ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

CONSTRUCTION INDUSTRY INSTITUTE (CII) BEST PRACTICE OF CONTRACTORS WITH MINIMUM TIME & COST OVERRUNS IN ETHIOPIAN ROAD AUTHORITY PROJECTS

By: **Mebatsiyon Alemu Gebremariam | GSR/3368/10**

Advisor: **Dr. Abraham Assefa Tsehayae**

A Thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering,

(Construction Technology and Management major)

Addis Ababa, Ethiopia

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DECLARATION

I declare that the research paper titled "Construction Industry Institute (CII) Best Practice of Contractors with Minimum Time and Cost Overruns in Ethiopian Road Authority Projects: A Study on Road Construction Projects Completed in the Last Ten Years (2009-2019 Gc)" is my own. The work has not been submitted for evaluation elsewhere. Where material from other sources was used, it was properly recognized / referred to.

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ABSTRACT

Roads form an integral part of any nation's transportation network, and are widely accepted to contribute positively to the socioeconomic development. This fact has meant many nations, particularly developing ones invest heavily in their infrastructure. In Ethiopia, this role is played by the Ethiopian Road Authority (ERA), which is responsible for the construction and administration of federal roads. However, road projects general face time and cost overruns as highlighted by numerous previous works. While the sources of these inefficiencies have been studied in detail, little investigation has been done to discover the reasons for some projects exhibiting above average performance.

In this research, the level of awareness and implementation of the Construction Industry Institute's (CII) best practices, which have been shown to improve project performance, on selected best performing road projects. The thesis set out by first identifying the top performing projects, followed by the identification of best practices of contractors said performance among ERA projects which were completed between 2009 and 2019GC. A questionnaire was used to assess the uptake of CII construction best practices was distributed among top performing projects stakeholders, namely contractors, consultants, and client (ERA), their client. Respondents were also asked to rank factors which negatively affected project performance. The results showed that negative factors correlated strongly with evidence from the literature review and showed a lack of proper planning and management among all stakeholders. Respondents also indicated that they are aware of CII best practices and their impact on project performance. The results showed that support from top management, vertical alignment, having a set of shared goals, establishing trust, and have an interdependent relationship among stakeholders were very important to the successful completion of projects. This research recommends that work must be done in the implementation of best practices and increasing the level of awareness among other industry members to improve sectoral performance, as their importance has been established in this research. This should be taken as a goal by the government and shall be incorporated in the curriculum. The use of best practices should also be extended to other construction industry sectors based on research similar to this.

Key words: Construction Best Practices; Construction Industry Institute (CII); Project Performance

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ABBREVIATIONS

ADR-Alternative Dispute Resolution

ASQ-American Society of Quality

BPR-Business Process Reengineering

CII- Construction Industry Institute

CIOB-Chartered Institute of Building

ERA- Ethiopian Road Authority

FEP- Front End Planning

GoE- Government of Ethiopia

ICB- International Competitive Bidding

NCB-National Competitive Bidding

QA/QC-Quality Assurance/Quality Control

RII-Relative Importance Index

RSDP-Road Sector Development Program

RRA-Regional Road Agencies

WRO- Woreda Road Offices

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1. INTRODUCTION

Roads are an important part of the transportation system that contributes significantly to a country's socioeconomic development. It is critical to the nation's growth and development. It is also a tool for poverty alleviation by providing access to employment, social, health, and educational services. In the context of Ethiopia's geography, settlement patterns, and economic activity, road transport plays a dynamic role in facilitating economic development, as it still accounts for 95% of the movement of people and goods. (Worku, 2011) Road transportation also allows for better use of land and natural resources, improved agricultural production and marketing, access to social services, and opportunities for long-term growth by allowing for the efficient movement of goods and people. Road networks have also linked previously inaccessible areas of Ethiopia with towns and cities, allowing for residents to receive better medical care, improved education, and better market access for their produce (ERA, Road Sector Developent Program 19 Years Performance Assesment, 2016)

Federal roads in Ethiopia are built by the Ethiopian Road Authority (ERA). The ERA is a legally autonomous entity responsible for the management of the country's roads, according to Proclamation No. 80/1997. The proclamation also specifies that the trunk and major link, which comprise the federal road network system are managed by the Ethiopian Roads Authority.

1.1. Inefficiencies of the Ethiopian Road Construction Sector

Time and cost overruns are the most common problems in ERA road projects, which are caused by a variety of factors. Time overrun in a construction project is defined as an extension of time beyond the contractual time agreed upon in the contract documents. Cost overrun is defined as an additional cost above the contractual cost agreed upon during the tender. (Endut et al., 2005) Many previous studies have identified cost and time overruns as widespread issues in the country's construction industry. Some of them include:

- Assessment of cause and impacts of local contractor’s time and cost performance in Ethiopian roads authority projects (Kassaye, 2016).

- Causes of delays during construction phase on road projects due to failures of contractor, Consultant and Employer in Addis Ababa City Road Authority (Yosef A, Emer T. , and Mamuye B., 2017).
- Factors affecting time performance of local road contractors on federal road construction projects (Kifle, 2013).
- A study on planning and scheduling in Federal road projects of Ethiopia: Causes of non-excusable delay in selected projects (Abdela, 2014).
- Assessment of Time and Cost Overruns in Construction Projects: Case Study at Defense Construction Enterprise (Taye, 2016).

