Time and Cost Overruns in Power Projects in Kenya: A Case Study of Kenya Electricity Generating Company Limited

David Kagiri
(Dkagiri@kengen.co.ke)
&
Gituro Wainaina
(wainainagituro@yahoo.com)

Abstract

Time and cost overruns in infrastructure development projects during implementation continue to pose great challenges to developing countries. Research has found that many factors impede the successful completion of projects on time, within budget and of good quality. This study sought to investigate the factors that significantly contributed to time and cost overruns in power projects implemented by KenGen, to evaluate their relative ranking and to quantify their impacts. The study was based on a questionnaire survey conducted with persons drawn from contractors, consultants and KenGen, who are involved in the implementation of one or more of the four projects in the study. Analysis of 33 significant variables from the survey revealed eight underlying factors contributing to overruns, namely, contractors' inability, improper project preparation, resource planning, interpretation of requirements, definition of the work involved, timeliness, government bureaucracy and risk allocation. As regards ranking, government bureaucracy topped the list while risk allocation was shown to have been the least significant. There was also a perception that these factors would recur in KenGen's future projects in a similar implementation environment. By closely relating the factors to the variables, it was observed that they resulted in overruns in the projects by varying magnitudes. The projects had time overruns ranging from –4.6% to 53.4 %, while the

cost overruns varied between 9.4% and 29%. These revelations should enable planners to take stock of past performance and incorporate the lessons learnt in future project planning and implementation. Because the variables and underlying factors are likely to recur in future projects, their occurrence needs to be anticipated and appropriate strategies and mechanisms designed in order to overcome or minimize their potential impact. Recommendations are given to assist the Government of Kenya (GoK) and KenGen on how project management could be improved when future projects are planned and implemented. The findings of this paper can be used as a reference by project owners, managers and agencies in developing their own project management strategies.

Keywords: KenGen; project management; overruns; variables; factors; project implementation

Background and Introduction

Individuals, private firms or public entities are continually acquiring physical assets in various forms, such as residential and commercial buildings, hospitals, schools and institutions, development infrastructure like water, roads, electricity and telecommunications. These assets represent major capital investment motivated by market demand 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 for money and competitive advantage. Understanding customers' needs and appropriately deploying the available resources to meeting them give a competitive edge over competitors in product and service provision. Thus, efficient and effective resource management through the appropriate use of tools and techniques for acquiring assets is critical. Customers are demanding better quality products through efficient and timely deliveries at low prices. It is therefore important that

the timing, cost and quality of constructed facilities are efficiently managed in the entire project life cycle for the efficient delivery of services or products. Delays and cost overruns in public sector investments can raise the capital-output ratio in the sector and elsewhere, reducing the efficacy of the investments (Morris, 1990). Thus, successful management of the processes employed to acquire these assets is to a large extent determined by the amount of resources expended, the time taken and the quality when compared to similar projects. Infrastructure includes the capital required to produce economic services from utilities (electricity, telecommunications and water) and transport (roads, bridges, seaports and airports) and is central to promoting economic activity (Chandra, 2002).

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

Electricity consumption is relatively low, at about 121KWh per capita. Overall, only 4 percent of rural and 46 percent of urban households have access to electricity, equivalent to a national average of 15 percent (GoK, 2003; 2004). This level of national penetration is very low relative to an average of 32 percent for developing countries (GoK, 2004). Because many people in Kenya do not have access to this commodity and it is costly, they depend on indigenous and traditional energy sources like wood and charcoal (GoK, 2003). This, in turn, has led to the depletion of forest resources and significant environmental damage. The lack of adequate, dependable and competitively priced power naturally hampers the

productivity and competitiveness of our industries in the region and global markets.

The current annual growth in demand for electric power stands at 6 percent (GoK, 2004). This translates into approximately 60 MW of additional capacity annually. This capacity takes care of retiring units and the aging of existing ones. The typical installation cost of a 1.0 MW diesel plant is approximately USD 1.0 million, while that of 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 for funds to undertake expansion. Alternatively, with the liberalization of the sector and the reforms in the economy, the private sector will increasingly have to play a vital role in meeting the shortfall. Currently, four IPPs are operating in the country.

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

Motivation for Research

The Government of Kenya and its development partners continue to allocate huge financial resources to finance infrastructure development. However, the intended benefits are partly or never realized due to the implementation of many unsuccessful projects. Specific research undertaken to investigate what ails the implementation of some public sector projects in Kenya provides an insight into what has been the major causes of project time and cost overruns, and the 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) focused on factors contributing to cost overruns in projects under the Ministry of Water. Talukhaba (1988) investigated the time and cost performance of construction projects. Mwandali (1996) did an analysis of major factors that affect project management of Kenya Railway projects. Similar observations have been made in developing countries like Indonesia (Kaming et al. 1997), Lebanon (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 overruns (Ogunlana and Promkuntong, 1996). Various factors contributing to overruns in Saudi Arabia were identified by Assaf et al. 1995 and in Ghana by Frimpong et al. 2003. Factors ranging from inflation, project complexity, inaccurate material estimation, financing, changes in orders, design changes, late submission of drawings, poor specifications, incorrect site information and poor contract management among many others were found to be the main causes of overruns.

Studies conducted in developed economies like Hong Kong (Kumararswamy and Chan, 1997; 1998), the UK/USA/Australia (Ireland,

1987), Florida (Ahmed et al. 2002) and Australia (Ireland, 1985) revealed a trail of time and cost overruns in building and infrastructure projects in the public and private sector, attributable to numerous factors that come into play during project implementation.

No studies have been conducted in Kenya to try and document the success or failure of public power projects to meet time and cost targets, neither have there been any studies on the few independent private power plants. Implementing a power plant project requires huge capital investment, and poor management of the process leads to huge financial loss in terms of penalties and revenue of the owner. Time and cost overruns in public power projects implemented by KenGen are a matter of public interest and concern for all stakeholders. To be able to respond to internal and external variables in a project environment that lead to overruns in implementing power projects, it was thought necessary to find out how and to what extent these variables contributed to delays and increased costs.

Research Objectives

This research identified and examined the factors that significantly contributed to time and cost overruns when KenGen implemented the construction of power projects on behalf of GoK. The research objectives were to:

(i) Identify the factors that significantly contributed to time and costs overruns in public power projects;
(ii) Establish the relative importance of these factors; and
(iii) Quantify the time and costs associated with the significant factors.

