



**ST. MARY'S UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

**ASSESSMENT OF FACTORS AFFECTING THE  
ACCURACY OF COST ESTIMATION IN PROJECT  
MANAGEMENT: THE CASE OF WATER WORKS DESIGN  
AND SUPERVISION ENTERPRISE (WWDSE)**

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**MARCH, 2015  
ADDIS ABABA, ETHIOPIA**

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ENTERPRISE**

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## **Abstract**

*Estimating is one of the most important functions of a successful project. Accurate estimates optimize good contracting as well as the process of calculating and analyzing all the costs that will enter into a particular job to arrive at a set total. (Barzandeh, 2011)*

*This research assesses factors affecting the accuracy of cost estimation and analyzes their effect on project management in water works design and supervision enterprise. The implications of errors in cost estimation are discussed. Descriptive research design is employed in this research. The financial & physical performance report of large scale projects are also reviewed in order to assess to what level of accuracy the cost estimation is predicted. Then the data collected through questioner are analyzed and interpreted.*

*The findings have indicated most of the estimated cost of the projects is either under-utilized or over utilized which shows there is undeniable inaccuracies in the project's cost estimation. The most influential factors that affect the accuracy of project cost estimation identified by this study are completeness of technical and socio economic information, work load during estimation, Availability of adequate time for estimation and Insufficient number of estimating staff, nonattendance of project managers in cost estimation, the effect of client on cost estimation, financial situation and budget of client, location, site constraint, weather condition and complexity of projects, availability of skilled labor in the market at predetermined cost, the impact of government policies.*

*The conclusion that have been drawn shows that the under utilization or over utilization of estimated project cost with large variance are seen and there is inefficiency in project management. The wide variance between the estimated and actual cost of the projects can make the actual profit to be different from the forecasted one with extensive gap. Therefore it is recommended that the management of the enterprise to give more attention to the most influential factors that affect the accuracy of projects cost estimation that are identified in this research in order to achieve more reliable and realistic estimates.*

*Keywords: Project, Project Management, Project manager, Cost estimating, Accuracy of the estimate*



## CHAPTER ONE - INTRODUCTION

### 1.1. BACKGROUND OF THE STUDY

Estimating is the art and science of using historical data, personal expertise, institutional memory, and the project scope statement to predict the resource expenditures, total cost, and duration of a project. (Rad 2002). According to Rad, constituent elements that can build the overall cost must be identified by project managers so that cost estimation can be computed and project costs will be known based on the resources required to complete the project.

The success of a project depends on the degree of accuracy of the estimates. (Trost & Oberlender, 2003) noted that estimates have to be as accurate as possible and should not be grossly inadequate since it affects competitiveness and it is the basis for tender comparison, assessment, evaluation or negotiations. Therefore, as notified in (Oberlender, 1993), the preparation of a cost estimate of the project is one of the most difficult tasks in project management because it must be done before the work is accomplished.

Pre-tender cost estimation is simply the final costing of the work carried out by a consultant before tenders are received. It sits somewhere between cost planning and post-contract cost control, provides an indication of the probable cost prior to contract-awarding and involves collecting, analyzing and summarizing all available data related to the project (Holm *et al.*, 2005). Thus, for a contractor to secure a job, its cost estimate must be as accurate and competitive as possible (Marjuki, 2006).

As we all know, an estimate can be accurate, low or high. An accurate estimate generally results in the most economical project cost, while either an underestimation or an overestimation often leads to greater actual expenditures. Inadequate estimating invariably leads to misallocation of scarce resources (Flyvbjerg et.al 2002). Therefore, the preparation of an accurate estimate, which is done prior to the physical realization of the work, needs a

detail study about economical and environmental factors that will have impact on the estimation. In water resource development projects specifically being done by waterworks design and supervision enterprise, before the, soil survey, topographic survey and socio economic study of the site on which the construction to be built are conducted project costs are estimated. That is why (Abdal-Hadi, 2010) suggested that such estimation involves being careful on the results of the study to come up with the cost consistent with the time on hand, the accuracy and completeness of the information submitted.

In view of the significance of accuracy of pre-tender cost estimate, it is assumed that identifying these factors which have vital effect on the accuracy of pre-tender cost estimate and reflecting on them at the early design stage can improve the accuracy and precision of the preliminary cost advice of the consultant quantity surveyor to his client. To argue that the need for estimates should be as accurate as possible, (Odusami & Onukwube, 2008) say that pre-tender cost estimate is an attempt to forecast a contractor's tender sum before detailed designs are finalized or upon the receipt of tenders, is undertaken by the consultant quantity surveyor on behalf of his client.

Factors that affect accuracy of estimating come from a large range of categories where sometimes are very difficult to counter. (Liu and Zhu, 2007) cited in (Mohammad Barzandeh, 2011) categorize the factors that influence the cost of a project as control factors and idiosyncratic. Control factors are those that can be determined by the estimators to increase the performance of the estimation. Idiosyncratic factors are factors that affect estimation but are outside the control of the Estimator. According to Liu and Zhu, the most significant and considerable influences are the idiosyncratic factors.

(Mohammad Barzandeh, 2011) in his analysis of 9 literatures focusing on the factors that influence the project cost estimation, he listed out the major factors in 5 categories. Among the large number of factors identified, here the researcher takes the following 4 categories which are closely related with the nature of the enterprise under this research.

#### **1. Factors related to consultants, design parameters and information**

- Experience of the consultant /estimator
- Number of estimating staffs

- Impact of team integration and alignment
- Amount of involvement by the project manager
- Completeness of cost information and details
- Accuracy and reliability of cost information
- Estimating methods/techniques used
- Consultants'/estimators work load during estimation
- Time allowed for preparing the cost estimate

**2. Factors related to client's characteristics**

- Type of contract
- Clients Financial situation and budget

**3. Factors related to project characteristics**

- Type of project
- Location of the project
- Site condition and topography of the site
- Site constraints
- Site requirements
- Project complexity

**4. External Factors and Market condition**

- Material, Labor, and Equipment (cost/availability/supply)
- Weather condition
- Impact of government Policy
- Number of competitors in the market

As far as the researcher knowledge is concerned, research work as to what extent the enterprise's project cost estimation is affected by such influential factors in the process of project management was not conducted at the organizational level.

## **1.2. BRIEF DESCRIPTION OF THE ENTERPRISE**

Water Works Design and Supervision Enterprise is established by the Council of Ministers regulation No.42/1998 Under Ministry of Water resource (Currently Named as Ministry of Water, irrigation and energy) as the supervising authority to support the effort being made to improve the gap observed in the national water resources development endeavor. According to Council of Ministers (Amendment) regulation No.110/2004, the authorized capital of the enterprise is birr 157,330,000.00 of which birr 38,983,000.00 is paid up in cash and in kind.

The Enterprise possesses multidisciplinary professional with extensive and proven experience in water resources development projects. According to the November 2014 monthly reports of the human resource management sub process of the enterprise, it is described that the total number of employees is 755 out of which 289 employees are working on permanent basis and the rest 466 employees are contract employees. About 397 employees have 1<sup>st</sup> degree and above in different disciplines. Currently, the Enterprise is the leading and the largest consulting firm in the water sector consultancy business in the country

According to the Council of Ministers regulation No.42/1998 the purposes for which the enterprise is established are:

- To conduct studies pertaining to hydraulics, dams irrigation, water supply, industry, sewerage disposal water works, and basin development master plans;
- To carry out surveys, designs and specification regarding hydraulics, hydro power, geotechnical, dam and irrigation structures, flood control, water supply, sewerage disposal and other related water works;
- To render consultancy services regarding contract administration and supervision, studies and design evaluation pertaining to water works;
- To render services regarding the preparation of bid and contract documents, and selection of contractors concerning water works;
- To engage in other related activities necessary for the attainment of its purposes ;

Water works design & supervision enterprise has delivered consultancy services for 95 study & Design projects as well as 55 construction supervision and contract administration projects since its establishment to date. Currently, there are about 37 projects in progress.

### **1.3. STATEMENT OF THE PROBLEM**

An estimate can be viewed as simply a prediction of the final values of project cost and duration once the project is fully implemented. Thus, (Parviz F. Rad 2002) tells that the expression of accuracy of the estimate is related to the expression of the probability that project's actual cost will match this prediction. Cost estimation is important because it can be used to establish an initial budget and assure a profit. Therefore, attention must be given to the factors that affect the estimation of project costs since the accuracy of cost estimation process can make or break project success.

In Water works design and supervision enterprise, on the annual budget utilization report of projects, the researcher observed that early plans and budgets for most of the projects are usually far from definitive and rarely predict the actual cost of the total project (2009 up to 2014 WWDSE Financial report). This may be due to some major influential factors that affect the cost estimation not clearly known by the management of the enterprise. Therefore identifying, evaluating and ranking essential factors affecting the accuracy of cost estimation categorized as Factors related to consultants, design parameters and information, External Factors and Market condition, Factors related to client's characteristics, Factors related to project characteristics and analyzing their effect is the interest of the researcher.

### **1.4. RESEARCH QUESTIONS**

The research attempted to explore factors affecting cost estimation and their effect on managing projects of Water Works Design & Supervision Enterprise by trying to address the following research questions:

- ❖ What influential factors are the causes for prediction errors in the enterprise?
- ❖ What are the effects of these project cost estimation errors on the effectiveness of project management?

## **1.5. OBJECTIVES OF THE STUDY**

### **1.5.1 General Objective**

The prime objective of this research is assessing factors affecting the accuracy of cost estimation and analyzing their effect on project management in water works design and supervision enterprise.