According to (Chimwaso, 2000) Projects in Botswana that are completed within budget are uncommon when compared to situations of cost overruns. Cost and time overruns are key issues in project development and are common occurrences in the construction sector, particularly in developing countries. While the causes of delays have been studied in detail, the solutions to these problems, as well as the best practices of contractors which have minimized delays and cost overruns have not been examined in the Ethiopian context.

1.2. Construction Industry Institute Best Practices

The Construction Industry Institute (CII) was founded in 1983 to improve the capital facilities industry's cost effectiveness from project conceptualization and front-end planning to completion and start-up. CII's membership includes more than 100 top owner, engineering, contractor, and supplier firms. The institute is housed at the University of Texas at Austin. (E. Ozbek et al., 2011) The institute (CII) defines Best Practices as processes or methods that, when followed correctly, result in better project performance. CII is able to effectively validate the effectiveness of best practices due to the institute's merger of academia and industry. The best practices, which are described in depth in the literature review, apply to all stages of a construction project and help to improve performance not just in terms of cost, schedule, and safety, but also in terms of consistency and predictability. These "Best Practices" have been used by CII member companies for a long time and have proven to be very beneficial. (CII, Best Practice, 2010b)

In the Ethiopian context, the problems of cost and time overrun are of significant concern, and the application of the CII Best Practices has the ability to address some of the industry's shortcomings, allowing for improved performance.

1.3. Background Information

The Ethiopian government has recognized that limited road network coverage and poor condition of existing road network, have hampered economic recovery and growth. As a result, in 1997, the government launched the Road Sector Development Program (RSDP) to address the problems in the road sector.

- RSDP I - From July 1997 to June 2002 (5 years plan)
- RSDP II - From July 2002 to June 2007 (5 years plan)
- RSDP III - From July 2007 to June 2010 (3 years plan)
- RSDP IV - From July 2010 to June 2015 (5 years plan)
- RSDP V - From July 2015 to June 2020 (Ongoing)

A total of 9,917 km of physical activity were carried out during the last year of the RSDP V, including 2,374 kilometers on Federal Road, 1,920 kilometers on regional roads and 5,622 kilometers on woreda road desks. Over the nineteen years of the RSDP, the Ethiopian Roads Authority (ERA), the Regional Road Agencies (RRAs), the Woreda Road Offices (WRO) and the municipalities have carried out physical activities involving rehabilitation and upgrading of trunk and connection roads, construction of new connecting roads, rural roads and district roads and maintenance of federal and regional roads.

1.3.1. RSDP's Physical and Financial Performance

Over the course of the past two decades, a total of 128,470 km of road, excluding normal maintenance and community roads, has been physically constructed. During this period, the total budget for the planned works was ETB 232.5 billion (USD 15.9 billion), however, the final expenditure was ETB 266.2 billion (USD 17.4 billion) during the same period. Despite the increases in cost of 15%, RSDP was only able to deliver 86% of the physical performance compared to the plan. While ERA and the RSDP has delivered significant gains, the road coverage

and quality remains low, and ERA still has a lot of work to do (ERA, Road Sector Developent Program 19 Years Performance Assesment, 2016).

1.4. Statement of the Problem

In a country's development, successful completion of road project plays an important role. (Chan Daniel & Kumaraswamy, 2002)Remarked that project performance measurement includes time, budget, safety, quality and overall client satisfaction. The completion of a project on planned time and cost is a major criterion for project success in the construction industry.
According to the construction industry institute (CII) in 2010b, using best practices for projects in Ethiopia will be a solution to the problem of road project cost and time overruns. Since Ethiopian Road Authority (ERA) extracts large road projects in Ethiopia, I had the opportunity to participate in a meeting with consultants regarding ERA project performance and learned that certain projects completed by ERA had issues with cost overrun and time overrun.

There are numerous references to the causes of cost overruns and time overruns in ERA projects, but there is little information on how to solve the problem. This made me believe that more research was required.

To identify the best practices of contractors who are performing well and have the fewest time and cost overruns. These practices should be documented and analyzed so that other contractors can learn from them in order to avoid time and cost overruns on road construction projects (ERA, Road Sector Development Program 17 Years Performance Assessment report., 2014).

1.5. Significance of the Study

Beyond the points discussed above, the benefits of the efficient delivery of road projects can't be understated. The results of this study can be beneficial to the wider economy, and the road sector through:

- The Ethiopian Road Authority is one of the largest recipients of federal funds, while federal road projects are plagued by cost and schedule overruns, wasting scarce resources. ERA can become a more efficient organization by reducing waste.

- Time and cost overruns are frequently the source of disagreements, which can be avoided with better performance. One of the root causes of disputes can be avoided by avoiding overruns.
- Ethiopian contractors currently focus on the local market and remain uncompetitive especially internationally. If contractors are able to reduce inefficiencies, they can become more profitable and competitive against foreign firms

1.6. Objectives

1.6.1. General Objective

The general objective of this study is to assess the best practices of contractors with minimum time and cost overruns of Ethiopian Road Authority Projects.

1.6.2. Specific Objectives

- To identify Ethiopian Road Authority (ERA) projects with the minimum cost and schedule overruns;
- To identify the best practices used by the selected contractors
- To recommend practices which can be transferred and replicated by other contractors.

1.7. Limitations of the Study

- The research is limited to ERA road projects over the last 10 years, whose construction work has been fully completed.
- Upgrading, maintenance, and rehabilitation projects won't be considered.
- Only contractors that were time and cost efficient will be considered.
- Case studies were not possible due to unavailability of the project representatives.
- Due to the pandemic, the gathering of data had become time taking and challenging.

