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**ASSESSMENT OF COST AND TIME OVERRUN IN ADDIS-
DJIBOUTI RAILWAY PROJECT**

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The undersigned have examined the thesis entitled “**Assessment of Cost and Time Overrun in Addis-Djibouti Railway Project**” presented by **Biniyam Ayele**, a candidate for the degree of **Master of Science** and hereby certify that it is worthy of acceptance.

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UNDERTAKING

I certify that research work titled “Assessment of Cost and Time Overrun in Addis-Djibouti Railway Project” is my own work. The work has not been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged / referred.

Biniyam Ayele

Abstract

Transportation is the back bone of a nation's economic activities. Mass transit system like rail systems shall be constructed for efficient transportation. The railway connecting Ethiopia with Djibouti was a meter gauge line opened in 1917. A new line contract was awarded to China Civil Engineering Construction Corporation (CCECC) and China Railway Engineering Corporation (CREC) having double track for the first 115 Km from Addis Ababa to Adama, and single track for the remaining 600Km to Djibouti. The huge investment in the project and import export importance of the line were a case for evaluating the presence and cause of cost and time overrun.

Since time overrun has a high attribute to cost overrun, in this thesis the time and cost overruns of the project had been assessed. This research assessed the effect of amendment on cost overrun and the increased out goings of the foreign currency.

Questionnaire survey has been conducted on a total of 28 respondents from client, contractors and client representative to model the cause factors of project overrun using Partial Least Square (PLS) approach via SmartplsV3 software package, to assess the cost and time management practice of the project and rank the major impacts of cost and time overrun using Relative Importance Index (RII). In addition, a detailed archival document review was conducted to get the actual essence of cost and time overrun of the project.

Findings of the research shows that, Project Management and Contract Administration related factors (PMCAR) are the most significant construct or group of factors causing cost and time overrun. Following PMCAR, Financial and Time Management related factors affects cost overrun, while Contractor's Site Management related factors (CSMR) affect time overrun respectively. Delayed compensation payments, drainage of foreign currency and lost economical contribution of the project in terms of Time value of money were main impacts of Cost and Time overrun of the Addis-Djibouti railway project. Power supply issues and design changes were the most significant factors which exposed the project to time overrun. Unfinalized feasibility study brought many amendments and cost overrun to the three EPC contracts of the project.

Keywords: Addis-Djibouti, cause factors, cost overrun, time Overrun, PLS-SEM, Railway

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The moral support from my family and friends will never be forgotten and this work is dedicated to them.

ACRONYMS

AVE :- Average Variance Extracted

CCECC:- China Civil Engineering Construction Corporation

CIECC :- China International Engineering Consulting Corporation

CR :- Composite Reliability

CREC: - China Railway Engineering Corporation

CSMR :- Contractor's Site Management Related factors

CTC:- Central Traffic Control

EPC:- Engineering, Procurement and Construction

ERC :- Ethiopian Railway Corporation

ETS :- Electric traction and Signaling

FTMR :- Financial and Time Management Related factors

LRT – Light Rail Transit

LV- Latent Variable

MV- Manifest Variable

NHR :- Non -Human Related factors

PLS :- Partial Least Square

PLS –SEM :- Partial Least Square – Structural Equation Modelling

PMCAR :- Project Management and Contract Administration Related factors

RII :- Relative Importance Index

SEM :- Structural Equation Modelling

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CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Transportation is the back bone of success in economic activities, it is necessary that a mass transit system like rail systems be constructed for efficient transportation (ILO, 1994). The railway connecting Ethiopia with Djibouti was a meter gauge line opened in 1917. It is the only railway line that connects landlocked Ethiopia with Djibouti Port, a major cargo entry point, but deteriorated due lack of maintenance and management.

According to railway-technology article, a feasibility study conducted in 2007 highlighted replacing the meter gauge section with a 1435 mm gauge line, and then the new line contract was awarded to China Civil Engineering Construction Corporation (CCECC) and China Railway Engineering Corporation (CREC) having double track for the first 115 Km from Addis Ababa to Adama, and single track for the remaining 600Km to Djibouti.

The project cost and time management of such a large project is very demanding due to the interdependency of cost and time overrun factors, and the high investment cost and time value of money.

In this research, cause of cost and time increment/overrun and their impacts in the construction project specifically in Addis-Djibouti railway project is assessed in relation to variation, amendment and contract type. The huge investment in the project, the project type, the contract type and border crossing scope of the construction is a case for evaluating the presence, causes and impacts of cost and time overrun.

1.2 Statement of the problem

Cost and time are two of the pillars in a project's success. The deviation of these pillars from the stipulated budget and schedule depend on the type of project and experience of similar projects before. Since the railway sector is an emerging industry in developing countries like Ethiopia, the investigation of cost and time overruns needs high attention.

According to Flyvbjerg et. al. (2003), infrastructure projects are globally estimated to have 86% probability of experiencing cost escalation with average cost overrun of 45% for rail projects, 34% for bridge projects and 20% for road projects. Similarly, Edwards, Irani and Lov (2012) and Odeck (2004) also contend that cost and time overruns could sometimes average 70% and 183% over the initial stipulated estimate respectively.

Weyessa (2015) investigated the cause and impact of cost overrun in Addis Ababa's LRT construction project. Since the time overrun have a high attribute to cost overrun, this thesis takes an emphasis on both time and cost overrun assessment. Researches on factors based modeling (E.g. PLS-SEM) and amendment effect on cost overrun were not done in Ethiopia's railway projects. The impacts of amendment on cost overrun and its effect on out goings of the foreign currency are in need to be assessed and the suitability of cause factor analysis for PLS is the benchmark for modelling based study.

In addition, mega project constructions like railway lines in developing countries constructed by a loan from different sources with an interest rate for payback. Due to this, the investment needs high attention. Engineering procurement construction (EPC) contract type hardly allows cost and time variations. On this thesis, the researcher investigates the causes, extent and impact of cost and time overruns in Addis –Djibouti standard gauge project in relation to contractual and organizational aspects and provides measures which can be used as an input to decrease the presence of cost and time increment in future projects.

1.3 Objective of the Study

1.3.1 General objective

The general objective of this paper is to investigate causes, extents and impacts of cost and time overrun in Addis- Djibouti railway project.

1.3.2 Specific objectives

1. To assess the presence and extent of cost and time overruns in Addis -Djibouti Railway project.
2. To identify the causes of cost and time overrun and modeling cause factors using PLS-SEM Approach
3. To assess the impacts of cost and time overrun in the project.

4. To assess the time and cost management practice in relation to Employer and Client representative in Addis -Djibouti Railway project.

1.4 Scope and limitation of the Study

This study is mainly focused on cost and time overrun investigation in the implementation phase of Addis -Djibouti railway project with scope of railway lines executed from Addis/Sebeta- Messo – Dewanle. Due to lack of well-organized documents on the side of the Djibouti project, this thesis does not fully cover the Dewanle-Negad section.

1.5 Organization and Contents of the Research

The research comprises of five chapters. Chapter one is the introductory chapter, which provides basic information about the study, including background and statement of the research problem, research objectives and scope and limitations of the research.

Chapter two presents theories and discussions related to cause factors which leads to cost and time overrun, impacts of project overrun, cost and time management aspects of project management guide books and overview of the Partial least square –Structural Equation Modeling (PLS-SEM) approach.

Chapter three covers the research methodology followed in order to achieve the objectives of the study. It presents an overview of the research design, sources of data and research instruments, research sampling and sample size determination and method of analysis.

Chapter four presents analysis of the research data obtained from the questionnaire survey and archival documents were discussed accordingly. The last chapter, which is chapter five, is devoted to the author’s conclusions and recommendations.

CHAPTER 2 LITERATURE REVIEW

This literature review was outlined to address three main objectives. The first objective was to assess cost and time management aspects of construction project specifically railway project with the aim of identifying the tools and techniques which affect contract cost and project duration of Addis- Djibouti railway project.

The second objective was to document the state of the industry with respect to the challenges of cost and time in construction projects and to overview the partial least square (PLS) approach in project overrun assessment. The work of many researchers in this area has helped to establish a framework for data collection and interpretation; they were used for developing an understanding of the cost and time factors involved in the increasing costs and duration of projects in rail way construction.

The third objective of this literature review was to clarify the scope of work being conducted in the construction of Addis Ababa – Djibouti railway project

2.1 Introduction

Infrastructure plays a paramount role in the economic growth of country. Delays in the infrastructure project implementation mean that the people and the economy have to wait for infrastructure facilities longer than is necessary. Cost overruns in such projects lead to an increase in the capital-output ratio for the entire economy.

The study done on delays and cost overruns in infrastructure projects from April 1992- Sept 2008 in India shows that from 120 completed railway projects 98.33 % of projects had a time overrun of 83 % (as % of implementation phase). In relation to cost overrun, 83.33 % of these projects had cost overrun and 84% Cost overrun as a percentage of initial cost of all projects. (Singh, 2009). This implies that project overrun in railway sector is a critical issue which requires intensive project management.

The traditional objective of project management is the coordination of multilayered construction tasks in order to successfully procure and deliver infrastructure projects “on time, in budget and according to contract design-specification”. Therefore, the iron triangular project management functions of cost, time and output performance (quality

and scope) becomes key criteria for project control and performance evaluation (Morris and Hough, 1987; Barnes, 1988).

Due to poor cost and time management these days, the construction industry is facing a huge amount of cost and time overrun. This has become quite a problem for the construction industry. Poor cost and time management are huge problem and very serious issue when it comes to project cost in both developed and emerging countries. The increasing complexity of infrastructure projects and the environment within which they are constructed place greater demand on construction managers to deliver projects on time, within the planned budget and with high quality. (Weyessa,2015)

2.2 Project Time Management

Mackenzie (1990) tells a wider definition for time management: “Time Management is the function required to maintain appropriate allocation of time to the overall conduct of the project through the successive stages of its natural life-cycle, (i.e. concept, development, execution, and finishing) by means of the processes of time planning, time estimating, time scheduling, and schedule control.”

Project time management needs the use of tools and policies in order to create a standard for monitoring and measuring project work. Both the individual and assigned tasks must be able to capture and manage time by utilizing the tools in this process.

Abbasi and Al-Mharmah (2000), Hutchings and Christofferson (2000; 2001), and Kazi (2002) have examined various schedule management tools and techniques. They have selected and identified seven-time management tools and techniques as the most popular tools among others. These tools include work breakdown structures, bar charts and linked bar charts, critical path method, resource leveling, schedule crashing and schedule updating, and have been adopted in this study.

2.2.1 Project Management Body of Knowledge: Project Time Management

Project quality can also be affected due to construction delays since the construction team usually dedicates less time to quality control when the main concern is completing the project on time. When this is the case, workers are usually pushed to work overtime and to increase the production rate, which very often entails failures and reworks.

In order to avoid the aforementioned incidents, contractors should implement project management processes that lead to success in the delivery of construction projects. Project management includes a number of planning and controlling processes that should be applied to comply with the owners' requirements related to project time, cost, and quality. In fact, project management has evolved towards a sophisticated and comprehensive process that depicts the primary approach to succeed on the delivery of any project. Since knowledge on project management has been developing over time, several professional associations around the world have issued guidelines and standards to put into practice such process. For instance, the Project Management Institute (PMI) has issued five editions of the PMBOK (Project Management Body of Knowledge) Guide, while the Association for Project Management (APM) has so far released the sixth edition of the APM Body of Knowledge. The standardization of the project management process contributes to disseminate best practices which implementation depicts a strategy to improve project performance.(Rómel , Gilberto and Alldo,2015)

2.2.1.1 PMBOK Guide

Project Time Management includes the processes required to manage the timely completion of the project. The Figure below provides an overview of the Project Time Management processes, presented as follows:

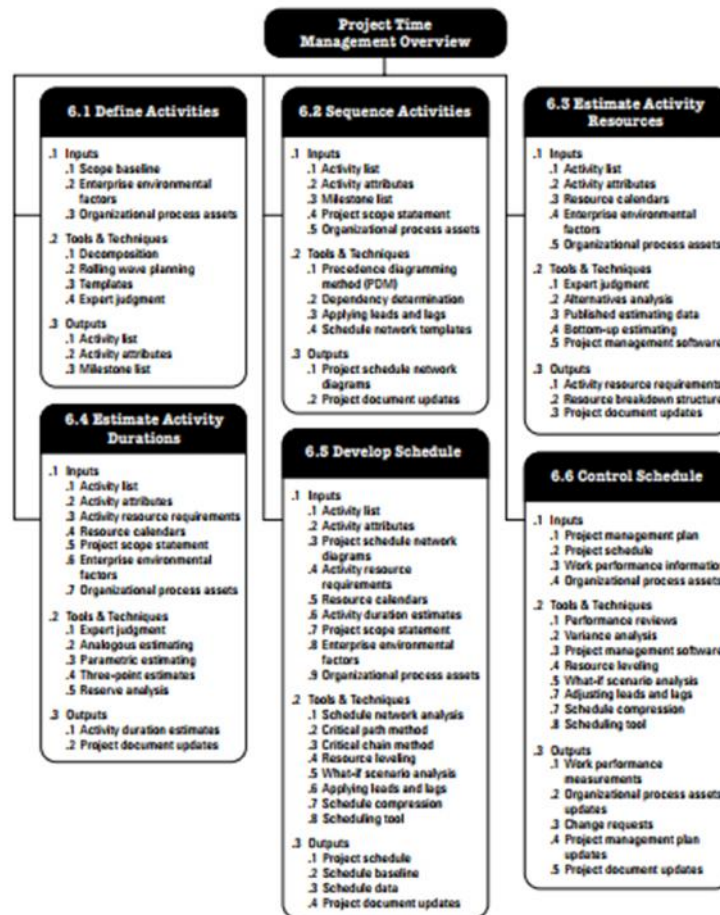


Figure 1 Project Time Management Overview

Plan Schedule Management—The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

Define Activities—The process of identifying and documenting the specific actions to be performed to produce the project deliverables.

Sequence Activities—The process of identifying and documenting relationships among the project activities.

Estimate Activity resources—The process of estimating the type and quantities of material, human resources, equipment, or supplies required to perform each activity.

Estimate Activity durations—The process of estimating the number of work periods needed to complete individual activities with estimated resources.

Develop Schedule—The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model.

Control Schedule—The process of monitoring the status of project activities to update project progress and manage changes to the schedule baseline to achieve the plan.

These processes interact with each other and with processes in other Knowledge Areas. The Project Time Management processes and their associated tools and techniques are documented in the schedule management plan.

2.2.1.2 APM-BOK

Time management, including phasing, will be included in “the when”. Budgets and Cost matters define the “how much”.

The effective planning and accomplishment of activities’ timing and phasing is a central skill of project management. Time scheduling/phasing comprises ordering the processes required to ensure timely completion of the project. Scheduling consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control.

2.3 Project Cost Management

As cited by Amanuel and Muluken (2018), Construction projects cost management is a process which complements the broad functions of estimating and tendering, scheduling, cost control and financial control. Construction cost management is the entire process, which ensures that the contract amount is within the cost limit of client’s approved budget. The cost performance of a project highly depends on cost variances, which is referred as any deviations in the budget or cost planned.

Project cost management includes the processes involved in planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project can be completed within the approved budget. But, it is identified that cost estimating, cost budgeting and cost controlling are the main and discrete processes of a cost management system.

Effective estimating and costing are important factors of a construction project success (Al-Shanti, 2003). Accordingly, cost estimate prior to the actual execution also takes place plays a significant role in any construction project (Ayed, 1997).

The range of Cost estimation accuracy increases as the quantity and quality of information increase through the life of a project. Therefore, available information, good estimating practice and experienced personnel are some of the factors found to have considerable impact on estimation accuracy. The CII (1998) study highlighted the major factors that are influencing the accuracy of estimate as: (i) quality and amount of information available for preparing the estimate (ii) Time allocated to prepare the estimate (iii) Proficiency of the estimator and the estimating team and (iv) Tools and techniques used in preparing the estimate. In this research, assessment of tools and techniques used in cost management of Addis -Djibouti railway projects presented as well.

2.3.1 Project Management Body of Knowledge: Project Cost Management

2.3.1.1 PMBOK Guide

Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.

Figure 2 provides an overview of the following Project Cost Management processes:

Plan cost Management—The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

Estimate costs—The process of developing an approximation of the monetary resources needed to complete project activities.

Determine Budget—The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.

Control costs—The process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.

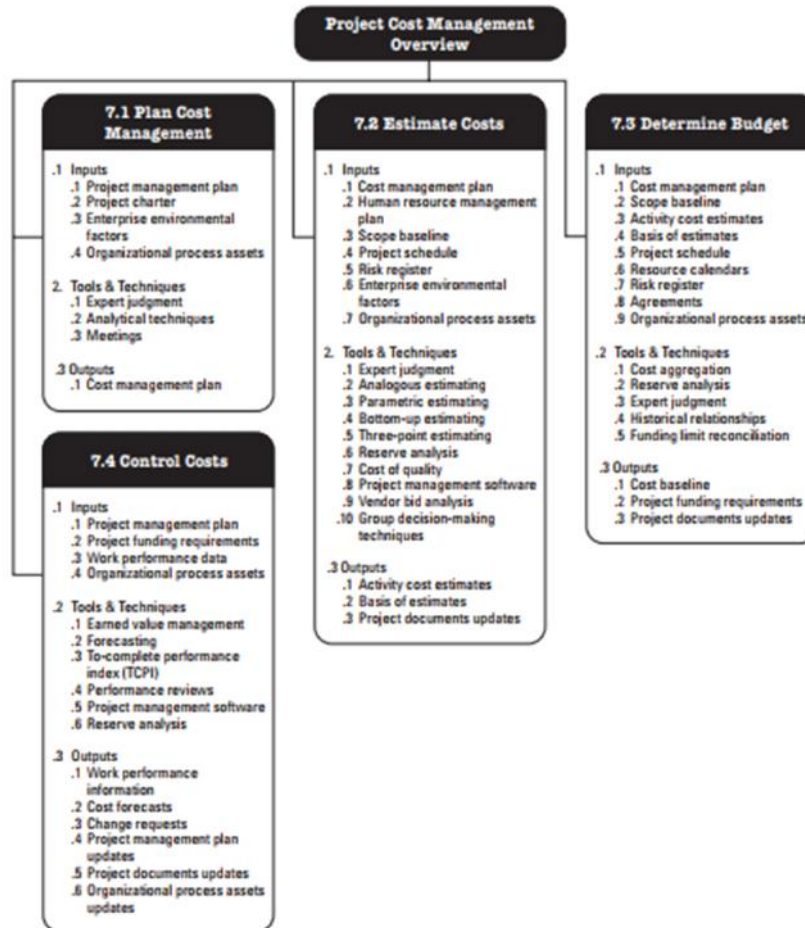


Figure 2 Project Cost Management Overview

These processes interact with each other and with processes in other Knowledge Areas. On some projects, especially those of smaller scope, cost estimating and cost budgeting are tightly linked and can be viewed as a single process that can be performed by a single person over a relatively short period of time. These are presented here as distinct processes because the tools and techniques for each are different. The ability to influence cost is greatest at the early stages of the project, making early scope definition critical.

2.3.1.2 APM-BOK

Budgeting and cost management

The completion of the project within its budget is a central objective of project management. Budgeting and Cost Management is the process of estimating the proper cost that should reasonably be expected to be incurred against a clear baseline, understanding how and why actual costs occur, and ensuring that the necessary response is taken promptly to ensure actual costs come under budget. Successful cost management on a project needs to be forwarded.

Typical information needed for cost management includes that on:

- Budgets (including estimating), generally based on work breakdown structure or [cost] code of accounts;

- Obtaining and recording commitments/accruals;

- Measurement of work accomplished and value earned/valuation of work, including treatment of changes (change control) and claims;

- Cash flow;

- Forecast out-turn costs;

- Variance analysis of the trend in forecast versus previous out-turn cost

2.4 Cost and Time Overrun

Time and cost are the two common concerns of construction management. Many factors relate to delay and cost overruns and vary along with types of project, locations, sizes, and scopes. Large construction projects with their features of complexity and capital requirement have resulted interest to many researchers. (Long, Young and Jun, 2008)

Delays and cost overruns are evidently frequent problems in the construction industries of many developed and developing countries.(Enshassi., Al Najjar and Kumaraswamy ,2009)

In developing countries, the constructions of large projects are financed by loan from lenders or government revenue from tax payers. Consistent cost and time overruns of public projects are not the best use of taxpayer money. In the public sector, money spent on project change orders and increased construction time reduces the number and size of

the projects that can be completed during any given fiscal year.(Pramen , Leslie and David ,2013).

According to Indian Ministry of Statistics and Programme Implementation (MOSPI), Total cost overrun of 205 delayed railway projects is whopping 2.21 lakh crore, the latest flash report of the Ministry for December 2018 showed. The MOSPI monitors central sector projects involving an expenditure of 150 crore and above. According to the report, the total original cost of these 205 projects was 1,68,116.34 crore up to December 2018. The total anticipated cost of these projects is estimated at 3,89,745.97 crore, which indicates overall cost escalation by 131.83 per cent.

The ministry monitored 367 projects of Indian Railways in December 2018. The report stated that 94 of these projects reported time overrun or delay of one month to 324 months. (Mint,2019)

The study of time and cost overruns in construction projects realization has great significance. Overruns analysis raise the quality level of preparation and control of projects, give a better picture of the realistic project goals and influence the measures taken by stakeholders. Therefore, the results of past project investigation are significant for decreasing both the chance of overrun occurrence and the level of negative consequences.

2.4.1 Time Overrun/Delay

Construction project time overrun can be defined as an extension of time beyond the contractual time agreed during the tender.(Al- Gahtani and Mohan ,2007).

Elinwa and Joshua (2001),defined it as the time lapse between the agreed estimation or completion date and the actual date of completion.

As cited by Mohammed (2017), Pickavance (2005) defines delay as something happening at a later time than planned, expected, specified in a contract or beyond the date that the parties agreed upon for the delivery of a project. It occurs when the progress of a contract falls behind its scheduled program.

There is no particular element in any project solely responsible for time overruns however; the construction phase holds a wider proportion of major troubles.

Construction time overruns are integrated parts, none of them can be divided from the other, and this is clearly seen by the costs construction time overruns leave behind (Sweis, 2013).

2.4.1.1 Causes of Time Overrun

The causes and effects of delay factors in construction industry vary from country to country due to environmental, topographical and technological constraints. In anticipation of the effect of globalization and the technological difference between developing and developed countries, it is necessary to identify the actual reasons of delay in order to reduce the impact of delay in any construction project (Shebob et al., 2012).

El-Razek, Bassioni and Mobarak (2008) found that delayed payments, slow delivery of payments, coordination problems and poor communication were important causes of delay in construction projects in Egypt.