### **1.5.2 Specific Objective**

The Specific objectives of the research are

- Identifying major factors that influence the accuracy of cost estimation which can be unique to the nature of water works design and supervision.
- Showing the implication of errors in cost estimation on the effectiveness of management of consultancy service projects running by the enterprise.

## **1.6 SIGNIFICANCE OF THE STUDY**

According to (Hoult et. al.1996 cited in Xiao et. al 2011 ), it is pointed out that companies which fail to estimate the cost of a product or service accurately at the conceptual design stage have a higher probability of schedule delay or increase cost at a later development stage, than those that complete cost estimation successfully. Hence, it is important for service-based companies to minimize the probability of being unsuccessful in estimation. To achieve this, it is necessary to identify possible factors that affect the accuracy of project cost estimation. Therefore this research will be useful to the management of Water works Design & Supervision enterprise in that it provide insight into the factors that significantly affect the cost estimation process and provide possible recommendations to minimize and solve problems.

## 1.7 SCOPE AND LIMITATION OF THE STUDY

The Enterprise mainly involved in large scale projects. Therefore, this research focus on only such large scale projects which the researcher believed that most of the affecting factors are reflected. Medium and small scale projects are not under study in this research. Limitation of the study includes time and cost issues which forced the researcher to use convenience sampling and may give results which will be biased to the small number of samples. Non response, carelessness and lack of collaboration from potential respondents might be the problem in data collection.

## 1.8 DEFINITION OF KEY TERMS

**Project** is temporary endeavor undertaken to create a unique product or service. The temporary nature of projects indicates a definite beginning and end. (PMBOK GUIDE, 2008)

**Project Management** is the application of knowledge, skill, tools, and techniques to project activities to meet the project requirements. (PMBOK GUIDE, 2008)

**Project manager** is the person who manages a specific project, who is expected to meet the approved objectives of the project, including project scope, budget, and schedule.(Larry Richman,2002)

**Cost estimating** can be described as the technical process or function undertaken to assess and predict the total cost of executing an item(s) of work in a given time using all available project information and resource (Kwakye, 1994 cited in Akintoye A., 2000)

**Accuracy of the estimate** is the probability project's actual cost will match a prediction of the final values of project cost and duration once the project is fully implemented. (Parviz F. Rad 2002)

## 1.9 ORGANIZATION OF THE PAPER

The first chapter of this paper explains about the factors that affect the project cost estimation identified in different literatures and a brief description of the enterprise water

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works design and supervision. Problem statement, research objective, significance and limitation of the study are also covered in this chapter. In the second chapter, appropriate theoretical and empirical literatures related to influential factors associated with cost estimation are discussed. The third chapter presents the research methodology which describes research design, source of data, data collection method, sampling techniques and data analysis method appropriate for the research. In chapter four, the data collected through the already identified methodology are presented and analyzed. Finally, summary and conclusion drawn from the data collected and recommendations are presented in the fifth chapter of the paper.



## CHAPTER TWO - REVIEW OF RELATED LITERATURE

### 2.1. THEORETICAL LITERATURE

Here in this part the researcher will try to see what is cost estimation, cost estimation techniques and the factors that can affect the accuracy of cost estimation explained in different books.

#### 2.1.1. Introduction

Cost estimating is the process of calculating the costs of the identified resources needed to complete the project work. The person or group doing the estimating must consider the possible fluctuations, conditions, and other causes of variances that could affect the total cost of the estimate. There is a distinct difference between cost estimating and pricing. A cost estimate is the cost of the resources required to complete the project work. Pricing, however, includes a profit margin. In other words, a company performing projects for other organizations may do a cost estimate to see how much the project is going to cost to complete. (Philips, 2004)

Project management is the supervision and control of the work required to complete the project vision. The project team carries out the work needed to complete the project, while the project manager schedules, monitors, and controls the various project tasks. Projects, being the temporary and unique things that they are, require the project manager to be actively involved with the project implementation. (ibid)

#### 2.1.2. Project Cost Management

**Cost management** is the process used to minimize the cost of the project while maintaining acceptable levels of quality as well as the scope of the deliverables for the duration of the project. The objectives of the cost management process are to track progress, compare actual values to planned values, analyze the impact of variances, and make adjustments in light of these variances (Rad 2002). As the business need undergoes

analysis, progressive elaboration and estimates are completed based on varying levels of detail, and eventually the cost of project will emerge. Often, however, the predicted costs and the actual costs vary (Philips, 2004).

On the other hand (Rad 2002) argued that the mission of a cost management system is not to control the costs at the original estimate level, which may or may not have been accurate. Instead, the cost management process should be designed to manage the inevitable changes to the project with the least combined impact on the triple constraints of cost, schedule, and scope.

According to (Rad 2002), the circumstances for changes to the project are grouped under five categories as follows:

- **Changes in owner's needs.** This includes those generated by the client. The client may not have articulated the project objectives correctly or accurately at the inception of the project.
- **Unexpected site conditions.** This include items such as changes in operating system, hardware characteristics, site platforms, or site conditions, as well as occurrences such as strikes, tornados, or snowstorms
- **Evolution in the design philosophy.** The occurrence of major evolutions of design philosophy depends on new technology and their introduction into the project plan will have a negative effect on the cost and schedule.
- **Design or budget errors.** Shows that the category of cases where the projects design team discovers a flaw in the basic design of the project. Depending on the character of this design flaw, corrective measures and product restructuring will impact the cost and schedule.
- **Implementation errors.** Account for errors in implementation such as substandard equipment, low quality components, or excessive error rate for a software component.

(Philips, 2004) noted that poor planning, skewed assumptions, and overly optimistic estimates all contribute to such variations. So he suggested that, in management of project cost, planning the project resource, identifying the resource requirement and cost

estimation are the activities that should be performed by project managers and presented as follows

### **2.1.2.1. Planning the Project Resources**

As part of the planning process, the project manager must determine what resources are needed to complete the project. Resources include the people, equipment, and materials that will be utilized to complete the work. (Philips, 2004)

In addition, the project manager must identify the quantity of the needed resources and when the resources are needed for the project. The identification of the resources, the needed quantity, and the schedule of the resources are directly linked to the expected cost of the project work.(ibid)

These are some familiar inputs to resource planning:

- **Work breakdown structure** The WBS is a deliverables-orientated breakdown of the components of the project. It helps the project manager and the project team identifies the components requiring specific people, equipment, and materials. The WBS is the primary input to resource planning.
- **Historical information** If similar projects have been completed, what resources were required on these projects? Historical information should be used if it's available, as it is proven information rather than speculation.
- **Scope statement** The scope statement should guide the resource planning process, as it identifies why the project was undertaken and the required work to complete the project. The required work, therefore, can help identify the required resources to complete the project.
- **Resource pool description** The project manager should identify what resources are available for the project. These include people, materials, and equipment. As the project passes through progressive elaboration, the identified pool of resources may vary.
- **Organizational policies** The performing organization's policies regarding staff acquisition must be taken into consideration. In addition, any procurement policies to ascertain, lease, or rent equipment must be evaluated. The project manager should be aware of these requirements before planning the resources

- **Activity duration estimates** The duration of the activities are needed so the project manager and the project team can consider the costs and benefits of assigning more effort to reduce tasks duration where feasible.

### **2.1.2.2. Identifying Resources Requirement**

Once the project manager and the project team have completed resource planning, the required resources to complete the project will have been identified. The resource identification is specific to the lowest level of the WBS. The identified resources will need to be obtained through staff acquisition or through procurement.

### **2.1.2.3. Cost estimation**

Cost estimating is the process of calculating the costs of the identified resources needed to complete the project work. The person or group doing the estimating must consider the possible fluctuations, conditions, and other causes of variances that could affect the total cost of the estimate. (Philips, 2004)

In estimating it assists the future expenditure as cost prediction like the expenditure will depend upon the cost of the respective activities. It assists the total benefits anticipated in an exact activity based on the relationship between projected revenue and projected costs. Cost estimation is helpful in business cost control, planning and decision making performance evaluation. (<http://www.expertsmind.com>)

(Ashworth 2004) states that the purpose of estimating is to indicate probable construction costs. This is an important factor that clients consider when deciding to build; it determines the feasibility of a project, or even provides the basis for budget control during tendering and construction.

### **2.1.2.4. Project Cost Control**

Project cost control is concerned with ensuring that projects stay within their budgets, while getting the work done on time and at the correct quality. One system for doing this, called *earned value analysis*, was developed in the 1960s to allow the government to decide whether a contractor should receive a progress payment for work done. The method

is finally coming into its own outside government projects, and it is considered the correct way to monitor and control almost any project. The method is also called simply variance analysis (Lewis 2007)

(Joseph Philips, 2004) suggested that a successful project manager must be able to plan, predict, budget, and control the costs of a project.(Lewis 2007) tells that variance analysis is the way that allows the project manager to determine trouble spots in the project and to take corrective action. He advised that the following definitions are useful in understanding the analysis:

- Cost variance: Compares deviations and performed work.
- Schedule variance: Compares planned and actual work completed.
- BCWS: (Budgeted cost of work scheduled): The budgeted cost of work scheduled to be done in a given time period, or the level of effort that is supposed to be performed in that period.
- BCWP: (Budgeted cost of work performed): The budgeted cost of work actually performed in a given period, or the budgeted level of effort actually expended. BCWP is also called earned value and is a measure of the dollar value of the work actually accomplished in the period being monitored.
- ACWP: (Actual cost of work performed): The amount of money (or effort) actually spent in completing work in a given period. Variance thresholds can be established that define the level at which reports must be sent to various levels of management within an organization.(ibid)

Therefore, using the above information one can analyze the variation on cost estimation and help to decide whether the costs were actually estimated, overestimated or underestimated. In the process of implementing such analysis (Richman2002) suggested the theory of percent complete that provides a more accurate way of planning and reporting on an activity where one part of the activity is more difficult than another. This method measures and reports the percent complete.

