FACTORS WHICH ARE CRITICAL IN PROJECT COST OVERRUNS:

A CASE STUDY OF MINISTRY OF WATER RESOURCES PROJECTS

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JULY, 1998

DECLARATION

This management project is my original work and has not been presented for a degree in any other university.

Signed:..... **Date:** 2/9/98

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This management project has been submitted for examination with my approval as the university supervisor.

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DEDICATION

Dedicated to my dear parents Mr. and Mrs. Joseph Kiwanuka for their love of Education, my husband Silas for his immense encouragement and support throughout the course and also a special dedication to my grandfather Mr. Angelo Daudi Muchiri (Deceased) for his inspiration to always aim higher. Besides, special dedication to my dear son Kukubo Barasa for his co-operation.

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ABSTRACT

This study sought to identify factors contributing to project cost overruns in the Ministry of Water Resources. The policy objective of the water sector is to create an enabling environment for orderly coordinated and sustainable development of water resources including their conservation and protection. Towards this end, the Ministry has a strategy of supporting and coordinating all water projects and programmes in both rural and urban areas. Unfortunately, many of these projects are finally completed after some years, at a cost several times the original estimate.

In order to achieve the objectives of this study, primary data was collected from a sample of 32 project participants. The respondents included project managers, site and office engineers, supervisors and project officers. The information sought in the study was collected by means of interviews and a self-administered questionnaire.

Factors Analysis was used to analyze the data. The results of the analysis indicated that empirically five factors do emerge as the critical factors contributing to project cost overruns in the Ministry of Water Resources. They are: project Organization, Environment, Project Management, Project definition and Infrastructure and logistics. Further, suggestions as to what needs to be done in the light of the above critical factors to minimize cost overruns have been included in the summary and conclusions. They include:-

- adequate personnel policy
- adequate organization structure

- coupling of the different decision circuits within the bureaucracy with regard to construction costs, personnel costs and general expenses.
- Assessment of time, costs and quality.
- External auditing.
- Good communication
- Environmental sensitivity
- Proper project management
- Complete definition of project requirements.
- Provision of adequate infrastructure facilities.

CHAPTER ONE

INTRODUCTION

Both cost estimating and project cost control are as old as history. It could hardly be otherwise. The Bible takes us back 2000 years in history, mentioning the function of the project cost control quite explicitly. We read (Luke 14:28, THE HOLY BIBLE King James Version).

> ***For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he has sufficient to finish it?***

It is notable that not only cost control, but also budgeting and resource planning are implied.

We exercise cost control to avoid cost overruns, and even those are nothing new, if that is any comfort to us in today's context! Shortly after the beginning of the Christian era, the rulers in Rome decided to build an aqueduct for the town of Troas in Asia Minor (now the town of Toras, in Turkey). The overrun was a hundred percent and this was covered by the generosity of the wealthy Julius Atticus (Kharbanda et.al. 1987). Today, particularly in Kenya, it would be the taxpayer who would have to foot the bill since many projects are finally completed after some years, at a cost several times the original estimate.

Overruns in time and cost are customarily seen as failure in project management and when extreme can well be a "distater". Such overruns, unfortunately are the norm rather than the exceptions that they ought to be in most developing countries (Grool et.al. 1986). Projects overrun on both time and cost could be avoided or minimized with planning, control and

experience. This includes everyone connected with the project, whether at site or head-office, together with all the suppliers and subcontractors. (Goemans and Hans, 1986).

Cost control is in effect the prevention of waste and since waste is caused by people, it can only be controlled by people. According to Kharbanda et.al (1987) most of the waste is potential to being with: a design that has not been optimized. That is where cost control must start: In the design office. Leaving it till construction starts is far too late.

However, time and cost overruns can occur on any project, large or small, if it is left to itself. Size has nothing to do with it. Goemans and Hans (1986) in a review of seven studies covering a large variety of project types and environments drew the conclusion that it is a fact of life that every project will overrun if left to itself, and both the owner and contractor can then only be silent spectators. At least, they may well be `silent' to begin with, but at the end of the day, when the position is not only apparent but irretrievable, they may well shout a lot: but by then it is too late.

According to Hayfield (1986) a project is a success if both the client and the company realizing the project are satisfied. Usually, the client is satisfied if his budget of costs was not exceeded, the date of completion was met and the quality of the project was up to expectations.

Thus, one significant factor for the success of projects is proper project cost control which is a vital part of project management. Without effective cost control there cannot be effective management.

In addition, the business world today is highly complex and fiercely competitive. This makes the process of cost control today more vital than ever before coupled with the sheer size and

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complexity of modern projects and the risks thereby involved. Also, projects are often initiated in the context of a turbulent, unpredictable, and dynamic environment hence if cost control, led in the first instance by cost monitoring, the prime task of the project team is not given its proper place in project management, then the owner is likely to be putting not only the project, but perhaps even his whole business at risk.

1.10 DEFINITIONS

Precise and common definitions are indispensable building blocks in any discipline, a key base of its conceptual structure. Before attempting a discussion of project cost control, it is important that some of the key concepts be adequately defined.

WHAT IS A PROJECT?

While almost everyone has had experience with projects in one form or another, developing a definition of what exactly a project is, is often difficult. Any definition of a project must be general enough to include examples of the wide variety of organisational activities which managers consider to be "project functions". However, the definition should be narrow enough to include only those specific activities which researchers and practitioners can meaningfully describe as "project oriented".

Three of the many definitions of projects that have been offered may be considered as follows:

> ***A project is an organisation of people dedicated to a specific purpose or objective. Projects generally involve large, expensive, unique, or high risk undertakings which have to be completed by a certain date, for a certain amount of money, within some expected level of performance. At a minimum. all projects need to have well defined objectives and sufficient resources to carry out all the required tasks (Steiner, 1969).***

The second definition is offered by Cleland and Kerzer (1985) in their work "A project Management Dictionary of Terms" and includes the following characteristics:

> **[A project is] A combination of human and non-human resources pulled together in a temporary organisation to achieve a specified purpose.**

Similarly, Dr. Mbeche (1997) broadly defined a project as a specific finite task to be complete whether large or small, long or short. It is usually a one time activity with a well-defined set of desired end results or objectives.

A project, then, can be defined as possessing the following characteristics:

- A defined beginning and end (specified time to completion);
- A specific, preordained goal or set of goals;
- A series of complex or interrelated activities;
- A limited budget

ESCALATION

This is the movement in cost of an installation which is the combination of supplied equipment, materials and labour, constructed over a period of time. Escalation therefore, reflects and includes inflation, but the movement in escalation is not necessarily parallel to the movement in inflation (Kharbanda et.al 1987).

1.20 THE RESEARCH PROBLEM

The literature on project cost control is growing rapidly and gives the impression that the subject is one of considerable complexity and sophistication. However, little specific research has been conducted in the field of project cost control in developing countries. Kharbanda et.al. (1987) contends that project cost control is vital yet badly neglected in developing countries. This has made project overruns from time and other lapses a common place in these countries. He further observes that with most of the so-called cost control procedures, the costs that are being incurred are carefully recorded, but not controlled.

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In Kenya, most of development is taking place by means of project execution and such development projects are vulnerable to cost overruns. According to a report from the Ministry of Water Resources; Ksh. 8.5 billion is required to rehabilitate more than 500 water projects countrywide. Its further estimated that 584 water projects in rural and urban areas have not been completed since 1992 due to lack of funds.(Daily Nation, 23rd march 1998).

Another example could be the Bura project(World Bank 1995).The construction of this project began two years behind schedule resulting in significant costs.(Table 2).By 1982,Bura was two years behind schedule and costs had risen to 187% of estimates in the World Bank's Appraisal Report. This increased the total costs to be borne directly by the Government of Kenya to about 50%. As a result, Bura has come to dominate spending on Agricultural development in Kenya, absorbing 31% of the Ministry of Agriculture's development budget in 1983-84 and 23% in 1984-85.

Little research has been conducted on project cost overruns. A study by Bruce et.al.(1974) revealed the principal determinants of cost and schedule overruns for both public and private sector projects. The focus had been on attempting to detail the relationships among situational structural, and process variables as they are related to project effectiveness. It is important to note that such conceptualisations and supportive empirical evidence have been obtained from advanced countries, with an implicit bias toward a Western mode of rationality. Such concepts may either have no application or may need modification before they are applied in developing countries where circumstances are very different.

Therefore, there is need to determine the factors that contribute to cost overruns in Kenya and from the perspectives of development projects, the public sector institutions, in our case the

Ministry of water resources projects. *Thus the central question in this study is to determine which factors are critical in project cost overruns? and what precautions are necessary to prevent these developments in future?*

1.30 OBJECTIVES OF THE STUDY

The broad objective of the present study is to determine those factors critical to project cost overruns. Often, the typical project manager has responsibility for successful project outcomes without sufficient power, budget or people to handle all the elements essential for project success. In addition, projects are often initiated in the context of a turbulent, unpredictable, and dynamic environment.

Consequently, the project manager would be well served by more information about those specific factors critical to project cost overruns. The project manager requires the necessary tools to help him or her focus attention on important areas and set differential priorities across different project elements. If the study can demonstrate that a set of factors can have a significant impact on project cost, time and Quality, the project manager will be able to effectively deal with the many demands created by his job.

The study will therefore address the following specific objectives

i) Identify factors which contribute to cost overruns; and to determine which of these factors are critical to project cost overruns.

ii) Identify what needs to be done in the light of the critical factors to minimise cost overruns.

1.40 OVERVIEW OF THE MINISTRY OF WATER RESOURCES

The policy objective of the water sector is to create an enabling environment for orderly co-ordinated and sustainable development of water resources including their conservation and protection against pollution and over exploitation among other aspects.

To achieve the water development objective, the Ministry will continue with the strategy of supporting and co-ordinating all water projects and programmes in both rural and urban areas.

First priority is given to the rehabilitation and augmentation of several water projects all over the country under social Dimensions of Development, which are considered to be core project. This is in line with the National Policy of assisting the vulnerable groups that have been adversely affected by the Structural Adjustment Programme (SAPs).

Second priority is given to the ongoing projects and programmes which have been identified as being of high priority through the Budget Rationalisation Programme. This will ensure that projects are completed in time and benefits realised faster. In addition, the Ministry will concentrate resources on the rehabilitation of existing water facilities to improve on the utilisation of existing capacity and increase coverage.

WATER PROJECTS

An interview with the Deputy Director, Water Development revealed that the major factors contributing to project cost overruns were:

i) Delays in implementation due to :

a) Delayed payments to the contractor arising from cashflow problems;

b) Adverse environmental conditions such as the El Nino phenomenon;

c) Inappropriate designs which later on cause variation to the works;

ii) Political Interference:

This at times causes erratic extensions to the projects.

iii) Unsatisfactory Project Management:

a) Insufficient use of project management tools

b) Poor planning: In most cases planning has been forgotten as a result of political goodwill.

iv) Delays in decision making

v) Contractors non-performance forcing termination of contract and retendering

vi) Cost element:

Fluctuations in currency during period of implementation affecting procurement of project inputs.

Costs overruns were seen to be normal in this Ministry as 99.9% of the projects are not completed on budget and within schedule. Currently, the Ministry of Water Resources has got

28 core projects, 145 high priority projects and 56 new projects. Of the on-going projects over 100 are Government of Kenya Projects while the others are external projects.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.10 PROJECT COST CONTROL

According to Kharbanda et.al (1987) we exercise cost control to avoid cost overruns. Project cost control, or cost monitoring, whilst it elevates the word cost has infact three dimensions:

- Cost (on-budget/within resource criterion)
- Time (on-schedule performance)
- Quality (Technical project success according to agreed-on objectives)

These three factors are interrelated and interdependence. They can all be expressed in monetary terms. Shorter completion times and improvement in quality will inevitably lead to higher cost. Due to this conflict Kharbanda et.al (1987) suggested the objective to be project completion in a reasonable time, at an economic cost, with adequate quality as the three are essentially incompatible as shown in Figure 1.

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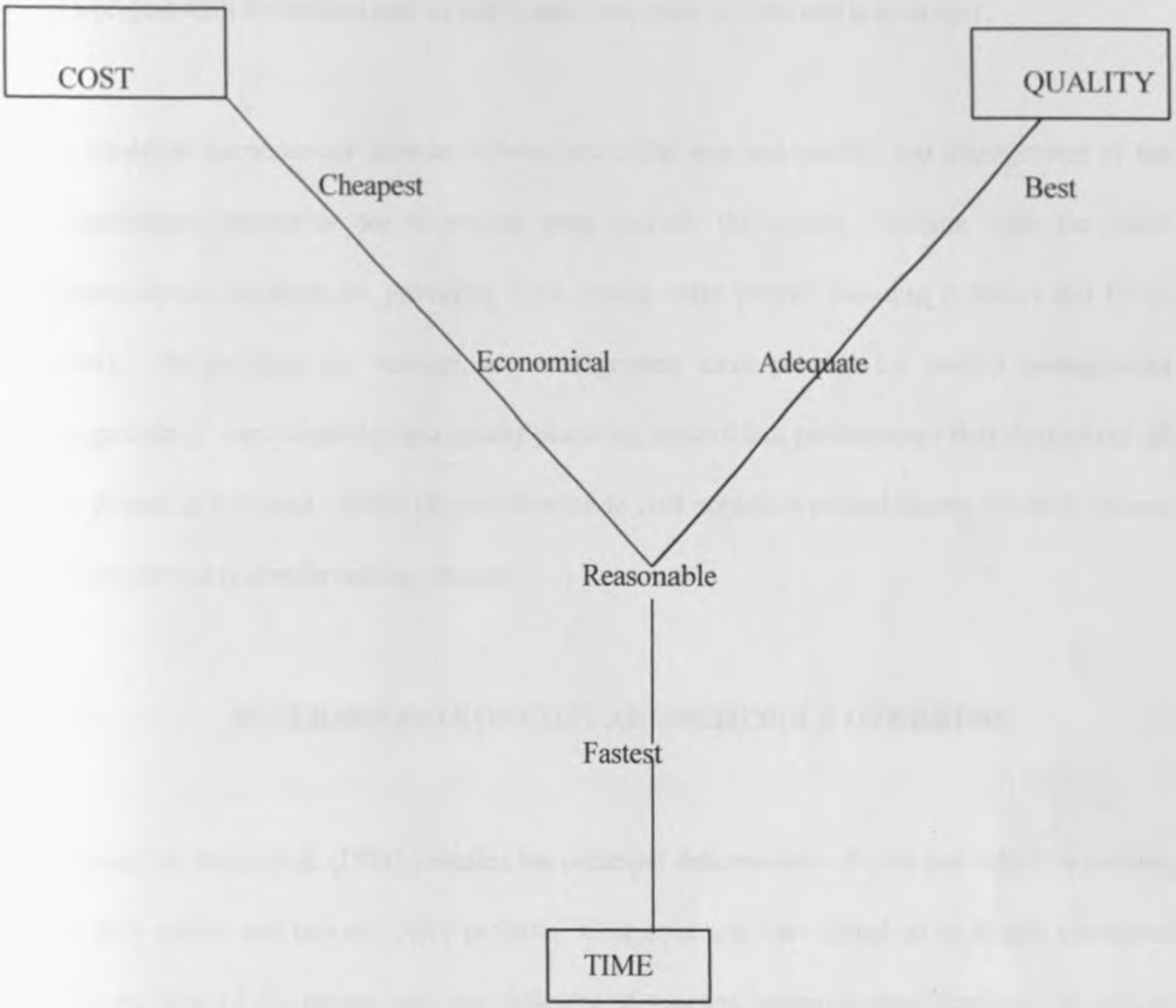
Figure 1: **THE ETERNAL TRIANGLE**



The art is to maintain a proper balance between the three, so that quality is not sacrificed for either time or cost.

For a project to be successful, top management must establish a meaningful balance between schedule, cost and quality. Emphasis on schedule can result in a project completed on time that is over cost and has unacceptable quality. Emphasis on cost can result in a project within cost

that is not completed on time and that has unacceptable quality. Emphasis on quality can result in a project with the desired quality that is not completed on time and is over cost.

