TIME AND COST OVERRUNS IN POWER PROJECTS IN KENYA: A CASE STUDY OF KENYA ELECTRICITY GENERATING COMPANY LIMITED

By

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DECLARATION

This management project is my original work and has not been presented for the award of any diploma or any degree in any university

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DEDICATION

Dedicated to my father, the late Mr. Jessii Kagiri who, despite all odds ensured I had an opportunity to attend school and be what I am today. To my mum, thanking her for being there to offer moral and emotional support in my life. Special dedication to my wife Anne, daughter Marjorie and my sons Kevin and Mike for being understanding during those days they had to bear with my absence.

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My appreciation goes to KenGen Management, which allowed me access to empirical data and information making the completion of the study to be realized. My great desire is to see the findings from the study used for the improvement of the company performance in project management.

The experience of interacting with lecturers and associating with fellow MBA colleagues gave me a wider perspective of the world of management and will be asset for my future.

ABSTRACT

Time and cost overruns on infrastructure development projects during implementation continue to pose great challenges to developing countries. Research has found that, there are many factors that impede on successful completion of projects on time, budget, and quality. This study sought to investigate on the factors that significantly contributed to time and cost overruns on power projects implemented by KenGen, evaluate their relative ranking, and to quantify their impacts.

The study was based on a questionnaire survey among persons drawn from contractors, consultants and KenGen, involved in the implementation of one or more of the four projects in the study. The results together with the empirical data from the three completed projects were presented.

Thirty-three variables were identified as significant in contributing to overruns. Factor analysis revealed eight underlying factors namely; contractor inabilities, improper project preparation, resource planning, interpretation of requirements, works definition, timeliness, government bureaucracy, and risk allocation as having been significant contributors to overruns. On ranking, government bureaucracy topped the list while risk allocation was shown to have been least significant. There was also a perception that these factors would recur on KenGen's future projects under similar implementation environment. The identifiable quantitative impacts of time and cost associated with the factors on the completed projects were presented together with overall time and cost overruns on the projects.

The study led to conclusions that, there were identifiable variables and underlying factors that contributed to time and cost overruns during the implementation of the four power projects. These revelations should enable planners to take stock of past performance and incorporate lessons learned on future projects planning and implementation. The variables and underlying factors have potential of recurring in future projects. Therefore, there is need to anticipate their occurrence, and to continually design appropriate

strategies and mechanisms to overcome or minimize their potential impacts. Government bureaucracy was seen to have been the lead factor in contributing to the overruns. There were time and cost overruns on all the four projects led by Olkaria II. Risk associated to these factors should continually be assessed through the various stages of the project life cycle, determined, and appropriate contingencies adopted.

LIST OF ABBREVIATIONS

AfDB	-	African Development Bank
CIDA	-	Canadian International Development Authority
EIB	-	European Investment Bank
FY	-	Financial Year
GDP	-	Gross Domestic Product
GoK	-	Government of Kenya
IBRD	-	International Bank for Reconstruction and Development
IDA	-	International Development Association
IFC	-	International Finance Corporation
JBIC	-	Japanese Bank for International Co-operation
KenGen	-	Kenya Electricity Generating Company Limited
KfW	-	Kredintsatalt für Weidraufbau (of Germany)
KPLC	-	The Kenya Power & Lighting Company Limited
LCNPDP	-	Least Cost National Power Development Plan
MoE	-	Ministry of Energy
ODA	-	Overseas Development Administration (UK)
USD	-	United States Dollar

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CHAPTER ONE: INTRODUCTION

1.1 Background

Individuals, private firms or public entities are continually engaging in acquisition of physical assets in various forms such as, residential, commercial buildings, hospital, schools/institutions, development infrastructure like water, roads, electricity and telecommunication. These assets represent major capital investment motivated by market demands or perceived needs (Hendrickson and Au, 1999).

To remain competitive in profit or non-profit engagements, these entities focus on processes and procedures that offer value and competitive advantage. Understanding the customer needs and appropriately deploying the available resources in meeting customer expectations offer competitive edge over competitors in product and service provision. Thus efficient and effective resource management through appropriate use of tools and techniques in asset acquisition is critical. Customers are demanding for better quality product through efficient and timely deliveries at low price. It is therefore important, that time, cost, and quality of constructed facilities are efficiently managed for effective service or product delivery. The end result will be a satisfied customer, wealth realization, growth, and sustainability to the owner.

Many projects are identified by these entities, planned and implemented. However, many are unable to meet their time, cost and quality objectives. Time and cost overruns during the projects implementation either lead these facilities to their complete failure by becoming financially and economically unsustainable or fail to meet market requirements. Carruthers et al. (2003) argue that, it is cost and financial viability that make a project feasible. This study focused on time and cost, as key variables determining project success largely dependent on other competing factors/variables existing in the project environment. Oladapo, Pearce and Robinson (2001; 1994) identified political, social/cultural, technological/infrastructure, financial/economic, legal, and institutional as broad factors within the project environment that may impede on their performance. Oladapo (2001) observed that, analysis of the key elements of the environment could provide a basis of establishing reasonable project objectives and also give an early warning of potential problems. Clients who initiate projects must put in place appropriate management, organisational structures, systems, and procedures for overcoming the effects of the environment.

Delays and cost overruns in public sector investments can raise the capital-output ratio in the sector and elsewhere bringing down the efficacy of investments (Morris, 1990). Thus, successful management of processes employed in acquisition of these assets is to a large extent, determined by the amount of resources expended, time taken and quality when compared to similar projects. Infrastructure includes the capital required to produce economic services from utilities (like electricity, telecommunication, and water) and transport (roads, bridges, seaport, and airports) and is central to promoting economic activity (Chandra, 2002).

The Kenyan power system has an installed generation capacity of about 1,211 MW including 30 MW imported from Uganda, on non-firm basis with an effective capacity of 988 MW. The bulk of this capacity is hydro- based (70 per cent) while the rest is supplied from oil-fired plant and geothermal (GoK, 2003). The 1996 liberalization of power generation, as part of power sector reform, saw the entrance of Independent Power Producers (IPPs) who contribute 173.5 MW to the national grid (KPLC, 2004).

The transmission network comprises of 941 km of 220kV lines, 2032 km of 132 kV lines and 580 km of 66 kV lines. The bulk of the distribution network is 11 kV lines comprising 13,788 km, followed by 5265 km of 33kV lines (GoK, 2003).

Electrical consumption is relatively low at about 121kWh per capita. Overall, only 4 per cent of rural and 46 per cent of urban households have access to electricity, equivalent to a national average of 15 per cent (GoK, 2003; 2004). This level of national penetration is very low relative to an average of 32 per cent for developing countries (GoK, 2004).

Demand for electricity in Kenya was projected to grow from 5,026GWh in FY 2003/04 to 9,542GWh in the FY 2013/14, representing an annual growth rate of 5.4 per cent. This translated into about 1,585 MW peak demand by 2013/14, from about 831 MW in FY 2003/04, corresponding to an effective capacity of about 1,831 MW. The projected high growth in demand was based on annual GDP growth of 6 per cent from 2005 (GoK, 2004). The rapid growth in the demand of electricity require new investment in capacity, efficient management of the existing facilities and upgrade of the aging ones. These require huge investments of capital by both the public and private sector.

In Kenya, public sector projects are identified, planned, and implemented by the government ministries or their implementing agencies in state corporations. The aims of these projects are to improve the country's infrastructure like health, communication networks, housing, energy, and water. Hence, expeditious implementation to realize the desired benefits to their users is important. However, in Kenya, it is a well-known fact that time and cost overruns are widely prevalent in the public sector projects (Mwandali 1996, Talukhaba 1988, Karimi 1998, and Musa 1999). Their findings showed that, poor communication, lack of experience by project manager, procurement delays, lack of planning, poor infrastructure, inadequate resources, lack of motivation, tendering methods, variations, project environment, poor project definition as being some of the major contributors to time and cost overruns.

Similar observations have been made in developing countries like Indonesia (Kaming et al. 1997), Labanon (Mezher and Tawil, 1998), India (Morris,1990; Pillai and Kannan, 2001), Nigeria (Mansfield et al. 1994), Vietnam (Long et al. 2004), Nepal (Manavazhi and Adhikari, 2002), and Nigeria (Aibinu and Jagboro, 2002). Thailand as a fast growing economy has not been spared of overruns (Ogunlana and Promkuntong, 1996). Various factors for overruns in Saudi Arabia were identified by Assaf et al. 1995, and in Ghana (Frimpong et al. 2003). Factors ranging from inflation, project complexity, inaccurate material estimation, financing, change orders, design changes, late submission of drawing, poor specification, incorrect site information, poor contract management among many others were found to be main sources of overruns.

Studies that have been conducted in developed economies like Hong Kong (Kumararswamy and Chan, 1997; 1998), UK/USA/Australia (Ireland, 1987), Florida (Ahmed et al. 2002), Australia (Ireland, 1985) revealed a trail of time and cost overruns on building and infrastructure projects in public and private sector, attributable to numerous factors that come into play during the projects implementation. Ahmed et al. (2002) identified these factors and grouped them into six categories namely; acts of God, design related, financial/economical, construction related, management and administration, and code related. Long et al. (2004) subjectively divided them into organizational, project attributes-related, coordination related and environmental problems. Chan and Kumaraswamy (1997; 1998) grouped them into eight factor categories; project related, contractor related, client related, design team related, material related, labour related, plant and equipment related, and external factors. Similar groupings were identified by Ogunlana et al. (1996).

Electricity is a primary factor of development and should therefore be harnessed, and developed in an efficient manner. It should also be available in adequate quantity, quality and affordable prices. The low access to this commodity to large population of Kenyan and high prices has resulted to dependence on indigenous and traditional energy sources like wood and charcoal (GoK, 2003). This, in turn, has led to depletion of forest resources and significant environmental damages. The lack of adequate, dependable, and competitively priced power naturally hampers the productivity and competitiveness of our industries in the region and global markets.

Time, scope, and cost management of processes associated to electricity harnessing, transmission to market and distribution to consumers is essential. These processes can be designed and managed through provision of adequate legal and institutional framework, project life cycle management and participation of the private sector. As Kannan and Pillai (2001) argue, timely completion of projects could avoid the substantial burden of capital cost escalation.

Since the middle of the 1990s, the Government with help of the World Bank has been undertaking legal and institutional reforms in the power sector to make it more responsive to market imperatives like demand growth, quality, pricing, generation mix, transmission, distribution, and financing for future development program (GoK, 2003). These reforms led to the separation of generation functions from those of transmission and distribution, and creation of a regulatory board for the sector.

KenGen is a Government of Kenya appointed agent under the Ministry of Energy responsible for the implementation of power plant projects under the LCNPDP and operation of the existing power stations across the country.

The financing of new developments in the power sub-sector is by the GoK through KenGen and KPLC, bilateral and multi-lateral agencies. The main agencies are IDA, KfW, ODA, EIB, CIDA, IBRD, AfDB, IFC and JBIC.

The current annual demand growth for electric power stands at 6 per cent (GoK, 2004). This translates to approximately 60 MW of additional capacity annually. This capacity takes care of retiring units and the aging of the existing ones. Typical installation cost of 1.0 MW of diesel plant is approximately USD 1.0 Million while that for a geothermal plant is slightly over USD 2.1 Million. The GoK, KPLC and KenGen are not capable of mobilizing the capital required to meet the growth in demand. Hence, they will continue to rely on bilateral and multi-lateral agencies in accessing funds to undertake expansion. Alternatively, with the liberalization of the sector and the reforms in the economy, private sector will increasingly have to play a vital role in meeting the shortfall. Currently, four IPPs are operating in the country.

This study focuses on time and cost, as key variables determining project success largely dependent on other competing factors/variables existing in the project environment.

1.2 The Problem Statement

The Government and its development partners continue to allocate huge financial resources to finance infrastructure development in Kenya. However, the intended benefits are partly or never realized due to unsuccessful project implementation (Morris 1990, Joy 1994).

Specific research undertaken to investigate what ails implementation of projects in other public sector projects in Kenya, provide an insight to what has been the major causes of projects time and cost overruns, failure to meet specifications and stakeholders expectations. Musa (1999) conducted a study on factors influencing delays in water projects in Kenya funded by the Government. A similar study by Karimi (1998) focussed on factors contributing to cost overruns in projects under the Ministry of Water. Talukhaba (1988) investigated on time and cost performance of construction projects. Mwandali (1996) did an analysis of major factors that affect project management in Kenya Railway projects.

There are no studies that have been conducted in Kenya to try and document the success or failure of public power projects to meet time and cost targets, neither are studies available for the few independent private power plants. Pillai and Kannan (2001) conducted a study on time and cost overruns of the power projects in Kerala, India. Table 1.1 represents a sample of two out of the four projects in the study. It is evident that there exists significant variance in time and cost during the projects implementation.

Table 1.1 Time and cost variance during implementation

Project Name	Original Competion Estimate		Actual Completion	Variance
Kipevu I	JPYen(Billion)	6.476	7.237	13%
	Ksh(millions)	557	592	6%
	Time (month)	22	22	-
Olkaria II	US$ (millions)	144.2	185.1	28.3%
	Time (months)	26	40	53.4%

Source: KenGen

Time and cost overruns in public power projects implemented by KenGen are a matter of public interest and all stakeholders. To be able to respond to internal and external variables in a project environment that led to overruns in implementation of the power projects, it was instructive to investigate and understand how and to what extent these factors contributed to delays and costs increases. To identify the reasons for delay and cost overruns, a survey was conducted on KenGen power projects. The research attempted to answer the following question; what factors significantly contributed to time and costs overruns in power projects implemented by KenGen on behalf of the Government of Kenya?

1.3 Research Objectives

The research objectives were threefold, namely:

(i) To identify factors that significantly contributed to time and costs overruns in public power projects;

(ii) To establish the relative importance of these factors; and

(iii) To quantify the time and costs associated with the significant factors.

1.4 Importance of the study

The results of this study will significantly contribute in:

(i) KenGen's management understanding of internal and external factors that contribute to overruns, and appropriately put measures in place to minimize their effect during future project implementation;

(ii) Creating awareness to other Government agencies on some of the significant factors they would possibly encounter in similar public projects; and

(iii) Documenting salient information that will be useful for future reference by researchers, construction industry and other stakeholders.

CHAPTER TWO: LITERATURE REVIEW

2.1 Project and project management

Harrison (1999) considered a project as a series of activities and tasks that have a specific object to be completed within certain specifications, have a defined start and an end dates, have funding limits (if applicable), and consume resources (i.e. money, people's time, equipment). Kerzener (2001), added a fifth dimension that the project, be multidimensional (i.e. cuts across several functional lines) while Joy (1994) added the dimension of project meeting owner's social responsibility.

Projects by their very nature have a characteristic life cycle, and thus the organization of a project tends to be subject to change as it passes through this cycle. Carruthers et al. (2003), see the project cycle phases differing from one industry to another. Kerzener (2001) applied the theoretical definitions of the life cycle and identified the following five phases; conceptual, planning, testing, implementation and closure. Essentially, a project is conceived to meet market demands or perceived needs in timely fashion.

Project management is the application of knowledge, skills, tools, and techniques to projects' activities in order to meet stakeholder needs and expectations from a project (Kerzener, 2001; Duncan, 1996). The chief aim of project management is project success, with reference to time, cost and quality. It is an integrated multidisciplinary function aimed at achieving success through proper planning, organizing, execution and control. In planning, there is definition of work requirements, quality of work and quantity, and the resources required for its successive execution. Project monitoring essentially involves tracking progress, comparing actual outcome to predicted outcome, analyzing impact, and making adjustments (Kerzener, 2001). The implementation phase essentially integrates the project's product or services into the existing organization. Joy (1994) introduced the concept of total project management as the whole process of creating a productive wealth or a fixed asset, capable of producing goods or generating services. Jugdev (2004) proposes the examination of project management with the Resource-Based View lens to be able to develop a clear picture of the characteristics of project management that contribute to a competitive advantage and better understanding of connection between project management and strategy.

Alternatively, Ireland (1985) saw project management as a separate procurement method when a project manager is appointed as the person responsible for managing the design and construction phases.

2.2 The Project Team

A Project team is usually a total function of an aggressive team or a task force consisting of members drawn from various functional specialist departments of the project owner led by a mature multidisciplinary generalist (Joy, 1994). The success of a project is largely dependent on the project team. The team's composition, organisational structure, expertise, and commitment to project success are very important aspects. The understanding of barriers to project team building can help in developing an environment conducive to effective team. Kerzener (2001) identified barriers to include; differing outlook, priorities and interests, role conflicts, project objectives/outcomes not clear, dynamic project environment, team personnel, leadership among others. In the management of projects, the organization subsystem establishes the pattern of interrelationships, authority, and responsibility between contributors, who are usually interdependent firms, to achieve client objectives (Oladapo, 2001).