In relation to cost control (Rad 2002) emphasize that cost management system is not to control the cost rather it is to manage the inevitable changes. In supporting this concept

(Richman 2002) pointed out a good understanding of where costs can get out of control and consider the following list of common causes:

- Poor budgeting practices, such as
  1. basing the estimates on vague information from similar projects rather than the detailed specifications of the project at hand,
  2. failure to plan sufficient contingency budget,
  3. failure to correctly estimate research and development activities, or
  4. Failure to consider the effects of inflation on the cost of materials or labor.
- Receiving or analyzing status information too late to take corrective action.
- A climate that does not support open and honest disclosure of information.
- Indiscriminate use of the contingency budget by activities that overrun their budgeted cost.
- Failure to re budget when
  1. flaws are discovered,
  2. technical performance falls below performance standards, or
  3. Changes in project scope are approved.

### 2.1.3. Estimating Models

Accurate Cost estimation is dependent on the reliable elements of the work breakdown structure (WBS). Since the estimation is driven out from the information contained in the WBS refers to as the bottom up estimate (Rad 2002). According to Rad the in accuracy of early estimates could be emerged from their nature which bases sketchy data so that detailed and accurate estimate requires explicit information.

Therefore, in the absence of detailed project information, (Rad 2002) Describe project managers may use the following estimating techniques for making preliminary project cost estimate

**Analogous estimating** is the simplest forms of estimating which refers to the estimating process where, in the project manager's opinion, there is significant similarity between the proposed project and those projects contained in the historical database.

**Modular Estimating** it is a model uses historical data and predictive formulas developed for the modules' characteristics to estimate the project's cost, duration, and the amount of necessary resources. It is characterized by indices describing the quantity and size of several key components

**Parametric Model** is Similar to the modular model; the *parametric model* uses historical data as the basis of the model's predictive features. However, the characteristics that are input into the process are primarily based on performance indicators such as speed, accuracy, tolerance, reliability, friendliness, error rate, and complexity of the environment of the deliverables

**Ratio Estimating** is one of the more basic forms of estimating in construction, industrial, and process projects. The basis of this technique is that there is a linear relationship between the cost and duration of the project and one or more of the basic features of the proposed project. The so-called ratios or factors are refined from personal experience, company files, or published industry-specific data

**Range Estimating** It refers to an estimate, to provide not just one estimate for the cost of an element but rather define the range of possible values for the cost of a specific element. This concept was the foundation of the PERT technique by which probabilistic project duration is obtained through the use of multiple durations defined for individual activity durations. Here a range of probable and likely duration values is computed.

## 2.2. EMPIRICAL LITERATURE

A wide range of factors influencing cost estimation has been identified by different researchers. Hence some empirical literatures are reviewed by the researcher and presented as follows:

Drawing from organization control theory and cost estimating literature, (Liu, L., & Zhu, K. 2007) has identified the critical factors for effective cost estimation which they classified as control factors and idiosyncratic factors. Control factors are the factors that can be controlled by estimators to improve the performance of estimation. Idiosyncratic

factors are factors that influence cost estimation but outside the control of the estimators including market condition, project complexity, weather, size of contract, site constraints, resource availability, type of procurement system, contract work type. The main focus of (Liu, L., & Zhu, K. 2007) in their research was on the control factors that affect the accuracy of cost estimation. They further categorized these factors as input control factors like Project Information, Team Experience and Cost information and as Behavioral control factors like Estimating Process, Team Alignment and Estimation Design or method.

(Odusami and Onukwube 2008) assess the factors affecting accuracy of pre-tender costs estimate and mentioned the following six main factors influencing accuracy of consultant

- Expertise of consultants;
- Quality of information and flow requirements;
- Project team's experience of the construction type;
- Tender period and market condition;
- Extent of completion of pre-contract design; and
- Complexity of design and construction.

In this research expertise of consultants was ranked as the most important factor and no attempt was made to measure empirically the association between these factors and the accuracy of pre-tender estimates.

(Trost and Oberlender, 2003) in their study 11 factors were identified as most representative and meaningful. From the 11 factors, the researchers specifically identified the following five factors that exhibit a significant impact on estimate accuracy

- Basic process design
- Site requirements
- Team experience and cost information
- Time allowed to prepare the estimate
- Bidding and labor climate



According to the research the most significant factor among the five major factors is the basic process design factor. As this factor constitutes process flow sheets, heat and material balance, project schedule, capacities, mechanical equipment list, and piping and instrumentation diagrams, it is thus entitled as crucial to the accuracy of an early estimate by the authors. In addition to process design, it is highlighted that the identification of the basic site requirements of a project fulfills an important role in estimate accuracy. (Trost and Oberlender, 2003)

(Mohammad Barzandeh, 2011) in his case study proved that the estimators' experience and expertise is one of the primary requirements for a successful project cost estimation. (Trost and Oberlender, 2003) ranked the team experience and cost information as the third most influential factor on the accuracy of cost estimation and it is described that the factor emphasizes the importance of the experience level not only of the estimating team but also of the engineering staff. The researchers also argue that in order to get accurate estimation picture, adequate scope definition, an experienced project team, and good cost information should be supported by adequate allotment of time allowed to prepare the estimate. The bidding and labor climate factor ranked fifth in significance in this research.

(Akintoye, A.2000) In his research to understand the factors influencing the cost estimation practice, project complexity, technological requirements, project team requirement, contract requirement, project duration and market requirements are the major factors.

As it is explained on the research, project complexity made up of type of structure, scale and scope of construction, complexity of design, site constraints and expected project organization. Technology factor consists of the amount of specialist work, lead time and limitation of operation. Project team requirement refers to particular skills & quality needed for a project. Project duration includes the anticipated frequency and extent of variations to the client's building requirement. Market requirement comprises the location of the project, tender period and market condition.

The ten most significant factors affecting accuracy of pre-tender cost estimate identified by (Polycarp O.A, *et.al* 2014) are:

- Experience and skill level of the consultants,
- Project teams experience on the construction type,
- clear and detail drawings and specification,
- completeness of cost information,
- accuracy and reliability of cost information,
- availability of all fields of specialization in a project team,
- quality of information and flow requirement,
- clear scope definition for the client,
- financial capability of the client, and
- Completeness of project documents.

In their research, Experience and skill level of the estimator is found that the most influencing factor affecting the accuracy of pre-tender cost estimate. This implies that to produce an accurate estimate is encompassing available of detail information, skill and requisite experience of the estimator.

## **CHAPTER THREE - RESEARCH METHODOLOGY**

This part deals with the research design and methodology of the study. It includes research design, source of data, data collection instrument, sampling techniques and methods of data analysis.

### **3.1. RESEARCH DESIGN AND SOURCE OF DATA**

This research is done to examine the possible significant factors that can affect the cost estimation of the projects and to analyze and show their effect on the effectiveness of project management and recommend possible solutions, the type of research Design employed in this research is descriptive research design. The research is also observational in reviewing financial performance of projects from the annual budget utilization report of large scale projects in order to assess to what level of accuracy the cost estimation can predict the actual cost of the project. The enterprise's procedural manual indicate that projects with annual income above birr 3,000,000.00 treated as large scale projects, projects with annual income between birr 1,000,000 and 3,000,000.00 treated as medium scale projects and projects with annual income below birr 1,000,000.00 treated as small scale projects. The data on the research questioner will be gathered from sample of employees who are expected to be involved in the preparation of technical proposal and project cost estimation since relevant information can be provided by those professionals.

### **3.2. DATA COLLECTION METHOD AND SAMPLING TECHNIQUES**

The study covers the cases of study, design and construction supervision of water resource development projects. In the research process, non probability sampling specifically purposive sampling technique is used for data collection from professionals to identify major factors affecting the project cost estimations related to the nature of the enterprise. In WWDSE employees from different disciplines are participated in providing valuable inputs to the technical proposal preparation committee. Topographic surveyors, Soil Survey technicians, geological & geotechnical experts, hydrologists & hydro geologists,

agronomists, sociologists, environmentalists and laboratory technicians are those who are involved. According to the information from the HRM sub process the total number of these professionals in the enterprise which are above the junior level are about 151 employees. From the total population who has direct and indirect involvement in the process of cost estimation, the professionals selected as a sample are the one who directly participate on the preparation of technical proposal and project cost estimation. Therefore the researcher chooses this sampling procedure that can yield results favorable to the purpose of the research. Study, Design and construction supervision core process managers, sub process managers, project managers and coordinators, Internal and external top technical team members and staffs from planning and market promotion process are used as a sample for primary data collection. The sample constitute 4 core process executive officers, 9 sub process managers, 14 project coordinators, 28 project managers, 5 top technical team members with a total of 60 samples.

The Data are collected through closed ended questioner in order to specifically address the already identified factors in different studies. In this questioner, five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) will be used. The questioner also include open ended questions to entertain other additional factors which can be mentioned other than those already identified. The researcher used personal interview as an option since it is found that the information gap in the data collection through questioner is filled through interview with executive officers. The reason why Questioner method is used for data collection is:

1. It takes less time to fill up a questioner. It also a common way of collecting information. Besides it is considered to be the most appropriate method to collect data for this study.
2. Respondents will have adequate time to give well thought out answers.
3. The data gathered through questioner is easy to analyze.

### **3.3. DATA ANALYSIS METHOD**

The responses which are gathered through the questioners are tabulated and analyzed qualitatively by using descriptive statistics namely percentages. The results of the highest & lowest number of respondents for the specific question are compared with what theoretical literatures tell about in order to see their effect and draw conclusion about the effectiveness of project management.