Research Methodology

The research was a multiple case study design that sought to obtain detailed, in-depth knowledge of a few power plant development projects. The

projects were procured, implemented and financed through similar processes but experienced different time and cost performance during implementation.

The study investigated four public sector power projects undertaken by KenGen in the last 15 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 clients, contractors and consultant personnel involved in these projects. Hence they were left out of the study.

The sample of projects encompassed the generating modes that KenGen has been developing and operating, namely, hydro-power, thermal and geothermal. The sample was small due to the nature of projects in this part of the world. The demand for their development is small and they take a long time to plan and implement thus limiting the availability of a large sample that could be subjected to rigorous statistical analysis. Records and data were 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). The sample of respondents for the survey was also purposive to meet the objectives of the study. Fifty-four respondents were selected.

The research employed both primary and secondary data. The primary data was collected through a self-administered questionnaire, which was pilot tested using four experts in the construction and management of projects. The final form of the questionnaire was e-mailed to the 54 respondents, who included project consultants/specialists, KenGen personnel (managers and engineers) and contractor personnel involved in the projects at senior level.

The questionnaire comprised three parts. Part A sought to capture the general

particulars of the respondents. Part B focused on the 50 factors (independent variables) identified from the literature review as the causes of overruns. This part gave each respondent an opportunity to identify the variables 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 of each variable in 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 been a significant cause of overruns.

The secondary data comprised information obtained from contract documents, claims documents, monthly, annual and project completion reports, expenditure spreadsheets, tables capturing data on progress payments and work progress schedules. The data and information were recorded on a continuous basis and collated at defined periods for monitoring, control and reporting purposes. Monitoring, control and reporting were compared with established baselines.

Data Analysis

Part A of the questionnaire was analyzed using descriptive statistics with a view to summarizing 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 the extent of contribution were analyzed using descriptive statistics and principle component factor analysis, using the Statistical Package for Social Science (SPSS). Kaming et al., (1997) 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).

A total of 54 questionnaires were e-mailed to potential respondents that participated in the implementation of one or more of the four projects. Of

these, 41 (75.9%) questionnaires were returned. 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. The proportion of respondents in terms of number of years in similar assignments ranged between 5 and 20.

Approximately 20% of the respondents did not complete part C. 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.

Preliminary Analysis

(i) Analysis of Variables' Extent of Contribution to Overruns

The calculated mean and standard deviations of responses on the extent of the contribution to the 49 causes of delay and cost are tabulated in Appendix I. 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, key factors among others in table II were delayed payment to contractors, employer cash flow problems, delay in disbursement of funds by financiers and bureaucracy of government agencies.

(ii)Relative Importance of Variables

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

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

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 an indicator or measure of the likelihood of 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 2 of Appendix II. By applying the criteria of over 60% or an RII greater than 1.8 the variables that most frequently occurred during the implementation of similar power projects in Kenya by KenGen were as follows: the length of implementation of the project, delays in approval by the engineer, complex interfaces of various work packages, delays in accessing the site, inadequate planning by employer before commencement of construction, delays in the procurement of materials and equipment, bureaucracy of government agencies, delays in the disbursement of funds by financiers, escalating cost of materials, disputes between parties, poor handing over, delayed payment to contractors, exchange rate fluctuations, delays in release of drawings, employer's cash flow problems, increased scope of work, inadequate/poor cost control, poor specifications in the contract, late design changes, poor communication between parties (e.g. engineer and contractor, engineer and employer), low labour productivity, underestimation of project duration, environmental issues and government regulations.

(iii) Comparison between Extent of Contribution and Relative Importance Index

To elicit the respondents' rating of the extent of the contribution to the occurrence of each variable a comparison was made between the mean

rating score of the extent of the contribution and the RII, and the results are shown in Appendix III. A scatter plot and correlation coefficient were used to examine the bivariate relationship between the two rankings. Figure 1 displays a plot of the extent of contribution index against RII.

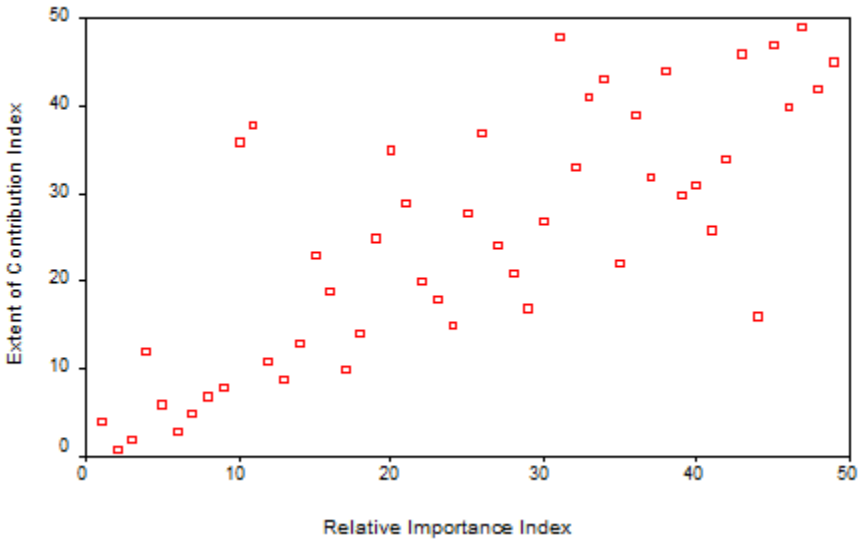

Fig. 1: *Scatter Plot for Extent Index and Relative Importance Index*

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 the 0.01 level (1-tailed).

Factor Analysis of Time and Cost Overrun Variables

(i) Preliminary Analysis

To capture and reveal any multivariate correlations among the variables identified as significant contributors to overruns, and to further explore the structure of the data, the Principal Component Analysis (PCA) technique

was employed to explain the relationships among several difficult-to-interpret correlated variables in terms of a few conceptually meaningful and relatively independent factors (Kleinbaum et al., 1988). To proceed with this technique, its appropriateness for factor extraction was examined through several tests. They included the 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 the Bartlett test of sphericity, which is a statistical test for the presence of correlations among variables (test of identity matrix).

Thirty-three highly ranked variables based on mean scores (extent of contribution indices) were selected for factor analysis, since the extent of their contribution was perceived as "somewhat" to "very" important and their means approximated to more than 2.4 (60%) on a scale of 1 to 4. This criterion was consistently chosen 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 the severity of each variable in the overruns. The normality test plots showed that the data was approximately normal. The other tests of the determinant of correlation matrix, KMO and Bartlett's Test indicated a lack of multicollinearity or singularity, which confirmed that the data were suitable for proceeding with factor analysis. Table 1 below shows the extracted factors and their respective variables that have loadings greater than 0.5.