1.8. Research Outline

Chapter One; describes introduction and background information about study, the study statement problem with objective of study within its limitations and significant.

Chapter Two; in this chapter different kinds of journal, studies and text book will be review which are helpful for the study. This literature review includes general concepts about management, time and cost management, project performance, Cause and effect of time and cost overruns, time and cost overrun caused by contractors, the construction best practice in terms of time and cost and also any other topic as their necessity for the study will be included.

Chapter Three; under this chapter the methodology use to meet the objective of the study will be discussed. It deals about the research method used for this study. Also how the data will be conduct from contractor, consultant and ERA engineers which will participate on the project with minimum time and cost by questioner surveys.

Chapter Four contains the analysis, description and discussion of information gathered through the questionnaire from professionals who are working for the client, consultants and contractors and involved on the selected Ethiopian Road Authority Road Projects. In this chapter the objective of study will be addressed.

Chapter Five under this chapter the study has clear and precise conclusion and it will recommend construction best practice in terms of time and cost for contractor and Ethiopian Roads Authority.

2. LITERATURE REVIEW

2.1. Construction Industry Institute (CII) Best practices

Best practice in construction industry is defined as a process or method that helps to execute effectively & enhance project performance (CII, Improving Project Performance, 2012). Also best practice is defined as a technique, method or process that believed to be more efficient and effective in achieving a goal than other techniques, methods and processes, when applied to a particular condition or circumstance (Liviu et al., 2010).There are several journals and thesis paper on best practice in construction industry, but most of them conducted by taking CII best practice guide as main reference. (CII, Improving Project Performance, 2012); Improving Project Performance list out the following main Construction Industry Institute (CII) best practice in construction

2.1.1. Front end planning

Front End Planning (FEP) is defined by the CII as the process of gathering sufficient strategic knowledge with which owners may handle risk and make decisions to commit resources in order to maximize the likelihood of a construction project's successful completion. (CII, Improving Project Performance, 2012). Front end loading, pre project planning, feasibility analysis, conceptual planning, programming/schematic design, and early project planning are all terms used to describe front end planning. (Cleland et al., 2010)View FEP as the process of understanding the goals of a project and implementing strategies to ensure its successful completion.

(Gibson et al, 1995) And (CII, Improving Project Performance, 2012) define the FEP process includes:

- Putting together the project team.
- Choosing technology.
- Choosing the project site.
- Creating the project scope, and
- Creating project alternatives (Gibson et al, 1995).

FEP starts during the initial stages of the project and needs the input of the stakeholders to understand their needs. Based on this information, a decision about whether to proceed with the

project as is needs to be made (Otávio et al., 2014). An important aspect of FEP is understanding and defining the scope of the project. This can affect the chances of successful completion of the project significantly (Gibson et al, 1995).

By properly utilizing FEP, a project team can identify project risks early in the project planning phases and develop project values (Bosfield, 2012).

Other benefits of FEP are:

- Identification of potential risks which allows for their mitigation;
- Incorporation of lessons learnt from previous projects, which allows contractors to improve their performance;
- Clients are able to have a clearer view of their project and its scope; and
- Greater understanding and collaboration between different stakeholders is made possible (Naderpajouh et al., 2015).

Poor FEP can have a variety of negative consequence (Jergeas, 2008) .This is due to:

- Unclear project scope definition.
- Unstable project team organization.
- Insufficient project requirements.
- Ambiguous roles and responsibilities within the project organization; and insufficient project plans (William & Samset, 2010).

2.1.2. Alignment

Alignment is the circumstance under which eligible project participants work within acceptable tolerances to produce and fulfill a set of project objectives that is uniformly defined and understood (CII, Improving Project Performance, 2012).

When a project team is aligned, the project team must be able to identify the goals of the project and be committed to working together towards their achievement. The most important element of the alignment process is the ability of the team members to communicate openly, directly and in a timely manner because the process requires all parties to review and give feedback regarding each other's actions (Larson, 1995).

In essence, goal alignment requires the team members to have adequate interpersonal skills and the ability to work together towards common goals without focusing on their personal interests and benefits (Wright et al., 2001).

If a project team is able to align itself towards the achievement of the same goals, it will create an environment where people work together and follow the same direction. This has the potential to improve the financial performance of the contractor CIOB 2010 (Stephen et al., 2007).

(CII, Improving Project Performance, 2012) Identifies several issues that can affect the alignment process. They are divided into the following categories:

- Company Culture, which includes attitudes, values, behavior, and environment of the client, contractor, consultant and FEP team;
- Execution Processes, the project systems, processes, and procedures that are used to develop and deliver the project.
- Availability and Quality of Information: The data elements, including business objectives that are used to define the scope of the project.
- Project Planning Tools such as software's, checklists, and aide-memoirs that are typically used to develop and manage projects.
- Obstacles, which are the impediments to establishing and maintaining project team alignment.

Similarly, (CII, Improving Project Performance, 2012) advice that the management must ensure the following in order to enhance the alignment process:

- All stakeholders must be sufficiently represented;
- The project leadership is well defined, effective, and accountable for its actions;
- The relative priorities among safety, required project features, schedule, and cost are clear;
- Open communication between various teams and stakeholders is made possible;
- Meetings must be made timely and effective;
- A company culture that fosters trust, honesty, and shared values must be encouraged;
- The front end planning process includes sufficient funding, schedule, and scope to meet the project objectives;

- The reward and recognition system that promotes meeting or exceeding the project objectives is made possible and utilized;
- The teamwork and team building programs are effective; and
- Planning tools (e.g., checklist, simulations, and work flow diagrams) are available and effectively utilized.

