised of employees who have been engaged in managing a recently completed project in all telecommunication firms with registered offices in Nairobi County and who are registered by regulator, Communication Authority of Kenya (CA) as licensees under Unified Licensing Framework.

The study targeted firms in the following six market segments: International gateway operators; Submarine cable landing rights operators; network facilities providers Tier 1; Network facilities providers Tier 2; Network facilities providers Tier 3; and telecommunications contractors. The target firms included the major telecom service providers in terms of users subscription such as mobile operators, mobile money providers, and fixed data and internet providers registered in Communications Authority of Kenya (2018) as licensees in the register of Unified Licensing Framework and who also submitted compliance returns for the period July-September 2018 (Communication Authority of Kenya, 2018). The total number of these companies was 592 therefore the target population for this study was 592 (see appendix 2). The targeted study respondents constituted of either project management office (PMO) heads; project managers; solution architects; operations and support teams; procurement or contract managers in each of the target firms.

The study used Yamane (1967) sample size determination formula because the formula is appropriate in cases where the population is large and known. Based on this formula, a precision error of 0.05 was used and the sample size was estimated as to be 239 as shown.

$n = {}^{N}/_{[1+(N\varepsilon^2)]} = {}^{592}/_{[1+(592(0.05)^2)]} = 239$ ……………………….. 3.1

Where;

n is the sample size

N is the target population

ε is the precision error

The study combined both probability and non-probability sampling method to select the respondents to be included in the sample. Saunders et al. (2016), probability sampling method, simple random sampling was used to select 239 companies from a sampling frame of 592 companies, refer to appendix 2. To conduct simple random sampling, the study listed the 592 companies and applied simple random sampling in Microsoft excel computer package to generate a list of 239 companies. Thereafter, non-probability sampling method, convenience sampling method was used to choose either project management office heads; project managers; solution architects; operations and support teams; procurement or contract managers for each selected company.

3.4 Data Collection Methods

3.4.1 Data Collection Instrument

The study used primary data collected through administration of a questionnaire. A structured questionnaire comprising of closed-ended questions was used. The adoption of questionnaire as the data collection instrument was preferred due to the capability to collect responses efficiently from large sample where each respondent is asked the same set of questions (Saunders et al., 2016). Use of questionnaire survey was preferred in this research owing to its cost effectiveness and being less time consuming compared to interviews (Azim, 2010).

The study adopted the questionnaire questions that have already been developed and used in other related studies and used by the researchers in investigating similar variables like the ones under study. Questions on project complexity were adopted from Bosch-rekveldt et al. (2011) study on Grasping project complexity in large engineering projects : The TOE (Technical , Organizational and Environmental) framework. The questions on project success were adopted from Khan et al. (2013) framework in the study of factors that influence the success of public sector projects in Pakistan.

3.4.2 Data Collection Procedure

The researcher recruited six enumerators to assist in data collection. The enumerators were university graduates and had experience in data collection. They were thoroughly trained on how to administer the questionnaire using tablets and survey monkey software. The enumerators visited the offices of the selected respondents and administered the questionnaire face to face but recorded their responses using Computer Aided Personal Interviews (CAPI) in the survey monkey software. Upon submission of the responses, the main researcher was able to view all the responses in the survey monkey software. After data collection, the data was downloaded from survey monkey and recoded in Statistical Package for Social Sciences (SPSS). Web questionnaire has been adopted by Rugenyi & Bwisa (2016) in his research on assessment of triple constraints in projects in Nairobi.

3.5 Data Analysis

In this study, both descriptive and inferential statistical methods were adopted to describe, make conclusions and predictions about the population from the collected data. The data was analysed by use Statistical Package for Social Sciences (SPSS).

Descriptive statistics were deployed to summarize the sample through use of statistical measures such as frequency, mean, median, and standard deviation. Descriptive statistics is useful in presenting data numerically or graphically in a simplified manner for ease of understanding and describing (Azim, 2010). On the other hand, the study made use of inferential statistics in order to make deductions of population from the collected data.

Factor analysis was used to create indices since the study variables were constructs. In factor analysis, the study used principal component matrix with varimax rotation method (Dao, 2016). The study created summated scores based on items that had factor loading greater or equal to 0.5 as opposed to factor scores. The use of summated scores was necessitated by the fact that summated scores retains the distribution of the original data. Kaiser-Meyer-Olkin (KMO) statistics was used to measure the sampling adequacy. For a construct to qualify for factor analysis, it had to have a value of KMO greater than or equal to 0.5 while the Chi Square of Bartlett's Test of Sphericity had to be significant. The researcher had to select either parametric (data following normal distribution) or non-parametric (distribution-free tests) based on the shape of the population distribution curve (e.g. normal distribution); sample size; and type of measurement (Azim, 2010). Pearson correlation analysis was also conducted to establish the strength and direction of the relationship between project success and project complexity.

Given that the dependent variable, project success was an index created from factor analysis and it was a continuous variable, Ordinary Least Square (OLS) was utilized. Since the independent variables were three, the study used multiple linear regression model to establish influence of each of the independent variable on the dependent variable. Project success was measured using project efficiency and organizational benefits therefore the study estimated two regression models specified as follows.

$PE_i = \beta_0 + \beta_1 TC_i + \beta_2 OC_i + \beta_3 EC_i + \varepsilon_i$ ……………………………………3.2

$OB_i = \beta_0 + \beta_1 TC_i + \beta_2 OC_i + \beta_3 EC_i + \varepsilon_i$ ……………………………………3.3

Where;

PE is Project efficiency, a measure of project success

OB is organizational benefits, a measure of project success

TC is technological complexity

OC is organizational complexity

EC is environmental complexity

β_0 is the constant term

$\beta_1, \beta_2,\ \beta_3$ are the coefficients of technological complexity, organizational complexity and environmental complexity respectively.

ε is the stochastic error term that is assumed to be a white noise

i denotes the individual respondent

To get the correct estimates and correct interpretation from equation 3.2 and 3.3, Classical Linear Regression Model (CLRM) assumptions need not be violated. The study tested for the violations of the following CLRM assumptions; normality, multicollinearity, heteroscedasticity and autocorrelation. Normality was tested using histograms with normality plot of the error term. Multicollinearity was tested using Pearson correlation coefficient where values of Pearson correlation coefficient greater than or equal to 0.8 indicated presence of severe multicollinearity. Heteroscedasticity was tested using Glejser test where significant coefficients would indicate presence of heteroscedasticity. Finally, autocorrelation was tested using Durbin-Watson test where values of Durbin-Watson close to 2 indicate absence of autocorrelation (Azim, 2010).

3.6 Research Quality, Reliability and Validity

Research quality is judged through the research reliability and validity. Saunders et al.(2016) defines research reliability in terms of replication and consistency and it is achieved if and when similar findings are obtained by replicating an earlier research design. Validity is defined in terms of the relevance of the measures used, accurate analysis of the results, and generalisability of the observations (Saunders et al., 2016). The study ensured that the research instrument was valid by adopting questions previously used and tested in other related researches testing same variables.

To test for reliability, Chronbach alpha was used where values greater than or equal to 0.7 indicated that the instrument is reliable otherwise it is unreliable. Using a pilot study of 24 respondents (10% of the sample size), the study found a Chronbach alpha of 0.66 which was equal to 0.7 suggesting that the questionnaire was reliable.

3.7 Ethical Considerations

The study observed ethical concerns related to: handling of research respondents, data collection and analysis, and overall responsibility and accountability to the society. Prior data collection, the research obtained consent from respective respondents. The study guaranteed confidentiality to respondents' identity by issuing out a commitment letter and also by use of online survey tool that ensured anonymity. The respondents were made aware of the objectives of the research prior participation in data collection. The researcher declared the details of current employer to avoid conflict of interest. Objectivity was maintained during data analysis and reporting of the findings.

The study sought approval from Strathmore University Ethics prior commencing on data collection. The researcher acquired research license from National Commission for Science, Technology and Innovation (NACOSTI) as stipulated by Section 17 (1) of the Science, Technology and Innovation Act, 2013.

CHAPTER FOUR: ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study. The analysis of the data was done using both descriptive and inferential statistics. Descriptive statistics was performed to establish the characteristics of the survey population. Under the inferential statistics, regression analysis was used to establish the relationship between the dependent variable and the independent variables. Finally, in order to reduce the dimensionality of the data and for the purpose of developing the variables, factor analysis was used. The section comprises of sub-sections namely; introduction and response rate, general information, factor analysis and lastly regression analysis.

4.1.1 Response Rate

The targeted sample size for this study was 239 respondents from telecom firms in Nairobi that have recently undertaken a project that has been handed over to customers and was considered by the organization as a complex project. Out of the expected 239 respondents from project stakeholders including project management office heads, project managers, solution architects, operations and support teams, procurement managers and contract managers there were 180 completed questionnaires that translated to a response rate of 75.3% (Table 4.1). According to Gendall (2000), this response rate is considered sufficient and hence acceptable for analysis.

Table 0.1 Response Rate

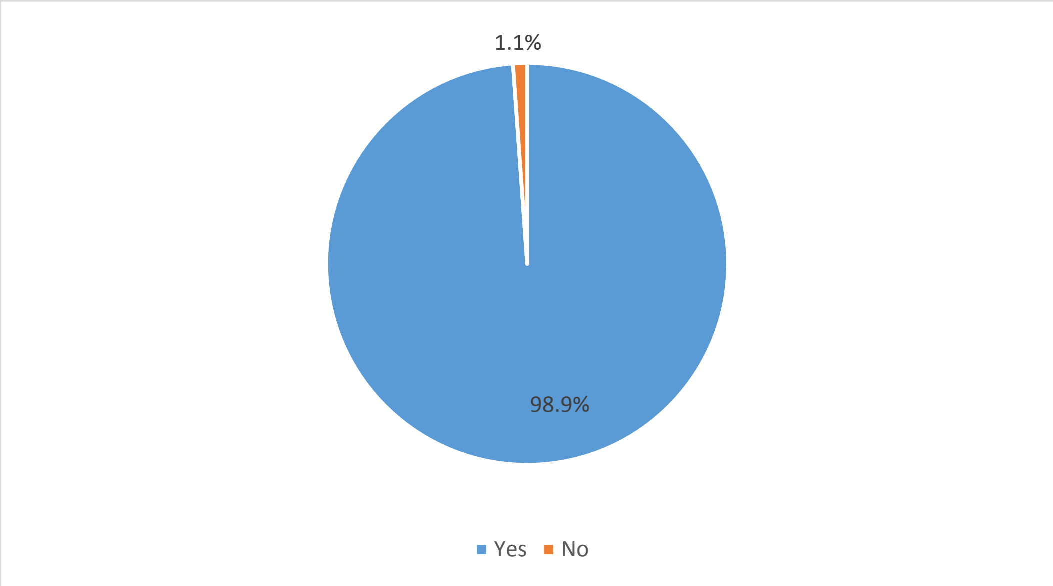
Sample Size	Number of Companies that Responded	Response Rate
239	180	75.3%

Source: Primary Data (2019)

4.2 General Information

The study revealed that majority **(**99%**)** of the respondents agreed that they had been stakeholders in a recent completed project while the remaining 1% stated that they have not been involved in any recent project. The results are presented in figure 4.1.

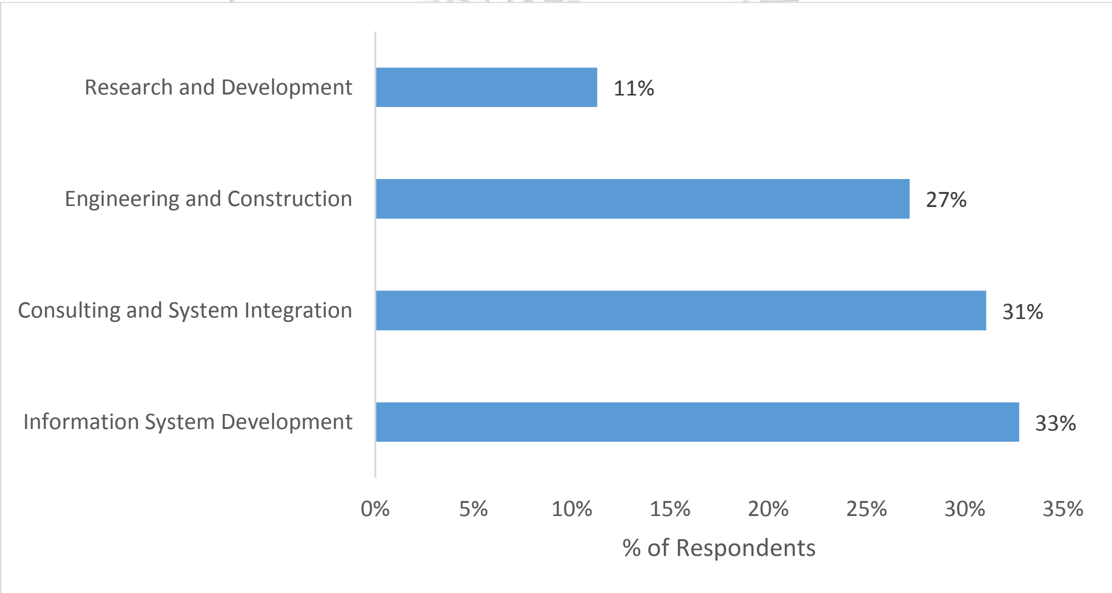
Figure 0.1 Recently Completed Project



Source: Primary Data (2019)

The study sought to find out the type of research the last project was predominantly based on. The results showed that 33% of the respondents were involved in Information System Development, 31% had taken part in a project on Consulting and Systematic Integration, 27% did a project on Engineering and Construction and the remaining 11% had completed a project in Research and Development. The results are presented in figure 4.2.

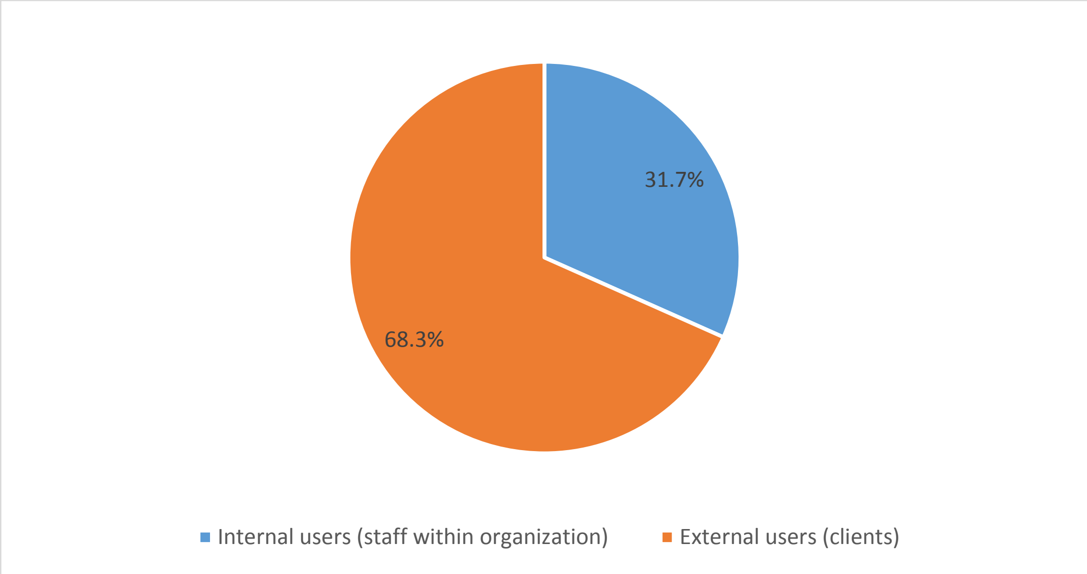
Figure 0.2 Project Field



Source: Primary Data (2019)

The study wanted to find out who the end users of the project were, whether internal users or external users. The results showed that 68% of the respondents indicated that the end users of their project were internal users while 32% stated that the end users were external users. The results are presented in figure 4.3.

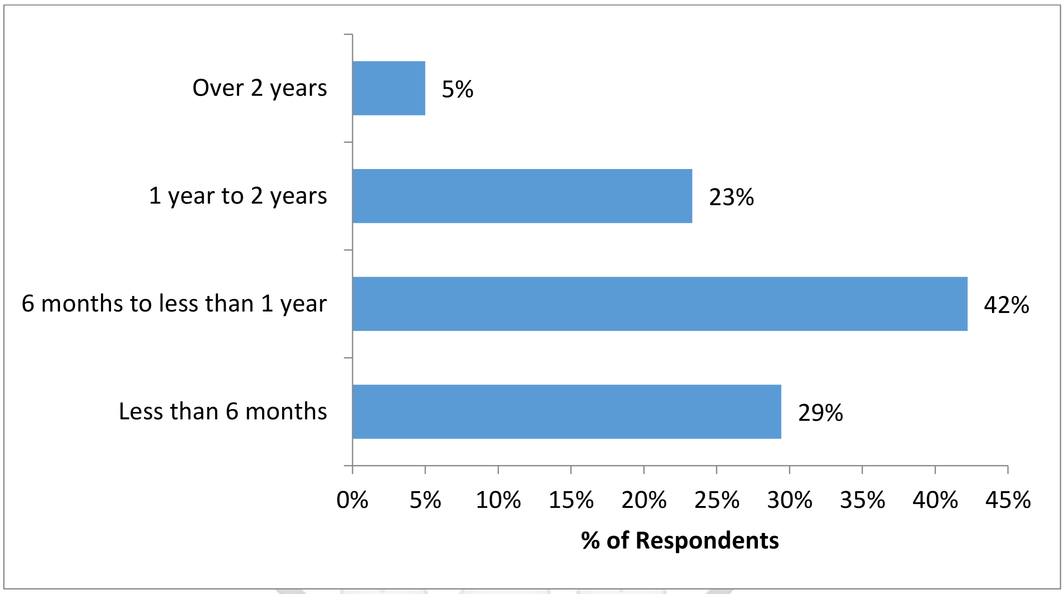
Figure 0.3 End Users of the Project



Source: Primary Data (2019)

The study also investigated the duration of time it took for the project to be completed. The results showed that majority **(**42%**)** of the respondents said the project took 6 months to less than 1 year to complete, 29% of the respondents said it took less than 6 months to complete, 23% of the respondents said it took 1 year to 2 years to complete and finally the remaining 5% said it took over 2 years to complete. The results are presented in figure 4.4.