2.3 Project Environment

Maylor (1999) asserted, that the change in competitive environment in which majority of organisations operates has necessitated a major rethink of the way in which projects are managed. Oladapo, Pearce and Robinson (2001; 1994) identified political, social/cultural, technological/infrastructure, financial/economic, legal, and institutional as broad factors within the project environment that may impede on their performance. Oladapo (2001) observed that, analysis of the key elements of the environment could provide a basis of establishing reasonable project objectives and also give an early warning of potential problems. Clients who initiate projects must put in place appropriate management, organisational structures, systems, and procedures for overcoming the effects of the environment.

2.4 Project Cost Management

The management of costs in a project is a common thread that runs through the entire life cycle of any project. Carruthers et al. (2003) argued that, it is cost and financial viability that make a project feasible and the project is not complete until the last payment and paper work is completed. Project cost management includes the processes required to ensure that the project is completed within the approved budget. The main processes are resource planning, cost estimating, cost budgeting and cost control (Duncan, 1996). A project costing system should yield accurate and timely cost information at the required level of detail, thus enabling the project manager to evaluate the trade-offs when making decisions on issues affecting schedule and performance (Cleland, 1998). The outcome of cost, quality and schedule define or determine the success of a project. Carruthers et al. and Oladapo (2003, 2001)) identified other factors, which influence cost during a project as being: the project contract, cost engineering, risk and contingency, availability of funds and cash flow, organizational arrangement and escalation. Mashayekhi (2000) presented a theory of cost and time overrun based on project cost structure. He argued that for a development project, *Base cost* keeps a project ready for physical progress while *progress cost* creates real physical progress on the project. He concluded that this cost structure has an important inherent dynamic characteristic with implications for the efficiency and effectiveness of project management.

Horman modeled the effects of lean capacity strategies on project performance. The modeling result showed that the best result achieved were a 40% reduction in project delivery time and 10% reduction in project costs. He argued that using additional capacity to prepare work assignments and to respond to problems that arise can reduce levels of waste and improve project performance. Adding resources increases costs, but the reduced waste that results shortens delivery time and lowers costs. The figure 1 shows what constitutes time and cost overruns and wastes as proposed by Horman.

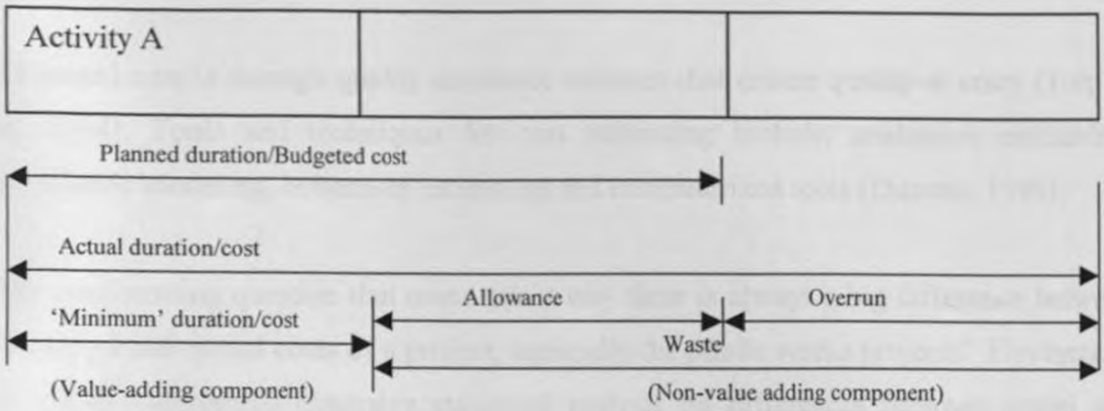


Figure 1.1: Connecting planned duration/budget and overruns

The cost overrun is the excess cost over and above the planned costs to complete the project. The planned cost includes the value adding component plus the allowance or the contingency.

2.5 Estimating Initial Cost of a Project

The process of cost estimation starts by asking the questions: what is the scope of the project? What are the essential components in each phase of the project and their corresponding activities? What level of accuracy is desirable for the estimate? What is an appropriate contingency to apply to capital estimate? Who should prepare the cost estimate? One of the most important assignments is cost planning and cost estimation of a project. Cost planning occurs before design begins and relies on historical or standard industry data to predict the project probable cost. It answers the question, "within what range will the project budget fall after the project is fully designed?" On the other hand, cost estimating refines the probable project cost from drawings and specifications. The process of cost planning and estimation is similar in any project. The variation in approach occurs due to number of items or activities considered, largely dependent on the size and complexity of a project. Ronai (2001) considers, basic material costs, design engineering, production engineering, production, assembly and construction activities, manufacturing, testing, labour allowances, supervision, direct management, and other direct charges to be the key variables in deriving costs estimates in transport infrastructure projects. The overhead, general and administrative expenses, and profit are usually added to costs as a percentage of direct project costs. Mitigation in variance to estimated cost is through quality assurance schemes that ensure quality-at entry (Torp et al. 2004). Tools and techniques for cost estimating include; analogous estimating, parametric modeling, bottom-up estimating and computerized tools (Duncan, 1996).

The confounding question that many ask is why there is always a big difference between estimated and actual costs of a project, especially the public works projects? Flyvbjerg et al. (2002) conducted extensive statistical analysis on differences between actual and estimated costs in 258 public transport infrastructure projects. Among the significant findings from this study were: in 9 out of 10 transportation infrastructure projects, costs were underestimated, cost underestimation appeared to be a global phenomenon, cost underestimation could not be explained by error and it seemed to be best explained by strategic misrepresentation, i.e., lying, and transportation infrastructure projects did not appear to be more prone to cost underestimation than are other types of large projects.

2.6 Project Time Estimation and Time Overrun

Time is one of the variables to be managed for successful completion of a project. The planned project completion time (Figure 1.1) is determined and fixed by the client. This is the time the client estimates the contractor/s to use to programme and cost its resources for the entire project after commencement of the contract. Time estimation involves the following processes: activity definition, sequencing, duration estimating, schedule development and control. Each of this process calls for certain inputs, require different tools and techniques to manage and generates outputs (Duncan, 1996). These processes interact and overlap with each other and each occurs at least once in every project phase. Hardie (2001) in his paper on the prediction and control of project duration claims that, recursive model would be more appropriate for planning and control of project overruns as opposed to the current planning systems such PERT. He concludes that the application of Markov chain analysis to project planning, which takes account of loops back to earlier activities during the course of a project, provides a more realistic model of how actual projects behave. Mashayekhi (2000) presented a theory to explain cost and time overruns of development projects. The paper showed that, the imbalances between the number of projects and available resources cause an increasing inefficiency and ineffectiveness regardless of the quality of management at the project level. The basic model he proposed showed how, under certain assumptions, imbalances between available and desired resources could create an exponential growth in completion cost and time in an environment without inflation and with perfect project management.

Bromilow et al. (1988) derived an empirical relation between "the average " construction time (T) and project cost (C) in the building construction industry in Australia. The relationship was described by the equation:

$$T = K\, C^{B}$$

Where:

T = duration of construction period in working days from date of possession of site to practical completion.

C = final cost of project in millions of dollars, adjusted to constant labour and material prices.

K = a constant describing the general level of time performance for a $ 1 million project and

B = a constant describing how the time performance was affected by project size as measured by cost.

Chan and Kumaraswamy (2002) developed construction time prediction models for three different types of construction buildings in Hong Kong. They were limited to provision of first-order approximation of duration estimates for the purposes of planning and tender document preparations. In any project, detailed construction programmes need to be prepared and analyzed using advanced/available programming computer softwares' such as Primavera Project Planner (P3) and Microsoft Project 2000.

2.7 Defining Success of a Project

Kerzener (2001) identified eight dimensions for defining successful projects. This included completion within the allocated time period and the budgeted cost, specification level, acceptance by customer/user/stakeholders, when you use the customer's name as reference, with minimum or mutually agreed upon scope changes, without disturbing the main work flow of the organisation and without changing the corporate culture. Torp et al. (2004) found that project organisation, contract management, project planning and controlling, and stakeholder management to be highly associated with critical success factors for project performance. Kwak (2002) classified into ten broad categories, factors that had to be taken into consideration in a conceptual framework for international development project management. These covered issues of politics, legal, culture, technical, managerial, economical, environmental, social, corruption, and physical. Dvir et al. (2003) contended that, success is more than achievement of planned time, cost and performance goals. They argued that these variables may be met but the projects turn out to be complete failures because they fail to produce actual benefits to the customer or adequate revenue and profit for the performing organisation. However, they found a significant positive relationship between the amount of effort invested in defining goals of the project (planning) and the functional requirements and technical specification of the product on one hand and project success on the other, especially in the eyes of the end user.

Project stakeholders are individuals and organisations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion. The ability of stakeholders to influence the final characteristic of a project product and the final cost of the project is highest at the start and gets progressively lower as the project continues (Carruthers et al, 2003). Conflicting interest among stakeholders, if not resolved early in the early stages of the project normally cause problems later. The uncertainties inherent in projects make project management very complex. Uncertainties should be eliminated in the minds of all stakeholders involved in the exact objectives or scope of the project.

2.8 Need for Development of Public Projects

The objective of undertaking improvement or addition of capacity for development (infrastructure) projects is to sustain the demand in economic growth in all sectors of an economy. Thus successful management of processes employed in acquisition of these assets is to a large extent, determined by the amount of resources expended, time taken and quality when compared to similar projects. Infrastructure includes the capital required to produce economic services from utilities (like electricity, telecommunication, and water) and transport (roads, bridges, seaport, and airports) and is central to promoting economic activity (Chandra, 2002). It is common knowledge that a country's economic development is achieved through various industrial and infrastructural development projects and that industrial growth depends on the country infrastructure (Joy, 1994). Good infrastructure helps in providing economic competitiveness, and supports high productivity. Poor infrastructure on the other hand, impedes economic growth and can be seriously detrimental to the efficient use of scarce resources (Chandra, 2002). Infrastructural projects are capital intensive and also characterized with huge sunk costs and have long operating life. The acquisition of a constructed facility usually represents a major capital investment, whether its owner happens to be an individual, a private corporation or a public agency. Since the commitment of resources for such an investment is driven by market demands or perceived needs, the facility is expected to satisfy certain objectives within the constraints specified by the owner and relevant regulations (Hendrickson and Au, 1999).

In many instances however, many development projects are hardly completed with the allocated budget, time and specification. Many factors contribute to these undesired outcomes; many of which are within the control of those managing the projects.

2.9 Previous Studies on Time and Cost Overruns

2.9.1 Developing Countries

Kaming et al. (1997) studied on the factors influencing construction time and cost overruns on high-rise projects in Indonesia and identified inflationary increase in material cost, inaccurate material estimating and project complexity to be the main causes of cost overruns while the predominant causes of delay were design changes, poor labour productivity and inadequate planning. Mezher and Tawil (1998) paper on causes of delays in the construction industry in Lebanon revealed 64 causes of delay which they grouped into ten categories: materials, manpower, equipment, financing, changes, government relations, project management, site conditions, environment and contractual relationships. In their findings, the most important delay factors as perceived by the owner were financing and scheduling by contractors. According to contractors, important delay factors were contractual relationships and design changes by the owner while the engineer considered project management and rated shop drawing to be the most significant factors. Odeh and Battaineh (2002) studied on causes of delays in construction projects with traditional type contracts in Jordan from the viewpoint of contractors and consultants.

Mansfield et al. (1994) studied the causes of delay and cost overruns in Nigeria's construction projects. Their results showed that financing and payment arrangement, poor contract management, material shortages, inaccurate estimating and the overall price fluctuation to be the most important factors. Long et al. (2004) looked at problems of large construction projects in Vietnam by grouping them under five major factors: incompetent designers/contractors, poor estimation and change management, social technological issues, site related issues, and improper techniques and tools. Manavazhi and Adhikari (2002) studied on material and equipment procurement in highway projects in Nepal. The study showed the main causes of procurement delay to be (in rank order) organizational weakness, suppliers defaults, government regulations and transportation delays.

In Nigeria, Aibinu and Jagboro (2002) undertook a study on the effects of construction delays on project delivery on 61 building projects. Six effects on project delivery identified were: time overrun, cost overrun, dispute, arbitration, total abandonment and litigation. Ogunlana et al. (1996) conducted a survey on high-rise residential, hospital, and academic buildings in Thailand to determine whether there were special problems that generate delays for construction in developing economies. Results of their study supported the view that construction industry problems in developing economies could be nested in three layers:

(a) problems of shortages or inadequacies in industry infrastructure (mainly supply of resources);

(b) problems caused by clients and consultants and

(c) problems caused by contractor incompetence/inadequacies.

From the study 26 main factors were identified. They grouped the sources of delays into six categories associated to owners, designers, construction manager or inspectors, contractors, resource suppliers and others. Assaf et al. (1995) in similar study in Saudi Arabia identified 56 factors which they grouped into nine major areas: materials, manpower, equipment, financing, environment, changes, government relations, contractual relationships, and scheduling and controlling techniques.

Hsieh et al. (2004) undertook statistical analysis of change orders in metropolitan public works by studying change orders in 90 public works projects in Taiwan. From the study, the causes of change orders could be divided into two main dimensions i.e. "technical" and "administrative". In the technical dimension, there were four types of causes, namely, planning and design, underground conditions, safety considerations and natural incidents. In administrative dimension there was, changes of work rules/regulations, changes of decision-making authority, special needs for project commissioning and ownership transfer, and neighborhood pleading. Frimpong et al. (2003) studied on causes of delay and cost overruns in construction of groundwater projects in Ghana. The result revealed that, out of the 26 factors used in the survey, the main causes of delay and cost overruns included: monthly payment difficulties from agencies; poor contractor management; material procurement; poor technical performances, and escalation of material prices.

In citing cost and time overrun in India, Joy (1994) identifies overruns of upto 1382 percent in some of the projects. While assessing overruns in public sector Mega projects ongoing in India in 1991, out of the 27 projects, 16 of these were in the power sector. The cost overruns ranged between 2 to 10 times, while time delays in construction ranged from 1 to 7 years with possibility of further overruns (Joy, 1994). Pillai and Kannan (2001) paper on time and cost overruns in 16 power projects in Kerala, concluded that these over-run are borne out of inefficiency of management coupled with political economy of vicious rent seeking. Other causative behind the delays were: changes in the technical designs and feasibility reports, original cost estimates being based on inadequate or incomplete data and unrealistic assumptions, inefficient management, inadequate geological and technical investigations of the project at the outset, vague and ambiguous specifications and conditions of contract, sluggish decision making at various stages of construction, lack of availability of material or of transportation facilities, infighting and ego clashes among different groups of the bureaucracy and technocracy of State utility Board, unwarranted transfer of planning and supervisory staff between projects during their construction, and lack of vision about the power needs of the state.

Kholi (2001) argued that, some projects become uneconomical due to time and cost overruns. He contended that the resource requirement for ongoing projects increase considerably, leaving very little for new projects to start. He associates these overruns to inadequate formulation, lack of proper implementation planning and poor management of implementation. For public sector enterprises, Morris (1990) saw the political expediency to take up large number of projects and short fund them all, as perhaps the most important factor for overruns.

2.9.2 Developed Countries

Ireland (1985) undertook an analysis of the effects of managerial actions on the objectives of reducing time, reducing cost and increasing quality by studying a sample of 25 high-rise office buildings in Australia. Increases in construction planning design and co-ordination across the design-construction interface were shown to have very strong effects on reducing construction time and increases in the cost variable. On the other hand, increases in variations to the contract, the complexity of the building, the number of storeys and the extent of industrial disputes were shown to strongly increase construction time. At the same time, increasing variations to the contract, the architectural quality, and the number of nominated sub-contractors increases the building cost.

Ahmed et al. (2000) conducted an empirical study on construction delays in Florida USA. Their survey identified the critical causes of delay based on the chance of occurrence.

Ireland (1987) did a comparison of U.S., U.K. and Australia management practices with special reference to lost time. Factors such as increment weather, organization of labour, safety, prices of material, contract strategy, quality, protection of public, value management, dispute resolution procedures were selected for the study. Chan and Kumaraswamy (1997) undertook a comparative study of causes of time overruns in Hong Kong construction projects and those in Saudi Arabia and Nigeria using 83 previously identified factors, which were grouped into eight major categories namely: project-related, client-related, design-related, contractor-related, material factors, and labour factors. The main reasons for delays were analyzed and ranked according to different groups classified on the basis of the role of the parties in the local industry (i.e. whether clients, consultants or contractors) and the type of projects. The study showed that poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client-initiated variations and necessary variation of works to be the principal and common causes of delays. Kumaraswamy and Chan (1998) extended their study using the previous study data to investigate the perception of the relative significance of factors between clients, consultants and contractors.