### **3.4. ETHICAL CONSIDERATION**

Ethics is there to minimize harm and to ensure that the research participants are not subjected to any risk or exposure due to improper methods of protecting privacy. Therefore the researcher granted permission by the concerned authority of WWDSE to use the enterprises financial and project performance information and to conduct survey. Each participant was asked to participate in the study in which they had voluntary participation. They were informed about the study and willingly filled the questioner. The responses of each participant are kept confidentially. Research findings are purely the results of analysis of the collected data without trimming and cooking. There is no intentional unacknowledged use or incorporation of any other person's work in my thesis.

## **CHAPTER FOUR - DATA PRESENTATION, ANALYSIS AND DISCUSSION**

### **4.1. INTRODUCTION**

In this chapter Findings obtained through the instrument used in the study are discussed. It presents the primary data, analyze them and interpret the findings. The findings are presented according to the method used to analyze the data.

Here, document analysis of 50 different large scale projects was made. Accordingly, financial and physical performance of 13 construction supervision projects, 16 study projects and 31 design projects with annual income of more than 3,000,000.00 over the last six years are presented. These documents were used as a fair representation of the enterprise's portfolio of work. The documents were obtained through permission from the chief executive officer of the enterprise. Using these data, the study shows how the estimated costs of the projects are varied from the actual cost and intends to answer the question:

1. What influential factors are the causes for prediction errors in the enterprise?
2. What are the effects of these project cost estimation errors on the effectiveness of project management?

A questionnaire survey was used to find out answer regarding factors affecting the accuracy of cost estimation in water works design and supervision enterprise (WWDSE). A five page questionnaire including a cover letter was sent to the employees who directly participate in project cost estimation. The design of the questionnaire was based on an extensive review of literature dealing with cost estimating. The questionnaire also asked the respondents experience on cost estimating factors and factors that enforce for projects completion dalliance that are specific for the enterprise.

The questionnaire was distributed to 60 purposely selected employees of WWDSE. A total of 54 respondents were able to return completed questionnaires in a usable format, representing a 90% response rate.

#### **4.2. COMPARISON OF ACTUAL COST OF WORK PERFORMED WITH PHYSICAL PERFORMANCE OF PROJECTS**

The following table is prepared from compiled annual projects financial and physical performance reports which cover the period from 2008/2009 to 2013/2014 budget year (attached with appendices). For the financial performance of the projects the researcher uses audited financial statements for actual cost of the projects and documents approved by the board of directors of WWDSE for the estimated cost of the projects for the period mentioned above. The researcher restrained from revealing every pieces of information about the projects. Hence the projects name and their annual income is kept confidential as per the information security agreement signed between the researcher and the Enterprise. Therefore Design projects are expressed as DEP 1, DEP 2, etc ... Study Projects are expressed as STP 1, STP 2, etc ... and Construction Supervision projects are expressed as CSP 1, CSP 2, etc ...

Earned value analysis (also known as variance analysis) is a way to measure and evaluate project performance. It compares the amount of work planned with what is actually accomplished to determine whether the project is on track. The theory of percent complete provides a more accurate way of planning and reporting on an activity where one part of the activity is more difficult than another and measures and reports the percent complete. (Richman, 2002). As this variance analysis compares budgeted cost of work performed with actual cost of work performed, the data is presented to compare actual cost with physical performance of projects.

Guide to Cost Predictability in Construction: An Analysis of Issues Affecting the Accuracy of Construction Cost Estimates November 2012 sets that 100% complete tender documents have acceptable variance of 5% for projects with low complexity and 10% variance for projects with high complexity. Since the study takes the cost performance of large scale projects, the researcher used the 10% variance of high complex projects to determine whether the projects' cost estimation is over or under. In the following tables below the accuracy of projects cost estimation are analyzed based on this acceptable range of variance and labeled as overestimated and underestimated.

ASSESSMENT OF FACTORS AFFECTING THE ACCURACY OF COST ESTIMATION

**Table 1 - Comparison of Actual Cost of work performed with Physical Performance of Construction Supervision Projects**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance
CSP1	82.01%	100.00%	17.99%	122.74%	100.00%	-22.74%	59.36%	100.00%	40.64%	102.34%	98.84%	-3.50%	57.89%	94.92%	37.03%	91.40%	84.54%	-6.86%
CSP2	76.64%	100.00%	23.36%	79.69%	100.00%	20.31%	84.68%	100.00%	15.32%	111.43%	99.84%	-11.59%	54.44%	100.00%	45.56%	83.19%	100.00%	16.81%
CSP3	92.27%	100.00%	7.73%	83.14%	86.50%	3.36%												
CSP4	27.74%	100.00%	72.26%	48.85%	91.43%	42.58%	76.67%	100.00%	23.33%	80.27%	92.80%	12.53%	70.90%	94.80%	23.90%	98.98%	97.06%	-1.92%
CSP5							77.00%	100.00%	23.00%									
CSP6							74.24%	100.00%	25.76%	76.94%	89.60%	12.66%	114.85%	100.00%	-14.85%	71.84%	100.00%	28.16%
CSP7							24.64%		-24.64%	20.93%	0.20%	-20.73%	48.83%	65.39%	16.57%	94.93%	84.99%	-9.93%
CSP8							46.80%	100.00%	53.20%	85.96%	95.41%	9.45%	63.66%	100.00%	36.34%	70.97%	92.95%	21.98%
CSP9										48.56%	92.08%	43.52%	53.62%	100.00%	46.38%			
CSP10				81.01%	91.83%	10.82%							172.93%	95.04%	-77.89%	60.47%	82.89%	22.42%
CSP11													79.12%	98.20%	19.08%	55.72%	100.00%	44.28%
CSP12													11.80%	94.27%	82.47%	29.71%	100.00%	70.29%
CSP13																18.79%	92.50%	73.72%

*Source: Compiled from projects financial & physical performance report of WWDSE from 2008/2009 to 2013/2014 budget year*

Table 1 shows that among 43 projects during the 6 years period 69.77% were overestimated and 13.95% were underestimated. Only 16.28% of the higher scale projects were under acceptable range of variance



ASSESSMENT OF FACTORS AFFECTING THE ACCURACY OF COST ESTIMATION

**Table 2 - Comparison of Actual Cost of work performed with Physical Performance of Study Projects**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance
STP1	19.00%	45.54%	26.54%	9.11%	16.15%	7.04%	9.46%	26.36%	16.89%	2.93%	13.43%	10.50%						
STP2	138.71%	100.00%	-38.71%															
STP3	218.74%	100.00%	-118.74%															
STP4	32.44%	73.50%	41.06%															
STP5	35.50%	51.02%	15.52%	87.55%	90.10%	2.54%												
STP6	31.55%	23.19%	-8.36%	29.79%	3.00%	-26.79%	23.99%	100.00%	76.01%									
STP7				124.93%	89.90%	-35.03%	85.91%	100.00%	14.09%									
STP8				33.48%	30.23%	-3.25%	46.81%	100.00%	53.19%	53.00%	58.98%	5.98%						
STP9										123.10%	96.89%	-26.21%						
STP10										61.20%	9.00%	-52.20%				75.59%	11.11%	-64.48%
STP11										12.49%	100.00%	87.51%	76.21%	100.00%	23.79%	73.38%	100.00%	26.62%
STP12													39.38%	94.17%	54.79%	1.99%	60.00%	58.01%
STP13													32.63%	92.37%	59.74%	49.79%	78.57%	28.78%
STP14													82.60%	94.20%	11.60%	50.47%	96.25%	45.77%
STP15													26.69%	87.18%	60.48%	25.53%	95.97%	70.44%
STP16																123.99%	100.00%	-23.99%

*Source: Compiled from projects financial & physical performance report of WWDSE from 2008/2009 to 2013/2014 budget year*

Table 2 shows that among 32 projects during the 6 years period 59.36% were overestimated and 25% were underestimated. Only 15.64% of the higher scale projects were under acceptable range of variance.

ASSESSMENT OF FACTORS AFFECTING THE ACCURACY OF COST ESTIMATION

**Table 3 - Comparison of Actual cost of work performed with Physical performance of Design Projects**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance	%age of Actual cost of work performed	%age of Actual Work performed	Variance
DEP1													115.21%	101.64%	-13.57%			
DEP2	74.78%	100.00%	25.22%															
DEP3	96.27%	100.00%	3.73%															
DEP4				98.39%	92.37%	-6.02%												
DEP5				114.86%	100.00%	-14.86%												
DEP6				54.00%	100.00%	46.00%												
DEP7				51.38%	100.00%	48.62%												
DEP8				207.75%	100.00%	-107.75%	82.07%	100.00%	17.93%	105.66%	68.68%	-36.98%	44.34%	88.06%	43.72%	35.01%	88.60%	53.59%
DEP9							61.00%	77.52%	16.52%	61.32%	68.10%	6.78%	39.87%	70.35%	30.48%	27.64%	35.66%	8.02%
DEP10										23.05%	72.50%	49.45%	18.42%	79.00%	60.58%			
DEP11										25.53%	100.00%	74.47%						
DEP12										255.51%	100.00%	-155.51%						
DEP13													25.90%	79.00%	53.10%	20.09%	6.38%	-13.71%
DEP14													13.06%	37.69%	24.63%	16.66%	77.82%	61.16%
DEP15																36.58%	85.06%	48.48%
DEP16																25.63%	98.13%	72.50%
DEP17																17.61%	64.80%	47.19%
DEP18																72.08%	87.33%	15.25%
DEP19																74.29%	86.99%	12.69%
DEP20																65.10%	100.00%	34.90%
DEP21																28.65%	100.00%	71.35%

*Source: Compiled from projects financial & physical performance report of WWDSE from 2008/2009 to 2013/2014 budget year*

Table 3 shows that among 31 projects during the 6 years period 67.74% were overestimated and 19.35% were underestimated. Only 12.91% of the higher scale projects were under acceptable range of variance.