To establish the necessary balance between schedule, cost and quality, top management of the organisation responsible for a project must include the quality function with the other organisational functions in, providing input during early project planning (Cleland and King, 1988). To maintain the balance, top management must provide for project management integration of cost, schedule; and quality planning, control and performance data throughout all the phases of a project. While proper attention to cost control is critical during the early phases of a project, it is a never ending process.

2.11 DETERMINANTS OF COST AND SCHEDULE OVERRUNS

A study by Bruce et.al (1974) revealed the principal determinants of cost and schedule overrun for both public and private sector projects. Cost overruns were found to be highly correlated with the size of the project and the difficulty of meeting technical specifications. However, schedule difficulties and resulting schedule overruns were primary casual factors leading to cost overruns. Schedule overruns were in turn, caused by the variables listed on Table 1.

TABLE 1. DETERMINANTS OF COST AND SCHEDULE OVERRUNS

- Cost underestimates
- Use of "Buy-in" strategies

- Lack of alternative back-up strategies
- Lack of project - team goal commitment
- Functional, rather than projectized, project organisation
- Lack of project team participation in setting schedules
- Lack of team spirit, sense of mission
- Inadequate control procedures
- Insufficient use of networking techniques
- Insufficient use of progress/status reports
- Over optimistic status reports
- Decision delays
- Inadequate change procedures
- Insufficient project manager authority and influence
- Lack of commitment to budget and schedule
- Overall lack of similar experience

In order to prevent schedule and cost overruns, or to minimise the amount of schedule and cost overrun when initial overoptimism or a "buy-in" has occurred, the research pointed to the need for employing networking techniques, systems management approaches, participative approaches to decision making within the project team, and a task-oriented style of leadership, with a backup relationship-oriented style.

2.12 CHARACTERISTICS OF A SUCCESSFUL PROJECT

Project success has been defined in many ways to include a large variety of criteria. However, in its simplest terms, project success can be thought of as incorporating four basic facets: A project is generally considered to be successfully implemented if it (Jeffrey and Dennin, 1987):

- Comes in on-schedule [Time Criteria]
- Comes in on-Budget [Monetary Criteria]
- Achieves basically all the goals originally set for it [Effectiveness Criteria]
- Is accepted and used by the clients for whom the project is intended [Client Satisfaction Criterion]

2.13 RELATIONSHIP BETWEEN COST AND TIME

To control cost you have to control time. Time is of essence, a s they say. To impress upon the money value of time, Kharbanda et.al (1987) in a case study of a typical world scale fertiliser plant in India, estimated the cost of just one day's delay in the completion of the project. The installation was of the four major plant units: two 1,000 tonnes/day ammonia plants and two 1,350 tonnes/day prilled urea plants, using natural gas a feedstock.

The total cost (1986 values) was of the order of US$ 1 billion. Then the cost of one day's delay is:

DIRECT COST TO THE PROJECT:		**US $ Million**
a)	Interest	0.5
b)	Escalation	0.6
INDIRECT COST (TO THE NATION):		
c)	Loss in taxes	1.5
d)	Loss in production	2.7
	TOTAL	5.3

Note: The loss in taxes relates primarily to excise duty and other levies that would be due to the government for one day's production. The loss in production is very serious for a country such as India (and any other developing country), since it has to be made good by imports and is thus using up scarce foreign exchange resources.

Delays can be avoided and their effects minimised by proper project cost control. Parkinson's law states that "Work expands to fill the time available "By analogy", "Cost expands to fill the budget available" Cost control is an effective tool to avoid, reduce and minimize waste (Kharbanda et.al. 1987). It is a set of procedures whereby the actual results being achieved in terms of time, and money are compared with the targets set and the appropriate action indicated. Realistic time frames, reasonable and achievable goals, and sufficient funding are fundamental to project success (Hess et.al. 1987)

Determination of costs should consider the full range from project initiation to self-support. Studies have indicated cases where assistance is discontinued too early in the Development transition or there is failure to make a gradual but steady transition from USAID-based to host country-based management over the course of the project leading to cost and schedule overruns (Hess et.al. 1987; Thompson-Dorman - 1992). This further supports some of the determinants of cost and schedule overruns revealed by Bruce et.al (1974) as per Table 1.

The Ministry of Water Resources according to the Minister, Mr. Kipng'eno Arap Ng'eny requires KShs. 8.5 billion to rehabilitate more than 500 stalled water projects country wide (Daily Nation 23rd March, 1998). He further said that a total of 584 water projects, in the rural and urban areas, had not been completed since 1992 due to lack of funds.

Another example could be the Bura project (World Bank, 1985). The design of Bura Project was based on the consultants' project planning Report, yet the financing was based on the World Bank's Appraisal Report. As a result, the project began life seriously underfunded. Regarding the issue of time, the construction of Bura began in mid 1979, two years behind schedule. This delay brought about significant and rapid inflation of project costs (Table 2.). By 1982, Bura was two years behind schedule and costs had risen to 187% of estimates in the World Bank Appraisal Report.

However, the design changes also played a significant part in this increase. More seriously, perhaps the proportion of total costs to be borne directly by the Government of Kenya had risen to about 50% both because of the additional capital costs of new design and the withdrawal of one donor.

This is a clear indication of timely completion. It affects not only the cost of the project as such - the capital investment - but also profitability for many years to come. Delay in completion is prohibitively expensive, because of the immense sums tied up which are bringing no income. To control cost, you have to control time.

The important feature of Bura, however, is not that problems existed, but that as they emerged the project was not reassessed. In the words of the World Bank appraisal: "there was about the Bura Scheme, during project conception and implementation, a momentum which resisted all attempts to halt or slow down the scheme despite clear signals which predicted trouble" (World Bank, 1985 p.43) As a result, Bura has come to dominate spending on agricultural development in Kenya, absorbing 31% of the Ministry of Agriculture's development budget in 1983-84 and 23% in 1984-85. Kharbanda et.al (1987) suggests that data contributing to the early assessment of the cost trend is valuable, since it provides an `early warning signal system' to management in relation to the estimates of both time and cost.

TABLE 2. COST ESCALATION OF THE BURA PROJECT

	ESTIMATED COST (Million KShs)
DATE	**1979 PRICES.**
May 1977	927.35
August 1977	1135.35
September 1979	1247.28
September, 1980	1385.02
September, 1981	1691.31
September, 1982	2201.14
September, 1983	2212.92
September, 1984	1504.16

Source : World Bank (1985) Appendix II

A long design and construction time increases the chances of cost overruns. A fundamental in project cost control is that "Time is Money".

2.14 QUALITY

Quality is a construct - in other words, a high-level abstraction that is difficult to illustrate by specific events, objects, observations, or measurements. (David and Gary, 1996). Since quality has no direct unit of measure associated with it (except maybe such indexes as process

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capability), organisations express quality in terms of other types of measures: timeliness, productivity, and financial (cost of quality).

There is no consensus among researchers as to what constitutes quality in projects. It is generally agreed that the quality of a project can be more objectively seen in terms of the quality of project outputs. Rejects, reworks, downgrades, wastes, returns and replacement are activities that do not add value to a project and are often the source of significant cost escalations (Bruggemann and Gosden, 1991).

Customer measures reflect how the organisation's various stakeholders perceive its project performance (Peter and Martin, 1995). Customer metrics are usually either direct measures taken via surveys, or (at less expenses) indirect measures such as the number of complains received. A study of a rural district in Kenya (Mwabu, Ainsworth, and Nyamete, 1993) looked at treatment-related measures of quality, including the availability of a variety of drugs and diagnostic equipment.

Mwea is probably the best known Kenyan Irrigation Scheme and is widely viewed as an economic success (Clayton, 1981). The development Plan 1984-88 showed Mwea to be the only self-supporting Irrigation Scheme in Kenya, the rest all requiring government subventions. Clayton argues that the high earning power of tenants means that no one leaves the scheme and there is a long waiting list of would-be tenants. This means that the clients accepted the project.

Conversely, Obura (1984) suggests that there has been over-investment in unprofitable directions in the Perkerra Irrigation Project that has suffered a series of technical problems, including unreliable water supply due to problems with the water distribution, rising levels of salinity among others. The poor agronomic performance has been exacerbated by water supply difficulties and lack of effective research. As a result of this there have been many desertions by tenants "demoralised by past mistakes,.....".

2.20 ORGANISATION SUPPORT FACTORS

Organisational problems have been found to pop up in project environments and this could escalate costs and time (MC Grool et.al. 1986).

2.21 COMMUNICATION

Increasingly, effective interpersonal communication is being recognised as a critical ingredient for project success. Good communications are basic to successful project management and play an important role in completing a project on time, and within the budget (Kharbanda et.al 1987). Baker, Murphy, and Fisher (1974), Thompson and Wilemon (1979) found poor communication to be a major barrier to effective team development efforts. This often led to unclear objectives, poor project control and co-ordination, and uneven workflow.

Communication is not only essential within the project team itself, but between the team and the rest of the organisation as well as with the client. A study by Jeffrey and Pinto (1987) found the need for adequate communication channels to be extremely important in creating an atmosphere for successful project implementation.

In this study, the communication factor refers not only to feedback mechanisms, but the necessity of exchanging information with both clients and the rest of the organisation concerning project goals, changes in policies and procedures, status reports among others. Though it was easy to blame Bura project's problems on poor management, Morris and Thompson (1987) highlighted

in particular the problems of poor communications as a constraint on management, other agencies and the tenants.

A key element for effective control is timely evaluation of potential cost and schedule hazards and the presentation of these evaluations with recommended solutions to project management. This means that the project team must be skilled and also be able to effectively communicate to management level. Sometimes, a skilled technician performance is not adequate because he is a poor communicator. Technical expertise will rarely compensate for lack of communication skills.

Project teams are mostly brought together from a variety of "melting pots" and the difficulty of establishing effective and appropriate communications at all levels should not be underestimated.

In this regard, the project manager is responsible for quickly establishing a positive working environment where the separate functions of design, procurement, construction, and control are welded into a unified, cost-conscious group. Project managers who relegate the control function to a reporting or accounting function are derelict in their duties.

2.2 PERSONNEL ISSUES

This involves an adequate personnel policy of recruitment, selection, and training. A study by Mwadali (1996) found staffing to be a significant factor in project management effectiveness. Durana (1995) established the need for development of expertise in local organisations to continue the technology transfer process beyond the bounds of Development assistance project and time frames.

Similarly, Thompson - Dorman (1992) found that projects often come to a close without reaching the critical knowledge, skills and production levels needed for sustainability without foreign intervention. Adams (1990) indicated that lack of trained operators and mechanics led to repeated breakdowns in 1983 and 1984 in the Bura project. This resulted in water being unavailable 25% of the time leading to delays and loss in production.

2.23 MANAGEMENT SUPPORT AND EXPERIENCE

Management's support of the project may involve aspects such as allocation of sufficient resources (financial, manpower, time, etc) as well as the project manager's confidence in their support in the event of crisis (Jeffrey and Dennis, 1987). Bruce et.al (1974) found schedule overruns to be caused by lack of commitment to the budget and schedule, lack of similar experience among other things. Hans (1983) found experienced management personnel to have a strong positive association to project team performance.

2.24 PROJECT MISSION

Project mission has been found to refer to the condition where the goals of the project are clear and understood, not only by the project team involved, but the other departments in the organisation. Hans (1983) found unclear project objectives and directions to be the strongest barriers to project team performance. Bruce et.al (1974) highlighted lack of team spirit and sense of mission to be a determinant of cost and schedule overruns.

2.30 PROJECT SIZE

Time and cost overruns can occur on any project, large or small, if it is left to itself (Kharbada et.al. 1987). The philosophy and the mechanics of project cost control are basically the same, no matter how small or large, the project. Size as such really does not influence the situation,

except that the larger the project, the greater the resources that are required in terms of men, money and materials. The stakes are therefore much higher, and there are more things to go wrong. Table 3 gives a general breakdown of projects into small, medium and large (Cleland and King, 1988).

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TABLE 3: PROJECT SIZE

		SMALL	MEDIUM	LARGE
a)	Engineering Manhours	100,000	600,000	1,500,000
b)	Engineering Manpower	100	200	400
c)	Construction Manhours	500,000	400,000	8,000,000
d)	Constriction	400	1500	3,000
e)	Construction Staff	50	150	500
f)	Schedule (months) i.e (detailed engineering to Completion of construction)	25	30	35

Popular critiques of rural development is sub-Saharan Africa focus increasingly on the inadequacies and ineffectiveness of large-scale, externally imposed, high technology projects (Adams, 1990). In their place, scholars and planners suggests alternative approaches involving "development from below" (Harrison, 1981, Stohr and Taylor, 1985; Timberlake, 1987). These latter ideas often subsumed under the tittle "sustainable development" They often focus on the question of scale and the importance of small-scale development projects. The merits of such approaches are often argued from a platform of the demonstrated failings of large scale approaches, and often justified on the grounds that they represent a polar opposite to the unsuccessful large-scale projects.

This line of thought is particularly well established in debates over African Irrigation, where the failings of large-scale developments are widely rehearsed (eg. Barnett, 1978; Wallace, 1981,

Adams and Grove, 1984; Moris, 1987 Adams and Hughes, 1987). The conclusions support the notion that it is the nature of control and not scale which is the key determinant of success or failure.

However, large projects with long lead times and major commitments of resources offer lower cost per unit of service. Norman (1990) established that large projects are vulnerable to the economic and bureaucratic equivalents of exocet missiles - inflation, personnel limitations, ethnic conflict, revised regime priorities, ineffective project leadership, new technology, corruption, administrative reorganisation, among others. He advances the proposition that other things being equal, there are diminishing return to project size. It means that, Ceteris Paribus, more can be accomplished with ten $ 5 million projects than with one $50 million project!.

2.40 PROJECT MANAGEMENT TOOLS

The project management team need tools for their work. Some of the tools used include milestone Bar charts, Gantt Charts, Network techniques, Project duration charts, Work Breakdown Structures among others. Mwadali (1996) found that the bar chart and the project duration charts were the most well known tools in Management of Kenya Railways Projects. Further, 50% of the project managers had no experience in project management making use of some tools difficult. For example, they were not aware of how tools like Critical Path Method, PERT and GERT are applied in the management of projects. The surest way and the quickest to disaster is to go and apply new tools untested by experience (Grool et.al. 1986).

Bruce et.al (1974) also found the use of insufficient networking techniques, progress/status reports and inadequate control procedures as principal determinant of cost and schedule overruns.

2.50 ENVIRONMENT

This is the influence exerted from outside the project organisation. These could include nature, inflation, politics, pressure from interest groups inter alia. Environmental sensitivity is an integral part of all good project management. It is central to competent design, construction and operation of engineering works. Environmental values cannot be clipped onto a project at great cost after it is fully designed, but are a fundamental element in project evolution. (Hans 1990).

Consideration of the environment when engineering structures are to be built has become more obvious in the last few decades. For example, hydraulic structures have significant environmental impacts which impose obligations on planners, engineers and managers. Dams, barrages and river diversions need careful analysis to ensure minimum environmental intrusion.

It is important that where projects are proposed their environmental implications are seriously considered. Extensive investigations are correctly devoted to establishing geological strata, topography, hydrology, Structural Analysis, access, relative costs among others. It is essential that the environmental implications in ecological, social, meteorological anthropological, aesthetic and other aspects are also given consideration in protecting various effects of the

structure. World Water (1981) reported that construction had to be halted on a hydro-electric projecting in Sweden to protect Sami (Lapps) archaeological finds.

The World Bank's mid-term appraisal offers a discouraging picture of the viability and replicability of the Bura Experience (World Bank, 1985). In technical terms, it is clear that the poor soils of the project area were a serious constraint, resulting in low economic returns.

Political involvement and legal aspects has been highlighted in the battle by environmental groups in Australia against the building of the Gordon below Franklin dam in Tasmania, described in detail in an article (Bandler, 1987). A similar public controversy took place in 1985 in Austria about a barrage across the Danube River at Hainburge, downstream from Vienna, also analysed by Bandler (1986). This led to substantial cost increases and delays.