Flyvbjerg et al. (2004), in their study on transport infrastructure, found that cost overrun were dependent on the length of the project implementation phase, the size of the project, and the type of the project ownership. Other important findings were that cost escalation appeared to be more pronounced in developing countries than in North America and Europe; and cost escalation has not decreased over the past 70 years. Flyvbjerg et al. (2003) performed a statistical study of cost performance in transport infrastructure projects covering 258 projects in 20 nations. The paper showed with overwhelming statistical significance that in terms of costs, transport infrastructure projects do not perform as promised. This applied to different project types, geographical regions, and different historical periods.

2.9.3 Kenya

Mwandali (1996), in a study to analyze the factors that affected management of projects at Kenya Railway, found that poor communication, little experience of project manager, late procurement of equipment, lack of training for the project managers, ineffective monitoring and controlling systems, lack of personnel motivation, and slow project selection methods to have negatively affected efficiency in project management.

Karimi (1998) studied on factors contributing to the cost overrun in Ministry of Water. The objectives of the study were two-fold; identify factors, which contributed to cost overrun and to determine which of these factors were critical to project cost overrun. Secondly, to identify what needed to be done in light of the critical factors to minimize cost overrun. Her study revealed five factors which contributed to cost overruns. These were project organization, environment, project management, project definition, and infrastructure.

Musa (1999) conducted a case study on factors influencing delays in water projects in Ministry of Water Resources for government-funded project. His findings revealed that quality of project management, operating environment, motivation of workers, infrastructure, inadequate resources and the organization of the project team constituted the main factors that influence project implementation in this ministry.

Talukhaba (1988) studied on time and cost overrun in construction projects in Kenya. The results demonstrated that time performance was the poorest, whereby about 70 percent of projects initiated had a chance of overrunning in time with a magnitude of up to about 53.3 percent as compared to the chance that about 53.7 percent can overrun in cost with the magnitude of about 20.7 percent. Tendering methods, variations and delayed payments were found to be significant factors in project performance.

CHAPTER THREE:RESEARCH METHODOGY

3.1 Research Design

The research was a multiple case study design. It was intended for development of detailed, intensive knowledge on the few cases of power plant development projects. The projects were procured, implemented, and financed through similar processes but experienced different time and cost performance during implementation. The case study approach has considered ability to generate answers to the "why?" perspective (Saunders et al., 2000).

The study considered four public sector power projects undertaken by KenGen in the last fifteen years through purposive sampling. Projects prior to this period were implemented by other government agencies. Their implementation records, data, and information were not easily available. For the planned survey, it would have been almost impossible to reach client, contractor, and consultant personnel involved in these projects. Hence they were left out of the study. The project details are presented in Table 3.1 below.

Table 3. 1: Power projects implemented by KenGen

Project Title	Capacity (MW)	Current status
Kipevu I Diesel Plant	75	Completed (1999)
Gitaru Unit 1 Hydro plant	81	Completed (1999)
Olkaria II Geothermal plant	70	Completed (2003)
Sondu Miriu Hydro plant	60	Under construction

Source: KenGen

3.2 The Sample

The projects sample encompassed the portfolio of generation modes that KenGen has been developing and operating in hydro-power, thermal and geothermal. The sample was small and was not intentional. This was due to the nature of projects in this part of the world. The demand for their development is small and they take long to plan and implement thus limiting the availability of a large sample that could be subjected to rigorous statistical analysis. Records and data are also not easily accessible. Reconstructing the total costs of a public project typically entails long and difficult archival work and complex accounting (Flyvbjerg et al., 2003). For the selected projects, (see Appendix III) the costs record and information necessary to facilitate this study were available and accessible in KenGen. The survey sample of respondents was also purposive to meet the objectives of the study. Fifty-four respondents were nominated.

3.3 Data Collection

The research employed both primary and secondary data.

3.3.1 Primary Data

The primary data collection was through a self-administered survey questionnaire. The preliminary data in the questionnaire was collected through detailed literature review. The literature review was done through books, Internet, conference proceedings, research thesis, leading construction management and engineering journals. The questionnaire was pilot tested using four individuals experts in construction and management of projects. The final form was e-mailed to all the 54 nominated respondents who included project consultants/specialists, KenGen personnel (managers and engineers), and contractor personnel involved on the projects at senior level. The data was collected in a period of six weeks.

The questionnaire comprised of three parts. Part A sought to capture the general particulars of the respondents. Part B focused on the 50 factors (independent variables) identified as causes of overruns from literature review. This part gave each respondent an opportunity to identify variables that they perceive to have contributed to overruns by responding on a Likert scale from 4 (very important) to 1 (not important). The respondents were also to rate the frequency of the likely occurrence for each variable on a similar KenGen project on an ordinal scale: high (3), medium (2) or low (1). Part C allowed the respondent to identify and rank other factors not included in Part B, which they considered to have had significant impact on overruns. The results of Parts B and C assisted in investigating the research questions and fulfillment of objectives 1 and 2.

3.3.2 Secondary Data

The secondary data comprised of information in the form of contract documents, claims documents, monthly, annual and project completion reports, expenditure spreadsheets and tables capturing data on progress payments, and works progress schedules. The data and information was recorded on continuous basis and collated at defined periods for monitoring, control, and reporting. The monitoring, control and reporting was against established baselines. Table 3.2 depicts how information was gathered from the above sources. The secondary data was used in quantifying the time and cost overruns.

Table 3. 2: Information and its source

Document type	**Information sought**
Contract document	Original contract price, contract schedule, contract terms
Monthly, annual, and completion report, project memos	Scope changes, delays and their causes, cost increases and their causes, final contract value, overall construction schedule, cost of claims, instructions to contractors etc
Claims documents	Basis of claims

3.4 Data Analysis

Part A of the questionnaire was analyzed using descriptive statistics with a view to summarize the general response data in terms of proportions, frequencies, and percentages. Part B, which was the core of the study was analyzed in two parts. The responses on extent of contribution were analyzed using descriptive statistics and principle component factor analysis by application of the Statistical Package for Social Science (SPSS). Kaming et al., (1997); Karimi (1998); Mwandali (1996), and Musa (1999), in similar studies used factor analysis. The second part on the frequency of occurrence was analyzed using the relative importance index analysis (Frimpong et al., 2003; Kaming et al., 1997; Kumaraswamy and Chan, 1998).

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter highlighted the data analysis methodology and outputs or findings thereof using the survey data and secondary data and information.

4.1.2 Response Rate

A total of 54 questionnaires were emailed to potential respondents that participated in the implementation of one or more of the four projects. Of these, 41 (75.9%) responses were received back. Eleven (26.8%) questionnaires were received from the employer/client personnel, eighteen (43.9%) from the contractors' personnel, and thirteen (29.3%) from the consultants' personnel, this was a good response. On the 13 questionnaires not received, 1 was non-responsive while the other 12 potential respondents could not confirm receipt of the questionnaire despite several reminders through their last email addresses.

4.1.3 Respondents characteristics

On Part A of the questionnaire, all the respondents completed the details required. The respondents were drawn from the four projects and distributed as represented in Table 4.1 with Olkaria having the highest proportion. Olkaria project had a wide scope comprising of five large and different construction contracts and a large workforce of consultant personnel. The other three were single lump-sum contracts.

Table 4. 1: Respondents Distribution on Projects

Project Title	Frequency	Percent	Cumulative Percent
Olkaria II Geothermal Power Project	29	70.73	70.73
Kipevu I Mombasa Diesel Power plant	4	9.76	80.49
Gitaru Third Unit Hydro Project	4	9.76	90.24
Sondu-Miriu Hydro Electric Power Project	4	9.76	100
Total	41	100	

The qualifications of the respondents in Table 4.2 indicated that, 88 % were engineers from various disciplines and 10% were quantity surveyors.

Table 4. 2: Qualifications of Respondents

	Frequency	Percent	Cumulative Percent
Civil Engineer	11	27	27
Electrical Engineer	6	15	42
Mechanical Engineer	14	34	76
Commercial Manager	1	2	78
Quantity Surveyor	4	10	88
Registered Engineer	5	12	100
Total	41	100	

The designation of respondents on the projects ranged from project managers, deputy project managers, building services supervisors, resident engineers, quantity surveyors, design and structural engineers, safety officer and client representatives among others. The designation were categorized and summarized in Table 4.3. The proportion of respondents with title of manager and above was 45%, quantity surveyor was 10%, resident engineers proportion was 17%, and that of client representative (employees) was 17%. The proportions represented may be taken as an indicator of participation in the survey, of respondents well versed and knowledgeable in the projects.

Table 4. 3: Summarized Designation of Respondents on the Projects

Designation	Frequency	Percent	Cumulative Percent
Project Manager	18	45	45
Resident Engineer	7	17	62
Quantity Surveyor	4	10	72
Clients Representative	7	17	89
Building Services Supervisor	1	2	91
Safety Officer	1	2	93
Reservoir and scheduling Engineer	2	5	98
Project Coordinator	1	2.	100
Total	41	100	

The proportion of respondents in term of numbers of years in similar assignment, Table 4.4, were; less than or equal to 5 years (17.5%), greater than 5 and less or equal to 10 years (20%), greater than 10 and less or equal to 15 years (22.5%), greater than 15 years or less equal to 20 years (10%), and more than 20 years (30%). Again, this characteristic of respondents where experience of 10 years or more (82.5%) participated in the study survey helped in improving the confidence on the data collected.

Table 4.4: Respondents experience in years in similar assignments

Range	Percent	Cumulative Percent
0<Year≤5	17.5	17.5
5<Year≤10	20	37.5
10<Year≤15	22.5	60
15<Year≤20	10	70
Year>20	30	100

On part B of the questionnaire, the 41 respondents completed all the parts. In a few cases where omissions were noted, the respondents were contacted and missing information obtained. The successful completion of this part could be attributed either to clarity of the statements was sufficient to facilitate this having pilot tested the questionnaire and as cited above, a large proportion of the respondents had a clear understanding of the issues (project environment) affecting the project/s they were involved. Others opinion could have been influenced by opinion of others in the course of project/s implementation.

Under part C of the questionnaire, the respondents were required to list any 5 "factors" [1] not included in part B that they considered significant in contributing to overruns. Approximately 20% of the respondents did not complete this part. Of those who did, 70% listed 3 to 5 "factors" while 48% listed the five "factors". For those who did not respond,

[1] "Factor" refers to causes of overruns. This is the same as variables and should not be confused with "factors" in principle component/factor analysis.

we may assume that they either found part B adequate and covered all factors; or found it tedious to crosscheck and consider other factors. Time could also have been a constraint having made the effort to complete the other parts. However, it is important to note that most of the "other factors" listed, when reviewed and analyzed, most of them closely related to variables in Part B. The factors were grouped into categories that appeared to relate to a particular party within and outside the project. They are many other ways to group the factors (Ahmed et al., 2002; Chan and Kumaraswamy, 1997, 1998; and Mezher and Tawil, 1998). The factors were grouped into seven categories namely; employer related, contractor, all parties related, government, financiers, consultant and project location related.

4.2 Preliminary Analysis

4.2.1 Analysis of Variables' Extent of Contribution to Overruns

The calculated mean and standard deviations of responses to extent of contribution of the 49 causes of delay and cost are tabulated in Table (II) in appendix II. The questionnaire sent to respondents had 50 listed causes of delay and time. However, it was noted that variable, 'late design changes' was repeated and one of them had to be eliminated from the analysis. In the SPSS analysis, the variables were labeled from 1 to 49 as listed in the questionnaire. The analysis of the mean revealed that "delayed payment to contractors" had the highest mean of 3.41. "Unpredictable weather" had the lowest mean of 1.86. Since the response to each statement varied from 1 to 4, a mean score of 2.4 (60%) and above was considered significant. From these criteria, the length of the implementation of the project, lack of adequate professional skill by project teams, delays in approval by the engineer, complex interfaces of various work packages, delay of access to site, inadequate planning by employer before commencement of construction, delay in procurement of materials and equipment, inadequate supervision of works, unexpected ground conditions, bureaucracy of government agencies, lack of involvement of the client team, delay of disbursement of funds by financiers, poor construction methods, and disputes between parties were significant.

Other variables included; unrealistic client budget, poor handover interface, delayed payment to contractors, poor subcontracting, delays in release of drawings, employer cashflow problems, increase in scope of work, poor specifications in the contract, poor relations between engineer and contractor, late design changes, complex payment process, inadequate contractor experience, poor communication between parties (e.g. engineer vs contractor, engineer vs employer), poor safety measures, client failure to supply information and materials, underestimation of project duration, bad relations with financiers, contractor's own cashflow problems, and government that could be considered as significant in influencing the overruns.

The standard deviation, which is a measure of dispersion from the mean score varied between from 0.80 and 1.18. For response scale of 1 to 4, standard deviation of more than 1 can be considered as high. 24 variables (49%) had standard deviations of more than 1. This level of variability in responses could be explained as due to degree of variation of occurrence of causes of overruns in the projects, or the variation in experience and qualification of the respondents or the individual respondent's overall understanding of project environment which could be limited by their designation. For example, a variable such as "employer unrealistic budget" will elicit different responses between a design engineer and project manager due to their difference in exposure to the issue.

4.2.2 Relative Importance of Variables

This is the analysis of Part B of the questionnaire where the respondents were required to rate the chance of occurrence for each variable. The Relative Importance Index (RII) derived to summarize the importance of each variable was computed as:

$$RII = \frac{\sum w}{A.N}$$

Where:

w = weighting as assigned by each respondent in a range from 1 to 3, where 1 implied "Low", 2 implied "Medium" and 3 implied "High;

A= the highest weight (3);

N= the total number in the sample.

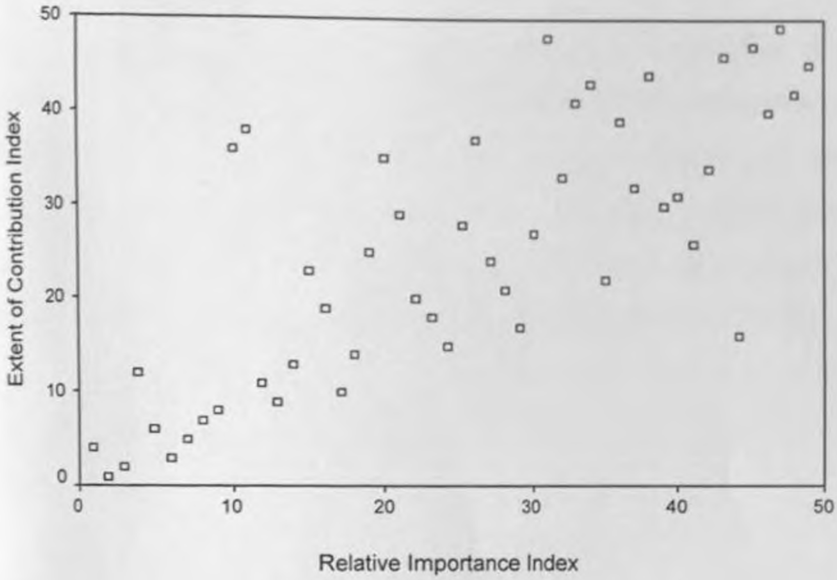
The RII is indicator or measure of the likelihood or recurrence of the variable from the respondents' point of view. The indices can, therefore, be used to determine the rank of each variable. The results are shown in Table (III) of appendix II.

By applying the criteria of over 60% or RII greater than 1.8 to identify variables that have higher rating for occurrence, the length of the implementation of the project, delays in approval by the engineer, complex interfaces of various work packages, delay of access to site, inadequate planning by employer before commencement of construction, delay in procurement of materials and equipment, bureaucracy of government agencies, delay of disbursement of funds by financiers, escalation on materials, disputes between parties, poor handover interface, delayed payment to contractors, exchange rate fluctuations, delays in release of drawings, employer cashflow problems, increase in scope of work, inadequate/poor cost control, poor specifications in the contract, late design changes, poor communication between parties (e.g. engineer vs contractor, engineer vs employer), low labour productivity, underestimation of project duration, environmental issues, and government regulations were seen as the most frequent variables to occur during implementation of similar power projects in Kenya by KenGen.

4.2.3 Comparison Between Extent of Contribution and Relative Importance Index

To closely relate and elicit the respondents' rating of extent of contribution to rating on occurrence of each variable, a comparison using the mean score of rating on extent of contribution and relative importance index was examined and the results are shown in Table (IV) in appendix II. A scatterplot and correlation coefficient were used to examine the bivariate relationship between the two rankings. Figure 4.1 displays a plot of extent of contribution index against the Relative Importance Index (RII).

Figure 4. 1 : Scatter for Extent Index and RII



The Pearson product moment coefficient of correlation, r, which is a measure of the strength of the linear relationship between two variables, was 0.773 and the correlation was significant at 0.01 level (1-tailed).