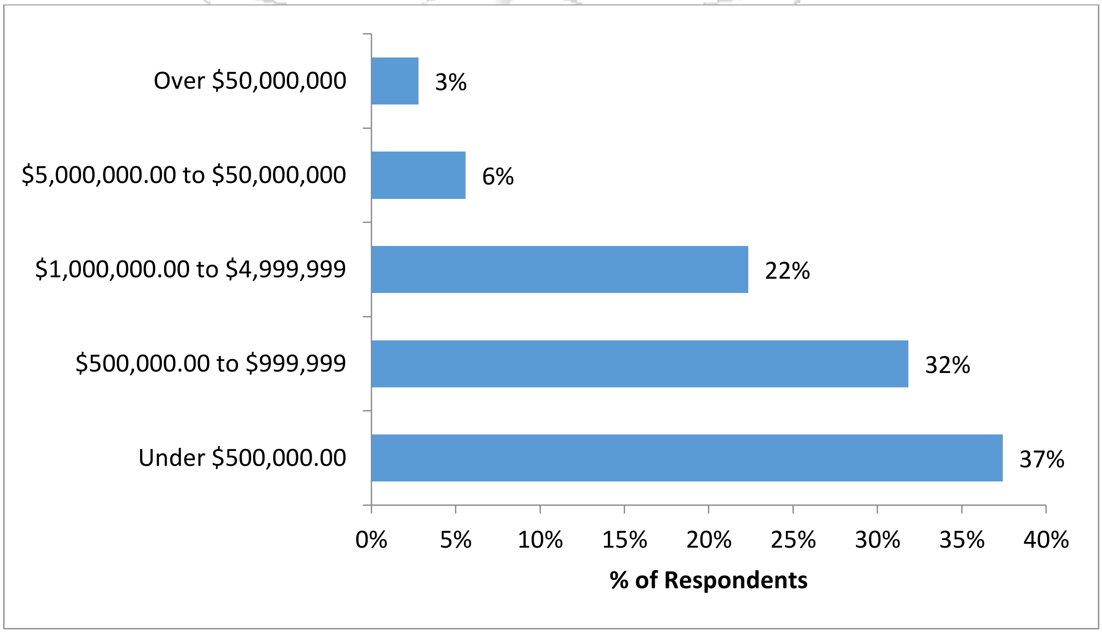
Figure 0.4 Total Duration of the Project



Source: Primary Data (2019)

The study sought to find out the value of the last project which was measured in dollars. The results show that majority 37% of the respondents had valued the project at under 500,000 dollars. About 32% of the respondents valued the project between 500,000 and 999,999 dollars. Only 3% of the respondents valued it at over 50,000,000 dollars. The results are presented in figure 4.5.

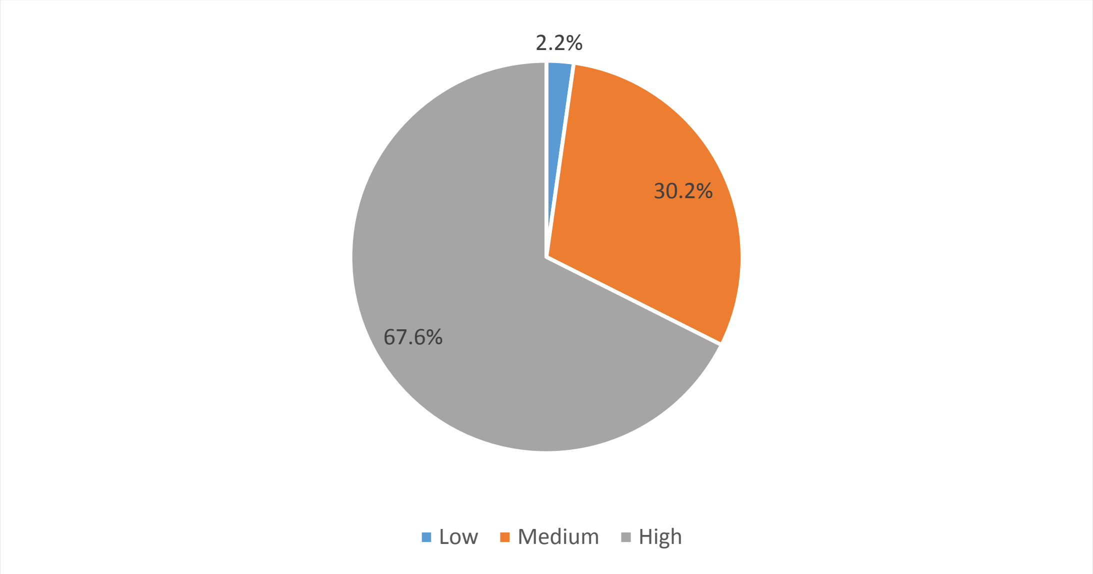
Figure 0.5 Value of Last Project



Source: Primary Data (2019)

The study sought to find out the urgency to delivery of the project. The results obtained from the respondents showed that; the majority (68%) had a high delivery urgency on the project, 30% had a medium delivery urgency on the project and the remaining 2% had a low delivery urgency. the results are presented in figure 4.6.

Figure 0.6 Urgency to Deliver the Project



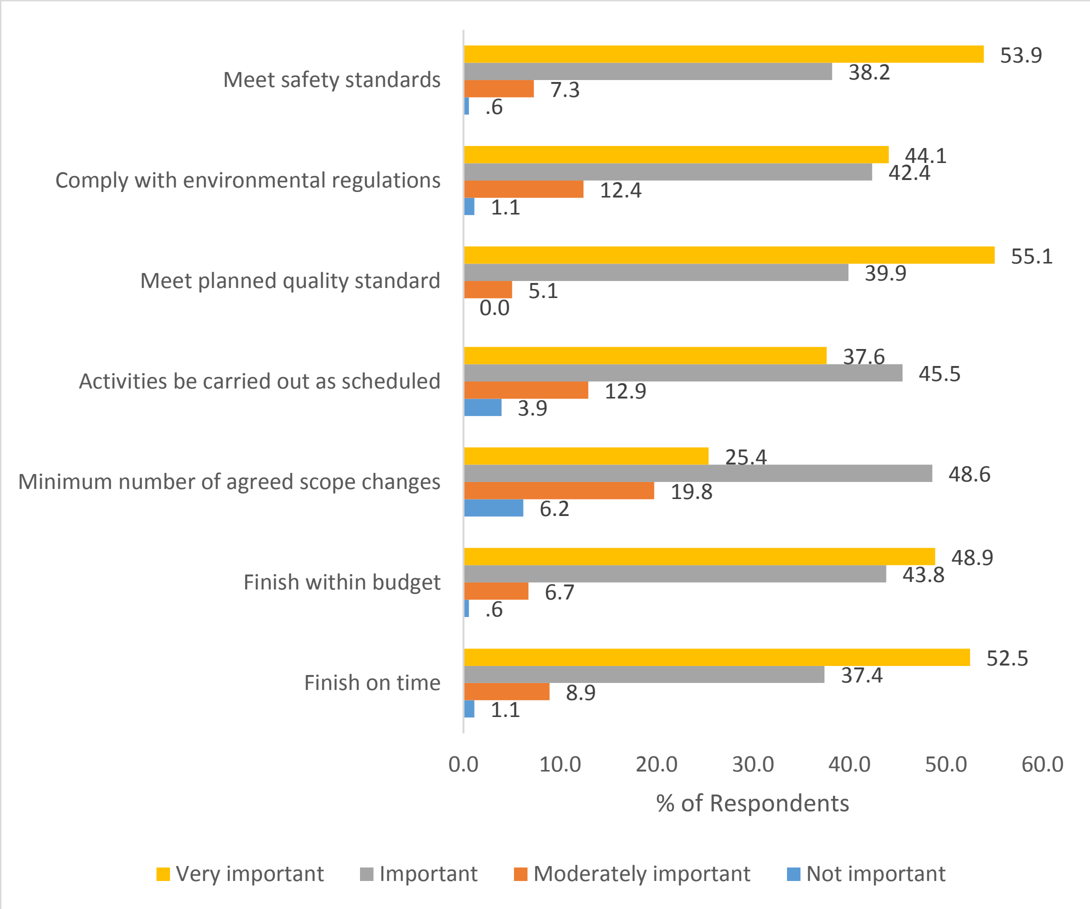
Source: Primary Data (2019)

4.3 Project Success Criteria

4.3.1 Project Efficiency

The study investigated the aspect of project efficiency which was broken down to sub sections namely; importance of finishing the project on time, finishing within the budget, minimum number of agreed scope changes, activities to be carried out as planned, meet planned quality standards, comply with environmental regulations and to meet the safety standards. The results showed that 52.5% of the respondents agreed that the project was to be finished on time,48.9% finished within the budget, 48.6% agreed to the project having minimum number of agreed scope changes, 45.5% of the respondents pointed that activities were to be carried out as scheduled, 55.1% of the respondents agreed that the project was supposed to meet the planned quality standards, 44.1% of the project was to comply with the environmental regulations and 53.9% respondents indicated that the project was supposed to meet the safety standards. The results are presented in figure 4.7.

Figure 0.7 Project Efficiency Factors Important to Overall Project Success

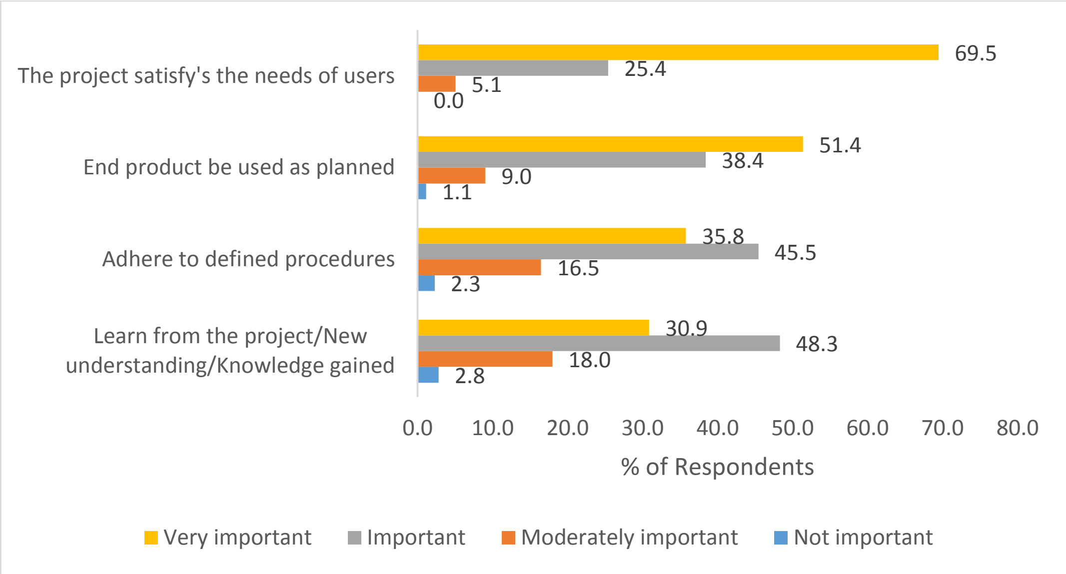


Source: Primary Data (2019)

4.3.2 Organizational Benefits

The study sought to find out the importance of organizational benefits based on these aspects; learning from the project, adhering to the defined procedures, end product to be used as planned and the project should satisfy the needs of users. The results were as follows; 69.5% of the respondents agreed that the project satisfied the need of users, 51.4% of the respondents added that the project's end product was used as planned, 45.5% of the respondents indicated that the project adhered to the defined procedures. The results are presented in figure 4.8.

Figure 0.8 Organizational Benefits Factors Important to Overall Project Success



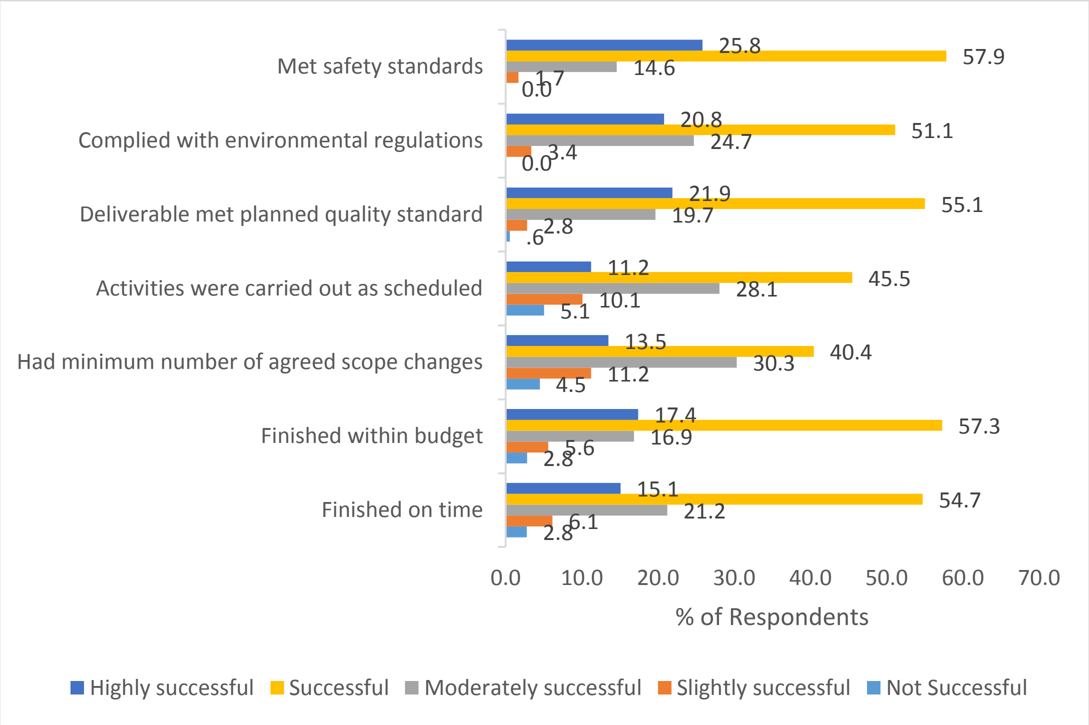
Source: Primary Data (2019)

4.4 Project Success Achieved

4.4.1 Project Efficiency

The study sought to find out if success was achieved based on project efficiency in the following; finishing on time, finishing within budget, having minimum number of agreed scope changes, activities were carried out as scheduled, deliveries met planned quality standard, complying with environmental regulations and meeting safety standards. The results of the respondents were as follows; 57.9% of the project met the safety standards, 51.1% of the project complied with environmental regulations, 55.1% of the project delivered planned quality standard, 45.5% of the activities were carried out as scheduled, 40.4% of the project had a minimum number of agreed scope changes, 57.3% of the respondents agreed that the project was finished within the budget and 54.7% of the respondents agreed that the project was finished on time. The results are presented in figure 4.9.

Figure 0.9 Project Success in Terms of Project Efficiency

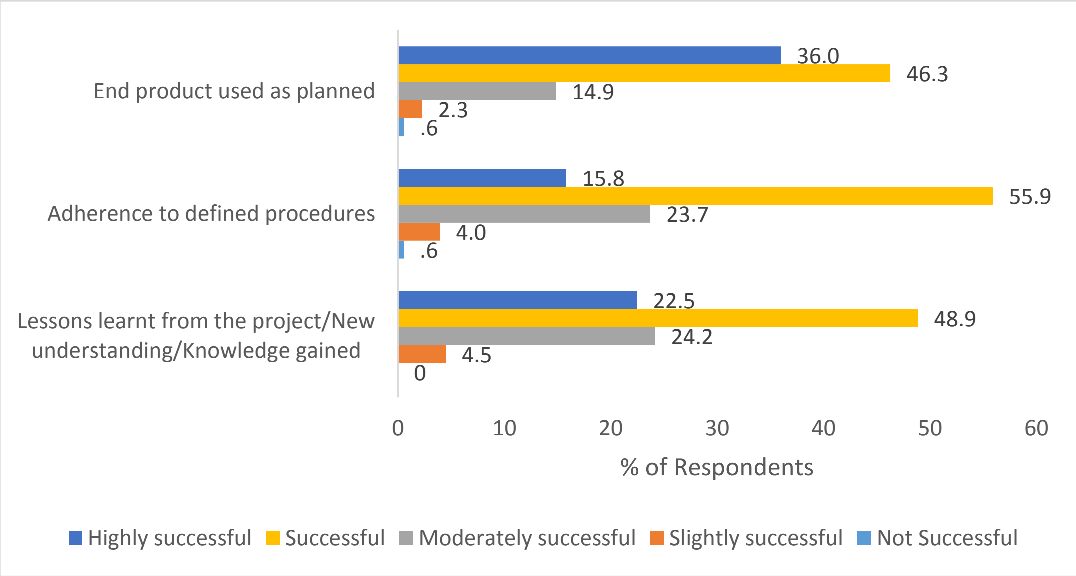


Source: Primary Data (2019)

4.4.2 Organizational Benefits

The study sought to find the project success in terms of; end product being used as planned, adherence to define procedures and lessons learnt from the new project. The results obtained were as follows; 46.3% of the respondents gave insights that the end product of the project was used as planned, 55.9% of the respondents adhered to the defined procedures of the project, 48.9% of the respondents agreed that the lessons they learnt from the project was successful. The results are presented in figure 4.10.

