

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

JIMMA UNIVERSITY
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TECHNOLOGY SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING
DEPARTMENT
Construction Engineering and Management

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT
IN ETHIOPIAN ROAD AUTHORITY PROJECTS
(CASE STUDY UNDER CENTRAL REGION)

BY
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A Thesis Submitted to the School of Graduate Studies of Jimma University In partial fulfillment of the requirements of the Degree of Master of Science In Civil Engineering Construction Engineering and Management

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ABSTRACT

In Ethiopia specially, it is road transport, which allows the ways for the movement of peoples and agricultural goods from rural areas to urban areas. Road transport also facilitates a means for usage of land and natural resources, improved agricultural production and marketing, access to social services, and opportunities for sustainable growth (ERA, 2013).

The Construction contract document error in construction project is one of the major factor in the construction industry. The final cost and project completion time can significantly differ from the initial estimated cost and time and also has significant impact because of this error.

The research was conducted first by identification of common contract document error literature review and desk study on selected road projects and then from the findings questionnaire was developed and distributed to the client (ERA), contractors and consultants to assess their insight about the impacts of errors on contract documents. A descriptive and exploratory survey design was used in this research. This research is exploratory type because it concerned on gaining ideas and approaching about Impact of errors in contract document, and it is a descriptive type because it tried to describe types of contract document errors and their impacts in Ethiopian roads authority road projects.

The research identified 38 types of contract document errors through literature review and desk study on selected four road projects constructed in central regions. A total of 44 valid Questionnaires were received back from contractors, consultants and client ERA to carried out the research. Based on the data gathered from the desk study and analysis of these four road projects contract document errors ranges from a minimum 11.11% of to a maximum of 121.05% of the original contract time for single projects and these analyzed projects have an average additional project time of 61.43% of the original completion date.

Errors and omission in the bills of quantities, Errors in capital cost estimating, Incomplete drawing / details needed, Ambiguity or Vague statements, Missing or Incorrect notes on the drawings, CADD (Computer) related problems, Dimensional errors, Errors in symbols and abbreviations and Coordination problem were the top ten most important contract document errors in central region road projects.

Spearman rank correlation coefficient and Relative importance index analysis were used to test the agreement between different groups of respondents participated in questionnaires survey and to rank contract document errors based on importance.

Keywords: *Contract Document, Impacts of Error, ERA, Central Region*

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ACRONYM

AIA = American Institute of Architects

BOT = Build Operate Transfer

BOOT = Build own operate Transfer

D&B= Dispute Review Expert

EPC = Engineering Procurement and Construction

ERA= Ethiopian Road Authority

ETB = Ethiopian Birr

FIDIC= Fédération International des Ingénieurs Conseils

LSTK)= Lump Sum Turn Key

LSPB = Lump Sum Procure and Build

MOWUD= Ministry of Work and Urban Development

QA=Quality assurance

UK= United Kingdom

VAT= Value Added Tax

CHAPTER ONE

1.1 Introduction

Construction contracts may be formed between a contractor and a client, between a contractor and subcontractors, between a client and a designer. The relationships, both contractual and otherwise, between the various parties in the building process have become complex and in many cases quite unclear. It is likely that some co-ordination and contractual problems are bound to occur, resulting in claims and disputes.

Contracts are part of the law of obligations. The law recognizes various obligations owed by people (including corporations) to others, and the law will allow those obligations to be enforced by way of a claim for recompense for breach. Certain wrongs, which are in no way based on promises, can create a liability to another. Under common law, most of these are classified as 'torts'. Statutes can also give a right to recompense. Lastly, there is the law of restitution. Restitution is the restoring to someone of something, or its value in money, where the defendant (the person sued) has been unjustly enriched. Contracts cannot be considered in isolation. (Thomas E and Philip D, 2002)

Contract documents are basically sets of documents containing the express terms and agreement of the contract. Mainly it would be made between the employer and the contractor and also other parties involved in a construction contract such as the architects, engineers, sub-contractors, quantity surveyors, consultants and other professionals. The contract documents will clearly describe each and every party's duties and obligations for the performance of the contract. There are many types of contractual documents in the construction industry. Among them are the articles of agreement, conditions, architect's plans and drawings, specifications and other documents. Another basic element of any contract is a laid out plan on contract documents to deal with any unforeseen events or conditions which might hinder the commencement of the project in any way. Preparation of contract document needs serious attention unless otherwise unsolvable contract errors can be happen at the time of construction in terms of cost and time (Anthony et. al., 1995).

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Contract documents can be defective because of error or omission, incompleteness, inadequate detail or description, conflicts, incompatibility or inconsistency, insufficient legibility or coordination to permit satisfactory construction, inability to use the particular materials or procedures specified, commercial unavailability of a specified item, or misleading provisions, or other similar problems. This can cause the contractor to perform extra work to correct the defect, delay the contractor while the owner determines how to correct the defect, disrupt the contractor's work by forcing the contractor to resequence its work to avoid the affected area the owner decides what to do. The contractor may be able to recover its increased costs as a result of these problems .(Richard J, 2013).

Construction contract document errors include; vagueness, dimensional errors, cost estimating errors and omission of the document are some of them. There are many contract document errors in many parts of the contract and specifications, which consequences from several problems during construction. Then contract document errors are the most common cause of contract claims. The impact of this error causes delays during construction due to work and cost variation. Therefore minimizing this error is very important to the good performance of a project.

1.2 Statement of the Problem

The development of the construction industry is affected by numerous problems. The final cost and project completion time can significantly differ from the initial estimated cost and time and also has significant impact because of this error. This research examined the main concerns on problems and their impacts associated with construction contract documents(Davis and Led better,1987).In general, contract document errors present problems to all parties involved in the construction process.

According to Wakjira's research (Wakjira, 2011) states that like the other many developing countries Ethiopia is also one of the countries that are highly affected by many project management related issues; from these one problem is contract document error.

Some of construction contract document errors include; dimensional error, missing or incorrect notes on the drawing, errors in cost estimating, design error, error or omission of bill of quantities, specification errors.

1.3 objective of the Research

1.3.1 General objective

- The general objective of this research was to investigate the impact of errors in construction contract document in selected ERA Central region road projects.

1.3.2 Specific objectives

- To identify common errors in construction contract documents.
- To determine the impact of contract document errors.
- To give recommendations of minimizing construction contract document errors.

Research Questions

1. What are common construction contract document errors in ERA central regions projects?
2. What are the impacts contract document errors in ERA central region road projects?
3. what are best recommendations to reduce construction contract document errors in ERA central region road projects

1.4. Scope and limitation of the research

The research in this area is relevant to any construction industry and the problem is universal; however, the scope is limited to a case study to ERA projects (under central region). Distribution of questionnaires, case studies and important data collected from these projects. Construction contract document errors have different impacts in a construction industry. This errors cause variation of cost and extension of time in the construction projects. Therefore, it is important to identify the impacts of errors of construction contract document in construction industry.

The research work was with some problems and limitations which were encountered throughout the preparation of this research. Its main limitation was unwillingness of providing contract error

related information and getting adequate documents from the client part for the study, and shortage of budget.

1.5 Significant of the study

This study aims to identify common errors in construction industry and determining the impact of contract document errors. After identifying the errors and determining the impact, it is important to take the possible measures to reduce the problem arising to the cost and time for this kind of contract document errors. The beneficiaries of the research are the clients, consultants, contractors and researchers.

**CHAPTER TWO
LITRATURE REVIEW**

2.1 The nature of construction industry

Construction projects can best be understood in the context of the whole industry. Technological complexity ranges from the familiar, well-known materials and trades through to highly complex facilities involving multiple interacting sub-systems. Regardless of its technological complexity, any reasonably sized project involves a high level of organizational complexity. This arises because there are many specialized skills and professions with a useful contribution to the process. Most who study the industry do so from the point of view of the profession to which they aspire. Because of this, there are many different descriptions of the construction industry, drawn from different specialist disciplines. This vagueness is compounded by the fact that construction involves such a wide range of activity that the construction industry's external boundaries are also unclear. The term 'construction' can include the erection, repair and demolition of things as diverse as houses, offices, shops, dams, bridges, motorways, home extensions, chimneys, factories and airports; thus, the industry (and issues that affect construction projects) are difficult to comprehend fully because: (John Murdoch and Will Hughes, 2000)

- The relationships between the parts are not always clear.
- The boundary of the industry is unclear.

In the Construction industry, Ethiopia has a rich history of wonderful construction activities.

2.2 Construction Industry in Ethiopia

The obelisk of Axum, the rock-hewn churches of Lalibela and the castles of Gondar are a few examples of this skill. With the arrival of modern civilization, mainly during the reign of Emperor Menelik, there have been some significant developments in this regard. The railway line of Addis-Djibouti is mentioned as an example where such a venture has been successfully carried out. In 1930 During the Italian occupation there were some construction activities, particularly in the development of long trunk roads. After the Italian occupation and before the 1960's, emigrant contractors generally dominated most of the medium and small civil and building projects. (Girmay Kahssay, 2003)

The experiences, as well as the financial benefits were almost completely in the hands of foreigners. Finally local construction businesses owned by Ethiopian professionals developed. It was however a long time before such companies was able to penetrate the international construction market or to be accepted by international financiers for international competitive bidding. (Abate,2002)

Not only in Ethiopia but also in the world construction and contract has a strong relation between them. Construction contract is an agreement between two parties may be from similar country but for international contract at least one of the parties is from different country of the project. (Thomas E and Philip, 2002)

2.3 Participants and their responsibilities in construction projects

Construction is a cooperation, which needs high level of performance from each one in the team. However, it should be noted that, the members who come jointly have different cultural diversity arising from their detailed professions. The key participants in a building project include: client / financier, contractors, sub-contractors, design team consisting of architect, engineers (structural, civil and engineers), quantity surveyor, and a project manager may be included in some projects. These parties come together to form a temporary organization to commence a project in hand for a definite period. This section discusses the key participants in a typical building project and how they are engaged in a project team in order to reflect on relationships existing among the project participants (Stanslaus Karoli, 2011).

2.3.1 Client / Employer

The client in a construction group is the owner or the developer of a building project, and when employs a contractor to undertake the works, is also referred to as the employer. In most projects the client is also the financier of the project although there are projects where the financier may be a different entity. The client can also enters into a contract with the design team (consultants) for design work and supervision of construction works, and a separate contract with general contractor for construction works. The key responsibility of a client when is also a financier in a building project is to finance the project.

2.3.4 Engineers

There are different engineering disciplines necessary in building projects. The most common disciplines are civil, structural, mechanical and electrical engineering. The engineers in line with their areas of specialization are accountable for design and supervision of their respective areas of knowledge. Engineers as is the case of quantity surveyors may be directly employed by the client or may be employed by a design team leader to work on behalf of the client. However, engineers also are employed by building contractors to work on their behalf in particular for supervision and management of construction works.

2.4 Construction Contracts

Construction contracts may be formed between a contractor and a proprietor, between a contractor and subcontractors, between a principal and a designer. The relationships, both contractual and otherwise, between the various parties in the building process have become complex and in many cases quite obscured. It is likely that some co-ordination and contractual problems are bound to occur, resulting in claims and disputes. Because the contractual relationships between the parties to a building contract are not likely to become less complex in the future, every effort should be made to minimize the number of claims and disputes and the impact they may have on the cost of the project. To achieve this, the parties to a contract should know the legal principles governing the formation of contracts. (Thomas E and Philip, 2002). There are numerous contract types used in construction depending on owner and project requirement.