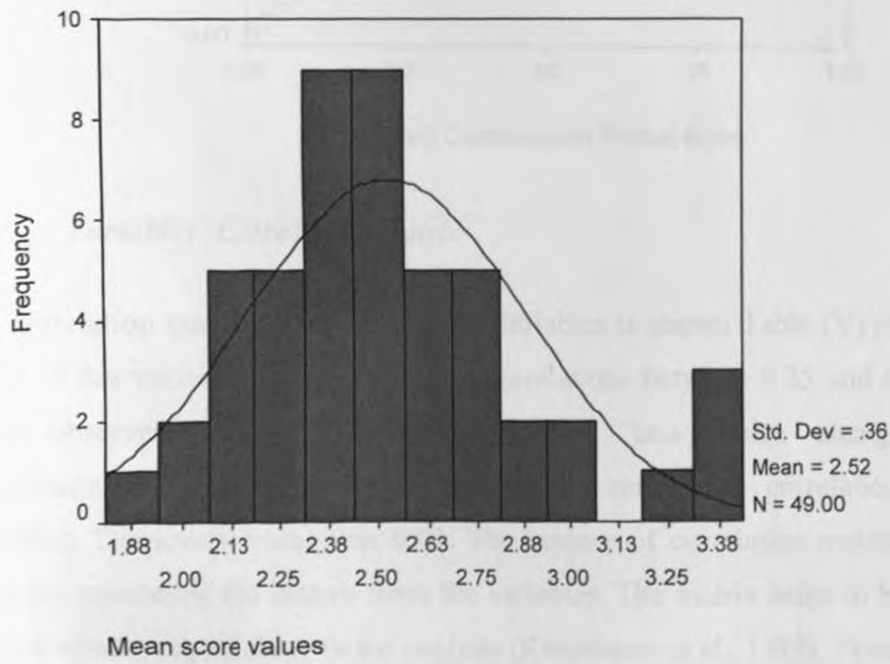
4.3 Factor Analysis of Time and Cost Overruns Variables

4.3.1 Preliminary Analysis

To capture and reveal any multivariate interrelationships among the variables identified as significant contributors to overruns, and to further explore the structure of the data, the Principle Component Analysis (PCA) technique was employed in order to explain relationships among several difficult-to-interpret, correlated variables in terms of a few conceptually meaningful, relatively independent factors (Kleinbaum et al., 1988). To proceed with this technique, its appropriateness for factor extraction was examined through several tests. They included determinant of correlation matrix, test of sampling adequacy measured by the Kaiser-Meyer-Olkin (KMO) statistics, which predicts if data are likely to factor well, based on correlation and partial correlation, and Bartlett test of sphericity- a statistical test for the presence of correlations among variables (test of identity matrix).

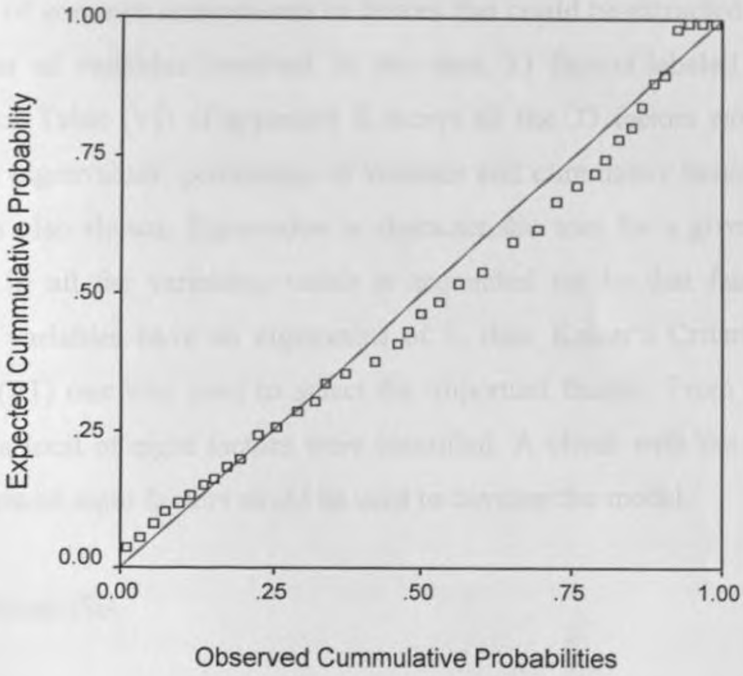
The 33 highly ranked variables based on mean scores (extent of contribution indices) were selected for factor analysis since their extents of contribution were perceived above "somewhat" to "very" important; their means approximated to or more than 2.4 (60%) on a scale of 1 to 4. This criterion was chosen consistently with the objectives of the study in mind. The mean scores of the variables reflect a measure of central tendency and are construed to indicate or measure severity of each variable on the overruns. Figures 4.2 and 4.3 show a normality test on the mean score data using a histogram with normal curve superimposed, and a normal probability plot. The plots showed the data was approximately normal.

Figure 4. 2: Histogram with Normal Curve



The determinant of correlation matrix was 7.946E-18, which indicates the lack of multicollinearity or singularity (Maddala, 2002). The KMO was found to be 0.603 and the Bartlett's Test of sphericity was 1070 significant at 5.03E-39. These measures confirmed the suitability of data to proceed with factor analysis.

Figure 4. 3: Normal Probability Plot



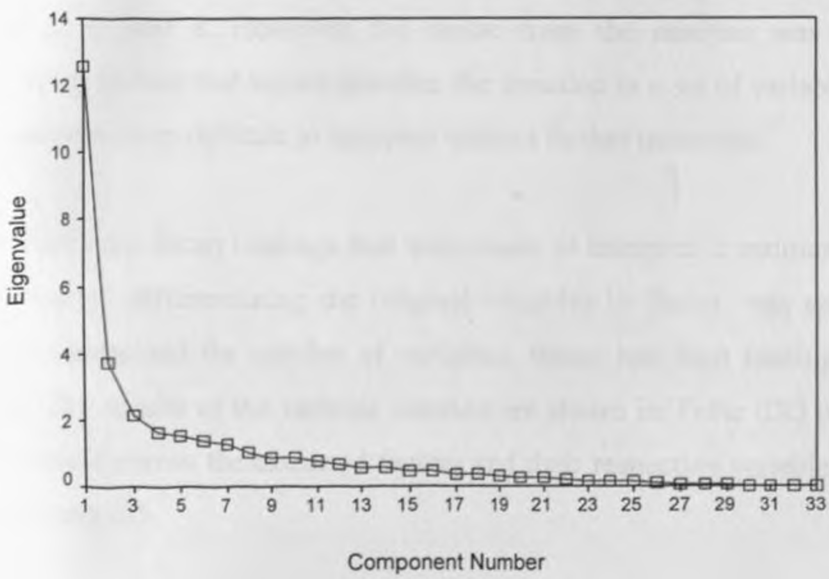
4.3.2 Variables' Correlation Matrix

The correlation matrix of the 33 selected variables is shown Table (V) of appendix (III). Many of the variables showed absolute correlations between 0.25 and 0.5. The highest value observed was 0.75 between variables 'late design changes' and 'poor communication between parties'. There are no zero value correlations amongst the variables. The lowest value was 0.01. The essence of correlation matrix is to form the basis for generating the factors from the variables. The matrix helps to have preliminary idea of what to expect from factor analysis (Kleinbaum et al., 1988). From the correlation values, we can assess the efficacy of the survey instrument. High (>0.7) and positive correlations are undesirable. This is because when two variables are highly and positively correlated, the implication is that the two variables are seeking the same response.

4.3.3 Factor Extraction

The PCA was conducted using the Statistical Package for Social Sciences (SPSS). The total number of common components or factors that could be extracted was equal or less to the number of variables involved. In this case, 33 factors labeled "component" in column one of Table (VI) of appendix II shows all the 33 factors extractable from the analysis. The eigenvalues, percentage of variance and cumulative percentage of variance of factors are also shown. Eigenvalue or characteristic root for a given factor measures the variance in all the variables, which is accounted for by that factor. Since all the standardized variables have an eigenvalue of 1, then Kaiser's Criterion of eigenvalue greater than (>1) one was used to select the important factors. From the Table (VI) of appendix II, a total of eight factors were identified. A check with the scree plot, Figure 4.4 below showed eight factors could be used to develop the model.

Figure 4. 4: Scree Plot



The percentage variance is a factor's eigenvalue divided by the *trace*. The cumulative total measures the total variance explained by the factors. In this case, 76.70% of the variance of the 33 variables is accounted by the eight factors extracted. The balance of 23.3% of variance in the variables is accounted for by other factors.

The 'initial" and 'after extraction" communalities are shown in Table (VII) of appendix II. The communality measures the percent of variance in a given variable explained by all the factors jointly and may be interpreted as the reliability of the indicator. For example, 76.89% of variance for the variable, "delayed payment to contractor" is accounted for by the factors extracted.

The factor loadings, also called component loadings in PCA Table (VII) of appendix II, were the correlation coefficients between the original variables (rows) and the factors/components (columns) emerging from factor analysis. Each loading represents the percent of variance in that variable explained by the factor. The primary use of loading matrix is to pinpoint those variables that are highly correlated (that is, "load high") with a given factor, so that the factor can be conceptually interpreted (Kleinbaum et al., 1988). For example, taking "load high" as loading greater than 0.5, 25 variables load on factor 1, 4 variables load on factor 2, 1 variable for each factor 4 and 7, while there was none on factor 3, 6, and 8. However, the desire from the analysis was to find meaningful underlying factors that would describe the variation in a set of variables. The results from this analysis were difficult to interpret without further treatment.

To achieve the factor loadings that were easier to interpret, a varimax rotation, which has the effect of differentiating the original variables by factor, was conducted. The effect was, it minimized the number of variables, which had high loadings on any one given factor. The results of the varimax rotation are shown in Table (IX) of appendix II. Table 4.5 overleaf shows the extracted factors and their respective variables that have loadings greater than 0.5.

Table 4. 5: Factor Loading of Contributors to Time and Cost Overruns- Rotated

Causes of time and cost overruns	Factors							
	CF1	CF2	CF3	CF4	CF5	CF6	CF7	CF8
Inadequate contractor experience	0.807							
Poor construction methods	0.750							
Delay in procurement of material and equipment	0.689							
Contractor's own cashflow problems	0.661							
Unrealistic client budget	0.590							
Poor specifications in the contract		0.529						
Poor labour productivity		0.521						
Bad relations with financiers		0.537						
Delayed payment to contractor			0.841					
Delay of access to site			0.828					
Lack of adequate professional skill by project team			0.812					
Poor subcontracting			0.513					
Poor relations between engineer and contractor				0.753				
Government regulations				0.554				
Increase in scope of work					0.837			
Complex interfaces of various work packages					0.689			
L ate design changes						0.812		
Poor handover interface						0.613		
Bureaucracy of government agencies							0.806	
Unexpected ground conditions								0.725
Poor communication between parties (e.g. engineer vs. contractor, engineer. vs. employer								0.614

"CF" stands for component factor. Factor loadings with values less than 0.50 are not shown in the table

4.3.4 Factor labeling

By analyzing each factor and their cluster of variables in the table above, they were given new titles to reflect the underlying meaning of the groupings. CF1 can be regarded as "contractor inabilities", CF2 as "improper project preparation", CF3 as "resource planning", CF4 as "interpretation of requirements", CF5 as "works definition", CF6 as "timeliness", CF7 as "government bureaucracy" and CF8 as "risk allocation".

Labeling the factor groupings this way is subjective and can be challenged as inappropriate. It is important to realize that there is no guarantee that variables that "hang together" on a given factor will describe conceptually meaningful factors (Klienbaum et al. 1988). However, it is sufficient if further analysis is to be carried out on this factors (Kaming et al., 1997).

4.4 Further Description and Analysis of Factors

The first objective of the study was to identify factors that significantly contributed to time and costs overruns in public power projects. The preliminary analysis and the principal factor analysis procedure resulted to fulfillment of this objective. The factors identified were contractor inabilities, improper project preparation, resource planning, interpretation of requirements, works definition, timeliness, government bureaucracy, and risk allocation. To conceptualize each of these factors, it was necessary to look at the variables associated to them in the context of their occurrence on the four projects. This was achieved by reviewing primary data from part C of questionnaire, secondary data and information from contract documents, periodical reports, contractors' claims documents, consultants claims assessment documents, loan or credit agreements, minutes of meetings, and project completion reports.

4.4.1 Contractor inabilities

This factor consisted of inadequate contractor experience, poor construction methods, and delay in procurement of materials and equipment, contractor's own cashflow problems and unrealistic client budget. At pre-qualification stage, contractors past experience in similar assignments and environment, and proposed team were among the parameters used in qualifying the contractors invited to bid for works. In KenGen, the process for the selection of contractors for power plant construction contracts followed the procurement guidelines from the financiers such as World Bank, EIB, KfW and JBIC. All the contracts were awarded to international contractors or consortiums on the International Competitive Bidding (ICB) basis. The participation of the local contractors in consortiums was limited except on the Olkaria II where a local contractor took up to 50% of the civil works.

Delay in procurement of material and equipment, arose on the projects from various parties involved. The contractors were responsible for the procurement of materials and equipment in all the contracts. On turnkey contracts, where delays occurred, the contractors were responsible. For multi-contract project like Olkaria II on which, the engineer had dual role on the civil contract, many factors interplayed leading to delays. On some contracts, there were delays by contractors in releasing of procurement drawings, delays in provision of design information from supply contractors to the engineer's designers to prepare procurement drawings. On the hand, delay in payment to contractors and placement of letters of credit exacerbated the whole process leading to overruns.

Contractor's own cash flow problem referred to contractor's inability to ensure there was sufficient cash to meet its financial obligations as they fall due in the process of executing his work on the project. Where there were reasonable delays in release of due payments to contractors, the contract envisaged that the contractor had its own cash or access to credit to finance the work and seek compensation from the client.

4.4.2 Improper Project Preparation

This factor consisted of poor specifications in the contract, poor labour productivity, and bad relations with financiers. Due to poor specifications, there were many instances where the works were delayed as parties attempted to find agreeable interpretation on them and often led to delays in execution of works. Many of the specification problems were encountered under Olkaria II project.

The specifications were prepared in the early 1990 but the implementation commenced ten years later. The consultants who prepared the specifications were different from those who supervised the implementation. There were many conflicts between the drawings and specifications. The Olkaria II project contracts had many conflicting requirements, as the supervising consultant was not required to extensively review them prior to tender. For example, a specification on one contract was different from that in another contract for similar item making it very difficult to harmonize between the two. There were cases where the supply of items was duplicated in two contracts and often, it was realized much later when either the design was advanced or complete. The contract conditions disallowed the cancellation of a works item from one contractor and awarding it to another. On the four projects, there were parts of the specifications that were inconsistent with the local projects requirements. This caused problems, for instance, on material selection for the residential housing at Olkaria.

Poor labour productivity was one of the main components of contractors' claims on loss of productivity. The claims by the contractors were on the basis of human resource waste during the slowdown due to failure to settle their payments on time. The contractors' compensation on slowdown for Olkaria II project was about US$ 3 million (KenGen, 2004[1]). There were reported cases of labour unrest on some contracts due to poor working conditions like poor transport of workers and lack of protective clothing.

The four projects under the study were financed through various packages. The financiers included IDA, KfW, GoK, JBIC, EIB and KenGen. The multilateral financiers had specific requirements for disbursement of funds on projects. In the event that GoK and the implementing agency, KenGen, failed to meet some of the stipulations in the credit/loan agreements, delays in disbursement would ensue.

4.4.3 Resource Planning

This factor consisted of delayed payment to contractors, delayed access to site, lack of professional skill by project team and poor subcontracting. The problems of delayed payments and access to site were the responsibility of the client. It was ranked 1st and 2nd on the two indices, an indication of the severity of the problem. Delayed payment arose due to several factors; inadequate funding of the project, complex payment processes, client cashflow problems and delays in disbursement processes. Interest on delayed payment costed Gitaru Unit 1 project, US$ 94,000 and Olkaria II, over US$900,000 (KenGen, 2003, 2004[1]) in addition to cost of the slowdown.

Delay to contractors' or their agents in access to site occurred in various forms on the projects and included; delayed release of worksite by employer or his agents to contractors on interface works, right of way issues with landowners on the power transmission line trace, delay in release of facilities for tests for use by another contractor. Failure to provide to the contractor, access to site, led to 28 days extension of time at Kipevu I project and payment of Japanese Yen 74 million (KenGen, 2000). Disruption of works through lack of access to various contractors engaged on Olkaria II project led to additional expenditure of over Ksh. 1,152 Million (US$ 15 million).

In the execution of works, the contractor was required to deploy sufficient and qualified manpower to deliver the project on time, within budget and to the specified quality. Repetitive cycles on drawings review and approvals, poor workmanship and reworks, delays in procurement, and delivery of material due to wrong estimates were reported.