Figure 0.10 Project Success in Terms of Organizational Benefits

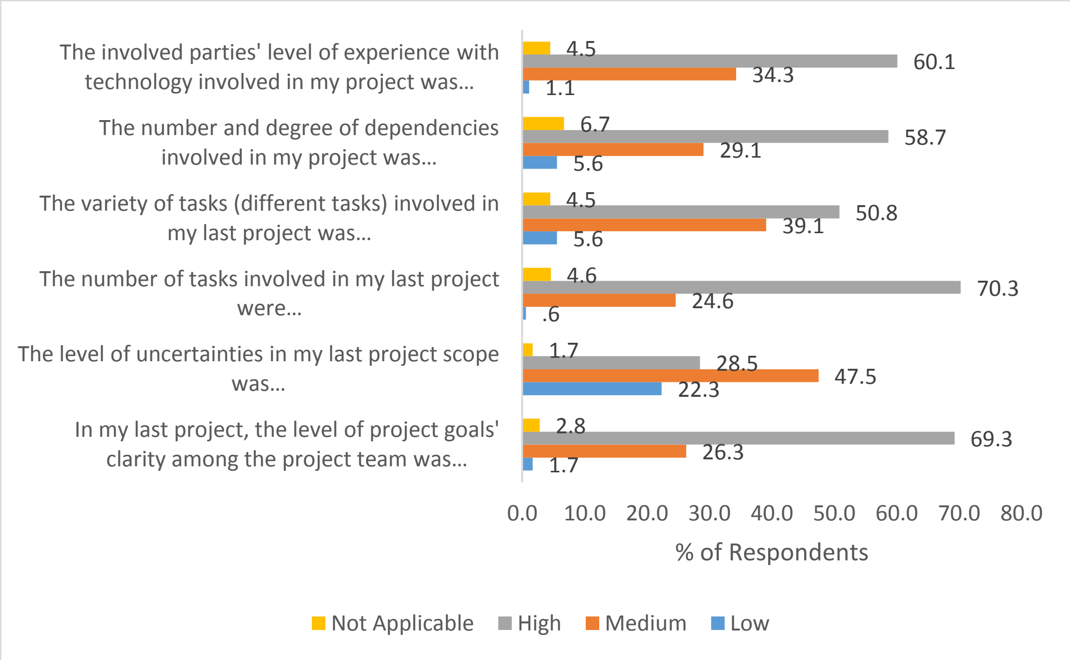


Source: Primary Data (2019)

4.5 Technological Complexity

The study sought to find out the effect of technological complexity on project success in terms of; project goals clarity, level of uncertainties, tasks involved, variety of tasks involved, number and degree of dependency, involved parties level of experience. The results obtained were as follows; 69.3% of the respondents indicated that the project was complex in terms of clarity, 47.5% recorded a complexity in uncertainties, 70.3% agreed that the tasks involved were complex, 50.8% included that the variety of tasks involved were complex, 58.7% stated that dependencies involved were complex and finally 60.1% said that the level of experience with technology was complex. The results are presented in figure 4.11.

Figure 0.11 Technology Complexity

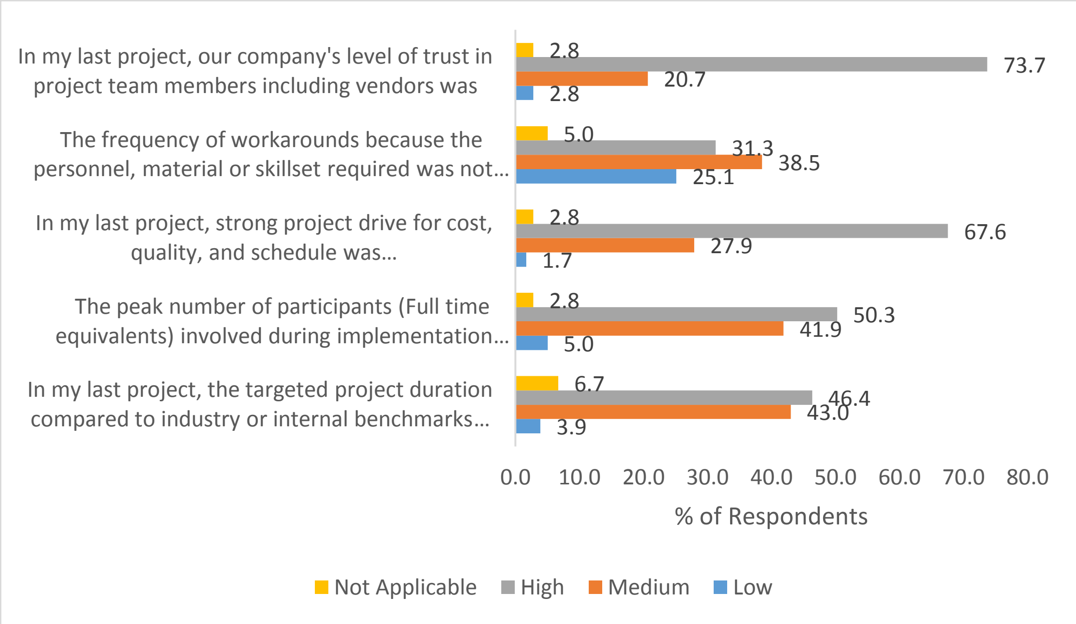


Source: Primary Data (2019)

4.6 Organizational Complexity

The study sought to find the organizational complexity in the project in terms of; company's level of trust, frequency of workarounds, project drive, peak number of participants and the targeted project duration. The results found were as follows; 73.7% of the respondents suggested that the company's level of trust was complex, 38.5% of respondents stated that frequency of workarounds was complex, 67.6% of the respondents indicated that project drive was complex, 50.3% of the said that peak number of participants was complex and 46.4% of the respondents indicated that targeted project duration was complex. The results are presented in figure 4.12.

Figure 0.12 Organizational Complexity

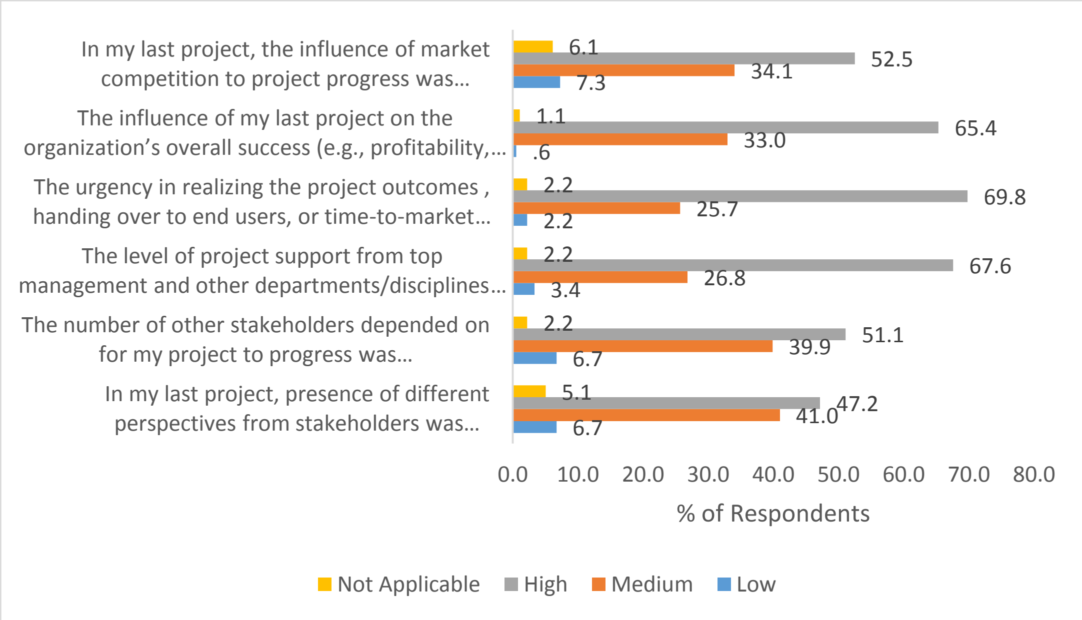


Source: Primary Data (2019)

4.7 Environmental Complexity

The study sought to find the environmental complexity of the project in terms of; presence of different perspectives from stakeholders, number of other stakeholders, project support, urgency in realizing project outcomes, organizational overall success and the market competition to the project progress. The results obtained were as follows; 52.5% of the respondents indicated that the project's market competition was complex, 65.4% of the respondents added that project's organization success was complex, 69.8% of the respondents indicated that the projects urgency in realizing the project outcome was complex, 67.6% suggested that project's support from top management was complex, 51.1% indicated that the project's number of stakeholders depending on the project to succeed was complex and 47.2% added that the project's different perspectives from stakeholders was also complex. The results are presented in figure 4.13.

Figure 0.13 Environmental Complexity

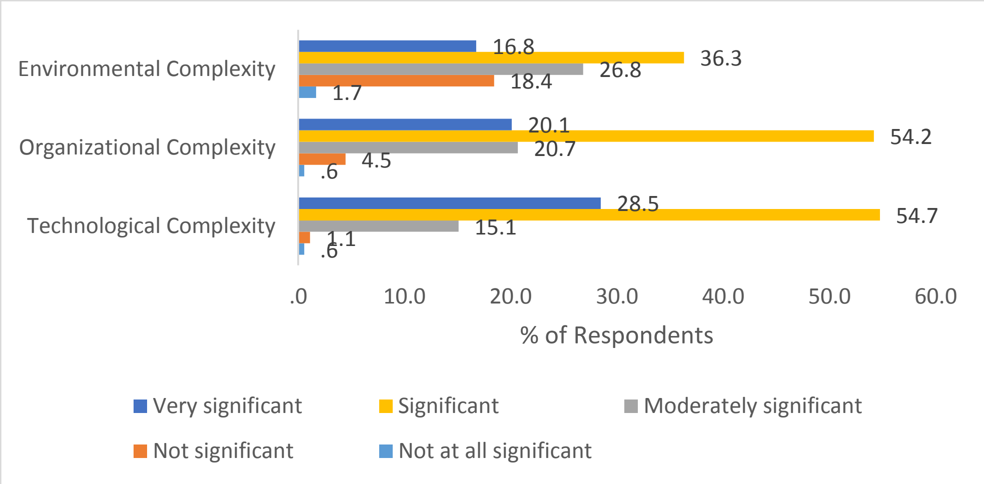


Source: Primary Data (2019)

4.8 Contribution to Project Complexity

The study further investigated the significance and contribution of environmental complexity, organizational complexity and technological complexity to the overall project complexity. Results indicated the level of significance for each as follows; environmental complexity was recorded by respondents to 36.3% significantly contribute to project complexity, organizational complexity 54.2% and finally technological complexity which recorded the highest entries (54.7%). Figure 4.14 presents this finding.

Figure 0.14 Contribution to Project Complexity



Source: Primary Data (2019)

4.9 Factor Analysis

This section presents results for factor analysis of project efficiency, organizational benefits, technological complexity, organizational complexity and environmental complexity.

4.9.1 Factor Analysis for Project Efficiency

The study used the Kaiser-Meyer-Olkin (KMO) statistics to measure the sampling adequacy and Bartlett's Test of Sphericity to measure the null hypothesis that the correlation matrix is inverse. The KMO Test is used to determine if the data should be subjected to factor analysis. To determine if the data should be subjected to factor analysis, the KMO statistics should be greater than 0.5. In this data, the KMO statistic was 0.743 hence factor analysis was applicable. The Bartlett's Test of Sphericity tests whether the correlation matrix is an identity matrix, which would be an indicator that the factor model was inappropriate. In this study, the Bartlett's Test of Sphericity was significant; that is, the associated p-value was 0.000. This meant that the correlation matrix was not an identity matrix and thus factor analysis was appropriate.

Initial communalities represent the relation between the variable and all other variables before rotation. The communalities results indicated that all the seven sub constructs of project efficiency had initial extraction values greater than 0.5. The results of total variance explained indicated that 64% of the variation in project efficiency was explained by the first two variables. A scree plot for choosing the appropriate number of factors to retain was done. Two factors were greater than one, supporting the results from the total variance explained results (see appendix 3).

From the results of the component matrix, for component 1, all the six components indicated a factor loading that was greater than 0.5. Thus the study used summated factor scores of the six components to create a project efficiency index. The results for rotated component matrix confirms that all the items had factor loading greater than 0.5 and thus they can be used for creating summated scores (Table 4.2).

Table 0.2 Rotated Component Matrix for Project Efficiency

	Component	
	1	2
Finished on time	.734	.021
Finished within budget	.809	.000
Had minimum number of agreed scope changes	.670	.374
Activities were carried out as scheduled	.756	.201
Deliverable met planned quality standard	.186	.789
Complied with environmental regulations	.137	.848
Met safety standards	.027	.854

Source: Primary Data (2019)

4.9.2 Factor Analysis for Organizational Benefits

The study further conducted a KMO and Bartlett's Test for organizational benefits and the results showed a value of 0.637 which is greater than 0.5 indicating that there are sufficient items for each factor. The Bartlett's Test of Sphericity was also found to be 0.00 giving a conclusion that it is significant indicating that the correlation matrix is significantly different from an identity matrix, in which correlations between variables are all zero.

Communalities for organizational benefits indicated suggested that much of the variances in each of the original variables were explained by the extracted factors. The total variance explained results for organizational benefits indicated that one component explained 58.819% of the total variability in the three items. The Scree plot showed that after the first component, differences between the Eigen values declined and the curve flattened, and they were less than 1.0 (see appendix 4). This again supported a one-component solution as indicated in the total variance explained for organizational benefits. The study used the all the items since they had factor loadings greater than 0.5 to compute summated factor scores for organizational benefits (Table 4.3).

Table 0.3 Component Matrix for Organizational Benefits

	Component
	1
Lessons learnt from the project/New understanding/Knowledge gained	.815
Adherence to defined procedures	.736
End product used as planned	.747

Source: Primary Data (2019)

4.9.3 Factor Analysis for Technological Complexity

Factor analysis was conducted to reduce the items of technological complexity. Technological complexity construct was measured using six items thereby the construct was factor analysed to come up with an appropriate measure. The study found that KMO had a value of 0.547 and Bartlett's test, x^2 = 22.348, p = 0.099. The KMO value was more than 0.5 and this indicates that a factor analysis will be useful with the study data. The value of Bartlett's test was less than 0.1 and this indicates that a factor analysis will be useful in the study.

Communalities for technological complexity suggest that much of the variances in each of the original variables are explained by the extracted factors. However, the variance "The level of uncertainties in my last project scope was and the number and degree of dependencies involved in my project was… " was less than 0.5. The total variance explained results for technological complexity indicated that three components explained 58.132% of the total variability in the six items.

The Scree Plot computed showed the initial Eigen values. Both the scree plot and the Eigen values supported the conclusion that the six variables could be reduced to three components. Since the scree plot flattens out after the third component. The study found that "In my last project, the level of project goals' clarity among the project team was…" had the highest factor load as component two, "The number of tasks involved in my last project were…" had the highest factor load as component one, "The variety of tasks (different tasks) involved in my last project was…" had the highest factor load as component one, lastly "The involved parties' level of experience with technology involved in my project was" with the highest factor loading which is component three (see appendix 5). The study also found out that all the rotated components except "The level of uncertainties in my last project scope was…" had a factor loading greater than 0.5. Thus, the items with factor loading greater than or equal to 0.5 were used to calculate summated scores. Results are presented in Table 4.4.

Table 0.4 Rotated Component Matrix for Technological Complexity

	Component		
	1	2	3
In my last project, the level of project goals' clarity among the project team was…	-.181	.851	.090
The level of uncertainties in my last project scope was…	.437	.177	-.321
The number of tasks involved in my last project were…	.457	.556	-.113
The variety of tasks (different tasks) involved in my last project was…	.745	.070	.091
The number and degree of dependencies involved in my project was…	.601	-.199	.062
The involved parties' level of experience with technology involved in my project was…	.101	.071	.938

Source: Primary Data (2019)

4.9.4 Factor Analysis for Organizational Complexity

The study carried out factor analysis to reduce items of organizational complexity. Organizational complexity construct was measured using five items thereby the construct was factor analysed in order to come up with an appropriate measure. The study found that KMO had a value of 0.463 and Bartlett's test, x^2 = 31.932, p = .000. The KMO value is less than 0.5 and this indicates that a factor analysis will not be useful with the study data. The value of Bartlett's test is less than 0.05 and this indicates that a factor analysis will be useful in the study.

Communalities for organizational complexity suggest that much of the variances in each of the original variables are explained by the extracted factors except in the "In my last project, the targeted project duration compared to industry or internal benchmarks was…" whose extraction value was less than 0.5. Total variance explained for organizational complexity showed that three components explained 70.618% of the total variability in the five items. The results for scree plot indicated that component one, two and three had Eigen values that were greater than one. The findings above are in agreement with total variance explained results for organizational complexity.

The study further found out that for component one, “In my last project, the targeted project duration compared to industry or internal benchmarks was…”, “The peak number of participants (Full time equivalents) involved during implementation stage of my last project was…” and “In my last project, strong project drive for cost, quality, and schedule was…” had the greatest factor loading of more than 0.5. The remaining two items had the highest factor loading at component two and three respectively (see appendix 6). Conducting the rotated matrix, as shown in Table 4.5 and found that all the items had factor loading greater than or equal to 0.5 thus they were used to calculate summated scores.