Table 1: *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*
Contractors' lack of experience	0.807							
Poor construction methods	0.750							
Delays in procuring materials and equipment	0.689							
Contractor's cash flow 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 in gaining access to site			0.828					
Lack of adequate professional skills of project team			0.812					
Poor sub-contracting			0.513					
Poor relations between engineer and contractor				0.753				
Government regulations				0.554				
Increased scope of work					0.837			
Complex interfaces of various work packages					0.689			
Late design changes						0.812		
Poor handing over						0.613		
Bureaucracy of government agencies							0.806	
Unexpected ground conditions								0.725
Poor communication between parties (e.g. engineer and. contractor, engineer. and. employer								0.614

"CF" stands for component factor; factor loadings with values less than 0.50 are not shown

Description and Analysis of Factors

The preliminary analysis and principal factor analysis resulted in the identification of the factors that significantly contributed to time and cost overruns. The factors identified were contractor's inability, improper project preparation, resource planning, interpretation of requirements, definition of work, timeliness, government bureaucracy and risk allocation.

(i) Contractors' Inabilities

This factor consisted of inadequate contractor experience, poor construction methods, delays in procuring materials and equipment, contractor's cash flow problems and unrealistic client budget. At the pre-qualification stage, contractors' past experience of similar assignments and environments, as well as the proposed team, were among the parameters used to judge which contractors would be invited to bid for the work. In the case of KenGen, the process for selecting contractors for power plant construction contracts followed the procurement guidelines of financiers such as the World Bank, EIB, KfW and JBIC. All the contracts were awarded to international contractors or consortiums on the International Competitive Bidding (ICB) basis.

Delays in procuring materials and equipment arose in projects due to the various parties involved. The contractors were responsible for procuring materials and equipment in all the contracts. For multi-contract projects, where the engineer had the dual role of designer and supervisor in civil engineering contracts, many factors were involved, leading to delays. In some contracts, the contractors delayed the release of drawings, and the supply contractors delayed giving design information to the engineer's designers so that they could prepare the drawings, while the delay in payment to contractors and the placement of letters of credit exacerbated the whole process, leading to overruns. Contractor's cash flow problem

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

(ii) 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 work was delayed while the parties attempted to find an agreeable interpretation of the specifications. In some projects, the specifications were prepared early in 1990 but implementation commenced ten years later. There were many conflicts over drawings and specifications. For example, a specification in one contract was different from that in another contract for a similar item, making it very difficult to harmonize the two. There were cases where the supply of items was duplicated in two contracts, which was often realized much later when either the design was advanced or complete. The contract conditions disallowed the cancellation of a piece of work item being undertaken by one contractor and awarding it to another. In the four projects, some of the specifications were inconsistent with local requirements. Poor labour productivity was one of the main components of contractors' claims for loss of productivity, because the labourers involved had engaged in a slowdown due to failure to pay them on time. There were reported cases of labour unrest in some contracts due to poor working conditions, like poor transport for workers and the lack of protective clothing.

The four projects that were studied were financed through various packages. The financiers included IDA, KfW, GoK, JBIC and EIB. The

multilateral financiers had specific requirements for the disbursement of funds to projects. In the event that GoK and the implementing agency, KenGen, failed to meet some of the stipulations in the loan agreements, delays in disbursement would ensue.

(iii) Resource Planning

This factor consisted of delayed payment to contractors, delayed access to the site, lack of professional skills of project team and poor sub-contracting. The problems of delayed payments and access to the site were the responsibility of the client. They were ranked 1st and 2nd, an indication of the severity of the problem. Delayed payment arose due to several factors; inadequate funding of the project, complex payment processes, client cash flow problems and delays in the disbursement process. Delaying contractors' or their agents' access to the site occurred in various forms in the projects and included delayed release of work site by the employer or his agents to the contractors involved in interface work, right of way issues with landowners concerning the power transmission line trace, and delay in releasing facilities for tests to be used by another contractor. The failure to provide the contractor with access to the site led to an extension of the time and additional costs. Disruption of the work through not giving access to various contractors engaged in projects led to additional expenditure.

In carrying out the work the contractor was required to deploy enough qualified manpower in order to deliver the project on time, within budget and to the specified quality. The repetitive demand for new drawings to be approved, poor workmanship and the need to rectify mistakes, delays in procurement and the delivery of insufficient materials due to wrong estimates were reported. The sub-contracting functions were the sole responsibility of the main contractor, whether or not he had been nominated. Such sub-

contracts were agreements between the main contractor and sub-contractor/s and involved no contractual relationship between the sub-contractors and KenGen. In these projects, power plant design, manufacture and construction involved many specialized skills. The contractor accomplished the task through allocating a part or parts of specialized work outside his core function to these other groups. The client approved or rejected the selection or nomination of the sub-contractor if he had reasons to doubt his ability to do a good job.

(iv) 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 were supervised by international consulting firms with little or no locally affiliated firms. One of the conditions for their selection was their familiarity with conditions pertaining to developing countries, especially in Africa. Poor relations between the two parties ensued with the result that each party tried to meet the project requirements independently. The differences in interpretation of the contract requirements between the engineer and the contractor appeared to be the major cause of the poor relations. For example, the contractor applied for compensation because of a perceived change in the specifications, but it was rejected. When the engineer was the designer and the contractor's proposal that the engineering design be improved was rejected, this appeared to be a source of contention. Many disagreements over re-measuring quantities under re-measurement contracts and assessing contractors' claims led to poor relations. These incidents generated a lot of correspondence, wasting many man-hours in resolving disputes.

The contractor was required to be familiar with Kenya's laws, regulations

and by-laws that might affect the project and to comply with the requirements. These related to tax/tariff requirements like duties, value added tax, legal entity establishment, and the 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 issues and corrupt business practices, among others.

(v) Definition of Work

This factor related to increased scope of work and complex interfaces of various work packages, which involved all the parties involved in the project. The engineer's design changes, the employer's need to improve the technology and the contractor's wrong estimates of the quantity of materials needed, among many other things, appeared to be the cause of delays and increased costs. The increased scope of work, due to technical changes, occurred in all the projects. It was evident that the definition of work in some of the projects was wanting in terms of scope, specifications and drawings. The complex interface of various work packages affected multi-contract projects, due to complications during bidding, such as delays in awarding contracts, which exacerbated their problems.