The subcontracting functions were the sole responsibility of the main contractor. The main contractor remained responsible for the performance of the subcontractors whether nominated or not. Such subcontracts were agreements between the main or prime contractor and subcontractor/s and involved no contractual relationships between the subcontractors and KenGen. On these projects, power plant design, manufacture and construction, involved many specialized skills. The contractor accomplished task through allocation of part or parts of the specialized works outside his core function to these other groups. The client approved or rejected the selection or nomination of the subcontractor if he had reasons to doubt its ability to perform.

4.4.4 Interpretation of requirements

Included in this factor were poor relations between the engineer and the contractor and government regulations. As mentioned earlier, the four projects were awarded to foreign contracting firms and supervised by international consulting firms with little or no local affiliated firms. One of the conditions for their selection was their familiarity with conditions pertaining to third world countries, and especially Africa. Poor relations between the two parties ensue as a result of each party trying to relate the project requirements with the expectations from each other. The differences in interpretation of the contract requirements between the engineer and the contractor appeared to be a major source of poor relations. For example, the contractors made many applications for compensation on perceived change of specification, but they were rejected.

Where the engineer was the designer, when contractor proposals on engineering design improvements were rejected, it appeared to be a source of contention. Many disagreements leading to poor relations related to re-measurement quantities under re-measurement contracts, and assessment of contractors' claims. These incidents generated numerous correspondences, wasting many man-hours on disputes resolution.

The contractor was required to be familiar with the laws governing in Kenya, regulations and by-laws that may affect the project and to comply with the requirements. These related to tax/tariff requirements like duties, value added tax, legal entity establishment, and application of tax laws, personal income tax, corporate tax and miscellaneous taxes. The legal requirements related to legal basis and standing, governing laws, contract type and procedures, environmental permitting and corrupt business practices, among others.

4.4.5 Works Definition

This factor grouping was made up of increase in scope of work and complex interfaces of various works packages. The increase in scope on the projects was due to all the parties involved on the project. The engineer's changes in design, the employer's need to improve on technology, and contractor's wrong estimates on material among many other changes appeared to be potential source of delays and costs increase.

The increase in scope of work occurred on all the projects. On Kipevu I projects, the scope changes were nine and resulted to cost increase of Japanese Yen 140 Million. There were 182 Scope or variation changes on the olkaria II with a net increase in project cost of Ksh. 556 million. Gitaru Unit 1 projects scope changes were 5 with a net increase in project cost of US$ 255,000 (KenGen, 2000, 2003, 2004[1]). On all the projects most scope changes were technical. It was evident that the works definition on the Olkaria II was wanting in scope, specifications and drawings. The Gitaru and Kipevu projects documents did not appear to have had these problems.

The complex interface of various works packages was a phenomenon for Olkaria II project. Each of the five contracts had a contract schedule while the project implementation was driven by an integrated schedule, driven by the civil contract. Unfortunately, due to complications during bidding, two supply and install contracts with shorter implementation durations were awarded 3 months ahead of the civil contract and had a lead of 5 months start on construction to the civil contract. The staggered award schedule resulted in numerous difficulties on attempts to harmonize the implementation programs for the various contracts with civil contract lagging behind (KenGen, 2004[2]).

4.4.6 Timeliness

The clusters of variables on this factor were late design changes and poor handover interface. During the implementation of a project, changes in design, material, specification, skills, and changes in the methods of construction or manner of work performance, sequence of work, changes in owner-furnished materials or facilities or changes in the contract time were common occurrence. The client, engineer or the contractor, due to various reasons, initiated changes in designs. For uniformity of design on facilities across various contracts on Olkaria II project, the engineer, on several occasion had to issue late design changes. In other instances, the contractors had to request for material and design changes to improve constructability.

Interface handover occurred during transfer of semi-complete or complete works or facilities between contractors or between the client and contractors. The purpose was for either party to undertake its scope of work. For example, on Olkaria II, the client handed over the turbines work area to civil contractor to construct the turbine pedestals and install embedded materials like turbine/generator anchor bolts for the supplier of generating facilities. Once the pedestals were ready to receive the turbines and generators, the civil contractor had to handover the facilities to the generating facilities supply contractor, who would install them and handover the works and facilities to the civil contactor for final grouting. The civil contractor would handover the facilities to the same contractor for testing and commissioning and testing, and finally to the facilities owner, the client. This process was complex for multi-contract project like Olkaria II and was a source for claims by contractors. There were many disruptions, leading to poor labour productivity and equipment utilization culminating to extensions of time to the affected contractors and additional cost of about US$ 15 million.

4.4.6 Government Bureaucracy

This factor related highly with only one original variable, "bureaucracy of government agencies. The government bureaucracy related to procedures or processes that had to be followed and executed for various functions related to the projects. These included, customs clearances, payment procedures, immigration and other permitting.

The procedures consumed a lot of time and manpower to sort out huge amount of paper works beside the never-ending delays in processing them through various government agencies. The contractors had to employ additional manpower to expedite the processes. The delays in release of projects' equipment and materials through the customs due to delay in release of duties and taxes exemption, affected the process on all the projects with added costs of logistics expediting, placement of bonds, storage and various claims by contractors. For example, in Kipevu I project, the contractor's original plan was to import and install the overhead mobile crane to erect the generator and many of the auxiliaries. This part of the work was on the critical path, but the exemption documents were released with 60 days. The contractor had to retain the tower crane and hire mobile cranes, and special lifting equipment from overseas. The total assessed additional time awarded to the contractor for customs delay for various equipment and plant was 96 days and Japanese Yen 192 Million (KenGen, 2000). On Gitaru project, the importation delays resulted to compensable delay of 25 days and the contractor's compensation of US$ 285,000 (KenGen, 2000). Direct costs for placement of bonds to minimize impact on Olkaria II project schedule due to tax exemption delays, costed Ksh. 70 million (US $ 0.92M).

The payment procedures through government agencies delayed effecting payments to contractors. The placement of letters of credit (LCs) for the contractors required certain sanctioning by the government, which was the borrower of the funds. In one supply and install contract, the placement of the foreign component LC delayed by 24 months partly due government delay in issuing necessary letters to the financier. Consequently, the contractor, though having completed the manufacture of equipment could not ship them and had to store them abroad. The contractor was awarded 430 days extension with miscellaneous claims totaling US $ 2.7million.

The immigration had occasional delays in issuing work permits to foreign workers. The delays occurred, despite the fact that the loan agreements between government and financiers takes cognizance of type of procurement to be employed in the execution of the work by contractors through its appointed agencies like KenGen. Many foreign personnel, both consultants and contractors had to spent many manhours on follow-up on issuance or renewal of work permits. Other permitting related to local authority approvals for construction, waste disposal, drilling of boreholes, and other environmental and safety compliance permits.

4.4.8 Risk Allocation

This factor consisted of unexpected ground conditions and poor communication between parties (e.g. engineer vs. contractor, engineer vs. employer). On the four projects, the risk of unexpected ground conditions was distributed between the three parties. The client (owner) had the responsibility to undertake precontract exploratory measures, the engineer (designer), where applicable had the responsibility to design for the conditions expected. The larger proportion of risk was transferred to the contractor. The extent that this was not feasible determined the degree to which KenGen retained a portion of the risk under the relevant clauses in the contracts. Respondents cited ineffective risk assessment, Changing contract conditions without allowing for adequate review of the consequential impacts, and lack of thorough risk assessment as shortfalls that led to overruns. Due to "unforeseen conditions", in Kipevu I project, the contractor claimed for encountering boulder/rocks that were not foreseeable from the geotechnical data and information provided by KenGen. A total of 10 days extension were awarded and KSh.17million compensation.

4.5 Relative Importance of Emerged Factors

The second objective of the study was to establish the relative importance of these factors. The eight "component factors" could conceptually be interpreted as explaining 77% of the variance of the thirty-three variables considered as significant in contributing to the overruns. To be able to relatively rank these factors, the average of the extent of contribution indices of variables, "hanging together" was used. For example, "resource planning", from Table II in appendix II, the average of 3.41, 2.68 and 2.61, was 2.90. From this ranking, government bureaucracy was ranked first with and an index, of 3.27, second was resource planning with an index of 2.90. Risk allocation was ranked eighth, with an index of 2.41 as shown in Table 4.6.

The perception of respondents to recurrence of these factors in similar, future projects was analyzed using the Relative Importance Indices of the associated variables, shown in Table III in appendix II. For example, the variables for "resource planning" were delayed payment to contractor, delay of access to site, and lack of adequate professional skill by project team. The respective RII were 0.821, 0.626, and 0.569 giving an average of 0.672 shown in Table 4.6 Government bureaucracy was ranked first, followed by works definition. Risk allocation and improper project preparation were ranked seventh and eighth respectively. The Pearson correlation coefficient between the two rankings was 0.81 and significant at 0.01 (1-tailed).

Table 4. 6: Ranking of the Emerged Factors

Emerged factor	**Average Extent Index**	**Rank**	**Average RII**	**Rank**
Contractor inabilities	2.58	6	0.593	6
Improper project preparation	2.59	5	0.558	8
Resource planning	2.90	2	0.672	3
Interpretation of requirements	2.47	7	0.606	5
Works definition	2.85	3	0.744	2
Timeliness	2.67	4	0.646	4
Government bureaucracy	3.27	1	0.837	1
Risk allocation	2.41	8	0.568	7

4.6 Quantitative Impact of Time and Cost Overruns

The third object of the study was to quantify the time and costs associated with the significant factors. It is important to state that the recording and documentation of the cost and time increases were not easy to extract in some of the contracts, as they were in some cases lumped together. However, after perusal of the documents, the data available was in the basic form of variables that related to time and cost overruns as shown in Table 4.7 below. Therefore, to fulfill this objective, the prudent approach was to discuss the impacts of these variables within the factor/s they closely fell.

Table 4. 7: Summary of impacts of variables to time and cost overruns

Project Title	**Variable description**	**Time extension**	**Costs currencies**			
		Days	**Kshs (Million)**	**US $**	**Japanese. Yen(Million)**	**Swiss Francs**
Kipevu I Mombasa Diesel Plant	-Adverse weather	16	-	-	-	-
	-Excavate in rocks	20	-	-	-	-
	-Erroneous measurement	10	-	-	34	-
	-Exemption delay	96	-	-	192	-
	-Access to facilities	28			74	
	-Site tests	11	-	-	1.82	-
	-Extension of time	183	-	-	308	
	Variation Orders	-	-	-	140	
Gitaru Unit I Hydro Project	-Importation delays	-25	-	285000		
	-Late payments	-	-	94000		
	-Variation orders	-	4.5	255000		200,000
Olkaria II Geothermal Project	-Variations	Aprox	556			
	-Interest on delayed payment	400 days Overall	67			
	-Escalation		453			
	-Bonds charges		70			
	-Disruption of works		1152*			
	-Slowdown of works		200*			
Sondu-Miriu Phase I Hydro Project.	-Additional works -Adverse conditions -Interest on payments -Inflation -remeasurements	The project phase I costs are still under evaluation and negotiation between parties.				

Note. * Figures are split estimates from slowdown and disruption across contracts in the project.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Research Findings

A survey of projects' personnel drawn from contractors, consultants and KenGen involved in the four recent projects was conducted to investigate on the factors that had significant contribution to time and cost overruns during their implementation by KenGen on behalf of the Government of Kenya. The survey also was used to elicit those factors that were considered to have high frequency of recurrence in future on similar project environment. The respondents identified additional causes or variables contributing to overruns. The analysis of the response data revealed that there were variables that significantly contributed to time and time overruns and have a chance of recurring in future projects. These included among others, delayed payments to contractor, employer cash flow problems, delay in disbursement of funds by financiers, bureaucracy of government agencies, complex interfaces of various work packages, the length of the implementation of the project, delay in procurement of materials and equipment, inadequate planning by employer before commencement of construction, late design changes, delay in approvals by engineer, delays in release of drawings, increase in scope of work, disputes between parties and delay of access to site.

From factors analysis, eight latent factors that could to large extent explain the common variance of these measured variables were identified. These were deduced as representing; contractor inabilities, improper project preparation, resource planning, and interpretation of requirements, works definition, timeliness, and government bureaucracy and risk allocation.

The ranking of these factors, using the average of the extent of contributions indices from their respective cluster of variables showed that government bureaucracy ranked high as a factor in contributing to overruns. This was followed by resource planning, works definition, timeliness, improper project preparation, contractor's inabilities, interpretation of requirements, and risk allocation.

The ranking using the relative importance index depicted a closely matched pattern to that of extent of contribution. Government bureaucracy was ranked highest, followed by works definition and resource planning. Timeliness came fourth followed by interpretation of requirements, contractor's inabilities, risk allocation, and improper project preparation. This order was important in revealing the variables that KenGen should lay emphasis on during the execution of future projects. For example, it is clear that the bureaucracy of government agencies contributed to overruns in all the projects in the study. This also had a high probability of occurring in future projects unless the problems encountered from these agencies are brought under control.

The implementation of three of the projects on the case study namely; Kipevu I, Gitaru Unit 1, and Olkaria II Geothermal plants was complete and full data and information was available for analyses. However, Sondu Miriu phase I was technically complete but decisions on the final costs were yet to be determined. By closely relating the factors to the various variables, it was observed that they resulted to overruns on the projects by varying magnitudes. Olkaria II Geothermal project had a 29% cost overrun and 53.4% variance on completion time. The Kipevu I project showed a cost increase of 13% of foreign costs and 6% of local costs. The potential time overrun of 14.3% was managed through cost increase by crashing the project activities. Gitaru Unit 1 manifested a cost increase of 9.4% and a negative time variance of 4.6%. The determined time variance for Sondu Miriu Phase 1 was 12.5%. The quantitative summaries of overruns associated with the significant variables were presented in Table 4.7 above.

5.2 Significant Factors Contributing to Overruns

The significant factors that influenced the overruns in the power projects and identified in the study were: contractor inabilities, improper project preparation, resource planning, interpretation of requirements, works definitions, timeliness, government bureaucracy, and risk assessment. Kaming et al. (1997), on a similar study for overruns on high-rise projects in Indonesia found that, equipment usage, resource estimates, buildability, and human resource shortage influenced delays while environment, cost data, and inflation were significant in determining the cost overrun. Musa (1999) in a study on water projects funded by the Government of Kenya, identified; quality of project management, operating environment, motivation of workers, infrastructure, inadequate resources, and organization of the project team as factors that determined the delays in the projects. Developing countries, lack resources, managerial skills and have low human capital productivity (Kwak, 2002). Long et al. (2004) identified incompetent designers/contractors, poor estimation and cost management, social and technological issues, site related issues, and improper techniques and tools in case study for Vietnam. Therefore, project design standards, specifications, and construction methods must be carefully selected so that they will be appropriate to local financial, human, and material resources required during both the implementation and its subsequent operation (Kwak, 2002). It is important to appreciate that, for a country like Kenya, with perennial power shortages, power projects are more often implemented on "fast track" basis and certain issues are easily overlooked during project preparation and often lead to projects implementation snags like delayed payment to contractor and consequential delay on schedule.

Contractor's experience manifests on how the project is managed and execution of defined responsibilities and obligations in the contract. The selection of project team, supervision, scheduling, coordination and control of work activities, methodologies, work plans, deployment and coordination of resources, procurement of material, knowledge territory of project, overall site management among others are indicators of an experienced contractor. The complexity of the technology, financial standing and experience required in the pre-qualification criteria on the four projects eliminated the participation of local contractors, confining them to minor subcontracting roles. Poor construction methods could be reflection of poor specification, lack of skills and experience, and inappropriate equipment from the contractor. Poor specifications led to resource and time waste as parties tried to agree on their interpretation. For turnkey (design-build) projects, it is easy to implement constructability; it is much more difficult to do projects where design and construction are accomplished by distinct and separate contracts. For example, on Olkaria II, the consultant was responsible for the design for the main civil works as well as supervision of the construction contractor. This led to protracted debates and correspondences, which could result in lost time and additional costs.

The cashflow problems occurred if a contractor was receiving regular payments from the employer but diverted funds to other activities unrelated to the project. The main casualties were the local subcontractors, with consequent effects manifested in delayed provision of services and goods and increase in attendant costs. Poor specification arose out of the fact that eternal consultants had a bias of specifying what they were familiar with, and the client may not have had time or internal capability to review them. To overcome specification problems, some of the requirements had to be dropped after extended delays in negotiating on alternatives.

In the mind of some of the respondents who were stakeholders, delay in disbursement of funds was perceived as bad relations. For example, one financier tied the initial release of funds for the Olkaria project, to GoK settlement of outstanding loan arrears in other sectors unrelated to the project. This happening, with implementation contracts already executed tended to strain the relations between the borrower and the financier.