Table 0.5 Rotated Component Matrix for Organizational Complexity

	Component		
	1	2	3
In my last project, the targeted project duration compared to industry or internal benchmarks was…	.335	.264	.524
The peak number of participants (Full time equivalents) involved during implementation stage of my last project was…	.781	.295	-.044
In my last project, strong project drive for cost, quality, and schedule was…	.777	-.365	.085
The frequency of workarounds because the personnel, material or skillset required was not available when needed to support project implementation was…	.007	.904	.031
In my last project, our company's level of trust in project team members including vendors was	-.125	-.103	.887

Source: Author (2019)

4.9.5 Factor Analysis for Environmental Complexity

Factor analysis was conducted to reduce items of environmental complexity. Environmental complexity construct was measured using six items thereby the construct was factor analysed in order to come up with an appropriate measure. The study found that KMO had a value of 0.583 and Bartlett's test, x^2= 57.720, p = .000. The KMO value is more than 0.5 and this indicates that a factor analysis will be useful with the study data. The value of Bartlett's test is less than 0.05 and this indicates that a factor analysis will be useful in the study.

Communalities for environmental complexity suggest that only two of the variances in two items of the original variables are explained by the extracted factors. While most (four items) the variances cannot be explained by the extracted factors. Total variance explained for environmental complexity showed that two components explained 47.636% of the total variability in the six items. The findings for scree plot indicated that component one and two had Eigen values that were greater than one. The findings corroborate total variance explained results for environmental complexity.

The study further found out that for component one, “In my last project, presence of different perspectives from stakeholders was…”, “The number of other stakeholders depended on for my project to progress was…”, “The urgency in realizing the project outcomes, handing over to end users, or time-to-market was…” and “In my last project, the influence of market competition to project progress was…” had the greatest factor loading of more than 0.5. One of the remaining item had the highest factor loading at component two while the last one had a factor loading of less than 0.5 (see appendix 7). Conducting the rotated matrix, as shown in Table 4.6, it is only the last item that had factor loading that was less than 0.5. The study used the other items with factor loading greater or equal to 0.5 to calculate environmental complexity index.

Table 0.6 Rotated Component Matrix for Environmental Complexity

	Component	
	1	2
In my last project, presence of different perspectives from stakeholders was…	.825	.003
The number of other stakeholders depended on for my project to progress was…	.771	.087
The level of project support from top management and other departments/disciplines was…	-.149	.679
The urgency in realizing the project outcomes, handing over to end users, or time-to-market was…	.222	.574
The influence of my last project on the organization’s overall success (e.g., profitability, growth, future industry position, public visibility, and internal strategic alignment) was…	.021	.665
In my last project, the influence of market competition to project progress was…	.308	.419

Source: Primary Data (2019)

4.10 Correlation Analysis

The results for correlation analysis between project success and technology, organizational, and environmental complexity are presented in the following sections.

4.10.1 Correlation between Project Success and Technology Complexity

The correlation analysis between project success and technology complexity shows that technology complexity had a weak positive and significant relationship with project efficiency but not with organizational benefit (Table 4.7).

Table 0.7 Correlation between Project Success and Technology Complexity

		Project Success	
		Project Efficiency	Organizational Benefit
Technological Complexity	Pearson Correlation	0.152*	0.110
	Sig. (2-tailed)	0.047	0.152
	N	173	171

Source: Primary Data (2019)

4.10.2 Correlation between Project Success and Organizational Complexity

The correlation analysis between project success and organizational complexity shows that organizational complexity had a weak positive and significant relationship with organizational benefit but not with project efficiency (Table 4.8).

Table 0.8 Correlation between Project Success and Organizational Complexity

		Project Success	
		Project Efficiency	Organizational Benefit
Organizational Complexity	Pearson Correlation	0.057	0.212**
	Sig. (2-tailed)	0.450	0.005
	N	178	174

Source: Primary Data (2019)

4.10.3 Correlation between Project Success and Environmental Complexity

The correlation analysis between project success and environmental complexity shows that environmental complexity had a weak positive and significant relationship with organizational benefit but not with project efficiency (Table 4.9).

Table 0.9 Correlation between Project Success and Environmental Complexity

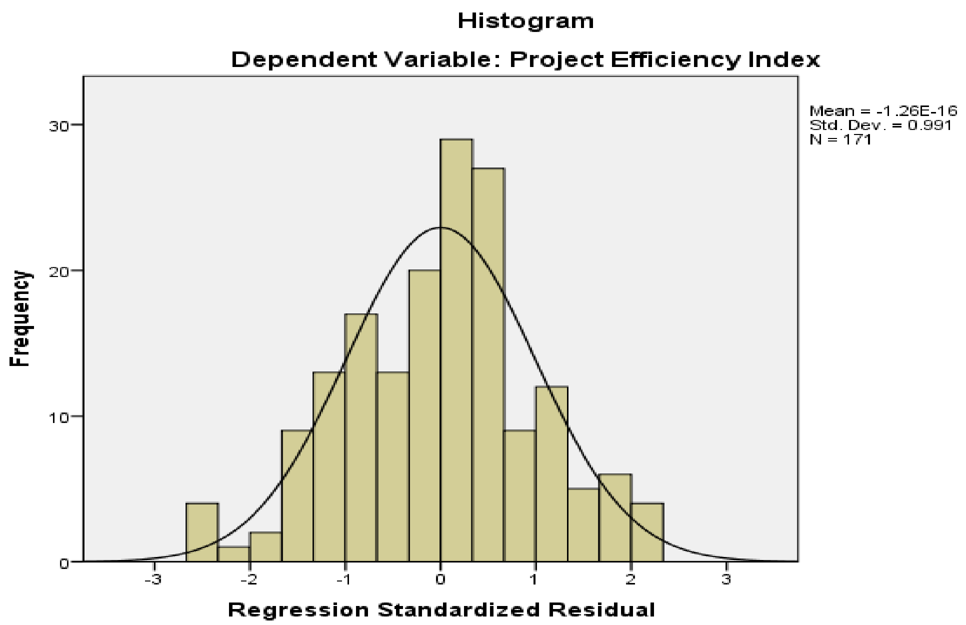
		Project Success	
		Project Efficiency	Organizational Benefit
Environmental Complexity	Pearson Correlation	0.081	0.231**
	Sig. (2-tailed)	0.284	0.002
	N	176	172

Source: Primary Data (2019)

4.11 Regression Analysis

The factors generated were used to model the relationship between project success and the independent variables using regression analysis. The study used regression to investigate the effect of independent variable (technological complexity, organizational complexity, and environmental complexity) on the dependent variable, project success (project efficiency, organizational benefits). Due to the fact that the researcher had more than one independent variable, the multiple linear regression was used. The study conducted diagnostic tests to check whether the assumptions of the CLRM were violated. Normality test indicated that the data was normally distributed since the curve in Figure 4.15 shows a bell shaped curve suggesting a normal distribution.

Figure 0.15 Normality Test



Source: Primary Data (2019)

The study tested for autocorrelation using Durbin- Watson and found a DW value of 1.97. This value is very close to 2 indicating that the data did not suffer from autocorrelation. The Glejser test of heteroscedasticity showed that there were no significant variables suggesting that the data was homoscedastic. Multicollinearity was tested using Pearson Correlation and the results indicated that technology complexity, organizational complexity and environmental complexity did not suffer from severe multicollinearity (Table 4.10).

Table 0.10 Test of Multicollinearity

		Technological Complexity	Organizational Complexity	Environmental Complexity
Technological Complexity	Pearson Correlation	1	.229	.345
	Sig. (2-tailed)		.002	.000
	N	174	174	172
Organizational Complexity	Pearson Correlation	.229	1	.327
	Sig. (2-tailed)	.002		.000
	N	174	179	177
Environmental Complexity	Pearson Correlation	.345	.327	1
	Sig. (2-tailed)	.000	.000	
	N	172	177	177

Source: Primary Data (2019)

4.11.1 Multiple Linear Regression Analysis for Project Efficiency

The regression results showed that the R-Squared which is the correlation of determination was found to be 0.026 which implies that project complexity which was considered in this analysis explains 2.6% variation in project success. The results are presented in Table 4.11.

Table 0.11 Model Summary for Project Efficiency

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.161	0.026	0.009	3.92596

Source: Primary Data (2019)

The ANOVA results showed that the mean square of sum of regression was 22.918 and the mean square of sum of residual was 2573.994. The *F*-statistic of the model was 1.487 with a p-value of 0.220, which is greater than *p*-critical value of 0.05. Therefore, project complexity does not statistically significantly predict project success. The results are presented in table 4.12.

Table 0.12 ANOVA for Project Efficiency

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	68.754	3	22.918	1.487	0.220
	Residual	2573.994	167	15.413		
	Total	2642.749	170			

Source: Primary Data (2019)

The regression results show that the coefficient of technological complexity was 0.367 with a p value of 0.086 suggesting that technological complexity was significant at 10%. However, the coefficients of organizational and environmental complexity had p values that were greater than 10% indicating that they had an insignificant effect on project efficiency. This therefore implies that technological complexity positively and significantly influences project efficiency but organizational and environmental complexities do not have significant effect on project efficiency. Results are presented in Table 4.13.

Table 0.13 Coefficients for Project Efficiency

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	20.080	3.442		5.834	.000
	Technological Complexity	.367	.213	.141	1.724	.086
	Organizational Complexity	.017	.189	.007	.091	.928
	Environmental Complexity	.099	.209	.040	.473	.637

Source: Primary Data (2019)

4.11.2 Multiple Linear Regression Analysis for Organizational Benefits

The regression results showed that the R-Squared which is the correlation of determination was found to be 0.078 which implies that project complexity explains about 8% variation in project success, organizational benefits. The results are presented in Table 4.14.

Table 0.14 Model Summary for Organizational Benefits

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.279	.078	.061	1.75899

Source: Primary Data (2019)

The ANOVA results showed that the mean square of sum of regression was 14.372 and the mean square of sum of residual was 510.517. The *F*-statistic of the model was 4.645 with a p-value of 0.004, which is less than *p*-critical value of 0.05. This shows that jointly technological, organizational and environmental complexities significantly predicts the project success, organizational benefits. The results are presented in Table 4.15.

Table 0.15 ANOVA for Organizational Benefits

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43.117	3	14.372	4.645	.004
	Residual	510.517	165	3.094		
	Total	553.633	168			

Source: Primary Data (2019)

The regression results show that the estimated coefficients of organizational and environmental complexities were positive and significant at 5%. However, technological complexity was insignificant. This finding suggests that organizational and environmental complexities have positive and significant effect on project success, organizational benefits but technological complexity did not influence organizational benefits. Results are presented in Table 4.16.

Table 0.16 Coefficients for Organizational Benefits

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.722	1.568		4.288	.000
	Technological Complexity	.018	.096	.015	.189	.850
	Organizational Complexity	.171	.085	.159	2.005	.047
	Environmental Complexity	.210	.095	.180	2.216	.028

Source: Primary Data (2019)`

CHAPTER FIVE: DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The aim of this chapter is to present the summary of the discussions, conclusions and recommendations. The study aimed at establishing the effects of project complexity on project success on telecom operators in Nairobi. Using quantitative data and multiple linear regression models, the relationship between the variables was established. The findings have guided development of conclusions of the study as well as the recommendations. The summary under this section has been done in line with the objectives of the study and areas of further research have also been suggested.

5.2 Discussion of Findings

The study sought to investigate the effects of project complexity on project success in telecom firms in Nairobi. The objectives of this study were to investigate the effects of technological complexity on success of projects managed by telecom firms, to assess the effects of organizational complexity on success of projects managed by telecom firms and to investigate the effects of environmental complexity on success of projects managed by telecom firms in Nairobi. Project success was measured on a multidimensional criterion which included project efficiency and organizational benefits as the constructs.

The study used both descriptive and explanatory research designs whereby descriptive research design was used to describe various measures of project involvement. Descriptive statistics was also used to provide an understanding of the respondents. Explanatory research design on the other hand was used to assess the effect of various measures of project complexity, on project success. Factor analysis and multiple linear regression models were used as inferential analysis techniques. The results for each of the objectives are discussed as follows.

5.2.1 Effects of Technological Complexity on Project Success

Technological complexity was measured based on clarity of goals, uncertainties in scope, number of tasks, variety of tasks, dependency between tasks, and experience with technology. Regression results showed that technological complexity had a positive effect on project success (project efficiency) of telecom firms in Nairobi.

However, technological complexity did not significantly influence project success (organizational benefits).

These findings corroborate Dvir and Shenhar (2007) who found that project uncertainty is influenced by the mix of new and mature technologies, as well as organization's existing knowledge required to deliver the product. These results therefore reveal that if a project is perceived to have technological complexity, it would be important to find out the prevalent complexity factors that will have an effect on determining success (project efficiency) of the project at hand.

Shenhar and Dvir (1996) conducted a 3-year study on 152 projects in Israel where 26 were case projects in research, toward a typological theory of project management. The study found that projects had a wide range of variations and technology uncertainty was the most prevalent factor affecting project characteristics.

The results of this paper corroborate the findings by Omonyo (2018) who conducted a study on moderating role of project leadership on the influence of complexity on success of public infrastructural megaprojects in Kenya and found that system behaviour had negative and significant influence on success of infrastructural megaprojects. Individual constructs, however had mixed influence on project success. As the number of connections increased in system connectedness dimensions, the lower was schedule and cost performance. However, the system dependency construct was associated with improved schedule and cost performance so long as the dependency was not on project's critical path.

Luo et al.(2016) used a deductive and positivistic approach to test the influence of different complexity factors on project success using structural-equation modelling technique. The study found that technological complexity had insignificant influence on project success. However, project success was measured using one indicator that combined the constructs that are similar to this study (project efficiency and organization benefits).

Floricel, Michela, and Piperca (2016) study on complexity, uncertainty-reduction strategies, and project performance used a survey questionnaire on 81 complex projects in three sectors: information and communication; energy and transportation; and biopharmaceutical which were geographically spread in 5 continents: Africa; Australia; Latin America; North America; and Europe. They found that complexity factors in overall were associated with reduction of project completion performance. The variables, technical and organizational complexities negatively affected completion performance and operation performance whereas market complexity variable was observed to improve innovation performance. Institutional complexity had positive impact on completion performance.

Lebcir and Choudrie (2011) conducted a study on the impact of project complexity factors on project cycle time using a system dynamics modelling approach and found that project complexity factors increased project cycle time. Project uncertainty had strongest influence on time to complete a project. Number of elements and their interconnectivity were observed to have impact on project cycle time. The higher the linkages in the project structure, the longer the project would take to complete.

5.2.2 Effects of Organizational Complexity on Project Success

Organizational complexity was measured based on following attributes: project duration, size of project team, project drive, resources and skills availability, and trust in project team.

Findings from regression analysis showed that organizational complexity had a positive and significant influence on project success (organizational benefits). These results support findings by Shenhar and Dori (2007) who found that complexity of the organization and interconnections among the actors involved adds to the project success. However, organizational complexity did not significantly influence project success (project efficiency). These findings hence reveal that complexities in the organizational levels of telecom firms had no influence on the success (project efficiency).

The results are partially supported by Xia and Lee (2004) study on Grasping the complexity of IS development projects conducted on 541 ISDPs in North American organizations through a web survey which found that of all other three components of ISDP complexity, structural organizational complexity had the strongest positive influence on all four project performance measures of delivery cost, time, user satisfaction, and functionality. Their measure of performance (delivery cost and time) are some of the success factors in project efficiency construct while performance measure (user satisfaction and functionality) are part of success factors in organization benefits construct of this study.

This finding contradict the Luo et al. (2016) who investigated the relationship between project complexity and success in complex construction projects in China and found that organizational complexity had insignificant effect on project success. Floricel et al.(2016) investigated 81 complex projects across 5 continents and touching on 3 sectors – biopharmaceutical, energy and transportation; and information and communication and found that operation performance was negatively affected by organizational complexity. Antoniadis (2016) conducted 5 case studies in construction projects and found an inverse relationship between complexity of interconnections and project performance.

5.2.3 Effects of Environmental Complexity on Project Success

The following attributes were used to measure environmental complexity: variety of stakeholders' perspectives, dependencies on the other stakeholders, company internal support, internal strategic pressure from business, and level of competition in the market.

Similarly, results for the regression on the effects of environmental complexity corroborated those for organizational complexity. The study found that environmental complexity positively influenced project success as measured by organizational benefits but does not influence project success as measured by project efficiency.

Our finding corroborate He et al. (2012) who used analytic network process to analyse influencing factors of project complexity used Analytic Network Process (ANP) to investigate the factors that influenced project complexity. Out of six complexity dimensions, the study ranked cultural complexity, environmental complexity, and goal complexity in positions 4^{th}, 5^{th}, and 6^{th} respectively, in the order of relative importance. Bosch-Rekveldt (2011) who adopted project complexity dimensions - technological complexity, organizational complexity, and environmental complexity conducted quantitative survey with 67 responses on how project complexity influenced project performance. The study found that all the three dimensions had significant correlation with project performance. Environmental complexity had the least correlation with project performance, while technological complexity had the strongest followed by organizational complexity.

Rolstadås and Schiefloe (2017) conducted a case study on an oil and gas project in Norway in order to validate the project complexity model. The complexity factors were grouped in three categories: system produced, producing system, and project context. Project context was examined through studying the actors (stakeholders) involved. The authors found that environmental complexity had significant influence on project performance.