Sambasivan and Soon (2007) found that poor planning, poor site management, inadequate supervisory skills on the part of the contractor, delayed payments, material shortages, labour supply shortages, equipment availability and failure, poor communication and rework were the most important causes of delays in the Malaysian construction industry.

In a study conducted by Ogunlana et al. (1996) comparing Thailand as a fast-growing economy country with other economies, 12 skyscrapers construction projects showed that the main reason of delays was resource supply problems in the boom-years of the construction sector. Shortage of supply of materials especially cement was the reason why projects were kept behind schedule.

From the above paragraphs, there is an agreement on poor communication and delayed payments are the key delay causes in both Egypt and Malaysia construction industry as per the researchers' findings.

Causes of delay may arise from contractor's control, Client control or External factors. Major delay causes can be categorized under their responsible sources.

Weyessa (2015) categorized Addis Ababa's light rail transit construction delay causes under Consultant, Contractor and client responsibility. In his study, causes such as

incomplete documents, Delayed and slow supervision in making decisions, absence of consultant's site staff, lack of managerial experience and supervisory personnel, lack of experience on the part of the consultant as a company are top five delay factors in descending order under Consultant's responsibility.

Contractor's responsibility delay causes ranked 1 to 7 are Financial problems, Poor site management, Delay in delivery of materials on site, Shortage of materials on site, equipments and tools shortage on site, Construction mistakes and defective works, Poor skill and experience of labor.

Site hand over and right of way, financial problems (delayed payments, financial difficulties and economic problems), lack of coordination with contractors, contract modifications (replacement and addition of new work to the project and change in specifications), slowness in making decisions and Lack of working knowledge are the major delay factors ranked in their order, under client's responsibility category.

The other source of delay cause is external factor, under this, external work due to public agencies (road, utilities and public service) is the first ranked delay factor and transportation delays, poor economic conditions (currency, inflation.), Poor site condition (location, ground), lack of material, equipment and tools on the market, change in laws and regulations and poor weather condition are factors ranked second to six as ordered above (Robel, 2015).

2.4.2 Cost Overrun

Choudhry (2004) defined cost overrun as the difference between the original cost estimate of project and actual construction cost on completion of works of construction project.

Cost overrun is defined as the change in contract amount divided by the original contract award amount. This calculation can be converted to a percentage for ease of comparison, Jackson (1990).

$$\text{cost overrun} = \frac{(\text{Actual Cost} - \text{Estimated Cost})}{\text{Estimated Cost}} \%$$

Cost overrun is a common problem in both the developed and the developing nations, making it difficult to complete many projects within budget. Being a common problem,

Allahaim & Liu (2012) reported that cost overruns were found across 20 nations and five continents. Cost overruns affect 90% of completed projects (Flyvbjerg, Holm & Buhl, 2004: 7; Memon, 2013: 1; Abdul-Rahman, Memon & Abd Karim, 2013: 268). However, the majority of developing countries experience overruns exceeding 100% of the initial budget (Memon, Abdul-Rahman, Zainun & Abd Karim, 2013: 1970).

According to Flyvbjerg (2003) nine out of ten transport infrastructure projects fall victim to cost overruns. The average cost overrun for all project types studied by them is 28%. The conclusion of their study was that cost estimates used in the decision making process are thus highly deceptive. Furthermore, they found that the risks generated by these misleading cost estimates are typically ignored and this may lead to further cost escalation.

Many well-known large-scale transport infrastructure projects incur major cost overruns. One of the most famous “project disasters” in this respect is the Channel Tunnel. This undersea rail tunnel linking the United Kingdom and France is the longest of its kind with a length of about 50 kilometers. Construction costs increased from £2.6 billion to £4.65 billion (1985 prices), which is 80 per cent higher than the forecasted costs (Flyvbjerg et al., 2003).

Weyessa (2015) studied cost overrun and impact assessment of Addis Ababa’s Light rail transit project, From desk study and survey analysis performed in this study there is a 5% and 4.2 % of cost increase observed respectively when comparison with the contract price was performed and a grand total of 25% cost increase was observed from the feasibility study estimate.

2.4.2.1 Causes of Cost Overrun

According to Flyvbjerg (2005) and Siemiatycki (2015), the factors influencing project cost overruns and time slippages can be broadly classified into three categories: Technical issues, optimism bias issues, and Strategic deception and misrepresentation issues.

According to User’s Guide (2005), the following are the factors that change the cost of the construction projects through time; poor project management, design changes, unexpected ground conditions, inflation, shortages of materials, change in exchange rates, inappropriate contractors, funding problems and force majeure.

As studied by Jahren, et al. (1990), the research on predictors of cost overrun rates they found the following factors to influence the cost overrun rates; the size of the project, the difference between lowest bid and engineer's cost estimate, the type of delivery method, the method of competition, quality of contract documents and the nature of interpersonal relations on the project.

The prime variables of cost overruns have been commonly identified as: unpredictable weather, inflationary material cost, inaccurate materials estimates, complexity of project, contractor's lack of geographical experience, contractor's lack of project type experience, and non-familiarity with local regulations (Kaming et al 1997).

As studied by Weyessa (2015), the main cause of cost increase/overrun observed in Addis Ababa's LRT project include delay and scope change of the contract date and items of work which resulted price adjustment with material at construction stage. Variation caused due to underground and elevated structures at construction stage, inadequate preconstruction study prior to the construction period which led to change in the control system and conceptual design of works. Type of project bidding and award (negotiation, lowest bidder...) which was caused due to lack of foreign currency and appropriate funding or loan to execute the project. Inadequate site investigation and unexpected ground conditions.

Ansar, Flyvbjerg, Budzier and Lunn, (2013) also suggest that another reason developing countries such as those in SubSaharan Africa are more prone to a greater frequency and magnitude of project overrun is inflation and currency exchange, arguing that foreign currency exchange volatility which is so prevalent in developing countries can severely impact project cost due to the high dependence on foreign goods for project materials. Indeed, inflationary pressures and its concomitant impact on local currency devaluation is a common theme in infrastructure procurement overruns in Sub-Saharan Africa.

Table 1 Causes of Cost and Time Overrun from previous Studies

Group/Construct	Item	Description of item	Sources
Project Management and Contract Administration Related Factors (PMCAR)	PMCAR 1	Amendments of contracts	Mewomo1,Aigbavboa and Lesalane(2018)
	PMCAR 2	Change in the scope of the project	Enshassi <i>et al.</i> (2009), Azhar <i>et al.</i> (2008), and Harisweni (2007)
	PMCAR 3	Delays in decisions making of the consultant	Enshassi <i>et al.</i> (2009)
	PMCAR 4	Delays in decisions making of the client	Frimpong <i>et al.</i> (2003) and Memon <i>et al.</i> (2010)
	PMCAR 5	Poor project management and coordination among parties	Le-Hoai <i>et al.</i> (2008) and Azhar <i>et al.</i> (2008)
	PMCAR 6	Design changes	Memon and Rahman(2014)
Contractors Site Management Related Factors (CSMR)	CSM 1	Poor site management and supervision	Le-Hoai <i>et al.</i> (2008), Harisweni (2007) and Memon <i>et al.</i> (2010)
	CSM 2	Construction Mistake and Defective works	Le-Hoai <i>et al.</i> (2008), Omoregie and Radford (2006) and Frimpong <i>et al.</i> (2003)
	CSM 3	Inaccurate time and cost estimates	Le-Hoai <i>et al.</i> (2008), Omoregie and Radford (2006)
	CSM 4	Inaccurate planning and scheduling	Ameh <i>et al.</i> (2010), Enshassi <i>et al.</i> (2009) and Azhar <i>et al.</i> (2008)
	CSM 5	Incompetent subcontractors	Le-Hoai <i>et al.</i> (2008) and Omoregie and Radford (2006)
	CSM 6	Site hand over and right of way issues	Weyssa(2015)

Financial and Time Management Related Factors (FTMR)	FTMR 1	Cash flow and financial difficulties faced by contractors	Le-Hoai <i>et al.</i> (2008), Frimpong <i>et al.</i> (2003) and Memon <i>et al.</i> (2010)
	FTMR 2	Financial difficulties of owner	Le-Hoai <i>et al.</i> (2008), and Frimpong <i>et al.</i> (2003)
	FTMR 3	Delay in progress payment by owner	Frimpong <i>et al.</i> (2003)
	FTMR 4	Delay payment to supplier /subcontractor	Omoriegie and Radford (2006)
	FTMR 5	Poor financial control system	Ameh <i>et al.</i> (2010) and Azhar <i>et al.</i> (2008)
	FTMR 6	Poor schedule control system	Abbasi and Al-Mharmah (2000)
	FTMR 7	Contractual claims, such as, extension of time with cost claims	Enshassi <i>et al.</i> (2009)
Non-human resource related (NHR)	NHR 1	Late delivery of materials	Harisweni (2007) and Frimpong <i>et al.</i> (2003)
	NHR 2	Fluctuation of currency exchange rate and inflation	Ameh <i>et al.</i> (2010) and Enshassi <i>et al.</i> (2009)
	NHR 3	Unforeseen site conditions	Ameh <i>et al.</i> (2010), and Enshassi <i>et al.</i> (2009)
	NHR 4	Weather Conditions	Weyssa(2015)
	NHR 5	External work due to public utilities and services	Weyssa(2015)

2.5 Effects of Cost and Time Overrun

The economic effects of project cost and schedule overrun are a myriad of problems ranging from the possible loss of the economic justification for the project to constituting a strain on financing capacity to secure additional foreign as well as domestic credit facility.

Aibinu and Jagboro (2002) studied the rising dilemma of construction that Nigeria witnessed at that time and how it prevented projects to be completed on time. They conducted a survey on 61 construction projects and came out with a definition and assessment of impact of delays on the delivery of construction projects. Finally, better management procedure compound with inclusion of an appropriate contingency allowance in the pre-contract estimate were recommended as a means of minimizing the adverse effect of construction delays in Nigeria.

Aibinu and Jagboro (2002) and Flyvbjerg (2005), have identified the following effects as critical consequences of infrastructure project overruns:

I. Inefficient allocation of Scarce resources: cost and schedule overrun often lead to waste of scarce resources as about three quarters of the infrastructure projects are funded with foreign loans or donor aid funds (Mold, 2012). According to Flyvbjerg (2005) Project cost underestimation at the planning stage arising from poor forecasting techniques often misleads decision makers to buy-in on inferior projects with high overruns and low cost-benefit thereby leading to allocative inefficiency.

Cost overrun can also lead to waste when project cost spirals out of control and therefore been abandoned due to inadequate resources. This is often referred to as throwing of good money after bad project called *white elephant* projects. A particularly notorious example of cost overrun leading to wastage is the Nigerian Ajaokuta Steel plant which was supposed to be commissioned to start operations in September 1979 and reported worth over US\$ 9 billion. Over three decades have passed since the commission of Ajaokuta steel plant, yet it had still not produced any steel (The Economist, 2000).

II. Further delays and cost escalation: cost and schedule overrun can further complicate an overrun situation as often takes a lot of time to secure additional funding to cover overruns (Flyvbjerg, 2005). In some instances, project overruns may require a renegotiation of the contract as well as seek fresh approvals thereby leading to further cost and schedule overruns. This was particularly the case in the Gabonese road maintenance project where delay in the disbursement of funds led to further deterioration of the roads and thus necessitating renegotiation of an increase in the financing amount and terms of agreement (AfDB's OED, 1997). Similarly, Gratwick, Ghanadan and Eberhard (2007) reported that the 180 MW natural gas-fired Tanzanian independent power plant located on the Songo Songo islands which was completed 2004 incurred a cost overruns of 50% in budget due to delays and thus requiring additional debt restructuring of capacity payments. The authors reported that nearly 30% of the cost overrun was attributed to increase in debt interest charges arising from project delay which amounted to US\$ 100 million.

III. Contractual disputes and litigation: contractual disputes, litigation and arbitration are major effect of project overrun in Sub-Saharan Africa especially amongst public-private partnerships (Aibinu and Jagboro, 2002; Gratwick, Ghanadan and Eberhard, 2007; Kikwasi, 2012). Claims and counterclaims amongst contractual parties (usually the government agency and private investor) on whom to bear the cost of overrun as well as on the terms of the concession agreement have often led to further loss of time and revenue.

Gratwick, Ghanadan and Eberhard, (2007) reported that the 100 MW Independent Power Tanzania Limited 100 MW power project that delayed for 44 months due to disputes and litigation. The cause of the dispute was over the actual cost of the engineering and procurement construction as well as non-adherence to the contract specification by the private investor firm. Similarly, the rehabilitation of the domestic wing of the Murtala Mohammed International Airport in Lagos concession to Bi-Courtney Aviation Services Limited (BASL) ran into disputes over the actual cost incurred by the concessionaire as well as the duration of the concession. BASL claims it obtained an extension of the concession period from 12 years to 36 years to enable it recoup the over US\$ 230 million invested. However, this claim is being contested by the Federal Airport Authority in

court as there are doubts on the concessionaire spending that much amount of money (Daily Trust, 2014).

IV. Negative public perception: significant overruns on critical public infrastructure projects often generate negative public perception and suspicion of corruption and inefficiency thereby reducing the attractiveness of the investment (Ansar, Flyvbjerg, Budzier and Lunn, 2013). This is particularly the case with the Bujagali Hydro Power project in Uganda which attracted a lot of negative public outcry regarding the cost overruns amidst swelling allegation of corruption. The Bujagali Hydro Power project experience a budget increase from an estimated USD 430 million to USD 860 million by the end of March 2007 which social activist alleged was due to corruption and kickbacks but the project developers refutes this claim citing increase in the cost of metals by an estimated 90% over the last 5 years, increase in the cost of oil by 140% between 2000 and 2006 as well as a shortage of power generation equipment as the main cause of cost overrun (IRM, 2008)

V. Loss of Job and Income: Projects completed at record time and with the stipulated amount will free up resources for other usage and this will generate additional utility in the economy. The essence of any project is to create more jobs, either directly or indirectly. When projects experience overruns, it jeopardizes this desire of more jobs and income. A good example is the Ajaokuta steel company that was estimated to create 6000 jobs directly and more than 1 million jobs indirectly, which never happen.

VI. Total project abandonment: The total abandonment of infrastructure project is perhaps the worst effect of project cost and schedule overrun. Project abandonment could be temporary or for permanent duration (Aibinu and Jagboro, 2002; Murali *et. al.*, 2007). The Nigerian Abandoned Projects Audit commission report (2011) revealed that 11, 886 federal government projects were abandoned across the country over the past 40 years due to a varied number of reasons including overruns. A particularly notorious example of abandoned project in Nigeria is the Ajaokuta Steel Company which was abandoned for over three decades after incurring over US\$ 9 billion (Mold, 2012).

2.5 Partial Least Squares (PLS)

PLS-SEM is a regression based modeling approach which uses a component-based (similar to principal components factor analysis) technique in analyzing path models (Vinzi, Trinchera, & Amato, 2010).

PLS path models comprises of two sets of linear equations: the outer model also referred as measurement model and the inner model also referred as structural model. The inner model specifies the relationships between unobserved or latent variables, whereas the outer model specifies the relationships between a latent variable and its observed or manifest variables (Ringle, Sarstedt, & Mooi, 2010). PLS-SEM technique follows a systematic sequential procedure in analyzing and assessing the theoretical model.

As cited by Abusafiya and Suliman (2017), The PLS path modeling method was developed by Wold (1982), every PLS path model is formed by two sub models: the structural or inner model, and the measurement or outer model. The structural model is the part of the model that has to do with the relationships between the latent variables (E.g. cost overrun and cost overrun groups). In turn, the measurement model is the part of the model that has to do with the relationships of the latent variable and its block of manifest variables (E.g. cost overrun groups and cost overrun factors).

There are many researches done on marketing sector using PLS-SEM. In construction sector there are some studies done using this model which discussed below

Hussain, Fangwei Siddiqi and Ali (2018) studied Factors Affecting Quality of Social Infrastructure Projects using Structural Equation Model. The authors developed a quantitative approach using smart-PLS version 3.2.7. This study shed light on the views of different experts based on their experience in public construction projects in Pakistan. Particularly, the authors aimed to find out the relationships between construction, stakeholders, materials, design, and external factors, and how these relate to project quality. The findings of this study revealed that the R^2 value of the model was scored at 0.749, which meant that the five exogenous latent constructs collectively explained 74.9% of the variance in project quality. The Goodness-of-Fit of the model was 0.458. The construction related factor was the most important out of the five constructs.

Ismail , Aftab and Ahmad (2013) published a paper focused on examining the effect of various factors on budget overrun in construction projects undertaken using management procurement method in Malaysia. It adopted a quantitative method for data collection using structured questionnaire survey amongst contractors, consultant and clients. A total of 118 samples were collected against 200 questionnaires that had been distributed nationwide. Gathered data was analyzed with an advanced multivariate method of structural equation modeling with PLS approach using SmartPLS software. The major finding showed all the constructs in model contributed significantly to budget overrun with R2 value of 0.623. Also, the developed model has substantial explaining power with GoF value of 0.62.

Abam et al. (2017) assess the management of project cost overrun, reasons for cost overrun and suggested solutions in selected Public Tertiary Institutions in Lafia Metropolis using Partial Least Squares-Structural Equation Modelling (PLS-SEM). The results show that contractor's site management related factors has 97.6% effect on cost overrun, followed by non-human resource related factors with an effect of 94.4% on cost overrun. The least was information and communication technology related factors having 75.7% effect on cost overrun. The findings reveal that the PLS-SEM is a model that evaluates a data as a collective entity.

Ismail, Aftab and Ade (2013) done a study focused on studying the fundamental relationship between factors of cost overrun using Partial Least Square-SEM method. Data collection was carried out with structured questionnaire survey amongst contractors involving in large construction projects in Malaysia. Hierarchal model for assessing causative factors and cost overrun was developed and analyzed using Smart PLS software of SEM and it was found that contractor's site management related factors had strong effect on cost overrun. The calculated Global Fit (GoF) Index of model was 0.405, which indicates that the developed model had substantial explaining power to represent the Malaysia construction industry focused of large construction projects. Hence, improvement in contractor's site management is the critical requirement to control construction cost overrun.

2.7 Types of Contract and Amendment

2.7.1 Contract Types

A contract is a voluntary agreement between two or more parties that a court will enforce. The rights and obligations created by a contract apply only to the parties to the contract (i.e., those who agreed to them) and not to anyone else.(NC State University)

As cited by Weyessa (2015), a contract is defined as: "an agreement made between two or more parties which is enforceable by law to provide something in return for something else from a second party". Contracts can be very simple or they may be very long and complicated legal documents. (Emad,2004)

Construction contract types, though they are known by many titles and there are numerous variations, they fall into two fundamental categories, fixed price and cost reimbursable contracts. The element of risk, the willingness of the parties, the competition, complexity of construction, and urgency may influence the general type of contract selected. In general, cost-reimbursable contracts transfer the economic risks to the owner, while fixed price contracts place the economic risks on the contractor. (Ostwald,2001)

Fixed Price Contract

Fixed Price contract a phrase used to mean that no bargaining is allowed over the price of the goods or services included in a contract. Fixed price contracts require significantly more time in advance, for all parties involved, to determine the price of each item to be included in the contract. Additionally, each fixed-price item must be specified in an addendum to the contract in order to determine the exact value and scope of the entire project. Once a fixed-price contract has been agreed to and the contractor has begun the project, making changes to the contract and/or the materials and work specified, becomes difficult for all parties because the purpose of a fixed price contract is to establish a specified price (Weyssa,2015).

Cost reimbursement contract

A cost-reimbursement contract is a contract where a contractor is paid for all of its allowed expenses to a set limit, plus additional payment to allow for a profit. Cost reimbursement contracts contrast with a fixed-price contract, in which the contractor is paid a negotiated amount regardless of incurred expenses.

The cost-reimbursement contract is considered high risk for the government because of the potential for cost escalation and because the government pays a contractor's costs of performance regardless of whether the work is completed. As such, cost reimbursement contracts are suitable only when the cost of the work to be done cannot be estimated with sufficient accuracy to use any type of fixed-price contract.

There are several variations of cost-reimbursement contracts, the most common being cost-plus-fixed-fee. This type of contract is used when uncertainties in contract performance are of such magnitude that the cost of performance cannot be estimated with sufficient reasonableness to permit use of a fixed-price contract. In addition to the cost-plus-fixed-fee contract, there are several other kinds of cost reimbursement-type contracts.

Types of Cost-reimbursement contracts

- ✓ Cost-sharing
- ✓ Cost-plus-incentive-fee
- ✓ Cost-plus-award-fee
- ✓ Cost-plus-fixed-fee

In cost-reimbursement contracts, contractor risk is minimal and government risk is high.(Don Philpott and Scott P Cook, <http://www.governmenttraininginc.com>)

A citation on Weyessa Ewenetu (2015) puts a criterion contracts can further be classified and listed as

- Design and build
- Design build finance and operate
- Emerging cost contracts

- Engineering procurement and construction contracts (EPC) turnkey contracts
- Engineering procurement and construction management contracts (EPCM)
- Fast-track construction
- Furniture fixtures and equipment (FF&E)
- Frame work agreement
- Guaranteed maximum price
- Lump sum contract
- Measurement contracts (re-measurement or measure and value contracts)
- Traditional contract (design –bid –build) (DBB)

For many years now it seems that the most desired way for an Owner to procure a major construction project, particularly one being project financed, was via a fixed price, lump sum turnkey route; the so called engineering, procurement and construction contract (“EPC contract”). By this route, funders and owners expect to get the degree of certainty as to time and costs that they require.(Phil Loots and Nick Henchie,2007)

The type of contract selected in Addis –Djibouti railway project was the EPC turnkey form of contract having 3 sections of EPC Contracts. This form of contract, also called EPC-contract (*Engineer, Procure, Construct-Contracts*) is a form of contract where the contractor is responsible for the design and building of the project.

2.7.1.1 Engineering procurement construction (EPC) turnkey contract

The selection of contracting criteria is the key factor which determines the entire project realization. Therefore, an awareness and knowledge of the specific characteristics of possible approaches is essential. The selection of the contracting strategy is the key factor which determines the entire project realization among the various types of contracting methods some of the methods are EPC, EPC/ with long lead items, EPC and progressive lump sum (PLC). (Plither, 1992).

Description of EPC Turnkey contract

In engineering and procurement construction (EPC) contract a single point contract is awarded which comprises as the name implies engineering, procurement and construction activities. This EPC contract contemplates that a single contractor will be responsible for the entire project from design through construction and testing (Weyessa,2015).

Engineering, Procurement and Construction (EPC) Contracts are called Turn-key projects, they have a combined scope of work involving services and supplies. broadly, an EPC contract encompasses the following key activities. (Ghosh, 2010)

AS cited by Weyessa (2015) Under EPC contract a contractor is obliged to deliver a complete facility to a developer who need only turn a key to start operating the facility; hence EPC contracts are sometimes called turnkey construction contracts. In addition to delivering a complete facility, the contractor must deliver that facility for a guaranteed price by a guaranteed date and it must perform to the specified level. Failure to comply with any requirements will usually result in the contractor incurring monetary liabilities.