(vi) Timeliness

This factor relates to late design changes and poor handing over. During implementation of a project, the following changes were a common occurrence: changes in design, materials specifications, the skills needed, the construction methods or how the work should be done, the sequence of work, changes in the materials or facilities provided by the owner and changes in the contract time. For various reasons, the client, engineer or contractor would make late changes in the design so that, for example, the design of facilities across various contracts would be uniform. In other

instances, a contractor would demand changes in the materials and design to ensure the construction would be sound. A project is handed over when semi-complete or the complete work or facilities are transferred from the contractor to sub-contractors or from the contractor to the client. For example, in one project, the client handed over the turbine work to a civil engineering contractor to construct the pedestals on which to bolt the turbine for the generation of electricity. Once the turbines were bolted on to the pedestals, the civil engineering contractor handed it over to the contractor responsible for the generating facilities, who would install them and then hand the work over to the civil engineering contractor for final grouting. He would then hand over the facilities to the same contractor for testing and commissioning and finally to the owner of the facilities, the client. This was a complex process in a multi-contract project and was the cause of claims by contractors. There were many disruptions, leading to poor labour productivity and equipment utilization, culminating in an extension of the time and added costs for the affected contractors.

(vii) Government Bureaucracy

This factor related highly to only one original variable, "bureaucracy of government agencies". This related to the procedures that various functions the projects had to follow, such as clearance through customs, payment procedures, immigration and other permits. The procedures consumed a lot of time and manpower going through the huge amount of paperwork as well as the never-ending delays in processing it through various government agencies. The contractors had to employ additional manpower to expedite the process. The delay in releasing project equipment and materials through customs due to the delay in dealing with exemption from duties and taxes affected all the projects, which incurred added costs for expediting the process, placing bonds, storing the equipment and for settling various claims by contractors. Because all these procedures through government agencies

took such a long time, payments to contractors were delayed. The placement of letters of credit by the contractors had to be sanctioned by the government, which was the lender of the funds. In one supply-and-install contract, the placement of the foreign component of the letter of credit was delayed by 24 months, partly due the government's delay in issuing the necessary letters to the financier. Consequently, although the contractor had finished manufacturing the equipment, he could not ship it and had to store it abroad. The immigration department occasionally delayed issuing work permits to foreign workers, despite the fact that the loan agreement between the government and financiers takes cognizance of the type of people to be employed in the execution of work by contractors through its appointed agencies like KenGen. Many foreign personnel, both consultants and contractors, had to spend a lot of time following up on the issuance or renewal of work permits. Other permits related to local authority approval for construction, waste disposal, and the drilling of boreholes, as well as those relating to environmental and safety compliance.

(viii) Risk Allocation

This factor consisted of unexpected ground conditions and poor communication between parties (for example, between the engineer and the contractor and vice versa). In the four projects, the risk of unexpected ground conditions was distributed between three parties. The client (owner) was responsible for undertaking pre-contract exploratory measures, the engineer (designer), where applicable, was responsible for designing for the conditions expected with the larger proportion of risk being transferred to the contractor. The extent to which this was not feasible determined the degree to which KenGen retained a portion of the risk under the relevant clauses in the contracts. The respondents stated that overruns were due to ineffective risk assessment, changes in the contract conditions without allowing for a proper review of the consequential impacts and the lack of

thorough risk assessment. Due to "unforeseen conditions" in one of the projects, the contractor claimed that the boulders/rocks he encountered had not been revealed by the geotechnical data and information provided by KenGen.

Relative Importance of these Factors

The second objective of the study was to establish the relative importance of these factors. The eight "component factors" could explain 77% of the variance in the thirty-three variables considered significant in contributing to overruns. To be able to rank these factors, the average of the extent of the contribution of variables "hanging together" was used. For example, for "resource planning", in Table 2, the average of 3.41, 2.68 and 2.61 (Appendix I) was 2.90. From this ranking, government bureaucracy was ranked first with an index of 3.27 and the 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 2.

The perception of respondents that these factors in similar, future projects would reoccur was analyzed using RII of the associated variables, shown in Table 2. For example, the variables for "resource planning" were delayed payment to contractor, delay in getting access to site and lack of adequate professional skills of project team. The respective RII were 0.821, 0.626, and 0.569 (Appendix III) giving an average of 0.672, shown in Table 2. Government bureaucracy was ranked first, followed by definition of work. 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 2: *Ranking of the Factors*

Emerged Factor	*Average Extent Index*	*Rank*	*Average RII*	*Rank*
Contractors' inability	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
Definition of work	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

Summary of Research Findings

A survey was conducted with project personnel drawn from KenGen, and the contractors and consultants involved in the four recent projects in investigating the factors that made a significant contribution to time and cost overruns during their implementation by KenGen on behalf of GoK. The survey was also used to elicit those factors that were likely to recur in similar projects in the future. The respondents identified additional causes or variables that contribute to overruns. An analysis of the responses revealed that some variables significantly contributed to time and cost overruns and have a chance of recurring in future projects. These included, among others, delayed payments to contractor, employer's cash flow problems, delay in disbursement of funds by financiers, bureaucracy of government agencies, complex interfaces of various work packages, length of implementation of the project, delay in procurement of materials and equipment, inadequate planning by employer before commencement of construction, late design changes, delays in approval by engineer, delays in the release of drawings, increased scope of work, disputes between parties and delay in getting access to site.

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

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

The ranking using the relative importance index closely matched the extent of contribution. Government bureaucracy was ranked highest, followed by definition of work and resource planning. Timeliness came fourth followed by interpretation of requirements, contractors' inability, risk allocation, and improper project preparation. This order was important because it revealed the variables that KenGen should emphasise 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 highly likely to occur in future projects unless the problems produced by these agencies are brought under control.

By closely relating the factors to the various variables, it was observed that they resulted in overruns in the projects by varying magnitudes. The projects had time overruns ranging from – 4.6% to 53.4 %, while cost overruns varied between 9.4% and 29%

Significant Factors Contributing to Overruns

The significant factors contributing to overruns in the power projects and identified in the study were contractors' inability, improper project preparation, resource planning, interpretation of requirements, definition of work, timeliness, government bureaucracy and risk allocation. Kaming et al. (1997), in a similar study on overruns in high-rise projects in Indonesia found that equipment usage, resource estimates and the shortage of human resources caused delays, while environmental issues, cost data and inflation were significant in determining cost overruns. Musa (1999) in a study on water projects funded by GoK identified the quality of project management, the operating environment and infrastructure, motivation of workers, inadequate resources and organization of the project team as factors that caused delays in the projects. Developing countries lack resources and 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 the case study of Vietnam. Therefore, project design standards, specifications and construction methods must be carefully selected so that they will be appropriate for the local financial, human and material resources required during both implementation and subsequent operations (Kwak, 2002). It is important to appreciate that, for a country like Kenya, with perennial power shortages, power projects are more often implemented on a "fast track" basis and certain issues are easily overlooked during project preparation that often lead to snags when implementing projects like delayed payment to the contractor with a consequential delay in the schedule.