5.3 Conclusions

The study established that the relationship between technological complexity and project success in terms of project efficiency was statistically significant but it was not significantly related with project success in terms of organizational benefits in various telecom firms in Nairobi. As per the results, the study therefore concluded that technological complexity positively and significantly influences success of projects in telecom firms. Thus project management office and project teams in telecommunication companies should work on identifying and recognizing technological complexity attributes prevalent in their projects early in initiation phase and along project life cycle in order to increase their chances of project success.

The study found out that complexity related with the organization positively and significantly affect the ability of a project to succeed with emphasis being on organizational benefits. In addition, the study also found out that organization complexity does not really influence project success in terms of project efficiency. This result suggests that project sponsors and project teams in an organization have higher chances of achieving project success if only they streamlined the organizational complexity attributes that are dominant in their specific projects. Identification of organizational complexity attributes would be instrumental for the project teams to make informed project planning and execution decisions that would enhance project success.

The study ascertained that environmental complexity positively affects project success as measured by organizational benefits. Even so, environmental complexity does not significantly influence ability of the project to succeed based project efficiency. The study concluded that actually, environmental complexity does have an impact or influence on success (organization benefits) of projects done by telecom firms in Nairobi. Thus project organizations may come up with new ideas to manage stakeholder environments: primary, secondary, tertiary environments to ensure environmental complexity did not adversely affect project success.

5.4 Recommendations from the Study

From the conclusions of the study and review of literature, a number of recommendations can be made. First, since project complexity was a key factor in influencing project success, telecom firms in Nairobi should seek ways to identify early in advance the prevailing complexities in their projects. Project organizations would then enhance measures of aligning project planning and execution to the complexities involved in projects. Training and development of their project teams on various fields regarding project complexity and most importantly technological complexity could contribute in success of the projects. Other strategies that firms can adopt include partnering or outsourcing to technology owners or vendors who have knowledge and experience in deploying the required technology.

In managing organizational complexity, project leaders in telecom firms could align their organization culture, drive, resources and skills to fit the organizational complexity attributes dominant to the project. Strategies for managing external resources (vendors, contractors) and owned resources involved in the project should be well integrated and aligned to project goals to ensure project success.

In order to tackle environmental complexity, project managers should understand and gauge the stakeholder environment in which the project is going to take place and device appropriate strategies that will help implementers adopt to the environment. Project organizations could map out market conditions, various stakeholders involved, their needs, and their influence to the project. Project leader competent with prevailing market conditions and skilled in managing stakeholders could be assigned if environmental complexity was dominant in such a project.

5.5 Limitations of the Study

This research could not be carried out without some limitations. The major challenge was the confidentiality policy of the firms which restricted most of the project managers from filling the questionnaire since it was considered to be exposing the organization's matters. This was however mitigated by the respondents being assured of utmost confidentiality and anonymity while disclosing that the study was only for academic purposes. An introduction letter obtained from the university and survey participation consent letter were presented to the firms' management so as to eliminate suspicion which enabled the respondents to disclose the information sought by the study.

Other challenges included some of the respondents not filling or completing the questionnaire correctly because of misunderstanding some issue and also inadequate responses to questions and similar unexpected occurrences. It was also noted that there were errors in the information provided which lead to ultra-vires data but this issue was mitigated through data cleaning.

The study could have collected biased data. Respondents may have selected and given information on their best performing projects in avoidance of portraying their organizations performance negatively despite assurance that the survey was confidential. The study adopted a cross-sectional time horizon with respondents being requested to give data on last completed project. The accuracy of such data was subject to respondents' memory capacity to recall and hence collected data was subject to recency bias. The respondents could have responded on account of impact and experience with complexity instead of evaluating

5.6 Areas for Further Research

The principal aim of this study was to establish the effects of project complexity on project success in telecom firms in Nairobi. Future studies could investigate the effects of contracting strategies on project complexity and project success: a case of telecom firms in Kenya. Future studies could investigate effects of project complexity on project success by adopting a longitudinal time horizon instead of cross-sectional horizon to see if they would reach similar findings. More research could be carried to investigate the project management methodologies adopted to manage project complexity for project success by telecom firms. Additionally, more studies could be done in other fields such as engineering firms and manufacturing companies. This study was limited to investigating only three types of project complexities namely; technological, organizational and environmental, however, further studies should investigate other dimensions of project complexities and how they affect project success in telecom industry.

REFERENCES

Aaltonen, T. M. L. K. (2017). Project governance in public sector agile software projects. *International Journal of Managing Projects in Business*, *10*(2).

Abouzahra, M. (2011). Causes of failure in Healthcare IT projects. *3rd International Conference on Advanced Management Science*, *19*, 46–50.

Adom, D., Hussein, E. K., & Joe, A. agyem. (2018). Theoretical and conceptual framework : mandatory ingredients theoretical and conceptual framework : mandatory ingredients. *International Journal of Scientific Research*, *7*(1), 438–441.

Antoniadis, D. (2016). Socio-organo Complexity and Project Performance – Further thoughts. In *White Paper*. https://doi.org/10.13140/RG.2.2.28542.18240

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, *17*(6), 337–342. Retrieved from https://www.academia.edu/1844767/Project_management_cost_time_and_quality_two_best_guesses_and_a_phenomenon_its_time_to_accept_other_success_criteria

Azim, S. W. (2010). *Understanding and Managing Project Complexity*. The University of Manchester.

Baccarini, D. (1996). The concept of project complexity a review. *International Journal of Project Management*, *14*(4), 201–204.

Bosch-Rekveldt, M. (2011). Managing project complexity: A study into adapting early project phases to improve project performance in large engineering projects. https://doi.org/798-94-91005-00-8

Bosch-rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H., & Verbraeck, A. (2011). Grasping project complexity in large engineering projects : The TOE Grasping project complexity in large engineering projects : The TOE (Technical , Organizational and Environmental) framework. *JPMA*, (July 2016). https://doi.org/10.1016/j.ijproman.2010.07.008

Communication Authority of Kenya. (2018). *First quarter sector statistics report for* *the financial year 2018 / 2019*. Nairobi.

Communications Authority of Kenya. (2018). *Register of unified licensing framework licensees*. Nairobi.

Dao, B. (2016). *Exploring and measuring project complexity* (Texas A&M University). Retrieved from https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/158012/DAO-DISSERTATION-2016.pdf?sequence=1

Davies, A., & Mackenzie, I. (2014). Project complexity and systems integration : Constructing the London 2012 Olympics and Paralympics Games. *International Journal of Project Management*, *32*(5), 773–790. https://doi.org/10.1016/j.ijproman.2013.10.004

Drazin, R. (1985). Alternative Forms of Fit in Contingency Theory Author (s): Robert Drazin and Andrew H . Van de Ven Source : Administrative Science Quarterly , Vol . 30 , No . 4 (Dec ., 1985), pp . 514-539 Published by : Sage Publications , Inc . on behalf of the John. *Administrative Science Quarterly*, *30*(4), 514–539.

Dvir, D., & Shenhar, A. (2007). The Diamond Approach to Succesful Growth and Innovation. In *Reinventing Project Management* (p. 5). https://doi.org/10.1111/j.1540-5885.2008.00327_2.x

Fiedler, F. E. (1964). A Contingency Model of Leadership Effectiveness. *Advances in Experimental Social Psychology*, *1*(C), 149–190. https://doi.org/10.1016/S0065-2601(08)60051-9

Floricel, S., Michela, J. L., & Piperca, S. (2016). Complexity, uncertainty-reduction strategies, and project performance. *International Journal of Project Management*, *34*(7), 1360–1383.

Geraldi, J., Maylor, H., & Williams, T. (2011). Now, let's make it really complex (complicated): A systematic review of the complexities of projects. *International Journal of Operations and Production Management*, *31*(9), 966–990. https://doi.org/10.1108/01443571111165848

Government of Republic of Kenya. (2007). *The popular version*. Retrieved from http://www.vision2030.go.ke/lib.php?f=vision-2030-popular-version

Hannah, W., & Ashton, P. (2010). The factors of project complexity. *18th CIB World Building Congress*, (2006), 69–80. Retrieved from http://eprints.brighton.ac.uk/id/eprint/14062

He, Q. H., Luo, L., Wang, J., Li, Y.-K., & Zhao, L. (2012). Using analytic network process to analyze influencing factors of project complexity. *International Conference on Management Science and Engineering - Annual Conference Proceedings*, (September), 1781–1786. https://doi.org/10.1109/ICMSE.2012.6414413

IBM. (2010). *Capitalizing on Complexity: Insights from the Global Chief Executive Officer Study*. Retrieved from https://www.ibm.com/downloads/cas/1VZV5X8J

ICCPM. (2017). *Contracting for Success in Complex Projects*. Retrieved from https://iccpm.com/resource/2016-rt-exec-summary/

Ika, L. A. (2009). Project Success as a Topic in Project management Journals. *Project Management Journal*, *40*(4), 6–19. https://doi.org/10.1002/pmj

Islam, J., & Hu, H. (2012). A review of literature on contingency theory in managerial accounting. *African Journal of Business Management*, *6*(15), 5159–5164. https://doi.org/10.5897/AJBM11.2764

Joslin, R. (2015). *Relationship between Project Management Methodology (PMM), Project Success , and Project Governance* (Skema Business School). https://doi.org/10.13140/RG.2.1.1755.8245

Jugdev, Kam, & Müller, R. (2005). A Retrospective Look At Our Evolving For Project Success. *Project Management Journal*, *36*, 19–32. https://doi.org/10.1109/EMR.2006.261387

Jugdev, KAM, & Ralf Müller. (2005). A Retrospective Look at Our Evolving Understanding of Project Success. *Project Management Journal*, *36*(4), 19–31. https://doi.org/10.1177/875697280503600403

Kenya National Bureau of Statistics. (2019a). *Economic Survey 2019*. Retrieved from https://www.knbs.or.ke/download/economic-survey-2019/

Kenya National Bureau of Statistics. (2019b). Leading economic indicators. In *Kenya National Bureau of Statistics*. Retrieved from https://www.knbs.or.ke/data-releases/

Khan, K., Turner, J. R., & Maqsood, T. (2013). Factors that influence the success of public sector projects in Pakistan. *Proceedings of IRNOP 2013 Conference, June 17-19, 2013*, (JUNE), 1–25. https://doi.org/10.13140/2.1.4832.9605

Kipkorir, N. G. (2014). *Challenges of strategic outsourcing by mobile telecommunication companies in Kenya* (University of Nairobi). Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/76051/kipkorir_Challenges of strategic outsourcing by mobile Telecommunication companies in Kenya.pdf?sequence=4&isAllowed=y

Lebcir, R. M., & Choudrie, J. (2011). Impact of Project Complexity Factors on Project Cycle Time : A System Dynamics Modelling Approach. *International Conference on Construction and Project Management*, *15*(2), 166–170.

Lee, S., Levendis, J., & Gutierrez, L. (2012). Telecommunications and economic growth: An empirical analysis of sub-Saharan Africa. *Applied Economics*, *44*(4), 461–469. https://doi.org/10.1080/00036846.2010.508730

Liebowitz, J. (1999). A look at why information systems fail A look at why information systems fail. *Kybernetes Industrial Management & Data Systems Iss Library Review*, *28*(04), 61–67. https://doi.org/10.1108/03684929910253243

Linton, G. (2014). Contingency Theory in Entre- preneurship re- search. *Örebro University School of Business*, p. 49. Retrieved from https://www.diva-portal.org/smash/get/diva2:705459/FULLTEXT01.pdf

Luo, L., He, Q., Xie, J., Yang, D., & Wu, G. (2016). Investigating the Relationship between Project Complexity and Success in Complex Construction Projects. *Journal of Management in Engineering*, *33*(2), 1–12. https://doi.org/10.1061/(asce)me.1943-5479.0000471

Mathur, G., Jugdev, K., & Fung, T. S. (2007). Intangible project management assets as determinants of competitive advantage. *Management Research News*, *30*(7), 460–475. https://doi.org/10.1108/01409170710759694

McGaghie, W. C., Bordage, G., & Shea, J. A. (2001). Problem Statement, Conceptual Framework, and Research Question. *Academic Medicine*, *76*(9), 923–924.

Munyoki, K. K., & Njeru, A. W. (2014). *The Effect of Project Management Office Role in the Delivery of Technology Projects in Mobile Communication Companies in Kenya*. *4*(3), 211–215. Retrieved from http://www.ijhssnet.com/journals/Vol_4_No_3_February_2014/20.pdf

Mwaro, J., Omwenga, J., & Kihonge, E. (2016). Effects of Project Complexity on Project Implementation : a Case of Orange Money Project At Telkom Kenya Limited. *International Academic Journal of Information Sciences and Project Management*, *2*(1), 1–16.

Nuottila, J., Kujala, J., & Nystén-Haarala, S. (2015). Flexible Contracting in Software Project Business: What We Can Learn from Agile Methods in the Software Industry. *Flexibility in Contracting*, *28*(2), 29–54.

Okendo, H. (2011). *Telecommunication and economic growth, evidence from Kenya (1980-2010)* (University of Nairobi). Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/3475/Mala_Telecommunication and economic growth%2C evidence from Kenya %281980-2010%29.pdf?sequence=1&isAllowed=y

Omonyo, A. B. (2018). *Moderating Role of Project Leadership on the Influence of Complexity on Success of Public Infrastructural Megaprojects* (Jomo Kenyatta University of Agriculture and Technology). Retrieved from http://ir.jkuat.ac.ke/bitstream/handle/123456789/4900/Final Thesis 2.pdf?sequence=1&isAllowed=y

Pinto, J. K., & Slevin, D. P. (1987). Critical Factors in Successful Project Implementation. *IEEE Transactions on Engineering Management*, *EM-34*(1), 22–27. https://doi.org/10.1109/TEM.1987.6498856

Pinto, J. K., & Slevin, D. P. (1988). Project success: Definition and Measurement Techniques. *Project Management Journal*, *19*(3), 67–73.

Rolstadås, A., & Schiefloe, P. M. (2017). Modelling project complexity. *Journal of Managing Projects in Business*, *10*(2), 295–314. https://doi.org/10.1108/IJMPB-02-2016-0015

Rolstadas, A., Tommelein, I., Morten Schiefloe, P., & Ballard, G. (2014). Understanding project success through analysis of project management approach. *International Journal of Managing Projects in Business*, *7*(4), 638–660. https://doi.org/10.1108/IJMPB-09-2013-0048

Rugenyi, F., & Bwisa, P. H. (2016). Effects of triple constraints on the management of projects in Nairobi: the project managers' perspective. *The Strategic Journal Ob Business & Change Management*, *3*(2 (16)), 344–367. https://doi.org/10.6007/IJARBSS/v5-i11/1889

Saed, A., Yong, K., & Othman, M. (2016). Project Complexity Influence on Project management performance – The Malaysian perspective. *MATEC Web of Conferences 66, 00065*. https://doi.org/10.1051/matecconf/20166600065

Saunders, M., Lewis, P., & Thornhill, A. (2016). Research Methods For Business Students. In *Journal of Chemical Information and Modeling* (Vol. 53). https://doi.org/10.1017/CBO9781107415324.004

Serrador, P., & Turner, R. (2014). The relationship between project success and project efficiency. *Procedia - Social and Behavioral Sciences*, *119*(1), 75–84. https://doi.org/10.1002/pmj.21468

Shenhar, A., & Dvir, D. (1996). Toward a typological theory of project management. *Research Policy*, *25*(4), 607–632. https://doi.org/10.1016/0048-7333(95)00877-2

Shenhar, A., Dvir, D., Lechler, T., & Poli, M. (2002). One size does not fit All - true for projects , true for frameworks. *PMI Research Conference*, 99–106. Retrieved from https://www.researchgate.net/publication/287936459_One_size_does_not_fit_all-true_for_projects_true_for_frameworks/download

Shenhar, A., Dvir, D., Levy, O., & Maltz, A. (2001). Project Success : A Multidimensional Strategic Concept. *Long Range Planning*, *34*(6), 699–725. https://doi.org/10.1016/S0024-6301(01)00097-8

Shenhar, A., & Holzmann, V. (2018). The Three Secrets of Megaproject Success: Clear Strategic Vision, Total Alignment, and Adapting to Complexity. *Project Management Journal*, *48*(6), 29–47.

Shenhar and Dori. (2007). *How Projects Differ, And What to Do About It*. https://doi.org/10.1002/9780470172391.ch50

Sherif, M. H. (2006). *MANAGING PROJECTS IN TELECOMMUNICATION SERVICES*. https://doi.org/10.1002/0470047682

Stalker, & Burns. (1961). Chapter 8 The Management of Innovation. In *The Management of Innovation* (pp. 103–108).

Standish Group International. (2013). *CHAOS MANIFESTO 2013*.

Thong, J., & Yap, C. (1995). CEO characteristics, organizational characteristics and information technology adoption in small businesses. *Omega. The International Journal of Management Science*, *23*(4), 429–442. https://doi.org/10.1016/0305-0483(95)00017-I

Tornatzky, L. G., Eveland, J. D., & Fleischer, M. (1990). Technological Innovation as a Process. In *The processes of technological innovation* (pp. 28–49).

Turki, A., Al-Karaghouli, W., & Eldabi, T. (2013). Alignment of large project management process to business strategy. *Journal of Enterprise Information Management*, *Vol. 26*(5), 596–615. https://doi.org/10.1108/JEIM-07-2013-0050

Turner, J. R. (2009). *The Handbook of Project-Based management*.

Vidal, L., & Marle, F. (2008). Understanding project complexity : implications on project management. *Kybernetes, Emerald*, *32*(8), 1094- 110. Retrieved from https://doi.org/10.1108/03684920810884928

Williams, T. M. (1999). The need for new paradigms for complex projects. *International Journal of Project Management*, *17*(5), 269–273.