Throughout the entire project, the variation between the budget and the actual costs seemed to fluctuate between an accurate and a very inaccurate project. When it is broken down into the elements, it shows that the historical data and quality of resource information used is not being updated and reviewed as frequently as it should be.

Generally Costs of more than 80% of the projects (taking the average of the sum of the over and under estimated costs of study, design and supervision projects) of WWDSE have accuracy problem in their estimation. Therefore knowing the factors behind this inaccuracy on project cost estimation is the interest of the researcher and the data are collected through questioner.

### **4.3. DESCRIPTION OF THE SAMPLE**

The summary presented in table-4 below shows position of respondents in the enterprise categorized based on sex. As the sample focus mainly on project managers and supervisors as well as top technical team members, the result which is 5.56% female respondents shows that the involvement of women on managerial & supervisory position is minimal in the enterprise. Majority of the respondents with a higher percentage of 55.56% are from managerial position followed by professional position holders with 35.19% of the total respondents. The greatest percentage of respondents with the managerial position will help the data collection process to address practical cases experienced by those respondents.

The experience of the respondents has a great influence on the response given. Therefore the more experienced the respondent, the greater the reliability and accuracy on the rate given to each questioner. Table-5 shows that a 74.07% majority of respondents are well experienced and have above 10 years of work experience. When such experiences are supported by education, the chance of the questioner to be seen thoroughly and getting additional valuable information will increase. In this regard the questioner was filled by the greatest number of respondents with higher and moderate educational status.

**Table 4 – Respondent by Position and sex**

Sex	Position of respondent							
	Managerial		Supervisory		Professional		Total	
	Count	Row %age	Count	Row %age	Count	Row %age	Count	%age
Female	2	66.67%	1	33.33%	0	0.00%	3	5.56%
Male	28	54.90%	4	7.84%	19	37.25%	51	94.44%
Row Total	30	55.56%	5	9.26%	19	35.19%	54	100.00%

*Source: Compiled from survey data March, 2014*

The respondents with first degree and second degree & above hold 15% and 85% rate respectively among 40 respondents who have more than 10 years of work experience. Only 16.67% of the respondents have first degree and only 5.56% of the respondents have less than 5 years of work experience. No respondent with college diploma and below.

**Table 5 – Respondent by Educational status and years of Experience**

Years of Experience	Educational status							
	College Diploma		First Degree		Second degree & Above		Total	
	Count	Row %age	Count	Row %age	Count	Row %age	Count	Row %age
0 - 5 years	0	0.00%	1	33.33%	2	66.67%	3	5.56%
5 - 10 years	0	0.00%	2	18.18%	9	81.82%	11	20.37%
Above 10 years	0	0.00%	6	15.00%	34	85.00%	40	74.07%
Row Total	0	0.00%	9	16.67%	45	83.33%	54	100.00%

*Source: Compiled from survey data March, 2014*

#### 4.4 DATA ANALYSIS AND DISCUSSIONS

Based on the literature review the questioner was prepared to constitute factors related to design parameters and information, factors related to client characteristics, factors related to project characteristics and factors related to external factors & market condition. It is also prepared to entertain additional information other than those already mentioned.

The respondents were asked to respond to each question by indicating their agreement or disagreement and the responses were measured using 5 point likert scale from strongly agree to strongly disagree which carries a score of 5 to 1. The response given to each question were analyze based on the mean score values of the question.

Table-6 below shows that there is a disagreement and most of the respondents which is 64.81% agreed that in the enterprise there are well experienced employees that can be assigned on the process of technical proposal preparation and cost estimation. It is known that to produce an accurate estimate, those involved in the estimating process must have the relevant professional knowledge and skills. Therefore the mean score of 3.67 for the experience level of cost estimators shows that the effect of this factor on the inaccuracy of the estimation in the enterprise is minimal. (Dysert (2003) cited in Abde-Hadi *et al.*, 2010) emphasized that if an estimator were more professional, budget and other related problems could be greatly reduced.

On the other hand the mean score value of 2.85 for the number of estimators in a group shows that more than 46.30% of the respondents believe that adequate numbers of professionals are not assigned in the estimating staff. As technical proposal preparation team members are composed of different professionals, there may be missing of important input that could have been contributed by a professional not included in the team. If that missing input can be a reason for creation of significant cost factor, it will be resulted in wider cost variance from estimated cost of the project. The mean score of 3.07 for the response on team integration and alignment proved that most of the respondents (who reply as 37.04% disagree and 11.11% strongly disagree) have a tendency towards disagreement on whether the enterprise adequately select and assign estimating staff from different disciplines with needed skill and quality.

**Table 6 - Factors related to consultant, design parameter and information**

Factors related to consultant, design parameters and information	No. of resp.	Percentage of Respondents					Mean score of likert's scale
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Experience level of cost estimators	54	7.41%	64.81%	14.81%	12.96%	0.00%	3.67
Adequacy of Number of estimating staffs	54	5.56%	24.07%	22.22%	46.30%	1.85%	2.85
Team Integration and alignment in the estimation staff	54	0.00%	29.63%	22.22%	37.04%	11.11%	3.07
Involvement of project Managers in cost estimation	54	12.96%	31.48%	18.52%	29.63%	7.41%	2.70
Completeness of cost information and details	54	7.41%	37.04%	27.78%	25.93%	1.85%	3.22
Accuracy and reliability of cost information	54	1.85%	44.44%	27.78%	24.07%	1.85%	3.2
Existence of Estimating method / technique for cost estimation	54	5.56%	44.44%	25.93%	22.22%	1.85%	3.3
Technical proposal preparation team and Estimators work load during estimation	54	0.00%	14.81%	16.67%	53.70%	14.81%	2.31
Availability of adequate time for estimation and technical proposal preparation	54	7.41%	14.81%	18.52%	50.00%	9.26%	2.61
Completeness of technical and socioeconomic information	54	3.70%	12.96%	35.19%	42.59%	5.56%	2.67

*Source: Compiled from survey data March, 2014*

As this table shows more than 37.04% of the respondents do not agree on the statement that says project managers have more involvement in project cost estimation and to be included in the team that prepares technical proposal. The mean score given to this point is 2.70 which are below the neutral attitude. In management of project cost, planning the project resource, identifying the resource requirement and cost estimation are the activities that should be performed by project managers. (Philips, 2004). This function will help the

project manager to control the costs by efficient use of resources and controlling the project schedule according to the plan.

The trend in the enterprise shows that project managers are assigned to the projects after the technical proposal and cost estimations are made. From the response given to the open ended question, the researcher understands that the role of managers of design projects in controlling projects schedule and costs is insignificant. This is because the design work is performed by the design team members in the design studio and several project design works could be received at a time. This will be resulted in a delay on timely completion of the projects and creates additional costs more than estimated. (Rad 2002) noted that Cost is directly impacted by changes in duration and scope, managing cost will always have to be done in concert with managing scope and schedule. Even if the baseline project scope remains unchanged, changes to the project schedule will bring corresponding changes in the resource expenditure and cost of the project.

Completeness of cost information and details, Accuracy and reliability of cost information and Existence of Estimating method / technique for cost estimation are rate at a mean score of 3.22, 3.2, and 3.3 by respondents respectively. These scores indicate that most respondents do not hesitate on the completeness accuracy and reliability of cost information. The table shows that, more than 37.04% of respondent agree with the completeness of cost information, more than 44.44 % of respondents proved that the cost information is accurate and reliable and 44.44% of the respondents know that the enterprise has an estimating method. This result shows that, the effects of these factors on project cost estimation are not the threats to the enterprise unlike the Completeness of technical and socioeconomic information which is rated 2.67. About 42.59% of the respondents disagree with the completeness of these data. The result shows that this factor is significant factor to affect cost estimation. This is because, according to (Rad 2002) accurate Cost estimation is dependent on the reliable elements of the work breakdown structure (WBS) which refers to components requiring specific people, equipment, and materials from which the estimation is driven out.

The mean score of 2.31 given to technical proposal preparation team and Estimators work load during estimation shows that the team members are given additional assignment and

the estimation work is not consider as a major and individual work. The table shows that about 53.70% of the respondents agree with this work load This condition reflects that the cost estimation process is highly affected by Availability of adequate time for estimation and technical proposal preparation factor which is rated at a mean score of 2.61 and confirmed by 50% of the respondents. Joseph Philips emphasized that the duration estimated for project activities is a basic input for project cost estimation (Joseph Philips, 2004). So the project manager and the project team can consider the costs and benefits of assigning more effort to reduce tasks duration where feasible. But in the absence of adequate time, cost estimation and technical proposal preparation process will be exposed to risk of being incomplete and the cost estimation will be affected by unforeseen factors during estimation.

**Table 7 - Factors related to client characteristics**

Factors related to client characteristics	No. of resp.	Percentage of Respondents					Mean score of likert's scale
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
The effect of type of contract on cost estimation	54	37.04%	51.85%	9.26%	0.00%	1.85%	4.22
The effect of financial situation and budget of clients	54	24.07%	51.85%	7.41%	12.96%	3.70%	3.80

*Source: Compiled from survey data March, 2014*

Table 7 shows that more than 51.85% of the respondents show their agreement that, the type of client have its own influence on the cost of the projects estimated by the enterprise and rated 4.22 mean score of likert scale. According to the information provided by the respondents, some contracts signed with client especially with the government body, enforces the enterprise to get into an agreement to complete the design & study projects which cannot be performed with in the agreed time period. Such condition make the enterprise to incur additional cost due to the work performed out of normal working hours and involvement of extra man power. Since the client is the government, the project work will be completed without making amendment on the contract for the additional cost.