The basic concept behind a design/build construction contract can best be understood by comparing it to a traditional construction contract. The typical contract involves a three-party arrangement between an owner, design professional and contractor. The owner hires a design professional to design the structure and then the contractor to construct the project according to the design plans and specifications. In so doing, the owner warrants the sufficiency of the plans and assumes any liability for defects for them to the contractor.

The contractor is then responsible for defective construction and workmanship, but is free from any liability for design defects. The design professional, while responsible for design, does not assume any liability for effective construction, other than for his failure to detect such defective construction as should have been obvious to him through the course of his field services rendered during the construction operations. (Alexander et al 2010)

By contrast, in a design/build contract, the owner enters into a single agreement by which the design/build contractor agrees to perform both the design and construction of the project. In some instances, the contractor may also agree to be responsible for acquiring land, financing the project and leasing the finished structure. This more comprehensive arrangement is often referred to as a “turnkey” contract. In either a design/build or turnkey arrangement, the contractor’s objective is to satisfy the owner’s broad performance specifications rather than to adhere rigidly to the design professional’s plans and specifications. As well as being responsible for faulty workmanship in construction, the contractor is also liable for any deficiencies in design under this arrangement. (Alexander et al, 2010)

Key characteristics of an EPC contract

- Single point of responsibility for performance of the works, communication and coordination remains with the contractor.
- Guaranteed completion date, performance and firm contract price
Clear division of obligation and liabilities
- High contract price due to mark ups: contract price may be inflated as the EPC contractor and due to the initial engineering phase.
- Full dependence on the contractor

Advantages of an EPC contracts

- The contractor bears the risk of integrating the performance of all package contractors, including designers
- The contractor bears supply chain solvency risk
- The transfer of other construction risks is maximized relative to other procurement methods
- A high degree of certainty (on paper) can therefore be attained as to cost, time and quality
 - Administrative burdens on the owner are minimized
- The documentation is relatively simple and standardized

Disadvantages of EPC Contracts

- Cost – contractors will add a substantial risk premium to the price

- Control – the contractor controls the detailed design and construction process
- Quality – the contractor will aim for the minimum compliant standard
- Bidder resistance – EPC has been unpopular among some contractors (though market conditions are rapidly changing)
- Employer has little control over the quality of construction more risk of latent defects and high maintenance costs

Conditions of contract for EPC /Turnkey project

These Conditions of Contract are intended for use where one entity (the Contractor) provides a fully equipped facility ready for operation at the ‘turn of the key’. The Employer is required to provide a fully descriptive document specifying precisely what is to be built and to what standards.

In defining the Employer’s Requirements, the employer may provide preliminary drawings, site data, and technical requirements including specifications. The Employer’s Requirements may also contain requirements for specified outputs from the completed facility. (Michael, 2011). Which may be suitable for the provision on a turnkey basis of a process or power plant, of a factory or similar facility, or of an infrastructure project or other type of development where. (Conditions of Contract for EPC/Turnkey Projects, First Edition 1999)

Conditions of contract circumstances suitable in EPC/Turnkey projects

-A high degree of certainty of final price and time is required

-The contractor takes total responsibility for the design and execution of the project with little involvement of the employer. Under the usual agreement for turnkey projects, the contractor carries out all the engineering, procurement and construction (EPC): providing a fully – equipped facility, ready for operation. (at “Turnkey”).

Conditions of contract for EPC/Turnkey projects which are not suitable for use in the following circumstances.

-If there is insufficient time or information for tenders to scrutinize and check the employer’s requirements or for them to carry out their design, risk assessment studies estimating (taking particular account of sub-clauses 4.12 and 5.1)

-If the employer intends to supervise closely or control the contractors 's work, or to review most of the construction drawings

-If the amount of each interim payment is to be determined by an official or other inter

Contractual conditions that impact contract cost in engineering procurement construction contracts (EPC).

Risk: - According to EPC contract first edition 1999 the contractor shall take full responsibility for the care of the works and materials and plant from the commencement date until the date of completion and turn over.

Variations: - EPC contracts generally attempt to limit any opportunity by the contract to claim for additional cost. However, the acceptance of variation may achieve a lower contract price and impart flexibility to the contract in dealing with risks and contingencies.

Force Majure/ Unforeseeable Difficulties: -The contractor accepts total responsibility for having foreseen all difficulties and cost of successfully completing the works, the contract price shall not be adjusted to take account of any un foreseen difficulties or costs

2.7.2 Amendment

Amendments are official changes of costs and/or schedules in the contract. In the owner's internal process, the reasons for changes have to be stated and attached as a backup when requesting an amendment. After the amendment is approved, a formal amendment stating the new work scope, cost, and time will be signed by the owner and consultant. (Andrew, Asce,2002)

Standard forms are perceived to be a fair and equitably balanced allocation of risks and power between the parties to construction contracts. Ramus, Birchall and Griffiths (2006: 52) earlier defined the standard forms of contract as "... a form that is developed to provide formal, predetermined arrangements and mechanisms to cope with the situations that can arise during the course of a construction project". They are specifically developed to offer a pragmatic approach to solving construction issues (Cunningham, 2013). In order to achieve its purpose, amendments to its contents should be kept to a minimum. ICE (2017) has noted the fact that complex interaction exists between many of the clauses within the standard forms. Therefore, any modification to the clauses should be carried out with care and by a specialist with good knowledge of construction and law of contracts.

Key Drivers of Amendments to Standard Forms of Contract

- Altering risk allocation
- Inserting additional obligation
- To correct something which is not applicable or should not exist
- Increased ease of contract administration
- Removing rights
- To reflect regulatory requirements (e.g. residential building legislation)
- Method of payment
- Form perceived to be poorly drafted

The above variable/key drivers are ranked top to bottom. The result shows that "altering risk allocation" is the most important key driver for making amendments to the standard forms of contract. This was similarly the case observed in Australia as reported by Sharkey et al. (2014). According to this report, 84% of the contract which employed a standard form were amended from the relevant published form. In addition, the need to

shift risk was identified as the main reason for amendment. In fact, a survey by the Royal Institute of Chartered Surveyors (RICS) as reported by Cartlidge (2013) also noted "altering risk allocation" and "inserting additional obligation" as some of the reasons for making amendments to the standard forms of contract.

Generally, the complexity and uncertainty involved in the construction process make it prone to high levels of risk. As such, many clients or their advisers modify the standard forms to meet the demands of the varying nature and unique characteristics of their project. Whilst it is understandable that certain situations can make alteration to the terms and condition of standard forms inevitable. (Modupe, Aigbavboa and Portia,2018)

2.8 Description of Addis- Djibouti Railway Project

The project contains engineering works of on SEBETA-Djibouti/NEGAD and in the port, and is divided in to three EPC contract sections. Detail of the project as follows:

Railway Length

I. SEBETA-NAGAD Section has the total length of main line as about 750.224km; there are three respective EPC Contract sections.

The first EPC contract section: SEBETA-MIESO(Included) section, with main line of 329.065km, among which SEBETA-ADAMA section of about 113.836km is double-track section, ADAMA-MIESO(Included)section of about 215.229km is single track one.

II. The second EPC contract section: MIESO (excluded)-DAWANLE (an Ethiopian city in the border between Ethiopia and Djibouti) section has a track length of 339.182km.

III. The third EPC contract section: DENWALE (excluded)-NEGAD (Front port station in Djibouti) has a track length of port railway is about 11km.

Main Control Points along the line

The New Standard–Guage railway of SEBETA-DJIBOUTI starts from SEBETA, Which from SEBETA, Which is located in the South west of Addis Ababa, extends eastward via LABU,INDODE,GELAN,DUKEM,BISHOFTU,MOJO,ADAMA,WELENCHITI,METEHARA, AWASH,ASEBOT,MIESO,MULU,AFDEM,BIKE,GOTA,DIRE DAWA,DEWANLE and the enters to the territory of Djibouti, then, it passes through GUELILE,HOLHOL and ends at NAGAD.

2.8.1 Main Technical Standards

Table 2 Major Technical parameters

Item	Value	Note
Number of Main Lines	SEBETA-ADAMA (included) is double track with distance between centers of tracks of 4.0 m, other sections are single track ones	Ballasted track
Target speed value	Passenger train: 120km/hr; Freight train:80 km/hr	
Minimal radius of Curve	1200m in normal condition,800m in difficult condition	
Maximum grade	Ruling grade:9%,pushing grade:18.5%	
Algebraic difference of maximum grade	12%	
Sugrade width	7.7m for single track ,11.7m for double track	
Gauge	1435mm	
Rail	50kg/m,25m standard gauge	
Type of traction	Electric Power	
Type of locomotive	Passenger train: HXD 3C series; Freight train :HXD 3B series	AC-DC-AC
Traction Mass	3500t	
Length of arrival departure track	850m for single – locomotive (880m for dual-locomotive)	
Communication Transition system	SDH 2.5 Gb/s(1+1) MSP main layer SDH 6.5 Gb/s(1+1) MSP access layer	New laid GYTA5332B1
Block type	Semi-automatic Block	Cable

SEBETA-MEISO

The Main line is 329.065 km long. SEBETA-ADAMA section is new double track one, where subgrade length is 89.816 km in section and 12.2km in station, the subgrade length for the main line is 102.02km, accounting for 89.062% of the total length. ADAMA-MEISO section is new single track one, where subgrade length is 199.91km in section and 8.7km in station, the subgrade length for the main line is 208.61km, taking up 97.75% of total track length. SBETA-MEISO section has a subgrade length of 289.72km in section and 20.9km in station, and a subgrade length for the mainline of 310.62km, accounting for 94.92% of total length. The rest are bridges and culverts, taking up 5.08% of the whole line. There is no tunnel.

In this section, there are altogether 37.9385 m³ earthworks and rockworks for sectional subgrade 4.7123 m³ for station and 94,485 m² for temporary facilities. The main line extends about 329.065 km, the actual length is 437.53km, and the tracks in stations and yards extends 35.59km, so total track length amounts to 473.12km.

The SEBETA-MIESO (Included) section has 19 stations. SEBETTA-ADAMA(Included) long 113.836km long and having 7 stations with average distance between two stations as 16. 26km.ADAMA(Excluded) –MIESO(Included) section is single track, totaling 215.229km long and having 12 stations with average distance between two stations as 17. 78km.In the initial stage ,10 stations will be constructed, conditions are reserved for construction of 1 station in short term and 8 in long term.

MEISO-NEGAD and Port railway in Djibouti

The main line is 412.159km long. Subgrade length is 382.268km in section and 16.3km in station, the subgrade length for the main line is 389.568km, accounting for 96.70% of the total track length. The rest are bridges and culverts, taking up 3.30% of the whole line. There is no tunnel in Mieso -Dawanle section; there are altogether 20.6297 million m³ earthworks and rockworks for sectional subgrade, 1.4357 million m³ for station and 30,000 m² for temporary facilities. In Dewanle- Negad section, there are altogether

11.8978 million m³ earthworks and rockworks for sectional subgrade and 21,915 m² for temporary facilities.

In this line additional two sections of port railway in Djibouti are 13. 805km. Thus the track length of this section is about 430km, track length in stations and yard is about 32km, so the total track length amounts to about 462km, and the length for the main line reaches about 430km.

MIESO (Excluded) –NAGAD (Included) has 26 stations in total. MIESO (Excluded) - DAWANLE (Included) section is single track, totaling 339.014km long and having 21 stations with average distance between two stations being 15. 91km. DAWANLE (Excluded)-NAGAD (Included) section is single track, totaling 81.977km long and having 5 stations with average distance between two stations being 16. 4km. In the initial stage, 10 stations will be constructed, conditions are reserved for construction of 4 stations in short term and 13 in long term.

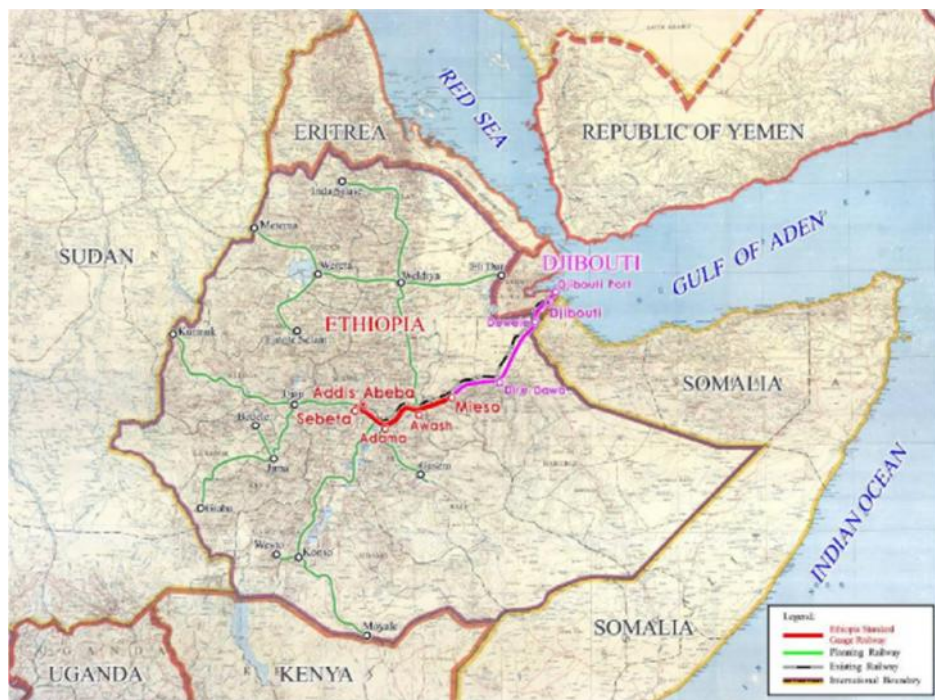


Figure 3 Map of Addis –Djibouti line

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This section describes the procedures undertaken to achieve the research objectives. The procedures adopted, including all the information relevant to the data collection and where those data were obtained are discussed. In addition, data and information sources, research instruments, sample size and method of analysis are presented.

3.2 Research Design

The strategy followed in carrying out the research was started with problem identification which has been done through unstructured literature review, formal and informal discussions with professionals in the sector and archival study; and then the research design was formulated.

Following this approach, information sources were determined based on the formulated research design. On the basis of the data and information sources the research instruments were decided; and available document sources relevant to the research were reviewed. The review includes journals, articles, e-books, and archival documents such as contract agreements, minutes of meeting, contractor's technical proposal, contractor's financial proposal, employer's requirement, Final evaluation report of the feasibility study, monthly progress reports of contractors and Project management monthly report of the client representative. In addition to this different literatures and software tutorials are studied to adopt the partial least square structural equation modeling (PLS-SEM) for this research.

In consideration of the nature of the research question, both quantitative and qualitative research method was selected for this study as the research questions relates to causal factor analysis and observational characteristics.

The research was carried out having a three phased approach in order to achieve the aims and objectives of the research. It was attempted to collect data from the employer(ERC),

the client representative (CIECC) and the two contractors engaged in the project consulting firms, and contractors) to assess the cost and time overrun aspects of Addis Djibouti railway project.

After a literature in-depth review and desk study, a questionnaire was designed and distributed to contractors, client representative and the employer to get their professional responses for the research questions.

3.3 Research Sampling and Sample size

The research populations are the contractors, client repetitive and employer of Addis-Djibouti railway project. In this research non probabilistic purposeful sampling method used for questionnaire survey due to the nature of the research questions requiring familiarity, the need for obtaining valid information from the actual respondents and the fact client's involvement in EPC turnkey are less to address the key professionals engagement in the research.

Sample size determination is done using GPower software. GPower version three (Buchner et al, 1997) is a program that allows high-precision power and sample size analyses. It computes power values for given sample sizes, effect sizes, and alpha levels (post hoc power analyses), sample sizes for given effect sizes, alpha levels, and power values (a priori power analyses), and alpha and beta values for given sample sizes, effect sizes, and compromise power analyses(Joseph and Gardner,2007).

Effect size, error probability, Power (1- err prob.) and Number of predictors are an input for the program to calculate the sample size. The test family selected for this research is t-test of Linear multiple regression. Effect size is a way of quantifying the difference between two or more groups and effect size determination is critical point which is based on how it is anticipated by the researcher.

Large effect size results to small sample size and to the reverse small effect size of the difference may be negligible in PLS algorithm which is not reliable in True effect. (Joseph and Gardner,2007). Due to this, in this research standardized medium effect size is used i.e. 0.5 for t-statistical test, alpha=0.05 and power=0.8.

Table 1. Standardised effect sizes for common statistical tests, alpha=0.05, power=0.8

Statistical test (symbol for effect size)	Small effect	Medium effect	Large effect
Student's t-test (<i>d</i>)	0.20	0.50	0.80
ANOVA fixed effects one way (<i>f</i>)	0.10	0.25	0.40
Chi-square goodness of fit (<i>w</i>)	0.10	0.30	0.50

Figure 4 Standardized effect sizes for common statistical tests (Joseph and Gardner,2007)

Inserting Effect size, error probability, and Number of predictors as an input for the program as shown in the above figure and to improve the sample size the Power (1- err prob) taken as 99%. The Sample size of was 34 obtained from the program.

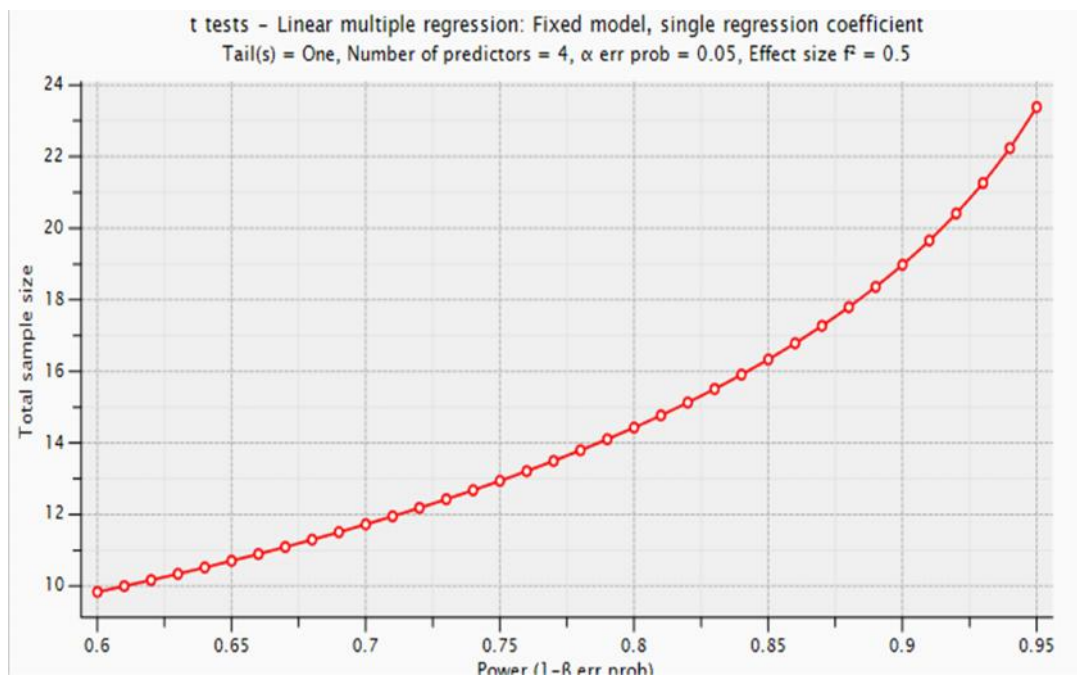


Figure 5 Sample size from Gpower Software

3.4 Data Collection

3.4.1 Primary Data

The source of the primary data was collected through distributing an open ended questionnaire through email and in person. The primary objective of the survey was assessing the presence or absence of cost and time overrun. The Second objective was to identify the main cause factors of cost and time overrun if the Addis –Djibouti railway project faced cost increment and delay during its implementation.

3.4.1 Secondary Data

The secondary data was gathered through reviewing related literatures for questionnaire designing and archival documents such as contract agreements, minutes of meeting, contractor's technical proposal, contractor's financial proposal, employer's requirement, Final evaluation report of the feasibility study, monthly progress reports of contractors and Project management monthly report of the client representative were studied to actual project data and these were included with the survey result in the Analysis and Discussion chapter.

3.5 Method of Analysis

The results of the questionnaires were analyzed using statistical techniques and the results used to form the basis for recommendations as well as areas for further research. The methods of analysis used in analyzing the data were: Importance Index (RII) and PLS-SEM based Cause factors modeling. This was followed by thorough discussions in order to draw a conclusion and to forward recommendations based on the findings of the study.

3.5.1 Relative Importance Index (RII)

Relative important index method is adopted to establish the relative importance of major impacts of cost and time overrun in Addis-Djibouti railway project. Rating scale is one of the most common formats for questioning respondents on their views or opinions of an event or attribute. In this research, a five point (1= Not Significant (NS) ,2= Slightly Significant (SS) , 3= Moderately Significant (MS, 4 = Very Significant (VS) and 5 = Extremely Significant (ES) Likert scale was used to assess the degree of

impact of cost and time overrun. It is used to calculate the importance index for each factor that is used to determine the relative ranking.

$$RII = \sum \frac{W}{A * N} \dots \dots \dots \text{Equation 1}$$

Where: -

W = weighting given to each impact by the respondents and ranges from 1 to 5 where '1' is Not Significant ' ' and '5' is very Significant,

A = highest weight (i.e. 5 in this case), and
N = total number of respondents.

3.5.2 PLS Structural Equation Modeling (PLS-SEM)

3.5.2.1 Why PLS?

The advantages of PLS include ability to model multiple dependents as well as multiple independents; robustness in the face of data noise and missing data; and creating independent latent variables directly on the basis of cross-products involving the response variable(s), making for stronger predictions.

PLS is a soft modeling approach to SEM with no assumptions about data distribution (Vinzi et al., 2010). Thus, PLS-SEM becomes a good alternative to Covariance based SEM when the following situations are encountered (Bacon, 1999; Hwang et al., 2010; Wong,2010):

1. Sample size is small.
2. Applications have little available theory.
3. Predictive accuracy is paramount.

PLS may be implemented as a regression model, predicting one or more dependents from a set of one or more independents; or it can be implemented as a path model, handling causal paths relating predictors as well as paths relating the predictors to the response variable(s). PLS is implemented as regression model by SPSS and by SAS's PROC PLS. SmartPLS is the most prevalent implementation as a path model(Garson,2016).