The purpose of resource planning is to ensure that adequate, suitable or appropriate factors of production (money, equipment, manpower, and land) are optimized and timely deployed in the process of generating value in assets acquisition. Timely facilitation of access to site by contractor or its agents was crucial in ensuring that the contractors continued to perform their obligation as planned with the allocated resources. Failure to do this led to poor resources utilization, slip on schedule and additional costs through claims by contractors. Deployment of competent personnel by contractors called for a competent team drawn from various professional disciplines and an appropriate organization structure that created a cohesive team to execute and deliver the project. Arising out of the poor relations between the engineer and the contractors were issues of disagreement that would often hold parts of the works interfering with smooth interface with other contractors on site.

The understanding of government regulations was crucial for smooth execution of the projects. However, it appeared that, at the start of construction, the contractors were unfamiliar with the requirements. Similarly, the engineer often found himself in similar situations and could not make timely decisions without procrastination and lengthy consultations. Immigration department delays in releasing of work permits led to removal of personnel from their work, which had to suffer delays and consequential cost to the projects

The details for works definition are derived from the formulation phase of the project where the project concept is crystallized after considerable effort, technical studies, consultations etc. Poor field investigations, incomplete and inadequate information, bad or deliberately wrong estimation, lack of expertise or experience, inadequate project analysis, omission of project linkages and poor appraisal and investment decisions led to wrong project definition and consequently wrong works definition. If the basic parameters of the project are wrong, the time and cost overruns are in-built from the very start and these are bound to follow later (Kholi, 2001). The absence of contract strategy that was a critical success factor on implementation of project could be inferred from the happenings under Olkaria II project. The number of and size of the contracts, interface between the different contracts, and the management of the contracts should have been appropriately defined and planned at formulation stage. The problem of complex interfaces among contracts may have been exacerbated by delays of mobilization of contractors as a consequent of delayed advance mobilization loan. During the entire implementation period, it was difficult to maintain a coherent integrated project schedule to work to as a result of inter-contracts delays.

The concepts and applications of risk management in construction projects have extensively been covered by Kerzner (2001) and Fisk (2000). One precept to be recognized is that all risks are rightfully owner's unless transferred or assumed by another party for fair compensation (Fisk, 2000). Risk allocation refers to risk spreading, or reaffirmation of the existing allocation of risk so that the risk stays where it would otherwise be (Fisk, 2000). The second guideline in determining whether a risk be should so transferred is whether the receiving party has both the competence to access the risk fairly and the expertise necessary to control or minimize it. In all contracts, it appeared that some of the risks were not well defined and allocated. For example, risks of delays associated with customs clearances were ill defined and were a source of protracted debates. Poor communication between parties appeared to be problematic where there was inadequate information and team spirit was lacking. For example, respondents cited lack of communication by client team at the commencement stage of the project, hoarding of information by staff, too many players on the client side which did not give simple point of responsibility on decision making, and rigidity of parties to assist each other as some of the factors that led to overruns.

The identification of these factors fulfilled the first objective of the study and was a pointer to solutions to the study problem. Variables associated to the eight factors included: inadequate contractor experience, poor construction methods, delays in procurement of materials and equipment, contractor's own cashflow problems, unrealistic client budget, poor specifications in the contract, poor labour productivity, bad relations wit financiers, delayed payments to contractor, delay of access to site, lack of adequate professional skills by project team, poor subcontracting, poor relations between engineer and contractor, government relations, increase in scope of work, complex interfaces of various work packages, late design changes, poor handover interface, bureaucracy of government agencies, unexpected ground conditions, and poor communication between parties. Similar findings were reported by Mansfield et al. (1994), Pillai and Kannan (2001), Adhikari (2002), and Frimpong et al. (2003).

Factor labeling was subjective, as some of the variables 'hanging together' did not provide conceptual meaning to the factors. For example, under contractor inabilities, the variable, 'unrealistic client budget' had no conceptual meaning to this factor. However, further analysis of the variables provided clarity on the factor label. Government bureaucracy related to one factor only. This was considered via the concept of *simple structure*. A factor structure is considered simple if each of the original variables relates highly to one factor and each factor can be identified as representing what is common to a relatively small number of variables (Kleinbaum et al., 1998).

5.3 Relative Importance of the Factors

The relative importance of these factors in contributing to overruns on future projects as perceived by respondents was achieved through ranking using the extent of contribution index and the concept of Relative Importance Index (RII). The RII has been used extensively in research to rank factors from different groups in a survey. Kumaraswamy and Chan (1998) used RII to rank factors as perceived by contractors, consultants and clients in building works and civil engineering works. Mansfield et al. (1994) used *severity index*, which was derived from the percentage of respondents giving a given response. Long et al. (2004) used mean score, same as the extent of contribution in ranking of factors.

In adopting this method of ranking, for factors, using the average of the mean scores and RII, the eight factors were ranked. The high correlation between the two techniques may be used to validate the ranking using either of the methods. One interpretation of the results was that, in the minds of the respondents, variables that they considered significant in contributing to overruns were also perceived as having high frequency of occurrence on future projects. The ranking of the eight factors provided KenGen management, and others in similar industries, with a guide on priority areas where more effort or focus should be directed in curbing overruns on projects during implementation.

5.4 Quantitative Impact of Factors

The quantitative assessment of the impact of the variables fulfilled the 3rd objective of the study. The results from the exercise were aimed at providing tangible effects of overruns and consequences of occurrence of any of these factors. The absolute values of overruns associated with some of the factors were identified. However, it was difficult to isolate some of the overruns, due to the way the data was presented. To avoid misrepresentation of impact of the factors, the absolute values on costs were reported as found in the reports. That is, the currencies for transactions were retained, as any attempt to convert to single reporting currency, had an inherent danger of distorting the results. Similar analyses were conducted by Pillai and Kannan (2001) on sixteen power projects in Kerara, India, Their analyses was limited to overall impacts to time and cost on the projects rather than the impact of individual factors. Thus, the case study provided a closer analysis of underlying factors to overruns from which, KenGen, investors or the Government would be in a better position to provide for appropriate contingencies during planning, having assessed the risks potential

5.5 Conclusions

Problems associated with implementation of construction projects by private and public sectors in the process of asset acquisition have extensively been reported through various literature. The problems are also pervasive in developed and developing economies. They occur in various forms and magnitude on different project types, economies and project environments leading to time and cost overruns. This study was undertaken with three objectives; to identify significant factors that contributed to time and cost overruns in power projects implemented by KenGen on behalf of the Kenya Government, to establish the relative importance of these factors, and to quantify the time and costs associated with the significant factors. From the study findings, the following conclusions were drawn,

(i) The were many variables that contributed to time and cost overruns in the four recent power projects implemented by KenGen on behalf of the Kenya Government. The variables included: delayed payments to contractor, employer cash flow problems, delay in disbursement of funds by financiers, bureaucracy of government agencies, complex interfaces of various work packages, the length of the implementation of the project, delay in procurement of materials and equipment, inadequate planning by employer before commencement of construction, late design changes, delay in approvals by engineer, delays in release of drawings, increase in scope of work, disputes between parties and delay of access to site. This revelation should enable planners to take stock of the past performance and incorporate lessons learned.

(ii) These variables have the potential of recurring in future projects implemented by KenGen under similar circumstances. There is a need to anticipate their occurrence and to continually design appropriate strategies and mechanism to overcome or minimize their potential impacts.

(iii) Through factors analysis, the 33 significant variables could largely be explained by eight underlying factors namely; contractor inabilities, improper project preparation, resource planning, interpretation of requirements, works definition, timeliness, government bureaucracy, and risk allocation. These factors offer a general view that would act as a guide in formulating new policies and strategies in managing projects in the future.

(iv) Government bureaucracy can be considered to have been the lead factor in contributing to overruns on these projects. The other factors in order of significance were resource planning, works definition, timeliness, improper project preparation, contractor inabilities, interpretation of requirements, and risk allocation. The occurrence of any of these factors on a project will largely depend of the project environment at the time of implementation. Hence there is a need to continually scan the environment and identify the actor and factors.

(v) There were time and cost overruns on all the four projects. Olkaria II Geothermal Power Project had the highest overruns in time and cost. Kipevu I Diesel Power Project was second on cost overrun followed by Gitaru Unit 1. Sondu Miriu Phase I also recorded time overrun. However, cost overruns were yet to be determined. The ability to minimize the impact of overruns will largely depend on proper definition of the project scope, adequate planning of schedule and resources, commitment of all project teams, and of application of modern project management techniques through use of qualified and motivated manpower. Risk should continually be assessed through the various stages of the project life cycle, determined, and appropriate contingencies adopted.

5.6 Recommendations

It is evident from the study that implementation of power project in Kenya, like any other infrastructure development will experience problems that often will lead to time and cost overruns. Based on the finding from this study, I would recommend that the Government of Kenya and KenGen undertake the following on all future projects implementation.

5.6.1 Contractor's Performance

In the foreseeable future, the Government and KenGen will continue to fund power projects through bilateral and multilateral financing agencies. This will continue to place constraints on the type of contracts or procurement strategies that can be adopted when selecting contractors to implement the construction. To overcome some of the problems associated with contractors inabilities, better contract management, penalties and incentives should be designed at implementation planning. The contract planning (both for works and equipment suppliers) will have to be linked closely to resource-based implementation planning of the projects (Kholi, 2001). Contractors and suppliers should be bound to give their resource and time plans integrated with project plans (based on PERT/CPM) and follow them. Enforcing liquidated damages clauses and enhancing incentives for early completion to contractors will ensure that they are interested in on-time completion. Contractors should be paid on time as per the contract agreement to avoid situations where timely resource planning is affected due to cashflow problems. KenGen should ensure that the engagement of subcontractors, and delegation of duties by the prime contractor does not impede on the project progress. Where delays are anticipated, project authority should be able to off-load contracts (partially of fully). Contractor's abilities to manage its finances should be assessed during the bidding process by ensuring that the balance sheets are in order and liquidity is sound to meet immediate obligation. Where consultants are used for planning, awarding, and following up the contracts, the effectiveness of consultants in contract management should be properly evaluated.

5.6.2 Project Preparation

During project preparation, enough time and resources should be allocated to ensure that adequate field investigation are conducted, appropriate and up to date information is gathered, specification are prepared, scope is well defined, good estimates on material are made, adequate project analysis is done, and linkages in projects activities are identified. From this, KenGen will be able to assess the risks involved, formulate adequate plans and contingencies. It is on this basis that KenGen will be able to sufficiently translate these plans into a budget that will ensure sufficient funds are secured. Flyvberg et al. (2004) observed that before a project owner decides to proceed and build a project, every effort should be made to conduct preparation, planning, authorization and ex ante evaluation is such a ways that problems are negotiated and eliminated that may otherwise resurface as delays during implementation. In cases where long delays (that is, a year or more) in award for project implementation will occur, review and update on the contents of the project documents should be a pre-requisite to ensure that the project will still meet the deliverables envisaged earlier. KenGen should ensure that consultants engaged on its projects understand local requirements for successful implementation. Project managers, in addition to traditional project management functions, must set up a process to scan the environment, to identify potential problems, and try to establish power relationships that can help them manage the key actors and factors on which successful implementation depends (Youker, 1992). There should also be sufficient manpower on KenGen's project team, qualified to work alongside the consultant and provide necessary knowledge cap between them on the project environment. Kwak (2002) observed, that international consultants engaged to assist with project preparation have different social-cultural background than the beneficiaries, may not be familiar with local resources, and are accustomed to different approaches to engineering and project management practices. Kenya, like any other developing countries, lack resources, managerial skills and have low human capital productivity (Kwak, 2002). Therefore, project design standards, specifications, and construction methods must be carefully selected so that they will be appropriate to local financial, human, and material resources required during both the implementation and its subsequent operation (Kwak, 2002). Kumaraswamy and Chan (1998) viewed interaction of other factors on the project affecting labour productivity. They further hypothesized that motivation of both management and labour can be key contributors to productivity

5.6.3 Resource Planning

Before actual implementation of the project starts, KenGen should undertake detailed implementation planning covering aspects such as physical work, time plan, input resources, inter-linkages, organization and management systems, output generation, and cost planning. Adequate resource plan and its linkage with time plan are crucial. The implicit resource requirements (manpower, materials, money etc.) for each period may not meet the availability constraint and hence the time plan may not be implementable (Kholi, 2001). All the major activities that may have impact on time and cost to the project should be conceived and sufficient time provided for. For example, land acquisition, right of ways (ROW), clearances and administrative procedures should be adequately covered. Sufficient funds to cover the entire project should be provided to minimize cost overruns that warrant higher outlays. KenGen should anticipate requirements of inter-linkages in contracts or its agencies and provide for them or should always initiate dialogue with interlinked agencies early in the planning stage so that realistic time durations are allocated. The organization and management systems needed for successful implementation should be properly planned. Inadequate project preparation leading to scope changes during implementation is perhaps the most important reason for overruns (Morris, 1990). No effort should be spared in the initial stage of a project to properly define the project goals and its deliverables (Dvir et al., 2003).

The tendering process should encourage the participation of the local contractors and consultants as a strategy in improving of the local skill and transfer of technology. The Government should formulate policies that help in developing local human capacity through proper training. This will call for providing incentives such as offering a tax deduction on money spent on training, and for authorizing trade unions or other agencies to regulate, follow-up on training, and classify trades. Developing human resources also applies to construction engineers who usually lack adequate managerial skills (Odeh and Battaineh, 2002).

5.6.4 Team Building

Collaborative approach or team building between KenGen, local and foreign contractors and consultants on a project will help in adopting innovative management techniques, value engineering in order to be more efficient and effective. Consultants (project manager) should be taken on board early on a project and their continuity ensured through the implementation so that they will provide effective link between the client and the contractor. The project manager must appreciate the environment of development projects, maintain flexibility, and be competent to analyze the nature of associated problems and their diverse effects on the success of the project, and address these promptly (Kwak, 2002). This will also apply to KenGen project team; it should be engaged on the project at formulation, through planning and implementation. If parties involved in planning, specifications and design can work as a team with those who will handle the actual construction and installation, many loose ends, and the seemingly endless delays and backtracking needed to resolve conflicts, can be eliminated before work even begins (Mezher and Tawil, 1998). Team- building approach will offer a single interaction with owners and allow more flexibility because of the wider mix of skills available, much better communication and much more response to the owner's needs.

5.6.5 Contract Strategy

The contract strategy adopted i.e. number of and size of contracts, interface or interlink between the different contracts and their management is a critical success factor for project performance. KenGen should formulate this at the planning stage. Complex works interfaces should be avoided and works should only be split into packages that can easily be managed. Late design changes will often complicate the management process of interfacing linked works or contracts.

5.6.6 Linkage with Government

Linkage with government agencies in future projects execution will be inevitable. To minimize the delays associated with Government agencies, KenGen should formulate strategies for constructive engagement with the relevant agencies through its communication department. For example, teams identified from these agencies could be inducted into the projects through initiatives like, invitations during launch of project's charter, occasional site visit for updates, and continuous dialogue and communication with or without a project ongoing. The key agencies are those in Ministry of Energy, Ministry of Finance, environmental and conservation, revenue collection, customs clearances, immigrations and local authorities.

On the hand, it will be beneficial to the projects if contractors could be encouraged to hire local experts in law, taxation and financial regulations, and environmental issues. This will greatly enhance compliance and reduce delays when directly dealing with the government agencies.

5.6.7 Risk Management

Project environment in Kenya comprises of diverse risk factors that may impede on their successful performance. KenGen should adopt modern risk management tools like International Project Risk Management (IPRA) for identification, assessment, analysis of impact, and management response (Gibson and Walewski).

5.7 Limitations on the Study

One of the main limitations on the study was the size of the sample of projects available for the study. Of the four selected, only three were completed and in commercial operation. It would have been more enlightening if a large sample of completed projects were available and a large sample of respondents could be used. The other limitation was on the secondary data; the difficulty in splitting into discrete time and cost impacts for each factor due to the close interrelationship between variables. Literature on similar studies in Kenya to collate with that from other countries was scarce.

5.8 Recommendations for Further Research

A lot of research has been done and documented on time and cost overruns in developing countries in Asia on many areas of infrastructure and commercial (e.g. high-rise building) development. However, this was lacking in Kenya, denying many potential investors or developers a source of information on what factors to consider for successful implementation of projects in Kenya. Further research in similar infrastructure developments was therefore recommended.

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APPENDIX I: QUESTIONNAIRE

Time and Cost Overruns in Public Sector Power Projects in Kenya: A Case of Kenya Electricity Generating Company Ltd.

Please email or mail back the answered questionnaire as soon as possible, as timely reply will greatly assist me in completing my thesis for the MBA program. Upon completion of the study, the final report will sent to each survey participant.

For more details, please contact:

Eng. David Kagiri
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THANK YOU VERY MUCH FOR YOUR KIND COOPERATION AND VALUABLE TIME

PART A: GENERAL INFORMATION

1. Name of the project...

2. a) Designation/title of respondent on this project....................................
   b) Qualification (e.g. civil engineer, economist etc).................................
   c) Experience in years of respondent on similar assignments ....