2.1.3. Constructability

Constructability is defined as the most effective application of construction knowledge and expertise in planning, design, procurement, and field operations to fulfill overall project objectives (CII, Improving Project Performance, 2012). If construction experience is integrated during project planning and design, this is referred to as constructability (Mendelsohn, 1997).

Constructability was formerly utilized to bridge the gap between the design and construction processes (ROSLI, 2004). Similarly, (Wong et al., 2007)suggest that the cost effectiveness and quality of the construction industry, as well as ensuring that construction is executed in accordance with a design, are some advantages of using constructability in the construction industry.

According to the Highway Constructability Guide (1990), the benefits of constructability review for each party are: (Fred et al., 1990)

- Project owners can achieve higher efficiency, resulting in lower costs and minimized schedules combined with higher quality.
- Designers can fully understand the constraints associated with the methodology employed on the project and rectify shortcomings; and
- Constructors can optimize the effort required to build efficiently with minimal resource wastages.

(Akpan, 2014) Identifies 21 principles of constructability, some of them are listed below;

- Site investigation
- Project plan development
- Selection of construction methods

- Involvement of construction personnel
- Understanding clients corporate and project objectives
- Construction driven schedule
- Simplification of erection process and etc.

According to the American Society of Civil Engineers cited in Griffith and Sidewell (1995), constructability should include (Griffith et al., 1995)

- Evaluating the various design options.
- Evaluating project systems and their interface with other project components.
- Knowledge of trade skills and techniques, as well as plant and equipment.
- Understanding of local climate conditions.
- Determining the availability of space and access routes on the job site; and
- Assessing site characteristics in regard to their influence on construction.

Benefits of applying Constructability on construction projects; (Fred et al., 1990) and (CII, Improving Project Performance, 2012)

- Increase productivity
- Reduce project costs
- Shorten project durations
- Reduce delays/meet deadlines
- Eliminate needless activity
- Reduce physical job stress
- Promote safety on construction sites
- Reduce conflict and
- Improve quality.

Due to a lack of constructability, the required time and expense for completing a building project have been increasing during the last few decades. To improve constructability, the common measures are: (Franky et al., 2006)

- Quantified assessment of designs;
- Constructability review; and

Implementation of constructability programs at different project stages.

2.1.4. Materials management

Materials management used to manage the definition, sourcing planning, quantification, supplier qualification, purchasing, supplier QA/QC, expediting, transportation, logistics and controlling of materials and associated information across the lifecycle of a capital project with consisting of people, organizations, technology, and processes. This make material management a complex and comprehensive process (CII, Improving Project Performance, 2012).

Effective material management have the following Benefits; as [(CII, Improving Project Performance, 2012), (Safa et al., 2004) and (Bell & Stukhart, 1986)].

- Minimize bulk supplies
- providing Better supplier performance
- Cash flow savings
- Reduced on-site storage and handling
- Increased craft worker productivity
- Improved project timeline
- Lower management personnel
- Risk reduction

Ineffective material management, on the other hand, has a detrimental impact on project performance (Enshassi et al., 2007) and (Zairra et al., 2017)

- Time delay
- Cost overruns
- Poor quality
- Loss of productivity and
- Excessive waste generation

When workers and managers realize that the available materials are insufficient, they tend to reduce their productivity because complete depletion of the stockpile will lead to an even greater reduction of productivity (Nagapan et al., 2012). Due to insufficient material storage materials need to be reordered and causes longer idling time at work place.

2.1.5. Team building

Team building is a project-focused approach that tries to strengthen team members' problem-solving skills by fostering shared goals, interdependence, trust and commitment, and responsibility

(CII, Improving Project Performance, 2012). A team is a group of people working towards a common goal and team Building involves the process of enabling the group of people to reach their goal (Fapohunda, 2013).

Another definition of a team is given by (Katzenbach & Smith, 1993) who defines a team as a small group of people with a similar aim and an approach to which they hold themselves mutually accountable.

Even while teamwork appears to be related to alignment and team building, it is a distinct idea with some overlap. Teamwork refers to how well individuals connect, cooperate, and support one another when working together, and team building refers to the process through which teams improve their capacity to work together. Meanwhile, alignment concerns whether the team members are all working toward the same, correct goal (CII, Improving Project Performance, 2012).

The primary objective of team building is to enhance communication with participants which can lead to increases in productivity and motivation towards the achievement of goals. This is done through ensuring all team members understand the project's goals, creation of a cooperative and supportive environment, increased trust and support. For teams with diverse backgrounds, this process can bring about greater cohesion leading to greater satisfaction and commitment (CII, Improving Project Performance, 2012).