Xia, bo, & Chan, A. P. c. (2012). Measuring complexity for building projects: A Delphi study. *Engineering, Construction and Architectural Management*, *19*(1), 7–24. https://doi.org/10.1108/09699981211192544

Xia, W., & Lee, G. (2004). Grasping the Complexity of IS Development Projects. *Communications of the ACM*, *47*(5), 69–74. https://doi.org/10.1145/986213.986215

APPENDICES

APPENDIX 1: INTRODUCTION LETTER

Strathmore Business School

16th April 2019

To Whom It May Concern.

Dear Sir/ Madam.

RE: FACILITATION OF RESEARCH – JOSEPH MWANGI KIMARU

This is to introduce Joseph Kimaru who is a Master of Business Administration student at Strathmore Business School, admission number MBA/90660/16. As part of our MBA Program, Joseph is expected to do applied research and undertake a project. This is in partial fulfilment of the requirements of the MBA course. To this effect, he would like to request for appropriate data from your organisation.

Joseph is undertaking a research paper on **"Effects of Project Complexity on Project Success: The Case of Telecom Firms in Nairobi"**. The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MBA seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours sincerely,

Caroline Tiara.
Manager – MBA Programs.

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APPENDIX 2: SAMPLING FRAME

1	ABLE WIRELESS COMPANY LIMITED	297	A-Z TECHNOLOGIES LIMITED
2	ACTIVE ELECTRONS LIMITED	298	AZANURU TECHNOLOGIES LIMITED
3	ADPOWER LIMITED	299	BALDWIN ENTERPRISES LIMITED
4	ADRIAN KENYA LIMITED	300	BALOZI DISTRIBUTED ANTENNAE SYSTEM LIMITED
5	ADWEST COMMUNICATION LIMITED	301	BANDWIDTH AND CLOUD SERVICES GROUP LIMITED
6	ADYS ENTERPRISES	302	BAYCOMS AFRICA LIMITED
7	AEROMATIC TECHNOLOGIES LIMITED	303	BEAMSPOT COMMUNICATIONS
8	AFRICOM AND DATA SOLUTIONS LIMITED	304	BELCOM COMMUNICATIONS AND TRAINING LIMITED
9	AFRICOM ENGINEERING SERVICES LIMITED	305	BELL INTERNATIONAL KENYA LIMITED
10	AFRISEC TELECOMS LIMITED	306	BELL WESTERN LIMITED
11	AFROEGYPT ENGINEERING COMPANY LIMITED	307	BENKELLS TECHNOLOGIES EAST AFRICA LIMITED
12	AGC NETWORKS AND CYBER SOLUTIONS LIMITED	308	BENRIS INVESTMENTS LIMITED
13	AGILE BUSINESS TECHNOLOGIES LIMITED	309	BETACOM NETWORKS LIMITED
14	AIRTEL NETWORKS KENYA LIMITED	310	BIOMETRICS TECHNOLOGY LIMITED
15	AKS EAST AFRICA LIMITED	311	BIRUS COMMUNICATION SERVICES
16	ALAN DICK & COMPANY (EAST AFRICA) LIMITED	312	BISON TECHNOLOGIES (EA) COMPANY LIMITED
17	ALERT TECHNOLOGY LIMITED	313	BITLINK COMPANY LIMITED
18	ALMOND TECHNOLOGIES	314	BLESSNET COMMUNICATIONS LIMITED
19	ALTECC NETWORKS LIMITED	315	BLUMAN VENTURES
20	ALTERNATIVE COMMUNICATIONS LIMITED	316	BOMA WIRELESS COMPANY LIMITED
21	AMACEC KENYA LIMITED	317	BOSQURE BUSINESS SYSTEMS LIMITED
22	AMAZI GROUP LIMITED	318	BRCK LIMITED
23	AMIRAN COMMUNICATIONS LIMITED	319	BRENT NETWORKS LIMITED
24	AMORTECH COMMUNICATIONS LIMITED	320	BRINKTECH ENTERPRISES LIMITED
25	ANGELS NINE ONE ONE VENTURES LIMITED	321	BRITE AFRIKA HOLDINGS LIMITED
26	ANQAD SYSTEMS LIMITED	322	BROADBAND COMMUNICATION NETWORKS LIMITED

27	ANTS NETWORKS LIMITED	323	BROADCAST COMMUNICATIONS AND ENERGY SYSTEMS LIMITED
28	APPLE WORKS LIMITED	324	BROADCAST GURUS
29	AQUASCOPE SERVICES LIMITED	325	BRULTO TRADING COMPANY LIMITED
30	ARNITEC INTERNATIONAL	326	BUKA ELECTRONICS
31	ASCOM NETWORKS LIMITED	327	BURHANI ENGINEERS LIMITED
32	ATLANCIS TECHNOLOGIES LIMITED	328	BUSHNET SYSTEMS LIMITED
33	ATTAIN ENTERPRISES LIMITED	329	BYCE BROADCAST & TECHNOLOGIES (K) LIMITED
34	AUA INDUSTRIA LIMITED	330	CABLE ONE LIMITED
35	AUDIO VISUAL CONTROL SYSTEMS LIMITED	331	CABLES AND ACCESSORIES LIMITED
36	AUTOCOMMS LIMITED	332	CALIKEN NETWORKS (E.A) LIMITED
37	AVATAR ROHRE INTERNATIONAL LIMITED	333	CAMBRIDGE ENGINEERING SERVICES LIMITED
38	AVEDI ENTERPRISES LIMITED	334	CAMUSAT KENYA LIMITED
39	AVIVA TECHNOLOGIES LIMITED	335	CAPTION DIGITAL TECHNOLOGIES LIMITED
40	AVTECH SYSTEMS LIMITED	336	DABUNET ENTERPRISES LIMITED
41	CARLSON TECHNOLOGIES LIMITED	337	DACE SOLUTIONS LIMITED
42	CASAMOKO CONTRACTORS LIMITED	338	DALAB CONSTRUCTION LIMITED
43	CASTELL SATCOM RADIO LIMITED	339	DATA WISE TECHNOLOGIES (E.A) LIMITED
44	CCS (KENYA) LIMITED	340	DATACORE LIMITED
45	CENTRIC LIMITED	341	DATAMIX COMMUNICATIONS LIMITED
46	CENTRO SYSTEMS LIMITED	342	DATANET LIMITED
47	CENTURION CABLE NETWORKS LIMITED	343	DATAPORT SOLUTIONS LIMITED
48	CHAFRA COMMUNICATION SERVICES	344	DATAWAYS TECHNOLOGIES LIMITED
49	CHARDAR EAST AFRICA LIMITED	345	DECKO LIMITED
50	CHASY ENTERPRISES	346	DEEPSEAS POWER EQUIPMENTS ENGINNERS AND GENERAL
51	CHATICOM LIMITED	347	DELTACOM (KENYA)
52	CHINA PETROLEUM PIPELINE BUREAU (CPP) LIMITED	348	DEMASSIN TECHNOLOGIES LIMITED
53	CHINA TELCOM (KENYA) LIMITED	349	DEMI SYSTEMS (KENYA) LIMITED
54	CHIREMA TELECOMMUNICATION (K) LIMITED	350	DEN OIL (K) LIMITED

55	CHUI FLEET MANAGEMENT SYSTEMS	351	DENGRIV LIMITED
56	CINNOX ELECTRONICS LIMITED	352	DETRIX COMMUNICATION LIMITED
57	CIRCUIT BUSINESS SYSTEMS LIMITED	353	DIAL A GEEK
58	CITIMAX TECHNOLGIES LIMITED	354	DIGITAL AFRICA SERVICES LIMITED
59	CITY TELECOMMUNICATION CENTRE LIMITED	355	DIGITAL RADIO LIMITED
60	COBRA SECURITY COMPANY LIMITED	356	DIMENSION DATA SOLUTIONS LIMITED
61	COM TWENTY ONE LIMITED	357	DIRECT COMMUNICATION SYSTEMS LIMITED
62	COMCHOICE AFRICA LIMITED	358	DITCO ENGINEERING AND CONSTRUCTION COMPANY LIMITED
63	COMDYNAMICS LIMITED	359	DITTMAN CONSTRUCTION COMPANY LIMITED
64	COMMCARRIER SATELLITE SERVICES LIMITED	360	DIVA ENGINEERING LIMITED
65	COMNAV KENYA LIMITED	361	DOUBLE-NET TECHNOLOGIES LIMITED
66	COMNET ENTERPRISES LIMITED	362	DR. WIRELESS LIMITED
67	COMPANY TWO LIMITED	363	DUNTECH TECHNOWLOGY LIMITED
68	COMPEDGE SOLUTIONS LIMITED	364	EAST AFRICA INFRASTRUCTURE SERVICES LIMITED
69	COMPNET ADVISORY SYSTEMS LIMITED	365	EAST FIBRE NETWORKS LIMITED
70	COMPUTACARE CONSULTANTS LIMITED	366	EASYLAN LIMITED
71	COMPUTER REVOLUTION AFRICA LIMITED	367	EDGE SYSTEMS LIMITED
72	COMPUTERWAYS LIMITED	368	EDGETECH DIGTAL SOLUTIONS LIMITED
73	CONANN COMMUNICATIONS	369	ELDAMA TECHNOLOGIES LIMITED
74	CONTEMPORARY ELECTRICAL ENTREPRISES LIMITED	370	ELECTROSERVE LIMITED
75	COOLIGHT TECHNOLOGIES AFRICA LIMITED	371	ELECTROTECHNICS COMMUNICATIONS AND DIGITAL IMAGING SYSTEMS LIMITED
76	CORRINGTON COMMUNICATIONS LIMITED	372	ELEX ENGINEERING SERVICES LIMITED
77	COSMOS TRADING COMPANY LIMITED	373	ELINK TECHNOLOGIES COMPANY LIMITED
78	CRYPTUM LIMITED	374	ELLIPSE PROJECTS KENYA LIMITED

79	CRYSTAL TECHNOLOGIES LIMITED	375	ELPAL SYSTEMS AND TECHNOLOGIES LIMITED
80	CUBIC BUSINESS SOLUTIONS LIMITED	376	FUTURETECH BUSINESS SOLUTIONS LIMITED
81	CYBERTECH ENGINEERING	377	GALLAGHER POWER FENCE SYSTEMS LIMITED
82	ELRIS COMMUNICATIONS SERVICES LIMITED	378	GATE MAINTENANCE & ACCESS CONTROL EQUIPMENT LIMITED
83	EMBARQ LIMITED	379	GAUSSIAN SOLUTIONS LIMITED
84	EMERGING COMMUNICATIONS	380	GEDA LIMITED
85	EMERGING MARKETS COMMUNICATIONS (K) LIMITED	381	GEMTHI GENERAL MERCHANTS
86	EN LINEA TECHNOLOGIES COMPANY LIMITED	382	GENER WIFI LIMITED
87	ENCAPSULATED EAST AFRICA LIMITED	383	GEO-NET COMMUNICATIONS LIMITED
88	ENTERPRISE DATA FOUNDRY LIMITED	384	GEONET TECHNOLOGIES LIMITED
89	EPINICIAN LIMITED	385	GEOPTICS COMMUNICATION SYSTEM LIMITED
90	EQUATOR DATANET KENYA LIMITED	386	GEOSCINTEX
91	ERICSSON KENYA LIMITED	387	GLAMA ELECTRICAL AND MECHANICAL COMPANY LIMITED
92	ETNS PROJECT SOLUTIONS KENYA LIMITED	388	GLARE TECHNOLOGY AND ELECTRICAL SYSTEMS LIMITED
93	EUROCOM SYSTEMS LIMITED	389	GLOBAL ACCESS NETWORKS LIMITED
94	EURONET KENYA LIMITED	390	GLOBALMARK TECHNOLOGIES LIMITED
95	E-WORLD COMMUNICATIONS NETWORK LIMITED	391	GLOBETEK SYSTEMS KENYA LIMITED
96	EWORLD INTERNATIONAL LIMITED	392	GLOSEC SOLUTIONS LIMITED
97	EX-LINE SERVICES LIMITED	393	GLOSEC SYSTEMS LIMITED
98	EXPRESS AUTOMATION LIMITED	394	GOABOAS ELECTROCOMS COMPANY (GEC) LIMITED
99	FABEC INVESTMENTS (KENYA) LIMITED	395	GORACEIT TECHNOLOGIES LIMITED
100	FAIRTON AGENCIES LIMITED	396	GOSSE ELECTRICAL LIMITED
101	FALCON FIBER WORKS COMPANY LIMITED	397	GRAVITY ELECTRICALS LIMITED
102	FALSAN (KENYA) LIMITED	398	GREEN DOT HOLDING COMPANY LIMITED
103	FASTCOM NETWORKS LIMITED	399	GREENLINE TECHNOLOGY LIMITED

104	FASTPOINT COMMUNICATIONS	400	GUZZER TECHNOLOGIES LIMITED
105	FESTONE HOLDINGS LIMITED	401	HARUN INTERNATIONAL LIMITED
106	FIBERHOME INTERNATIONAL TECHNOLOGIES (KENYA) CO.LIMITED	402	HIGHWAY AUDIO VISUAL SOLUTIONS LIMITED
107	FIBERLINK LIMITED	403	HIRANI TELECOMMUNICATION LIMITED
108	FIBERTECH NETWORK LIMITED	404	HIRANI TELECOMMUNICATION LIMITED
109	FIBRECOM SOLUTIONS LIMITED	405	HORYAL SERVICES LIMITED
110	FIBRENET TECHNOLOGIES LIMITED	406	HOSPITALITY SYSTEMS CONSULANTS LIMITED
111	FIDELITY TELECOMMUNICATIONS SERVICE LIMITED	407	HUAWEI TECHNOLOGIES (KENYA) COMPANY LIMITED
112	FINE PRINT SOLUTIONS LIMITED	408	IBRAHIM DONALD CONSULTANTS LIMITED
113	FIRESIDE COMMUNICATIONS LIMITED	409	ICOM ENGINEERING COMPANY LIMTED
114	FIRST SOURCE LIMITED	410	ICOM TECHNOLOGIES LIMITED
115	FLOWMATICS LIMITED	411	ICOM TECHNOLOGIES SYSTEMS LIMITED
116	FLYEAGLE SECURITY SERVICES	412	ICON TELESEC SERVICES LIMITED
117	FORECAST ELECTRONIC SOLUTIONS LIMITED	413	ICON WIRELESS LIMITED
118	FOUNTAIN TECHNOLOGIES LIMITED	414	IDEAL SYSTEMS LIMITED
119	FOURTH GENERATION NETWORKS LIMITED	415	IENGINEERING KENYA LIMITED
120	FREJED ENGINEERING SERVICES LIMITED	416	KABONGO TELECOM SERVICES LIMITED
121	FRONTIER OPTICAL NETWORKS LIMITED	417	KARUNDU ELECTRICS
122	ILLIYUN INVESTMENT LIMITED	418	KEITH INTERIORS (K) LIMITED
123	INDUSTRIAL TECHNOLOGY TRADING COMPANY LIMITED	419	KENYA AIRPORT PARKING SERVICES LIMITED
124	INFINITY GENERAL SUPPLIES LIMITED	420	KENYA EDUCATION NETWORK
125	INFORMED SYSTEMS LIMITED	421	KENYA ELECTRICITY TRANSMISSION COMPANY LIMITED
126	INFORPARTS TECHNOLOGIES LIMITED	422	KENYA PIPELINE COMPANY LIMITED
127	INFRABUILD LIMITED	423	KENYA TOWERS LIMITED

128	INFRAENERGY SERVICES LIMITED	424	KEVIN INTERNATIONAL GROUP (AFRICA) LIMITED
129	INFRASOLVE LIMITED	425	KEVWINY AGENCIES LIMITED
130	INSYNC SOLUTIONS LIMITED	426	KEYNOTE SYSTEMS LIMITED
131	INSYNQUE SOLUTIONS LIMITED	427	KINDE ENGINEERING WORKS LIMITED
132	INTEGRATED FIRE AND SAFETY SOLUTIONS LIMITED	428	KINGSWAY BUSINESS SYSTEMS LIMITED
133	INTEGRATED SUPPLIES AND CONSULTANCY LIMITED	429	KLASS IMAGE LIMITED
134	INTEGRATED TECHNOLOGIES & SYSTEMS LIMITED	430	KOBE HOLDINGS LIMITED
135	INTEL NETWORKS LIMITED	431	KOMBETE ENTERPRISES LIMITED
136	INTELLECT GROUP LIMITED	432	KONNEXION SYSTEM LIMITED
137	INTELLIGENT BUILDING MANAGEMENT SOLUTIONS LIMITED	433	KONVERGENZ NETWORK SOLUTIONS LIMITED
138	INTELVISION TECHNOLOGIES LIMITED	434	KRYPT COMMUNICATIONS LIMITED
139	INTERMASS TECHNOLOGIES E.A LIMITED	435	LAJO ENGINEERING WORKS LIMITED
140	INTERNET SOLUTIONS KENYA LIMITED	436	LAMBDA COMMUNICATIONS
141	INTRANET COMMUNICATION SOLUTIONS LIMITED	437	LANTECH (AFRICA) LIMITED
142	ISON TECHNOLOGIES KENYA LIMITED	438	LAPIMAR AGENCIES LIMITED
143	ITECK SYSTEMS LIMITED	439	LAUSER TECHNOLOGIES LIMITED
144	IWAY AFRICA KENYA LIMITED	440	LAZIMA TECHNOLOGIES LIMITED
145	IZMIR ENTERPRISES LIMITED	441	LEADCOM INTEGRATED SOLUTIONS LIMITED
146	IZZY GO-DOWNS LIMITED	442	LEKHA TRADING COMPANY LIMITED
147	JACKNET COMMUNICATIONS LIMITED	443	LEXCOM ENGINEERING LIMITED
148	JACREY COMPANY LIMITED	444	LINKSOFT INTEGRATED SERVICES (EAST AFRICA) LIMITED
149	JAGUAR COMMUNICATIONS	445	LIQUID TELECOMMUNICATIONS KENYA LIMITED
150	JAMII TELECOMMUNICATIONS LIMITED	446	LONGSIDE ELECTRONICS LIMITED
151	JARLSO TELECOM SOLUTION LIMITED	447	LUMATECH SOLUTIONS
152	JASLEX LIMITED	448	MAARS TECHNOLOGIES LIMITED
153	JAYNET TELECOMS LIMITED	449	MAGENTA (K) LIMITED