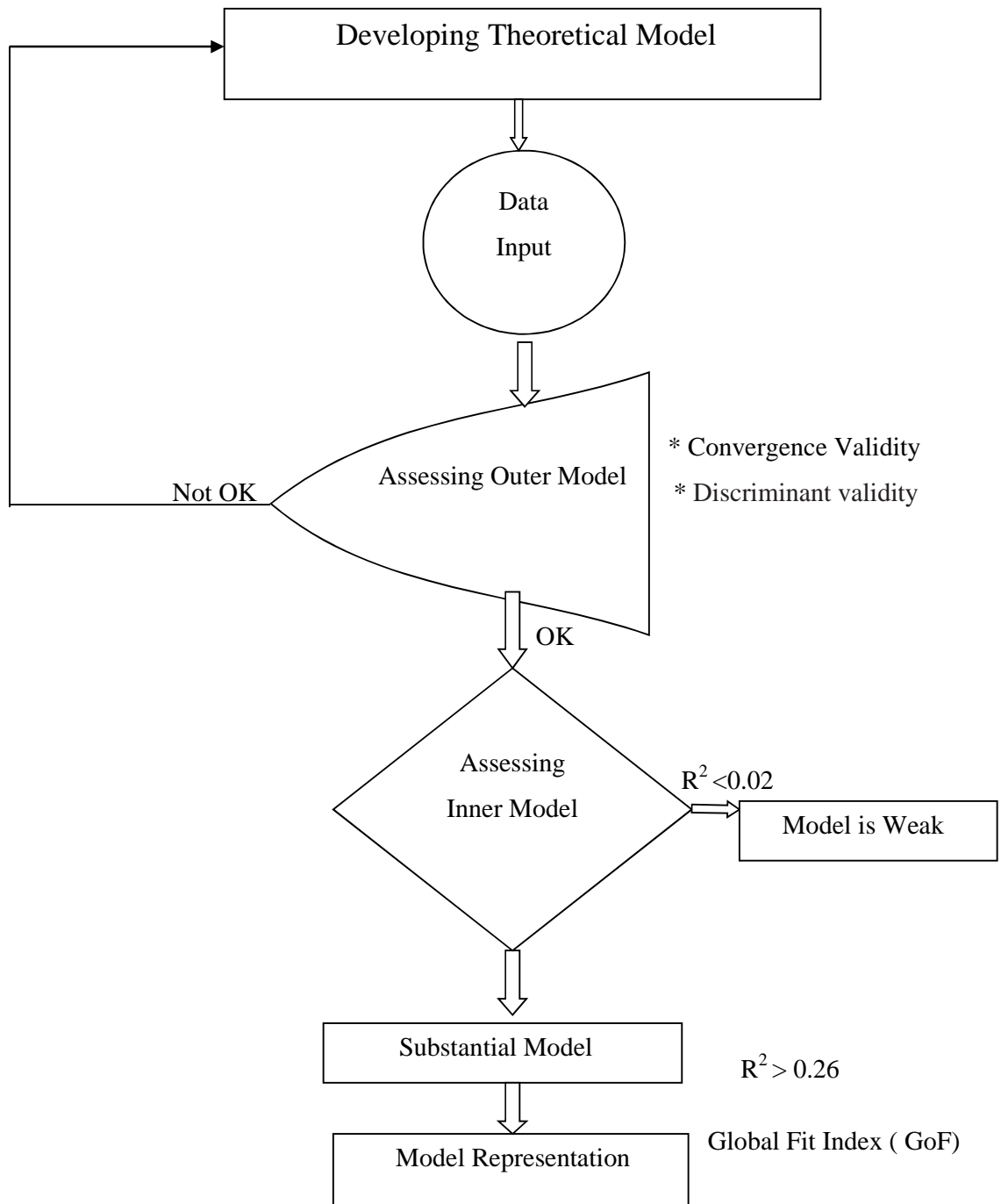


Figure 6 Schematic Diagram of PLS-SEM Analysis

The PLS algorithm aims at estimating the values of latent variables; it is essentially a sequence of regressions in terms of weigh vectors. The weight vectors are obtained when convergence satisfies fixed point equations. The basic PLS algorithm, as suggested by Lohmöller (1989), includes the following two stages: Stage 1 is the iterative estimation of latent variable scores, consisting of a 4-step iterative procedure that is repeated until convergence is obtained or the maximum number of iterations is reached. Stage 2 is the estimation of the path coefficients; this is how smartpls software works

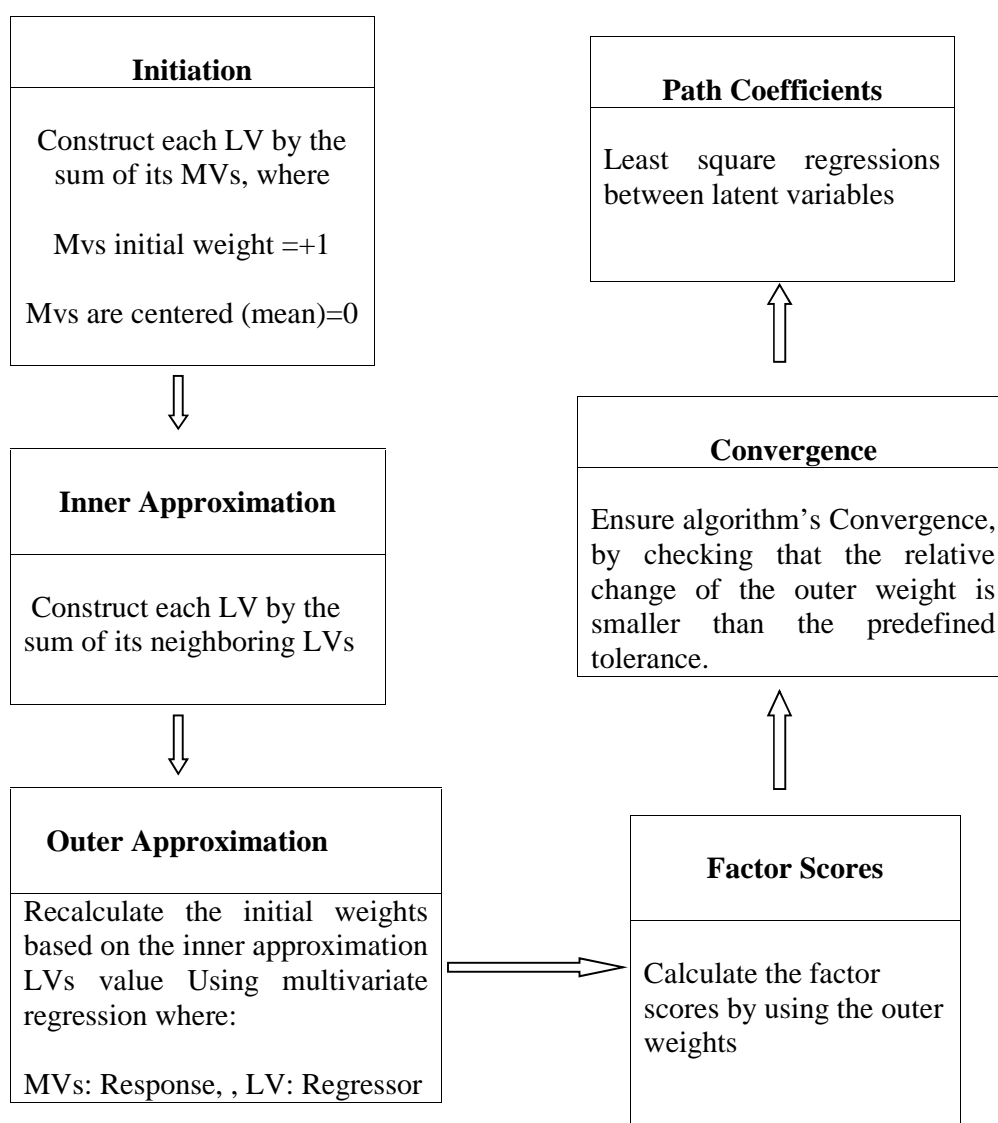


Figure 7 The Flow chart for PLS algorithm

3.5.2.2 PLS Procedural Methods

3.5.2.2.1 Develop Theoretical Model and Data Input

A complete theoretical model for evaluation is developed based on 24 factors affecting cost and time overrun. Theoretical model defines the causal relationships between the factors of project overrun, to assess their effect on cost overrun or time overrun. In this two independent model for cost and time overrun were formulated. This model is drawn in SmartPLS V3 software for simulation process. Input data to this model was done through note pad (*.txt) file format which contains the respondent's input from the questionnaire survey.

3.5.2.2.2 Evaluation of Outer Model

Evaluation of the outer model (measurement model) is to examine the reliability and validity of the constructs of the model (Hulland, 1999). It determines how well the indicators (specific questions) load on the theoretically defined constructs. This can be carried out in two stages as:

A) Convergent validity of the measures (Hulland, 1999).

B) Discriminant validity of the research instruments (Gefen, Straub & Boudreau, 2000)

A) Convergent validity of constructs

Convergent validity is the measure of the internal consistency. It is estimated to ensure that the items assumed to measure each latent variable measures them and not measuring another latent variable (Fornell & Larcker, 1981; Hulland, 1999).

Convergent validity of the construct can be determined by calculating individual item reliability, Cronbach's alpha, Composite reliability (CR) and Average Variance Extracted (AVE) as suggested by (Aibinu, Ling & Ofori, 2011)..

Individual Item Reliability is the extent to which measurements of the latent variables measured with multiple-item scale reflects mostly the true score of the latent variables relative to the error.

It is assessed by calculating standardized loadings of each variable where items with loadings of less than 0.4 should be dropped (Hulland, 1999) while (Chin, 1998) suggested that item with loading lower than 0.5 should be dropped.

Cronbach's Alpha is the coefficient of reliability (or consistency). It measures how well a set of items (or variables) measures a single one dimensional latent construct. (Litwin, 1995) suggested that value of cronbach alpha should be higher than 0.7.

Composite Reliability (CR) measure is used to check how well a construct is measured by its assigned indicators. However, the interpretation of composite reliability score and Cronbach's Alpha is same. (Chin, 1998; Hair, Ringle, & Sarstedt, 2011) suggested 0.7 as a benchmark for 'modest' composite reliability.

Average Variance Extracted (AVE) test is used to assess internal consistency of the construct by measuring the amount of variance that a latent variable captures from its measurement items relative to the amount of variance due to measurement errors (Fornell & Larcker, 1981).

A basic assumption is that the average covariance among indicators has to be positive. Barclay, Thompson, and Higgins (1995) and Hair et al., (2011) stated that AVE should be higher than 0.5. This means that at least 50% of measurement variance is captured by the latent variables.

B) Discriminant validity of constructs

Discriminant validity indicates the extent to which a given construct is different from other constructs (Hulland, 1999). It is tested through analysis of average variance extracted by using the criteria that a construct should share more variance with its measures than it shares with other constructs in the model (Fornell & Larcker, 1981). This is examined by comparing the AVE of construct shared on it and other constructs. For valid discriminant of construct, AVE shared on it should be higher than variance shared with other constructs (Chin, 1998).

3.5.2.2.3 Evaluation of Inner Model

Inner model (structural model) evaluation is carried out to assess the relationship between exogenous and endogenous latent variables in respect of variance accounted (Hulland, 1999).

It also determines the explanatory power of the model by evaluating squared multiple correlations (R^2) and path co-efficient () values, where R^2 indicates the percentage of a

construct's variance in the model, whilst the path coefficients indicate the strengths of relationships between constructs (Chin, 1998).

According to (Cohen,1988; Cohen, Cohen, West, & Aiken, 2003) R^2 of endogenous can be assessed as substantial =0.26, moderate =0.13 and weak=0.02 while for path coefficient assessment, value of all structural paths is compared, highest value indicates that effect of the construct is most significant and lowest value shows the lowest effect of construct on endogenous latent variable

3.5.2.2.4 Performance of Model

Performance of the developed model was assessed with two-step process as (i) outer model evaluation to examine the reliability and validity of the construct, and (ii) inner model evaluation to assess the relationship between exogenous and endogenous latent variables (independent latent variables and dependent variable) in respect of variance accounted for (Hulland, 1999).

3.6 Data coding

While analyzing the questioner the author has coded factors (research variables). The coding is according the sequential arrangement on the questioner. First, the group of variables (exogenous latent variables) has been coded taking the first letter of the group name e.g. Project Management and Contract Administration related factors coded as (PMCAR) and the variables under this group coded according to their sequence like Amendments of Contracts (PMCAR 1), Change in the scope of the project (PMCAR2) and Delays in decisions making of the consultant (PMCAR 3).

For the analysis of major Impacts of the cost and time overrun of the Addis-Djibouti railway project. Coding for major impact taken as MI and MI1, MI2, M3 were coded for major impacts listed in the questionnaire in their sequential manner. For assessment of Time management coding like TA1 which T stands for Time Management, A for the sequential functional group of tools and techniques and 1 for the number of the tool or technique in the group, this coding style also used for Cost Management assessment like CA1 and its can be understood with the same meaning as Time management coding.

CHAPTER 4

ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the contents of the questionnaire findings and the archival facts of different documents of the project. The questionnaire used to identify the presence of cost overrun and time overrun, to model the main causal factors with Partial least square Structural Equation Modeling (PLS-SEM) for both cost and time overrun independently, to rank the major impacts of cost and time overrun in Addis- Djibouti railway Project and assess mitigation measures being used to avoid the occurrence of cost and time overrun for future railway projects.

The questionnaire survey was conducted being inclusive of key professionals from major stakeholders of the project, these are the client (ERC), the client representative (CIECC), and the contractors (CREC and CCECC).

Prior to final questionnaire distribution a pilot study was conducted with 5 respondents from the sector to get feedback on contents of the questionnaire and after its enhancement a total of 34 questionnaires were distributed, 14 for the ERC), 10 for CIECC, and 10 for contractors (CREC and CCECC) in respect to their direct relation to the project, the objective of the research and the project contract i.e. EPC Turnkey.

4.2 Analysis of Questionnaire Response

To perform a comprehensive study on assessment of the presence, causal factors and impacts of cost and time over run Addis-Djibouti railway project a total of 34 respondents were selected after Pilot study was conducted and the questionnaire get advancement; those of 34 respondents were comprised of office engineers, claim experts, section managers, contract administrators and project managers.

Among out of those 34 respondents 30 questioners were collected giving a response rate of 88.24 % and from 30 questioners which were collected 2 questioners were found to be invalid due to lack of full information given by the respondents. Therefore, valid

response rate of 82.35% is obtained. On the basis of these 28 questioners analysis was conducted to determine the presence of the project overrun and model the causal factors that attribute for cost and time overrun.

Table 3 Questionnaire response rate

Respondents Category		Questioner Distributed	Questioner Received	Percentage Collected	Valid Response	Valid Response Rate
Client		14	13	92.86%	12	85.71%
Client Representative		10	10	100%	9	90%
Contractor	CREC	5	4	80%	4	80%
	CCECC	5	3	60%	3	60%
Total		34	30	83.22%	28	78.93 %

4.2.1 Respondents Academic Background and Work Experience

The purpose of section one was to know the educational and professional capability of respondents under this survey.

The survey result shows that among 12 respondents of ERC workers 12 of them hold MSc. degree and 1 only 1 respondent have BSc. degree which is 91.67 % of them hold second degree. From CIECC 6 of them were with MSc. degree and the rest 3 were with BSc. (i.e. 33.33 % of the client representative respondents). The CREC respondents have 2 Msc. and 2 BSc. Whereas the CCECC respondents have 2 MSc. and only 1 BSc. Holder. In other word 50 % and 66.67% of respondents were with second degree from the two contractors respectively.

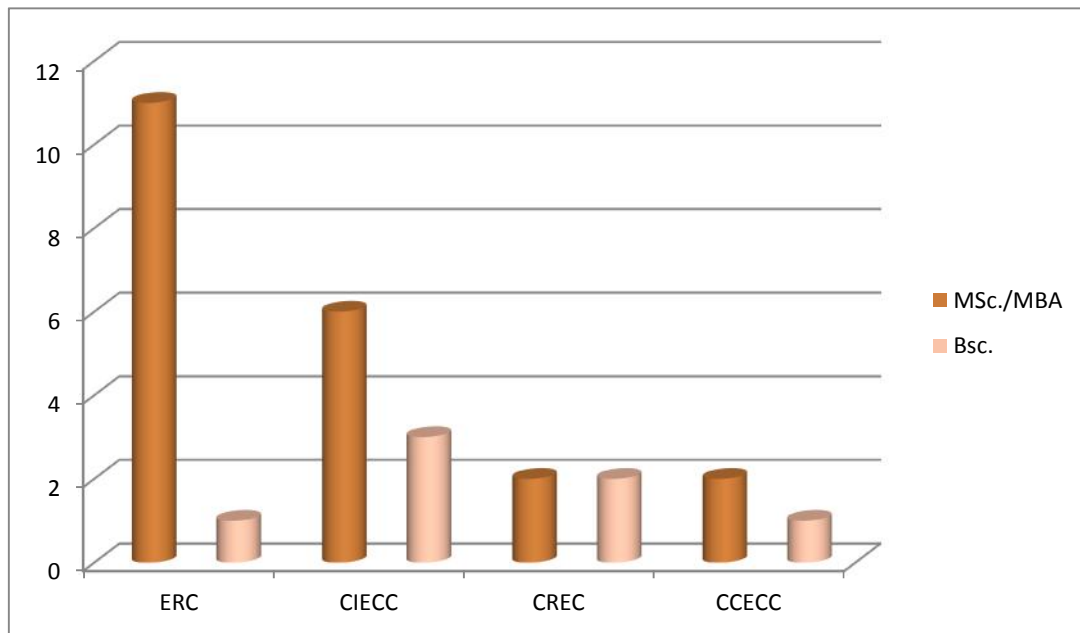


Figure 8 Academic background of respondents

The work experience of the respondents presented as follow, which implies that most respondents have a 5 – 10 years work experience.

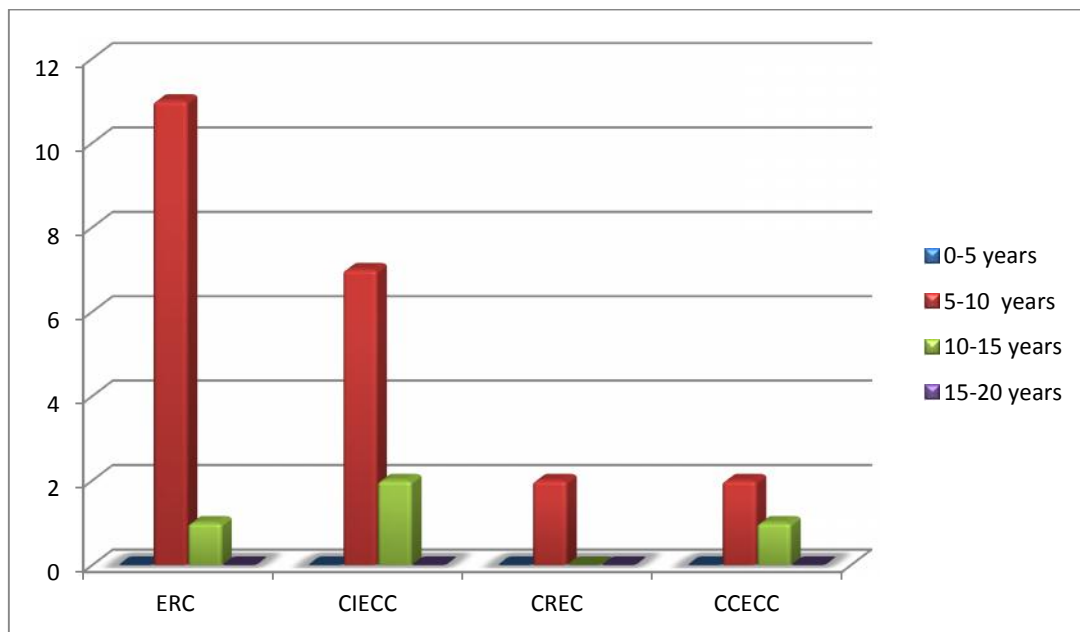


Figure 9 Work Experience of the respondents

4.3 PLS Assessment of the questionnaire for Cost overrun

4.3.1 Model Development

In order to assess the most influential causes of cost overrun, reflective construct was adopted. A hierarchal model based on groups and items identified in Table 1 showing relation to endogenous latent variable i.e. cost overrun.

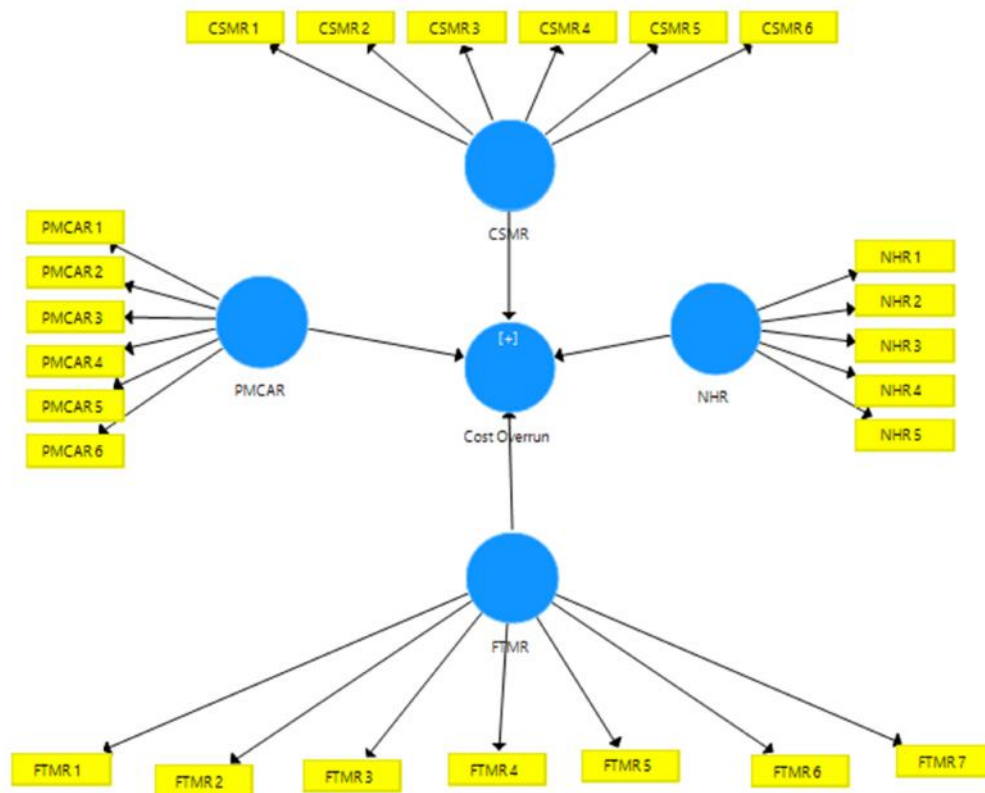


Figure 10 Theoretical Model of Cost overrun assessment in Smart Pls

In the above theoretical model, the items represented in yellow are indicators of the model which are the cost overrun cause factors which the data was drawn from the conducted survey. The middle circles named such as PMCAR, CSMR, FTMR and NHR are exogenous latent variables which are group/constructs of the indicators and the main latent variable to be assessed is cost overrun which in the model represented as endogenous latent variable.