2.5 Types of Construction Contracts

Construction contracts are typically drafted by the Owner or his representative (consultant) and contain the subject matter and terms and conditions. The construction contract is typically comprised of (Ashly & Workman, 1986):

- Bid Form
- Agreement Form
- General Conditions or Standard Specifications
- Special Provisions
- Plans
- Addenda

Construction contracts must also include a compensation system and generally are classified according to the compensation system as follows:

1. Fixed Price Contracts

This category includes all contract types in which financial terms require the contractor to “establish a stipulated sum for the completion or execution of a defined quantity of work”. (Ibbs et al, 1986). Under this category the following types are listed:

a. Lump Sum

The contractor in this type of contract is required to construct the project in accordance with plans and specification for a fixed sum. Contractor will be solely responsible for any cost exceeding the agreed amount. The scope may include or exclude materials, procurement or engineering as agreed.

The term Lump Sum Turn Key (LSTK) is often used to indicate a lump sum contract including design procurement and construction. Sometimes it is referred to as simply turnkey contract. Sometimes the term Design and Build (D&B) is used to indicate a lump sum contract. Another form of lump sum type contract used in industrial construction is the Lump Sum Procure and Build (LSPB).

b. Unit Price

This contract type contains a detailed list of estimated work quantities such as cubic meters of excavated land or concrete or a total length of different pipe sizes. The owner in this case will take the risk of variation in quantity. Actual price paid (fixed) is determined by actual units done as constructed. Unit price contract allows owner the freedom to make changes in the volume of work and permit more control (Ayers, 1988)

c. Guaranteed Maximum

In this type of contracts the owner is guaranteed a maximum price for executing the work as defined in the contract. Normally the contract contains incentive

clauses for cost under-runs and penalty clauses for cost overruns. Ashly and Workman (1986) discussed the effects of incentives in the contract and concluded that they promote an attitude of motivation on the contractual relationship and take the form of inducements, encouragement and threats. The study also indicates that motivations are a tool used by owners to adjust the contractor's fee.

According to Ayers (1988), about 90% of the contracts in construction are one form or another of fixed type contracts. Ayers (1988), believes that fixed type contracts insure by competition that owners get lowest prices possible. Fixed type contracts are, also characterized by well-defined scope and low risk for owners. According to Ayers (1988), the quality of work is usually poor.

2. Cost-Reimbursable Contracts

This category includes all contract types, in which financial terms allows the contractor price adjustment relative to project costs. Ibbs et al (1986) summaries the type of contracts which fall under this category as:

a. Cost plus Fixed Fee

The contractor in this type of contract is paid whatever cost associated with the project plus a lump sum fee for corporate overhead and profit.

b. Cost plus Percentage

In this type of contract the contractor is paid all costs associated with the project plus a percentage of these costs rather than a fixed sum or fee.

c. Target Price Plus a Fee

In this type of contract, a target price is first established for the cost of the project based on contract documents or unit prices. "The contractor's fee will be based on this sum. Typically financial arrangements make provision for the contractor to share any savings below the target price or participate in the liability of cost overruns".

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According to Ayers (1988), cost plus contract insure better quality at higher costs to owners. The block diagram below depicts the contract format division:

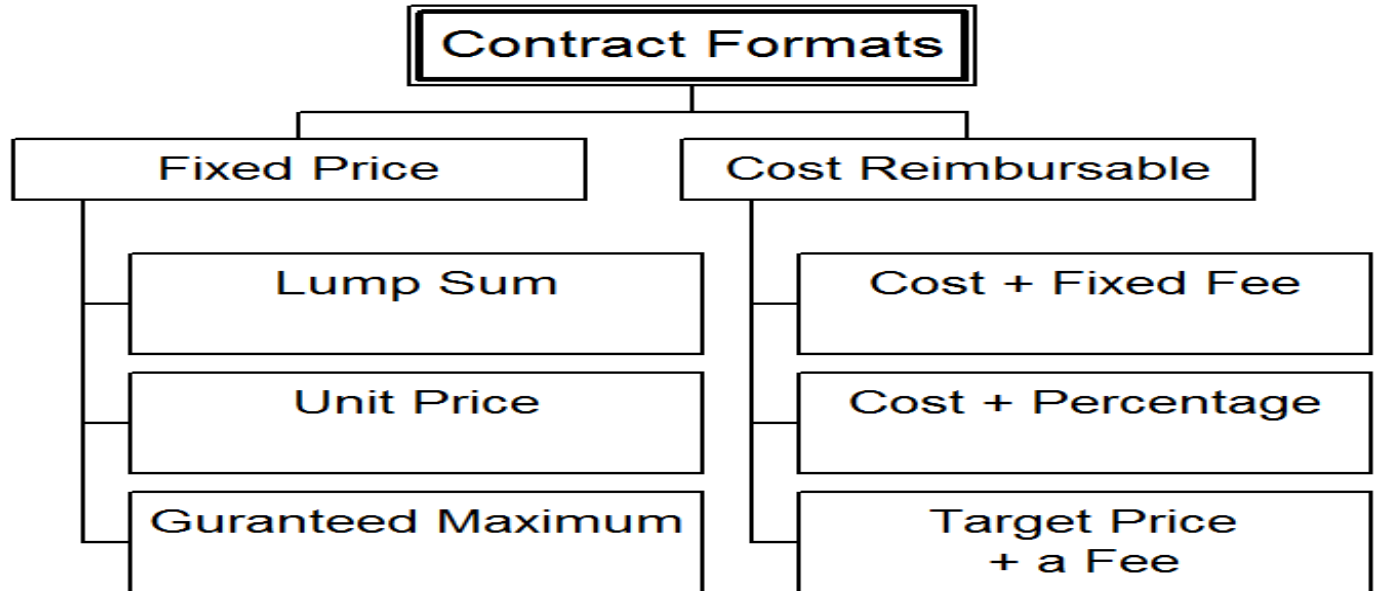


figure 2.11 forms of a construction contract

There are other classifications or names used to describe certain contract formats based on scope or on contractual strategy such as the Engineer-Procure and Construct contract (EPC) which is quite common in industrial construction. Other type includes Build-Own-Operate-Transfer (BOOT) and Build-Operate-Transfer (BOT) contract methods.

The construction contract is prepared by contract document form. The contract represents the whole and incorporated agreement between the parties here to and replace prior negotiations, either written or oral. The contract may be amended or only by modification. The contract document shall not be interpret to create a contractual relationship between:(AIA, 2006)

1. The contractor and the architect or the architect's consultant
2. The owner and the subcontractor or a sub-subcontractor
3. The owner and the architect or the architect's consultant
4. Any person or entities other than the owner and the contractor.

As a construction contract requires the collaboration of services from different people from different backgrounds for its success, it is better if the agreement between them could be clearly documented and is legally binding. This may involve many different contract documents.

2.6 Construction Contract Documents

Many researchers define contract document in different forms, but I selected for this thesis definition of (Mohammed, R.E., 2007) which says, contract document is the written and graphical documentation which communicates in a professional manner and in compliance with regulations and laws for the tendering purpose all needs, wants, and knowledge of the project stakeholder to contractor(s) for the purpose of construction of the project and which enable the client and/or designer a smooth and effective administration during the construction stage within the set objectives of time, cost, and quality.

As civil engineering works are often complex, involving the contractor in many hundreds of different operations using many different materials and manufactured items, including employment of a wide variety of specialists, the documents defining the contract are complex and comprehensive. The task of preparing them for tendering therefore warrants close attention to detail and uniformity of approach, so as to achieve a coherent set of documents which forms an unambiguous and manageable contract. (A.C. Twort et al. ,2004)

2.7. Main parts of contract document are :(AIA 2006)

1. The Specification
2. The contract drawings
3. Bill of quantities or schedule of prices
4. Conditions of contract

1. The Specification

The specifications are that portion of the contract documents consisting of the written requirements for materials, equipments, systems, standards and workmanship for the work, and performance of related services.

“Specification” means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works. (FIDIC, 2010)

2. The contract drawings

The Drawings are the graphic and pictorial portions of contract documents showing the design, location and dimensions of the work, generally including plans, elevations, sections, details, schedules and diagrams.

“Drawings” means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract. (FIDIC, 2010)

3. Bill of quantities or schedule of prices

“**Bill of Quantities**”, “**Day work Schedule**” and “**Schedule of Payment Currencies**” mean the documents so named (if any) which are comprised in the Schedules. (FIDIC ,2006)

Bills of Quantities consist of a schedule, defined as “a list of items giving brief identifying descriptions and estimated quantities of work comprising the execution of the works to be performed”

4. Conditions of a contract

The general conditions includes which outlining the rights, responsibility, and duties of owner and contractor as well as others involved in the construction process (including the designer). Special condition of contract is generated from the general condition of the contract but for specified projects.

2.8. Purposes of Contract Document

Regardless of the contents of contract documents, they have to serve the following purpose (AIA 1994, p703; Murdoch et al., 1997, p143):

- They form a model for the designer's ideas and help to articulate and predict problems with construction and with appearance.
- They communicate to the owner, in detail, what the project involves.
- They establish the contractual obligations, how much the owner and contractor owe each other during the project, and lay out the responsibilities of the designer or any other part of the administrating or managing construction contracts for the owner.

- They may be the basis for obtaining regulatory and financial approval needed to proceed with construction.
- They communicate the quantities, qualities, and configuration of the work required to construct the project. The contractor, in turn, uses the documents to request bids or quotations from subcontractors and suppliers.

During preparation of construction contract document close attention is very important unless otherwise unsolvable contract errors can be happen at the time of construction in terms of cost and time.

2.9. Errors in general

Many researchers investigate different kinds of definition for error. Some of the definitions are as follows;

The term error relates to those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the involvement of some chance agency.(Reason. J, 1990)

Error is something that has been done, which was: not intended by the author; not desired by a set of rules or an external observer; or that lead the task or system outside its acceptable limits. Senders, J.W. et al., 1991)

Errors are the occurrences which were unexpected – involve surprise and which could not be attributed entirely to chance or circumstance. (Busby, 2001)

Generally from the above definitions, error in construction documents is unwanted condition and the non-fulfillment of intended requirements in the construction documents which will have an influence on one or more of the time, cost, and quality of the project.

2.10. Contract document errors

Some of construction contract document errors include; design error, error or omission of bill of quantities, dimensional error, missing or incorrect notes on the drawing, and errors in cost estimating, specification errors are major errors. Survey result shows that most of the time contract documents are not usually well written. There are many errors and omissions in many

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parts of the contract and specifications, which results in several problems or claims during construction. (Al-Subaie, 1987).

Contract document errors always lead to claims from contractors for extension of time and additional compensation. When owners have tight budgets or are unwilling to pay more for a project, a dispute results. The dispute leads to further increased costs. (Revay, 2010)

The bad cases of lost time and cost in construction projects are the result of errors and omissions in the construction documents. Many of these errors, unwanted by any of the designers, unforeseen but not unavoidable, could throw site work into confusion. (NEDO,1988).