154	JEKIM TECHNOLOGIES	450	MAGNATEC SOLUTIONS LIMITED
155	JERRISON ELECTRICAL AGENCIES	451	MAINA KANGETHE AND ASSOCIATES LIMITED
156	JO WORLD AGENCIES LIMITED	452	MANAAL VENTURE LIMITED
157	JODEM JOY COMPANY LIMITED	453	MANYOTA LIMITED
158	JOMYTEL TECHNOLOGIES LIMITED	454	MARGE ENTERPRISES LIMITED
159	JOPLINK HOLDINGS LIMITED	455	MASABA SERVICES LIMITED
160	JOY LINK CONTRACTORS LIMITED	456	NEXGEN TECHNOLOGIES LIMITED
161	JUNIPER INTAKES LIMITED	457	NEXT TECHNOLOGIES LIMITED
162	MASTER POWER SYSTEMS LIMITED	458	NEXT THING NETWORKS LIMITED
163	MASTER TECHNOLOGIES LIMITED	459	NEXUS ICT LIMITED
164	MASTERSEED TECHNOLOGY LIMITED	460	NICEPAT ENTERPRISES
165	MATRIX VISION SYSTEMS LIMITED	461	NIMBA TECHNOLOGIES LIMITED
166	MAVERICK DIGITAL LIMITED	462	NISOM AGENCIES LIMITED
167	MAVERICK VENTURES LIMITED	463	NOAN KENYA LIMITED
168	MEGATECH SOLUTIONS LIMITED	464	NOBILITY INVESTMENTS LIMITED
169	MEHTA ELECTRICALS LIMITED	465	NOBSCOTT LIMITED
170	MER KENYA INFRASTRUCTURES LIMITED	466	NORTECH SERVICES LIMITED
171	METSEC CABLES LIMITED	467	NOVEL TECHNOLOGIES EAST AFRICA LIMITED
172	MFI TECHNOLOGY SOLUTIONS LIMITED	468	NUBLY TECHNOLOGIES LIMITED
173	MICROLAN SERVICES LIMITED	469	NUMERIQA COMPANY LIMITED
174	MICROLINE SYSTEMS LIMITED	470	NYANA ENGINEERING COMPANY LIMITED
175	MICRONET POWER SYSTEMS LIMITED	471	OCEANIC CONSTRUCTION COMPANY LIMITED
176	MICRONICS TECHNOLOGIES LIMITED	472	OK LIMITED
177	MILELE LIMITED	473	ONELIFE CONSULTANTS LIMITED
178	MILLENIA LIMITED	474	OPTACE LIMITED
179	MOBILE TELEPHONE NETWORKS BUSINESS (K) LIMITED	475	OPTICOM (K) LIMITED
180	MODERN INFORMATION AND COMMUNICATIONS TECHNOLOGY CONSULTANTS	476	OPTIMAL DATA SOLUTIONS LIMITED

181	MOSKO TECHNOLOGIES LIMITED	477	OPTIMAX GROUP LIMITED
182	MUCHARAGE TELECOMMUNICATION SERVICES	478	OPTINET TECHNOLOGIES LIMITED
183	MUGA ELECTRICAL CONTRACTORS LIMITED	479	OPTPLAN AFRICA LIMITED
184	MUI WA MUI LIMITED	480	ORIOLEC AFRICA LIMITED
185	MULTI CONSTRUCTION LIMITED	481	OUTSOURCE TECHNIQUE LIMITED
186	MUSTARD PROJECTORS & COMMUNICATIONS LIMITED	482	PALADIN TRADING LIMITED
187	MY ISP LIMITED	483	PAMTEC TECHNOLOGIES LIMITED
188	NAIROBI PROJECTORS SERVICES	484	PARJOY SYSTEMS LIMITED
189	NARS TECHNICAL SERVICES LIMITED	485	PECHANT TELEC LIMITED
190	NASE COMMUNICATIONS COMPANY LIMITED	486	PECLEX ENTERPRISES LIMITED
191	NATEC SYSTEMS LIMITED	487	PELINGS COMPANY LIMITED
192	NAVCOM LIMITED	488	PENTACOM CONSULTANCY LIMITED
193	NDITRONICS COMMUNICATIONS	489	PERGAMON LIMITED
194	NETIS EAST AFRICA LIMITED	490	PHILAFE ENGINEERING LIMITED
195	NETLINE TECHNOLOGIES LIMITED	491	PHYPERS ELECTRONICS CREATIONS
196	NETPLUS COMMUNICATIONS LIMITED	492	PHYSCOM ELECTRONIC SERVICES
197	NETPRO INTERNATIONAL	493	PINKERTONS KENYA LIMITED
198	NETWORK INFRASTRUCTURE KENYA LIMITED	494	PLAY EQUIPMENT INDUSTRIES LIMITED
199	NETWORK OPTIONS AND SOLUTIONS LIMITED	495	PLUTON ICT LIMITED
200	NEW BRIDGE NETWORKS LIMITED	496	SCANPEX COMMUNICATION SYSTEMS LIMITED
201	NEW EDGE SOLUTIONS LIMITED	497	SEA SUBMARINE COMMUNICATIONS LIMITED
202	POA INTERNET KENYA LIMITED	498	SEAB LIMITED
203	PONG AGENCIES LIMITED	499	SECULOGIX (E.A) LIMITED
204	POWER GROUP TECHNOLOGIES LIMITED	500	SECURE DIGITAL LIMITED
205	POWERGEN TECHNOLOGIES LIMITED	501	SECUREX AGENCIES (KENYA) LIMITED
206	PREVANSHAL ENTERPRISES LIMITED	502	SECURITY SYSTEMS INTERNATIONAL LIMITED
207	PRICOFAX OFFICE SERVICES LIMITED	503	SEKOMM SERVICES LIMITED
208	PRIMALINKS NETWORKS LIMITED	504	SEMGIL FIBER SOLUTIONS LIMITED

209	PRIME TELECOMS LIMITED	505	SEO AND SONS LIMITED
210	PROFAB KENYA LIMITED	506	SESS SOLUTIONS LIMITED
211	PROFESSIONAL DIGITAL SYSTEMS LIMITED	507	SEVEN SEAS TECHNOLOGIES LIMITED
212	PROGRESSIVE TECHNOLOGIES LIMITED	508	SHARVIC EAST AFRICA LIMITED
213	PROSCENE SYSTEMS LIMITED	509	SHUJANA LIMITED
214	QUAVATEL LIMITED	510	SHURETECH LIMITED
215	QUEST GROUP LIMITED	511	SIDNEY WEINBERG GENERAL CONTRACTORS (K) LIMITED
216	QUIXTAL NETWORKS LIMITED	512	SIEDEL TECHNOLOGIES
217	RABETCO GENERAL MERCHANTS	513	SIMBANET COM. KENYA LIMITED
218	RADDY FIBER SOLUTION LIMITED	514	SIX SPEED LIMITED
219	RADIANT TECHNICAL SERVICES COMPANY LIMITED	515	SKY BROADBAND KENYA LIMITED
220	RADIO FREQUENCY SYSTEMS (EA) LIMITED	516	SKYLINE (K) LIMITED
221	RAHMA ENERGY LIMITED	517	SKYPOWER LIMITED
222	RAKMAN ENGINEERING LIMITED	518	SMARTEX AFRICA LIMITED
223	RAMSA LIMITED	519	SMARTSTREAM TECHNOLOGIES LIMITED
224	RAPHA-ERETS INTERNAL LIMITED	520	SMOOTHTEL & DATA SOLUTIONS LIMITED
225	REAL TIME ADVANCED SYSTEMS LIMITED	521	SOLITON TELMEC LIMITED
226	REAL TIME ADVISORY LIMITED	522	SOLMANN ENTERPRISES
227	REALTEK (K) LIMITED	523	SOLVIC SOLUTIONS LIMITED
228	REGENCY SYSTEMS	524	SOMCOM KENYA TELECOMS LIMITED
229	RESJOS ENTERPRISES LIMITED	525	SOMKEN TECH LIMITED
230	RIPPLE MATRIX CIRCUIT SYSTEM	526	SOPHYTECH SYSTEMS LIMITED
231	RIPPLES TECHNOLOGIES LIMITED	527	SOULCO KENYA LIMITED
232	RIVER ISLAND ELECTRONICS	528	SPANS VENTURES LIMITED
233	ROBE TELEX SERVICES LIMITED	529	SPAR COMMUNICATIONS
234	ROMAG COMPANY LIMITED	530	SPECIALIZED TECHNOLOGIES LIMITED
235	ROMAN COMPANY LIMITED	531	SPECICOM TECHNOLOGIES LIMITED
236	SAAVA ENGINEERING LIMITED	532	SPECTRA LINK SOLUTIONS LIMITED
237	SAFARICOM LIMITED	533	SPECTRUM ENGINEERING LIMITED

238	SAGEMCOM KENYA LIMITED	534	SPECTRUM WIRELESS COMMUNICATIONS LIMITED
239	SAMMNET TECHNOLOGIES LIMITED	535	SPEEDWAVE LIMITED
240	SANTIQUE COMMUNICATIONS	536	THREE SIXTY VISION TECH LIMITED
241	SAURUS NETWORKS LIMITED	537	THREECS BUSINESS SOLUTIONS
242	SPHERICAL SYSTEMS LIMITED	538	THRUST BORE TECHNICS LIMITED
243	SPIRIT SYSTEMS LIMITED	539	TIBYAAN ENTERPRISE LIMITED
244	SPRING-LINE AGENCIES LIMITED	540	TIMSIM NETWORK LIMITED
245	STARHUB ENGINEERING SERVICES LIMITED	541	TIROTO CONSTRUCTION AND GENERAL ENTERPRISES LIMITED
246	STARMAX ELECTRICALS LIMITED	542	TOP CHOICE SURVEILLANCE LIMITED
247	STARSOLE TECHNICS LIMITED	543	TOROR MERCHANTS LIMITED
248	STEMINAK PREMIER TECHNOLOGIES LIMITED	544	TOUCH POINT AGENCIES LIMITED
249	STESKOM TECHNOLOGIES LIMITED	545	TOWERTECH AFRICA LIMITED
250	SUNBEAM COMPUTER SYSTEMS (EA) LIMITED	546	TRACE SHEILD LIMITED
251	SUNRAYS DATA SYSTEMS LIMITED	547	TRADE CIRCLES LIMITED
252	SUPER SERVE TECHNOLOGIES LIMITED	548	TRANSCOM TECHNOLOGIES LIMITED
253	SUPERCOM TECHNOLOGY SYSTEMS	549	TRENCHLESS TECHNOLOGIES KENYA LIMITED
254	SWIFT GLOBAL (K) LIMITED	550	TRIOPT AFRICA LIMITED
255	SYBYL KENYA LIMITED	551	TRIPPLE K SMART TECHNOLOGIES LIMITED
256	SYNCHRONISED TECHNOLOGIES EAST AFRICA LIMITED	552	TROFIX SYSTEMS
257	SYNERGY SYSTEMS E.A LIMITED	553	TROPICAL TECHNOLOGY LIMITED
258	TECHBIZ LIMITED	554	TUIOKIM CONSTRUCTION LIMITED
259	TECHMINDS TECHNOLOGIES LIMITED	555	TUKSTECH ENGINEERING LIMITED
260	TECHNICAL SUPPLIES AND SERVICES (K) LIMITED	556	TUNNELS TECHNOLOGIES LIMITED
261	TECHNOLOGY ASSOCIATES EAST AFRICA LIMITED	557	TUNYA SYSTEMS LIMITED
262	TECHNOLOGY CAPITAL MANAGEMENT	558	TWO WAY COMMUNICATIONS LIMITED
263	TECHNOLOGY STRATEGIES LIMITED	559	UBORA SYSTEMS AND SOLUTIONS LIMITED

264	TECHNOLOGY TWENTY ONE LIMITED	560	UCHUMI DEVELOPERS LIMITED
265	TECHNOPRO SOLUTIONS KENYA LIMITED	561	UNIDATA SYSTEMS LIMITED
266	TECHNOTRAC LIMITED	562	UNITEL SERVICES LIMITED
267	TECH-WORLD AFRICA LIMITED	563	UNIVERSAL TECHNOLOGY ASSOCIATES LIMITED
268	TEKNOBYTE LIMITED	564	URIIC COMPANY LIMITED
269	TELCO LIMITED	565	VALLEYPOINT TELECOMS LIMITED
270	TELEBUS COMMUNICATIONS LIMITED	566	VALUE CONNECTION SERVICES LIMITED
271	TELECOMMUNICATIONS TODAY LIMITED	567	VASTECH ENGINEERING LIMITED
272	TELEDATA TECHNOLOGIES LIMITED	568	VAYACOM LIMITED
273	TELEKEN LIMITED	569	VERITECH LIMITED
274	TELEWISE SERVICES LIMITED	570	VIBERCOM TECHNOLOGIES INTERNATIONAL LIMITED
275	TELKOM KENYA LIMITED	571	VIRTUAL ELECTRIC LIMITED
276	TERA TECHNOLOGIES LIMITED	572	VOACOM NETWORKS LIMITED
277	TERIKSSON LIMITED	573	VODACOM BUSINESS (KENYA) LIMITED
278	TEYBRIDGE LIMITED	574	WAINEER CONSTRUCTION COMPANY LIMITED
279	THE EAST AFRICAN MARINE SYSTEM LIMITED	575	WALLEX AGENCIES
280	THE KENYA POWER AND LIGHTING COMPANY LIMITED	576	ZANNA BUSINESS SYSTEMS
281	THE YELLOW FIBER AFRICA LIMITED	577	ZEALOUS ELECTRICAL ENGINEERING LIMITED
282	WANANCHI GROUP KENYA LIMITED	578	ZENIC VENTURES LIMITED
283	WANANCHI TELECOM LIMITED	579	ZODIAC LOGISTICS LIMITED
284	WASP SYSTEMS (E.A) LIMITED	580	ZTE (KENYA) LIMITED
285	WEBCO AGENCIES LIMITED	581	Nokia International oy Limited
286	WELLINGTON AFRICA LIMITED	582	Multichoice Kenya Limited
287	WEMPS TELECOMS LIMITED	583	REIME KENYA LIMITED
288	WESNET TECHNOLOGY LIMITED	584	WORLD ELECTRONICS COMPANY LIMITED
289	WESTWOOD MANAGEMENT (E.A) LIMITED	585	WYTECH TECHNOLOGIES LIMITED
290	WHITESPACE TECHNOLOGIES LIMITED	586	XEQKURE IT LIMITED
291	WIAFRICA KENYA LIMITED	587	XTRANET COMMUNICATIONS LIMITED

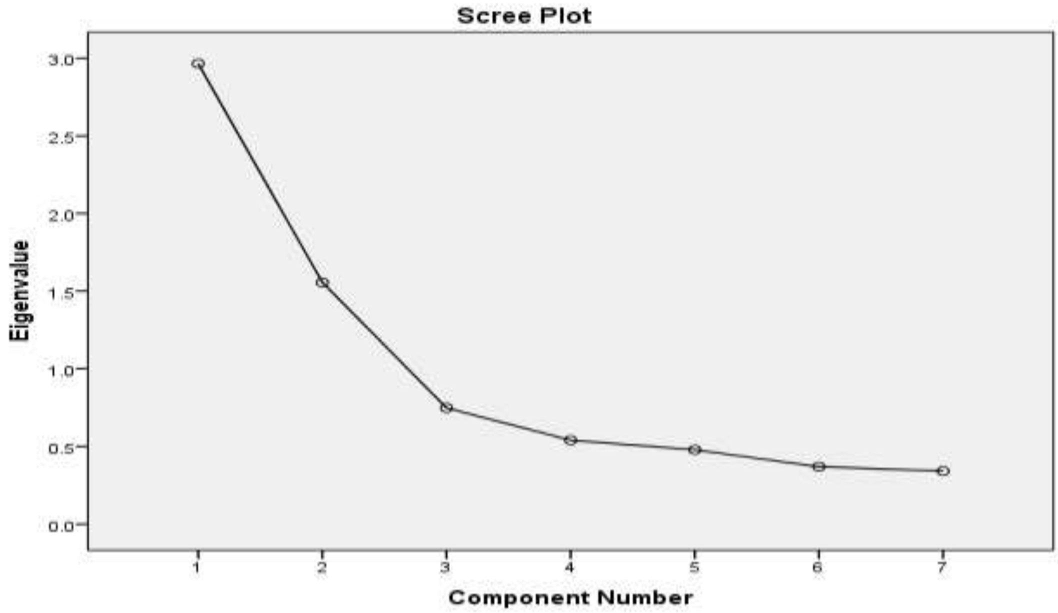
292	WIDEBYTES SOLUTIONS LIMITED	588	X-TREME ELECTRONICS LIMITED
293	WILCOM SYSTEMS LIMITED	589	YARROW CONSTRUCTION COMPANY LIMITED
294	WILHELM ENGINEERING LIMITED	590	YIELD HOLDINGS LIMITED
295	WINGS ENTERPRISE LIMITED	591	WIRELESS INTERLINK TECHNOLOGY LIMITED
296	WINSOL COMPANY LIMITED	592	WOOF ENTERPRISES LIMITED