If all the multidisciplinary environmental considerations are fully explored and suitably managed in the planning stage and acted upon before the project hits the drawing board, a project will be produced which will be beneficial, not just by meeting the user needs but also one which will not be seriously at odds with its environment.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

A descriptive actual research design of the cross-sectional type was selected for this study. This is because the aim of the study, at a point in time is to describe certain characteristics associated with subject population to estimate proportions of the population that exhibit these characteristics , and to discover the association among different variables, which are objectives associated with descriptive studies (Emory 1985, PP 68).

The Case study design was adopted in this study because of the resources and time scale constraints which the researcher faced. However, different projects within the Ministry of Water Resources were used. The projects studied and the method of analysis used should permit the findings obtained to be generalised for the public sector projects.

3.2 POPULATION

This study was conducted at the Ministry of Water Resources to identify factors which are critical in project cost overruns. The focus was on those projects that were not completed within the estimated budget costs. The basic principles of good project management and cost control remain the same, whatever the content. Size makes no difference. Location makes no difference. Thus, in this study, the researcher sought to identify those factors contributing to

project costs overruns in all Projects at the Ministry of Water Resources listed in the Public Investment Programme that are funded by the Government of Kenya . Other projects at this Ministry are External Projects funded by Finland, Netherlands, Italy, Japan, Danida among others. The philosophy and mechanics of project cost control are basically the same, no matter how small or large, our project. Small or large, meticulous preparation and planning is the key to success - and successful project cost control. That is why the study focused on all Government of Kenya projects which are development projects identified through the Budget Rationalisation Programme.

3.3 SAMPLING

All projects were selected and analysed for the period 1984 to 1998. This period was chosen because the researcher was likely to find those who participated directly in the project and are still working at the Ministry of Water Resources. Reports from the Ministry indicated in Chapter Two had it that 584 projects countrywide were incomplete since 1992 due to lack of funds. Thus, the period was considered enough to find a reasonable number of projects for this study.

A list of projects from the Public Investment Programme is attached at the back as Appendix. Government of Kenya Projects covering the stated period totalled to 36 distributed as shown:

North Easter Province	2
Coast Province	5
Central Province	5
Rift Valley Province	6
Eastern Province	5
Western Province	4
South Nyanza Province	4
Nairobi	5
Total	**36**

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A judgemental sample of 32 projects was selected. Personal judgement was used to ensure that the sample reflects the projects which were executed in different locations and which are

characterised by cost overruns. However, the major problem at this stage was that all information pertaining to the projects particularly the actual costs incurred could not be obtained. Attempts to include additional projects from earlier periods not in the list failed as they were unknown to the people working there who did not participate in them. The list selected constituted 26 projects.

3.4 DATA COLLECTION

Primary data was collected through a questionnaire and interviews from project participants. The questionnaire was self administered to participants in each project comprising Project Managers, Engineers, supervisors and other project support staff. The researcher with the help of the Deputy Director, Water Development explained the purpose of the study to the respondents and arrangements were made on the time to administer the questionnaire and interviews at the Ministry of Water Resources Head quarters. The questionnaire was developed from the pilot study at the Ministry of Water Resources confirming the existence of project cost overruns. The information from this study was important in understanding the factors leading to project cost overruns and was used to prepared an in-depth structured questionnaire for this study. The Questionnaire had only one part containing 50 questions. A sample questionnaire is attached at the back as appendix one. These questions sought information about the major factors contributing to project cost overruns as obtained from the pilot study. They include:-

a) Delays in implementation due to delayed payments to contractors, adverse environmental conditions such as bad weather, and inappropriate designs which later on cause variation to the works.

b) Political interference which at times causes erratic extensions to the projects.

c) Unsatisfactory project management, insufficient use of tools and inadequate planning.

d) Delays in decision making.

e) Contractors non-performance forcing termination of contract and retendering.

f) The cost element involving fluctuations in currency during project execution and inflation.

The respondents were asked to indicate to what extent the factors contributed to project costs overruns where no extent at all (scored 1) and Great extent (scored 3). This was to obtain information for objective number one.

The questionnaire was structured so as to obtain ease of administration, ease of comprehension by the respondent and objectively measurable reliability.

Personal interviews were conducted with Senior Project Officials (Deputy Directors, Water Development and Project Managers) to achieve objective number two. They were approached to develop strategies (on the basis of the critical factors determined) that will minimise project cost overruns in future.

Secondary data was also used in this study. Official project records were examined as a source of data relating to project costs, schedules and problems experienced in the project execution process. Such records included project progress reports and evaluation reports.

3.5 VALIDITY AND RELIABILITY OF THE MEASUREMENT SCALE

To test the validity of the scale used in the questionnaire, a validity test was carried out before collection of the data. The data in appendix 3 was subjected to five project participants whom the researcher knew had much experience with the Government of Kenya projects and were conversant with the causes of project costs overruns. To generate information on the extent of factors to contribute to cost overruns, a scoring procedure was used as shown in appendix 3 (table 1).

The reliability of the measurement scale was tested using the coefficient alpha as shown in appendix 3. Coefficient Alpha ranges between Zero and One. A value of 0.6 or less is considered unsatisfactory while a value above 0.6 is considered satisfactory. In general, the constructs were found to be valid and reliable.

3.6 ANALYSIS OF DATA

The data collected from secondary sources was analysed by use of descriptive statistics such as proportions and percentages. They explained those projects that were started on schedule, not started on schedule, project costs and the problems experienced during execution.

Further, three hypothesis were tested using the student t-distribution statistic. The t-distribution is used in this study where the sample size is less than 30 and the population standard deviation is unknown. The assumption was that the population was normal or approximately normal.

$$\text{Test Statistic} = t_{calculated} = \frac{\bar{x} - \mu_o}{s/\sqrt{n}}$$

This value of t-statistic is compared with the table value of $t\alpha$, n-1 (degrees of freedom). A sample of the t-distribution table is attached as appendix 4.

Where, $\bar{x}$ = sample mean

n = sample size

s = sample standard deviation

α Level of significance

NB; The alpha (α) in this study was 0.01 or 99% level of confidence.

The hypotheses in this study were:

I) Null hypothesis: On average the Ministry of Water Resources projects outrun their budget costs estimates by 50% or more.

Alternative hypothesis: On average the Ministry of Water Resources projects outrun their budget costs estimates by less than 50%.

ii) Null Hypothesis: The mean differences of the budgeted project costs and the actual costs incurred is greater than zero.

Alternative hypothesis: The mean differences of the budgeted project costs and the actual costs incurred is less than zero.

iii) Null Hypothesis: None of the identified critical factors was significant in the project total cost.

Alternative Hypothesis: Some of the identified critical factors were significant in the project total cost.

The questionnaire was analysed using Factor analysis. The factors that were considered most important to project cost overruns are highlighted in order of importance. The researcher applied factor analysis to the set of data to identify which factors were considered important by the respondents. The primary goal of factor analysis is to reproduce as accurately as possible

original intercorrelation matrix from a small number of hypothetical factors which original variables are linearly related. Varimax rotation was employed on the initial factor matrix to improve in the interpretability of the data.. The most common procedure in factor analysis is to single out for each factor those variables having the highest loadings in absolute value.

To perform this analysis SYSTATW5 (Window based) computer package was used.

3.6.1. FACTOR ANALYSIS

Factor analysis employs an advanced form of correlation analysis to the responses to a number of statements. The purpose of this analysis is to determine if the responses to the several of the statements are highly correlated. If the reponses to three or more statements are highly correlated, it is believed that the statements measure some factor common to all of them (Churchill, 1983).

3.6.2 STEPS OF FACTOR ANALYSIS

There are three steps in factor analysis solution:-

1. To identify a set of correlations between all combinations of the variables of interest (intervally scaled input variables).

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2. To extract a set of initial factors from the correlation matrix developed in the first step, and

3. To "rotate" the initial factors to find a final solution.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

A total of 36 questionnaires were issued out. The following analysis was based on 32 responses from the project participants. The other four respondents were unavailable (on leave). This was a 89% response rate and was considered good to allow the completion of the study.

This section is divided into two parts. Part one is the analysis of project costs, schedules and problems experienced during the project execution. It is summarised and presented in terms of proportions and percentages. Secondary data from 26 projects was used. Part two is presented using Factor analysis.

4.1 ANALYSIS OF PROJECT COSTS, SCHEDULES AND PROBLEMS EXPERIENCED IN PROJECT EXECUTION.

Table 4.1 Project cost overruns.

PROJECT NAME	BUDGET ('000'K£	ACTUAL COST ('000'K£	OVERRUN (%)
Construction of Water Supply :			
Garisa	10600	13100	23.59
Lamu Urban	2000	3600	80
Kigumo	5400	7800	44.44
Kipiripiri	482	522	8.30
Moyale	850	1150	35.30
Athi-River	500	750	50
Tigania	850	1200	41.18
Isabenia	800	1080	35
Sigor- Longisa	2330	2660	14.16
Masiro	460	510	10.87
Fort Ternan	500	683	36.60
Ainbkoi	900	1600	77.78
Sacho/Remo/Kabasis	985	1172	18.90
Timboroa	360	434	20.56
Lugulu	120	150	25
Juja	2000	3110	55.60
Machakos/alanzoni	2208	3063	38.72
Meru Town	605	860	42.15
Marsabit Town	2450	2900	18.37
Njoro Kubwa	170	279	64.11
Kiserian dam	3241	5439	67.81
Thuku Borehole	869	1139	31.07
Ndia	1046	1352	29.25
Kibishi project	115	165	43.49
Catchment conservations & Rehabilitation	5000	9496	89.92
Bura Bisp	375	600	60

Sample mean x = 40.85%
Sample standard deviation (s) = 22.09%

1) To test hypothesis number one which is on average the Ministry of Water Resources Projects outrun their costs by 50% or more.

H_0: $\mu_0 > 0.50$

H_A: $\mu_0 < 0.50$

Critical region will be $t < -t_{0.01}$,25 hence $t_{calculated} < -2.485$ (from t-tables)

$\bar{x} = 40.85\ \%$ $s = 22.09\ \%$ $n = 26$

Therefore,

$$t_{cal} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

$$\frac{40.85 - 50}{22.09/\sqrt{26}}$$

$$\frac{-9.15}{4.33} = -2.11$$

INTERPRETATION:

Since -2.11 is greater than -2.485, the null hypothesis (H_o) should be accepted at 99% level of confidence. It can then be concluded that on average the Ministry of Water Resources projects outrun their original cost estimates by 50% or more. This further confirms what most project participants had noted with these projects. They agreed that most projects outrun their costs by a significant margin but could not establish the correct percentage. The project managers cited project underfunding as the major reason why these projects could not be completed at the original budget estimates. This problem led to many projects delaying hence not meeting their completion dates. Reports from this Ministry have indicated that 584 projects have not been completed since 1992 due to lack of funds .The danger arising from incompleted projects is quite eminent. There have been cases of Water boreholes that have been left uncovered in some parts of the country. This has led to deaths of school children and water contamination causing water-borne diseases.

Other reasons given for cost overruns in these projects were environmental issues. These were external to the projects and could not be absorbed by the usual 5% contingency provided for these projects. Political interference leading to scope changes not in line with the original plans were experienced especially during the general election period. Bad weather conditions caused delays to some of the projects and this again constitute the unmeasurables.

There were also isolated cases of vandalism in some projects particularly in some areas involved in tribal clashes in the country. These projects were characterised by delays because the staff could not work under such conditions of insecurity.

Extra works and claims by contractors were other reasons for these cost overruns. The major cause of extra works is the unexpected. For example ,ground conditions could require extra excavation not in the original contract. This makes the contractor to place claims which if not paid lead to implementation delays.

Communication problems and poor infrastructure in other areas contributed to delays and escalation of costs .

Table 4.2 Paired Samples of budgeted project costs and the actual costs incurred.

PAIR NUMBER	SAMPLE VALUES (X1) K£000	SAMPLE VALUES (X2) K£000	Difference (x1-x2) K£000
1	13100	10600	2500
2	3600	2000	1600
3	165	115	50
4	7800	5400	2400
5	9496	5000	4496
6	522	482	40
7	1150	850	300
8	750	500	250
9	1200	850	350
10	1080	800	280
11	600	375	225
12	2660	2330	330
13	683	500	183
14	510	460	50
15	1600	900	700
16	1172	985	142
17	434	360	74
18	150	120	30
19	3110	2000	1110
20	3063	2208	855
21	860	605	255
22	2900	2450	450
23	279	170	109
24	5439	3241	2198
25	1139	869	250
26	1352	1046	306

Sample mean difference = 751.27.
Sample difference standard deviation =1066.

ii) To test hypothesis number two which states that the mean difference ($_D$) of the budgeted cost estimates and actual costs was greater than zero.

H_o: $\mu_0 > 0$

H_A: $\mu_0 < 0$

Critical Region will be $t < t_{0.01}, 25$ hence

$t_{calculated} < 2.485$ (from t- table)

$\bar{D} = 751.27$ $S_D = 1066$ n =26

Therefore ,

$$t_{cal} = \frac{\bar{D} - \mu_0}{S_D/\sqrt{n}} = \frac{751.27 - 0}{1066/\sqrt{26}}$$

$$\frac{751.27}{209.06} = 3.59$$

INTERPRETATION:

Since 3.59 is greater than 2.485, the null hypothesis (H_o) should be accepted at 99% confidence level. It can be concluded that the mean differences of the actual project costs and the budgeted cost estimates is greater than zero. The reason for the differences in actual project costs and the budgeted project costs can be traced quite simply to a poor cost estimate on these projects and perhaps no cost control. This resulted in most of the projects having cost overruns of 50% or more (hypothesis number one). Effective and meaningful project cost control must begin even before the design stage and is maintained by proper and scientific cost estimation and data analysis. This shows that cost reporting is not cost control. It is all too easy to establish a system of project organisation and administration , with a regular flow of reports, and then believe that costs are under control. Usually, it is important to have a process of evaluation, followed by corrective action. This ensures that any potential divergence can be studied and the appropriate action taken. The result of action taken has also to be ascertained as it occurs if the system of control is to be fully effective. Most of the managers agreed that delays can be avoided, and their effects minimised, by proper project cost control.

Further, the cashflow must be in accordance with the original planning upon which the project was approved, otherwise the long range prospects will be completely upset. But to maintain the cashflow within the budget detailed cost control is essential.

Table 4.3: Project Start Schedules.

	Frequency	Percentage
Completed on Schedule	5	19.23
Not Completed on Schedule	21	80.77
Total	26	100

From table 4.3 above, 38.46% of the projects were started as scheduled while 61.54% were not started as scheduled. Most project Managers attributed the delayed start of Projects to revisions to specifications, cashflow problems, equipment delays and failures, scope changes and adverse external conditions. Other problems given were administrative and delays in approvals. Such problems resulting in delays to project completion are further accentuated by the failure to appreciate the money value of time.

Table 4.4: Project Completion Schedules

	Frequency	Percentage
Completed on schedule	5	19.23
Not completed on schedule	21	80.77
Total	26	100

Table 4.4. shows that only 19.23% of the projects were completed as scheduled. Most of the other projects 80.77% were not completed as scheduled. This was attributed to problems in project execution such as low budget estimates, scope changes and design variations, delayed payment to contractors arising from extra works and claims, influence from external environmental conditions and inadequacy in scope definition.

The other reasons for projects not being completed on time, and within budget, were poor morale, poor human relation, poor labour productivity and lack of commitment by those involved. All of these owe much to, and are even generated by, poor communications.

Table 4.5.: Problems experienced during project execution.

Problem	Experienced	%	Not experienced	%
Project underfunding	23	88.5	3	11.5
Adverse external environment	19	73.1	7	26.9
Scope changes	21	80.8	5	19.2
Lack of infrastructure & poor communication	11	42.3	15	57.7
Extra works & claims	7	26.9	19	73.1

Table 4.5. shows that 88.5% of the projects were underfunded. Project Managers attributed Project Cost overruns to cashflow problems arising from lack of funds. This has led to many projects arising from lack of funds. This has led to many projects in the Ministry of Water Resources to delay in their completion. Reports from the Ministry (as indicated in chapter two) indicate that 584 projects countrywide have not been completed since 1992 due to lack of funds.