PART B

Question: To what extent do think that each of the following factors contributed to time and cost overruns? Please rate the chance of occurrence by circling a suitable a figure as indicated below.

Scale of extent of contribution: 1- **Not Important**, 2- **somewhat important**, 3- **Important**, 4- **very Important**

Scale of chance of occurrence: **High** (3), **Medium** (2), or **Low** (1)

Causes of delay and cost	*Extent of contribution*				*Chance of occurrence*		
The length of the implementation of the project	4	3	2	1	3	2	1
Lack of adequate professional skill by project teams	4	3	2	1	3	2	1
Delays in approvals by engineer	4	3	2	1	3	2	1
Inappropriate organizational structure	4	3	2	1	3	2	1
Complex interfaces of various works packages	4	3	2	1	3	2	1
Delay of access to site	4	3	2	1	3	2	1

Inadequate planning by employer before commencement of construction	4	3	2	1	3	2	1
Delay in procurement of materials and equipment	4	3	2	1	3	2	1
Inadequate supervision of works	4	3	2	1	3	2	1
Unexpected ground conditions	4	3	2	1	3	2	1
Bureaucracy of government agencies	4	3	2	1	3	2	1
Lack of involvement by client team	4	3	2	1	3	2	1
Delays in disbursement of funds by financiers	4	3	2	1	3	2	1
Poor construction method	4	3	2	1	3	2	1
Escalation on materials	4	3	2	1	3	2	1
Disputes between parties	4	3	2	1	3	2	1
Unrealistic client budget	4	3	2	1	3	2	1
Poor handover interface	4	3	2	1	3	2	1
Delayed payment to contractor	4	3	2	1	3	2	1
Lack of motivation from all teams	4	3	2	1	3	2	1
Labour disputes	4	3	2	1	3	2	1
Poor subcontracting	4	3	2	1	3	2	1
Exchange rate fluctuations	4	3	2	1	3	2	1
Political interference	4	3	2	1	3	2	1
Corruption or rent seeking	4	3	2	1	3	2	1
Delays in release of drawings	4	3	2	1	3	2	1
Employer cashflow problems	4	3	2	1	3	2	1
Increase in scope of work	4	3	2	1	3	2	1
Inadequate/Poor cost control	4	3	2	1	3	2	1
Poor specifications in the contract	4	3	2	1	3	2	1
Poor relations between engineer	4	3	2	1	3	2	1

and contractor		
Unpredictable weather	4 3 2 1	3 2 1
Project contract terms	4 3 2 1	3 2 1
Complex payment process	4 3 2 1	3 2 1
Contractor Shortage of equipment for work	4 3 2 1	3 2 1
Inadequate contractor experience	4 3 2 1	3 2 1
Poor communication between parties (e.g engineer Vs contractor, engineer Vs employer)	4 3 2 1	3 2 1
Poor infrastructure e.g. road, telecommunication	4 3 2 1	3 2 1
Inadequate work inspection	4 3 2 1	3 2 1
Poor safety measures	4 3 2 1	3 2 1
Low labour productivity	4 3 2 1	3 2 1
Client failure to supply information and materials	4 3 2 1	3 2 1
Underestimation of project duration	4 3 2 1	3 2 1
Lack of client top management support	4 3 2 1	3 2 1
Bad relations with financiers	4 3 2 1	3 2 1
Contractor's own cash-flow problems	4 3 2 1	3 2 1
Environmental issues	4 3 2 1	3 2 1
Government regulations	4 3 2 1	3 2 1

PART C

Question: What other factors not listed in part B do you consider to have had significant contribution to overruns in the project/s you were involved? Please list five (5) in the order of their importance.

i) ……………………………………………

ii) ……………………………………………

iii) ……………………………………………

iv) ……………………………………………

v) ……………………………………………

APPENDIX II: TABLES FOR ANALYSES

Table (I) Summary of Factors from Part C of the Questionnaire	
Groups	Factors
Contractor related	Poor quality of work leading to re-work
	Inexperience of contractor staff and lack of skill
	Poor management by contractor manager
	Hoarding of information by staff
	Cost cutting on some subcontracted items
	Subcontracting problems
	Contractor joint venture arrangement
	Poor contractor project management and planning
	Poor transport facilities of labour by contractors
	Inadequate manpower on the side of the contractor
	Non-availability of key resources (or changes during the project
	Low morale
	Contractors' lack of territorial experience
	Contractor lack of understanding of government procedures
	Contractors infrastructure and support in the territory of the site
	Accommodation of staff
	Slow mobilization and manning by civil contactor
	Frivolous claims by contractors- resources spent assessing them
	High "claim conscious" attitude by contractor resulting in a lot of unnecessary project correspondences, delays and disputes
	Lack of utility for test/commissioning on time
	Misunderstanding of owners requirements
	Financial problem of the contractor's head office
Employer related	Delay in approval of variations
	Unachievable milestones set in the contract
	Delay in financial approval of variations
	Delay on acting on engineer/owner instruction
	Lack of acceptance of improvements of design by employer
	Coordination with KPLC for safe access into substations
	Late resolution of transmission wayleaves
	Careless in original specificaton such as derating of plant
	Principal application of european product (e.g. ABB) due to engineer's specification
	Variation to material and specifications

	Allow enough time, pre-construction contract, for thorough risk assessment, assessment of contract form, specifications, management contracting and contracting strategy
	Lack of value engineering
	Lack of continuity of consultant in preparation of contract documents and supervision of construction giving rise to ambiguities and difficulties in adopting technical specs.
	Use of very old technical specifications for parts f the works without allowing for adequate review and revision for other than safety related issues.
	Lack of updated drawings on existing equipment to be modified
	Ill defined scope
	Delay between project design and awards
	No complete review of design
	Late review of civil works designs necessitated by revised civil work requirement of plant contract
	Delay in receipt of adequate design data from plant contractor
	Redesign of the project
	Inadequate check measures against engineer's error and conduct
	Inadequate involvement of project team at an early stage (pre-award)
	Poor involvement of employer's project takeover staff as resource persons
	Too many players on the client side which does no give simple point of responsibility on decision making
	Lack of environment that nurtures and encourages meritocracy
	Lack of communication by client team at the commencement stage of the project
	Failure to incorporate lesson learnt re-inventing the wheel)
	Changing contract conditions without allowing for adequate review of the consequential impacts
	Time became "at large" because of delays that were the responsibility of the (if not the fault) of the employer
	Failing to Secure full project finance and commitment thereof at the start
	Financial influence on condition of contract
	Inappropriate funding arrangement
	Contracting strategy of construction contracts
All parties related	Rigidity of parties to assist each other
	Variation to material and specifications

	Poor management of scope change
	Ineffective risk management
	Security of construction site
	Involvement of lawyers to contractual issues of the project
Government related	Changes in legislation e.g. customs procedures
	Lost time by tax exemptions
	Changes of priority with respect to funding e.g. emphasis on regional interconnection.
Financiers related	Rigid conditions placed by donors leading to non-optimal awards
	Delay in release of funds
	Terms and conditions of financing, for instance with regard to contract packaging and appointment of consultants
	Longer durations required by the World Bank to approve tender documents and tender evaluations
	Longer durations required by financiers/client for approval of properly justified additional funds for successful execution and completion of contracts.
	Dividing of the loan to phases by financiers
	Inappropriate relationship between the employer and lending institutions-the employer need to be much firmer with the lenders and to insist on sensible and pragmatic observance of lenders procurement rules and the lenders need to understand the project technology better.
Consultant related	Poor design by engineer
	Poor actioning of design deficiency by engineer
	Lack of support by engineer to contractor engineering principle
	Poor management of key interfaces between contractors
Project location related	Local ethnic groups at construction site (e.g. maasai) interface of
	Indirect related parties (schools, hospital, farm, etc)
	Location of plant being in a national park
	Terrain of pipeline- difficult in some places
	Economic benefits to local community for instance in employment and subcontracting
	Empowerment of stakeholders e.g. NGOs
	Interference by local community

	Poor relations between client and community surrounding the project area

Table II Descriptive Statistics- Variables' Extent of Contribution			
	N	Mean	Std. Deviation
Delayed payment to contractor	41	3.414634	0.805469
Employer cashflow problems	41	3.390244	0.891012
Delays in disbursement of funds by financiers	41	3.365854	0.968403
Bureaucracy of government agencies	41	3.268293	0.742442
Delay of access to site	41	2.97561	1.060373
The length of implementation of the project	41	2.95122	1.094331
Delay in procurement of materials and equipment	41	2.878049	0.92723
Inadequate planning by employer before commencement of construction	41	2.829268	0.972174
Late design changes	41	2.804878	1.054028
Delays in approvals by engineer	41	2.756098	0.969033
Delays in release of drawings	41	2.731707	1.00061
Increase in scope of work	41	2.707317	1.006079
Disputes between parties	41	2.707317	0.980915
Delay of access to site	41	2.682927	0.985876
Poor specifications in the contract	41	2.634146	1.042979
Bad relations with financiers	40	2.625	1.169867
Lack of adequate professional skill by project teams	41	2.609756	0.891012
Inadequate supervision of works	41	2.609756	1.021715
Environmental issues	41	2.560976	1.049971
Poor subcontracting	41	2.560976	0.97593
Inadequate contractor experience	41	2.560976	1.141245
Government regulations	41	2.536585	1.185276
Poor handover interface	41	2.512195	0.977802
Low labour productivity	41	2.512195	0.897829
Underestimation of project duration	41	2.487805	1.164516
Poor construction method	41	2.463415	1.097669
Unrealistic client budget	41	2.439024	1.025885
Poor communication between parties.	41	2.414634	1.094888
Complex payment process	41	2.414634	0.94804
Unexpected ground conditions	41	2.414634	0.974054
Client failure to supply information and materials	41	2.390244	0.971546
Lack of involvement by client team	41	2.390244	1.115304
Poor relations between engineer and contractor	41	2.365854	1.042979
Contractor shortage of equipment for work	41	2.341463	0.964618
Inadequate / Poor cost control	41	2.317073	1.010916
Escalation on materials	41	2.317073	1.010916
Contractor's own cash- flow problems	41	2.292683	1.167131
Exchange rate fluctuations	41	2.268293	0.949326
Inappropriate organizational structure	41	2.268293	0.895109
Project contract terms	41	2.219512	1.084255
Poor relations between engineer and contractor	41	2.195122	0.95445
Lack of motivation from all teams	41	2.170732	0.891696
Poor safety measures	41	2.146341	0.963353
Political interference	41	2.121951	1.029445

Lack of client top management support	40	2.1	1.127739
Inadequate work inspection	41	2.073171	0.932476
Labour disputes	41	2.02439	0.907959
Corruption or rent seeking	41	1.95122	1.071243
Unpredictable weather	41	1.878049	0.812254
Valid N (listwise)	40		

Table (III) Relative Importance Indices (RII) for the Variables				
Variable	N	SUM	Mean	RII
Bureaucracy of government agencies	41	103	2.512195	0.837398
Delayed payment to contractor	41	101	2.463415	0.821138
Employer cashflow problems	41	99	2.414634	0.804878
Increase in scope of work	41	94	2.292683	0.764228
The length of the implementation of the project	41	93	2.268293	0.756098
Delay in disbursement of funds by financiers	41	91	2.219512	0.739837
Complex interfaces of various works packages	41	89	2.170732	0.723577
Delay in procurement of materials and equipment	41	88	2.146341	0.715447
Inadequate planning by employer before commencement o construction	40	83	2.075	0.691667
Escalation on materials	41	85	2.073171	0.691057
Exchange rate fluctuations	40	82	2.05	0.683333
Delay in release of drawings	41	84	2.04878	0.682927
Late design changes	41	82	2	0.666667
Disputes between parties	41	81	1.97561	0.658537
Poor handover interface	41	79	1.926829	0.642276
Government regulations	41	79	1.926829	0.642276
Delays in approval by engineer	41	77	1.878049	0.626016
Delays of access to site	41	77	1.878049	0.626016
Underestimation of project duration	41	76	1.853659	0.617886
Inadequate/poor cost control	41	74	1.804878	0.601626
Complex payment process	41	74	1.804878	0.601626
Poor subcontracting	41	73	1.780488	0.593496
Inadequate supervision of works	41	72	1.756098	0.585366
Poor specifications in the contract	41	72	1.756098	0.585366
Poor communication between parties (e.g. engineer vs contractor)	41	72	1.756098	0.585366
Contractor's own cashflow problems	41	72	1.756098	0.585366
Low labour productivity	40	70	1.75	0.583333
Inadequate contractor experience	41	71	1.731707	0.577236
Lack of adequate professional skill by project teams	41	70	1.707317	0.569106
Unrealistic client budget	41	70	1.707317	0.569106
Corruption or rent seeking	41	70	1.707317	0.569106
Poor relations between engineer and contractor	41	70	1.707317	0.569106
Poor infrastructure e.g. roads, telecommunication	41	70	1.707317	0.569106
Poor safety measures	41	70	1.707317	0.569106
Environmental issues	41	70	1.707317	0.569106
Inappropriate organizational structure	41	69	1.682927	0.560976
Lack of involvement by client team	41	69	1.682927	0.560976
Political interference	41	69	1.682927	0.560976
Unexpected ground conditions	40	66	1.65	0.55
Client failure to supply information and materials	40	65	1.625	0.541667
Poor construction methods	41	66	1.609756	0.536585
Contractor shortage of equipment for work	41	66	1.609756	0.536585
Inadequate work inspection	41	64	1.560976	0.520325
Bad relations with financiers	40	61	1.525	0.508333

Labour disputes	41	62	1.512195	0.504065
Poor contract terms	40	58	1.45	0.483333
Unpredictable weather	41	58	1.414634	0.471545
Lack of motivation from all teams	41	57	1.390244	0.463415
Lack of client top management support	40	54	1.35	0.45

Table (IV) Comparison of extent of contribution to frequency of occurrence of variables				
Variables/causes of overruns	Extent Index	Rank	RII	Rank
Delayed payment to contractor	3.41	1	0.821	2
Employer cash flow problems	3.39	2	0.805	3
Delays in disbursement of funds by financiers	3.37	3	0.739	6
Bureaucracy of government agencies	3.27	4	0.837	1
Complex interfaces of various works packages	2.98	5	0.724	7
The length of implementation of the project	2.95	6	0.756	5
Delay in procurement of materials and equipment	2.88	7	0.715	8
Inadequate planning by empl. Before comm. of constrn.	2.83	8	0.691	9
Late design changes	2.80	9	0.667	13
Delays in approvals by engineer	2.76	10	0.626	17
Delays in release of drawings	2.73	11	0.683	12
Increase in scope of work	2.71	12	0.764	4
Disputes between parties	2.71	13	0.659	14
Delay of access of site	2.68	14	0.626	18
Poor specification in the contract	2.63	15	0.585	24
Bad relations with financiers	2.63	16	0.508	44
Lack of adequate professional skill by project teams	2.61	17	0.569	29
Inadequate supervision of works	2.61	18	0.585	23
Environmental issues	2.56	19	0.642	16
Poor subcontracting	2.56	20	0.593	22
Inadequate contractor experience	2.56	21	0.577	28
Government regulations	2.54	22	0.569	35
Poor handover interface	2.51	23	0.624	15
Low labour productivity	2.51	24	0.583	27
Underestimation of project duration	2.49	25	0.618	19
Poor construction method	2.46	26	0.537	41
Unrealistic client budget	2.44	27	0.569	30
Poor communication between parties	2.41	28	0.585	25
Complex payment process	2.41	29	0.602	21
Unexpected ground conditions	2.41	30	0.550	39
Client failure to supply information and materials	2.39	31	0.542	40
Lack of involvement by client team	2.39	32	0.561	37
Poor relations between engineer and contractor	2.37	33	0.569	32
Contractor shortage of equipment for work	2.34	34	0.537	42
Inadequate/poor cost control	2.32	35	0.602	20
Escalation on materials	2.32	36	0.691	10
Contractor's own cash flow problems	2.29	37	0.585	26

Exchange rate fluctuations	2.27	38	0.683	11
Inappropriate organizational structure	2.27	39	0.561	36
Project contract terms	2.22	40	0.483	46
Poor infrastructure eg. Roads, telecom	2.20	41	0.569	33
Lack of motivation from all teams	2.17	42	0.463	48
Poor safety measures	2.15	43	0.569	34
Political interference	2.12	44	0.569	38
Lack of client top management support	2.10	45	0.450	49
Inadequate work inspection	2.07	46	0.520	43
Labour disputes	2.02	47	0.504	45
Corruption or rent seeking	1.95	48	0.569	31
Unpredictable weather	1.88	49	0.471	47