As mentioned earlier most of the respondents said that amendment on the contract regarding the additional cost may not be signed with the government due to the financial situation or budget. Such conditions also enforce the enterprise to get into an agreement that expose to expend more than what estimated earlier. The mean score of 3.80 for the effect of client’s financial situation or budget tells that it is a case that most respondents which is about 51.85% agree with it.

The Enterprise is established to support the national water resource development. That is why these factors become the main factors that affect the cost estimation of the project in the enterprise since most of the projects are dam, irrigation and water supply project works provided to federal and state governments, city administration and other governmental organizations. These factors may not have influence on the projects whose clients are privet organizations.

**Table 8 – Factors related to Project characteristics**

Factors related to Project characteristics	No. of resp.	Percentage of Respondents					Mean score of likert's scale
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
The effect of project type related factors on cost estimation	54	37.04%	38.89%	14.81%	9.26%	0.00%	4.04
The effect of location of projects, site conditions on data collection	54	59.26%	31.48%	5.56%	3.70%	0.00%	4.46
The extent to which projects complexities resulted in different actual cost	54	44.44%	40.74%	11.11%	3.70%	0.00%	4.26
The effect of site constraints and site requirements	54	44.44%	46.30%	1.85%	7.41%	0.00%	4.28

*Source: Compiled from survey data March, 2014*

As it is shown in table 8 above, with a mean score of 4.04, we can see that the project type whether it is dam, irrigation or water supply projects has greater effect on cost estimation. As it is explained and strongly agreed by about 37.04% of respondents, the level of detail information about soil survey, geological and geotechnical investigations, topographic survey, GIS information is different for each project type. In the absence of projects detail

information at the required level, the cost estimated to complete the project will be different from the actual cost.

The mean score of 4.26 shows that most respondents agree with the effect of project complexity on cost estimation. According to the respondents who strongly agree with this factor which are 59.26 % of the total respondent, some unexpected geological factors may extend the time and use more resources. (Rad 2002) argued that the circumstances for changes to the project cost are unexpected site conditions. Therefore due to this condition project cost components like per diem and fuel costs are incurred more than what was estimated.

Table-8 also shows that the effect of location of the projects and site constraints are given a mean score of 4.46 and 4.28 and supported by 44.44% of the respondents respectively. The respondents explained that when the project sites are far from towns, there will be a problem of health care services and drinking waters. In addition the absence of access road also will be a reason for the delay of projects performance and resulted in additional costs. Therefore the actual cost will be far from what was estimated. According to (Cleveland 1995 cited in Akintoy A.2000), remoteness of site must be analyzed completely for cost elements that are unique to the location and have a greater effect on the cost estimate.

Table-9 shows that 42.59% of the respondents show their disagreement for the availability of labor with the required skill in the market at predetermined cost and give it a mean score of 2.67. According to the explanation given by the respondents some input to the study or design projects may not be provided by the internal labor. Therefore the enterprise may search an institution as a sub consultant or freelancers. In this case the enterprise face challenges of getting sub consultant or freelancers whose payments can be covered by the cost previously estimated.

**Table 9 - External Factors and Market Condition**

Factors related to External Factors and Market Condition	No. of resp.	Percentage of Respondents					Mean score of likert's scale
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Availability of labor with the required skill and previously estimated fee	54	3.70%	20.37%	24.07%	42.59%	9.26%	2.67
Availability of scientific instruments and other equipments at predetermined cost	54	5.56%	37.04%	33.33%	16.67%	7.41%	3.17
The effect of weather condition on the estimated cost	54	24.07%	53.70%	14.81%	7.41%	0.00%	3.94
The impact of government policies on cost estimation	54	12.96%	40.74%	31.48%	14.81%	0.00%	3.52
The possibility of estimating less to be competitive and win bids.	54	9.26%	48.15%	27.78%	14.81%	0.00%	3.52

*Source: Compiled from survey data March, 2014*

Unlike the skilled labor, most respondents which are 37.04 % agree with the availability of scientific instrument and other equipments in the market. The mean score given to this factor is 3.17. Regarding equipments, the enterprise mostly sign an agreement that requires the client to fulfill such facilities. The costs are included in the contract agreement as reimbursable cost. The enterprise purchase the items and the purchase cost at current market prices will be reimbursed and items will be returned to the client after the end of the project. Therefore this factor may not have influence on the project cost estimation.

As the enterprises project works are mostly related to water resource development at project site, weather condition can delay the project's completion period. Therefore all related costs with delayed project will increase the total cost above what was estimated. More than 53.70% of respondents agree with the influence of this factor and give it a mean score of 3.94.

As the enterprise is governmental organization, the strategy of the enterprise is set to fulfill the government policies in water resource development sector. About 40.74% of

respondents agreed that the cost estimation is performed without sufficient information due to the impacts created through government policies. They show their agreement with mean score of 3.52. According to the respondents' explanations, some projects are implemented following fast track approach. This means Design and construction supervision works of the same projects are expected to be performed simultaneously. Therefore such fast track approach to implement the government policies will affect the quality of work. Such condition exposed for rework and additional cost more than estimated. On the other hand, more than 48.15% of respondents confirm that there is the possibility of estimating project cost less than what should be in order to win bids. The factor has given a mean score of 3.52 by respondents.

## CHAPTER FIVE- SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

### 5.1. SUMMARY OF FINDINGS

This study covers the case of higher scale projects of water works design and supervision enterprise in assessing the factors affecting the accuracy of projects cost estimation. Professionals who directly participate on the preparation of technical proposal and project cost estimation are selected as a sample to assess cost estimation factors related to consultant, design parameters and information, factors related to projects and client characteristics, external factors and market condition. Based on the literature review, the questioner consisted of all factors mentioned above were prepared and measured on 5 point likert scale. The respondents were also granted a space provided to mention other factors related with the nature of the projects run by the enterprise.

In this research six years data concerning the physical performance of the projects and percentage of actual cost utilized with budgeted (estimated) costs of projects were analyzed. Comparison of budgeted cost of work performed with actual cost of work performed for study, design and construction projects was made. As a result

- Among 43 constructions supervision projects during the 6 years period 69.77% were overestimated and 13.95% were underestimated. Only 16.28% of the higher scale projects were under acceptable range of variance
- Among 32 study projects during the 6 years period 59.36% were overestimated and 25% were underestimated. Only 15.64% of the higher scale projects were under acceptable range of variance
- Among 31 design projects during the 6 years period 67.74% were overestimated and 19.35% were underestimated. Only 12.91% of the higher scale projects were under acceptable range of variance.

In general, the study found that costs of more than 80% of the projects of WWDSE have accuracy problem in their estimation.

The research tried to find out the cases that contribute for such inaccuracies using the data collected through questioner. The questioner was distributed to relevant respondents with the majority of project managers and supervisors who have plenty of years of work experience and higher educational status. Technical proposal preparation team and Estimators work load during estimation was described as the main influencing factor concerning the factors related to consultant, design parameters and information. Unavailability of adequate time for estimation and incomplete technical and socioeconomic information are also identified as the factors that affect the cost estimation. In addition to the involvement of inadequate number of estimating staff, the data shows that the responsibility given to project managers in cost estimation is very low and their roll in controlling projects schedule and costs is insignificant.

The study shows that the type of client, its financial situation and budget are identified as the major factors to influence the cost estimation from the factors categorized as factors related to client characteristics. Such factors are indeed influential since the major client of the enterprise is the government. The study also shows that factors related to project characteristics like project type and complexity and location and site constraints of the projects are the major factors affecting the accuracy of cost estimation. Some geological factors, access road unavailability and social problems which were unforeseen during estimation make the actual cost different from what was predicted.

The answers given by most of the respondents show their disagreement for the availability of labor with the required skill in the market at predetermined cost since some input to the study or design projects may not be provided by the internal labor. Therefore the enterprise face challenges of getting sub consultant or freelancers whose payments can be covered by the cost previously estimated. Unlike the skilled labor, the availability of scientific instrument and other equipments in the market is not the affecting factor. Moreover, the study indicated that all costs related with delayed project due to weather condition increase the total cost more than what was estimated. The government policies forced project works to follow fast truck approach that expose for rework and inaccuracies in project cost estimation.

## 5.2 CONCLUSION

The results of actual project data, the conclusion can be drawn that most of the estimated cost of the projects is either under-utilized or over utilized which shows there is undeniable inaccuracies in the project's cost estimation. The major findings of this study compiled from the data collected through the questioner shows the following are the most influential factors that affect the accuracy of project cost estimation.

- Completeness of technical and socio economic information
- Technical proposal preparation team and cost estimators work load during estimation
- Availability of adequate time for estimation and technical proposal preparation
- Insufficient number of estimating staff
- Nonattendance of project managers in cost estimation
- The effect of client on cost estimation
- Financial situation and budget of client
- Location, site constraint, weather condition and complexity of projects
- Availability of skilled labor in the market at predetermined cost
- The impact of government policies

One of the nine knowledge areas that project managers should be familiar with is the project cost management. It involves estimating the cost of resources, including people, equipment, materials, and such things as travel and other support details. After this is done, costs are budgeted and tracked to keep the project within that budget. (James P. Lewis, 2007). Therefore, we can conclude that, the under utilization or over utilization of estimated project cost with large variance shows that, there is inefficiency in project management.

It is known that a company performing projects for other organizations do cost estimate to see how much the project is going to cost to complete. Then, with this cost information, they calculate a profit into the project work. The wide variance between the estimated and actual cost of the projects can make the actual profit to be different from the forecasted one with extensive gap. Such cases make the profits are under question which are earned during the six years of performance of the enterprise covered in this research.