Elimination of errors in construction documents plays a major role in achieving the objectives of the project. 56% of all contract modifications are made to correct design deficiencies. (Kirby J. G. et. al. 1988)

In UK 25% of variations on construction works is the result of inadequate consideration of design and 16 % defect occurs in contract documents.(Hibberd, P.R., 1980)

The research of (Burati et al.,1992) founded that design change accounted for 67-90% of the total number of deviations on the project and that the design deviations generally accounted for the greatest increase in total project cost, ranging from 0.4% to 20.6% of the total project, with an average of 12.4%.

The impacts of design errors or design deficiencies, such as terrible failure or death, have been frequently reported in many professional publications and newspapers (Andi et.al, 2003).For instance, the collapse of Melbourne's West Gate Bridge in 1970, which killed 35 people and injured many others, was primarily due to the errors upon errors committed in its box-girder design.(Public Record Office Victoria, 2005). The most serious case was the collapse of the hanging walkway at the Hyatt Regency Hotel in Kansas City in 1981 which killed 114 people.(Banset et.al, 1989). This failure was caused by a design error in a box beam hanger rod connection supporting a walkway, which arose because of poor communication between the engineer and steel fabricator.(Hauck, 1983). As a result of this accident, injured victims, guests of the hotel who observed the collapse, and rescue workers all suffered psychiatric symptoms. (Wilkinson, 1983)

The primary sources of amend in construction, naturally, are the documentation on which the construction activity is based. These largely consist of design changes, errors and omissions indicates that deviations on the projects accounted for an average of 12.4% of the total project costs, and design deviations average 78% of the total number of deviations, 79% of the total deviation costs, and 9.5% of the total project cost.(Burati et. al., 1992). Finally to minimize errors and omissions, discovering the types of error has a great advantage during preparation of contraction contract documents.

2.11. Identification of errors in contract documents

The finding of errors within contract documents show different scale and character during different stages of producing the contract documents. This can be credited mainly to the function of the contract documents at such stages and the people discovering such errors. In particular, the nature of error' types discovered in the contract documents showed the following behavior at each stage (Mohammed R.E., 2007):

a. Design project team

The design project team includes all members involved in the production of the contract documents. The members of the team encounter different sources of errors (e.g. client, identifying project requirement, time constraints, design management etc.) during the process of producing the contract documents. The design process is a stage wise modification of specifications where vague needs and wishes are transformed into requirements, then via a varying number of steps, to detailed designs. Simultaneously, this is a process of problem detection and solving (Koskela, 1992). The design team finds out these types of errors in the process of preparing the contract documents and before the tendering process. However, the quantification of such errors is difficult, as designers think such lack of details and inconsistency as part of the process of developing the documents. It will depend mainly on the availability of members of the design team and retaining good records for documents during different stages.

b. Tender questions

Tender questions are a good source of estimating the extent of errors in the contract documents. It is normally easier to calculate the cost of these errors. The disadvantage of this process especially in the case of lump sum contracts - is that the contractor might hide some errors that are in his favor, or he can claim later during the construction stage.

These types of errors are associated mainly to those which have cost and time implications for the contractors.

c. Quality assurance documents

Quality assurance (QA) documents are also a good source for getting the number of errors in the contract documents where QA approaches exist. QA is normally passed through by the design team as an internal quality assurance and control (Stasiowski et al., 1994), or it can be carried out by the client if he has the experience. The drawback of this is that it does not discover all types of errors and missing items, particularly when the reviewer(s) do not have enough experience. QA normally focuses on coordination problems and the general look of the drawings as per the office procedure.

d. On-site construction phase

These relate to errors examined during the construction phase. They are discovered either by the supervision team or by the contractor. They are normally recorded in variation lists to claim either money or extension of time. The errors are usually a place for dispute between client, contractor and the supervision team. Some errors are not usually registered because they have been sorted out between the supervisor and the contractor.

e. Correspondence

Some errors may be identified in the correspondence between client and consultant regarding the project. The correspondence may include letters, faxes, emails, reports, and minutes.

f. Client feedback

These relate to errors only discovered by the client during the operation phase of the project. (Hammarlund et al., 1991) estimated quality failures that have occurred after a project has been completed to be as high as 4% of the actual project's production cost. Interestingly, the origin of defects occurring during maintenance is principally in design; 51% of these failure costs were found to be design related, while 26% were related to poor installation of materials and 10% to material failure. These errors are related mainly to designer errors, lack of knowledge and experience. The occurrences of this type of errors are few compared with other types of errors.

2.12. Common Types of contract document errors

It is necessary to identify types of construction contract documents errors because once an error has been identified it is possible to take action to address it. Some of these errors include the following; (Mohammed, 2007)

- Dimensional error
- Errors in cost estimating
- Designer errors
- Errors and omission in the bills of quantities
- Errors in Specification
- Incorrect or missing notes on the drawing
- Document not meet design criteria of the client's
- Soil investigation errors.

1. Dimensional error

Before dimensioning there must be a brief understanding of the sequence of construction, for new gatherings can only be located relative to assemblies already in place.

All important numerical dimensioning should be indicated on the drawings. The contractor is not permitted to depend on scaling the drawings for dimensioning; the drawings should contain the minimum dimensioning consistent. Most dimensional errors can be easily prevented if the proper guidelines for dimensioning are followed (Mohammed, 2007).

Dimensional errors include:

- the dimensions do not add up,
- conflict of dimension between drawings,
- details, and
- Schedules.

To minimize this type of error, one should refer for example to AIA dimensioning guidelines for the set of standards for dimensioning drawings. (AIA, 1994)

2. Errors in cost estimating

Based on the available contract document, the consultants are providing cost estimates because part of some contracts is to the client. Therefore, if this service provided and found to be wrong after the bidding process, it will be considered an error according to the above definition. The most important decisions of the client are based on this estimate. Then, it will be considered a serious error that overcome the purpose of the construction documents (Mohammed, 2007)

Many companies realize that budget overruns are not necessarily the result of bad project control/cost control work, but are rather the result of bad capital cost estimating and budgeting work. Evidently many unfortunate budget and control estimates could have been drastically improved if some simple and well-known facts had been implemented. (Sigurdson A.,1996)

Dimensional error will be discovered during the tendering stage, when the bidders submit their offer to perform the work. The designer may have to do the exercise of minimizing the cost of the project or revise the documents to stay within the client budget if he had signed a contract of guaranteed maximum cost.

3. Designer errors

These types of errors are the most serious as they are related to the pure mistakes of the designer owing to the lack of education, knowledge or experience. They include missing item(s) and missing consideration of some important item(s) in the design.

These errors may cause the failure of the documents to deliver the purpose of the project. (Kasiem Seid,2008) Errors in the design stages of the project are the result of the lack of understanding and incorrect interpretation of customer requirements. (Love et al., 1999)

4. Errors and omission in the bills of quantities

Researchers identified errors and omissions in the bills of quantities as a main source of variations in the construction projects (NEDO, 1988).

The practice of pricing the project in most contract procurements is dependent on the bills of quantities. However, the influence of this type of errors on the project depends on the procurement of the contract selected for the execution of the project.(Kasiem Seid,2008)

The main types of errors under this are:

- wrong description items
- missing of items in the bills of quantities
- wrong measurement
- the item is included in the bills but not shown in the drawings
- wrong unit measurement

5. Errors in Specification

The specifications present written requirements for materials, equipment, and construction system as well as standards for products, workmanship, and the construction services required to produce the work .(AIA,1994)

Errors include missing items in the specification, items included in the drawings but not in the specification or vice versa, items do not conform to client / discipline criteria, the list of applicable applications incorrect, or inconsistency with industry practice. (Kasiem Seid,2008)

6. Document not fit design criteria of the client's

The client usually puts criteria's for the scope, quality, and budget of the construction project. According to the definition of error, if the construction documents constraint set up by the client in the brief, this will be considered as an error. (Mohammed, 2007)

Contractually, the designer has to develop a design solution based on the approved project requirements and constraints. The client has the right to pursue the designer to correct the error if it has been proved that the construction documents failed to address the requirement of the client brief. Failure to address the requirement(s) of the client at the early stages of the documents' development process will raise the cost of change at a later stage.(KasiemSeid,2008)

7. Incorrect or missing notes on the drawing

The notes are the text on the drawings which convey the intent clearly, describe the contents or set up the conditions for the applicability of the design in the drawings. (AIA, 1994)

Written information on drawings causes poor coordination because when making revisions it can be difficult to make sure that all affected drawings are changed. Construction Project Information Committee (CPIC, 2003)

Explanation should be put on drawings only for good reason, and if there is not a good reason it should not be given.

8 . Soil Investigation errors

Soil investigation is the investigation of the geology and previous uses of any site, together with the determination of its engineering, environmental and contamination characteristics is fundamental to both safe and economic development.

There is always a geotechnical survey and site visit before starting the design of the project, but it has been found that some errors occur in the contract documents which neglect some important factors which are critical in the design of the project, such as soil characteristics, site contours, and the access to the site.

Appropriate differences, such as limited working areas or weather have been found to weight construction costs significantly. This type of error is mainly the result of missing or misleading information regarding the project site. It will lead to delay of the start up of the project and compensation for the contractor to correct the documents as per the site condition(s) and requirements. (Arics, 1987)

2.13. Sources of Contract Document error

Errors occur in all phases of the building process: planning, design, construction, and utilization. In the most general sense, it is useful to think of error as the agent that causes things to go wrong (Knoll, 1982). More specifically, an error is an unintended departure from accepted practice (Nowak, A., and Carr, R, 1985) or a fundamental avoidable mistake, (Douma, 1973). Errors are caused by people as a result of influences that are not considered properly. Not all errors are dangerous, and some that are not may actually contribute to structural safety, (Melchers, R. E., and Stewart, M. B, 1985).

A simpler classification system for errors, (Nowak, A., and Carr, R, 1985) identified three basic types of error (and the human characteristics giving rise to them) as:

- (1) Errors of concept (stupidity, ignorance);
- (2) Errors of execution (carelessness, forgetfulness, negligence); and
- (3) Errors of intention (venality, irresponsibility).

The first type includes loads not envisioned, incorrect assumptions, and incorrect analytical modeling. Discovery of new potentially active faults, failure to consider soil-structure interaction, and nonlinear material behavior or large deformation behavior fall into this category.

The second type includes calculation or detailing errors, mistakes in reading drawings and

specifications, and defective workmanship. Finally, the third type includes unwarranted shortcuts to save money, substitution of components that may not be equivalent to those originally specified, and acceptance of marginal workmanship in order to maintain construction schedules.

2.14. Causes of errors in construction contract documents

To understand why errors occur in the first place, the factors which cause and motivate their occurrence have to be identified, it is important to understand the inherent factors and the mechanisms whereby errors occur, (Wilkinson, 1983).

Causes for the occurrence of construction contract document error are;

- Management
- Designers
- Clients
- Project Characters

1. Management

We categorized factors on management as follow;

a. Management organizational structure

Organizational forms that achieve effective communication are appropriately responsive to client objectives, project and external environment characteristics, management style, and the organizational cultures of project stake holders. (Morris, 1994).(Walker, 1989, p210) highlights the complexity of designing organizational structures based on interdependency and relationships between teams.