Contractor's experience is manifested in how the project is managed and how the responsibilities and obligations defined in the contract are carried out. The selection of the project team, supervision, scheduling, coordination

and control of work activities, methodologies, work plans, deployment and coordination of resources, procurement of materials, knowledge of the territory of the project and overall site management are indicators of an experienced contractor. The complexity of the technology and the financial standing and experience that were pre-qualification criteria for the four projects eliminated the participation of local contractors, confining them to minor sub-contracting roles. Poor construction methods by the contractor could be a reflection of poor specifications, lack of skills and experience and inappropriate equipment. Poor specifications led to a waste of resources and time as parties tried to agree on their interpretation. Turnkey (design-build) projects are easy to implement, but it is much more difficult to implement projects where the design and construction are done by different contractors. For example, in two of the projects that were studied, the consultant was responsible for designing the main civil engineering work and supervising the construction contractor. This led to protracted debates and correspondence, which could result in lost time and additional costs.

Cash flow 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 local sub-contractors, with consequent effects manifested in the delayed provision of services and goods and increased costs. Poor specifications arose from the fact that external consultants were biased to specifying what they were familiar with, and the client may not have had the time or ability to review them. To overcome specification problems, some of the requirements had to be dropped after extended delays in negotiating alternatives.

In the mind of some of the respondents who were stakeholders, the delay in the disbursement of funds was perceived as being due to bad relations.

For example, one financier tied the initial release of funds for one project to GoK settling an outstanding loan in other sectors unrelated to the project. Such a situation therefore tended to strain relations between the borrower and the financier.

The purpose of resource planning is to ensure that enough suitable factors of production (money, equipment, manpower and land) are obtained and timely deployed in order to generate a profit. Giving the contractor or his agents timely access to the site was crucial for ensuring that the contractor fulfilled his obligations with the allocated resources. Failure to do this led to poor resource utilization, delays in the schedule and additional costs. The deployment of competent personnel by contractors called for a competent team drawn from various professional disciplines and an appropriate organizational structure that created a cohesive team for executing and delivering the project. Arising out of the poor relations between the engineer and the contractor were disagreements that would often interfere with the work of other contractors on the site.

Having an understanding of government regulations was crucial for the smooth execution of the projects. However, it appeared that, at the start of construction, the contractors were unfamiliar with the requirements. The engineer often found himself in a similar situation and could not make timely decisions without lengthy consultations. Immigration department delays in releasing work permits led to the removal of personnel from the projects, which led to delays and added costs.

The definition of the work to be carried out is derived from the formulation phase of the project, when the concept is crystallized after technical studies and consultations have been conducted, requiring considerable effort. Poor field investigations, incomplete or 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 a wrong definition of the work to be carried out. If the basic parameters of the project are wrong, the time and cost overruns are built in from the start and are bound to follow later (Kholi, 2001). The absence of a contract strategy that was critical for the successful implementation of the project could be inferred from what was happening in the projects. The number and size of the contracts, the interface between the different contracts and the management of the contracts should have been appropriately defined and planned for at the formulation stage. The problem of complex interfaces between contracts may have been exacerbated by delays in mobilizing contractors because of a delay in the mobilization loan. During the entire implementation period, it was difficult to maintain a coherent project schedule to work to as a result of inter-contract delays.

The concept and application of risk management in construction projects have been extensively covered by Kerzner (2001) and Fisk (2000). One precept to be recognized is that all risks are rightfully the owner's unless transferred to 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 should (Fisk, 2000). The second guideline for determining whether a risk should be transferred is whether the receiving party has both the competence to handle the risk 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, the risk of delays associated with customs clearance was ill defined and was a source of protracted debates. Poor communication between parties appeared to be a problem when there was inadequate information and team spirit was lacking. For example, the respondents stated that

some of the factors that led to overruns were lack of communication by the client team at the commencement of the project, hoarding of information by staff, too many players on the client side, which made it difficult to know who was responsible for making decisions, and the rigidity of parties, making it hard for them to assist each other.

Identification of these factors fulfilled the first objective of the study and was a pointer to solutions to the study problem. The variables associated with the eight factors were contractors' lack of experience, poor construction methods, delays in the procurement of materials and equipment, contractor's cash flow problems, unrealistic client budget, poor specifications in the contract, poor labour productivity, bad relations with financiers, delayed payments to contractor, delay in getting access to site, lack of adequate professional skills by project team, poor sub-contracting, poor relations between the engineer and contractor, relations with the government, increased scope of work, complex interfaces of various work packages, late design changes, poor handing over, 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 labelling was subjective, as some of the variables 'hanging together' did not relate to the meaning of the factors. For example, under contractors' inability, the variable, 'unrealistic client budget' did not relate to the meaning of this factor. However, further analysis of the variables provided clarity on factor labelling. Government bureaucracy related to one factor only. This was considered a *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).

Relative Importance of the Factors

The relative importance of these factors in contributing to overruns in future projects as perceived by the respondents was achieved through ranking, using the extent of contribution index and the concept of 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 the factors perceived by contractors, consultants and clients in building and civil engineering works. Mansfield et al. (1994) used the *severity index*, which was derived from the percentage of respondents giving a certain response. Long et al. (2004) used mean score, which is the same as the extent of contribution in the ranking of factors. Adopting this method of ranking factors, using the average of the mean scores and RII, 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, the variables they considered significant in contributing to overruns were also perceived as having a high probability of recurring in future projects. The ranking of the eight factors provides KenGen management and others in similar industries with a guide to priority areas where more effort should be directed at curbing overruns in projects during implementation.

Quantitative Impact of Factors

The quantitative assessment of the impact of the variables expressed as a percentage fulfilled the third objective of the study. The results from the exercise were aimed at showing the tangible effects of overruns and the consequences of any of these factors occurring. The absolute values of overruns associated with some of the factors were identified and expressed as percentages. However, it was difficult to isolate some of the overruns, due to the way in which the data was presented Thus, the case study

provided a closer analysis of the underlying factors leading to overruns, from which KenGen, investors or the Government will be in a better position to provide for appropriate contingencies during planning, having assessed the potential risks.