Team building brings about several benefits to a construction project by overcoming poor relationships between stakeholders in a project. Those are a lack of a unified project mission, adversarial conditions exacerbated by a lack of trust, suspected ethical infractions, litigation contingency planning, a lack of team spirit, team building promotes collaboration and improves project effectiveness, establishing both internal and external ties, decreased combative interactions, fostering trust and team spirit, engaging in open dialogue, Increasing cooperation, cohesion, and problem-solving abilities, Improving the overall quality of the project, and etc. (CII, Improving Project Performance, 2012)

The process of team building requires a range of skills and actions on the part of managers. According to (Vašková, 2007), there are two basic skills required for team building. Firstly, team members must be able to recognize the relevant issues, and then find the appropriate order in which they must be tackled. Secondly the team building process is also dependent on the size and nature

of the team and must be adapted as necessary. The goal of this process is to change the behaviors and attitudes of team members towards a common objective. This process can lead to significant increases in productivity, especially for problems which require creative solutions and cooperation (Vašková, 2007).

(Katzenbach & Smith, 1993) Present an alternative technique and outline the following team-building requirements:

- The team's purpose should be meaningful.
- Specific goals must be stated.
- The team's approach to the task must be widely known.
- The leadership structure must be properly defined.
- Team members must exhibit a sense of mutual accountability.

2.1.6. Partnering

Partnering is either a long-term commitment between two or more organizations taking the form of an alliance or it can be applied to a shorter period of time such as the duration of a project only. The goal of partnership is to maximize the effectiveness of each participant's resources in order to achieve specified business goals. In order to realize the increases in efficiency, the traditional relationships must be transformed into a shared culture and work environment without regard to organizational boundaries (CII, Improving Project Performance, 2012)

According to (Egan, 1998) Partnering entails two or more organizations collaborating to improve performance by agreeing on shared objectives, devising a method of resolving any disagreements, and committing to continual development, monitoring progress, and sharing the gains.

Partnering can bring about a sense of cooperation and teamwork between firms that are traditional competitors and change the culture of the industry from an adversarial to a cooperative one (Steen, 2000).However, partnerships can be successful only if the relationship between the two or more organizations is based on trust, dedication towards common goals, and understanding the expectations and values of the other partners.

Beyond improved efficiency, there benefits of partnerships include: (CII, Improving Project Performance, 2012)

- Cost effectiveness for each organization may result from more effective deployment and utilization of resources;
- Increased opportunity for innovation exists in a partnership due to new ideas being brought in by partners;
- Partnering promotes continuous improvement of quality products and services; and
- Increased earnings (value) for all stakeholders are possible

(Appel, 1993)and (Penna, 1993) Identify Other advantages include less susceptibility to litigation, cost overruns, and delays, which can increase product quality because enterprises are more focused on working toward a common objective rather than competing with one another.

2.1.7. Quality management

Quality management, according to the American Society of Quality (ASQ) dictionary, is the use of quality management in managing a process to achieve maximum customer satisfaction at the lowest total cost to the business while continuing to improve the process. (Abdul Razzak, 2011). Quality management guarantees the consistency of an organization, product, or service. It is made up of four major components, which are as follows; (Kenneth et al., 2005)

- Quality planning(identification of quality standards),
- Quality assurance(evaluation of overall project Performance), s
- Quality control(monitoring of specific project results),
- Quality improvement.

All above components of the QMS process are important, but quality control is of particular importance because it ensure conformity to the project requirements (Mane & Patil, 2015).

The International Standard for Quality Management (ISO 9001:2015) incorporates a number of management principles that top management can utilize to drive their organizations toward higher performance.

- **Customer focus: -** The primary focus of quality management is to meet customer requirements and to strive to exceed customer expectations.
- **Leadership:-**Leaders at all levels create conditions in which people are engaged in achieving the organization's quality objectives by establishing unity of purpose and

direction. Leadership must initiate the necessary adjustments for quality improvement and instill a feeling of quality throughout the organization.

- **Process approach: -** When activities are understood and managed as interconnected processes that function as a cohesive system, consistent and predictable results are achieved more effectively and efficiently.
- **Improvement: -** Successful firms are constantly striving for betterment.
- **Evidence based decision making**: - Decisions based on data and information analysis and review are more likely to generate desired results.
- **Relationship management: -** In order to achieve long-term success, a firm must manage its relationships with stakeholders such as suppliers and retailers.

There are numerous approaches for enhancing quality. These include product enhancement, process enhancement, and people enhancement. The following are quality management approaches and procedures that embrace and drive quality improvement: (ISO, 2015)

- **ISO 9001:2015**:- a quality management system (QMS) certification for organizations that wish to demonstrate their capacity to consistently offer products and services that fulfill the expectations of their customers and other relevant stakeholders.
- **QFD (quality function deployment):** also known as the quality house strategy.
- **Kaizen**: - Japanese for better change; the usual English word is "constant improvement."
- **Zero Defect Program: -** created by NEC Corporation of Japan, based on statistical process management and was one of the inputs for the designers of Six Sigma.
- **PDCA (plan, do, check, act cycle**):- for the purpose of quality control (The DMAIC approach (define, measure, analyze, improve, control) of Six Sigma may be considered as a specific application of this.
- **Quality circle** — a group (people oriented) approach to improvement.
- **TQM (total quality management):-** is a management technique aiming at embedding quality awareness in all organizational processes. The Deming Prize was first promoted in Japan and was then taken and adapted in the United States as the Malcolm Baldrige National Quality Award and in Europe as the European Foundation for Quality Management award (each with their own variations).

- **BPR — business process reengineering**: - a management technique aimed at optimizing an organization's workflows and procedures.

When a QMS is implemented, the benefits can include: (CII, Improving Project Performance, 2012)

- Increased customer satisfaction;
- Ongoing organizational learning and continuous improvement;
- Stable work processes with minimal variation;
- Productivity improvements;
- Failure prevention; and
- Satisfaction of contractual requirements.