Many factors shape the ultimate management structure that will be effective. Such factors include company policy, client characteristics, the industrial relations, climate prevailing at the time of project and available skills of the proposed team which itself may be affected by changing technology. (Walker, 1990/91)

b. Project manager experience

The experience of the project manager in handling previous projects of the same nature will help in guiding the project to establish the consequence of decisions and preventing errors which occurred in previous projects in selecting the most efficient and effective project team members, in selection of the proper procurement of handling the project, and transferring the risk to the proper party of the project team. (Mohammed, 2007)

c. Project brief

It described background information for a construction project. According to Nina's study, 'The project brief defines the project in terms of quantities, quality, costs and time. The brief describes specifications with regard to functions, connections, area needs, technical systems, working environment, architectural design, budget, etc. (Nina, 2004)

The project manager prepares the project brief in coordination with the client. The project brief purpose is to make sure that the project team members understand the client requirements and are updated with current requirements and plans.

The brief may include (AIA-1994, p559):

- Review of project requirements as developed by the client and the designer. This may cover project goals, scope, quality, schedule, budget, codes and regulations, key design and construction standards, and other project information.
- Review of the project work plan, critical tasks, responsibility uncertainties, and potential problem areas.
- Review of schedule and milestone dates.
- Review of project policies. These include (as relevant) project responsibility and authorities, client structure and relationships, approaches to identifying and resolving problems, team meetings and communications, project charges and reports, and other key management issues.

2. Designer

Designers can contribute to construction productivity in a number of ways without detracting from the quality of design. Complicated design details may not necessary lead to high cost, and

design details that may appear simple and straightforward may prove to be expensive. (Mohammed, 2007)

So for designers, the following factors have influence on for the generation of errors in the contract documents:

a. Design process

(NEDO, 1987, p3) states; “The design process is difficult enough to control when there are several disciplines to bring together, each of which can affect the performance of others. If information is incomplete or erroneous at time of tender, tenders have little chance to assess the resources required and price accordingly. The customer’s principal advisor should coordinate the contributions from all the design specialists”.

b. Design Management Experience

Designer experience is the knowledge or skill of a particular job that has been gained because of working at the job for a long time. This is related to the experience of project Lead Architect / Lead Engineers (sometimes he is the Head of Discipline) who is responsible for guiding other member of the team to finish the work. His/her experience and knowledge will affect the number of errors generated in the contract documents. Enough design experience for the type of the project in hand influences the number and types of errors in the construction documents. (Rukn Eldeen, 2007). (Coles, 1990) found that the most significant causes of design problem are poor briefing and communication, inadequacies in the technical knowledge of designers and lack of confidence in preplanning for design work.

c. Designer professional education

Generation of an error depends on the designer’s amount and quality of education they have. Proper education provides all the necessary knowledge about the process of the developing the documents, how to solve problems, how to communicate and coordinate with other disciplines, etc.

d. Designer experience

Enough design experience for the type of the project in hand influences the number and types of errors in the construction documents (AIA 1994, p453). Similarly, (Burbridge, 1987, p16) identified lack of technical expertise as a main cause of failure in design quality. Lyneis (Lyneis et al., 2001) is of the opinion that less experienced people make more errors and work more

slowly than more experienced people. However; Franken Berger (E. Franken berger et al., 1998) found that experience has nearly no relevance for deficient analysis and decisions. This was because a lack of experience can be balanced by other factors, e.g., the theoretical education, the motivation and /or the open-mindedness of the designer. Very often, the consultation of colleagues in the design process compensates for a lack of experience.

A realistic time schedule for design is important for the number of errors generated in the construction documents. (AIA, 1994) Designers regarded insufficient design time as the most important issue influencing design document quality (Andi and Takayuki Minato, 2003).

e. Design fees

Several researchers write about unsatisfactory fees for professional services and financial pressure as causes of errors. Where designers are selected based on low design fees, then the level and quality of the service provided is likely to be limited and generally translates into additional project costs to the owner (Abolnour, 1994). Similarly, the expected profit from the project influences the generating of errors in the construction documents. (Bubshait et al., 1998; AIA 1994, p453). Also, research by Andi (Andi et al., 2003) found that designers regarded the client's tendency to shop around for design fees and a low design fee as most important factors affecting the quality of design documents.

f. Design time

A realistic time schedule for design is important for the number of errors generated in the construction documents (AIA 1994, p450). Andi (Andi et al., 2003) found that the designers regarded insufficient design time as the most important issue influencing design document quality. (NEDO, 1987, p17) citing Building Research Establishment (BRE) studies of communication and control of quality on a wide variety of no housing projects, stated that "Projects with quality problems were often those which are behind with their program. Tight contract times did not necessarily militate against quality".

3. Client

The client is the entity that identifies the need for a building and is the genesis of the construction process. The client defines project objectives independently or in conjunction with advisers. Shaping a project's scope and complexity, therefore, lies very much in the hands of the client and project inception team. "Clients who get the quickest result are those who provide the building

team with well- defined specialized needs and are able to become closely involved with the building process.” (Sidwell A.C, 1984)

If the client has clear, well-enunciated goals which are effectively communicated in the briefing and team selection process, then it can be expected that a better climate exists for goal congruence. A better chance of project success is a consequence of this. The client also needs to have a clear idea of the expected performance and reputation of key project team members to build effectively a project team that has a promising chance of success.

A client who is cooperative with the project team will help in minimizing his distractive influence in the project. The committed client can play a crucial role in assuming responsibility for initiating, directing and maintaining momentum of a project .(Walker, 1994)

a. Type of client (private, government)

(Sidwell, 1982) established that public clients, who may well, as an organization, have much experience of commissioning buildings and many similar buildings, can experience higher cost and time over run compared with privately funded clients. He explains this in part by drawing attention to bureaucratic procedures that are publicly funded and to which some privately funded clients are subject.(Kaka and Price,1991,p398) in a study of 801 UK projects conclude that public buildings take longer to build than private ones of similar construction cost. According to Walker found that government projects are likely to take longer to construct than similar private sector client projects. (Walker, 1994). He also found that the client’s sophistication needed to be measured in terms of performance (rather than designation of being from the public or private sector or experienced in terms of having being involved in few or many projects).

b. Client experience

Less experienced clients may have unrealistic expectations of consultants. They may expect more than the law requires of architects and will be disappointed with anything. A client who is experienced and sophisticated in terms of project management may choose to take the initiative and lead the process. In many instances the client is a corporation, government department or syndicate of joint ventures. (Mohammed, 2007).

c. Attitude of Client

Client attitudes will be the key in achieving the most effective and efficient construction industry in the world. This was just one of many messages delivered at "The Big Debate", part of the Constructing Excellence conference held at the DTI Conference Centre, London, on 22nd November 2004.

A client who is cooperative with the project team will help in minimizing his distractive influence in the project. The committed client can play a crucial role in assuming responsibility for initiating, directing and maintaining momentum of a project (Walker, 1994).

4. Project characters

The project characters influence the number of errors generated in the construction documents, because they establish the size, budget, time frame for getting the construction documents. These factors are factors that the design team should be able to manage properly in order to minimize the number of errors generated in the construction documents. (Mohammed, 2007)

a. Project Budgeted cost

(Rosemond, 1984) and (Rowland, 1981) found that the errors rate increased when the winning bid was below the client estimate. A comparison was made by Charles et al. (1991, p550-51) between contracts with award amounts differing from the estimate. It was found that contracts with award amounts less than the estimate were more likely to have a cost overrun rate above 5%. This difference may indicate a lack of understanding between the owner and designer regarding the scope of work.

b. Project size

Study (Rowland, 1981) has shown that the project size influences the number of errors. Because the stakes are higher on larger projects, more care may be exercised in the bidding and planning process; thus, the cost overruns may be reduced. However, larger projects are generally more complex, and the complexity may increase the number of errors. The review of the literature indicates support for both conflicting views. (Randolph et al., 1987) found that the number of errors decreased as the contract size increased, while (Rowland, 1981) found the errors rate increased as the project size increased.

c. Project Quality

The existence of a proper quality system in place owing to the nature of the project will minimize the number of errors generated in the construction documents and it will reduce the time spent redoing services caused by the consultant's mistakes .(AIA994, p388).

2.15. Impacts of contract document errors

Construction contract document errors have different impacts on a construction project. Some of the impacts lead to raise claims for extension of time and compensation of costs. In addition to this, it causes delay the commencement of the execution of the project when the designer tries to minimize the cost to stay within the client budget and in some case because of the seriousness of the impact, it might lead to the cancellation the project, if the estimate is beyond the capacity of the client. Dimensional error might affect the duration of the project when the contractor has to wait for explanation from the designer about contradictory or missing dimensions.

When we see the impact of errors and omission in the bills of quantities, it may raise many questions during the tendering stage and will create a poor impression of the designer when the contract is based on a lump sum price. When an item in the bills contradicts other documents, it might lead to a claim for cost compensation and a request for time extension during the construction stag. Not only this but the impact of document not feet design criteria of the client's is a vast error to the client, because of the project does not fulfill his/her requirement, and this can raise the cost of the project to become varied and makes dalliance of the delivery of the project time for the designer, it might raises a legal case against him and at this time the court can judges the designer himself must cover the revising cost of the construction contract documents. (Mohammed, R.E., 2007).

Generally, if there is an error in a contract document, the most serious impact is large quantity of changes to the work with respect to time and cost. It comes as a result of: (Revay, 2010)

- Errors and omissions on the drawings and specifications leading to revisions
- Additional requests from the owner
- Unforeseen site conditions on which should have been identified through earlier investigations
- Lack of essential coordination

2.16. Developing the quality of the contract documents

Quality of the contract documents has a major influence on the overall performance and efficiency of construction projects (Burati et al., 1992; Lutz et al., 1990; Kirby et al., 1988), and any improvements in the document quality can only lead to corresponding improvements in the efficiency of the construction process (Tilley et al., 1999). Defective designs get a negative impact on project performances and the participants (Andi and Minato, 2003) and are responsible for many construction failures (Sowers, 1993). Efforts are therefore made to reduce them.