Conclusions

Problems associated with the implementation of construction projects by the private and public sector have been extensively reported in various literature. The problems are also pervasive in developed economies. They occur in various forms and magnitude in different types of projects, economies and environments, leading to time and cost overruns. From the study findings, the following conclusions are drawn.

(i) There were many variables that contributed to time and cost overruns in the four recent power projects implemented by KenGen on behalf of KoG. The variables were 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, length of implementation of the project, delay in procurement of materials and equipment, inadequate planning by employer before commencement of construction, late design changes, delay in approval by engineer, delay in release of drawings, increased scope of work, disputes between parties and delay in getting access to site. This revelation should enable planners to take stock of past performance and incorporate the lessons learnt.

(ii) These variables are likely to recur in future projects implemented by KenGen in similar circumstances. There is a need to anticipate their occurrence and to design appropriate strategies and mechanisms to overcome or minimize their potential impact.

(iii) Through factors analysis, the 33 significant variables could largely be explained by eight underlying factors, namely, contractors' inability,

improper project preparation, resource planning, interpretation of requirements, definition of work, timeliness, government bureaucracy and risk allocation. These factors give a general view and could act as a guide to formulating new policies and strategies for managing projects in the future.

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

(v) There were time and cost overruns in all four projects, ranging from – 4.6% to 53.4 %, while the cost overruns varied between 9.4% and 29%. The ability to minimize the impact of overruns will largely depend on having a proper definition of the project scope, adequate planning of the schedule and resources, commitment of all project teams, and the application of modern project management techniques through using qualified and motivated manpower. The risks should continually be assessed throughout the stages of the project and appropriate contingencies adopted.

Recommendations

It is evident from the study that implementation of power projects in Kenya, like any other infrastructure development, will experience problems that will often lead to time and cost overruns. Based on the finding from this study, it is recommended that GoK and KenGen undertake the following when implementing future projects.

(i) Contractors' Performance

In the foreseeable future, the Government and KenGen should 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 construction. To overcome some of the problems associated with contractors' inability, there should be better contract management, and penalties and incentives should be designed at the implementation planning stage. Contract planning (both for the work and equipment suppliers) will have to be linked closely to resource-based planning and implementation of the projects (Kholi, 2001). Contractors and suppliers should be bound to integrate their resource, time and project plans (based on PERT/CPM) and follow them. Enforcing liquidated damages clauses and enhancing contractors' incentives for early completion will ensure that the project is completed on time. Contractors should be paid on time as per the contract agreement to avoid the situation of timely resource planning being affected due to cash flow problems. KenGen should ensure that the engagement of sub-contractors and the delegation of duties by the prime contractor do not impede the project's progress. Where delays are anticipated, those in authority should be able to offload contracts (partially of fully). Contractors' ability to manage their finances should be assessed during the bidding process, by ensuring that the balance sheets are in order and that there are enough funds to meet immediate obligations. Where consultants are used for planning, awarding and following up contracts, the effectiveness of consultants in contract management should be properly evaluated.

(ii) Project Preparation

During project preparation, enough time and resources should be allocated to ensure that an adequate field investigation is conducted, appropriate up-to-date information is gathered, specifications are prepared, the scope

is well defined, good estimates for materials are made, adequate project analysis is done and linkages in project activities are identified. From this KenGen will be able to assess the risks involved and formulate adequate plans and contingencies. On this basis 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 with construction , every effort should be made to make preparations, plan and authorize ex ante evaluation so that problems that may otherwise surface as delays during implementation are identified and eliminated. If long delays (that is, a year or more) are likely to occur in project implementation, reviewing and updating the contents of the project documents should be a prerequisite to ensure that the project will still produce the deliverables envisaged earlier. KenGen should ensure that consultants engaged in its projects understand local requirements for successful implementation. In addition to traditional project management functions, project managers should set up a process to scan the environment to identify potential problems, and should seek 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 in KenGen's project team, who are qualified to work alongside the consultant and can provide the knowledge needed on the project environment. Kwak (2002) observed that international consultants engaged to assist with project preparation have a different socio-cultural background from the beneficiaries, they may not be familiar with local resources and are accustomed to different approaches to engineering and project management practices. Kenya, like other developing countries, lacks resources and managerial skills and has low human capital productivity (Kwak, 2002). Therefore, project design standards, specifications and construction methods must be carefully selected so that they will be appropriate for the local financial, human and material resources required both during implementation and subsequent operations (Kwak, 2002). Kumaraswamy and Chan (1998) were of the

view that the interaction of other factors in the project affected labour productivity. They further hypothesized that motivation of both management and labour could be key contributors to productivity.

(ii) Resource Planning

Before actual implementation of the project starts, KenGen should undertake detailed implementation planning covering aspects such as the physical work, time plan, input resources, inter-linkages, organizational and management systems, output generation and cost planning. An adequate resource plan and its linkage with the time plan is crucial. The implicit resource requirements (manpower, materials, money, etc.) for each period may not be available and so the time plan may not be implementable (Kholi, 2001). All the major activities that may impact the timing and cost of the project should be defined and sufficient time provided for this. For example, land acquisition, right of way issues, clearances and administrative procedures should be properly looked into. Sufficient funds to cover the entire project should be provided to minimize cost overruns that lead to higher outlays. KenGen should anticipate the need for linkages between contractors or their agencies and provide for them or it should always initiate a dialogue with interlinked agencies early in the planning stage so that realistic time durations are arrived at. The organizational and management systems needed for successful implementation should be properly planned. Inadequate project preparation leading to scope changes during implementation is perhaps the major reason for overruns (Morris, 1990). No efforts should be spared at the initial stage of a project in properly defining the project's goals and its deliverables (Dvir et al., 2003).

The tendering process should encourage the participation of local contractors and consultants as a strategy for improving local skills and transferring technology. The Government should formulate policies that

will help develop local human capacity through proper training. This will mean providing incentives, such as offering a tax rebate for money spent on training, and for authorizing trade unions or other agencies to regulate and 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).