2.1.8. Change management

Change management is the act of introducing a balanced change culture of project recognition, planning, and evaluation into an organization in order to effectively manage project changes (CII, Improving Project Performance, 2012). In construction projects if there is a scope change, design change, estimate adjustments, schedule adjustments, changed condition from it is original contract this is called project change (CII, Improving Project Performance, 2012) And (Mohamed et al., 2019). Change can be categorized into two intended and unintended changes. The change that happens by result of low-quality work, poor work conditions, and external scope change without control of managerial action is categorized under unintended change. (Bakhary et al., 2015) State that, Planned or managerial changes are those changes need the approval and application of project manager action.

(Mišić & Radujković, 2015). Gives a conclusion on the most common alterations that happened in building projects, such as design changes that are monitored by safety management and contracts between clients and contractors.

Project finance is highly effected by ineffective change management which is lead to projects cost overruns or even claims and legal disputes (Cunningham, 2017).

Project Change should affect construction phase in different side;

- Productivity,
- The planned schedules and deadlines,
- Work methodology,

- Resource procurement,
- The budget

Therefore, to control the impacts of change at each construction phases project change management is important (Radujković & Sjekavica, 2017).

Benefits of change management on project as; (CII, Improving Project Performance, 2012)

- Provides archival, periodic, and end-of-project statistics to aid in measuring the impact of change and planning future initiatives.
- Reduces the amount of adjustments required in future projects.
- Allows for the forecasting of project modifications and effective remedial actions.
- Improves project safety.
- Saves money and time.
- Enhances job quality.
- Improves inter-phase team relationships.

2.1.9. Disputes prevention and resolution

In construction industry, there is idea difference on a case between construction projects participants this is tends to them into conflicts. If this conflict events are not managed properly, it have high chance to transform into disputes. Construction experts are not agreed on the differences between conflicts and dispute which lead to use these two terms interchangeable in most cases. (Acharya et al., 2006)

Collins's dictionary defines conflict as a serious disagreement and argument about important issues Collins Cobuild English dictionary (1995). (Wilmot & Hocker, 2001) also defined conflict as a disagreement between at least two independent parties who observe incompatible goals, scare resources, and interference from other.

On other hand (Diekmann & Girard, 1995), defined dispute as the disagreement between project parties on any contract that must be settled beyond the jobsite management. If dispute is not resolved at early stage it is transformed into a claim. In construction industry dispute is resolved by using several methods. However, there is no one best dispute resolving methods suitable for all dispute cases. So it is important for both owners and contractors to identify the advantage and disadvantage of each dispute resolving method in details to resolve the disputes properly (Wesam et al., 2018).

The more common methods Alternative Dispute Resolution (ADR) methods are: (Alexander & Partner, 2015)

- Negotiation
- Dispute review boards (DRB)
- Mediation
- Arbitration

2.1.10.Zero accident techniques

In construction project poor planning and design at early stage is the cause of most accidents. To prevent accidents in construction project all the construction projects stakeholders have responsibility for safe design and construction procedures (Manase et al.) .

(Adams, 1976) State Accident can cause time and cost overrun and sometimes loss the names of organization and losing the confidence among workforce.

Additionally, it can also cause dissatisfaction among stakeholders, be uncompetitive during tendering, financial losses due to property damages and penalties from authorities.

(Jain & Sunil, 2009)Explained that if the site planning is safe and easy to access it help to prevent accident, reduce hazards and also to eliminate accidents from construction site. It also helps to ensure the work progress rapidly. Towards a successful and effective prevention, the following should be given adequate attention. In order to prevent accident in successful and effective way they suggest the following methods;

- **Education and Training**: Lectures, films shows, handouts, safety bonus and short time course
- **Evaluation Method**: Field managers and supervisors should be evaluated for promotions and compensation increases based on safety, productivity, and cost, as this will provide them with greater motivation to follow the company's safety regulations.
- **Health and Safety Commission**: To take over the duty for creating policies in the health and safety department, the government should establish a health and safety commission made up of representatives from industry and local governments.

- **Power of Inspectors**: Safety inspectors should have the authority to enter any premises at any reasonable time if they have reason to believe it is necessary for them to carry out any of the legislative provisions within their enforcing authority's scope of responsibility.
- **Enforcement:** If an inspector discovers a violation of any decree provision, he can issue a prohibition notice to stop the activity that is causing the risk until the remedial measure indicated in the notice is taken.
- **Local Authority**: Local government officials should execute the decree in specific fields of employment, according to the commission's recommendations.

(CII, Improving Project Performance, 2012) suggest Zero Accident techniques include the site-specific safety programs and implementation, auditing, and reward efforts to create a project environment and level of training that supports the concept that all accidents are preventable and that zero accidents is an attainable goal.

Benefits of applying zero accident techniques in construction projects (CII, Improving Project Performance, 2012).

- Protection of employee’s life and health
- Reduced insurance costs
- Improved experience modification rate
- Improved incident rate
- Improved frequency rate
- Improved severity rate
- Ability to compete for new projects
- Repeat business

2.2. Project Management

Project is defined as a short-term activity done to create a one-of-a-kind product, service, or outcome Temporary implies that each project has a distinct beginning and finish point (PMBOK Guide, 2013).