To improving the performance of the construction industry through increasing the quality of contract documents can be a solution for the problem. Then the following are some of the practices that have been suggested as a means of increasing quality of contract documents.

a. Partnering

Partnering has been recommended by many agencies as a possible solution for reducing the difficult nature of construction. As a result, partnering has become a popular event for attaining specific project objectives such as safety performance, quality improvement and time and cost saving. Partnering also may be used to improve contractual relations and communication, and increase understanding between participants (Cook, 1990, pp 431-446). Similarly, Weston and Gibson found that the use of partnering has a good impact on reducing project time and cost (Weston et al., 1993, pp410-425). These quality improvements are the result of the sharing of knowledge between the contractor and the designer about buildability and constructability.

b. Constructability

It has been recommended that the use of the constructability analysis could broadly reduce design and construction rework (Love et al. 1998; Mc George et al., 1997). A publication prepared by the Construction Industry Institute (1986) suggests that savings on the order of 6-2% of original estimate are achievable through proper constructability review (Construction Industry Institute, 1986, pp6-12). Constructability is a strategy that can be used to achieve optimum combination of construction knowledge throughout the procurement process, as well as balance various project and environment constraints so as to maximize project goals and building performance. This is done by using the knowledge and experience of key design and construction personnel during the design process so as to improve teamwork, planning and scheduling of site operations, which in turn can translate into surprising project performance in

terms of time, cost, and quality. Projects where constructability has been specifically addressed have reported saving of 6%-10% of construction costs (CMC, 1991).

c. Design review management

Several problems related to time and cost growth result from errors of inadequacies in the contract documents. Technical design reviews and biddability, constructability, and operability reviews during the design phase can aid in detecting omissions, ambiguities, and inadequacies in the design, substantially reducing contract adjustments or change orders during the construction phase (Construction Industry Institute, 1986; Kirby et al., 1988). Also the Architects / Engineers are responsible and increasingly recognizing the impact of design reviews in reducing the risk of errors and omissions claims against the design professionals and the potential of subsequent litigation. The organization of a formal design review programme carried out by qualified professionals is the most effective means of identifying deficiencies and incorporating improvements into the contract documents. The process of reviewing contract documents for accuracy, completeness, and corrections is widely recognized as being integral to the proper execution of professional design services. Such reviews should be undertaken by the designer of the record of detecting and correcting errors, omissions, and technical deficiencies and are motivated by the desire to minimize the firm's exposure to liability. The maximum potential of design reviews occurs when they are conducted early in the conceptual design stage and diminishes as the design effort proceeds to completion (Kirby et al., 1988).

d. Sequencing the work process

According to Dr W. Edward Deming (Stasiowski et al., 1994) every work is a process that can be represented by a flow chart. This is particularly true of design projects, which have a natural sequence of activities that lead to the most efficiently produced product. Variations from this natural sequence introduce rework and errors, which cost time and money to correct. This natural sequence can be determined by preparing a task precedence diagram for each project. After shaping the natural sequence of activities, the project manager can evaluate the impact of design changes throughout the project. Change can be made at relatively low cost during the early stages of a project; however, once the size of the project team begins to increase, every minor change has the possibility for generating many costly errors.

2.17 Literature summary

Different literatures shows that construction contract document error is the major problem of construction industry and from these construction sectors road projects are highly affected by this problem. The problem is a global phenomenon in the construction industry where developed and developing countries are facing the challenge of completing the projects within the budgeted cost and time.

In general, this literature review part of the thesis mainly focused on to investigate the impact of errors in construction contract document in selected ERA Central region road projects from previous studies.

By reviewing different literatures 65 causes that leads road projects to contract document errors were identified and used in the questionnaire survey.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study Area

The research was conducted on ERA Federal Road Projects that are completed and substantially completed in the recent years and executed by different contractors in Central parts of ERA projects of Ethiopia Region.

3.2 Research Design

A descriptive and exploratory survey design was used in this research. This research is exploratory type because it concerned on gaining ideas and approaching about Impact of errors in contract document, and it is a descriptive type because it tried to describe types of contract document errors and their impacts in Ethiopian roads authority road projects. The research was conducted first by identification of common contract document error literature review and desk study on selected road projects and then from the findings questionnaire was developed and distributed to the client (ERA), contractors and consultants and client to assess their insight about the impacts of errors on contract documents.

3.3 Population

The population for this research were contractors, consultants, and client (ERA), who participates on Ethiopian Roads Authority Central Regions Road Projects.

3.4 Sample Size

For this study, the sample population composed of professionals from client organization (ERA), consulting firms, and contractors, who participated in the construction of road projects. These includes project engineers, office engineers, contract administrators', project managers, construction managers' project team leaders and resident engineers.

Structured questionnaire survey was carried out by distributing a total of 65 questionnaire sets. It has been distributed to 20 client (ERA) employees, 30 contractors firms, and 15 consultant firms. From these distributed questionnaires, 47 responses were received back. However, some of the questionnaires were not completed which were considered as invalid and not used for further analysis.

3.5 Data Collection process

In order to conduct this research the collection of data was done through using questionnaire survey approach and desk study for selected road projects that are executed on Ethiopian roads authority in the central region road projects.

3.5.1 Questionnaire approach

A questionnaire was used to evaluate the perceptions of client (ERA), consultants, and contractors on the issues of impacts of error on contract document and common errors of contract document in Ethiopian roads authority central region road projects. The respondents of the questionnaires were first asked to give general information about the organization they are working and their work experience, and then they are asked to give value by the occurrence of errors as shown below.

Occurrence of contract document errors

- 1- No Occurrence = (0%)
- 2 -Very few = (25%)
- 3 -few = (50%)
- 4 -High = (75%)
- 5 Very high = (100%) significant

3.5.2 Desk Studies

To conduct this study, four road projects were selected purposively for desk study analysis to gain real data from all the relevant documents of each projects such as correspondence letters,

project progress reports, payment certificate and project completion reports were thoroughly investigated to identify impacts of error in contract document in Ethiopian roads authority central region road projects.

3.6 Data Processing and Analysis

The collected data was analyzed using Microsoft excel software and relative importance index formula to determine the occurrence of contract document error on Ethiopian roads authority central region road projects.

$$RII = \sum W/A * N$$

$$(0 \leq RII \leq 1)$$

Where:

W – is the weight given to each factor by the respondents ;

A – is the highest weight and;

N – is the total number of respondents.

Finally, Spearman's coefficient of rank correlation was used to test whether there is agreement or disagreement among each pair of parties (respondents) in ranking Errors of construction contract document on Ethiopian roads authority central region road projects. The pair of parties tested for agreement are clients versus consultants, clients versus contractors, and consultants versus contractors. Spearman's formula is given as

$$\rho = 1 - 6 \sum d^2 / (n^2 - 1)$$

Where

ρ = Spearman coefficient

d = the difference between ranks

n= number of subjects or pairs of ranks

**CHARTER-FOUR
FINDINGS AND DISCUSSION****4.1 Identification of common Errors in contract document**

This section of the research focused to investigate common contract document errors in Ethiopian roads authority central region road projects by analyzing four different road projects. Based on the data gathered from questionnaire, desk study and literature review common contract document errors are;

Table 4.1 common contract document errors

S. No	Main contract document errors	S. No	Main contract document errors
1	Errors and omission in the bills of quantities	10	Coordination problem
2	Errors in capital cost estimating	11	Contradicting statements
4	Incomplete drawing / details needed	12	Lack of experience
5	Ambiguity or Vague statements	13	Using inappropriate codes
6	Missing or Incorrect notes on the drawings	14	Copy and paste of the whole condition of contract from other general condition
7	CADD (Computer) related problems	15	Incomplete general condition
8	Dimensional errors	16	Statements do not describe clearly the type, size, or method of fixing.
9	Errors in symbols and abbreviations	17	Bearing capacity test error of the soil

Errors and omission in the bills of quantities

Researchers identified errors and omissions in the bills of quantities as a main source of variations in the construction projects (Choy and Sidwell,1991).

It was ranked as first place and most important error of contract document with $R_{II} = 0.921$ as agreed by all the respondents.

During the construction stage, when an item in the bills contradicts other documents, it might lead to a claim for cost compensation and a request for time extension.

Errors in capital cost estimating

The consultants are given that cost estimates as part of some contracts to the client, based on the obtainable documentation. Therefore, if this service provided and found to be wrong after the bidding process, it will be considered an error as per the definition stated at the beginning of the chapter. Most important decisions of the client are based on this estimate. Therefore, it will be considered a serious error that defeats the purpose of the contract documents.

The rank for this error was the second, $R_{II}= 0.916$. The error is severe in some situations as it might lead to the cancellation of the project, if the estimate is ahead of the capacity of the client.

Incomplete drawing/detail needed

incomplete drawing/detail needed resulting in extra construction cost and time and the documents as they are do not transfer the information clearly to the contractors for construction purposes. The documents need more detail to be clear and understandable because of the ambiguities in the current situation of the documents.

It has been ranked by all respondents in second place with $II=0.904$ as the third most important contract document errors.

Ambiguity or Vague statements

Ambiguity or Vague statements like, statements that conflict with other statements, or parts of the same statement that conflict with each other. It might lead to a change in variation orders as the contractor might price for item as per his understanding only.

It was ranked as the fourth most important error with $RII=0.896$ according to all respondents point of view

Incorrect or missing notes on the Drawings;

error includes the note is not applicable to the drawings or details, describes wrongly what it is meant to be, or an additional note is needed to make the drawings clear and understandable.

The construction project information committee (CPIC 2003) accepted that written information on drawings is often the cause of poor coordination because when making revisions it can be difficult to ensure that all affected drawings are changed. It was ranked as the fifth most important error with $RII=0.87$ according to all respondents point of view..

This type of error might raise claims for extension of time if notes are missing or the content is vague. It might also raise requests for time extension and cost compensation in the case when the note is incorrect.

CADD –related problem

CADD related problem was ranked as the fourth most important error with $RII=0.843$ according to all respondents point of view. Lack of computer software knowledge, such as Computer Aided Design and Drafting (CADD) software used, and setup of the CADD standards and procedures. The CADD problem increases as the project complexity increases with the reality that more people and even firms will work simultaneously on the same project.

This type of error may influence the duration of the project and raise claims from the contractor(s) as more time might be needed to resolve problems and update drawings or preparations of the shop drawings.

Dimensional error

These errors include the dimensions do not add up, scaling error, conflict of dimension between drawings, details, and schedules. It was ranked as the eighth most important contract document error with $RII=0.837$ according to all respondents point of view. This type of error might affect the duration of the project as the contractor has to wait for clarification from the designer about conflicting or missing dimensions.

Symbol and abbreviation errors

Symbols and abbreviation errors was ranked as the fourth most important cause of cost overrun with $RII=0.813$ according to all respondents. The need to communicate a great deal of information in inadequate space commonly dictates the use of many symbols and abbreviations. Descriptions on the drawings should be consistent and be coordinated with those used in the other parts of the construction documents, such as schedule, specifications etc. (AIA, 1994).

This type of error will lead to misunderstanding and confusion about the documents which might lead to needs for extension of time resulting from time wasted while waiting for a reply from the designer.

coordination problem

it was ranked as the last most important error, $RII= 0.773$ of the errors in ERA central region projects referred to this type of error which occur within one order e.g. the coordination problem between plans, elevations, sections and the detail drawings, between the calculations and the drawings, or between the drawings and the specifications.

This type of error is not discovered during the construction documents process, but it will raise problems later in the construction stage and raise claims for extension of time and sometimes compensation of extra costs.

4.2. Determination of impacts of Contract document Error.

This part of the study provides the analysis and the results to meet the second objective of the thesis, which focused on the determination of impacts of Contract document Error on road projects. In order to determine these errors review of different literatures related to impacts of contract document error and desk studies for selected road projects were done.

For this study, four road projects were analyzed for desk study. All of these projects experienced contract document problems due to additional cost and extension of time for construction.

A. Additional project cost due to contract document error

The Figure below shows the original contract amount and final contract amount within Ethiopian road authority central region of selected road projects.