Scope changes and revisions to specifications were experienced by 80.8% of the projects. Often such changes lead to project delays. Influence from adverse external environmental conditions includes heavy rains, floods, and difficult terrain's. Inflation was also included in such conditions. These problems were experienced by 73.1% of the projects.

42.3% of the projects experienced infrastructural and communication problems. These were related to delayed equipment deliveries, and delayed approvals. Good communications are

basic to successful project management and play a very important role in completing a project on time, and within the budget.

Extra works were experienced in 26.9% of the projects. The major cause of extra works is the unexpected. For instances, ground conditions calling for extra excavation, errors on drawings that have to be rectified. The end results are project delays and claims from the contractor.

4.2 FACTOR ANALYSIS

Factor analysis was performed on the questionnaire to determine those factors that are critical in project cost overruns. The questionnaire was structured with 50 questions on delays in implementation, project management, project environment and delays in decision making.

A statistical package known as **SYSTATW5** (Window based) was used to analyse this data and the results are presented below

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TABLE 4.6 MATRIX OF CORRELATION COEFFICIENTS BETWEEN PAIRS OF STATEMENTS

	1	2	3	4	5	6	7	8	9	10
1	1									
2	0.982	1								
3	0.994	0.960	1							
4	0.931	0.847	0.829	1						
5	0.954	0.968	0.975	0.902	1					
6	0.936	0.769	0.760	0.898	0.931	1				
7	0.858	0.994	0.571	0.765	0.939	0.940	1			
8	0.583	0.826	0.780	0.923	0.871	0.874	0.769	1		
9	0.322	0.459	0.931	0.845	0.767	0.765	0.434	0.424	1	
10	0.608	0.732	0.871	0.968	0.902	0.691	0.699	0.598	0.799	1
11	0.679	0.608	0.478	0.931	0.586	0.582	0.934	0.994	0.734	0.842
12	0.550	0.592	0.858	0.705	0.769	0.591	0.879	0.769	0.846	0.691
13	0.769	0.798	0.986	0.634	0.994	0.891	0.719	0.902	0.769	0.842
14	0.943	0.844	0.504	0.946	0.599	0.719	0.678	0.549	0.548	0.698
15	0.820	0.830	0.834	0.871	0.494	0.324	0.344	0.232	0.698	0.547
16	0.867	0.902	0.939	0.803	0.858	0.909	0.569	0.602	0.994	0.636
17	0.992	0.734	0.858	0.705	0.799	0.776	0.994	0.892	0.858	0.792
18	0.938	0.000	0.622	0.975	0.639	0.754	0.774	0.749	0.769	0.902
19	-0.110	-0.132	-0.329	-0.419	-0.149	-0.212	-0.324	-0.149	-0.241	-0.230
20	0.055	0.139	0.445	0.239	0.591	0.345	0.436	0.405	0.345	0.056
21	0.149	0.304	0.473	0.349	0.456	0.322	0.249	0.341	0.591	0.341
22	-0.591	-0.484	-0.608	-0.694	-0.473	-0.504	-0.394	-0.605	-0.369	-0.369
23	0.439	0.322	0.524	0.459	0.354	0.445	0.432	0.439	0.563	0.699
24	0.822	0.767	0.902	0.936	0.869	0.927	0.767	0.891	0.699	0.779
25	0.949	0.991	0.898	0.994	0.994	0.868	0.874	0.997	0.789	0.897
26	0.868	0.871	0.765	0.879	0.794	0.776	0.852	0.899	0.344	0.338
27	0.237	0.386	0.224	0.345	0.230	0.202	0.286	0.204	0.239	0.329
28	0.923	0.902	0.931	0.954	0.973	0.948	0.901	0.954	0.903	0.791
29	0.975	0.949	0.968	0.897	0.939	0.909	0.921	0.997	0.245	0.907
30	0.926	0.858	0.897	0.754	0.926	0.894	0.763	0.698	0.841	0.341
31	0.826	0.749	0.744	0.975	0.745	0.749	0.697	0.754	0.346	0.932
32	0.990	0.975	0.997	0.890	0.987	0.902	0.894	0.881	0.997	0.831
33	0.522	0.618	0.541	0.563	0.624	0.497	0.576	0.601	0.436	0.347
34	0.186	0.727	0.234	0.324	0.324	0.204	0.193	0.432	0.349	0.236
35	-0.803	-0.705	-0.689	-0.673	-0.508	-0.409	-0.347	-0.604	-0.419	-0.501
36	0.202	0.361	0.106	0.024	0.202	0.032	0.093	0.017	0.346	0.347
37	0.939	0.871	0.948	0.898	0.936	0.845	0.847	0.932	0.869	0.932
38	0.994	0.931	0.896	0.965	0.899	0.681	0.798	0.694	0.536	0.601
39	0.968	0.855	0.946	0.845	0.966	0.502	0.497	0.974	0.699	0.968
40	-0.269	-0.186	-0.317	-0.304	-0.344	-0.324	-0.401	-0.356	-0.234	-0.307
41	0.032	0.147	0.438	0.312	0.243	0.594	0.234	0.491	0.506	0.142
42	0.000	0.000	0.023	0.107	0.407	0.704	0.381	0.541	0.193	0.231
43	0.030	0.478	0.232	0.324	0.522	0.495	0.254	0.497	0.499	0.349
44	0.322	0.523	0.498	0.551	0.475	0.624	0.568	0.601	0.703	0.522
45	-0.110	-0.139	-0.145	-0.234	-0.104	-0.034	-0.234	-0.345	-0.233	-0.341
46	0.364	0.568	0.589	0.495	0.489	0.689	0.781	0.497	0.597	0.487
47	0.486	0.336	0.433	0.345	0.564	0.797	0.694	0.894	0.345	0.961
48	-0.803	-0.767	-0.684	-0.564	-0.794	-0.434	-0.705	-0.631	0.634	-0.681
49	0.254	0.419	0.233	0.450	0.398	0.563	0.311	0.495	0.932	0.432
50	0.864	0.939	0.947	0.898	0.871	0.949	0.899	0.643	0.787	0.992

	11	12	13	14	15	16	17	18	19	20
11	1									
12	0.871	1								
13	0.768	0.841	1							
14	0.341	0.457	0.341	1						
15	0.596	0.631	0.699	0.592	1					
16	0.858	0.892	0.781	0.799	0.322	1				
17	0.790	0.799	0.849	0.902	0.902	0.892	1			
18	0.849	0.858	0.997	0.994	0.745	0.799	0.859	1		
19	-0.339	-0.394	-0.419	-0.123	-0.388	-0.231	-0.149	-0.332	1	
20	0.343	0.948	0.586	0.698	0.574	0.431	0.345	0.354	0.431	1
21	0.693	0.331	0.341	0.446	0.324	0.981	0.691	0.331	0.587	0.496
22	-0.123	-0.465	-0.396	-0.149	-0.109	-0.234	-0.401	-0.233	-0.103	-0.321
23	0.698	0.519	0.235	0.754	0.927	0.845	0.697	0.43	0.237	0.589
24	0.947	0.834	0.761	0.932	0.873	0.697	0.785	0.903	0.499	0.949
25	0.898	0.873	0.846	0.901	0.954	0.581	0.861	0.791	0.867	0.903
26	0.871	0.761	0.691	0.754	0.763	0.899	0.797	0.346	0.879	0.698
27	0.231	0.284	0.546	0.697	0.754	0.671	0.901	0.239	0.892	0.204
28	0.948	0.892	0.754	0.697	0.845	0.948	0.779	0.934	0.954	0.789
29	0.897	0.932	0.936	0.881	0.965	0.231	0.508	0.934	0.756	0.679
30	0.754	0.834	0.591	0.701	0.691	0.698	0.767	0.859	0.691	0.873
31	0.744	0.997	0.749	0.881	0.776	0.345	0.845	0.349	0.873	0.735
32	0.831	0.835	0.89	0.798	0.694	0.744	0.744	0.605	0.634	0.902
33	0.634	0.719	0.354	0.974	0.346	0.624	0.436	0.576	0.495	0.539
34	0.431	0.545	0.434	0.798	0.968	0.618	0.545	0.234	0.345	0.235
35	-0.149	-0.231	0.345	-0.544	-0.341	-0.334	-0.347	-0.323	-0.104	-0.249
36	0.341	0.495	0.341	0.502	0.591	0.693	0.032	0.325	0.236	0.147
37	0.861	0.716	0.929	0.909	0.845	0.897	0.945	0.87	0.939	0.555
38	0.741	0.870	0.845	0.776	0.697	0.341	0.799	0.798	0.497	0.674
39	0.946	0.936	0.894	0.868	0.771	0.902	0.679	0.966	0.894	0.349
40	-0.391	-0.236	-0.123	-0.932	-0.146	-0.431	-0.356	-0.132	-0.233	-0.145
41	0.434	0.419	0.106	0.624	0.936	0.845	0.142	0.312	0.563	0.619
42	0.701	0.641	0.741	0.547	0.365	0.697	0.545	0.785	0.861	0.234
43	0.241	0.349	0.536	0.071	0.231	0.711	0.671	0.946	0.785	0.499
44	0.558	0.785	0.498	0.567	0.641	0.584	0.89	0.525	0.634	0.564
45	-0.349	-0.323	-0.409	-0.324	-0.321	-0.341	-0.133	-0.235	-0.175	-0.11
46	0.691	0.591	0.563	0.781	0.984	0.349	0.68	0.781	0.874	0.624
47	0.336	0.239	0.634	0.807	0.992	0.597	0.345	0.564	0.436	0.541
48	0.971	-0.343	-0.508	-0.107	-0.321	-0.861	-0.321	-0.24	-0.142	-0.349
49	0.243	0.946	0.927	0.794	0.932	0.341	0.897	0.564	0.632	0.502
50	0.340	0.901	0.847	0.897	0.831	0.697	0.939	0.937	0.791	0.849

	21	22	23	24	25	26	27	28	29	30
21	1									
22	-0.705	1								
23	0.791	0.763	1							
24	0.439	0.349	0.357	1						
25	0.698	0.870	0.867	0.732	1					
26	0.997	0.785	0.795	0.636	0.567	1				
27	0.349	0.233	0.323	0.909	0.899	0.778	1			
28	0.778	0.697	0.592	0.344	0.459	0.845	0.997	1		
29	0.591	0.841	0.684	0.845	0.765	0.682	0.799	0.532	1	
30	0.682	0.581	0.722	0.932	0.789	0.859	0.545	0.867	0.792	1
31	0.829	0.699	0.592	0.845	0.899	0.776	0.948	0.539	0.845	0.679
32	0.727	0.946	0.799	0.994	0.769	0.619	0.869	0.624	0.785	0.719
33	0.997	0.679	0.819	0.868	0.597	0.568	0.870	0.419	0.639	0.634
34	0.147	0.324	0.367	0.619	0.233	0.234	0.123	0.642	0.234	0.534
35	-0.127	-0.355	-0.143	-0.235	-0.419	-0.341	0.419	-0.236	-0.145	-0.145
36	0.429	0.340	0.232	0.145	0.346	0.419	0.792	0.324	0.145	0.541
37	0.623	0.639	0.349	0.835	0.799	0.894	0.540	0.858	0.540	0.679
38	0.734	0.527	0.692	0.919	0.841	0.674	0.576	0.745	0.568	0.841
39	0.568	0.869	0.797	0.745	0.679	0.541	0.841	0.721	0.624	0.932
40	-0.346	-0.345	-0.231	-0.236	-0.145	-0.233	-0.136	-0.159	-0.232	-0.324
41	0.329	0.348	0.247	0.807	0.829	0.294	0.605	0.551	0.758	0.936
42	0.237	0.551	0.742	0.549	0.724	0.758	0.555	0.597	0.679	0.419
43	0.519	0.431	0.563	0.599	0.656	0.894	0.966	0.721	0.564	0.798
44	0.785	0.619	0.792	0.721	0.369	0.946	0.796	0.540	0.679	0.721
45	-0.159	-0.323	-0.629	-0.234	-0.159	-0.324	-0.231	-0.345	-0.237	-0.233
46	0.897	0.736	0.589	0.540	0.576	0.619	0.344	0.568	0.842	0.785
47	0.619	0.345	0.437	0.679	0.732	0.434	0.676	0.742	0.867	0.336
48	-0.327	-0.291	-0.231	-0.340	-0.299	-0.142	-0.531	-0.349	-0.145	-0.355
49	0.697	0.605	0.846	0.841	0.829	0.858	0.835	0.807	0.946	0.824
50	0.843	0.799	0.927	0.932	0.994	0.902	0.819	0.778	0.924	0.936

	31	32	33	34	35	36	37	38	39	40
31	1									
32	0.769	1								
33	0.720	0.574	1							
34	0.597	0.419	0.547	1						
35	-0.231	-0.324	-0.149	-0.424	1					
36	0.656	0.434	0.734	0.524	0.630	1				
37	0.599	0.785	0.851	0.898	0.846	0.767	1			
38	0.931	0.909	0.867	0.719	0.843	0.798	0.834	1		
39	0.869	0.639	0.712	0.658	0.619	0.858	0.869	0.712	1	
40	-0.156	-0.231	-0.159	-0.324	-0.234	-0.902	-0.936	-0.823	-0.792	1
41	0.597	0.736	0.841	0.419	0.524	0.343	0.547	0.325	0.419	0.523
42	0.342	0.432	0.549	0.549	0.792	0.634	0.867	0.732	0.846	0.802
43	0.946	0.861	0.835	0.759	0.732	0.858	0.902	0.820	0.902	0.725
44	0.619	0.794	0.868	0.994	0.792	0.936	0.797	0.992	0.940	0.939
45	-0.321	-0.291	-0.219	-0.239	-0.324	-0.145	-0.219	-0.329	-0.136	-0.419
46	0.589	0.829	0.902	0.732	0.798	0.723	0.584	0.829	0.792	0.729
47	0.820	0.674	0.536	0.540	0.619	0.619	0.742	0.729	0.858	0.532
48	-0.141	-0.240	-0.140	-0.237	-0.149	-0.145	-0.324	-0.232	-0.192	-0.132
49	0.721	0.697	0.732	0.779	0.898	0.869	0.867	0.725	0.867	0.902
50	0.807	0.859	0.920	0.854	0.936	0.994	0.902	0.849	0.994	0.829

	41	42	43	44	45	46	47	48	49	50
41	1									
42	0.768	1								
43	0.844	0.736	1							
44	0.858	0.859	0.769	1						
45	-0.147	-0.323	-0.145	-0.412	1					
46	0.834	0.869	0.874	0.639	0.546	1				
47	0.619	0.936	0.902	0.854	0.824	0.769	1			
48	-0.324	-0.359	-0.134	-0.146	-0.179	-0.234	-0.091	1		
49	0.869	0.849	0.798	0.769	0.864	0.784	0.846	0.924	1	
50	0.841	0.994	0.902	0.902	0.939	0.894	0.902	0.709	0.894	1

Table 4.6. Matrix of Correlation Coefficients between pairs of statements

Table 4.6 shows the correlation matrix of the fifty variables contained in the questionnaire. This was the basis of generating factors and shows the intercorrelation among variables for high correlation the number should either be close to 1 or -1. Zero indicate no correlation while between 0.7 and -0.7 indicate weak correlation. For example, statement number two is highly correlated with statement number one by 0.982. Variable 25 is highly correlated to variables 1, 2, 3, 4, 5, 6, 7, 8, 9,10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 22, 23 and 24. Other variables are negatively highly correlated, for example variable 48 is negatively highly correlated to variables 1, 5, and 11.

Table 4.7 Initial output of variable, communality and eigen values

Variable	1	2	3	4	5	6, ...	50
Communality	1	1	1	1	1	1,.....	1
Eigen Values	29.4	10.4	5.3	2.6	2.1	0, ...	0
% Variance	58.8	20.8	10.6	5.2	4.2	0,.....	0

Table 4.7 above shows the initial output of the variables, communality and eigen values of the initial factor matrix. A statement's communality is merely the sum the squares of its factor loadings. The factor loading associated with a specific factor and a specific statement is simply the correlation between that factor and that statement's standardized response scores. All variables have a good contribution to the factors, this is indicated by 1 or 100%.