4.3.2 PLS Algorithm Results for Cost Overrun

The first step for successful model was linking the indicators and latent variables together, and then the path modeling procedure can be carried out. The statistical software application SmartPLS 3.0 was used to compute the PLS path model, and assess the strength of each factor affecting cost overrun through the developed model. The indicators of cost overrun in construction are correlated and interchangeable, all arrows are pointing outward; which means they are reflective.

In the PLS-SEM diagram there are two types of numbers: the number in the circle which shows how much the variance of the latent variable is being explained by the other latent variables; and numbers on the arrows, these are called the path coefficients, they explain how strong the effect of one variable is on another variable. The weights of different path coefficients enable the ranking of their relative statistical importance. The results of the first iteration shown as follows

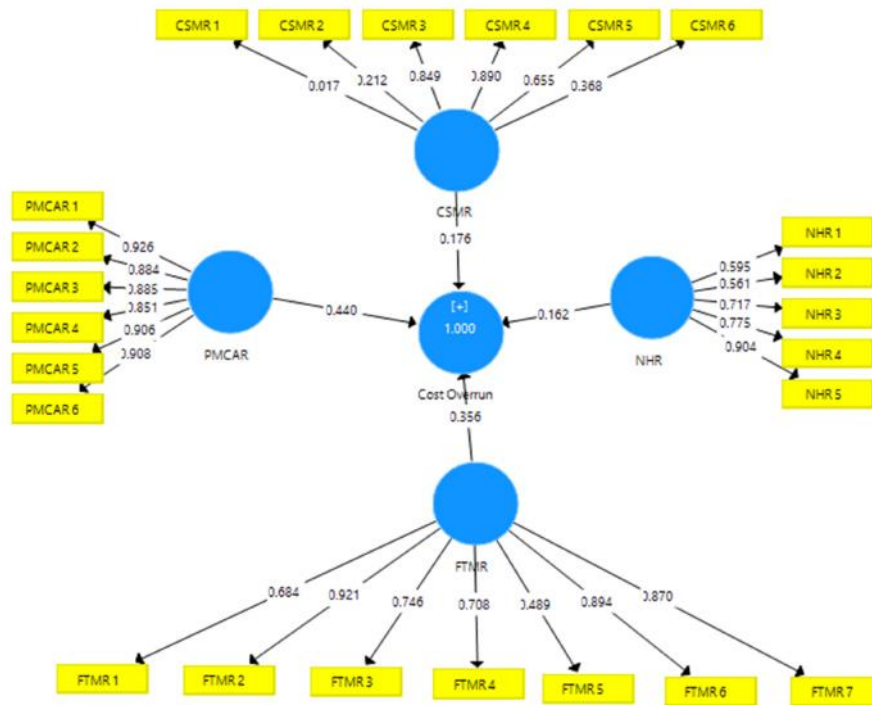


Figure 11 Results of PLS Algorithm for Cost overrun (Iteration 1)

The PLS algorithm sequence ensures that reliability and validity of measures of constructs are ascertained before attempting to draw conclusions about the nature of the relationships between constructs (Aibinu et al., 2011). To ensure reliability and validity of the measures, first the measurement model assessment is done and then the structural model assessment follows.

4.3.3 Measurement Model Assessment for Cost Overrun

I. Individual item reliability and convergent validity:

To evaluate individual item reliability, the standardized loadings (or simple correlation) should be reviewed, and perhaps dropped since they would add very little explanatory power to the model were assessed.

Table 4 Individual factor reliability and convergent validity of outer Model (Iteration 1)

Construct	Item	Loading	AVE	CR	Alpha
PMCAR	PMCAR 1	0.926	0.798	0.960	0.949
	PMCAR 2	0.884			
	PMCAR 3	0.885			
	PMCAR 4	0.851			
	PMCAR 5	0.906			
	PMCAR 6	0.908			
CSMR	CSMR 1	0.017	0.354	0.698	0.483
	CSMR 2	0.212			
	CSMR 3	0.849			
	CSMR 4	0.890			
	CSMR 5	0.665			
	CSMR 6	0.368			
FTMR	FTMR 1	0.684	0.483	0.909	0.878
	FTMR 2	0.921			
	FTMR 3	0.746			
	FTMR 4	0.708			
	FTMR 5	0.489			
	FTMR 6	0.894			
	FTMR 7	0.870			
NHR	NHR 1	0.595	0.520	0.840	0.757
	NHR 2	0.561			
	NHR 3	0.717			
	NHR 4	0.775			
	NHR 5	0.904			

A common threshold for reliability is that the items with outer loading higher than 0.7 should be considered highly satisfactory (Hulland, 1999; Henseler *et al.*, 2009; Gotz *et al.*, 2010) and for items with loading between 0.4 to 0.7 practical potential significance should be assessed prior to elimination. If an indicator’s reliability is low and eliminating this indicator goes along with a substantial increase of composite reliability, it makes sense to discard this indicator (Henseler *et al.*, 2009)

Composite Reliability scores (CR), Cronbach’s alpha and Average Variance Extracted (AVE) tests were used to determine the convergent validity of measured constructs with cut-off value for AVE, CR and Cronbach’s Alpha were 0.5, 0.7 and 0.7, respectively.

Table 5 Individual factor reliability and convergent validity of outer Model (Iteration2)

Construct	Item	Loading	AVE	CR	Alpha
PMCAR	PMCAR 1	0.926	0.798	0.960	0.949
	PMCAR 2	0.884			
	PMCAR 3	0.885			
	PMCAR 4	0.851			
	PMCAR 5	0.906			
	PMCAR 6	0.908			
CSMR	CSMR 1	Omitted	0.666	0.855	0.750
	CSMR 2	Omitted			
	CSMR 3	0.858			
	CSMR 4	0.903			
	CSMR 5	0.669			
	CSMR 6	Omitted			
FTMR	FTMR 1	0.684	0.595	0.909	0.878
	FTMR 2	0.921			
	FTMR 3	0.746			
	FTMR 4	0.708			
	FTMR 5	0.489			
	FTMR 6	0.894			
	FTMR 7	0.870			
NHR	NHR 1	0.595	0.520	0.840	0.757
	NHR 2	0.561			
	NHR 3	0.717			
	NHR 4	0.775			
	NHR 5	0.904			

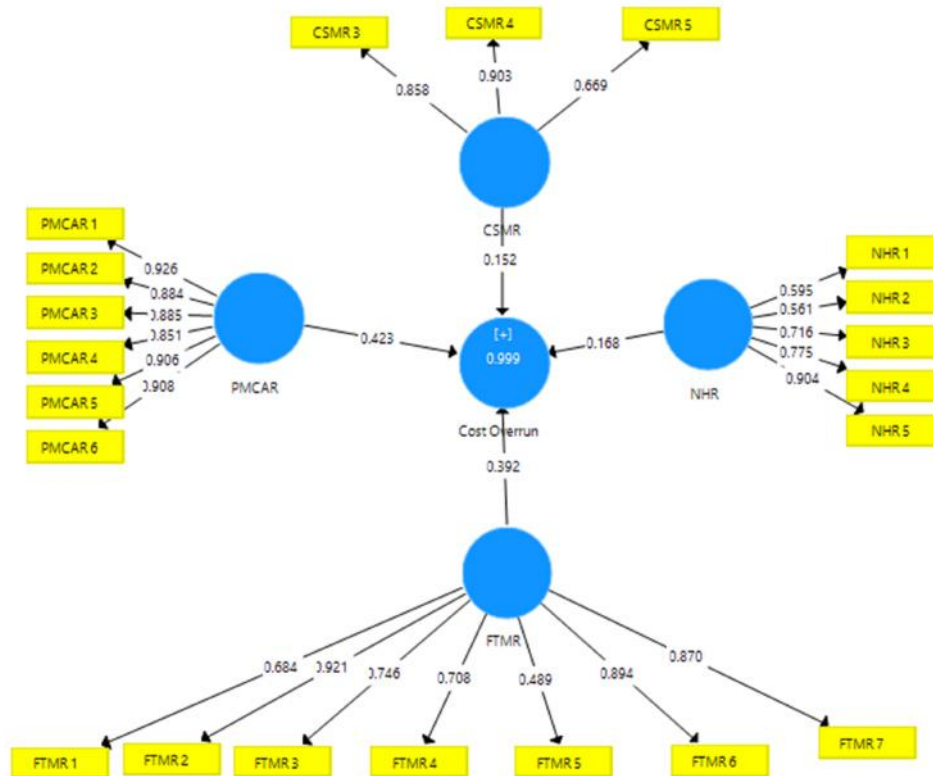


Figure 12 Results of PLS Algorithm Iteration 2(After Deletion of items with low loading)

In iteration 1 the outer loading of all construct items are above the cutoff point 0.4 except the CSMR 1, CSMR 2 and CSMR 6 with low outer loading of 0.017,0.212 and 0.368 respectively and the values of Average Variance Extracted (AVE, Composite Reliability (CR) and Cronbach’s Alpha of this construct are below the acceptable limit.

Hence the CSM construct was considered for modification and the item with lowest loading value i.e. CSMR 1, CSMR 2 and CSMR 6 was selected for omission.

Using the iterative process of deletion, in iteration 2. As shown in results of iteration 2 in Table 4, the omitting of these items from the construct CSM resulted in improving the value AVE, CR and Alpha to 0.666, 0.855,0.750 which exceeded than required cut-off values.

Following the omission of selected CSM items, the measurement model was considered satisfactory with the evidence of adequate reliability, convergent validity.

II. Discriminant validity of constructs

Discriminant validity indicates the extent to which a given construct is different from other constructs (Hulland, 1999). This can be examined by comparing the AVE of construct shared on it and other constructs.

Table 6 Correlation matrix (Discriminant Validity of constructs)

	CSMR	FTMR	NHR	PMCAR
CSMR	0.816			
FTMR	0.818	0.771		
NHR	0.527	0.292	0.721	
PMCAR	0.713	0.786	0.700	0.894

As shown in Table 6 the correlation matrix of all constructs were above 0.7 i.e. the cutoff point for this test. Therefore, the measurement model gets valid in terms of dicriminant validity

4.3.4 Structural Model Assessment for Cost Overrun

Structural model can be assessed by testing the explained variance on endogenous latent variable (R^2) and path co-efficient also termed as beta (β) values of each path.

According to Cohen (1988) R^2 of endogenous can be assessed as substantial = 0.26, moderate = 0.13 and weak = 0.02. From Fig.13 R^2 of the endogenous latent variable (cost overrun) is 0.999 which is higher than the cut-off value and hence the model lies at high satisfactory level. In assessing the path coefficient, beta value of all structural paths is compared, higher the path co-efficient the significant effect on endogenous latent variable.

As shown in Fig. 13 PMCAR have the highest path co-efficient i.e. 0.423. This means the CSM have large effect on cost overrun.

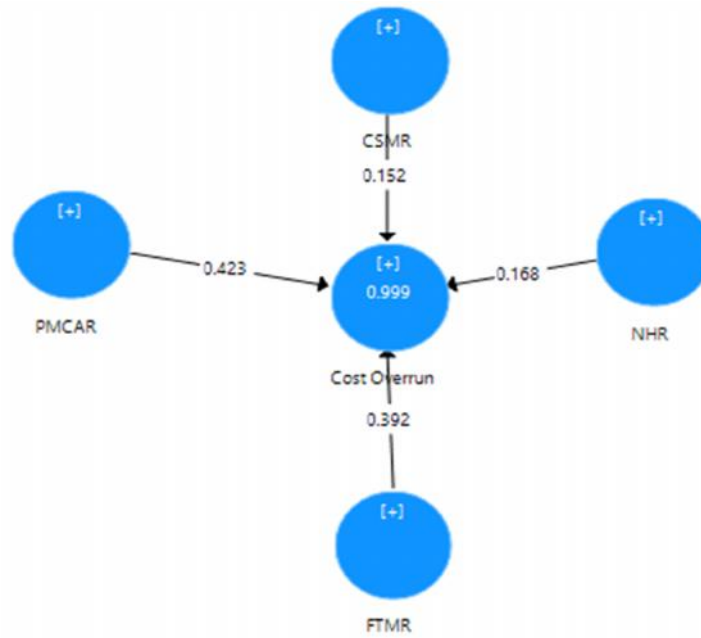


Figure 13 Cost overrun Structural Model Results

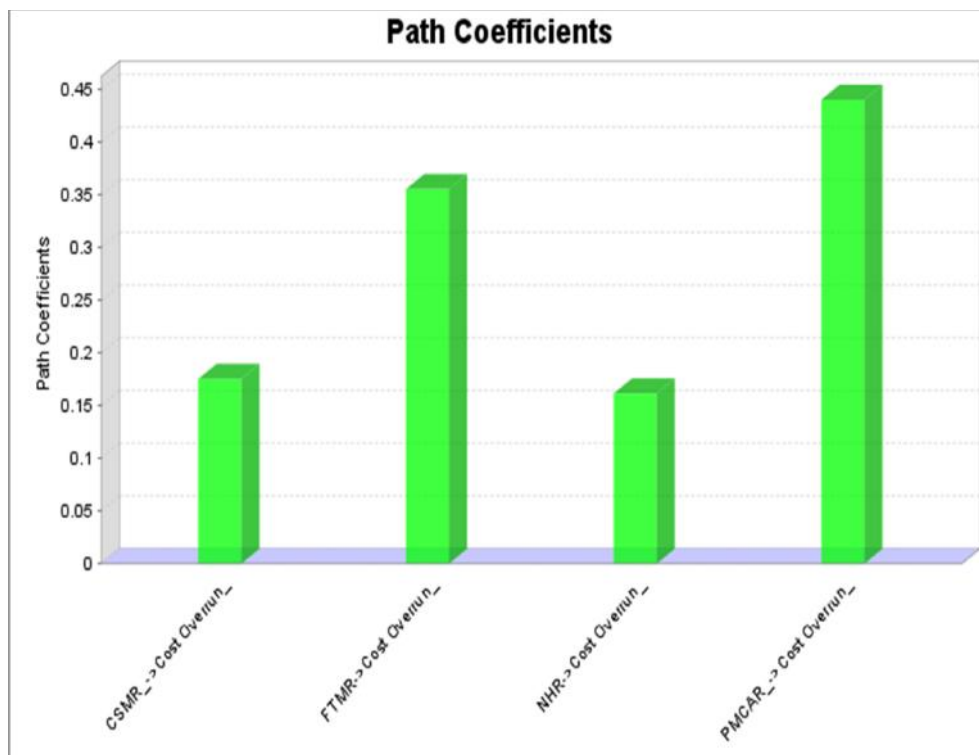


Figure 14 Cost overrun's Model Path Coefficient results of Iteration 1

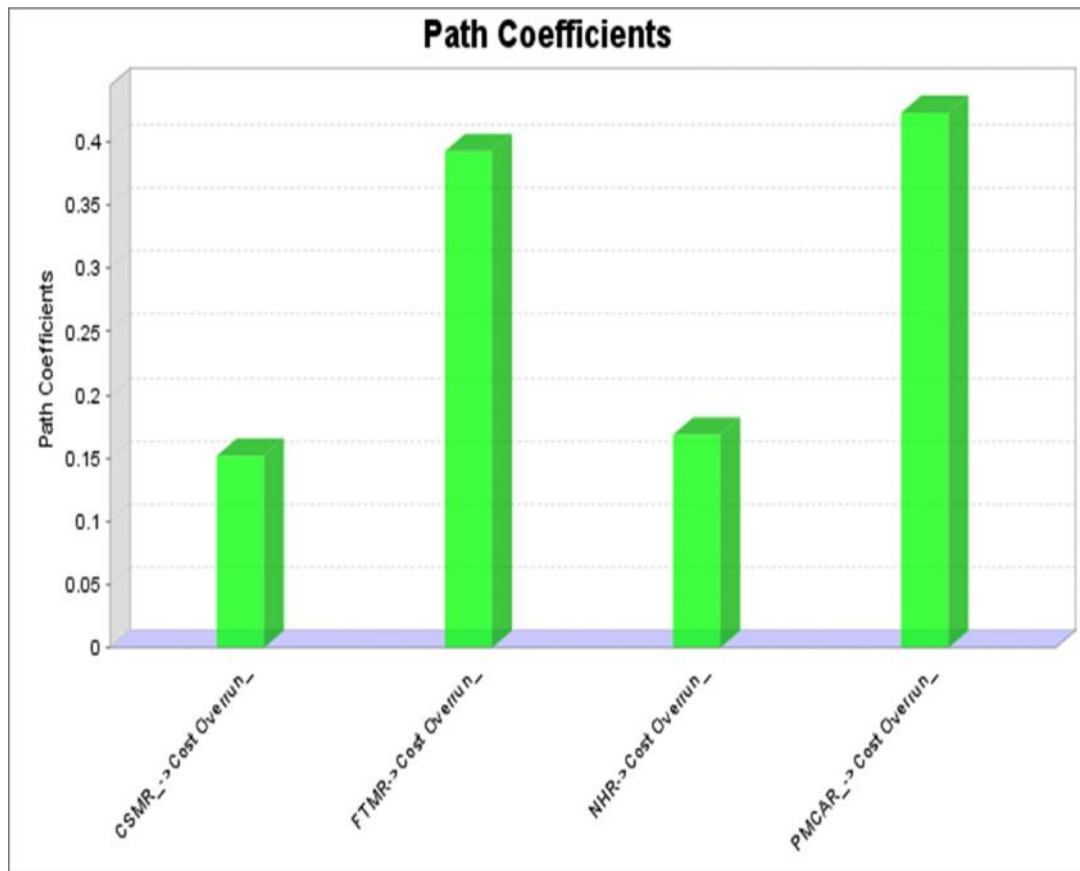


Figure 15 Cost overrun's Model Path Coefficient results of Iteration 2

The second major construct affecting cost overrun is FTMR with path co-efficient of 0.392. Further, the significance of the path co-efficient was tested by calculating t-value using non-parametric bootstrap procedure with SmartPls software.

4.3.5 Bootstrapping

The boot strap technique provides an estimate of the shape, spread, and bias of the sampling distribution of a specific statistic. Bootstrapping treats the observed sample as if it represents the population. The procedure creates a large, pre -specified number of bootstrap samples (e.g., 5,000 used in this research). Each bootstrap sample should have the same number of cases as the original sample.

Bootstrap samples are created by randomly drawing cases with replacement from the original sample. The PLS results for all bootstrap samples provide the mean value and

standard error for each path model coefficient. This information permits a student's t-test to be performed for the significance of path model relationships (Henseler *et al.*, 2009).

For all the paths, a two tail t-test was used. The exact p values (probability value) associated with the t values of each path coefficient were also estimated. Table 7 shows that all the paths retrieved t-value higher than minimum cut-off value i.e., 2.58 at significance level = 5% (Hair *et al.*, 2011)

Table 7 Cost Overrun's Model bootstrapping path results

	Beta ()	t -value	Inference
CSMR-> Cost Overrun	0.152	5.675	Significant
FTMR > Cost Overrun	0.392	6.484	Significant
NHR > Cost Overrun	0.168	3.852	Significant
PMCAR> Cost Overrun	0.423	10.051	Significant

The above table implies that all the construct have significant effect on cost overrun. PMCAR, FTMR, NHR and CSMR get influential construct rank 1,2,3 and 4 respectively on cost overrun.

4.4 PLS Assessment of the questionnaire for Time overrun

4.4.1 Model Development

The model used Time overrun attribute factor analysis has similar network connections of the latent variables and indicators with that of the model developed for Cost overrun PLS assessment

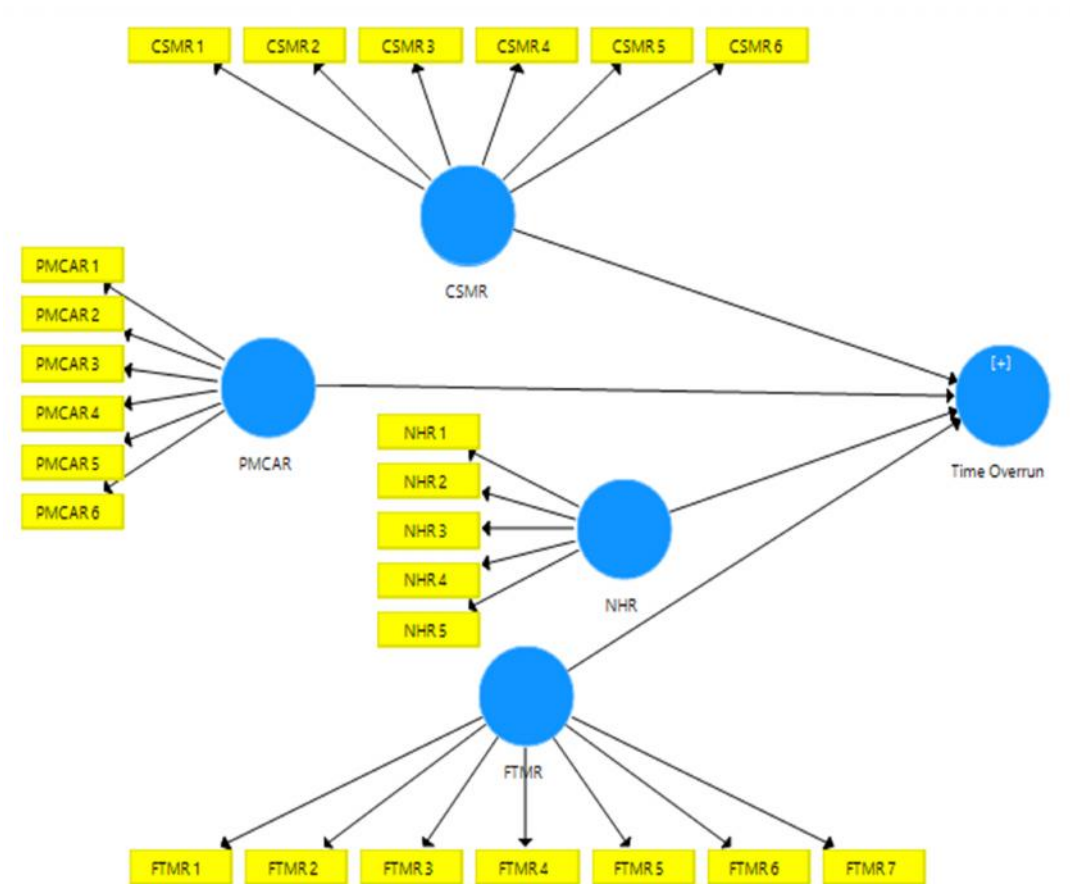


Figure 16 Theoretical Model of Time overrun assessment in Smart PIs

As described in the cost overrun model, the items represented in yellow are indicators of the model which are the time overrun cause factors which the data was drawn from the conducted survey and the blue circles are the latent variables.