### 5.3 RECOMMENDATION

After detail analysis of the study, the researcher recommended the management of Water Works Design and Supervision Enterprise that, they have to give more attention to the most influential factors that affect the accuracy of projects cost estimation that are identified in this research in order to achieve more reliable and realistic estimates.

The management of the enterprise should pay more attention to the cost estimating process by improving the completeness of technical inputs and socio economic information by engaging all relevant professionals or specialist required for a particular project type with sufficient number and adequate time. The amount of time and resources used to make the estimates should be appropriate to the size and complexity of the project. (Trost and Oberlender, 2003) argued the importance of time by stating as, Adequate scope definition, an experienced project team, and good cost information do not fully explain the estimate accuracy picture, but must be combined with an adequate allotment of time. All these factors will enable cost estimators come up with most accurate cost estimates of the project and has greatest in importance to the realization of a feasible estimate.

The top management of the enterprise should enhance the responsibility given to project managers in cost estimation and their roll in controlling projects schedule and costs. As part of the planning process, (Philips, 2004) insist that the project manager must determine what resources like people, equipment, and materials that will be utilized to complete the project. To carry out this task, project managers must use work break down structure (WBS) and other valuable information. (Rad 2002) suggested that, the most accurate and most reliable estimate for a project can be developed when all the elements of the work breakdown structure (WBS) have been identified with a reasonable degree of reliability and when the resource breakdown structure (RBS) has been defined with the desired degree of certainty. Therefore the involvement of project manager on cost estimation will help to increase the level of accuracy. Such actions will also increase the roll of project managers in ensuring that all work is completed on time, within budget and scope, and at the correct performance level.



The enterprise should also focus on capacity building by strengthening the existing short term and long term trainings. This will help the enterprise to get internal skilled labor and minimize the chance of facing the unavailability of labor from the market at the predetermined fee on cost estimation. The planning and market promotion process executive officers should make market search and obtain accurate cost information about scientific equipment. This cost information has to be updated at the time of cost estimation to increase accuracy.

It is also recommended that training courses on factors affecting the accuracy of cost estimates should be conducted. These activities would improve the local practice of cost estimating and increase the capabilities of estimators.

#### **5.4. FUTURE RESEARCH**

This research tried to find out that there is inaccuracy in cost estimation and assess possible factors that affect the accuracy of cost estimation. The variance between the estimated and actual cost may not be occurred only due to the reasons identified by this research. Therefore it would be more analyzed and get valuable recommendation if a future study focus on problems on cost allocation in the financial recordings and which element of the project cost have significant impact for the cost variation. This study only takes the large scale projects of six years data to see their performance. So, future research can add the remaining medium and small scale projects for the past 15 years to make research on the case mentioned above.

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## **APPENDIX - A**

### **St. Mary's University School of Graduate Studies**

#### **Questioner Designed to Water Works Design & Supervision Enterprise**

*Dear Respondent,*

This questionnaire is developed to collect data concerning assessment of factors affecting the accuracy of cost estimation in project management taking the case of Water Works Design & Supervision Enterprise. The questions will solely be used for a thesis conducted for the partial fulfillment of masters of business administration in accounting and finance. Your genuine response is used for academic purpose only and the data will be treated as most confidential.

I, therefore, kindly request you to carefully read all the questions and give your answers with due care and return within the soonest possible time.

Thank you in advance for sacrificing your time and effort to fill the questionnaire.

**Note that:**

1. You don't need to write your name or any identifying remark
2. Indicate your choice by putting a  $\surd$  mark.

## Part 1 – General Information

1. Gender

Male

Female

2. Educational Background

College Diploma

First Degree

Second Degree and Above

3. Years of Services

0-5 Years

5-10 Years

Above 10 years

4. Position you are working on

Managerial

Supervisory

Professional

## Part II- Research Questionnaire

Please Indicate Your Response by using tick mark (√) According to Your Choice.

Research Questionnaire	Likert's Rating Scale				
	5	4	3	2	1
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>Factors Related to consultant, design Parameters and information</b>					
• Professionals who are assigned for project cost estimation are well experienced					
• Adequate number of professionals are assigned in the estimating staff					

Research Questionnaire	Likert's Rating Scale				
	5	4	3	2	1
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<ul style="list-style-type: none"> <li>The enterprise focuses on team integration and alignment and the estimating staff is selected from different disciplines with needed skill and quality</li> </ul>					
<ul style="list-style-type: none"> <li>Project managers have more involvement in project cost estimation and to be included in the team that prepares technical proposal</li> </ul>					
<ul style="list-style-type: none"> <li>There is detail &amp; complete cost information to assign on the inputs based on technical proposal</li> </ul>					
<ul style="list-style-type: none"> <li>The cost information is believed to be accurate &amp; reliable</li> </ul>					
<ul style="list-style-type: none"> <li>The enterprise has an estimating method/ techniques that are being used for project cost estimation</li> </ul>					
<ul style="list-style-type: none"> <li>Technical proposal preparation team &amp; cost Estimators do not have work load due to additional assignment during estimation</li> </ul>					
<ul style="list-style-type: none"> <li>Adequate time is available for estimating team during technical proposal preparation and cost estimation</li> </ul>					
<ul style="list-style-type: none"> <li>The cost estimation is performed based on complete projects technical and socio economic information</li> </ul>					
<b>Factors Related to client characteristics</b>					
<ul style="list-style-type: none"> <li>The type of client have its own influence on the cost of the project estimated by the enterprise</li> </ul>					
<ul style="list-style-type: none"> <li>Clients financial situation &amp; budget have effect on the cost Estimation process</li> </ul>					

Research Questionnaire	Likert's Rating Scale				
	5	4	3	2	1
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>Factors Related to project characteristics</b>					
<ul style="list-style-type: none"> <li>The type of project whether it is water supply, dam or irrigation has project type related unique factors on project cost estimation.</li> </ul>					
<ul style="list-style-type: none"> <li>Location of the project, site condition and topography of the site have their own effect on the data collected for technical proposal and on the cost estimated that is based on the data collected.</li> </ul>					
<ul style="list-style-type: none"> <li>Project complexities are resulted in different actual cost from what was previously estimated.</li> </ul>					
<ul style="list-style-type: none"> <li>Site constraints and site requirements enforce to incur a cost more than what was estimated</li> </ul>					
<b>External factors &amp; market conditions</b>					
<ul style="list-style-type: none"> <li>The enterprise can get labor with required skill for any projects and make payments that can be covered from the cost of the project which was previously estimated</li> </ul>					
<ul style="list-style-type: none"> <li>Scientific instruments and other equipments are available in the market to perform the project cost at predetermined price in the cost estimation.</li> </ul>					
<ul style="list-style-type: none"> <li>Whether condition have effect on the estimated cost and come up with different actual cost</li> </ul>					
<ul style="list-style-type: none"> <li>The cost estimation are performed in a way to address the impacts that can be created through government policies</li> </ul>					
<ul style="list-style-type: none"> <li>The enterprise estimates project cost less than what should be if it was estimated accurately and try to be competitive when there is more competitors</li> </ul>					



If there are other factors with respect to the nature of the projects other than those already mentioned above, please list them out on the space provided below. (If the space is not enough, please use the backside of this paper)

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If you believe that all projects are not completed within the predetermined time, please list out the reason you think on the space provided below. (If the space is not enough, please use the backside of this paper)

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**Thank You!!**

## APPENDIX - B

### Water Works Design and Supervision Enterprise Construction Supervision Projects Physical Performance From 2008/2009 to 2013/2014 Budget Year

Project	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed
CSP1	20.00%	20.00%	100.00%	25.00%	25.00%	100.00%	12.00%	12.00%	100.00%	25.00%	24.71%	98.84%	25.00%	23.73%	94.92%	41.59%	35.16%	84.54%
CSP2	20.00%	20.00%	100.00%	25.00%	25.00%	100.00%	12.00%	12.00%	100.00%	25.00%	24.96%	99.84%	25.00%	25.00%	100.00%	32.80%	32.80%	100.00%
CSP3	21.50%	21.50%	100.00%	20.00%	17.30%	86.50%												
CSP4	10.00%	10.00%	100.00%	30.00%	27.43%	91.43%	27.50%	27.50%	100.00%	27.50%	25.52%	92.80%	25.00%	23.70%	94.80%	52.00%	50.47%	97.06%
CSP5							9.10%	9.10%	100.00%									
CSP6							50.00%	50.00%	100.00%	50.00%	44.80%	89.60%	50.00%	50.00%	100.00%	56.00%	56.00%	100.00%
CSP7							50.00%			25.00%	0.05%	0.20%	11.27%	7.37%	65.39%	29.65%	25.20%	84.99%
CSP8							50.00%	50.00%	100.00%	29.20%	27.86%	95.41%	20.42%	20.42%	100.00%	57.00%	52.98%	92.95%
CSP9										100.00%	92.08%	92.08%	92.00%	92.00%	100.00%			
CSP10				33.30%	30.58%	91.83%							25.00%	23.76%	95.04%	58.50%	48.49%	82.89%
CSP11													50.00%	49.10%	98.20%	50.00%	50.00%	100.00%
CSP12													78.50%	74.00%	94.27%	8.00%	8.00%	100.00%
CSP13																57.50%	53.19%	92.50%