A factor's eigen value is merely the sum of the squares of its factor loadings. The table 4.7 indicates that there are five main factors. The factors are indicated by Eigen values of more than 1. Eigen values indicate how well any given factor fits the data from all of the respondents on all the statements.

The % variance indicates the proportion of the variance in the entire set of standardised response scores which is explained by that factor. For example, table 4.7 shows that factor F1 explains 58.8 percent of the variance of the standardized response scores from all of the respondents on

all fifty statements. By adding these figures for the five factors, one sees that the five factors together explain 58.8 + 20.8 + 10.6 + 5.2 + 4.2 = 99.6 percent of the variance in the entire set of the response data. This figure can be used as a measure of how well, overall, the identified factors fit the data. In general, a factor analysis that accounts for 60 - 70 percent or more of the total variance can be considered a good fit to the data.

TABLE 4.8 INITIAL FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
1	0.877	-0.472	0.125	0.233	-0.030
2	0.863	-0.445	0.287	-0.028	0.188
3	0.914	0.394	-0.098	0.007	0.166
4	0.983	0.034	0.072	0.156	0.059
5	0.851	-0.319	0.247	-0.323	0.193
6	0.111	0.974	-0.116	-0.157	0.034
7	0.655	0.518	-0.453	0.313	0.409
8	0.622	0.368	-0.351	0.108	0.100
9	0.854	-0.319	0.247	0.323	-0.020
10	0.908	0.391	0.128	-0.080	-0.237
11	0.851	-0.439	0.222	0.184	0.138
12	0.935	0.092	-0.322	-0.116	0.157
13	0.294	0.916	0.106	0.250	0.034
14	0.817	-0.478	0.182	0.269	-0.169
15	-0.607	0.131	0.765	0.170	-0.127
16	0.883	-0.357	-0.188	0.240	0.012
17	0.635	-0.381	-0.666	0.088	0.134
18	0.246	0.931	0.138	-0.231	0.092
19	0.914	0.394	0.098	0.007	0.193
20	0.935	-0.543	-0.033	0.405	0.116
21	0.787	-0.487	0.304	0.246	0.166
22	0.841	-0.472	0.125	0.233	0.061
23	0.622	-0.010	-0.526	0.580	0.082
24	0.889	-0.214	0.363	0.176	0.034
25	-0.427	-0.034	0.613	0.663	0.138
26	-0.169	0.740	0.374	0.532	0.034
27	0.756	0.474	0.451	0.061	0.111
28	0.474	0.061	0.756	0.451	-0.169
29	0.817	-0.478	0.182	0.269	0.085
30	-0.021	0.634	0.182	0.669	-0.127
31	0.269	0.937	0.131	-0.231	0.020
32	0.034	0.072	0.166	0.983	0.031
33	0.513	-0.451	0.658	0.313	0.193
34	0.923	0.369	0.104	-0.030	0.020
35	0.984	0.157	-0.021	-0.860	0.028
36	0.796	-0.105	0.436	-0.406	0.405
37	0.856	-0.319	0.247	-0.323	0.246
38	0.922	0.316	-0.215	-0.065	0.184
39	0.886	0.447	-0.012	-0.127	0.080
40	0.905	-0.237	0.298	0.188	-0.108
41	0.889	-0.214	0.363	0.176	-0.127
42	0.819	0.193	0.417	-0.399	0.125
43	0.409	0.513	0.374	0.629	0.287
44	-0.381	-0.666	0.635	0.532	-0.060
45	0.518	-0.453	0.655	0.061	-0.010
46	0.931	0.138	0.246	0.406	0.157
47	0.394	-0.098	0.914	0.088	-0.034
48	0.034	0.072	0.983	0.313	-0.279
49	0.655	0.518	-0.453	0.491	0.381
50	0.877	-0.469	-0.053	0.092	0.247

Table 4.8 shows the initial factor matrix with coefficients indicating the correlation between the factors and the statement's standardised response scores. Thus, table 4.8 shows that factor 1 is highly correlated with the response to statement 1 (0.877 correlation), statement 2 (0.863 correlation), statement 3 (0.914 correlation), statement 4 (0.983 correlation) and statement 5 (0.851correlation).

Other statements include 9,10,11,12,14,16,19,20,21,24,27,29,34,35,36,37,38,39,40,41,42,46 and 50. There is need to rotate the initial factor matrix. Varimax rotation was performed on the initial factor matrix to obtain a final factor matrix. This final factor matrix represents the terminal solution and stands both for a pattern and a structure matrix with the coefficients representing both regression weights and correlation coefficients. The loading in a given row indicates regression coefficients of factors that describe a given variable.

TABLE 4.9 FINAL ROTATED FACTOR MATRIX FOR RESPONDENTS.

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
1	0.941	0.076	0.334	0.110	0.009
2	0.838	-0.091	-0.086	0.129	0.219
3	0.970	0.028	0.397	0.063	0.166
4	0.261	0.443	0.762	0.194	0.179
5	0.876	0.215	0.427	0.240	0.344
6	0.955	-0.397	0.391	-0.002	-0.251
7	0.857	0.019	0.217	0.347	0.338
8	0.318	0.723	0.003	0.451	0.076
9	-0.529	0.899	-0.048	0.603	0.136
10	0.067	0.988	0.013	0.163	-0.342
11	-0.171	0.792	0.110	0.212	0.022
12	0.019	0.867	0.169	0.024	0.153
13	0.594	0.354	-0.183	0.799	0.132
14	0.551	0.215	0.002	0.944	0.288
15	0.372	0.792	0.093	0.210	0.322
16	0.215	0.839	0.384	0.166	-0.040
17	-0.307	0.751	0.179	0.301	0.378
18	0.000	-0.040	0.369	0.212	-0.899
19	-0.076	0.179	0.518	0.024	-0.862
20	0.912	-0.183	-0.086	0.129	0.187
21	0.870	0.001	0.140	0.354	0.066
22	0.762	0.170	0.576	0.391	0.072
23	0.941	0.220	0.331	0.068	-0.048
24	0.876	0.174	0.045	0.240	0.416
25	0.458	0.301	0.586	0.727	-0.064
26	0.781	-0.095	0.187	-0.086	0.129
27	0.594	0.207	0.751	-0.222	0.170
28	0.914	-0.215	0.347	0.163	-0.132
29	0.389	0.163	0.845	0.487	0.094
30	0.717	0.067	0.546	0.391	-0.003
31	0.418	0.222	0.838	0.372	0.007
32	0.923	0.132	0.358	0.091	0.028
33	0.097	0.129	0.843	0.529	0.001
34	0.331	-0.028	0.883	0.344	-0.136
35	0.578	0.220	0.792	0.194	0.179
36	0.085	0.187	0.988	0.110	0.067
37	0.127	0.261	0.347	0.914	0.163
38	0.453	-0.249	0.332	0.912	0.223
39	0.178	0.416	0.301	0.378	0.717
40	0.541	-0.171	0.839	0.212	0.063
41	0.792	0.001	0.379	0.427	0.217
42	0.899	0.261	0.372	0.210	0.093
43	0.174	0.988	0.089	0.110	0.067
44	-0.048	0.874	-0.249	0.153	0.022
45	0.170	0.792	0.379	0.427	0.217
46	0.110	0.883	0.318	0.244	0.007
47	0.048	0.839	0.384	0.382	0.153
48	-0.145	0.751	0.458	0.288	-0.063
49	0.222	0.288	0.471	0.166	0.843
50	0.556	-0.022	0.212	0.745	0.483

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Table 4.9 shows that factor one is good fit on the data from statements 1,2,3,5,6,7,20,21,22,23,24,26,28,30,32,41, and 42 but a poor fit on the other statements. This indicates that the statements are probably measuring the same value system; and it is this finding that provides the researcher with evidence that a factor exists. Because of the contents of these statements, the researcher concluded from these results that **Project Organisation** was the factor that tied these statements together in minds of the respondents.Table 4.9 also shows that factor two is a good fit on statements 8,9,10,11,12,15,16,17,43,44,45,46,47 and 48 but a poor fit on the other statements. This factor is clearly measuring something different from other statements and the researcher concluded the statements were related to **Environment**. Factor 3 is a good fit only on statements 4, 27, 29, 31,33, 34, 35, 36 and 40. The factor was related to **Project Management**. Factor 4 is a good fit on statements 13,14,25,37,38 and 50. This factor was related to the **Project Definition**. The factor underlying statements 18,19,39 and 49 was related to **Infrastructure and Logistics**. This are shown in table 4.11

Table 4.11 The Factors Identified

Factor 1: Project Organisation

This includes both the formal organization structures, contractual relationships, systems of information flow and control procedures, and also informal patterns of working relationships and communication.

1. Contractors who were paid for sub-standard work contributed to cost overruns
2. Contractors paid before doing the work contributed to cost overruns
3. Termination of contracts and retendering contributed to cost overruns
5. Delayed payments to the contractors contributed to cost overruns
6. Delayed payments to sub-contractors contributed to cost overruns
7. Delayed payment to consultants contributed to cost overruns
20. A project team that does not understand their role on the project led to cost overruns
21. Poor supervision of project tasks led to cost overruns
22. Lack of commitment of project leaders led to cost overruns
23. Lack of the necessary authority from management led to cost overruns

24. Lack of management support contributed to cost overruns

26. Excessive approval delays led to cost overruns

28. Delays in decision making contributed to cost overruns

30. Project Organisational complexity led to cost overruns

32. A complex project startup contributed to cost overruns

41. General Mishandling of the project activities contributed to cost overruns

42. Corrupt practices within the project contributed to cost overruns

Factor 2: Environment

8. The weather conditions heavily contributed to cost overruns

9. The Nature of the terrain contributed to cost overruns

10. Political interference during project definition led to cost overruns

11. Political interference during implementation led to cost overruns

12. Excessive regulatory costs led to cost overruns

15. Use of inappropriate materials contributed to cost overruns

16. Use of substandard materials contributed to cost overruns

17. Use of less efficient equipment contributed to cost overruns

43. High interest rates contributed to project cost overruns

44. Unstable currency exchange disparities contributed to cost overruns

45. Spiraling Inflation contributed to cost overruns

46. Escalation in the cost of equipment contributed to cost overruns

47. Escalation in the cost of materials contributed to cost overruns

48. Escalation in the cost of wages contributed to cost overruns

Factor 3: Project Management

4. Selection of poor contractors contributed to cost overruns

27. Poor decisions led to cost overruns

29. Many stages of decision making involving project matters contributed to cost overruns

31. A longer construction period led to cost overruns

33. Failure to use project management tools e.g. Gantt Charts, CPM, Milestone Charts contributed to cost overruns

34. Improper use of project management tools contributed to cost overruns

35. Unclear project objectives contributed to project cost overruns

36. Unclear project directions contributed to project cost overruns

40. Lack of monitoring and control contributed to cost overruns

FACTOR 4: PROJECT DEFINITION

13. The variations in design contributed to cost overruns

14. The reworks in project activities contributed to cost

overruns

25. Excessive construction delays led to cost overruns

37. Optimistic budgets based on limited technical definitions led to cost overruns

38. Unrealistic budgets contributed to project cost overruns

50. Failure to learn from past mistakes contributed to cost overruns

FACTOR 5: INFRASTRUCTURE AND LOGISTICS

This relates to provision of adequate facilities, utilities, equipment, communication to accomplish the project

18. Use of unskilled or properly trained labour contributed to cost overruns

19. Lack of sufficient manpower to complete the project led to cost overruns

39. Lack of commitment to the budget contributed to cost overruns

49. Overall lack of similar experience contributed to cost overruns

iii) To test hypothesis number three that none of the identified factors was significant in the project's total cost; an average cost analysis of the 26 projects was used as indicated below.

	Project Total Cost (%)
Initial Costs.:	1.5
Design and Engineering :	7.0
Project Management and Site Supervision :	4.5
Equipment and Civil Engineering :	28.0
Construction and Civil Engeering :	20
Commissioning :	3.0
Insurance and Gurantees :	6.0
Contingency :	5.0
Overheads :	25.0
	100.00

sample mean $\bar{x}$ = 11.11

sample standard deviation = 10.24

H_0: $\mu_0 \leq 0.50$

H_A: $\mu_0 > 0.50$

Critical region will be $t < -t_{0.01}$,8 hence) reject H_0

if $t_{calculated} > 2.896$ (from t-tables)

$\bar{x} = 11.11$ $s = 10.24$ $n = 9$

Therefore,

$$t_{cal} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

$$\frac{11.11-0}{10.24/\sqrt{9}}$$

$$\frac{11.11}{3.41} = 3.25$$

INTERPRETATION:

Since 3.25 is greater than 2.896 reject H_0 and conclude that at least some of the identified critical factors were significant to project total costs at 99% confidance level

This further confirms that these factors contributed to the project cost overruns. However,even if it becomes apparent as the project develops, that the expenditure is going to be substantially greater than was first envisaged,it can be extremely difficult to avoid that extra expenditure.If the the money is not spent there is the very real danger that one is left with a partly completed project, of no real value to anybody. this possibility emphasizes the vital importance of adequate cost control in light of the critical factors leading to cost overruns.

Project Organisation.

Bruce et.al. (1974) found that functional, rather than projectized, project organisation as a determinant of cost and schedule overruns. This results in project organisations where there is lack of project team goal commitment, lack of team spirit, decision delays and sense of project mission.

Most project participants agreed that unclear project objectives and directions were the strongest barriers to project team performance. Good communications are basic to successful project management and play an important role in completing a project on time, and within the budget. Morris and Thompson (1987) highlighted poor communications as a constraint on the management of the Bura project. Thus a key element for effective control is timely evaluation of potential cost and schedule hazards and the presentation of these evaluations with recommended solutions to project management.

Environment.

This is the influence exerted from outside the project organisation. Environmental sensitivity is an integral part of all good project management. Other than the social, ecological and meteorological aspects of the environment, political involvement was cited as a major

influence on the planning and implementation of most of the projects. This has led to substantial cost increase and delays.

Project Management;

Bruce et.al (1974) found the use of insufficient networking techniques, progress reports and inadequate control procedures as principal determinants of cost and schedule overruns. At the Ministry of Water Resources, most of the Project Participants were not aware of how project management tools like networking techniques are applied in the management of projects. They rely on the contractors program of works.

Project Definition

This is assuring that the project is produced to technical specification, on the time and budget. The project participants highlighted changes in design as the principal determinants of cost and schedule overruns. This is mainly due to political involvement leading to erratic extensions during project execution. Bruce et.al (1974) also found cost underestimates, inadequate change procedures and overall lack of similar experience to lead to cost and schedule overruns.

Infrastructure and Logistics;

This relates to provision of adequate facilities, utilities, equipment and communication to accomplish the project. it requires management support of the project for allocation of sufficient resources (financial, manpower, time etc). Bruce et al. (1974) found schedule overruns to be caused by lack of commitment to the budget and schedule among other things.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

This study was carried out to achieve certain objectives as set out in chapter one. The conclusions derived are presented in summary in this section.

The findings reveal that on average the projects outrun their original cost estimates by 50% or more. This was attributed to project underfunding leading to completion delays. The danger posed by incomplete projects cannot be undermined. There have been cases of boreholes in the country that are incomplete. This has led to deaths of school children and water contamination resulting in water-borne diseases.

In such cases, the projects fail to meet their primary objective of providing safe drinking water to the beneficiaries. Lack of an adequate clean water supply is not only an inconvenience to the development in the area, but also a most serious constraint factor to the development of this nation. This further constrains the governments' objective to provide the entire population with the benefits of a safe water supply by the year 2,000.

Other major reasons for the cost overruns were adverse external environmental conditions, vandalism, extra works and claims, lack of infrastructure and poor communications. It is, however, important to stress that the continuous delay in the implementation of such development projects tend to frustrate the beneficiaries. When a community is informed that a water project or any project for that matter is to be constructed, the expectation is that it should

be started immediately without unnecessary delay. A delay forces the frustrated beneficiaries to seek alternative solutions to their water problem. Organisations like the Catholic Church have come to the aid of such beneficiaries by funding such projects. This has made some projects by the time they are completed unpopular with the intended beneficiaries and result in underutilization if not complete abandonment.