4.4.2 PLS Algorithm Results for Time Overrun

For this analysis, Path weighting scheme of the Smart PLS Algorithm used for Time overrun modeling. Path weighting is the recommended approach. This weighting scheme is generally applicable for all kinds of PLS path model specifications and estimations.

When the path model includes higher-order constructs (often called second-order models). The model used for Time overrun assessment was a second order and the Pls algorithm shown in figure below

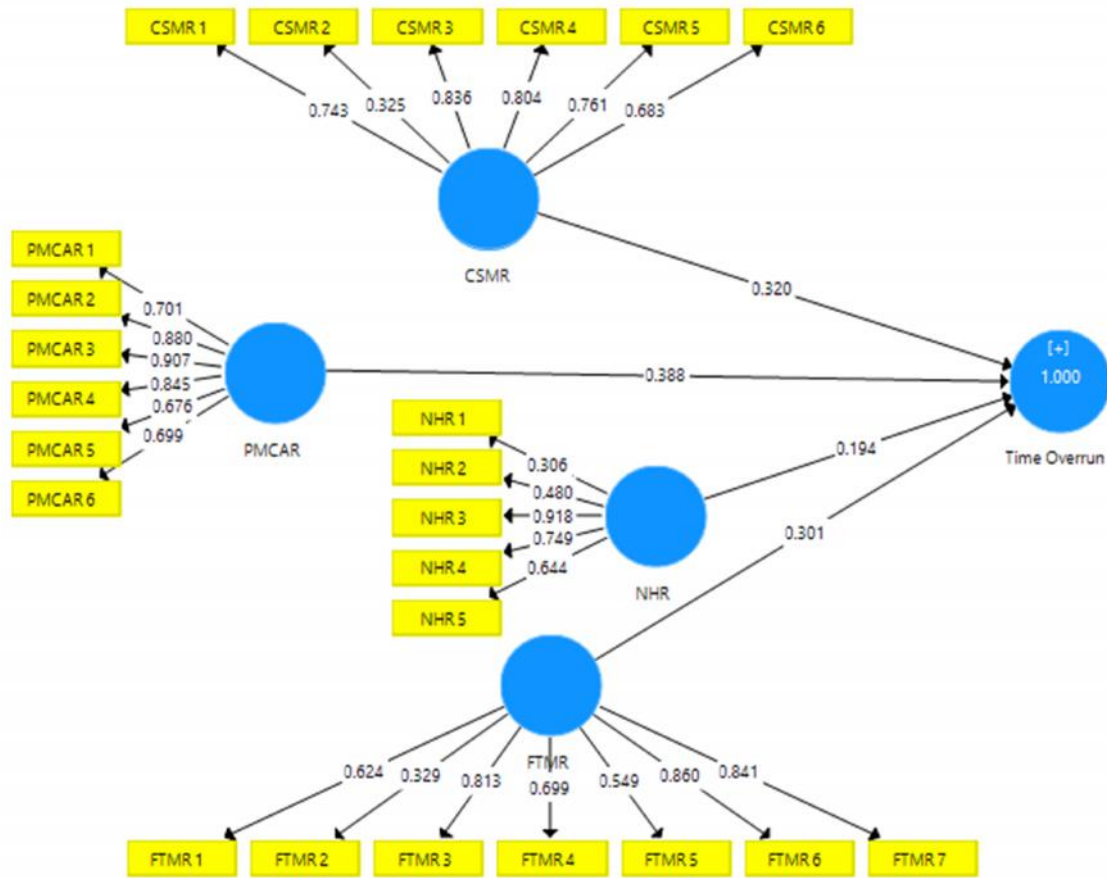


Figure 17 Results of of PLS Algorithm for Time overrun

4.4.3 Measurement Model Assessment for Time Overrun

Individual item reliability and convergent validity

Table 8 Individual factor reliability and convergent validity of outer Model (Iteration 1)

Construct	Item	Loading	AVE	CR	Alpha
PMCAR	PMCAR 1	0.701	0.625	0.908	0.876
	PMCAR 2	0.880			
	PMCAR 3	0.907			
	PMCAR 4	0.845			
	PMCAR 5	0.676			
	PMCAR 6	0.699			
CSMR	CSMR 1	0.743	0.508	0.854	0.793
	CSMR 2	0.325			
	CSMR 3	0.836			
	CSMR 4	0.804			
	CSMR 5	0.761			
	CSMR 6	0.683			
FTMR	FTMR 1	0.624	0.485	0.860	0.826
	FTMR 2	0.329			
	FTMR 3	0.813			
	FTMR 4	0.699			
	FTMR 5	0.549			
	FTMR 6	0.860			
	FTMR 7	0.841			
NHR	NHR 1	0.306	0.428	0.770	0.608
	NHR 2	0.480			
	NHR 3	0.918			
	NHR 4	0.749			
	NHR 5	0.644			

The outer loading below 0.4 must be dropped. In Iteration 1 of Time overrun modeling the items such as CSM 2, FTMR 2 and NHR 1 were below the outer loading cutoff point. The Average variance Extracted (AVE) of FTMR and NHR constructs and Cronbach's Alpha of NHR construct are below the limit. Therefore, items should be reviewed and should be dropped selected.

Table 9 Individual factor reliability and convergent validity of outer Model (Iteration 2)

Construct	Item	Loading	AVE	CR	Alpha
PMCAR	PMCAR 1	0.699	0.625	0.908	0.876
	PMCAR 2	0.880			
	PMCAR 3	0.907			
	PMCAR 4	0.845			
	PMCAR 5	0.678			
	PMCAR 6	0.700			
CSMR	CSMR 1	0.731	0.591	0.878	0.826
	CSMR 2	Omitted			
	CSMR 3	0.842			
	CSMR 4	0.804			
	CSMR 5	0.754			
	CSMR 6	0.707			
FTMR	FTMR 1	0.624	0.548	0.876	0.833
	FTMR 2	Omitted			
	FTMR 3	0.813			
	FTMR 4	0.699			
	FTMR 5	0.549			
	FTMR 6	0.859			
	FTMR 7	0.841			
NHR	NHR 1	Omitted	0.819	0.931	0.890
	NHR 2	Omitted			
	NHR 3	0.939			
	NHR 4	0.994			
	NHR 5	0.826			

The NHR 2 item was above the cutoff point but omission is required to enhance the Average Variance Extracted (AVE) and Cronbach’s Alpha of its construct with the deletion of NHR 1. Following the dropping of CSMR 2 and FTMR 2 their AVE get improved above the cutoff point in the second iteration.

After the omission of the selected four items, the measurement model was considered satisfactory with the evidence of adequate reliability, convergent validity.

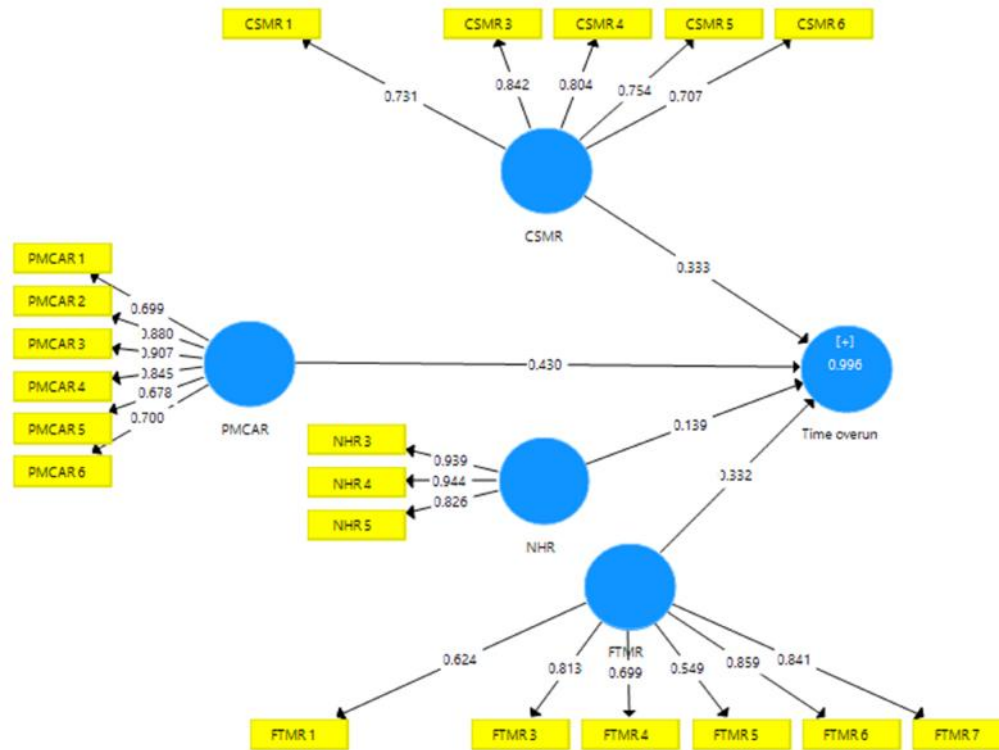


Figure 18 Results of PLS Algorithm Iteration 2

Discriminant validity of constructs

For adequate discriminant validity, the diagonal elements need to be greater than the off-diagonal elements in the corresponding rows and columns (Hulland, 1999).

Table 10 Correlation matrix (Discriminant Validity of constructs)

	CSMR	FTMR	NHR	PMCAR
CSMR	0.769			
FTMR	0.537	0.740		
NHR	0.232	0.680	0.905	
PMCAR	0.753	0.417	0.291	0.790

The correlation matrix of all constructs were above 0.7 i.e. the cutoff point for this test.

4.4.4 Structural Model Assessment for Time Overrun

The measurement model was confirmed that valid and reliable. The next step was to measure the inner Structural Model outcomes. This included observing the model’s predictive relevancy and the relationships between the constructs. The coefficient of determination (R^2) and path coefficient (b value) of the inner model presented in Fig 19 as follows

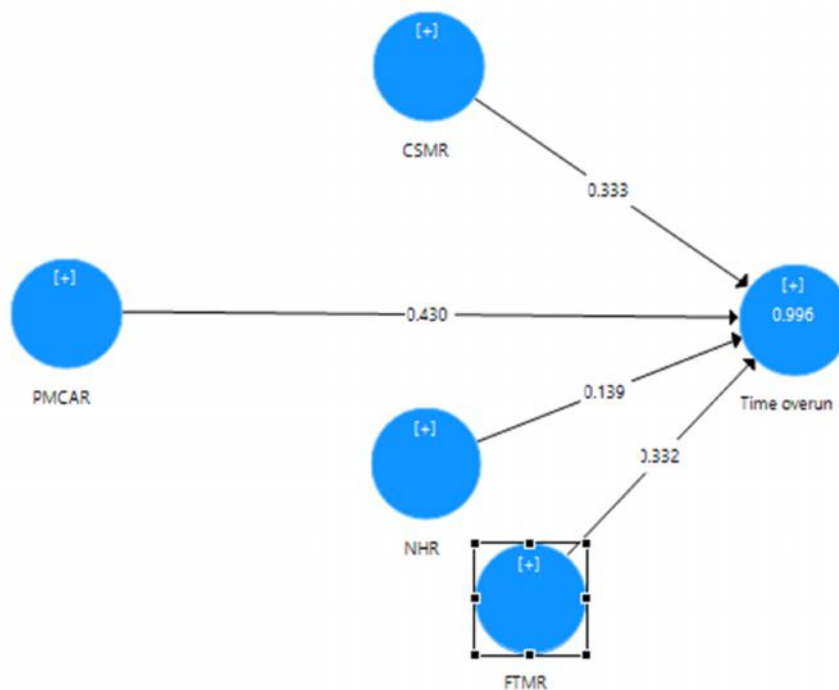


Figure 19 Time overrun Structural Model results

As it is shown in the above figure R^2 of the endogenous latent variable (Time overrun) is 0.996 which is higher than the cut-off value and hence the model lies at high satisfactory level.

PMCAR are the strongest construct which have an effect on Time overrun with a path coefficient of 0.430 and CSMR followed to be the second with 0.333 path coefficient values.

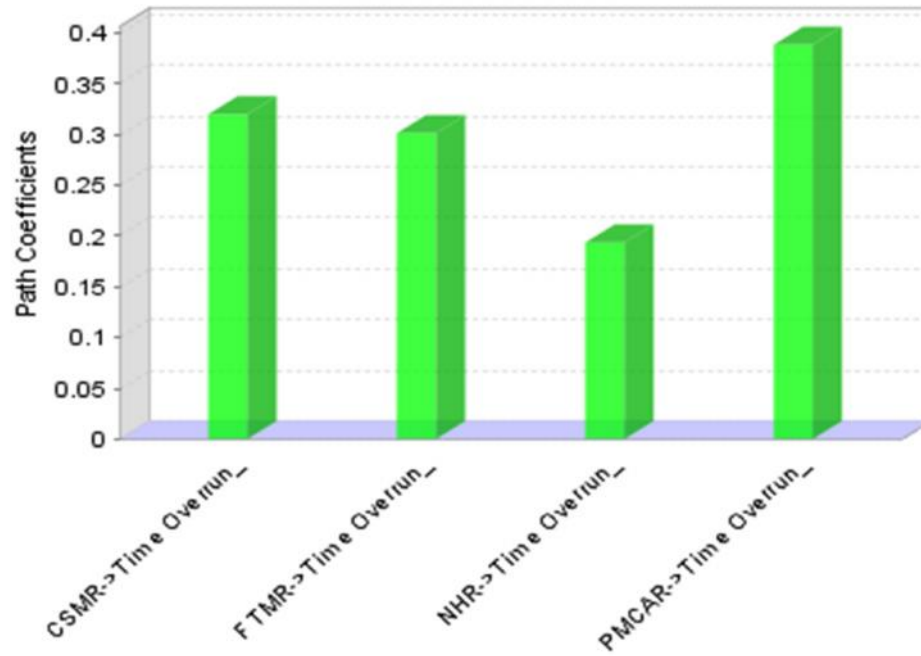


Figure 20 Time overrun's Model Path Coefficient results of Iteration 1

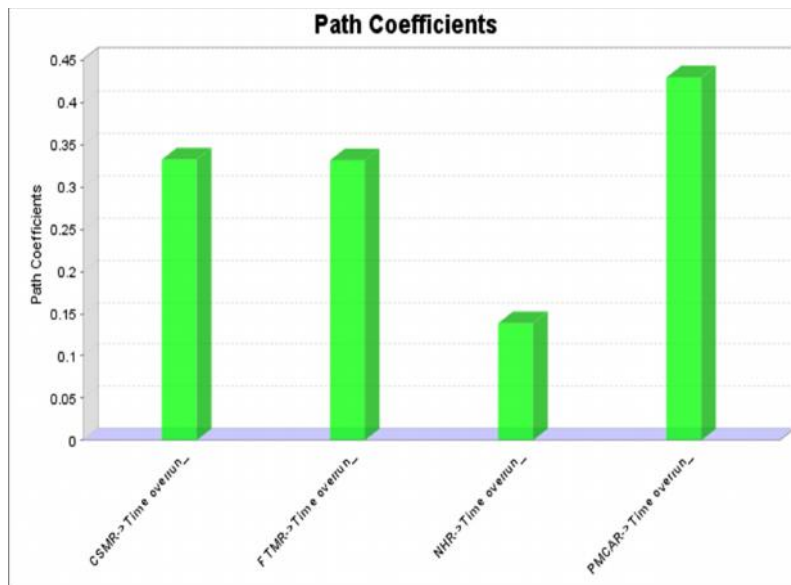


Figure 21 Time overrun's Model Path Coefficient results of Iteration 2

4.4.5 Bootstrapping

To test the significance of the path coefficient and T-statistics values, a bootstrapping procedure using 5000 subsamples with no sign changes was carried out for this study as presented in Table below

Table 11 Time Overrun’s Model bootstrapping path results

	Beta ()	t -value	Inference
CSMR-> Time Overrun	0.333	4.831	Significant
FTMR > Time Overrun	0.332	3.514	Significant
NHR > Time Overrun	0.139	1.409	Insignificant
PMCAR> Time Overrun	0.430	4.145	Significant

The significance of all path coefficients were ensured via bootstrapping except the NHR construct. Having a t-value of 1.409 which is below the cutoff point and P-value of 0.079, NHR construct become insignificant. PMCAR, CSMR and FTMR construct ranked 1, 2 and 3 respectively having significant path coefficients.

This means the PMCAR construct shares high value of variance with respect to time overrun have large effect on time overrun. The second major construct affecting time overrun is CSMR with path co-efficient of 0.333.

4.5 Overall Measurement Model Assessment (Model Validation)

Global Fit measure (GoF) for PLS path modeling, defined as the geometric mean of the average communality and average R2 (for endogenous constructs) was used to assess over all model fitness and explaining power of model. The GoF index is bounded between 0 and 1. Wetzels *et al.* (2009) suggest using 0.50 as the cut off value for communality (Fornel and Larcker, 1981) and different effect sizes of R2 (Cohen, 1988 cited by Akter *et al.*, 2011b) to determine GoFsmall (0.10), GoFmedium (0.25) and GoFlarge (0.36) leading to achieve GoFsmall = 0.1, GoFmedium = 0.25, GoFlarge = 0.36 as cut-off values for global validation of PLS model as adopted by Akter *et al.*, 2011). Following equation used by (Akterbet *et al.*, 2011) was adopted to calculate GoF:

$$GoF = \sqrt{AVE \times \bar{R}^2} \dots\dots\dots\text{Equation 2}$$

Using the Above equation, the Global Fit Model for Cost overruns PLS Model and Time overrun PLS Model calculated as follows

GoF for Cost overrun PLS Model

AVE average= AVE of the four latent variables/4= 0.798+0.666+0.595+0.520/ = 0.645

R²= 0.999

GoF_{Cost overrun} = $\sqrt{0.645 \times 0.999}$ = 0.806

GoF for Cost overrun PLS Model

AVE average= AVE of the four latent variables/4= 0.625+0.591+0.548+ 0.819/4=0.646

R²=0.996

GoF_{Time overrun} = $\sqrt{0.646 \times 0.996}$ = 0.802

From the above calculations, we can say both the two models were highly satisfactory having a largely exceeded GoF than the cutoff point for global validation of PLS model.

4.6 Archival Data on Cost overrun

The type of contract selected in Addis –Djibouti railway project was the EPC turnkey form of contract having 3 sections of EPC Contracts. EPC is a form of contract where a high degree of certainty of final price and time is required.

EPC contracts generally attempt to limit any opportunity by the contract to claim for additional cost. However, the acceptance of variation or Amendment in contract may results Cost overrun on the project.

Causes for cost overrun gathered from different documents are presented as follows

A) Amendments of Contracts and Design changes (PMCAR 1 and PMCAR 6)

Amendments are official changes of costs and/or schedules in the contract. In Addis-Djibouti in total 7 cost based Amendments of contracts were signed. To understand the whole changes, records from the Amended contract agreements and CIECC'S report of project management were presented

EPC Contract for Sebeta-Adama –Meiso (Included) Section

Contract Agreement

The EPC contract for Sebeta-Adama –Meiso (Included) section was signed on Oct. 25, 2011 between ERC and CRCE, effective on Feb 12, 2012. The construction period is 42 months and, with a grace period of 6 months. Total contract price is USD 1,639,031,409.00.

Amendments

Amendment No.1: The contract price was revised due to change of some technical standards in Technical Proposal, as require by the Feasibility Evaluation Report. ERC and CREC signed the first amended contract on Nov. 5, 2012 and adjusted the contract price in to USD 1,841,470,000.00.

Amendment No.2: ERC and CREC signed the second amended contract on Feb.7, 2013 and changed the proportion of foreign currency (USD) and local currency (Birr) in payment as: Foreign currency (USD) 70% and local currency (Birr) 30%.

Amendment No.3: ERC and CREC signed the third amended contract on Mar. 15, 2013 and changed the proportion of foreign currency (USD) and local currency (Birr) in payment as: Foreign currency (USD) 78.01% and local currency (Birr) 21.99 %.

EPC Contract for Meiso (Excluded) –Dewanle Section

Contract Agreement

The EPC contract for Meiso (Excluded) –Dewanle Section was signed on Dec. 16, 2011 between ERC and CCECC, effective on Apr.12, 2012. The construction period is 42 months and, with a grace period of 10 months. Total contract price is USD 1,197,400,000.00

Amendments

Amendment No.1: The contract price was revised due to change of some technical standards in Technical Proposal, as require by the Feasibility Evaluation Report. ERC and CCECC signed the first amended contract on Nov. 2, 2012 and adjusted the contract price in to USD 1,401,800,000.00

Amendment No.2: ERC and CCECC signed the second amended contract on Feb.7, 2013 and changed the proportion of foreign currency (USD) and local currency (Birr) in payment as: Foreign currency (USD) 70% and local currency (Birr) 30%.

Amendment No.3: ERC and CREC signed the third amended contract on Mar. 8, 2013 and changed the proportion of foreign currency (USD) and local currency (Birr) in payment as: Foreign currency (USD) 77.69% and local currency (Birr) 22.31 %.

EPC Contract for Dewanle-Negad Section and Port Rail Way

Contract Agreement

The EPC contract for Dewanle-Negad Section and port rail way was signed on January 30, 2012 between Ministry of Economy and Finance in charge of Industry and planning of the Republic of Djibouti and China Civil Engineering Construction Corporation (CCECC), effective on Apr.12, 2012. The Execution date means the date on which the contractor has received 15% of advance payment. The contract duration is 60 months and contract price is USD 505,000,000.00

Amendment

Amendment No.1: As Feasibility Evaluation requires to adjust technical standards in the original Technical Proposal, there is a change in a contract price. Ministry of Economy and Finance in charge of Industry and planning of the Republic of Djibouti and CCECC signed the first amended contract on Nov. 7, 2012 in which the contract price was adjusted to USD 578,580,000.00

The basic reason written in first amendments for contract price adjustment was the change of some technical standards in the technical proposal and the changed standards that results contract price adjustments were not described.

As it was seen in the Final evaluation report on the feasibility study, employer's requirement, minutes of meeting and progress reports some standards with design changes were done to the bottom scale. E.g. Welded long steel rails with a length of 300m changed to 25m long fish plate jointed rail, the Design running speed changed from 160 km/hr to 120km/h passenger maximum running speed and 80km/h of freight train speed and the Grade I ballast changed to Grade II ballast.

As we can infer from the above data, the basic cost overrun factors of Addis-Djibouti railway project are Amendments of Contract and Design changes

The cost overrun due to Amendments of contract is two faced. The contract adjustments rose because of Unfinalized report document during contract agreement signing and Dual currency proportion adjustment.

Due to some change in technical standards in final feasibility report Contract prices of the three contract sections varied as USD 202,438,591, USD 204,400,400,00 and USD 73,580,000respectively.