APPENDIX 3: FACTOR ANALYSIS FOR PROJECT EFFICIENCY

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.743
Bartlett's Test of Sphericity	Approx. Chi-Square	379.219
	df	21
	Sig.	.000

	Initial	Extraction
Finished on time	1.000	.540
Finished within budget	1.000	.654
Had minimum number of agreed scope changes	1.000	.589
Activities were carried out as scheduled	1.000	.612
Deliverable met planned quality standard	1.000	.657
Complied with environmental regulations	1.000	.738
Met safety standards	1.000	.731

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.965	42.355	42.355	2.965	42.355	42.355	2.268	32.396	32.396
2	1.556	22.230	64.585	1.556	22.230	64.585	2.253	32.188	64.585
3	.749	10.693	75.278						
4	.540	7.720	82.998						
5	.479	6.838	89.836						
6	.370	5.281	95.117						
7	.342	4.883	100.000						



	Component	
	1	2
Finished on time	.537	.502
Finished within budget	.575	.569
Had minimum number of agreed scope changes	.740	.205
Activities were carried out as scheduled	.679	.389
Deliverable met planned quality standard	.687	-.430
Complied with environmental regulations	.694	-.506
Met safety standards	.620	-.589

APPENDIX 4: FACTOR ANALYSIS FOR ORGANIZATIONAL BENEFITS

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.637	
Bartlett's Test of Sphericity	Approx. Chi-Square	70.629
	df	3
	Sig.	.000

	Initial	Extraction
Lessons learnt from the project/New understanding/Knowledge gained	1.000	.665
Adherence to defined procedures	1.000	.542
End product used as planned	1.000	.558

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.765	58.819	58.819	1.765	58.819	58.819
2	.698	23.271	82.090			
3	.537	17.910	100.000			

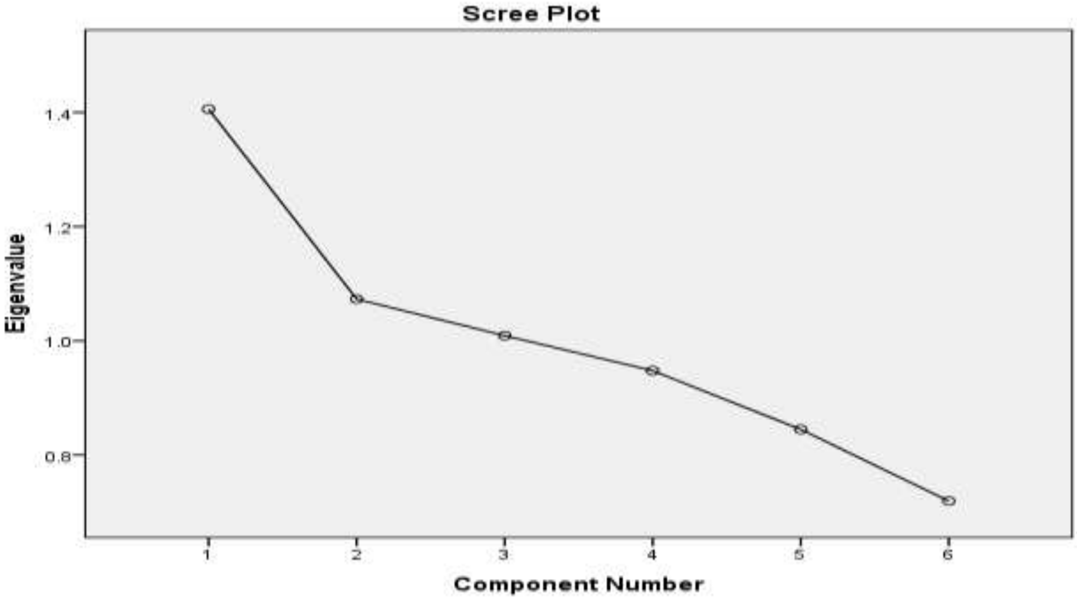
APPENDIX 5: FACTOR ANALYSIS FOR TECHNOLOGICAL COMPLEXITY

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.547
Bartlett's Test of Sphericity	Approx. Chi-Square	22.348
	df	15
	Sig.	.099

	Initial	Extraction
In my last project, the level of project goals' clarity among the project team was…	1.000	.765
The level of uncertainties in my last project scope was…	1.000	.325
The number of tasks involved in my last project were…	1.000	.530
The variety of tasks (different tasks) involved in my last project was…	1.000	.569
The number and degree of dependencies involved in my project was…	1.000	.404

The involved parties' level of experience with technology involved in my project was…	1.000	.895

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.406	23.430	23.430	1.406	23.430	23.430	1.359	22.645	22.645
2	1.073	17.885	41.315	1.073	17.885	41.315	1.113	18.558	41.203
3	1.009	16.817	58.132	1.009	16.817	58.132	1.016	16.929	58.132
4	.948	15.794	73.927						
5	.845	14.082	88.008						
6	.720	11.992	100.000						



	Component		
	1	2	3
In my last project, the level of project goals' clarity among the project team was…	.149	.840	-.191
The level of uncertainties in my last project scope was…	.472	-.103	-.304
The number of tasks involved in my last project were…	.631	.291	-.218
The variety of tasks (different tasks) involved in my last project was…	.718	-.171	.156
The number and degree of dependencies involved in my project was…	.483	-.366	.191

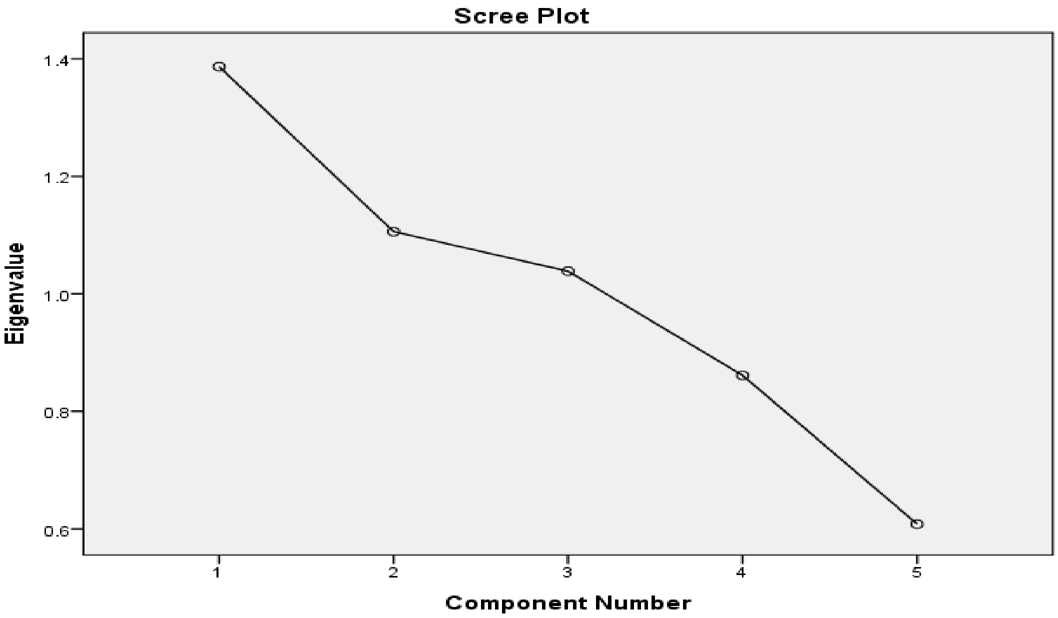
The involved parties' level of experience with technology involved in my project was…	.119	.330	.878

APPENDIX 6: FACTOR ANALYSIS FOR ORGANIZATIONAL COMPLEXITY

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.463
Bartlett's Test of Sphericity	Approx. Chi-Square	31.932
	df	10
	Sig.	.000

	Initial	Extraction
In my last project, the targeted project duration compared to industry or internal benchmarks was…	1.000	.457
The peak number of participants (Full time equivalents) involved during implementation stage of my last project was…	1.000	.698
In my last project, strong project drive for cost, quality, and schedule was…	1.000	.745
The frequency of workarounds because the personnel, material or skillset required was not available when needed to support project implementation was…	1.000	.818
In my last project, our company's level of trust in project team members including vendors was	1.000	.813

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.387	27.734	27.734	1.387	27.734	27.734	1.342	26.834	26.834
2	1.106	22.116	49.850	1.106	22.116	49.850	1.117	22.344	49.178
3	1.038	20.768	70.618	1.038	20.768	70.618	1.072	21.440	70.618
4	.861	17.222	87.840						
5	.608	12.160	100.000						



	Component		
	1	2	3
In my last project, the targeted project duration compared to industry or internal benchmarks was…	.530	.224	.356
The peak number of participants (Full time equivalents) involved during implementation stage of my last project was…	.774	.068	-.306
In my last project, strong project drive for cost, quality, and schedule was…	.665	-.547	-.059
The frequency of workarounds because the personnel, material or skillset required was not available when needed to support project implementation was…	.216	.866	-.143
In my last project, our company's level of trust in project team members including vendors was	.133	.037	.891

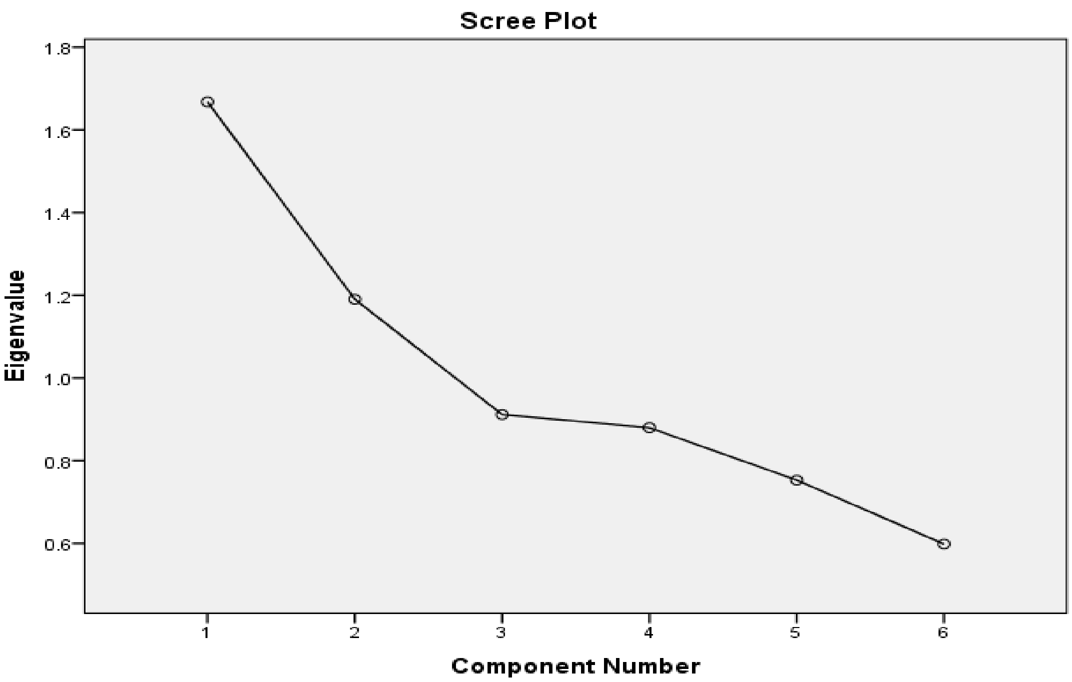
APPENDIX 7: FACTOR ANALYSIS FOR ENVIRONMENTAL COMPLEXITY

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.583
Bartlett's Test of Sphericity	Approx. Chi-Square	57.720
	df	15
	Sig.	.000

	Initial	Extraction
In my last project, presence of different perspectives from stakeholders was…	1.000	.680
The number of other stakeholders depended on for my project to progress was…	1.000	.603

The level of project support from top management and other departments/disciplines was…	1.000	.483
The urgency in realizing the project outcomes, handing over to end users, or time-to-market was…	1.000	.379
The influence of my last project on the organization’s overall success (e.g., profitability, growth, future industry position, public visibility, and internal strategic alignment) was…	1.000	.442
In my last project, the influence of market competition to project progress was…	1.000	.271

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.668	27.796	27.796	1.668	27.796	27.796	1.443	24.042	24.042
2	1.190	19.839	47.636	1.190	19.839	47.636	1.416	23.593	47.636
3	.912	15.192	62.828						
4	.879	14.657	77.485						
5	.753	12.547	90.032						
6	.598	9.968	100.000						



	Component	
	1	2
In my last project, presence of different perspectives from stakeholders was…	.601	-.565
The number of other stakeholders depended on for my project to progress was…	.620	-.467
The level of project support from top management and other departments/disciplines was…	.358	.596
The urgency in realizing the project outcomes, handing over to end users, or time-to-market was…	.556	.264
The influence of my last project on the organization's overall success (e.g., profitability, growth, future industry position, public visibility, and internal strategic alignment) was…	.472	.469
In my last project, the influence of market competition to project progress was…	.512	.093

APPENDIX 8: QUESTIONNAIRE

I. Qualification for Survey

Question: Have you managed or been a stakeholder in a recently completed project and handed over to users/customers that was considered by your organization as a complex project? *

***This question is required.**

☐Yes ☐No

II. Project Information

The following survey questions enquires about the type of project you managed.

Select the category that best represents your project.

1. My last project predominantly entailed the following (please select one)

   ☐ Information System Development

   ☐ Consulting and System Integration

   ☐ Engineering and Construction

   ☐ Research and Development

   ☐ Others (please specify) ______________________________

2. In my last project, the end users were predominantly (please select one)

   ☐ Internal users (staff within organization)

   ☐ External users (clients)

3. The total duration of my last project was

   ☐ Less than 6 months

   ☐ 6 months to less than 1 year

   ☐ 1 year to 2 years

   ☐ over 2 years

4. The value of my last project was

☐ Under $500,000.00 (or dollar equivalent)

☐ $500,000.00 to 999,999

☐ $1,000,000.00 to 4,999,999

☐ $5,000,000.00 to 50,000,000

☐ Over $50,000,000

5. The urgency to deliver my last project was:

☐ Low

☐ Medium

☐ High

III. Importance of project success criteria

6. In my last project, the following factors were important for overall project success*

***This question is required**

Project Success indicators	Not important	Moderately important	Important	Very important
1. Project Efficiency				
Finish on time				
Finish within budget				
Minimum number of agreed scope changes				
Activities carried out as scheduled				
Meet planned quality standard				
Comply with environmental regulations				
Meet safety standards				
2. Organizational benefits				
Learn from the project/ New understanding/Knowledge gained				
Adhere to defined procedures				
End product be used as planned				
The project satisfy the needs of users				

IV. Project Success Achieved

7. My last project was successful in terms of*

***This question is required**

Project Success indicators	**Not Successful**	**Slightly successful**	**Moderately successful**	**Successful**	**Highly successful**
1. Project Efficiency					
Finished on time					
Finished within budget					
Minimum number of agreed scope changes					
Activities carried out as scheduled					
Met planned quality standard					
Complied with environmental regulations					
Met safety standards					
2. Organizational benefits					
Learned from the project/ New understanding/Knowledge gained					
Adhered to defined procedures					
End product used as planned					

V. Factors contributing to project complexity

The following factors are envisaged to contribute to project complexity.

Indicate the level of impact of each factor on overall project complexity.

8. In my last project, the project was complex in terms of *

***This question is required**

	Project Complexity Factors	Low	Medium	High	Not Applicable	Highly successful
	1. Technological Complexity					
Technological complexity	In my last project, the project goals level of clarity amongst the project team was…					
Technological complexity	The level of uncertainties in my last project scope was…					
Technological complexity	The number of tasks involved in my last project was…					
Technological complexity	The variety of tasks (different tasks) involved in my last project was…					
Technological complexity	The number and degree of dependencies involved in my project was…					
Technological complexity	The involved parties' level of experience with technology involved in my project was…					

	Project Complexity Factors	Low	Medium	High	Not Applicable	Highly successful
	2. Organizational Complexity					
Organizational complexity	In my last project, the targeted project duration compared to industry or internal benchmarks was…					
Organizational complexity	The peak number of participants (Full time equivalents) involved during implementation stage of my last project was…					
Organizational complexity	In my last project, strong project drive for cost, quality, and schedule was…					
Organizational complexity	The frequency of workarounds because the personnel, material or skillset required was not available when needed to support project implementation was…					
Organizational complexity	In my last project, our company's level of trust in project team members including vendors was …					
Organizational complexity	In my last project, our company's level of trust in project team members including vendors was …					

	3. Environmental Complexity					
Environmental complexity	In my last project, presence of different perspectives from stakeholders was…					
Environmental complexity	The number of other stakeholders depended on for my project to progress was…					
Environmental complexity	The level of project support from top management and other departments/disciplines was…					
Environmental complexity	The urgency in realizing the project outcomes, handing over to end users, or time-to-market was…					
Environmental complexity	The influence of my last project on the organization's overall success (e.g., profitability, growth, future industry position, public visibility, and internal strategic alignment) was…					

VI. Project Complexity

9. In my last project, the following areas were significant in contributing to project complexity*

***This question is required**

	Project Complexity	**Not at all significant**	**Not significant**	**Moderately significant**	**Significant**	**Very significant**
1	Technological Complexity					
2	Organizational Complexity					
3	Environmental Complexity					