It is important to have a process of evaluation, followed by corrective action. This ensures that any potential divergence can be studied and the appropriate action taken.

The findings further reveal that most projects were not started as scheduled and delayed in completion. Such were the projects characterised by poor communications, scope changes and design variations, low budget estimates and external adverse conditions.

The study revealed that a number of problems were experienced during project execution. These were project underfunding, scope changes, lack of infrastructure and poor communications, extra works and adverse external environmental conditions.

These problems contributed to project delays leading to cost overruns. Constant and continuos effort to control cost is required throughout the life of the project. Also, the initial cost targets set should be seen as a challenge to be beaten.

The results of the factor analysis shows that the most important factor that contributes to project cost overruns is the project organization. That is creating the organization needed to execute the project - this includes both the formal organization structures, contractual relationships, systems of information flow and control procedures, and also informal patterns of working relationships and communication.

Organizational problems have been experienced in project environments and this has lead to escalation in costs and time in the Ministry. To provide satisfactory steermanship to the whole project process, Senior Management suggested;

i) Adequate personnel policy for the entire project life with special attention on the part of participating departments to ensure availability and reintegration afterwards. There should also be an adequate policy of recruitment, selection and training for effective project management. Further, there is need for development to expertise in the organization to continue the technology transfer process beyond the bounds of development assistance projects and time frames.

ii) Adequate organization structure; This in particular means a relatively flat project organization in which there should be place for constant change.

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iii) Adequate coupling of the different decision circuits within the bureaucracy with regard to construction costs, personnel costs and general expenses.

iv) Assessment of time, cost and Quality. The total project work must be split up into a number of manageable parts and the separate elements should be constantly synthesized, as the responsible sectors tend to over stress the risks and to treat costs as secondary.

There is need for setting up of cost reduction units especially on big projects where construction accounts for a substantial proportion of the expenditure. This should not, however, destruct from the quality of the work.

In this case it is expedient to carry out Sensitivity analysis in which certain terms construction processes are considered in terms of their consequences for time, costs and risks with the aid of computer programs.

v) External Auditing

Technical audits, made in consultation with experts increase confidence in certain solutions. In addition a periodic management audit may be held.

vi) Good communication

Good communications are basic to successful project management and play an important role in completing a project on time, and within budget. Poor communication has been a major barrier to effective team development efforts. This has often resulted in unclear project objectives, poor project control and objectives, poor project control and coordination, and uneven workflow.

There has to be an integrated whole, including not only the construction team on site, but also the home office staff concerned with design, engineering, procurement, expediting and the financing of the project. The members of this team belong to a wide range of disciplines and have very diverse functions. With their different backgrounds engineering, buying, accounting - all radically different in concept, effective communication is a must for proper project control.

The second factor is the Environment. The environmental sensitivity is an integral part of all good project management. Nature, inflation, politics, pressure from interest groups, risks and other uncertainties, have to be evaluated, through discussion, from the viewpoint of the various agencies involved, such as suppliers, standard equipment vendors, engineering contractor, construction companies, utility owner and governmental authorities. For example, Dams, barrages, and river diversions need careful analysis to ensure minimum environmental intrusion.

The Ministry ensures extensive investigations are correctly devoted to establishing geological strata, topography, hydrology, Structural analysis, access and other relative costs upon project proposal.

The estimate has to be examined item by item from these several viewpoints, and the risk quantified in discussion, and with the assistance of the experts in the particular field, where possible, in areas of significant risk, such as in relation to new regulations, a consensus, of opinion from a number of experts in the field should be taken if possible. All those opinions are then consolidated, and cost parameters set. This probabilistic cost estimate should awaken management to the fact that they are dealing with an estimate, and an estimate with a very wide margin of error, at that.

Another aspect is that this approach highlights the critical cost areas, helping to provide "warning signals". It is always possible, perhaps by speeding up work in those areas, to mitigate against the growing cost. If expert opinion is used intelligently, there will be something far more reliable than a contingency.

Inflation forms an important element in the cost development of projects. The longer a project takes, the greater the chance of cost overrun, moreover, any extra work involved is also hit by inflation. It was found advisable to agree at the start of the project on price compensation procedures so that suitable provision can be made in the budget.

The major environmental challenge is to avoid excessive regulatory costs as it inhibits growth, reduces productivity, restrains innovation and inflates costs. It was suggested that probably the best way of securing reasonableness in this sphere is to seek any and every opportunity to cooperate with the appropriate governmental bodies, so as to ensure that the legislation that results is both sensible and reasonable.

Thus, if all the multidisciplinary environmental considerations are fully explored and suitably managed in the planning stage and acted upon before the project hits the drawing board, a project will be produced which will be beneficial, not just by meeting the user needs but also one which will not be seriously at odds with its environment.

The third factor was project management. This included the project selection, scheduling, use of project management tools, monitoring and control. It was found that most of the project managers and other project participants need to be trained for them to appreciate the tools and techniques of managing a project. Also, there was need to train potential managers so that they can be equipped with the necessary skills of project management to ensure proper coordination of both human and non-human resources.

The project management tools should be used that give better and accurate project visibility. It was suggested that tools used should take care of the routine work and give more time for planning, analysis and anticipating.

Lack of control during the implementation of the project is a major cause of failure. A feedback system should be designed so that the 'controller' knows at any point in time whether the project is keeping to set targets.

The fourth factor is project definition. This is assuring that the project is produced to technical specification, on time, and in budget. It was suggested that a complete definition of the work requirements should be provided. Effective planning and implementation of projects cannot be accomplished without a complete definition of the requirements. A complete definition of project requirements must include:-

- Scope (or statement) of work
- Specifications
- Schedules (gross or summary)

The scope of work identifies the goals and objectives which are to be achieved. If a funding constraint exists, it was suggested that this information might also appear in the Statement of work. Misinterpretation of the statement of work were found to lead to severe cost overruns and schedule slippages.

The second major item in the definition of the requirements was the identification of the specifications, if applicable. This is because specifications form the basis from which man-hours, equipment, and materials are priced out. Small changes in a specification has been

found to cause large cost overruns. Where such standards team may have to use educated guesses based upon the estimated degree of difficulty.

The third item in the identification of the requirements is the gross schedule. In summary, the gross schedule identifies the major milestones of the project and include such items as start date, end date, other major milestone activities, Data items and reports.

The fifth factor is Infrastructure and logistics. It was suggested that adequate facilities, transportation, communication and other utilities should be provided to accomplish the project.

CONCLUSION:

Cost increases in projects are almost invariably related to schedule slippage, so strict design change control procedures are vital and adequate funding should be provided. The elements of such projects are so closely related that if one of them fails to achieve the scheduled objective, then probably the entire project is in jeopardy.

The key to effective project management on any project lies in leadership, together with the innovative skill and dedication of all the people involved. Successful completion of a project within the allocated time and budget is possible, but a compressive team effort is required for this.

5.1 LIMITATIONS OF THE STUDY:

This study is limited by the following considerations:-

There were time and budgeting constraints that made it difficult to use a survey research design. This could have examined projects from other organizations. It would have been the researcher's interest to investigate projects in the private sector and probably using discriminate analysis compare projects in this different environments.

Also, corrupt practices have been known to contribute to project cost overruns particularly in development projects. Unfortunately, for this study this variable was difficult to operationalize and could not be measured.

5.2 RECOMMENDATIONS FOR FURTHER RESEARCH

The following is the recommendation for further study in this area:-

i) Critical success factors in Effective project cost control;

ii) Quality Program Management in Project Management in the Public Sector: Success and Failure Patterns compared to Private Sector Projects.

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APPENDIX I

UNIVERSITY OF NAIROBI
FACULTY OF COMMERCE
MBA — PROGRAMME

LOWER KABETE CAMPUS

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May 8, 1998

INTRODUCTORY LETTER: KARIMI ROSE BERNADETTE

KARIMI ROSE BERNADETTE is a Masters student in the faculty of commerce, University of Nairobi. In partial fulfilment of the requirements of the Masters in Business and Administration (MBA) he is conducting a study on " FACTORS WHICH ARE CRITICAL IN PROJECT COST OVERRUNS: A CASE OF MINISTRY OF WATER RESOURCES PROJECTS"

Your organization/firm has been selected to form part of this study. To this end, we kindly request your assistance in completing the questionaire which forms an intergral part of the research project. Karimi Rose will be responsible for the administration of the questionnaire. Any additional information you might feel necessary for this study is welcome.

The information and data required is needed for academic purposes and will be treated in strict confidence. A copy of the research project will be made avilable to your organization/firm upon request.

Thank you.

Yours sincerely,

M. B. A. OFFICE
P. O. Box 30197.
11 MAY 1998
NAIROBI.
UNIVERSITY OF NAIROBI FACULTY OF COMMERCE

LELEI
MBA Co-ordinator

APPENDIX 1

QUESTIONNAIRE

Please indicate to what extent do you consider each of the following factors to have contributed to cost overruns in the project which you participated in.

		NO EXTENT AT ALL	SOME EXTENT	GREAT EXTENT
1.	Contractors who were paid for sub-standard work contributed to cost overruns	1	2	3
2.	Contractors paid before doing the work contributed to cost overruns	1	2	3
3.	Termination of contracts and retendering contributed to cost overruns	1	2	3
4.	Selection of poor contractors contributed to cost overruns	1	2	3
5.	Delayed payments to the contractors contributed to cost overruns	1	2	3
6.	Delayed payments to sub-contractors contributed to cost overruns	1	2	3
7.	Delayed payment to consultants contributed to cost overruns	1	2	3
8.	The weather conditions heavily contributed to cost overruns	1	2	3
9.	The Nature of the terrain contributed to cost overruns	1	2	3
10.	Political interference during project definition led to cost overruns	1	2	3
11.	Political interference during implementation led to cost overruns	1	2	3
12.	Excessive regulatory costs led to cost overruns	1	2	3

13.	The variations in design contributed to cost overruns	1	2	3
14.	The reworks in project activities contributed to cost overruns	1	2	3
15.	Use of inappropriate materials contributed to cost overruns	1	2	3
16.	Use of substandard materials contributed to cost overruns	1	2	3
17.	Use of less efficient equipment contributed to cost overruns	1	2	3
18.	Use of unskilled or properly trained labour contributed to cost overruns	1	2	3
19.	Lack of sufficient manpower to complete the project led to cost overruns	1	2	3
20.	A project team that does not understand their role on the project led to cost overruns	1	2	3
21.	Poor supervision of project tasks led to cost overruns	1	2	3
22.	Lack of commitment of project leaders led to cost overruns	1	2	3
23.	Lack of the necessary authority from management led to cost overruns	1	2	3
24.	Lack of management support contributed to cost overruns	1	2	3
25.	Excessive construction delays led to cost overruns	1	2	3
26.	Excessive approval delays led to cost overruns	1	2	3
27.	Poor decisions led to cost overruns	1	2	3
28.	Delays in decision making contributed to cost overruns	1	2	3
29.	Many stages of decision making involving project matters contributed to cost overruns	1	2	3
30.	Project Organisational complexity led to cost overruns	1	2	3
31.	A longer construction period led to cost overruns	1	2	3

32.	A complex project startup contributed to cost overruns	1	2	3
33.	Failure to use project management tools e.g. Gantt Charts, CPM, Milestone Charts contributed to cost overruns	1	2	3
34.	Improper use of project management tools contributed to cost overruns	1	2	3
35.	Unclear project objectives contributed to project cost overruns	1	2	3
36.	Unclear project directions contributed to project cost overruns	1	2	3
37.	Optimistic budgets based on limited technical definitions led to cost overruns	1	2	3
38.	Unrealistic budgets contributed to project cost overruns	1	2	3
39.	Lack of commitment to the budget contributed to cost overruns	1	2	3
40.	Lack of monitoring and control contributed to cost overruns	1	2	3
41.	General Mishandling of the project activities contributed to cost overruns	1	2	3
42.	Corrupt practices within the project contributed to cost overruns	1	2	3
43.	High interest rates contributed to project cost overruns	1	2	3
44.	Unstable currency exchange disparities contributed to cost overruns	1	2	3
45.	Spiraling Inflation contributed to cost overruns	1	2	3
46.	Escalation in the cost of equipment contributed to cost overruns	1	2	3
47.	Escalation in the cost of materials contributed to cost overruns	1	2	3
48.	Escalation in the cost of wages contributed to cost overruns	1	2	3

49.	Overall lack of similar experience contributed to cost overruns	1	2	3
50.	Failure to learn from past mistakes contributed to cost overruns	1	2	3

APPENDIX II

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balan Remain
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	ONGOING PROJECTS															
	GOK PROJECTS															
009	Construction of Water Supply - Livestock Programme	C		4,402	-	-	4,402	1,902	-	1,902		2000	530	545	440	38
043	Livestock and Water Supplies Development - ENSDA	C		13,000	-	-	13,000	12,723	-	12,723	1993	2000	72	150	200	12,30
057	Minor Urban Water Supply Programme	C		20,000	-	-	20,000	16,500	-	16,500		2000	150	150	500	15,70
059	Water Supply/Livestock Development & Marketing - CDA	C		13,000	-	-	13,000	12,800	-	12,800	1994	2000	520	1,050	1,000	10,23
062	Livestock and Water Development - ENNDA	C		13,000			13,000	12,777		12,777		2000	72	150	150	12,40
110	Rehabilitation of Hola Pumping Station - NIB	C		23,000	-	-	23,000	22,000	-	22,000	1994	2000	1,000	1,500	1,500	18,00
116	Rehabil. of Canals & Proposed Gravity Sys._BISP	C		60,000	-	-	60,000	60,000	-	60,000	1992	2000	5,000	10,000	10,000	35,00
257	Construction of Water Supply - Garissa	C		10,600	-	-	10,600	2,500	-	2,500	1995	1997	1,300	1,200	-	-
310	Construction of W/S - Conservation Structures	C		15,000	-	-	15,000	14,700	-	14,700	1989	2000	75	75	75	14,475
479	Construction of Water Supply - Rehabilitation	C		60,000	-	-	60,000	54,007	-	54,007		2000	5,000	5,000	5,000	39,007
559	Construction of Water Supplies - Lamu Urban	C		2,000	-	-	2,000	1,600	-	1,600	1984	1997	1,000	600	-	-
591	Yala Swamp Phase II LBDA	C		17,800	-	-	17,800	17,705	-	17,705	1984	2000	1,000	1,000	1,000	14,705
001	Kibishi Multipurpose Project - TRP	H		115	-	-	115	50	-	50	1987	1998	10	15	25	-
006	Miscellaneous Other Charges - TRP	H		860	-	-	860	506	-	506	1990	2000	80	90	100	236
025	Construction of Water Supplies - Kigumo	H		5,400	-	-	5,400	2,400	-	2,400	1990	1993	500	500	1,400	-
036	Rainfed Rice Project(ADF/OPEC) - LBDA	H		2,306	-	-	2,306	1,718	-	1,718	1998	1999	1,000	718	-	-
041	Horticultural and Irrigation Development - ENNDA	H		600	-	-	600	595	-	595	1995	2000	35	50	50	460
042	Catchment Conservation & Rehabilitation - ENSDA	H		5,000	-	-	5,000	4,496	-	4,496	1993	1998	100	200	1,000	3,196
045	Construction of Buildings - ENSDA	H		2,500	-	-	2,500	2,450	-	2,450	1993	2000	100	386	450	1,514
046	Construction of Buildings - ENSDA	H		1,000	-	-	1,000	886	-	886	1993	2000	55	200	450	181
047	Dams/Pans Construction - ENSDA	H		2,500	-	-	2,500	2,448	-	2,448	1993	2000	200	500	948	800
048	Horticultural and Irrigation Development - ENSDA	H		1,500	-	-	1,500	1,488	-	1,488	1993	2000	20	300	400	768
055	Construction of Water Supply - Embu Rural	H		845	-	-	845	745	-	745	1990	2000	75	150	155	365
058	Horticultural and Irrigation Development - CDA	H		1,500	-	-	1,500	1,488	-	1,488		2000	20	300	400	768
061	Catchment Conservation and Rehabilitation - ENNDA	H		5,000	-	-	5,000	4,930	-	4,930	1994	2000	100	500	500	3,830
063	Construction of Water Supplies - Kipipiri	H		482	-	-	482	40	-	40		1998	30	10	-	-
064	Contruction of Buildings (non-residential) - ENNDA	H		2,500	-	-	2,500	1,980	-	1,980	1995	2000	100	240	240	1,400
065	Construction of Buildings - ENNDA	H		2,000	-	-	2,000	1,990	-	1,990	1995	2000	100	200	90	1,600
069	Construction of Water Supplies - Moyale	H		850	-	-	850	300	-	300		1997	105	195	-	-
070	Construction of Water Supply - Wote	H		35,000	-	-	35,000	34,986	-	34,986		2000	1,000	1,000	1,000	31,986
071	Construction of Water Supply - Athi Yatta	H		500	-	-	500	250	-	250		1998	50	100	100	-
072	Construction of Water Supply - Chuka	H		400	-	-	400	286	-	286		1999	100	100	86	-

VOTE D20 MINISTRY OF LAND RECLAMATION, REGIONAL AND WATER DEVELOPMENT (Thousands of K£) – (Contd.)