**Water Works Design and Supervision Enterprise  
Study Projects Physical Performance  
From 2008/2009 to 2013/2014 Budget Year**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed
STP1	57.60%	26.23%	45.54%	41.30%	6.67%	16.15%	60.70%	16.00%	26.36%	44.46%	5.97%	13.43%						
STP2	49.30%	49.30%	100.00%															
STP3	61.20%	61.20%	100.00%															
STP4	100.00%	73.50%	73.50%															
STP5	93.10%	47.50%	51.02%	52.50%	47.30%	90.10%												
STP6	56.50%	13.10%	23.19%	43.75%	1.31%	3.00%	4.00%	4.00%	100.00%									
STP7				79.20%	71.20%	89.90%	27.75%	27.75%	100.00%									
STP8				43.00%	13.00%	30.23%	27.50%	27.50%	100.00%	30.50%	17.99%	58.98%						
STP9										48.85%	47.33%	96.89%						
STP10										63.00%	5.67%	9.00%				9.00%	1.00%	11.11%
STP11										4.00%	4.00%	100.00%	53.00%	53.00%	100.00%	40.00%	40.00%	100.00%
STP12													24.00%	22.60%	94.17%	15.00%	9.00%	60.00%
STP13													32.75%	30.25%	92.37%	56.00%	44.00%	78.57%
STP14													16.55%	15.59%	94.20%	41.83%	40.26%	96.25%
STP15													68.25%	59.50%	87.18%	29.25%	28.07%	95.97%
STP16																15.37%	15.37%	100.00%

**Water Works Design and Supervision Enterprise  
Design Projects Physical Performance  
From 2008/2009 to 2013/2014 Budget Year**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed	Planned Work	Actual Work performed	%age of Actual Work performed
DEP1													59.60%	60.58%	101.64 %			
DEP2	75.00%	75.00%	100.00%															
DEP3	72.50%	72.50%	100.00%															
DEP4				51.10%	47.20%	92.37%												
DEP5				76.40%	76.40%	100.00%												
DEP6				76.40%	76.40%	100.00%												
DEP7				76.40%	76.40%	100.00%												
DEP8				27.50%	27.50%	100.00%	40.00%	40.00%	100.00%	79.50%	54.60%	68.68%	54.00%	47.55%	88.06%	50.00%	44.30%	88.60%
DEP9							25.80%	20.00%	77.52%	62.50%	42.56%	68.10%	34.50%	24.27%	70.35%	41.70%	14.87%	35.66%
DEP10										80.00%	58.00%	72.50%	41.00%	32.39%	79.00%			
DEP11										100.00%	100.00%	100.00%						
DEP12										46.00%	46.00%	100.00%						
DEP13													41.00%	32.39%	79.00%	70.35%	4.49%	6.38%
DEP14													83.85%	31.60%	37.69%	71.40%	55.56%	77.82%
DEP15																65.00%	55.29%	85.06%
DEP16																75.00%	73.60%	98.13%
DEP17																75.00%	48.60%	64.80%
DEP18																36.53%	31.90%	87.33%
DEP19																36.50%	31.75%	86.99%
DEP20																100.00%	100.00%	100.00%
DEP21																100.00%	100.00%	100.00%

## APPENDIX - C

### Water Works Design and Supervision Enterprise Construction Supervision Projects Financial Performance From 2008/2009 to 2013/2014 Budget Year

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan
CSP1	5,594,500.00	4,588,176.71	82.01%	5,433,770.00	6,669,545.04	122.74%	6,054,170.00	3,593,630.58	59.36%	5,628,870.00	5,760,770.25	102.34%	11,047,200.00	6,395,236.86	57.89%	7,385,400.00	6,750,591.01	91.40%
CSP2	8,023,900.00	6,149,443.00	76.64%	6,264,590.00	4,992,563.57	79.69%	6,661,120.00	5,640,814.44	84.68%	7,044,980.00	7,849,870.76	111.43%	16,627,300.00	9,051,432.23	54.44%	9,337,900.00	7,768,395.37	83.19%
CSP3	1,031,200.00	951,497.03	92.27%	1,215,140.00	1,010,260.54	83.14%												
CSP4	2,771,000.00	768,788.63	27.74%	3,021,630.00	1,476,059.59	48.85%	3,745,850.00	2,871,767.44	76.67%	4,455,710.00	3,576,499.64	80.27%	6,085,600.00	4,314,518.12	70.90%	6,121,300.00	6,058,790.85	98.98%
CSP5							1,327,780.00	1,022,454.66	77.00%									
CSP6							2,895,280.00	2,149,574.11	74.24%	3,272,200.00	2,517,481.69	76.94%	2,797,700.00	3,213,045.28	114.85%	5,668,400.00	4,072,189.73	71.84%
CSP7							2,370,600.00	584,149.62	24.64%	1,770,030.00	370,457.45	20.93%	5,124,500.00	2,502,282.95	48.83%	3,390,500.00	3,218,454.12	94.93%
CSP8							3,383,000.00	1,583,402.03	46.80%	2,330,770.00	2,003,639.15	85.96%	4,026,200.00	2,562,924.86	63.66%	3,784,700.00	2,686,066.77	70.97%
CSP9										1,245,840.00	605,019.35	48.56%	1,488,900.00	798,355.38	53.62%			
CSP10				1,137,480.00	921,509.02	81.01%							1,680,000.00	2,905,239.81	172.93%	5,890,500.00	3,562,061.40	60.47%
CSP11													3,578,600.00	2,831,440.96	79.12%	1,521,000.00	847,545.54	55.72%
CSP12													4,093,700.00	483,062.04	11.80%	799,000.00	237,415.70	29.71%
CSP13																1,543,200.00	289,921.13	18.79%

**Water Works Design and Supervision Enterprise  
Study Projects Financial Performance  
From 2008/2009 to 2013/2014 Budget Year**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan
STP1	22,144,000.00	4,207,388.29	19.00%	20,454,090.00	1,864,008.70	9.11%	15,299,400.00	1,447,993.70	9.46%	11,410,140.00	333,771.16	2.93%						
STP2	4,981,600.00	6,909,818.82	138.71%															
STP3	10,041,300.00	21,964,241.52	218.74%															
STP4	2,620,900.00	850,270.93	32.44%															
STP5	3,761,200.00	1,335,075.17	35.50%	4,028,000.00	3,526,565.80	87.55%												
STP6	2,667,500.00	841,470.16	31.55%	1,689,930.00	503,389.99	29.79%	1,568,790.00	376,407.94	23.99%									
STP7				6,275,250.00	7,839,448.35	124.93%	3,303,370.00	2,837,787.23	85.91%									
STP8				1,848,540.00	618,903.04	33.48%	1,935,000.00	905,686.60	46.81%	1,778,780.00	942,826.45	53.00%						
STP9										1,437,090.00	1,768,988.33	123.10%						
STP10										1,439,920.00	881,180.01	61.20%				1,288,400.00	973,900.16	75.59%
STP11										1,146,080.00	143,128.07	12.49%	1,890,500.00	1,440,771.26	76.21%	2,406,100.00	1,765,516.86	73.38%
STP12													1,716,400.00	675,878.26	39.38%	1,635,200.00	32,543.18	1.99%
STP13													4,413,500.00	1,439,932.52	32.63%	2,814,100.00	1,401,257.74	49.79%
STP14													3,966,600.00	3,276,265.71	82.60%	4,301,300.00	2,170,979.68	50.47%
STP15													3,213,000.00	857,701.01	26.69%	1,588,700.00	405,548.97	25.53%
STP16																743,000.00	921,278.95	123.99%

**Water Works Design and Supervision Enterprise  
Design Projects Financial Performance  
From 2008/2009 to 2013/2014 Budget Year**

Project code	2008/2009			2009/2010			2010/2011			2011/2012			2012/2013			2013/2014		
	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan	Estimated Cost	Actual Cost	%age of Actual cost Over Plan
DEP1													1,308,500.00	1,507,532.42	115.21%			
DEP2	3,965,800.00	2,965,459.02	74.78%															
DEP3	2,742,850.00	2,640,597.71	96.27%															
DEP4				2,276,000.00	2,239,302.29	98.39%												
DEP5				3,065,260.00	3,520,741.06	114.86%												
DEP6				2,513,140.00	1,357,073.10	54.00%												
DEP7				2,982,860.00	1,532,661.37	51.38%												
DEP8				2,562,040.00	5,322,665.95	207.75%	4,450,080.00	3,652,115.36	82.07%	3,022,790.00	3,193,785.07	105.66%	8,944,600.00	3,965,710.70	44.34%	10,528,100.00	3,686,108.24	35.01%
DEP9							16,665,1330.00	10,333,941.21	61.00%	29,798,670.00	18,271,467.11	61.32%	29,115,500.00	11,608,351.11	39.87%	36,418,600.00	10,066,093.00	27.64%
DEP10										3,866,380.00	891,065.08	23.05%	9,265,400.00	1,706,403.51	18.42%			
DEP11										1,681,900.00	429,317.74	25.53%						
DEP12										1,941,400.00	4,960,464.70	255.51%						
DEP13													13,147,300.00	3,405,754.10	25.90%	12,543,200.00	2,519,676.29	20.09%
DEP14													16,675,400.00	2,177,107.62	13.06%	6,829,500.00	1,137,474.25	16.66%
DEP15																6,414,800.00	2,346,848.36	36.58%
DEP16																4,980,000.00	1,276,522.21	25.63%
DEP17																3,645,000.00	641,887.78	17.61%
DEP18																5,743,600.00	4,139,825.45	72.08%
DEP19																4,644,700.00	3,450,775.55	74.29%
DEP20																1,089,700.00	709,415.73	65.10%
DEP21																2,303,700.00	659,901.77	28.65%

## **DECLARATION**

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Dejene Mamo (Asst. Prof.), my thesis advisor. All sources of materials used for the thesis have been duly acknowledged, I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

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Name

St Mary's University, Addis Ababa

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Signature & Date



## **ENDORSEMENT**

This thesis has been submitted to St. Mary's University, school of Graduate Studies for examination with my approval as a university advisor.

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Advisor

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Signature & Date