The Addis/Sebeta Meiso section get 12.35% cost overrun, the Meiso Dewale section also affected by 17.07 % increment and the Dewale –Negad section affected by 1.46% cost overrun.

The dual currency payment adjustment amendments didn't justify the reasons for the proportion adjustment in both amended agreements of the two projects in which the two EPC contracts were signed with 60% (USD) and 40% local currency(Birr) proportion

changed to 70 % USD and 30%local currency(Birr) in second Amendments and then to78.01% (USD) and 21.99 % local currency (Birr) , and 77.69% (USD)and 22.31 %local currency (Birr) in Sebeta-Meiso and Meiso-Dewanle contracts in third Amendments respectively . These dual currency proportion adjustments result USD 579,627,167 foreign currency drainage.

B) Variation

Variation of CTC Axle counter and traction substations change of 15 KV external power supply to 33 KV in each station was the major cost increase factor as a design change in the side of the contractors even if the claim for additional cost was not confirmed.

4.7 Archival Data on Time overrun

As defined by Fung and Tung (2006) delay is the slowing down of work without stopping construction entirely which can lead to time overrun either beyond the contract date or beyond the date that parties have agreed upon for the delivery of the project. In this section causes factors of delay which lead to time overrun of the project are listed below

1. Relocation of Public Utilities (NHR 5)

Despite a small quantity, Demolition or relocation works are regarded as a major factor that may impede project progress due to its long term and coordination problems among the parties. Relocation of the water pipe in Indode locomotive section wasn't been done on time due to the requirement of the employer involvement, which affects the construction progress of subgrade work and the whole locomotive section.

Relocation of 10 places with crossing power lines and communication cables were been a prerequisite for electric transmission for the railway system. (Progress Report NO. 36 for Sebeta-Meiso section by CIECC,2016)

2. Contractors Inadequate planning and scheduling (CSMR 4)

The main reason of the time overrun was slow progress of ETS and station building works. In both section i.e. Addis/Sebeta- Meiso and Meiso –Dewanle section the progress of the refereed works was behind schedule.

This problem resulted due to insufficient number of Mobilized plant and equipment for ETS and station building works, insufficient turnover materials including formworks and scaffolds used for station buildings, insufficient and unsmooth cement supplies which affected the concrete structures and insufficient number of skilled workers with low average work efficiency. (Project Management Report for Addis Ababa- Djibouti Railway by CIECC (January, 2017), Progress Report N0. 36 for Sebeta-Meiso section by CIECC(Marcch,2016) and Progress Report N0. 37 for Meiso-Dewanle section by CIECC(March,2016))

3. Change in the scope of the Work (PMCAR 2)

The addition of loading and unloading facilities of passing station for Sebeta-Meiso-Dewanle results a claim for time extension by both contractors and it has been one driving factor for approval of time extension on construction period. (Project Management Report for Addis Ababa- Djibouti Railway by CIECC (January, 2017)

4. Change in the Design (PMCAR 6)

The External power supply changed from the independent double lines power supply in to loop circuit with the employer’s requirement as per proposed by EEP (Ethiopian Electric Power agency which caused power supply changes in 7 positions of the whole line and affected the construction period.

The signal system upgraded into CTC+ Axle counters by the employer requirement. This change alteration resulted a claim for additional construction time by the contractors and then resulted a delay in the construction period. (Progress Report N0. 36 for Sebeta-Meiso section by CIECC (March, 2016) and Project Management Report for Addis Ababa- Djibouti Railway by CIECC (January, 2017))

5. Poor Coordination among parties (PMCAR 5)

As the power supply mode outside stations and traction substations was not in line with the EPC contract and the signal system gets updated, relative works were not being started in time. The traction power supply played an important role that influence the construction period. This was mainly because the delayed negotiation between ERC and EEP to decide the traction substation scheme. (Progress Report N0. 36 for Sebeta-Meiso section by CIECC (March, 2016) and ERC letter to EPP Ref. No. 2.2/1228/20/2008)

6. External Factors

A. Plunder and Public Security - Materials and goods of the project have been stolen or robbed which caused bad influence on the project construction because some items take quite long period to import again from china. This issue adversely affects the construction progress. The violence and attacks from local residents along the line due to delayed compensation for right of way and less awareness about the project was the other issue for affecting the project progress.

B. Custom Clearance is handled inefficiently and at low speed, as a result equipment and materials such as used for ETS and Station building works were not being delivered on site as scheduled.

C. Weather – During rainy season, part of the bridges, culverts and conical protections have been damaged by eroding which puts in question the construction quality and the hydrology works. (Progress Report N0. 37 for Meiso-Dewanle section by CIECC(March,2016))

7. Time Extension

According to the article of EPC Contract, the Meiso-Dewanle project should have past the completion acceptance as of October 11, 2015. Due to the factors discussed above an extension of time made to the project which 8 months. The project completion time for Sebeta-Messo project also extended to September, 2016 i.e. 9 months time extension. Finally, additional 6 month was added for both contracts, results 15 and 14 months time overrun to Sebeta – Meiso and Meiso-Dewanle projects respectively (Progress Report

N0. 37 for Meiso-Dewanle section by CIECC(March,2016) and ERC letter to CIECC with ref No. 2.17/682/21/2016)

4.8 Reliability Test by Cronbach’s alpha (α) coefficient

The data gathered through questionnaires were checked by Cronbach’s alpha (α) coefficient for reliability or consistency. Cronbach’s alpha (α) coefficient ranges from 0 to 1.0. The minimum level for reliability using Cronbach’s alpha (α) coefficient is 0.7 and any value below this indicates the variables are inconsistent and unreliable

$$= \frac{I}{I-1}(1-\sum_{i=1}^I Si^2/St^2)..... Equation (3)$$

Where: α = Cronbach’s alpha
 I= the number of item in the scale
 Si^2 = the variance of item i
 St^2 = the variance of the observed total test scores

4.8.1 Test for Major impact of Impact of Cost and time overrun data

I= Items/Components =12
 Sum of the items variance =14.4
 Variance of Total score =72.39
Cronbach's alpha =0.87

4.8.2 Test for Cost management assessment data

Items/Components =24
 Sum of the items variance =28.99
 Variance of Total score =167.54
Cronbach's alpha =0.86

4.8.3 Test for Time management assessment data

Items/Components =32
 Sum of the items variance =41.46
 Variance of Total score =626.53
Cronbach's alpha =0.96

The reliability test done using Cronbach’s alpha coefficient indicate that these the data collected from questionnaires in three sections were well consistent.

4.9 Additional Factors to Project Overrun from Open-ended Questionnaire Part

Factors Attributes for Cost overrun

- The change of the consultant in early stage of the project from SWERoad to CIECC for unjustified reason.
- Poor feasibility study which amended after the EPC contract has been signed allowing high cost variation.
- Lack of assigning professionals in the management staff and decisive positions.
- Lack of transparency in ERC in handling contractual cases

Factors Attributes for Time Overrun

- Right of issues unsolved immediately for compensation
- Poor rate of unit price for compensation
- Payment delay due to bureaucracy and shortage of hard currency
- Poor project management and leadership in keeping the contract agreement
- Change of legislation (E.g. Quarry and borrow pit Administration scheme)
- Relocation of public utilities
- Security issues and political instability at the time

4.10 Assessment of Major Impact of Cost and Time overrun

The impacts of delay and cost overrun in Addis –Djibouti project were assessed by using the Relative Importance index (RII) to rank the major impacts. Table 11 shows the RII and ranks of the major impacts

Table 12 RII Major Impact Assessment

No.	Major Impacts	Code	RII	Rank
1.	Drainage of foreign currency	MI 1	0.63	3
2.	Delayed compensation for right of way and temporary sites	MI 2	0.73	1
3.	Waste of Scarce resources	MI 3	0.44	12
4.	Further delay and cost escalation to secure additional funding	MI 4	0.52	9
5.	Contractual dispute and litigation	MI 5	0.57	8
6.	Negative public perception	MI 6	0.59	7
7.	Loss of confidence and loss of reputation by the employer	MI 7	0.49	10
8.	Made the employer for additional cost and loss its investment return money lately	MI 8	0.61	4
9.	Adversarial relationship between participants of the project	MI 9	0.6	6
10.	Discourage investment in road construction projects by government	MI 10	0.45	11
11.	Increased political pressure/ instability	MI 11	0.61	5
12.	Economical contribution of the infrastructure for import /export has affected	MI 12	0.64	2

The Cost and time overrun of the Addis-Djibouti railway project mainly affects the residents along the line because of delayed compensation for right of way and temporary sites. Affected Economical contribution of the infrastructure for import /export and Drainage of foreign currency were the second and third main impacts of the Project Overruns.

4.11 Assessment of Cost and Time management practice

In this section the cost and time management practices regarding the tools and techniques used in every cost and time management phases in Addis-Djibouti Railway project will present. For this research, the tools and techniques used to assess the practice were drawn from *A Guide To The Project Management Body of Knowledge (PMBOK Guide-Fifth Edition*

Table 13 Tools and Techniques used in the Cost Management

No.	Tools and Techniques	Code	RII	Rank
I. Plan cost Management				
1.	Expert judgment	CA1	0.41	3
2.	Analytical techniques	CA2	0.46	1
3.	Meetings	CA3	0.44	2
II. Estimate costs				
1.	Expert judgment	CB1	0.44	3
2.	Analogous estimating	CB2	0.39	8
3.	Parametric estimating	CB3	0.41	4
4.	Bottom-up estimating	CB4	0.39	6
5.	Three-point estimating	CB5	0.35	10
6.	Reserve analysis	CB6	0.38	8
7.	Cost of quality	CB7	0.4	5
8.	Project management software	CB8	0.39	6
9.	Vendor bid analysis	CB9	0.46	2
10.	Group decision-making technique	CB10	0.52	1

III. Determine Budget				
1.	Cost aggregation	CC1	0.42	3
2.	Reserve analysis	CC2	0.41	4
3.	Expert judgment	CC3	0.43	2
4.	Historical relationships	CC4	0.36	5
5.	Funding limit reconciliation	CC5	0.49	1
IV. Control costs				
1.	Earned value management	CD1	0.46	2
2.	Forecasting	CD2	0.46	3
3.	To-complete performance index (TCPI)	CD3	0.42	6
4.	Performance reviews	CD4	0.51	1
5.	Project management software	CD5	0.43	5
6.	Reserve analysis	CD6	0.44	4

The Relative Index (RII) and ranking were within the entire group of the cost management to assess the practice of the tools and techniques in Addis- Djibouti in each cost management segmental phases. The Project Time management practice also presents as follow

Table 14 Tools and Techniques used in the Time Management

No.	Tools and Techniques	Code	RII	Rank
III. Plan Schedule Management				
1.	Expert judgment	TA1	0.44	3
2.	Analytical techniques	TA2	0.47	2
3.	Meetings	TA3	0.55	1
IV. Define Activities				
1.	Decomposition / Work breakdown structure (WBS)	TB1	0.56	1
2.	Rolling wave planning	TB2	0.44	3
3.	Expert judgment	TB3	0.5	2
V. Sequence Activities				
	Precedence diagramming method (PDM)	TC1	0.46	1
VI. Estimate Activity resources				
1.	Expert judgment	TD1	0.42	3
2.	Alternative analysis	TD2	0.44	2
3.	Published estimating data	TD3	0.36	5
4.	Bottom-up estimating	TD4	0.4	4
5.	Project management software	TD5	0.46	1
VII. Estimate Activity durations				
1.	Expert judgment	TE1	0.41	5
2.	Analogous estimating	TE2	0.44	4
3.	Parametric estimating	TE3	0.44	3
4.	Three-point estimating	TE4	0.41	6

5.	Group decision-making techniques	TE5	0.54	1
6.	Reserve analysis	TE6	0.46	2
VIII. Develop Schedule				
1.	Schedule network analysis	TF1	0.52	1
2.	Critical path method	TF2	0.44	7
3.	Critical chain method	TF3	0.44	6
4.	Resource optimization techniques	TF4	0.48	2
5.	Modeling techniques	TF5	0.46	5
6.	Schedule compression	TF6	0.464	4
7.	Scheduling tool	TF7	0.47	3
IX. Control Schedule				
1.	Performance reviews	TG1	0.49	3
2.	Project management software	TG2	0.48	4
3.	Resource optimization techniques	TG3	0.87	1
4.	Modeling techniques	TG4	0.84	2
5.	Leads and lags	TG5	0.42	6
6.	Schedule compression	TG6	0.41	7
7.	Scheduling tool	TG7	0.44	5

Archival documents such as progress reports shows that Review of Bill of quantizes for payments was the main cost controlling mechanism being used on the project. On the part of scheduling controlling Performance reviews of major works and S-curve of the work progress of the project were used by the consultant and the employer.

4.12 Power Analysis of the Actual Sample

As its described in chapter 3, the number of received valid questionnaires were 28 which is 6 less than the estimated sample size. Therefore, a power analysis test should be conducted to check whether the 28 valid questionnaires were explanatory or not.

Power analysis ($1 - \beta$) test is to check the stability of the model’s parameters with the sample size used for the analysis. It is to confirm whether the sample size used is sufficient for generating a stable model and valid analysis. The test is conducted through GPower 3.1.2 software package.

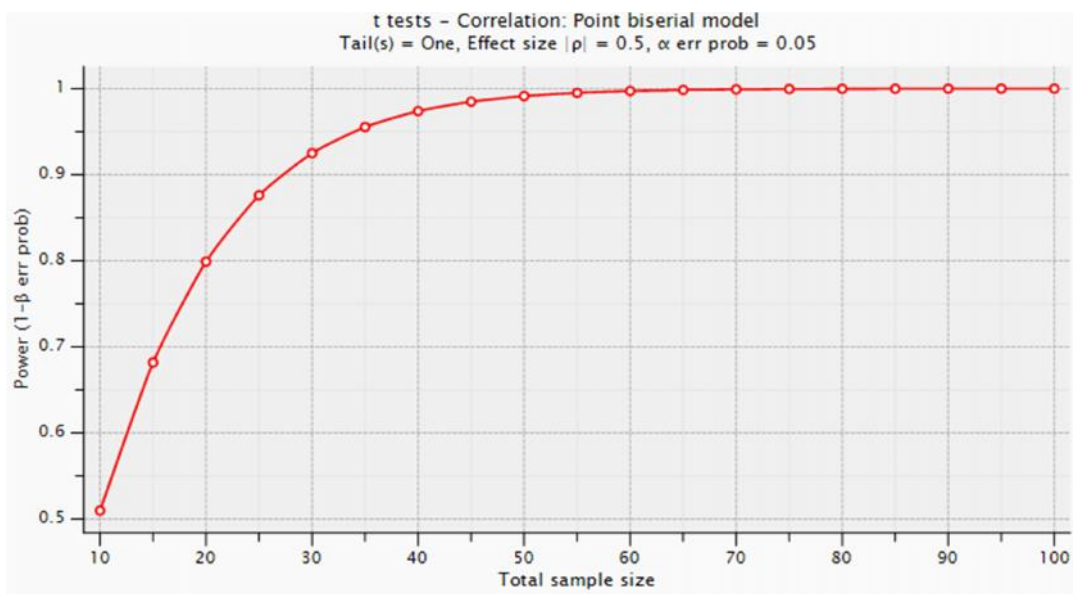


Figure 22 Power Analysis Test

Input parameters for this study were significance level as 0.05(i.e., 95% of confidence level), sample size (N) as 28, and effect size (ES) as 0.5. The Power ($1 - \beta$) generated by the referred input parameters with 28 sample size was 0.908 which beyond the cutoff point of power analysis test i.e. 0.8 and it is obvious that it is more adequate for achieving substantial power. Fig 22 indicates that the power increases as the number of samples size increases.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The Construction of railway projects in developing countries like Ethiopia incurs a huge investment taking loan sourced investment with interest rate. Due to the huge capital investment of the sector and economical contribution of such projects to the country, researches on cost and time overrun assessment of railway projects gives a bench mark for corrective measures for further project implementations.

The identification of the most influential group of cause factor on cost and time overrun helps to take a focus area on projects to minimize project overruns and it shows also assignments of related departments of the Ethiopian Railway Corporation (ERC) and partner intuitions to overcome delay and cost increment of projects.

5.2 Conclusions

The results obtained in the analysis of the questionnaire survey, PLS modeling of cost and Time overrun and the Archival findings have been discussed and presented in the previous Chapters in detail. Therefore, from the results of the analysis of desk study and respondents’ responses the following major conclusions have been drawn:

Project Management and Contract Administration related factors (PMCAR) are the most significant construct or group of factors causing cost and Time overrun.

Following Project Management and Contract Administration factors (PMCAR), Financial and Time Management related factors are affects cost overrun and Contractor’s Site Management related factors (CSMR) are the second significant construct second to PMCAR. Power supply issues which relates to the Ethiopian Electric Power (EEP) and design changes were the most significant factors which exposed the project to time overrun.

Unfinalized feasibility study before the contract agreement and its final evaluation after the contract signing brought many amendments and cost overrun to the three EPC contracts of the project.

Amendments relating to Dual currency payment mode proportion adjustments put the Ethiopia for additional foreign currency expenses and foreign currency drainage because of the fact that the foreign currency based payments to contractors was paid via china banks.

Delayed compensation payments, drainage of foreign currency and lost economical contribution of the project in terms of Time value of money were main impacts of Cost and Time overrun of the Addis-Djibouti railway project.

5.3 Recommendations

From the study of the research paper; the following major recommendations are forwarded to the Employer and other researchers;

5.3.1 Recommendation to the Employer (ERC)

- ERC is advised to have well developed and finalized feasibility study and employer's requirement prior to contract agreements.
- Improved performance evaluation and better coordination among stakeholders is in need.
- ERC should finalize and handle Right of Way issues and temporary sites prior to commencement of projects.
- Security ensuring works such as giving awareness about projects for residents along railway projects and better coordination with public security government bodies should be taken to an emphasis points.
- Supports for contractors regarding custom clearance during machines and equipment importation should enhance.
- Even though, EPC contract should be done by contractors, ERC is advised to have thoroughly done cost estimates and risk identifications which should compatible with the contract type and project locations.

- Schedule reviews should be always on desk tasks, works which are not inter sequential can be done independently, reviewing contractors progress should be done in well enhanced manner.
- Empowering Project Managers for better leadership and Assigning the right professionals to the right task position is the last recommendation

5.3.2 Recommendation to further studies

The author would like to suggest future research to be carried out on: Comparative study of project overrun on Ethiopia's railway projects. It is believed that they will contribute a better towards railway construction industry and to the country's construction development as a whole.

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APPENDIX

Appendix 1 Questionnaire

Questionnaire

Date: _____

Dear Sir/ Madam

This is a questionnaire designed for a research purpose in Addis Ababa Institute of Technology, African Railway Center of Excellency, MSc Program in Railway Engineering (Civil Infrastructure). The questions are prepared for the **Assessment of Cost and Time overrun in Addis-Djibouti Railway Project**. The main objective of this study is to assess the Causes of Cost and Time overrun in Addis-Djibouti railway Project and their impacts. Thus, your responses to the questions would be kept confidential and be used only for academic purpose.

Therefore, please be helpful and give your precise and correct answers to the questions. The responses are used for study purposes only and perhaps for further recommendations to improve similar works in the future. I would like to thank you in advance for giving your precious time.

Biniyam Ayele

Addis Ababa Institute of Technology
African Railway Center of Excellency
MSc Program in Railway Engineering (Civil Infrastructure)

Dear respondents,

This questionnaire is prepared for data collection of a research on *Assessment of Cost and Time overrun in Addis-Djibouti railway project*

Part one: personal data

1.1 Academic background _____

1.2 Work experience in the railway sector (in years)

0-5 5-10 10-15 >15

Part two: Company back ground information

2.1 Organization you are working for

- | | |
|--|--------------------------|
| Ethiopian Railway Corporation (ERC) | <input type="checkbox"/> |
| China Civil Engineering Construction Corporation (CCECC) | <input type="checkbox"/> |
| China International Engineering Consulting Corporation (CIECC) | <input type="checkbox"/> |
| China Railway Engineering Corporation (CREC) | <input type="checkbox"/> |
| Ethio- Djibouti Railway (EDR) | <input type="checkbox"/> |

2.2 Work experience of the organization in the railway sector (in years) _____

Part three: Assessment of Cost and Time overrun aspects in Addis-Djibouti railway project

3.1 Did the project affected cost and time overrun?

Yes

No

3.2 If your answer for question number 3.1 is Yes, Which of the following are the most contributing causes for cost and time overrun of Addis –Djibouti EPC turnkey contract project?

Please put the degree to which you agree or disagree with the following scale

1= Not Significant (NS)

4 = Very Significant (VS)

2= Slightly Significant (SS)

5 = Extremely Significant (ES)

3= Moderately Significant (MS)

Table 1.Major Causes for Cost and Time Overrun

No.	Major Causes	Cost Overrun					Time overrun				
		1	2	3	4	5	1	2	3	4	5
I. Project Management and Contract Administration related factors (PMCAR)											
1.	Amendments of Contracts										
2.	Change in the scope of the project										
3.	Delays in decisions making of the consultant										
4.	Delay in decisions making of the client										
5.	Poor project management and coordination among parties										
6.	Design Changes										
II. Contractor's Site Management related factors (CSMR)											

1.	Poor site management and supervision																			
2.	Construction mistake and Defective Works																			
3.	Inaccurate Cost and time estimate																			
4.	Inaccurate planning and scheduling																			
5.	Incompetent subcontractors																			
6.	Site handover and Right of way issues																			
III. Financial and Time Management related factors (FTMR)																				
1.	Cash flow and financial difficulties faced by contractors																			
2.	Financial difficulties of owner																			
3.	Delay in progress payment by owner																			
4.	Delay payment to supplier/subcontractor																			
5.	Poor Financial control system																			
6.	Poor Schedule control system																			
7.	Contractual claims, such as, extension of time with cost claims																			
IV. Non-human resource related Factors (NHR)																				
1.	Late delivery of materials and equipment																			
2.	Fluctuation of currency exchange rate																			
3.	Unforeseen Site conditions and Weather conditions																			

4.	Weather Conditions											
5.	External work due to public utilities and services											

3.3_Please write additional contributing cause factors for Cost overrun. (if any)

3.4 Please write additional contributing cause factors for Time overrun. (if any)

3.5 Which of the following are the major Impacts of Cost and Time Overrun in Addis-Djibouti Railway project?

Please put the degree to which you agree or disagree with the following scale

1= Not Significant (NS)

4 = Very Significant (VS)

2= Slightly Significant (SS)

5 = Extremely Significant (ES)

3= Moderately Significant (MS)

Table 2 Major Impacts Of Cost and Time overrun in Addis –Djibouti railway Perojrect

No.	Major Impacts	Degree of Impact				
		1	2	3	4	5
1.	Drainage of foreign currency					
2.	Delayed compensation for right of way and temporary sites					
3.	Waste of Scarce resources					
4.	Further delay and cost escalation to secure additional funding					
5.	Contractual dispute and litigation					
6.	Negative public perception					
7.	Loss of confidence and loss of reputation by the employer					
8.	Made the employer for additional cost and loss its investment return money lately					
9.	Adversarial relationship between participants of the project					
10.	Discourage investment in road construction projects by government					
11.	Increased political pressure/ instability					
12.	Economical contribution of the infrastructure for import /export has affected					

3.6 Please write additional Impacts of Cost and Time overrun in Addis-Djibouti ? (If any)

3.7 Which Project Cost Management tool and techniques your company used for the following project cost management processes?