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balance Remaining
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	ONGOING PROJECTS – *(Contd.)*															
	GOK PROJECTS – *(Contd.)*															
075	Construction of Water Supply-Nyamira	H		1,250	-	-	1,250	890	-	890	1992	2000	100	300	300	190
076	Construction of Water Supply - Migori	H		1,500	-	-	1,500	1,486	-	1,486		2000	100	150	200	1,036
081	Construction of Water Supply - Kathiaani	H		6,000	-	-	6,000	4,000	-	4,000		2000	100	100	500	3,300
084	Construction of Water Supply - Kikumbulyu Phase II	H		6,500	-	-	6,500	6,000	-	6,000		2000	500	500	1,000	4,000
087	Construction of Water Supply - Tigania	H		850	-	-	850	350	-	350		1997	100	200	50	-
088	Construction of Water Supply - Bomet	H		500	-	-	500	486	-	486		1999	100	100	100	186
089	Construction of Water Supply - Mwingi	H		4,000	-	-	4,000	3,800	-	3,800		2000	500	500	1,000	1,800
103	Ahero Research Station - NIB	H		800	-	-	800	500	-	500	1994	1996	50	50	50	350
112	Contr. of Offices,Mills and Stores - NIB	H		2,000	-	-	2,000	2,000	-	2,000	1994	2000	100	100	300	1,500
115	Construction of Water Supply Kiareni	H		1,743	-	-	1,743	1,038	-	1,038		2000	100	320	300	318
117	Construction of Water Supply - Sidindi Malanga	H		1,150	-	-	1,150	483	-	483		1997	100	200	183	-
122	Construction of Water Supply - Isebania	H		800	-	-	800	280	-	280		1998	75	75	130	-
129	Bura Fuelwood Project - BISP	H		375	-	-	375	225	-	225		1997	75	75	75	-
135	Community Wells Project - TRP	H		500	-	-	500	455	-	455	1992	2000	35	55	75	290
139	Construction of Water Supply - Sigor Longisa	H		2,330	-	-	2,330	330	-	330		1998	100	100	130	-
140	Construction of Water Supply - Fort Teman	H		500	-	-	500	183	-	183		1997	50	50	83	-
143	Construction of Water Supply - Mosiro	H		460	-	-	460	50	-	50		1995	30	20	-	-
151	Construction of Water Supply - Ainabkoi	H		900	-	-	900	700	-	700		1998	50	200	450	-
159	Construction of W/S Sacho Remo/Kabasit/Seretounin	H		985	-	-	985	142	-	142		1997	50	92	-	-
164	Construction of Water Supply - Timboroa	H		360	-	-	360	74	-	74		1997	74	-	-	-
208	Construction of Water Supply - Malaba Kocholia	H		4,250	-	-	4,250	2,060	-	2,060		2000	200	500	500	860
211	Construction of Water Supply - Malanga/Lugulu	H		120	-	-	120	30	-	30		1996	30	-	-	-
238	Construction of Water Supply - Juja	H		2,000	-	-	2,000	1,100	-	1,100		1998	100	500	500	-
252	Construction of Water Supply - Umaa Dam	H		7,000	-	-	7,000	6,120	-	6,120		2001	500	500	500	4,620
254	Construction of Water Supply - Machakos/Kalanzoni/Birigani	H		2,208	-	-	2,208	855	-	855		1998	600	100	155	-
256	Construction of Water Supply - Meru Town	H		605	-	-	605	255	-	255		1995	50	100	105	-
263	Construction of Water Supply - Marsabit Town	H		2,450	-	-	2,450	450	-	450		1996	450	-	-	-
265	Consctruction of Water Supply - Wajir	H		1,000	-	-	1,000	350	-	350		1999	20	130	200	-
301	Ground Water Management	H		15,000	-	-	15,000	14,750	-	14,750		2000	514	439	195	13,602
318	Construction of Kipkaren Dam - NWCPC	H		4,150	-	-	4,150	2,487	-	2,487	1994	2000	250	200	200	1,837
323	Construction of Water Supply - State Lodges	H		250	-	-	250	74	-	74		1999	10	40	24	-
325	Construction of Water Supply - Njoro Kubwa	H		170	-	-	170	109	-	109		1995	30	30	49	-

VOTE D20 MINISTRY OF LAND RECLAMATION, REGIONAL AND WATER DEVELOPMENT (Thousands of K£) – (Contd.)

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balance Remaining
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	ONGOING PROJECTS – *(Contd.)*															
	GOK PROJECTS – *(Contd.)*															
326	Construction of Water Supply - Yatta Canal	H		5,000	-	-	5,000	4,828	-	4,828	1990	2000	500	500	500	3,328
327	Construction of Water Supply - Nyando Protection	H		9,000	-	-	9,000	8,800	-	8,800	1985	2000	100	300	500	7,900
353	Construction of Kisenian Dam	H		3,241	-	-	3,241	2,198	-	2,198	1990	1998	561	837	800	-
358	Construction of Water Supply - Thuku B/Hole	H		869	-	-	869	250	-	250	1989	1997	250	-	-	-
403	Construction of Water Supply - Ndia	H		1,046	-	-	1,046	306	-	306		1995	306	-	-	-
411	Construction of Water Supply - Nyakach	H		1,550	-	-	1,550	1,463	-	1,463		2000	180	200	200	883
455	Malindi Pipeline Project - NWCPC	H		15,132	-	-	15,132	8,850	-	8,850		1998	1,000	3,000	4,850	-
546	Construction of Water Supply - Homa Bay	H		500	-	-	500	400	-	400	1985	1997	100	100	200	-
553	Construction of Water Supply - Mbale	H		2,000	-	-	2,000	1,961	-	1,961	1985	2000	300	500	700	461
566	Coastal Fishing Project - CDA	H		2,500	-	-	2,500	2,500	-	2,500	1985	1998	950	800	750	-
571	Horticultural Development - LBDA	H		814	-	-	814	396	-	396	1984	1998	132	132	132	-
573	Livestock Development - LBDA	H		2,000	-	-	2,000	1,706	-	1,706	1984	2005	50	50	50	1,556
575	Fisheries Project - LBDA	H		3,000	-	-	3,000	2,985	-	2,985	1984	2005	10	20	25	2,930
577	Yala Swamp Complex - LBDA	H		1,000	-	-	1,000	410	-	410	1984	1998	100	150	160	-
579	Effluent Monitoring and Health Surveillance_LBDA	H		200	-	-	200	200	-	200	1984	2000	10	11	10	169
580	Catchment Conservation and Rehabilitation - LBDA	H		780	-	-	780	776	-	776	1984	1999	40	40	240	456
582	Tiles and Bricks Manufacture - LBDA	H		1,650	-	-	1,650	1,471	-	1,471	1985	2000	50	40	40	1,341
583	Construction of Buildings Hqs - LBDA	H		8,900	-	-	8,900	7,337	-	7,337	1990	2005	2,500	500	500	3,837
589	Flood Control and Drainage - LBDA	H		6,800	-	-	6,800	6,380	-	6,380	1982	2005	40	40	440	5,860
592	Minor Irrigation - LBDA	H		19,500	-	-	19,500	9,382	-	9,382		2000	10	15	20	9,337
625	Catchment Conservation and Rehabilitation - CDA	H		5,000	-	-	5,000	4,895	-	4,895		2001	1,000	1,000	1,000	1,895
626	Construction of Buildings(non-resden.) - CDA	H		2,500	-	-	2,500	2,430	-	2,430		2000	40	200	450	1,740
627	Minerals Exploration Project - CDA	H		1,000	-	-	1,000	985	-	985		2000	20	70	100	795
024	Construction of Water Supplies - Warazo Luton	M		900	-	-	900	314	-	314		2000	50	50	50	164
095	Tourism and Fisheries Development CDA	M		2,000	-	-	2,000	1,994	-	1,994		2000	20	400	400	1,174
119	Construction of Water Supplies - Oyugis	M		1,150	-	-	1,150	493	-	493		2000	50	50	100	293
570	Poultry Development - LBDA	M		400	-	-	400	314	-	314	1988	2000	20	40	40	214
572	Cotton Project - LBDA	M		1,350	-	-	1,350	1,215	-	1,215		2000	10	10	10	1,185
574	Groundnut Project - LBDA	M		1,000	-	-	1,000	787	-	787		2000	20	10	10	747
576	Bee Keeping Project - LBDA	M		1,000	-	-	1,000	748	-	748		2000	10	10	10	718
585	Construction of Buildings(residential) - LBDA	M		1,982	-	-	1,982	1,833	-	1,833	1991	2005	50	100	120	1,563
587	LBDA - Water Resource Database	M		780	-	-	780	758	-	758	1986	1998	-	-	758	-

VOTE D20 MINISTRY OF LAND RECLAMATION, REGIONAL AND WATER DEVELOPMENT (Thousands of K£) – (Contd.)

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balance Remaining
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	ONGOING PROJECTS – *(Contd.)*															
	GOK PROJECTS – *(Contd.)*															
621	Purchase of Demonstration Equipment - TRP	M		250	-	-	250	244	-	244		2000	9	14	20	201
622	Construction of Building - TRP	M		50	-	-	50	23	-	23	1990	1998	6	7	10	-
623	Construction of Water Supplies - Kiunga	M		197	-	-	197	97	-	97	1990	1999	30	50	17	-
624	Construction of Water Supplies - Karimeu	M		2,500	-	-	2,500	2,000	-	2,000		1998	500	100	750	650
	TOTAL GOK			502,907	-	-	502,907	427,087	-	427,087			33,666	42,246	48,575	302,600
	EXTERNAL PROJECTS															
016	Food Aid to Core Activities in ASAL	C	WFP	1,000	5,000	-	6,000	607	2,500	3,107	1996	1997	1,905	1,202	-	-
026	Drought Preparedness and Early Warning sys.	C	NETHERLANDS	6,000	26,000	-	32,000	6,000	26,000	32,000		2000	350	2,180	6,000	23,470
345	2ND MSA & Coastal W/S Eng. & Rehabilitation - NWCP	C	IDA	47,440	-	79,430	126,870	40,300	19,230	59,530	1992	1999	25,000	30,000	4,530	-
385	Construction of Sewerage - Rehabilitation	C	JAPAN	11,416	2,046	-	13,462	11,303	1,023	12,326		1999	2,326	3,000	7,000	-
002	Kwale/Kilifi Rural Development programme	H	IFAD	3,559	1,600	9,922	15,081	559	3,222	3,781		2000	767	785	2,000	229
003	Taita Taveta ASAL	H	DANIDA	470	8,787	-	9,257	32	1,121	1,153	1994	1998	500	653	-	-
004	Water Project Consolidation	H	FINLAND	190	8,720	-	8,910	131	5,170	5,301		1998	2,000	2,000	1,301	-
005	Kitui Integrated Dev. Programme	H	DANIDA	5,260	11,943	-	17,203	581	2,500	3,081	1990	1996	2,500	581	-	-
007	Kajiado ASAL	H	NETHERLANDS	264	7,719	-	7,983	213	3,007	3,220	1987	1999	410	500	1,000	1,310
008	Laikipia ASAL	H	NETHERLANDS	70	21,000	-	21070	60	21,000	21,060	1995	1998	200	500	2,000	18,360
011	West Pokot ASAL	H	NETHERLANDS	64	4,345	-	4,409	-	205	205	1995	1998	65	140	-	-
012	Elgeyo Marakwet ASAL	H	NETHERLANDS	70	5,016	-	5,086	20	2,101	2,121	1995	1998	700	400	500	521
017	Coastal ASAL Development Project	H	IFAD	1,000	-	5,500	6,500	50	4,503	4,553	1991	1998	1,000	1,200	2,000	353
028	Narok Development Project - ASAL	H	NETHERLANDS	70	12,500	-	12,570	70	11,940	12,010		2000	1,017	1,027	2,000	7,966
077	Construction of W/S - Masinga/Matuu/Kitui	H	AUSTRIA	850	32,500	-	33,350	850	10,806	11,656	1994	1997	5,506	515	-	5,635
102	Extension of Ahero Irrigation Scheme - NIB	H	JAPAN	3,750	37,500	-	41,250	3,750	37,500	41,250		1995	1,000	1,000	10,000	29,250
106	Rehab. of W/Kano & Bunyala Irrigation Sch._NIB	H	NETHERLANDS	1,000	5,000	-	6,000	1,000	5,000	6,000	1995	1996	200	200	3,000	2,600
304	Water Resource assessment Programme	H	NETHERLANDS	2,075	6,820	-	8,895	775	1,334	2,109		1996	2,109	-	-	-
330	Rural Water Supply Programme	H	SIDA	5,000	11,400	15,000	31,400	490	10,535	11,025	1987	1998	4,855	3,000	3,170	-
331	Construction of Water Supply - Kitui ASAL	H	DANIDA	5,000	3,800	-	8,800	2,438	824	3,262		1998	1,440	1,440	382	-
334	Construction of Water Supply - Baringo	H	IDA	600	-	6,600	7,200	590	6,420	7,010		1998	200	1,000	2,000	3,810
356	A.S.A.L. - Kajiado (Water)	H	NETHERLANDS	1,520	9,000	-	10,520	1,420	8,439	9,859	1994	1999	1,500	1,500	3,000	3,859
502	Dry Areas Small Holders & Community Services	H	IFAD	413	1,694	-	2,107	246	1,090	1,336		1999	300	400	600	36

VOTE D20 MINISTRY OF LAND RECLAMATION, REGIONAL AND WATER DEVELOPMENT (Thousands of K£) – (Contd.)