The application of knowledge, skills, tools, and procedures to project activities in order to accomplish the project's objectives is referred to as project management. Integration of the 42 logically grouped project management processes comprising the 5 process groups. These 5 process groups are; (PMBOK Guide, 2013)

- Initiating
- Planning
- Executing
- Monitoring & Controlling
- Closing

2.2.1. Project Time Management

Project time management has progressed from its simple beginnings to the more complex, computer-aided procedure that it is today. Project time management encompasses the processes required to ensure that the project is completed on time. These are the procedures: (PMBOK Guide, 2013)

1. ***Plan schedule management-*** in this process project schedule planning, developing, managing, executing and controlling is done by establishing the policies, procedures and documentation.
2. ***Define activities-*** The specific actions executed to produce the project deliveries will be identifying and documenting by this process.
3. ***Sequence activities-*** The relationships between project activities is identifying and recording in this process.
4. ***Estimate activity Resources-*** In this process the required Material type and quantities, human resources, equipment to perform each activity of project is estimating.

5. ***Estimate Activity durations-*** The technique of predicting the time required to execute certain tasks using estimated resources.
6. ***Develop schedule-*** In this process all above listed process are analyzed and schedule constrains to create schedule model of the project.
7. ***Control schedule-*** The process helps to update project progress and manage changes to the schedule model to achieve the plan by controlling the status of project activities.

2.2.2. Time Management Techniques/ Methods

Time management is one of the key effective project management areas. Poor time management will cause project delays (Kerzner, 2003) . There are numerous techniques or methods used to manage construction projects time discussed as follow:

1. Gantt Bar Chart

Gantt Charts are commonly use method in construction industry for scheduling and controlling, because it is simple and easy to create (Arditi et al., 2002).The main advantages of Gantt Charts:

- It is used for project planning and scheduling.
- It calculates the entire project length.
- It determines the resource needed for each activity.

2. Critical Path Networks/Method

Critical Path Method (CPM) has been widely used for network analysis and project planning industry (Ming & AbouRizk, 2000) and it develops scheduling and project administration tasks, supporting project managers to ensure project is completed on time and budget (Kyunghwan & Garza, 2003).

In addition, CPM helps to determine project duration, early and late dates, float time, critical path, logical constraints and a number of other activity characteristics (AbouRizk et al., 1998).

Milestone date programming can be used in conjunction with CPM to indicate the major dates for a construction project such as the completion of the foundation works, super-structural works etc.

Precedence Network Diagrams are very similar to CPM, and is used widely in the construction industry. Also, it is easier to draw and modify; additional activities can be inserted without changing node reference numbers.

3. Program Evaluation and Review Technique (PERT)

PERT is a variation of the Critical Path Method which allows for the inclusion of the randomness in the duration of activities. PERT is also a simplification of Monte Carlo Simulation methods.

The key advantages of PERT are:

- It is used for new project which have not been done before.
- It helps to estimated time and cost performance.
- It provide an assessment of the probability of reaching certain milestones by specified dates or of achieving overall project completion within a specified time period (Callahan et al., 1992).

4. Elementary Trend Analysis/ Line of balance Method (LOB)

LOB scheduling is a visual scheduling technique that allows the planner to explain the flow of the project implicitly (Olofsson et al., 2007).

Some advantages of this method are:

- It shows the work taking place in a certain area at specific time of the project in clear way.
- It highlights and optimize the resources used by large number of repeated activities, executed in several zones or locations.
- It analyzes easily cost and time optimization because of all the information available for each activity in the project

2.2.3. Project Cost Management

The processes involved in estimating, planning, and controlling costs so that the project can be completed within the allocated budget are referred to as project cost management. The following project cost management methods are included: (PMBOK Guide, 2013)

• **Plan cost management**- The development of policies, methods, and documentation to plan, manage, spend, and control project costs.

• **Cost Estimation**- This procedure assesses the financial resources needed to perform the project tasks.

• **Determine Budget**- The process of integrating the anticipated costs of various activities or work packages to generate an authorized cost baseline.

• **Cost Control**- By regulating the state of project operations, the process helps to update project progress and manage changes to the cost model.

The primary focus of project cost management is the cost of the resources required to fulfill the project operations.

2.2.4. Cost Management Techniques/ Methods

One of the most essential project management components is cost management, which is a vital tool for controlling and improving project cost performance. It aids in keeping the project inside the financial constraints. Poor cost management frequently leads to project cost overruns.

According to (Tang, 2005), cost management techniques are:-

A. Cost Planning and Control

Cost planning can be used efficiently for estimating the project cost. More than 80% of project costs are determined during the initial stage of the design. If cost estimating and planning done by skillful and professional, it adds real value by enabling informed decision-making from the outset.

(Ashworth, 2010) Proposed the general advantages of cost planning include:

- The tender sum is more likely to equate with the approved budget estimate.
- There is less likelihood of addendum in bills of quantities or re-costing being required.
- Cost-effectiveness and a value-for-money design are more likely to be achieved
- A balanced distribution of expenditure is likely to produce a more rational design
- The amount of pre-tender analysis by the architect and quantity surveyor should enable more decision to be taken earlier, resulting in a smoother running of the project on site.

Cost planning provides a sound basis for comparing different projects process of cost planning consists of three phases including;

- Establishment of a realistic first estimate.
- Plan showing how this estimate should be spent among the various parts or elements of a project, and
- Process monitoring to guarantee that the real design details for the various pieces can be built within the budget.