Table (V) Variables Correlation Matrix

	VAR19	VAR27	VAR13	VAR11	VAR05	VAR01	VAR08
VAR19	1	0.705697	0.694395	-0.29837	0.32216	0.294763	-0.13538
VAR27	0.7056968	1	0.490949	-0.4139	0.451326	0.368714	-0.18907
VAR13	0.694395	0.490949	1	-0.26556	0.33947	0.193242	-0.02811
VAR11	-0.298373	-0.4139	-0.26556	1	-0.17902	-0.10248	-0.0486
VAR05	0.32216	0.451326	0.33947	-0.17902	1	0.173233	0.240775
VAR01	0.294763	0.368714	0.193242	-0.10248	0.173233	1	0.07314
VAR08	-0.135383	-0.18907	-0.02811	-0.0486	0.240775	0.07314	1
VAR07	0.475926	0.366722	0.305856	-0.11404	0.433421	0.320568	0.277893
VAR32	0.259281	0.337012	0.304286	-0.25496	0.657303	0.408723	0.448896
VAR03	0.161374	0.080172	0.227885	-0.08805	0.455957	0.196984	0.448906
VAR26	0.137543	0.201186	-0.02986	-0.21319	0.464294	0.304684	0.375627
VAR28	0.024876	0.070219	0.185975	-0.13572	0.294441	0.071312	0.39988
VAR16	0.493915	0.35127	0.52884	-0.18373	0.378397	0.241423	0.122126
VAR06	0.408248	0.388934	0.270239	-0.10441	0.277656	0.261909	0.235624
VAR30	-0.090029	0.071157	-0.04362	-0.04093	0.464059	0.10823	0.297653
VAR47	0.29758	0.308511	0.45506	-0.24354	0.377018	-0.06254	0.367019
VAR02	0.211709	0.083665	0.124569	-0.163636	0.276185	0.075048	0.349976
VAR09	0.012257	-0.08304	-0.01018	-0.13375	0.449285	0.018136	0.609271
VAR50	-0.262501	-0.24924	-0.24035	0.113924	0.138952	0.05848	0.344159
VAR22	-0.13506	-0.16339	-0.1349	-0.13159	0.298361	0.064827	0.431871
VAR37	0.067352	-0.0507	0.177168	-0.36747	0.32574	0.016609	0.660359
VAR48	0.048513	0.00913	0.155599	-0.31615	0.435299	-0.02542	0.534036
VAR18	-0.019771	0.026044	-0.04516	-0.31462	0.300701	0.278515	0.283258
VAR42	0.055924	0.098663	-0.01016	-0.23837	0.48177	-0.16613	0.432748
VAR44	0.242061	0.255094	0.156392	-0.26414	0.472388	0.387999	0.429281
VAR14	0.087422	-0.03948	0.314686	-0.25439	0.244783	0.118571	0.544849
VAR17	0.329759	0.172378	0.372841	-0.04998	0.394046	0.301556	0.483163
VAR38	0.14869	0.300262	0.167456	-0.31982	0.455275	0.344282	0.398366
VAR35	0.237915	0.376834	0.248412	0.135214	0.324251	0.300072	0.068563
VAR10	0.070746	0.192438	0.268458	-0.14913	0.340107	0.22065	0.50666
VAR43	0.161644	0.215367	0.23498	-0.2734	0.512266	0.194324	0.416484
VAR12	0.097915	0.09755	0.074159	-0.23568	0.389252	0.02237	0.342769
VAR31	0.132463	0.210752	0.252578	0.016425	0.429903	0.268375	0.166118

Determinant = 7.946E-18

Table (VI) Eigenvalues & Variance			
Component	Initial Eigenvalues	% of Variance	Cumulative %
1	12.589	38.149	38.149
2	3.727	11.295	49.444
3	2.122	6.430	55.874
4	1.663	5.040	60.913
5	1.554	4.710	65.623
6	1.381	4.183	69.806
7	1.258	3.813	73.619
8	1.018	3.085	76.704
9	0.885	2.682	79.386
10	0.860	2.607	81.993
11	0.805	2.439	84.432
12	0.685	2.076	86.508
13	0.576	1.747	88.255
14	0.526	1.594	89.849
15	0.463	1.404	91.253
16	0.437	1.325	92.578
17	0.366	1.109	93.687
18	0.343	1.039	94.727
19	0.283	0.859	95.585
20	0.275	0.833	96.419
21	0.234	0.710	97.129
22	0.194	0.588	97.717
23	0.180	0.544	98.261
24	0.148	0.448	98.709
25	0.126	0.382	99.091
26	0.090	0.271	99.363
27	0.055	0.168	99.530
28	0.053	0.160	99.690
29	0.039	0.117	99.807
30	0.024	0.073	99.880
31	0.020	0.061	99.941
32	0.011	0.034	99.975
33	0.008	0.025	100.000

Table VII Communalities			
	Initial	Extraction	
VAR19	1	0.769	
VAR27	1	0.847	
VAR13	1	0.827	
VAR11	1	0.806	
VAR05	1	0.601	
VAR01	1	0.790	
VAR08	1	0.619	
VAR07	1	0.648	
VAR32	1	0.829	
VAR03	1	0.721	
VAR26	1	0.738	
VAR28	1	0.806	
VAR16	1	0.666	
VAR06	1	0.837	
VAR30	1	0.892	
VAR47	1	0.905	
VAR02	1	0.724	
VAR09	1	0.897	
VAR50	1	0.728	
VAR22	1	0.603	
VAR37	1	0.926	
VAR48	1	0.828	
VAR18	1	0.793	
VAR42	1	0.831	
VAR44	1	0.712	
VAR14	1	0.761	
VAR17	1	0.671	
VAR38	1	0.707	
VAR35	1	0.659	
VAR10	1	0.745	
VAR43	1	0.782	
VAR12	1	0.786	
VAR31	1	0.860	
Extraction Method: Principal Component Analysis.			

Table (VIII) Component Matrix-Unrotated								
	Component							
	1	2	3	4	5	6	7	8
VAR19	0.272	0.817	-0.121	-0.062	-0.057	-0.038	0.018	0.059
VAR27	0.268	0.789	0.146	-0.286	-0.203	-0.028	-0.010	-0.087
VAR13	0.305	0.706	-0.211	-0.041	0.100	0.162	-0.380	0.092
VAR11	-0.304	-0.208	0.339	0.276	0.630	-0.015	0.131	0.254
VAR05	0.631	0.228	0.196	-0.313	-0.034	-0.112	-0.023	-0.012
VAR01	0.281	0.383	0.427	0.265	-0.310	0.372	0.226	0.163
VAR08	0.594	-0.384	-0.166	0.079	0.149	0.245	-0.039	-0.023
VAR07	0.646	0.324	0.052	0.250	0.020	-0.132	0.195	-0.069
VAR32	0.813	0.071	0.237	-0.056	-0.194	-0.081	-0.168	0.176
VAR03	0.739	-0.001	0.072	0.250	0.067	-0.269	0.163	0.054
VAR26	0.672	-0.134	0.163	-0.181	-0.307	-0.084	0.312	0.103
VAR28	0.540	-0.154	0.267	0.006	-0.006	-0.049	-0.643	0.054
VAR16	0.584	0.452	-0.230	0.240	0.095	-0.020	0.005	0.027
VAR06	0.561	0.370	0.042	0.247	0.266	-0.134	0.279	-0.394
VAR30	0.521	-0.195	0.445	-0.306	0.217	0.175	0.026	-0.461
VAR47	0.576	0.169	-0.333	-0.529	0.351	0.144	-0.025	0.101
VAR02	0.682	-0.018	-0.271	0.248	0.118	-0.242	0.108	0.199
VAR09	0.833	-0.297	-0.097	0.067	0.157	-0.256	0.066	-0.076
VAR50	0.428	-0.550	0.363	-0.103	0.070	0.204	-0.060	0.223
VAR22	0.581	-0.456	0.035	-0.070	-0.137	0.095	0.094	0.126
VAR37	0.808	-0.241	-0.379	0.080	0.006	0.157	0.001	-0.203
VAR48	0.798	-0.247	-0.287	-0.147	0.032	0.088	0.071	-0.113
VAR18	0.562	-0.207	0.170	0.284	-0.516	0.188	0.068	-0.137
VAR42	0.660	-0.269	-0.065	-0.446	0.004	-0.331	0.061	-0.084
VAR44	0.750	0.088	-0.063	-0.123	0.009	0.198	0.288	0.007
VAR14	0.676	-0.158	-0.369	0.228	-0.141	0.229	-0.087	0.109
VAR17	0.657	0.171	-0.047	0.177	0.263	0.314	-0.045	0.089
VAR38	0.778	-0.010	0.227	-0.052	-0.156	-0.100	-0.110	-0.023
VAR35	0.378	0.277	0.454	-0.110	0.353	0.201	0.136	0.195
VAR10	0.655	-0.018	-0.048	0.217	0.055	0.339	-0.285	-0.260
VAR43	0.764	0.000	-0.094	-0.226	-0.035	0.030	0.113	0.350
VAR12	0.697	-0.095	-0.143	0.187	-0.083	-0.411	-0.190	0.154
VAR31	0.620	0.096	0.495	0.192	0.135	-0.297	-0.255	-0.112
Extraction Method: Principal Component Analysis.								
A	8 components extracted.							

Table VIII Component Matrix- Rotated								
	Component							
	1	2	3	4	5	6	7	8
VAR19	-0.055	0.050	0.828	0.240	-0.050	0.106	-0.072	-0.025
VAR27	-0.227	0.172	0.812	0.100	0.062	0.204	0.195	-0.109
VAR13	0.229	-0.123	0.841	0.027	0.194	-0.050	-0.095	0.051
VAR11	-0.169	-0.278	-0.389	0.095	-0.026	-0.106	-0.040	0.725
VAR05	0.065	0.512	0.382	0.198	0.293	0.056	0.245	0.029
VAR01	0.023	0.058	0.286	0.093	0.033	0.812	0.029	0.185
VAR08	0.689	0.253	-0.172	0.119	0.146	-0.015	0.092	0.081
VAR07	0.205	0.209	0.311	0.626	0.107	0.239	0.061	0.041
VAR32	0.242	0.537	0.250	0.236	0.544	0.260	0.016	0.016
VAR03	0.258	0.377	0.032	0.651	0.245	0.131	-0.029	0.094
VAR26	0.145	0.735	-0.013	0.232	0.100	0.314	0.090	-0.076
VAR28	0.270	0.154	0.048	-0.005	0.837	-0.008	0.069	0.024
VAR16	0.364	0.066	0.513	0.491	0.073	0.075	-0.113	0.032
VAR06	0.194	0.024	0.304	0.753	-0.035	0.079	0.356	0.068
VAR30	0.215	0.311	-0.065	0.088	0.257	0.047	0.806	0.141
VAR47	0.450	0.494	0.493	-0.024	-0.041	-0.391	0.148	0.197
VAR02	0.416	0.344	0.081	0.572	0.122	-0.060	-0.276	0.061
VAR09	0.473	0.496	-0.130	0.554	0.277	-0.135	0.096	-0.004
VAR50	0.301	0.428	-0.388	-0.145	0.367	0.161	0.140	0.322
VAR22	0.418	0.544	-0.269	0.052	0.179	0.158	0.030	0.003
VAR37	0.807	0.334	0.011	0.314	0.096	-0.028	0.120	-0.198
VAR48	0.661	0.529	0.030	0.237	0.078	-0.091	0.163	-0.115
VAR18	0.369	0.250	-0.158	0.191	0.240	0.613	0.094	-0.300
VAR42	0.185	0.740	-0.030	0.227	0.209	-0.288	0.219	-0.150
VAR44	0.464	0.521	0.260	0.269	-0.061	0.199	0.185	0.091
VAR14	0.750	0.244	0.059	0.177	0.143	0.148	-0.209	-0.136
VAR17	0.590	0.112	0.314	0.256	0.158	0.146	0.060	0.312
VAR38	0.250	0.484	0.146	0.292	0.480	0.207	0.168	-0.058
VAR35	0.026	0.227	0.299	0.117	0.128	0.208	0.257	0.614
VAR10	0.687	-0.024	0.160	0.181	0.350	0.159	0.253	-0.047
VAR43	0.391	0.701	0.243	0.149	0.134	0.073	-0.115	0.141
VAR12	0.293	0.375	0.039	0.488	0.466	-0.077	-0.274	-0.146
VAR31	0.017	0.143	0.101	0.504	0.689	0.125	0.244	0.158
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.								
A	Rotation converged in 14 iterations.							

APPENDIX III SUMMARY DESCRIPTION OF THE CASE STUDY PROJECTS

Kipevu I (73 MW)Mombasa Diesel Generating Power Plant Project

The project works included the design, supply, construction and putting into service on turnkey contract basis of a complete diesel power station at Kipevu, in Mombasa. The project included six diesel generators units each with a nominal rating of 12.25 MW, associated mechanical, electrical and control systems, all civil and building works, rebuilding and extending the outdoor 132kV and upgrading and extending the KPLC communication system Kipevu to Nairobi to provide the necessary information at the National Control Center in Nairobi (KenGen, 2000).

A loan from JBIC to the Gok was on lent to KenGen towards financing of the project works. The loan financed the all the foreign component of the plant including engineering services. The local component of the civil works was finance by KenGen. The contract was awarded to a consortium of Mitsubishi Corporation and Mitsubishi Heavy Industries with a contractual completion period of 22 calendar months from the commencement date. The six diesel generator units were in commercial operation between 20th August 1999 and 6th October 1999, which was essentially on programme. Mott Macdonald, Brighton UK, provided engineering services. The Engineer was responsible for pre-qualifying tenderers, the preparation of the tender documents complete with engineering specification, tender adjudication and the supervision during the execution of the project as well as witness testing at manufacturers' works.

Gitaru Unit 1 (81.5 MW) Hydro Power Project

The project work included the design, supply, construction and putting into service on turnkey basis of a 72.5 MW third unit at the existing Gitaru hydroelectric power station. The plant is located on the Tana River about 162 km from Nairobi (KenGen, 2003).

Gitaru Power Station was designed to accommodate three units but only Units 2 and 3 were installed during initial construction period. However, the penstock and draft tube liner for Unit 1 were installed. Units 2 and 3 were commissioned in 1978 and each has a unit power of 72.5 MW.

KenGen wholly financed the Unit 1 project. The contract was awarded to a consortium of Siemens-Voith with 670 days to completion date after the letter of acceptance. Engineering Services were provided by Mott MacDonald Ltd, Brighton UK with Knight Piesold, Brighton, UK, providing engineering for the Civil works. The Engineer was responsible for pre-qualifying the tenderers, tender adjudication and supervision during of the execution of the project as well as witness testing at manufacturers' works. The initial specification called for a 72.5MW but improved design led to installation of an 81.5MW machine.

Olkaria II (70 MW) Geothermal Power Plant Project

The Olkaria II 70 MW Geothermal Power Plant Project is located in Hell's Gate National Park, near Naivasha, 120km north of Nairobi. It utilizes steam drilled from the earth crust and brought to the surface via steel pipe casing. It is the second plant of this type to be installed in Kenya, 4km north of The Olkaria 1, (48) MW plant and only one in Africa. IDA of World Bank, EIB, KfW, GoK, and KenGen provided the funds for the project.

The project was implemented through five international contracts, three of which were design-build, while two were build only, with design by KenGen consultants. The project were; consultants services awarded to Sinclair Knight Merz, PB Kennedy & Donkin (UK) and Howard Humphreys (K) Ltd, Civil and Structural Works awarded to Mitsubishi Corporation/Mitsubishi Heavy Industries/ H. Young & Co. (East Africa) Consortium, Power Station Mechanical and Electrical Plant awarded to Mitsubishi Corporation/ Mitsubishi Heavy Industries Consortium, High Voltage Substations awarded to Siemens AG; Germany, High Voltage Transmission Lines awarded to KEC International of India, and Steamfield Development awarded to NKK/ Marubeni/ Zakhem Consortium; Japan/ Kenya. The initial design based on available steam was for a 2x32 MW plant. However, a

2x35MW plant was realized through improved design that was achieved by incentives based evaluation criteria during bidding that called for optimization of available steam.

Sondu/Miriu (60 MW) Hydropower Project

The Sondu/Miriu Hydropower Project is being constructed in phases. The first phase, which has been completed, was constructed as the first phase of the overall multipurpose development of the Sondu River basin. It will be a run-of- river scheme transferring the water of the Sondu River to the Kano plain through a 4.2 metre diameter, 6.2km headrace tunnel, penstock and power station to harness a water head of some 197m. The phase 1 included the intake facility comprising of intake weir and weir sill, sand flushing bay, inlet gate, settling basin, and intake (to tunnel). The waterway comprised of headrace tunnel, the surge tank and the penstock. The construction of the remaining part of the project targeted for completion by end of 2008 (5 years behind schedule) is being implemented through other four contracts similar to Olkaria II project.