(iv) Team Building

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

(v) Contract Strategy

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

(vi) Linkage with Government

Linkage with government agencies in executing future projects is inevitable. To minimize the delays associated with Government agencies, KenGen should formulate strategies for constructively engaging with the relevant agencies through its communications department. For example, teams identified by these agencies could be inducted into projects through, for example, an invitation to the launch of a project's charter, occasional site visit for updates, and continuous dialogue and communication whether or not a project is ongoing. The key agencies are the Ministry of Energy, the Ministry of Finance, those dealing with the environment and conservation, revenue collection, customs clearance and immigration and local authorities. It will be beneficial to the projects if contractors could be encouraged to hire local experts in legal, taxation and financial regulations, as well as environmental issues. This will greatly enhance compliance and reduce delays when dealing directly with the government agencies.

(vii) Risk Management

The project environment in Kenya comprises diverse risk factors that may impede the successful performance of projects. KenGen should adopt modern risk management tools like International Project Risk Management to identify, assess and analyse the impact and management's response (Gibson and Walewski).

Limitations on the Study

One of the main limitations of the study was the size of the sample of projects available. 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 had been available and a large sample of respondents had been used. The other limitation concerned the secondary data as regards the difficulty of splitting the discrete time and cost impacts for each factor due to the close relationship between the variables. Literature on similar studies in Kenya to collate with that from other countries was scarce.

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 ensuring successful implementation of projects in Kenya. Further research on similar infrastructure developments is therefore recommended.

References

Ahmed, S.M., Azhar, S., Castillo, M. and Kappagantula, P. (2002) Construction Delays in Florida: An Empirical Study, Final Report Submitted to State Florida, Department of Community Affairs, (smahmed@eng.fiu.edu) (online).

Assaf, S.A., Al-Khalil, M. and Al-Hazml, M. (1995) 'Causes of Delay in Large Building Construction Projects', *Journal of Management in Engineering, Vol. 11, No. 2.*

Chan, D.W.M and Kumaraswamy, M.M. (1997) 'A Comparative Study of Causes of Time Overruns in Hong Kong Construction Projects', *International Journal of Project Management Vol. 15, No. 1, pp. 55-63.*

Chandra, P. (2002) *Projects Planning, Financing, Implementation and Review.* (5th edition) Publisher, Tata McGraw-Hill Publishing Company.

Chris, H. and Au (1999) *Project Management for Construction Fundamental Concepts for Owners, Engineer, Architects and Builders.* Prentice-Hall, Inc.

Dvir, D., Raz, T. and Shenhar, A.J. (2003) 'An Empirical Analysis of the Relationship Between Project Planning and Project Success', *International Journal of Project Management*, 21, pp. 89-95.

Fisk, E.R. (2000) Construction Projects Administration (6th edn), Prentice-Hall Inc.

Flyvbjerg, B., Holm M.K.S., and Buhl S.L. (2003) 'How Common and How Large are Cost Overruns in Transport Infrastructure Projects'. Department of Development and Planning, Aalborg University, Denmark, Transport Reviews, 2003, Vol. 23, No. 1, 77-88.

Flyvbjerg, B., Holm M.K.S., and Buhl S.L., (2004) 'What Causes Cost Overrun in Transport Infrastructure Projects'. Department of Development and Planning, Aalborg University, Denmark, Transport Reviews, Vol. 24 No. 3-18, January 2004.

Frimpong, Y., Oluwoye, J. and Crawford L. (2003) 'Delay and Cost Overruns in Construction of Groundwater Projects in a Developing Countries; Ghana as a Case Study', *International Journal of Project Management*, 21, 321-326.

Gibson, G.E. and Walewski, P. 'Risks of International Projects: Reward or Folly', (egibson@mail.utexas.edu) (online).

GoK (2003) Kenya Energy Sector Development Strategy, Nairobi, Ministry of Energy.

GoK (2004) Draft National Energy Policy, Nairobi, Ministry of Energy.

Ireland, V. (1985) 'The Role of Managerial Actions in the Cost, Time and Quality Performance of High-Rise Commercial Building Projects', *Construction Management and Economics*, 3, 59-87.

Ireland, V. (1987) 'A Comparison of U.S., U.K. and Australia Management Practices with Special Reference to Lost Time', *The Building Economist*, December, pp. 4-10.

Jagboro, G.O. and Aibinu A.A. (2002) 'The Effects of Construction Delays on Project Deliver in Nigerian Construction Industry', *International Journal of Project Management,* 20, 593-599.

Kaming, P.F., Olomolaiye, P.O., Holt, G.D. and Harris, F.C. (1997) 'Factors Influencing Construction Time and Cost Overruns on High-Rise Projects in Indonesia', *Construction Management and Economics*, 7, 83-94.

Karimi, R.B., "Factors which are Critical in Project Cost Overruns: A Case Study of Ministry of Water Resources Projects", Unpublished MBA Thesis, University of Nairobi, 1998. KPLC (2004), 2003/2004 Annual Report and Account.

Kerzner, H. (2001) *Project Management :A System Approach to Planning, Scheduling, and Controlling* (7th edition), John Wiley & Sons, Inc.

Kleinbaum, D.G., Kupper, L.L. and Muller, K.E. (1988) *Applied Regression Analysis and Other Multivariate Methods* (2nd edition), PWS-KENT Publishing Company, Boston.

Kohli U. (2001) "How to Minimize Time and Cost Over-Runs of Projects", Available at Http://www.shilpabichitra.com/shilpa2001/v083.htm (Cited 13-August-04).

Kumaraswamy, M.M. and Chan, D.W.M (1998) 'Contributors to Construction Delays', *Construction Management and Economist*, 16, 17-29.

Kwak, Y.H. (2002) *Critical Success Factors in International Development Project Management*. (kwak@gwu.edu) (online).

Long, N.D., Ogunlana, S., Quang T. and Lam, C.K. (2004) 'Large Construction Projects in Developing Countries: a Case Study from Vietnam', *International Journal of Project Management,* 22, 553-561.

Manavazhi, M.R. and Adhikari, D. K. (2002) 'Material and EEquipment Procurement Delays in Highway Projects in Nepal', *International Journal of Project Management*, 20, 627-632.

Mansfield, N.R., Ugwu O.O., and Doran T. (1994) 'Causes of Delay and Cost Overruns in Nigeria Construction Projects', *International Journal of Project Management*, 12 (4), 254-260.

Mezher, T.F. and Tawil, W. (1998) 'Causes of Delays in the Construction Industry in Labanon', *Engineering, Construction and Architectural Management*, 3, 252-260.

Morris, S. (1990) 'Cost and Time Overruns in Public Sector Projects', *Economic and Political Weekly,* Nov. 24, Vol. XXV, No. 47, pp. M154 -168.

Musa, G. H., "Determination of Factors Influencing Projects Delays in Water Projects in Kenya: The Case of Government Funded Projects", Unpublished MBA Thesis University Of Nairobi, 1999.