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balance Remaining
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	ONGOING PROJECTS – (Contd.)															
	EXTERNAL PROJECTS – (Contd.)															
503	New Rural Water Project	H	FINLAND	145	21,300	-	21,445	145	21,040	21,185		2000	360	300	6,000	14,625
537	Farmers Group & Community Support	H	IFAD	1,623	9,198	-	10,821	1,423	6,586	8,009		1999	1,687	2,000	2,500	1,822
540	Construction of Water Supply - Kilifi	H	FRG	1,500	9,000	-	10,500	1,200	4,240	5,440		1999	500	2,000	294	2,646
552	Baringo F.F. Project	H	NETHERLANDS	20	6,000	-	6,020	20	6,000	6,020	1995	1998	2,000	2,000	2,020	
555	Fish Processing Plant & Cold Storage - LBDA	H	ITALY	6,000	-	-	6,000	5,995	-	5,995		1999	1,000	1,000	2,000	1,995
590	Construction of Community Wells - LBDA	H	NETHERLANDS	7,000	11,357	-	18,357	3,080	7,700	10,780	1990	1996	1,500	1,500	3,500	4,280
628	Mwea Irrigation Scheme(mutithi) - NIB	H	JAPAN	373	-	20,000	20,373	373	12,500	12,873	1995	1998	2,000	2,000	6,000	2,873
562	Monitoring and Evaluation	M	DANIDA	-	1,497	-	1,497	-	1,239	1,239		2000	175	175	200	689
	TOTAL EXTERNAL			113,742	280,742	136,452	530,936	83,721	244,775	328,496			64,972	64,198	72,997	136,329
	NEW PROJECTS															
629	Integrated Coastal Zone Mgmt Pro. - CDA	H		13,000	-	-	13,000	13,000	-	13,000		1999	6,000	4,000	3,000	-
630	Construction of W/S - Methci/Musgut/Tot	H		20,000	-	-	20,000	20,000	-	20,000	1990	1998	10,000	5,000	5,000	-
631	Construction of W/S - Masa	H		6,750	-	-	6,750	6,750	-	6,750		1998	3,000	2,750	1,000	-
632	Construction of W/S - Kobaacha	H		50,000	-	-	50,000	50,000	-	50,000		2000	10,000	10,000	15,000	15,000
633	Construction of W/S - Kapsakwony	H		500	-	-	500	500	-	500		1999	200	200	100	-
634	Perkerra Dam	H		20,000	-	-	20,000	20,000	-	20,000		2001	35	35	35	19,895
665	Tudor Housing Re-Development Pro. - CDA	H		1,000	-	200,000	201,000	1,000	200,000	201,000		2000	51,600	45,150	103,200	1,050
668	Construction of W/S-Nyando/Muhoroni/Tamboros	H		1,000	175,000	-	176,000	1,000	175,000	176,000		2008	350	350	350	174,950
635	Seed Maize Bulking Project - CDA	M		1,032	-	-	1,032	1,032	-	1,032		1999	530	236	266	-
636	Integrated Coconut Project - CDA	M		7,653	-	-	7,653	7,653	-	7,653		1999	3,179	2,238	2,236	-
637	Mwenenyenzala Citrus Project - CDA	M		15,225	-	-	15,225	15,225	-	15,225		2000	2,000	3,000	5,000	5,225
638	Bee Keeping Pro. and Honey Refinery - CDA	M		1,603	-	-	1,603	1,603	-	1,603		1999	617	501	450	35
639	Coast Rural Health Project - CDA	M		8,247	-	-	8,247	8,247	-	8,247		2000	5,423	649	700	1,435
640	Promotion of Oil Seeds Growing - CDA	M		5,699	-	-	5,699	5,699	-	5,699		2000	1,905	1,221	1,220	1,353
641	Minor Irrigation - TRP	M		78	-	-	78	78	-	78		1998	20	25	33	-
642	Livestock Dev. Project - TRP	M		50	-	-	50	50	-	50		1998	15	20	15	-
643	Study of Lake Naivasha	M		950	-	-	950	950	-	950		2000	343	422	79	106
644	Flood Forcasting Studies	M		650	-	-	650	650	-	650		1998	450	150	50	-
645	Hydrological Monitoring and Forcasting	M		500	-	-	500	500	-	500		1998	300	100	100	-

VOTE D20 MINISTRY OF LAND RECLAMATION, REGIONAL AND WATER DEVELOPMENT (Thousands of Kf) - (Contd.)

Proj. No.	Project Name	Priority	Source of Fund	Total Estimated Costs				Balance Required to Complete			Year Started	Year of Completion	Proposed Expenditure Schedule			Balance Remaining
				GoK	External Grant	External Loan	Total	GoK	External	Total			1996/97	1997/98	1998/99	
	NEW PROJECTS - (Contd.)															
646	Groundwater Monitoring and Conservation	M		600	-	-	600	600	-	600		2000	200	100	100	200
647	Geophysical Survey	M		2,400	-	-	2,400	2,400	-	2,400		2000	300	400	700	1,000
648	Construction of W/S - Kibirichia	M		15,000	-	-	15,000	15,000	-	15,000	1987	1998	3,000	5,000	7,000	-
649	Construction of Building - KEWI	M		1,500	-	-	1,500	1,500	-	1,500	1995	1998	500	500	500	-
650	Water Resources Assessment and Mgmt.Pro.	M		300	-	-	300	300	-	300		1998	100	100	100	-
651	Community Training in Wildlife Conservation - ENSDA	M		5,000	-	-	5,000	5,000	-	5,000	1995	2000	500	3,000	500	1,000
652	Socio-cultural Development and Studies - ENSDA	M		5,000	-	-	5,000	5,000	-	5,000	1995	2000	500	2,000	1,000	1,500
653	Cereals Seed Development and Marketing - ENSDA	M		25,000	-	-	25,000	25,000	-	25,000	1995	1996	5,000	20,000	-	-
654	Mineral Explo. and Exploitation - ENSDA	M		500	-	-	500	500	-	500	1995	2000	150	150	100	100
655	Regional Dev. Studies - LBDA	M		500	-	-	500	500	-	500		2000	10	10	10	470
656	Baringo Boreholes & Water Pans - NWCPC	M		35,000	-	-	35,000	35,000	-	35,000		2000	3,500	2,000	10,500	19,000
657	Nyangores Dam & Associate Work - NWCPC	M		35,000	-	-	35,000	35,000	-	35,000		2000	3,500	15,750	15,750	-
658	Kivu Dam & Associate Work - NWCPC	M		15,000	-	-	15,000	15,000	-	15,000		2000	1,500	13,500	-	-
659	Soin W/S_NWCPC	M		35,000	-	-	35,000	35,000	-	35,000		2000	3,500	15,750	15,750	-
660	Amopno Dam & Associated Work - NWCPC	M		27,000	-	-	27,000	27,000	-	27,000		2000	2,600	12,200	12,200	-
661	Cheragani Dam & Associated Work - NWCPC	M		13,000	-	-	13,000	13,000	-	13,000		2000	1,300	7,800	3,800	100
662	Poro Dam & Associated Work - NWCPC	M		18,000	-	-	18,000	18,000	-	18,000		2000	1,800	16,200	-	-
663	National Water Quality Monitoring Pro.	M		250	-	-	250	250	-	250		2000	50	50	50	100
669	Road Network Development - CDA	M		-	-	25,000	25,000	-	25,000	25,000		2000	5,000	5,000	10,000	5,000
670	Road Network Development - ENSDA	M		-	-	25,000	25,000	-	25,000	25,000		2000	5,000	5,000	10,000	5,000
672	Road Network Development - ENSDA	M		-	-	25,000	25,000	-	25,000	25,000		2000	5,000	5,000	10,000	5,000
676	3rd Mombasa Water Project - NWCPC	M		108	10,800	-	10,908	108	10,800	10,908	1996	2000	3,600	3,600	3,000	708
664	Rehab. of Equipment - NIB	C	AUSTRIA	900	9,000	-	9,900	900	9,000	9,900		1998	9,000	900	-	-
666	Lake Chala Water Rrsources Development - CDA	H	IFAD	800	8,362	-	9,162	800	8,362	9,162		2000	3,024	2,072	3,265	801
667	Poultry Development for s/scale Rural Women - CDA	H	ADB	774	-	8,000	8,774	774	8,000	8,774		1998	4,515	2,573	1,686	-
671	On-farm Water & Sanitation Dev.(E/Prov.)	M	IFAD	-	7,645	-	7,645	-	7,645	7,645		2000	500	500	500	6,145
673	Integrated Regional Development Master Plan - ENNDA	M	ADB	450	4,500	-	4,950	450	4,500	4,950	1994	2000	1,000	1,250	1,000	1,700
674	Longopito Multiplication Centre - ENNDA	M	ADF	1,500	28,752	-	30,252	1,500	28,752	30,252		2002	5,000	10,000	5,000	10,252
675	Brick/Tiles Project - ENNDA	M	ADF	370	3,700	-	4,070	370	3,700	4,070	1995	2001	185	162	-	3,723

APPENDIX III

APPENDIX III

VALIDITY AND RELIABILITY TESTS

Validity Test Data.

For each of the following statements please indicate to what extent you consider each to have contributed to project cost overruns in a project you have participated in;-

3 = Great Extent

2 = Some extent

1 = No extent at all

Selection of poor contractors	3 2 1
Adequate use of Project Management tools	3 2 1
Corrupt practices within the project	3 2 1
Adverse environmental conditions	3 2 1
Adequate monitoring and control	3 2 1

Delayed payments to contractors 3 2 1

Good communications 3 2 1

Lack of commitment to the budget 3 2 1

Table 1: Scoring Procedure

Statements	**Great extent**	**Some extent**	**No extent**
Positive	1	0	-1
Negative	-1	0	1

The table shows that if a respondent ticked great extent for a positive statement the score was one. A respondent who ticked no extent at all for a positive statement scored negative one. Also, a respondent who ticked great extent for a negative statement scored negative one. The one who ticked no extent at all for a negative statement scored one. A neutral response got a score of zero.

Table 2: Project Participants Response

1	4	0.8
2	5	1
3	5	1
4	5	1
5	4	0.8
6	5	1
7	5	1
8	5	1
Total	38	7.6

The overall mean score is 7.6/8=0.95

In general, the project participants responses were positive attributing project cost overruns to the positive causes stated.

APPENDIX THREE (3)

RELIABILITY TEST OF THE MEASUREMENT SCALE

STATEMENT	SCORE
1	70
2	75
3	75
4	60
5	66
6	83
7	79
8	60
9	56
10	56
11	59
12	56
13	40
14	40
15	57
16	59
17	34
18	37
19	70
20	70
21	71
22	75
23	67
24	42
25	60
26	52
27	57
28	66
29	54
30	70
31	54
32	75
33	52
34	54
35	55
36	54
37	40
38	42
39	37
40	59
41	37
42	34
43	80
44	86
45	86
46	83
47	79
48	67
49	80
50	86

Using Spearman's Rank Correlation;

$$r_s = I - \frac{6(Edi^2)}{n(n^2-1)}$$

where r_s is the correlation coefficient

R= Ranks is 1-20

i) r_{s_1} (for set number one)

X	Rank	Y	Rank	di	di^2
70	7	75	5	2	4
75	5	60	10	-5	25
66	9	83	2	7	49
79	4	60	10	-6	36
56	13	56	13	0	0
59	11	56	13	-2	4
40	18	40	18	0	0
57	12	59	11	1	1
57	12	34	20	-8	64
37	19	70	7	12	144
70	7	71	6	1	1
75	5	67	8	-3	9
42	17	60	10	7	49
52	16	66	9	7	49
54	15	70	7	8	64
54	15	75	5	10	100
52	16	54	15	1	1
55	14	54	15	-1	1
40	18	42	17	1	1
37	19	59	11	8	64
37	19	34	20	-1	1
80	3	86	1	2	4
86	1	83	2	-1	1
79	4	67	8	-4	16
80	3	86	1	2	4
					$Edi^2=692$

Therefore,

$$r_{s_1} = I - \frac{6(692)}{25(25-1)}$$

$$= I - \frac{4152}{15600} \qquad = I - 0.2662$$

$$\simeq 0.7338$$

ii) (for set number two)

X	Rank	Y	Rank	di	di^2
86	1	79	4	-3	9
67	8	80	3	5	25
86	1	86	1	0	0
83	2	80	3	-1	1
34	20	37	19	1	1
59	11	37	19	-8	64
42	17	55	14	3	9
54	15	40	18	-3	9
54	15	54	15	0	0
75	5	52	16	-11	121
70	7	52	16	-9	81
66	9	54	15	-6	36
67	8	42	17	-9	81
60	10	75	5	5	25
37	19	34	20	-1	1
70	7	70	7	0	0
57	12	71	6	6	36
59	11	57	12	-1	1
57	12	59	11	1	1
40	18	34	20	-2	4
56	13	40	18	-5	25
56	13	56	13	0	0
60	10	66	9	1	1
83	2	79	4	-2	4
60	10	70	7	3	9
75	5	75	5	0	0
					$\Sigma di^2=544$

Therefore,

$$r_{s_2} = I - \frac{6(544)}{25(25^2-1)}$$

$$= I - \frac{3264}{15600} = 1-0.209^2$$

$$\simeq \underline{0.7908}$$

iii) r_{s_3} (for set number three)

X	Rank	Y	Rank	di	di^2
37	19	42	17	2	4
55	14	59	11	3	9
40	18	34	20	2	4
37	19	54	15	4	16
52	16	54	15	1	1
54	15	75	5	10	100
52	16	54	15	1	1
66	9	67	8	1	1
70	7	75	5	2	4
42	17	60	10	7	49
34	20	34	20	0	0
57	12	40	18	-6	36
59	11	57	12	-1	1
59	11	37	19	-8	64
56	13	57	12	1	1
70	7	71	6	1	1
40	18	56	13	5	25
70	7	66	9	-2	4
75	5	70	7	-2	4
79	2	75	5	-3	9
60	10	60	10	0	0
83	2	80	3	-1	1
79	4	86	1	3	9
67	8	56	13	-5	25
86	1	83	2	-1	1
					$Edi^2 = 388$

Therefore,

$$r_{s_3} = I - \frac{6\ (388)}{25\ (25^2-1)}$$

$$= I - \frac{2328}{15600} = 1-0.1492$$

$$\simeq \underline{0.8508}$$

Therefore, then the coefficient alpha becomes the average of the three sets of correlation coefficients as shown;

$$\frac{r_{s_1} + r_{s_2} + r_{s_3}}{3} = \frac{0.7338 + 0.7908 + 0.8508}{3}$$

$$= \frac{2.3754}{3} \simeq \underline{0.7918}$$

Further, Spearman Brown Correlation is used to obtain the internal consistency reliability (r_w)

$$r_w = \frac{n\,(r_s)}{1 + (n-1)\,r_s}$$

$$= \frac{25\ (\ 0.7918)}{1 + (25-1)\ \ 0.7918}$$

$$= \frac{19.795}{20.0032}$$

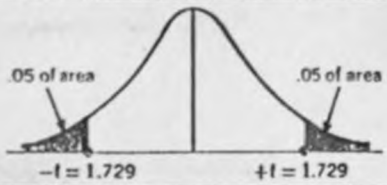
$$\simeq \underline{0.9896}$$

From the above, there is evidence of a strong reliability of the scale (0.7918) and a strong internal consistency reliability of 0.9896.
Usually, a measure with a reliability measure of 0.6 and more is considered reliable.

APPENDIX IV

t DISTRIBUTION

Areas In Both Tails Combined for Student's *t* Distribution.*



0.05/2

EXAMPLE: To find the value of *t* which corresponds to an area of .10 in both tails of the distribution combined, when there are 19 degrees of freedom, look under the .10 column, and proceed down to the 19 degrees of freedom row; the appropriate *t* value there is 1.729.

Degrees of freedom	Area in both tails combined			
	.10	.05	.02	.01
1	6.314	12.706	31.821	63.657
2	2.920	4.303	6.965	9.925
3	2.353	3.182	4.541	5.841
4	2.132	2.776	3.747	4.604
5	2.015	2.571	3.365	4.032
6	1.943	2.447	3.143	3.707
7	1.895	2.365	2.998	3.499
8	1.860	2.306	2.896	3.355
9	1.833	2.262	2.821	3.250
10	1.812	2.228	2.764	3.169
11	1.796	2.201	2.718	3.106
12	1.782	2.179	2.681	3.055
13	1.771	2.160	2.650	3.012
14	1.761	2.145	2.624	2.977
15	1.753	2.131	2.602	2.947
16	1.746	2.120	2.583	2.921
17	1.740	2.110	2.567	2.898
18	1.734	2.101	2.552	2.878
19	1.729	2.093	2.539	2.861
20	1.725	2.086	2.528	2.845
21	1.721	2.080	2.518	2.831
22	1.717	2.074	2.508	2.819
23	1.714	2.069	2.500	2.807
24	1.711	2.064	2.492	2.797
25	1.708	2.060	2.485	2.787
26	1.706	2.056	2.479	2.779
27	1.703	2.052	2.473	2.771
28	1.701	2.048	2.467	2.763
29	1.699	2.045	2.462	2.756
30	1.697	2.042	2.457	2.750
40	1.684	2.021	2.423	2.704
60	1.671	2.000	2.390	2.660
120	1.658	1.980	2.358	2.617
Normal Distribution	1.645	1.960	2.326	2.576

* Taken from Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh) and by permission of the authors and publishers.

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