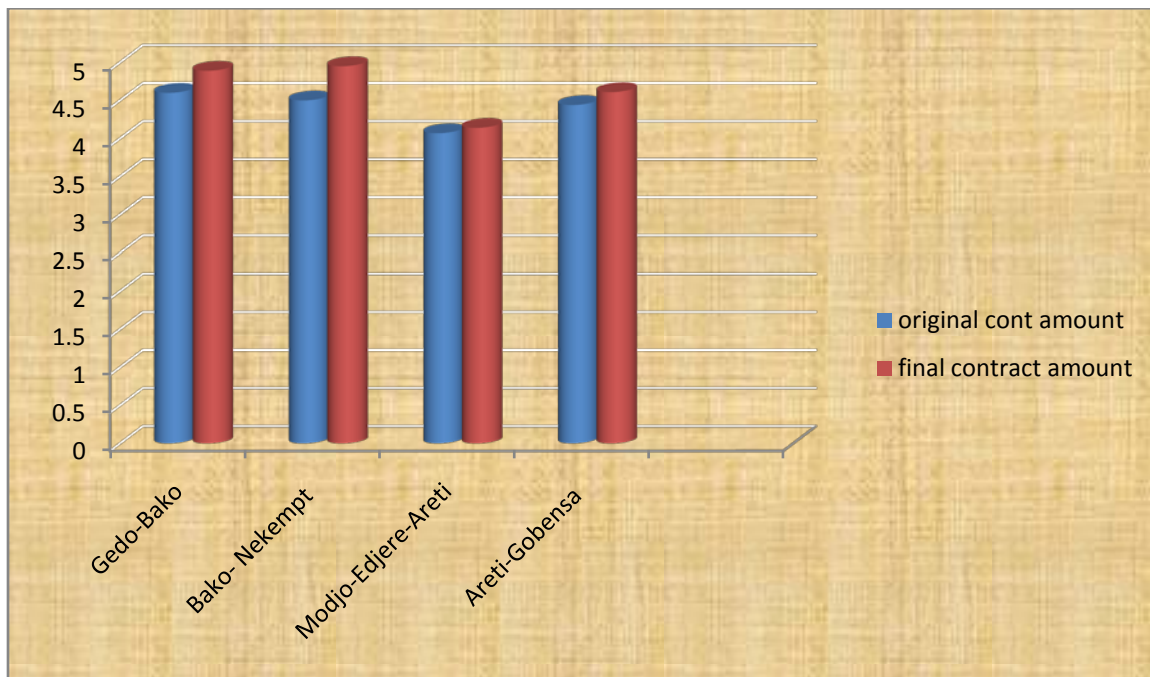


Figure 4.1 Original Contract Amount vs. Final cost of the selected road Projects

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Table 4.2 original contract amount and final contract amount of the projects

S.N	Project name	Original Contract amount (ETB)	Final contract amount (ETB)	Variation cost (ETB)	Additional project cost(%)
1	Gedo-Bako	488,251,320.12	495,490,000	7,238,680.1	1.482573
2	Bako- Nekempt	480,850621.11	489,642,000	8,791,379.2	1.828297
3	Modjo-Edjere- Areti	407,320,609.16	414,485,516.15	7,164,907.01	1.759034
4	Arerti-Gobensa	444,696,050.11	461,323,773.85	16,627,724.05	3.739121
	Average				2.202

To investigate the difference between the contract amount and the final cost of the project the formula shown below was used.

Final contract amount (ETB) -Original Contract amount (ETB)= variation cost

when we have seen from table 3.2 and figure 3.1 all of the investigated road projects have suffered from additional project time that ranges from a minimum of 11.11% to a maximum of 121.05% of the original contract time for single projects and these analyzed projects have an average additional project time of 61.43% of the original completion date.

B. original completion date and final completion date

Table 3.3 below shows the original completion date and final completion date plus percentage of additional time due to contract document error for investigated Ethiopian road Authority road projects.

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Table 4.3 original completion date and final completion date plus percentage of additional time

Serial No.	Project name	Original Completion date(months)	Final Completion date (months)	Extension of time (months)	Additional project time(%)
1	Gedo-Bako	36	40	4	11.11
2	Bako- Nekempt	30	36	6	20
3	Modjo-Edjere-Areti	31	60	29	93.55
4	Arerti-Gobensa	19	42	23	121.05
	Average				61.43

The Figure below shows the original completion date and final completion date within Ethiopian road authority central region of selected road projects.

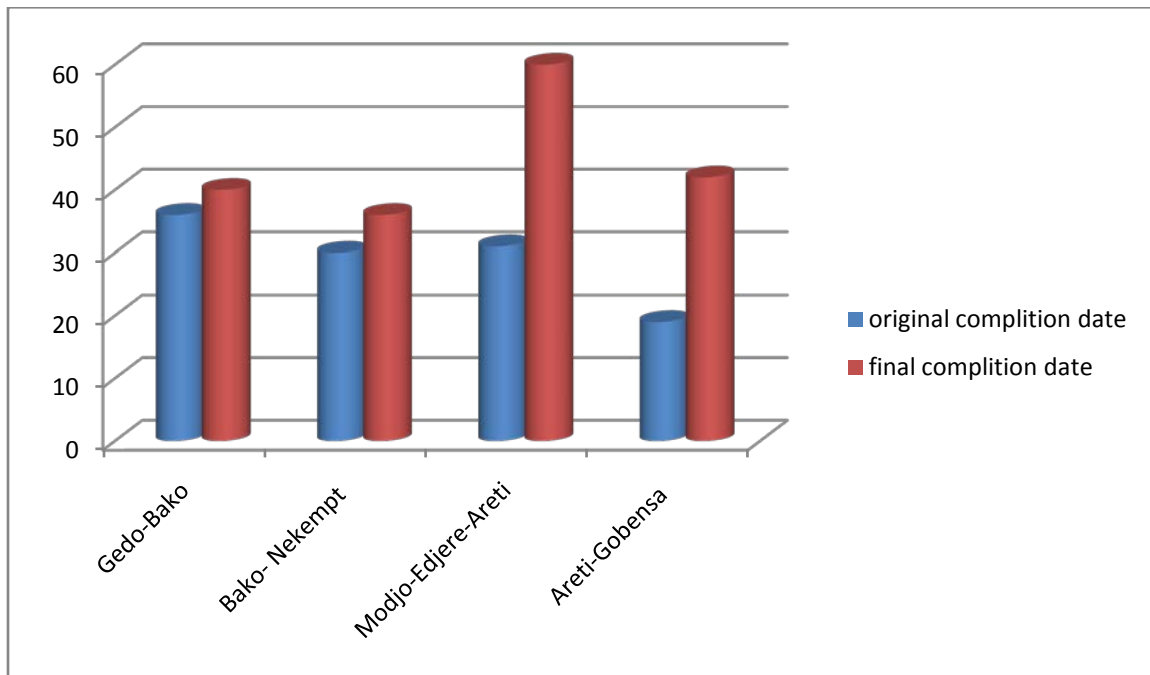


Figure 4.2 the original completion date vs. final completion date of the projects

According to the above tables and figures, the investigated road projects have suffered from contract document error (due to extension of time and additional cost) ranges from minimum of 11.11% and maximum of 121.05% of extension of time and from 1.482% to 3.739 % of additional contract amount for each road projects.

Impacts of Contract document Error on the selected road projects

The characteristics of these road projects; i.e. brief descriptions of construction type, length, contractor, consultant, project status, original contract amount, final cost, type of contract document occurred, impact of contract document in % and how it handled and managed are described as follows.

1. Bako Nekempt Road Development projects

Project: Road Construction
Location: A road Between Bako and Nekempt
Client: Ethiopian Road Authority (ERA)
User: The public
Consultant: Mouchel Limited of UK in association with Civil Works Consulting Engineers (CWCE)
Contractor: China Highway Group P.L.C
Supervisor: The Client
Length of the Road: 64.814km
Total contract amount: 489,642000 ETB
Original commencement date: 10October2009
Actual commencement date: 21January 2010
Original Completion date: 9 April 2012
Revised Completion date :14th October 2012

Type of contract document error:

- Specification error /Contract Document Writing error
- omission of words
- Ambiguity or Vagueness problems

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Impact of contract document error in (%):

- Additional project cost 1.83%
 - Additional project time 20%
-
- At the time there was ambiguity or vagueness in relation to local taxes and/or VAT, during the bidding period.
 - ERA did not specify clearly in the Contract that the Contractor was to include VAT in all the tendered unit rates and that as the ‘specifier’ of the contract.
 - In the case of this contract document error (ERA) paid VAT which is, 15% of the total contract values for the Contractor.

Finally, the client carried the responsibility for any variances, discrepancies, vagueness or ambiguities. Because of this specification writing error the client (ERA) paid VAT which is, 15% of the total contract values for the contractor.

2. Gedo Nekempt Road Development projects

Project: Road Construction
Location: A road Between Gedo and Nekempt
Client: Ethiopian Road Authority (ERA)
User: The public
Consultant: SABA Engineering plc. (SABA)
Contractor: China Highway Group P.L.C
Supervisor: The Client

Total contract amount: 495,490,000 ETB

Original commencement date: 10 October 2009

Revised commencement date: 21 January 2010

Original Completion date: 14 October 2012Eth.Cal

Actual completion date: 19 February 2013l

Type of contract document error:

- Specification error

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

- Design error
- Ambiguity or Vagueness problems

Impact of contract document error in (%):

- Additional project cost 1.48%
- Additional project time 11.11%

- At the time there was ambiguity or vagueness in relation to local taxes and/or VAT, during the bidding period. The same error with Bako Nekempt road project.
- ERA did not specify clearly in the Contract that the Contractor was to include VAT in all the tendered unit rates and that as the ‘specifier’ of the contract.
- In the case of this contract document error (ERA) paid VAT which is, 15% of the total contract values for the Contractor.
- Design error of a bridge at Km 87+035 also happened by this road Rehabilitation Project.
- one wing wall for the bridge at Km 87+035 was incorrectly designed in that construction to the length and location required by the Engineer led to the unavoidable use of earthwork side slope batters much steeper than shown on the drawings.

Finally, the client carried the responsibility for any variances, discrepancies, vagueness or ambiguities. Because of this specification writing error the client (ERA) paid VAT which is, 15% of the total contract values for the contractor and the Engineer/designer was responsible for the design error of this road project.

3.Modjo- Edjere- Areti Road Development project

Project: Road upgrading project
Location: A road Between Modjo, Edjere and Areti
Contract Funded by: Government of Ethiopia
Client: Ethiopian Road Authority (ERA)
User: The public

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Supervision Consultant: Associated Engineering Consultants (AEC) in joint venture with CORE consulting engineers

Contractor: Yencomad Inc. Plc

Length of the Road: 64.5 km

Original total contract amount: 407,320,609.16 ETB

Value of variation order to date: 7,164,909.99 ETB

Revised final contract amount: 414,485,516.15ETB

Contract signed date: January 10, 2008

Commencement date: 12 February 2008

Original completion date: 24 August 2010

Revised Completion date: January 28, 2013

Type of contract document error:

- Specification error
- Ambiguity or Vagueness problems

Impact of contract document error in (%):

- Additional project cost 1.76%
 - Additional project time 93.55%
-
- There was an ambiguity word which is 'unsuitable material' that arisen dispute between the client Ethiopian Road Authority (ERA) and the contractor Yencomad construction company.
 - Both parties couldn't agree with the ambiguous word. As the contractor expression, the client's specification needs some correction but the client didn't agree with the contractor idea.
 - Because of their disagreement, they hired a Dispute Review Expert (DRE) and he justified that the client specification is correct and has no ambiguous meaning at all.

- The contractor didn't agree on the DRE's decision and he will go to the arbitration for further decision.