Mwandali, D., "Analysis of Major Factors that Affect Projects Management: A Case of Kenya Railways Projects", Unpublished MBA Thesis, University of Nairobi, 1996.

Odeh, A.M., and Battaineh, H.T. (2002) 'Causes of Construction Delay: Traditional Contracts', *International Journal of Project Management*, 20, 67-73.

Ogunlana, S.O., Promkuntong, K and Jearkjirm, V. (1996) 'Construction Delays in a Fast-Growing Economy: Comparing Thailand with Other Economies', *International Journal of Project Management.* Vol. 14, No. 1, pp. 37-45.

Pillai, N.V and Kannan, K.P. (2001) 'Time and Cost Over-runs of the Power Projects in Kerala', Centre for Development Studies, Thiruvananthapuram, Working Paper No. 320 (available: www.cds.edu).

Talukhaba, A.A., "Time and Cost Performance of Construction Projects", Unpublished M.A. Thesis, University of Nairobi, 1988.

Youker, R. (1992) 'Managing the International Project Environment', *International Journal of Project Management* 10, No. 4; Butterworth-Heinemann; pp 219-226.

Appendices

Appendix I: *Descriptive Statistics - Variables' Extent of Contribution*

Causes of Time and Cost Overruns	*N*	*Mean*	*Standard Deviation*
Delayed payment to contractor	41	3.414634	0.805469
Employer cash flow 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 in getting access to site	41	2.975610	1.060373
The length of implementation of the project	41	2.951220	1.094331
Delay in procurement of materials and equipment	41	2.878049	0.927230
Inadequate planning by employer before commencement of construction	41	2.829268	0.972174
Late design changes	41	2.804878	1.054028
Delays in approval by engineer	41	2.756098	0.969033
Delays in release of drawings	41	2.731707	1.000610
Increased scope of work	41	2.707317	1.006079
Disputes between parties	41	2.707317	0.980915
Delay in getting access to site	41	2.682927	0.985876
Poor specifications in the contract	41	2.634146	1.042979
Bad relations with financiers	40	2.625000	1.169867
Lack of adequate professional skills of project teams	41	2.609756	0.891012
Inadequate supervision of work	41	2.609756	1.021715
Environmental issues	41	2.560976	1.049971
Poor sub-contracting	41	2.560976	0.97593
Contractors' lack of experience	41	2.560976	1.141245
Government regulations	41	2.536585	1.185276
Poor handing over	41	2.512195	0.977802
Low labour productivity	41	2.512195	0.897829
Underestimation of project duration	41	2.487805	1.164516
Poor construction methods	41	2.463415	1.097669

Causes of Time and Cost Overruns	*N*	*Mean*	*Standard Deviation*
Unrealistic client budget	41	2.439024	1.025885
Poor communication between parties.	41	2.414634	1.094888
Complex payment process	41	2.414634	0.948040
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 short of equipment for work	41	2.341463	0.964618
Inadequate / Poor cost control	41	2.317073	1.010916
Escalation in cost of materials	41	2.317073	1.010916
Contractor's 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	0.954450
Lack of motivation in all teams	41	2.170732	0.891696
Inadequate safety measures	41	2.146341	0.963353
Political interference	41	2.121951	1.029445
Lack of client top management support	40	2.100000	1.127739
Inadequate inspection of work	41	2.073171	0.932476
Labour disputes	41	2.024390	0.907959
Corruption or rent seeking	41	1.951220	1.071243
Unpredictable weather	41	1.878049	0.812254
Valid N (list-wise)	40		

Appendix II: *Relative Importance Indices 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 cash flow problems	41	99	2.414634	0.804878
Increased 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 of construction	40	83	2.075000	0.691667
Escalation in cost of materials	41	85	2.073171	0.691057
Exchange rate fluctuations	40	82	2.050000	0.683333
Delay in release of drawings	41	84	2.048780	0.682927
Late design changes	41	82	2.000000	0.666667
Disputes between parties	41	81	1.975610	0.658537
Poor handing over	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 in getting 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 sub-contracting	41	73	1.780488	0.593496
Inadequate supervision of work	41	72	1.756098	0.585366
Poor specifications in the contract	41	72	1.756098	0.585366
Poor communication between parties (e.g. engineer and contractor)	41	72	1.756098	0.585366

Variable	*N*	*Sum*	*Mean*	*RII*
Contractor's cash flow problems	41	72	1.756098	0.585366
Low labour productivity	40	70	1.750000	0.583333
Contractor's lack of experience	41	71	1.731707	0.577236
Lack of adequate professional skills of 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
Inadequate 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	1.650000	0.550000
Client failure to supply information and materials	40	65	1.625000	0.541667
Poor construction methods	41	66	1.609756	0.536585
Contractor short of equipment for work	41	66	1.609756	0.536585
Inadequate inspection of work	41	64	1.560976	0.520325
Bad relations with financiers	40	61	1.525000	0.508333
Labour disputes	41	62	1.512195	0.504065
Poor contract terms	40	58	1.450000	0.483333
Unpredictable weather	41	58	1.414634	0.471545
Lack of motivation in all teams	41	57	1.390244	0.463415
Lack of client top management support	40	54	1.350000	0.450000

Appendix III: *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 employer before commissioning construction	2.83	8	0.691	9
Late design changes	2.80	9	0.667	13
Delays in approval by engineer	2.76	10	0.626	17
Delays in release of drawings	2.73	11	0.683	12
Increased scope of work	2.71	12	0.764	4
Disputes between parties	2.71	13	0.659	14
Delay in getting access to site	2.68	14	0.626	18
Poor specifications in the contract	2.63	15	0.585	24
Bad relations with financiers	2.63	16	0.508	44
Lack of adequate professional skills of project teams	2.61	17	0.569	29
Inadequate supervision of work	2.61	18	0.585	23
Environmental issues	2.56	19	0.642	16
Poor sub-contracting	2.56	20	0.593	22
Contractor's lack of experience	2.56	21	0.577	28
Government regulations	2.54	22	0.569	35
Poor handing over	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 methods	2.46	26	0.537	41

Variables/Causes of Overruns	*Extent Index*	*Rank*	*RII*	*Rank*
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 short of equipment for work	2.34	34	0.537	42
Inadequate/poor cost control	2.32	35	0.602	20
Escalation in cost of materials	2.32	36	0.691	10
Contractor's 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 in all teams	2.17	42	0.463	48
Inadequate 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 inspection of work	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