Project Cost Management processes

-Plan cost Management

-Estimate costs

-Determine Budget

-Control costs

Please put the degree of applicability to which the tools and techniques were used for the project with the following scale

1= Not Significant (NS)

4 = Very Significant (VS)

2= Slightly Significant (SS)

5 = Extremely Significant (ES)

3= Moderately Significant (MS)

No.	Tools and Techniques	Degree of Applicability				
		1	2	3	4	5
I. Plan cost Management						
1.	Expert judgment					
2.	Analytical techniques					
3.	Meetings					
II. Estimate costs						
1.	Expert judgment					
2.	Analogous estimating					

3.	Parametric estimating					
4.	Bottom-up estimating					
5.	Three-point estimating					
6.	Reserve analysis					
7.	Cost of quality					
8.	Project management software					
9.	Vendor bid analysis					
10.	Group decision-making techniques					
III. Determine Budget						
1.	Cost aggregation					
2.	Reserve analysis					
3.	Expert judgment					
4.	Historical relationships					
5.	Funding limit reconciliation					
IV. Control costs						
1.	Earned value management					
2.	Forecasting					
3.	To-complete performance index (TCPI)					
4.	Performance reviews					
5.	Project management software					
6.	Reserve analysis					

3.8 Which Project Time Management tool and techniques your company used for the following project time management processes?

Project Time Management processes

- Plan Schedule Management
- Define Activities
- Sequence Activities
- Estimate Activity resources
- Estimate Activity durations
- Develop Schedule
- Control Schedule

Please put the degree of applicability to which the tools and techniques were used for the project with the following scale

- | | |
|--------------------------------|--------------------------------|
| 1= Not Significant (NS) | 4 = Very Significant (VS) |
| 2= Slightly Significant (SS) | 5 = Extremely Significant (ES) |
| 3= Moderately Significant (MS) | |

No.	Tools and Techniques	Degree of Applicability				
		1	2	3	4	5
I. Plan Schedule Management						
4.	Expert judgment					
5.	Analytical techniques					
6.	Meetings					
II. Define Activities						
1.	Decomposition / Work breakdown structure (WBS)					

2.	Rolling wave planning					
3.	Expert judgment					
III. Sequence Activities						
1.	Precedence diagramming method (PDM)					
IV. Estimate Activity resources						
2.	Expert judgment					
3.	Alternative analysis					
4.	Published estimating data					
5.	Bottom-up estimating					
6.	Project management software					
V. Estimate Activity durations						
1.	Expert judgment					
2.	Analogous estimating					
3.	Parametric estimating					
4.	Three-point estimating					
5.	Group decision-making techniques					
6.	Reserve analysis					
VI. Develop Schedule						
1.	Schedule network analysis					
2.	Critical path method					
3.	Critical chain method					
4.	Resource optimization techniques					
5.	Modeling techniques					

6.	Schedule compression					
7.	Scheduling tool					
VII. Control Schedule						
1.	Performance reviews					
2.	Project management software					
3.	Resource optimization techniques					
4.	Modeling techniques					
5.	Leads and lags					
6.	Schedule compression					
7.	Scheduling tool					

Appendix 2 Data for Major Impact Assessment of Cost and Time overrun

No.	MI 1	MI 2	MI 3	MI 4	MI 5	MI 6	MI 7	MI 8	MI 9	MI 10	MI 11	MI 12	Total
1	1	4	1	4	1	4	4	4	4	4	4	4	39
2	4	4	2	2	2	2	2	3	2	3	2	3	31
3	4	5	4	2	4	5	5	3	4	5	5	4	50
4	2	4	1	1	2	2	2	1	2	2	3	2	24
5	4	4	2	4	3	3	2	3	3	1	3	2	34
6	3	4	2	4	3	3	2	4	4	4	4	4	41
7	3	4	2	2	3	1	3	3	2	1	1	1	26
8	3	2	2	4	3	3	4	4	3	1	4	3	36
9	5	5	1	3	4	5	1	5	3	4	5	5	46
10	3	2	2	2	3	2	1	2	2	1	3	2	25
11	1	3	1	1	1	2	1	2	4	1	2	3	22
12	5	5	4	3	5	4	3	3	3	2	2	4	43
13	2	3	2	2	2	2	2	3	3	1	3	2	27
14	2	4	2	4	2	4	4	4	4	4	3	4	41
15	4	4	3	2	2	2	2	3	2	3	2	3	32
16	4	5	4	2	4	5	5	3	4	5	5	4	50
17	2	4	1	1	2	2	2	1	2	2	3	4	26
18	3	4	2	4	3	3	2	3	3	1	3	4	35
19	3	4	2	4	3	3	2	4	4	4	4	4	41
20	3	4	2	2	3	1	3	3	2	1	1	1	26
21	2	2	2	4	3	3	4	4	3	1	4	4	36
22	5	5	1	3	4	5	1	5	3	4	5	5	46

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

23	4	2	2	2	3	2	1	2	2	1	2	2	25
24	1	3	1	1	1	2	1	2	4	1	3	3	23
25	5	5	4	3	5	4	3	3	3	2	2	4	43
26	3	3	2	2	2	2	2	3	3	1	2	3	28
27	4	5	4	3	5	4	3	3	3	2	2	3	41
28	3	3	2	2	2	2	2	3	3	1	3	3	29
Sum	88	102	62	73	80	82	69	86	84	63	85	90	
RII	0.629	0.729	0.443	0.521	0.571	0.586	0.493	0.614	0.6	0.45	0.607	0.643	
Rank	3	1	12	9	8	7	10	4	6	11	5	2	
Variance	1.408	0.954	0.979	1.096	1.27	1.423	1.39158	0.92	0.571	1.973	1.320	1.097	

Items/Components	12
Sum of the items variance	14.4031
Variance of Total score	72.3929
Cronbach's alpha	0.87387

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

Appendix 3 Data for Assessment of Cost Management Practice

No.	CA1	CA2	CA3	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CB8	CB9
1	2	3	3	3	2	2	1	1	1	1	3	3
2	4	4	4	5	4	4	4	5	4	5	4	4
3	3	3	3	3	3	3	3	3	3	3	3	3
4	5	5	5	4	4	4	4	3	4	4	4	4
5	4	2	3	4	1	1	1	1	1	1	1	1
6	1	1	2	1	1	3	3	2	2	1	1	2
7	1	1	1	3	4	3	4	3	4	5	3	4
8	1	5	1	1	1	1	1	1	1	1	1	4
9	3	4	2	3	2	3	3	2	2	3	3	3
10	3	2	5	2	4	3	3	3	3	3	2	3
11	2	2	3	2	2	2	2	2	3	2	2	3
12	2	3	4	4	3	3	2	2	3	3	4	3
13	3	3	3	3	2	2	1	1	1	2	3	3
14	4	4	4	5	4	4	4	5	4	3	4	4
15	3	3	3	3	3	3	3	3	3	1	2	1
16	5	5	5	4	4	4	4	3	4	1	1	2
17	4	2	3	4	1	1	1	1	1	4	3	4
18	2	3	2	1	2	4	3	3	2	4	3	4
19	3	1	1	3	3	3	4	2	4	2	2	4
20	1	5	1	1	1	1	1	1	1	3	3	3
21	2	4	3	3	2	4	2	2	2	4	2	3
Sum	58	65	61	62	53	58	54	49	53	56	54	65

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

RII	0.41429	0.46429	0.43571	0.44286	0.37857	0.41429	0.38571	0.35	0.37857	0.4	0.38571	0.46429
Rank	3	1	2	3	8	4	6	10	8	5	6	2
Variance	1.51474	1.70522	1.60998	1.47392	1.29705	1.13379	1.38776	1.36508	1.39229	1.74603	1.0068	0.84807

CB10	CC1	CC2	CC3	CC4	CC5	CD1	CD2	CD3	CD4	CD5	CD6	Total Score
3	3	1	3	1	3	3	5	4	4	4	1	60
5	2	2	2	2	2	3	3	3	3	3	3	84
3	3	3	3	3	3	3	3	3	3	3	3	72
4	4	4	4	4	4	4	4	4	4	4	4	98
4	4	4	4	4	4	3	4	3	4	4	3	66
2	2	3	1	2	2	3	2	2	3	1	3	46
5	3	4	4	5	4	3	4	3	3	3	4	81
5	1	1	1	1	5	1	1	1	4	1	1	42
3	3	2	4	2	3	4	2	3	3	4	2	68
1	3	2	2	1	4	5	2	4	3	2	4	69
4	3	3	3	1	2	3	4	4	4	4	4	66
3	4	3	2	1	3	3	2	2	3	1	2	65
3	3	2	3	1	3	3	5	4	4	4	2	64
2	4	3	4	2	2	3	3	3	3	3	3	84
4	3	4	4	3	3	3	3	3	3	3	3	70
2	2	3	2	4	4	4	4	4	4	4	4	83
5	3	4	4	4	4	3	4	3	4	3	4	74

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

5	3	4	4	2	2	3	2	2	3	1	3	67
5	1	2	1	5	4	3	4	3	3	3	4	70
3	2	2	3	1	5	1	1	1	4	1	2	48
2	3	2	2	2	3	4	2	3	3	4	3	66
73	59	58	60	51	69	65	64	59	72	60	62	
0.52143	0.42143	0.41429	0.42857	0.36429	0.49286	0.46429	0.45714	0.42143	0.51429	0.42857	0.44286	
1	3	4	2	5	1	2	3	6	1	5	4	
1.48753	0.72562	0.94331	1.17007	1.86395	0.87075	0.75283	1.37868	0.80726	0.2449	1.36054	0.90249	

Items/Components	24
Sum of the items variance	28.988662
Variance of Total score	167.53741
Cronbach's alpha	0.8629273

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

Appendix 4 Data for Assessment of Time Management Practice

	TA1	TA2	TA3	TB1	TB2	TB3	TC1	TD1	TD2	TD3	TD4
1	3	1	3	3	1	3	3	3	1	1	1
2	4	4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	5	5	5	4	4	4	4	4
5	4	4	4	5	4	4	4	3	4	2	4
6	1	3	3	4	2	1	1	1	3	2	3
7	3	3	4	2	4	3	2	3	4	3	3
8	1	4	4	4	1	4	3	1	1	1	1
9	4	3	4	4	3	3	5	4	4	2	4
10	3	2	4	5	3	3	5	4	2	2	2
11	4	3	4	4	4	4	3	4	3	3	3
12	2	3	3	2	2	2	1	2	3	3	3
13	2	4	4	4	1	4	3	1	1	1	1
14	3	1	3	3	1	3	3	3	1	1	1
15	4	3	4	3	4	4	4	4	4	4	4
16	3	3	3	3	3	3	3	3	3	3	3
17	4	4	4	5	5	5	4	4	4	4	4
18	4	4	4	5	4	4	4	3	4	2	4
19	1	3	3	4	2	1	1	1	3	2	3
20	3	3	4	2	4	3	2	3	4	3	3
21	2	4	4	4	1	4	3	1	1	1	1
Sum	62	66	77	78	61	70	65	59	61	51	56
RII	0.44286	0.47143	0.55	0.55714	0.43571	0.5	0.46429	0.42143	0.43571	0.36429	0.4

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

Rank	3	2	1	1	3	2	1	3	2	5	4
Variance	1.09297	0.78912	0.22222	0.96599	1.80045	1.07937	1.32426	1.29705	1.4195	1.10204	1.29705

TD5	TE1	TE2	TE3	TE4	TE5	TE6	TF1	TF2	TF3	TF4	TF5
4	3	3	1	1	4	3	4	4	1	1	1
4	4	4	4	4	4	3	4	4	5	4	4
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
3	2	3	4	2	4	5	3	3	5	4	4
1	1	3	3	2	2	3	2	2	2	4	3
4	4	4	3	4	4	3	4	3	3	4	5
1	1	1	1	1	4	1	4	1	1	1	1
5	4	2	4	2	4	3	4	4	2	2	3
5	3	3	3	1	2	3	3	3	5	4	2
4	4	2	3	3	4	4	4	3	3	4	4
2	2	3	4	3	3	3	2	2	3	4	4
1	1	1	1	1	4	1	4	1	1	1	1
4	3	3	2	2	4	3	4	4	1	1	1
4	4	4	4	4	4	3	4	4	5	4	4
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
3	2	3	4	3	4	5	3	3	5	4	4
1	1	3	3	4	2	3	2	2	2	4	3
4	4	4	3	4	4	3	4	3	3	4	5
1	1	1	1	2	4	1	4	1	1	3	1

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

65	58	61	62	57	75	64	73	61	62	67	64
0.46429	0.41429	0.43571	0.44286	0.40714	0.53571	0.45714	0.52143	0.43571	0.44286	0.47857	0.45714
1	5	4	3	6	1	2	1	7	6	2	5
1.80045	1.4195	0.94331	1.18821	1.2517	0.53061	1.09297	0.53515	1.03855	2.14059	1.39229	1.75964

TF6	TF7	TG1	TG2	TG3	TG4	TG5	TG6	TG7	Total Score
1	1	4	4	1	1	1	1	1	68
5	4	4	4	5	4	5	4	5	132
3	3	3	3	3	3	3	3	3	96
4	4	4	4	4	4	4	4	4	131
3	3	3	3	3	3	3	2	3	110
4	4	1	1	3	2	2	3	3	75
5	5	4	4	5	5	3	4	4	118
1	1	4	3	1	1	1	1	1	57
1	3	2	2	2	2	2	2	2	97
3	4	5	4	4	3	5	3	3	106
4	4	5	4	4	3	5	5	4	119
3	2	2	2	3	3	2	2	2	82
1	2	4	3	1	1	1	1	2	60
1	1	4	4	1	1	1	1	2	71
5	4	4	4	5	4	5	5	4	130
3	3	3	3	3	3	3	3	4	97
4	4	4	4	4	4	4	4	4	131
3	3	3	3	3	3	3	2	3	111
4	4	1	1	3	2	2	3	2	76

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

5	5	4	4	5	5	3	4	4	118
2	2	4	3	1	1	1	1	2	64
65	66	68	67	122	117	59	58	62	
0.46429	0.47143	0.48571	0.47857	0.87143	0.83571	0.42143	0.41429	0.44286	
4	3	3	4	1	2	6	7	5	
1.99093	1.45578	1.19728	0.9161	1.95011	1.60998	1.96372	1.70522	1.18821	

Items/Components	32
Sum of the items variance	41.4603
Variance of Total score	626.531
Cronbach's alpha	0.96395

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

Appendix 5 Data for Smartpls Analysis of Time overrun

No .	PM CA R 1	PM CA R 2	PM CA R 3	PM CA R 4	PM CA R 5	PM CA R 6	CS M R 1	CS M R 2	CS M R 3	CS M R 4	CS M R 5	CS M R 6	FT M R 1	FT M R 2	FT M R 3	FT M R 4	FT M R 5	FT M R 6	FT M R 7	N H R 1	N H R 2	N H R 3	N H R 4	N H R 5
1	3	2	2	3	3	4	3	1	4	4	3	2	2	4	3	3	1	3	4	1	2	2	2	2
2	1	2	3	3	4	5	4	4	3	4	4	3	5	5	5	5	5	5	5	1	1	5	5	5
3	3	3	3	3	2	4	2	2	3	4	3	5	2	4	3	3	3	2	3	3	4	2	1	1
4	4	1	1	1	1	5	3	3	2	4	4	3	5	5	5	1	2	5	5	3	3	3	2	4
5	4	5	4	4	4	5	4	3	4	4	4	4	5	5	5	5	1	5	5	5	4	5	4	5
5	1	1	1	1	2	1	4	4	2	4	2	1	5	5	4	3	1	1	2	1	2	3	3	3
6	1	2	1	1	2	4	3	1	3	3	3	3	5	5	3	3	3	3	3	4	1	2	2	3
7	3	3	2	3	2	4	3	2	4	4	4	3	4	4	5	5	4	4	5	4	4	3	1	2
8	5	4	5	4	3	5	5	3	5	5	5	5	5	3	5	5	5	5	4	3	4	3	3	3
9	2	2	2	3	2	3	2	4	2	3	4	2	2	2	2	2	2	2	1	2	1	1	1	2
10	2	3	3	4	2	4	3	1	2	4	4	4	2	4	4	2	3	2	3	2	2	1	1	4
11	2	3	2	2	3	5	3	2	3	4	3	4	3	3	4	4	4	3	4	2	3	3	2	4
12	3	3	3	1	1	2	4	4	5	4	5	4	4	4	5	5	4	3	3	5	2	2	2	2
13	4	4	4	4	4	5	4	4	5	5	5	5	2	3	2	2	3	3	4	2	4	2	2	3
14	4	3	4	5	2	5	3	3	2	5	5	2	2	3	3	2	3	5	4	3	4	3	2	3
15	1	2	3	3	4	5	4	4	3	4	4	3	5	5	5	5	5	5	5	1	1	5	5	5
16	3	3	3	3	2	4	2	2	3	4	3	5	2	4	3	3	3	2	3	3	4	2	1	1
17	4	1	1	1	1	5	3	3	2	4	4	3	5	5	5	1	2	5	5	3	3	3	2	4
18	4	5	4	4	4	5	4	3	4	4	4	4	5	5	5	5	1	5	5	5	4	5	4	5
19	1	1	1	1	2	1	4	4	2	4	2	1	5	5	4	3	1	1	2	1	2	3	3	3

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

20	1	2	1	1	2	4	3	1	3	3	3	3	5	5	3	3	3	3	3	4	1	2	2	3
21	3	3	2	3	2	4	3	2	4	4	4	3	4	4	5	5	4	4	5	4	4	3	1	2
22	5	4	5	4	3	5	5	3	5	5	5	5	5	3	5	5	5	5	4	3	4	3	3	3
23	2	2	2	3	2	3	2	4	2	3	4	2	2	2	2	2	2	2	1	2	1	1	1	2
24	2	3	3	4	2	4	3	1	2	4	4	4	2	4	4	2	3	2	3	2	2	1	1	4
25	2	3	2	2	3	5	3	2	3	4	3	4	3	3	4	4	4	3	4	2	3	3	2	4
27	3	3	3	1	1	2	4	4	5	4	5	4	4	4	5	5	4	3	3	5	2	2	2	2
28	4	4	4	4	4	5	4	4	5	5	5	5	5	2	3	2	2	3	3	4	2	4	2	3

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

Appendix 6 Data for Smartpls Analysis of Cost overrun

No .	PM CA R 1	PM CA R 2	PM CA R 3	PM CA R 4	PM CA R 5	PM CA R 6	CS M R 1	CS M R 2	CS M R 3	CS M R 4	CS M R 5	CS M R 6	FT M R 1	FT M R 2	FT M R 3	FT M R 4	FT M R 5	FT M R 6	FT M R 7	N H R 1	N H R 2	N H R 3	N H R 4	N H R 5
1	2	4	3	3	2	3	5	3	3	4	2	4	2	2	2	3	4	4	3	1	1	1	2	2
2	5	5	5	5	5	5	4	4	3	4	4	4	3	3	1	4	5	5	2	2	2	5	5	5
3	3	3	2	2	3	3	5	4	2	4	5	5	4	3	5	2	4	4	3	4	4	1	1	2
4	1	1	1	1	2	2	5	4	2	4	4	1	1	1	2	1	1	1	1	3	4	4	2	4
5	1	1	2	1	1	1	1	5	2	3	4	4	4	2	1	2	2	2	2	1	1	4	1	2
5	3	2	1	5	1	4	4	4	2	4	3	4	1	1	1	2	5	1	1	1	4	3	3	3
6	3	3	3	5	3	5	3	4	3	3	3	1	1	1	2	2	5	3	2	4	5	3	3	4
7	4	3	3	5	3	4	4	3	4	4	5	4	2	3	5	2	5	4	4	3	5	2	1	2
8	5	4	5	5	5	5	5	4	5	5	4	5	5	4	5	3	4	5	4	3	4	4	3	4
9	5	4	5	5	5	5	5	5	5	5	4	4	5	4	5	3	4	5	4	3	4	4	3	4
10	2	1	1	1	1	2	5	4	2	2	2	5	1	2	1	2	2	2	2	1	1	1	1	2
11	2	2	2	2	3	2	4	3	2	3	3	5	4	2	2	2	3	2	3	2	4	1	1	3
12	4	4	3	3	4	4	5	4	3	4	4	4	2	2	2	3	3	5	3	2	3	3	2	4
13	5	3	3	4	4	5	4	4	4	4	4	4	5	2	4	2	4	2	4	3	4	3	2	3
14	2	4	3	2	3	2	5	4	5	5	5	5	4	4	4	4	3	5	4	2	4	2	2	3
15	2	4	5	2	3	3	2	5	2	5	5	2	1	3	4	2	3	5	3	3	4	1	1	3
16	2	4	3	3	2	3	5	3	3	4	2	4	2	2	2	3	4	4	3	1	1	1	2	2
17	5	5	5	5	5	5	4	4	3	4	4	3	3	3	1	4	5	5	2	2	2	5	5	5
18	3	3	2	2	3	3	5	4	2	4	5	5	4	3	5	2	4	4	3	4	4	1	1	2
19	1	1	1	1	2	2	4	3	2	4	4	3	1	1	2	1	1	1	1	3	4	4	2	4

Assessment of Cost and Time Overrun in Addis –Djibouti Railway Project

20	1	1	2	1	1	1	5	3	2	3	4	3	4	2	1	2	2	2	2	1	1	4	1	2
21	3	2	1	4	1	4	4	4	2	4	2	4	1	1	1	2	5	1	1	1	4	3	3	3
22	3	3	3	5	3	5	4	4	3	3	3	3	1	1	2	2	5	3	2	4	5	3	3	4
23	4	3	3	4	3	4	4	3	4	4	5	4	2	3	5	2	5	4	4	3	5	2	1	2
24	5	4	5	5	5	5	4	3	5	5	4	5	5	4	5	3	4	5	4	3	4	4	3	4
25	5	4	5	4	5	5	2	5	5	5	4	4	5	4	5	3	4	5	4	3	4	4	3	4
27	2	1	1	1	1	2	5	4	2	2	2	2	1	2	1	2	2	2	2	1	1	1	1	2
28	2	2	2	2	3	2	1	4	2	3	3	5	4	2	2	2	3	2	3	2	4	1	1	3