But from the contractor information if the arbitrator decides the word 'unsuitable material' is an ambiguous word, Ethiopian Road Authority will pay around 40 million ETB for the contractor.

4. Areti-Gobenssa Road Development project

Project: Road Construction
Location: A road Between Areti and Gobensa
Client: Ethiopian Road Authority (ERA)
User: The public
Consultant: CORE Consulting Engineering P.L.C
Contractor: Yencomad Construction Company
Supervisor: The Client
Length of the Road: 36.36 km
Original Total contract amount: 444,696,050 ETB
Value of variation order to date : 46,307,004 ETB
Value of Claim approved to date : 3,978,393.42 ETB
Revised final contract amount: 461,323,773.85 ETB
Contract signed date: 22 May 2008
Commencement date: 23 June 2008
Original Completion date: 21 December 2010
Revised Completion date: 25, November 2012

Type of contract document error:

- Specification error /Contract Document Writing error
- Ambiguity or Vagueness problems

Impact of contract document error in (%):

- Additional project cost 3.74%
- Additional project time 121.05

- There was an ambiguity word which is 'unsuitable material' that arisen dispute between the client Ethiopian Road Authority (ERA) and the contractor Yencomad construction company. The same case as the previous one.
- Both parties couldn't agree with the ambiguous word. As the contractor expression, the client's specification needs some correction but the client didn't agree with the contractor idea.

Because of their disagreement, they hired a DRE (other than the previous Dispute Review Expert) but he justified that as the client's specification has an error and the client ERA paid around 3.5 million ETB for the contractor because of the ambiguous word on his specification.

4.3 Analysis and Ranking

- Questionnaires Response Rate
- Ranking of the errors based on relative importance index
- Test of agreement between the respondents in ranking of contract document errors

a. Questionnaires Response Rate

Structured questionnaire survey was carried out by distributing a total of 65 questionnaire sets. It has been distributed to 20 client (ERA) employees, 30 contractors firms, and 15 consultant firms. From these distributed questionnaires, 47 responses were received back. However, some of the questionnaires were not completed which were considered as invalid and not used for further analysis as shown below in table.

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Table 4.4 Type of respondents organization, number and percentage of distributed, received and valid responses of questionnaires.

Respondents Organization	Number of questionnaires Distributed	Number of questionnaires Received	% of response received	Number of valid questionnaires'	% of valid responses
Client	20	16	80	15	75
Consultant	15	10	66.67	10	66.67
Contractor	30	21	70	19	63.33
Total	65	47	68.12	44	63.77

In this research, 34.01% (15) clients (ERA), 22.73 % (10) consultants, 43.18 % (19) contractors replied a valid questionnaire.

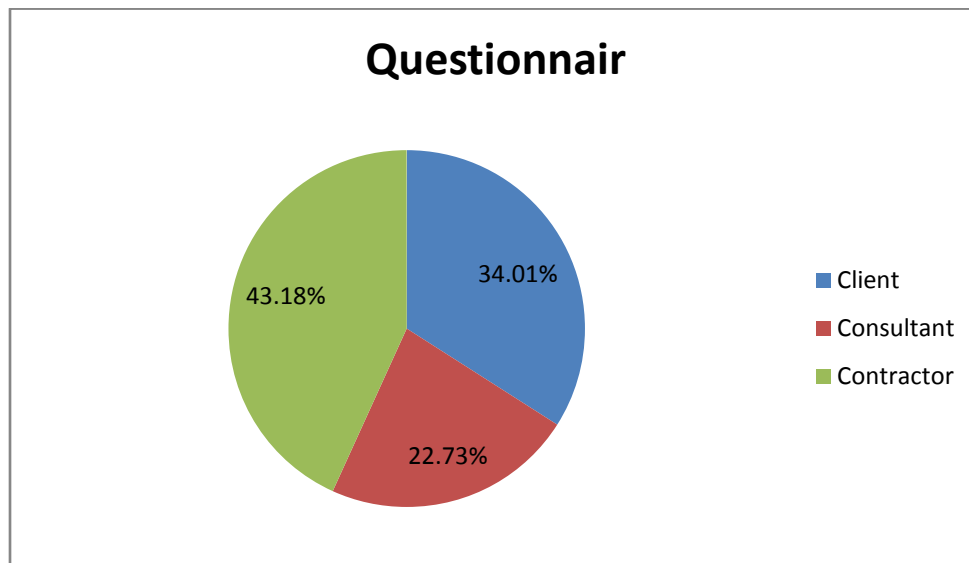


Figure 4.3 Respondents' organizational type replied valid questionnaires

b. Ranking of the errors based on relative importance index

This part of the study provides the analysis of contract document errors based on relative importance(RII). It is computed as per the following formula:

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

$$RII = \sum W/A * N$$

$$(0 \leq RII \leq 1)$$

Where:

W – is the weight given to each factor by the respondents ;

A – is the highest weight and;

N – is the total number of respondents

The indicated below shows the calculated importance index values and rank for each causes of occurrence of contract document error from contractor, consultant, client (ERA), and overall respondents viewpoints.

The table as indicated below shows the calculated importance index values and rank for each causes of cost overrun from contractor, consultant, client (ERA), and overall respondents viewpoints.

Table 4.5 Relative Important Index of client, consultant and contractor

S.No	Main contract document errors	Client RII	Consultant RII	Contractor RII	overall	Rank
1	Errors and omission in the bills of quantities	0.922	0.93	0.912	0.921	1
2	Errors in capital cost estimating	0.92	0.91	0.92	0.916	2
3	Incomplete drawing / details needed	0.91	0.901	0.903	0.904	3
4	Ambiguity or Vague statements	0.9	0.89	0.9	0.896	4
6	Missing or	0.89	0.85	0.89	0.87	6

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

	Incorrect notes on the drawings					
7	CADD (Computer) related problems	0.82	0.83	0.88	0.843	7
8	Dimensional errors	0.812	0.82	0.88	0.837	8
9	Errors in symbols and abbreviations	0.81	0.78	0.85	0.813	9
10	Coordination problem	0.77	0.77	0.78	0.773	10
11	Contradicting statements	0.71	0.75	0.75	0.736	11
12	Lack of experience	0.71	0.72	0.72	0.716	12
13	Using inappropriate codes	0.69	0.69	0.72	0.7	13
14	Copy and paste of the whole condition of contract from other general condition	0.69	0.69	0.68	0.686	14
15	Incomplete general condition	0.65	0.66	0.66	0.656	15
16	Statements do not describe clearly the type, size, or method of fixing.	0.63	0.622	0.66	0.637	16
17	Bearing capacity test error of the soil	0.621	0.62	0.65	0.630	17

4.3.1 Test for agreement in ranking among respondents

This part of the study checks whether there is an agreement between respondents (client, contractors and consultants) in ranking occurrence of contract document error based on Spearman rank correlation coefficients.

$$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

Where

ρ = Spearman rank correlation coefficient

d = the difference between ranks

n = number of subjects or pairs of ranks

Based on the above formula degree of agreement between client vs. consultant, client vs. contractor and consultant vs. contractor were checked and presented below in the tables.

According to Salleh (2009) spearman rank coefficient, value ranges from -1 to +1 and different ρ value have different meanings as it is described below. If spearman rank correlation coefficient value (ρ)

Is -1 there is a perfect negative correlation

Lying between -1 and -0.5, there is a strong negative correlation

Lying between -0.5 and 0, there is a weak negative correlation

Is 0 there is no correlation

Lying between 0 and 0.5, there is a weak positive correlation

Lying between 0.5 and 1, there is a strong positive correlation

Is 1 there is a perfect correlation

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

Table 4.6 Spearman rank correlation coefficient for importance

		Client	Consultant	contractor
Spearman rank correlation coefficient	Client	1	0.991	0.89
N		10	10	10
Spearman rank correlation coefficient	consultant	0.991	1	0.88
N		10	10	10
Spearman rank correlation coefficient	contractor	0.89	0.88	1
N		10	10	10

The tables above showed that the calculated spearman rank correlation coefficient values for all pair of parties (client vs. consultant, client vs. contractor and consultant vs. contractor) for relative importance index were between 0.5 and 1, which shows there is a strong positive correlation in ranking the occurrence of contract document errors. This indicates there is a strong agreement between the respondents in ranking the contract document errors in Ethiopian roads authority central region road projects

Case Studies

Case Studies on Contract Document Error and their impacts on ERA(*under Central Region*) projects

This chapter presents data collected from four ERA under central region road projects in Ethiopia. The following information was collected for each case study project:

- Brief description of the project
- Types of contract document error
- Impacts of the error
- How was it handled and managed?

Case Study No. 1

Bako Nekempt Road Development projects

Contract Document Error and the Impact

I. Particulars of the project under study

Project: Road Construction

Location: A road Between Bako and Nekempt

Client: Ethiopian Road Authority (ERA)

User: The public

Consultant: Mouchel Limited of UK in association with Civil Works Consulting Engineers (CWCE)

Contractor: China Highway Group P.L.C

Supervisor: The Client

Length of the Road: 64.814km

Total contract amount: 489,642,000 ETB

Original commencement date: 10October2009

Actual commencement date: 21January 2010

Original Completion date: 9 April 2012

Revised Completion date :14th October 2012

Contract Document Writing error;

- At the time there was ambiguity or vagueness in relation to local taxes and/or VAT, during the bidding period.
- ERA did not specify clearly in the Contract that the Contractor was to include VAT in all the tendered unit rates and that as the 'specifier' of the contract.
- In the case of this contract document error (ERA) did pay VAT which is, 15% of the total contract values for the Contractor.

Finally, the client carried the responsibility for any variances, discrepancies, vagueness or ambiguities. Because of this specification writing error the client (ERA) paid VAT which is, 15% of the total contract values for the contractor.

Case Study No. 2

Gedo Nekempt Road Development projects

Contract Document Error and the Impact

I. Particulars of the project under study

Project: Road Construction

Location: A road Between Gedo and Nekempt

Client: Ethiopian Road Authority (ERA)

User: The public

Consultant: SABA Engineering plc. (SABA)

Contractor: China Highway Group P.L.C

Supervisor: The Client

Length of the Road:

Total contract amount: 495,490,000 ETB

Original commencement date: 10 October 2009

Revised commencement date: 21 January 2010

Original Completion date: 14 October 2012Eth.Cal

Actual completion date: 19 February 2013

- **Contract Document Writing error;**
- At the time there was ambiguity or vagueness in relation to local taxes and/or VAT, during the bidding period. The same error with Bako Nekempt road project.
- ERA did not specify clearly in the Contract that the Contractor was to include VAT in all the tendered unit rates and that as the ‘specifier’ of the contract.
- In the case of this contract document error (ERA) did pay VAT which is, 15% of the total contract values for the Contractor.

Finally, the client carried the responsibility for any variances, discrepancies, vagueness or ambiguities. Because of this specification writing error the client (ERA) paid VAT which is, 15% of the total contract values for the contractor.

- **Design Error**
- Design error of a bridge at Km 87+035 also happened by this road Rehabilitation Project.
- one wing wall for the bridge at Km 87+035 was incorrectly designed in that construction to the length and location required by the Engineer led to the unavoidable use of earthwork side slope batters much steeper than shown on the drawings.

Finally the Engineer was responsible for the design error of this road project.

Case Study No. 3

Modjo- Edjere- Areti Road Development project

Contract Document Error and the Impact

I. Particulars of the project under study

Project: Road upgrading project

Location: A road Between Modjo, Edjere and Areti

Contract Funded by: Government of Ethiopia

Client: Ethiopian Road Authority (ERA)

User: The public

Supervision Consultant: Associated Engineering Consultants (AEC) in joint venture with CORE consulting engineers

Contractor: Yencomad Inc. Plc

Length of the Road: 64.5 km

Original total contract amount: 407,320,609.16 ETB

Value of variation order to date: 7,164,909.99 ETB

Revised final contract amount: 414,485,516.15ETB

Contract signed date: January 10, 2008

Commencement date: 12 February 2008

Original completion date: 24 August 2010

Revised Completion date: January 28, 2013

Specification Error

- There was an ambiguity word which is 'unsuitable material' that arisen dispute between the client Ethiopian Road Authority (ERA) and the contractor Yencomad construction company.
- Both parties couldn't agree with the ambiguous word. As the contractor expression, the client's specification needs some correction but the client didn't agree with the contractor idea.
- Because of their disagreement, they hired a Dispute Review Expert (DRE) and he justified that the client specification is correct and has no ambiguous meaning at all.
- The contractor didn't agree on the DRE's decision and he will go to the arbitration for further decision.

Arbitration is remedy for clear and approved claim by consultant and refused by the client; because the Claimants and Respondents submittal of their case is mainly based on the facts analyzed by professional evidences during discovering the claims.

But from the contractor information if the arbitrator decides the word 'unsuitable material' is an ambiguous word, Ethiopian Road Authority will pay around 40 million ETB for the contractor.

If the client refuses to pay the money which is approved by the arbitrator for the contractor, the last resort would be court appeal. Court appeal is not preferred at any extent: Because:

1. Application cost for the court is from initial claiming party,
2. No one knows how long it will take to conclude the case,
3. Unexpected outcome,
4. Leaving bad image to a construction firm because of the litigation track.

Case Study No. 4

Areti-Gobenssa Road Development project

Contract Document Error and the Impact

I. Particulars of the project under study

Project: Road Construction

Location: A road Between Areti and Gobensa

Client: Ethiopian Road Authority (ERA)

User: The public

Consultant: CORE Consulting Engineering P.L.C

Contractor: Yencomad Construction Company

Supervisor: The Client

Length of the Road: 36.36 km

Original Total contract amount: 444,696,050 ETB

Value of variation order to date : 46,307,004 ETB

Value of Claim approved to date : 3,978,393.42 ETB

Revised final contract amount: 461,323,773.85 ETB

Contract signed date: 22 May 2008

Commencement date: 23 June 2008

Original Completion date: 21 December 2010

Revised Completion date: 25, November 2012

Specification Error

- There was an ambiguity word which is 'unsuitable material' that arisen dispute between the client Ethiopian Road Authority (ERA) and the contractor Yencomad construction company. The same case as the previous one.
- Both parties couldn't agree with the ambiguous word. As the contractor expression, the client's specification needs some correction but the client didn't agree with the contractor idea.

Because of their disagreement, they hired a DRE (other than the previous Dispute Review Expert) but he justified that as the client's specification has an error and the client ERA paid around 3.5 million ETB for the contractor because of the ambiguous word on his specification.

The analysis of the above projects and interviews with each case study project were important for understanding the occurrence of errors in the construction documents. The purpose of the research was explained to the individual interviewed before commencing an interview. The unstructured interviews were held with the client (ERA) Central region managers and with managers of the contractor who executed the work.

Face-to-face interviews allowed the research to review fully the meaning of questions and to add supporting contextual evidence. The unstructured format of these interviews provided an opportunity to make further observations qualitatively that would influence the subsequent deployment of the research.

CHARTER-FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the finding of the research, the study concludes that in order to prevent the occurrence of errors in contract documents, the consultants' experience, lack of design reviews, value engineering studies and constructability, design management experience, communications and availability of information and unclear and ambiguous requirements for design specifications should be worked upon by the stakeholders concerned in order to prevent the occurrence of errors in contract documents.

Minimizing errors require their identification first; as soon as an error has been identified, action can be taken to address it. The errors in the contract documents have been defined. The research found that the impact of errors in contract documents is large and errors were the most significant factors for project delay and change order. On the research we have tried to see different types of error which are arising on a contract document. To reduce errors effectively, it is important to understand the inherent factors and the mechanisms whereby errors occur.

These factors include project management, designer, client, and project characters.

Finally, the most critical requirement for signing of the contract agreement is the drawings, specifications and other parts of the contract documents are as close to 100% complete as possible.

5.2 Recommendation

The research recommends the following points

1. At the time of tender, prior to signing a contract for the contractor, if the contract language or contract requirements are not clear or are conflicting, ask for clarification. Differing interpretations of the contract documents during construction will simply lead to disputes.
2. Giving adequate training for contract document preparing parties can minimize the occurrence of errors.
3. The use of words and phrases unambiguously is the aim of all document drafters.
4. The contractor should be open to working collaboratively with the owner's team to develop solutions that avoid claims or mitigate damages incurred.
5. More importantly, monitoring actual progress of the various trades working on site can provide an early warning of problems. Both owners and contractors can mitigate damages or losses if problems are identified early.
6. If the project is large, request a peer/deep review of the design for errors and omissions. Owners have to recognize that the design of a facility is not an exact science, and simply allowing a contingency for design errors and omissions may not be the most cost-effective approach. It is more cost-effective to find errors and omissions before a contract is awarded than to have them treated as changes later.
7. When consultants have been asked why incomplete documents are issued for contracts, the usual response has been that the fees are not adequate to do a complete job. Designers should be cautious that commercialism does not replace professionalism

Appendix A

Glossary of Terms

Partnering :A commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. This relationship is based on trust, dedication to common goals, and an understanding of each other's individual expectations and values.(Construction Industry Institute,1995)

Constructability: The best integration of construction knowledge and experience in planning, engineering, procurement and field operations to achieve overall project Objectives.

Omission: Any part of a system, including design, construction and fabrication, that has been left out resulting in a deviation. An omission requires an evaluation to determine what corrective action is necessary.

Project: All those elements associated with a facility from initial concept to final disposition.

Quality Assurance: All those planned or systematic actions necessary to provide adequate confidence that a product, processor service will conform to established requirements.

Tort: The body of the law which allows an injured person to obtain compensation from the person who caused the injury.

Law of Obligation :A legal requirement established by law, contract or as a result of unlawful harm caused to the person or property of another.

Restitution :The return to a rightful owner of a thing wrongfully taken

Addenda: Addenda are written text or drawings that modify or interpret the bidding documents including the Drawings and Specifications issued after the bidding documents have been issued to bidders, but before the opening of bids

Appendix B
Questionnaire

Dear Sir,

This research is MSc research in which aims to investigate the impact of errors in construction contract document in Ethiopian Roads Authority Central Region Road Projects carried out at Jimma University Construction Engineering and management department.

The aim of this research is to assess the extent of errors and recommend ways of improving the construction industry, through the development of a strategy for eliminating or at least reducing the number of errors generated in construction contract documents.

The responses to the questionnaire would therefore be much appreciated and treated with confidentiality.

Thanking you in anticipation of your kind cooperation.

For any clarification regarding any question, you are kindly requested to contact me by using the address given below.

Yours faithfully,
Selamawit Hailu

Post Graduate student
Jimma Universtiy Technology Institute
Civil Engineering Department
Construction Engineering and Management Stream
Phone 0911142095

Part I.

Construction contract documents sometimes contain errors which affect construction projects. In your opinion which one of these errors affects your project? Please base your overall experience in road construction projects in Ethiopia to indicate your answer by ticking the appropriate boxes. Please add and evaluate any additional contract document error that you have experienced before and not listed in the given list.

Occurrence of contract document errors

- 1- No Occurrence = (0%)
- 2 -Very few = (25%)
- 3 -few = (50%)
- 4-High = (75%)
- 5. Very high = (100%) significant

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

1. Technical

A. Specification Errors

	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1	Items included in the drawings but not in the specification							
2	Incomplete sentences such as sentences (or lines) missing from paragraphs.							
3	Unclear statements such as meaningless or confused statements in the specification							
5	Statements do not describe clearly the type, size, or method of fixing.							
6.	Ambiguity or Vague statements like, statements that conflict with other statements, or parts of the same statement that conflict with each other.							
7	Listing only one brand when it is obvious there are other known brands.							
8	Subjective specification; using words like <ul style="list-style-type: none"> • high quality • the best quality • the best commercial quality 							

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

B. Bill Of Quantity Errors

	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1	Error in or omission of information in an item which is the subject of a provisional sum for defined work							
2	The cost of the work for a Bill item which has not been priced by the contractor is included in the prices entered elsewhere in the Bill.							
3	Differences between the total final quantity of work done and the quantity for an item or The final quantities of work for an item may be different to the estimate in the tendered documents.							
4	Differences between the quantities in the original tendered Bill and the as-built quantities. The actual quantities for an item differ from the quantity in the Bill							
5	The preparation of the Bills of Quantities may be incorrect, with items omitted which should have been included in the tendered Bill for the original work described in Drawings and Specification.							
6	The Bills of Quantities may not have been prepared in accordance with the Standard Method of Measurement for the original							

IMPACT OF ERRORS IN CONSTRUCTION CONTRACT DOCUMENT

	work described in the Drawings and Specifications.							
7	Unfilled unit rate on the bill of quantity forms							
C. Drawing Errors								
	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1.	Incomplete Drawing; Resulting in extra construction cost and delay							
2.	Dimensional error; (these errors include the dimensions do not add up, scaling error, conflict of dimension between drawings, details, and schedules)							
3.	Incorrect or missing notes on the Drawings; (error includes the note is not applicable to the drawings or details, describes wrongly what it is meant to be, or an additional note is needed to make the drawings clear and understandable.)							
4.	Lack of computer software knowledge; such as Computer Aided Design and Drafting (CADD) software used, and setup of the CADD standards and procedures)							
5.	Coordination error; type of error occurs when the coordinate given to the drawing							
D. Soil Investigation Errors								
a. Subsurface investigations								

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	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1.	Soil Compaction test Error							
2	Bearing capacity test error of the soil							
3	Error on permeability/ drainage characteristics of the soil							
4	Error in Foundation design recommendations							
5	Incorrect log							

b. Surface investigations

	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1	Presence of trouble soils Peat, soft clay, loose silt, or fine water bearing sands.							
2	Rock close to the surface(require blasting for excavations)							
3	Dumps or Fills							
4	Evidence of slides or subsidence							

2. Legal

a. General Condition of contract Errors

	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1.	Incomplete general condition							
2	Copy and paste of the whole condition of							

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	contract from other general condition							
3	Using inappropriate codes							
4	Lack of experience							
5	Contradicting articles							
b. Special Condition of contract Errors								
	Types of common contract documents errors	Impact of contract document errors		Occurrence of error				
		Time	Cost	1	2	3	4	5
1	Incomplete special condition because of the condition comes from incomplete general condition.							
2	Copy paste from other projects							
3	Experience of contract condition preparing body.							
4	Contradicting statements							
	Others (please specify)							

Appendix C

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