As noted in (Basak, 2006), project cost controlling a team endeavor and depends on how well the basic project management practices are implemented on the project. When governance, owner organization and rosters, roles and duties, project execution techniques, reporting and communications are defined, project cost control is effective (Halpin, 1985). Highlights that project cost control data are important to project management in decision-making process, additionally it is important to company's estimates and planning departments because these data provide feedback information essential for effective estimates and bids on new projects.

B. Estimating

This technique is usually used at pre-tender stage in construction to provide sign of the probable cost of construction. Cost estimating is the basic process of answering question how much is the project expected to cost? The estimate also provides the basis for budgeting and control of the construction cost. The estimate may be reviewed and revised many times during project development and construction phases (Schuette & Liska, 1994).

The goal of generating a pre-tender estimate is to divide it into the following categories:

- Budgeting- this determines whether the project will go as planned.
- Controlling- Throughout the design process, the estimate is used as a control mechanism.
- Comparing- this uses the estimate as a starting point for evaluating other design ideas (Ashworth, 2010).

C. Budgeting

A budget evaluates the financial future course of action set out in a business plan. It is shows detailed plan in terms of money, the plans for income and expense in respect of a future period of

time (Weetman P. , 2006). The budgetary process fits into the overall planning process, it evaluates the financial consequences of the plan and provides financial feedback so that plans can be monitored and revised (Schuette & Liska, 1994). The purpose of a budget system is to help the needs of management in terms of the judgments and decisions required to provide a basis for the management functions of planning control.

D. Cash Flow Forecasting

As (Weetman, 2006) Explain the actual cash flows:

$$Cash\ Flow = Cash\ inflows\ to\ the\ enterprise - Cash\ outflows\ from\ the\ enterprise \ldots\ldots \text{(Eq.1)}$$

Both inflow and outflows cash are caused by different factors and the enterprise will try to identify the causes. A typical construction project's cash flow includes: cash out (bid costs, preconstruction costs, engineering, design, mobilization, materials and supplies, equipment and equipment rentals, payments of subcontracts, labor, and overhead), and cash in (billings less retentions, retentions, claims, and change orders).The duration of the project, the retention conditions, the times for receiving payments from the client, credit arrangement with suppliers or vendors, equipment rentals, and times of payments to subcontractors, and etc. are the factors that affect cash flows (Hyung, 2005).

At the project level, cash flow is comprised of a complete history of all cash disbursements and earnings collected as a result of project execution. Many construction projects have negative net cash flows until the final payment is collected or an advance payment is received before the project begins. This is a common occurrence when the final payment consists of retention money and the retention % is greater than the project's profit percentage. Financial and cost reports, for example. The purpose of a financial report and a cost report is to document all financial activities, payments in and out, as well as sums owed and outstanding. (Burke, 1999).

This kind of information is essential for the top management in decision making and also for the financing of the project and it is an obvious need for senior management to know

- Financial performance to date
- Anticipated financial performance of current year and
- Anticipated financial performance at the end of the project (Burges, 1982).

H. Judgment

The final component of cost control and planning is the judgment of the manager. Without the application of judgment cost management techniques cannot be used effectively (Fortune & Lees, 1996). It should be noted that a successful price forecasting technique must combine both historical trend data and competent "judgment" based on construction experience and understanding. (Hashem & James , 1992).

2.3. Project Performance

(Chan Daniel & Kumaraswamy, 2002)Remarked that project performance measurement includes time, budget, safety, quality and overall client satisfaction. In construction project, poor performance such as low quality, time overrun and cost overrun are common. (Kuprenas, 2003) stated that project performance measurement is a cost, schedule, and quality enhancement for design and construction. (Long et al., 2004) stated that project performance is measured in terms of time, budget, quality, specifications, and stakeholder satisfaction. People, cost, time, quality, safety and health, the environment, client satisfaction, and communication are some of the project performance areas that have been recognized by (Cheung et al., 2007) .

Time performance is critical for construction projects to be completed on time, as clients, users, stakeholders, and the general public typically look at project success from a macro perspective, with the completion time appearing to be their primary criterion for project success. (Lim & Mohamed, 2000).

(Michell, 2007) also stated that timely completion of a construction project is frequently seen as a major criterion of project success by clients, contractors and consultant alike (Salter & Torbett, 2003). It was mentioned that one of the strategies for analyzing project performance in construction projects is time variance. The issue of time could signify to project managers that the project was not progressing as planned.

Cost performance is defined as the degree to which the general conditions promote the completion of a project within the estimated budget (Bubshait & Almohawis, 1994).

Cost variance is an important aspect in determining project performance since it reflects whether the project is above or under budget. Generally, time and cost management of construction project

is defined as coordination of time cost planning, organizing and controlling in the fieldwork or in the construction sites to meet the goals of project schedule, cost and quality estimation (Ritz, 1994).

2.4 Definition of Time Overruns and Cost Overruns

Time and cost overruns are defined as any delay beyond the planned construction schedule or cost (Aftab and Memon, 2011). (Abubeker, 2015) Defines an overrun as the inability to complete a project either by the original planned time or budget, which ultimately leads to a project delay. In both cases, the overrun is seen as the percentage difference between the baseline that is established in contractual documents and the actual time or cost upon completion.

2.4.1 Time Overrun

• As stated by (Al- Gahtani K. and Mohan, 2007) time overrun is an extension of time beyond the contractual time agreed upon during the tendering of a construction project.
• Time overrun is defined by (Chan, 2001) as the discrepancy between the actual completion time and the expected completion time. It is given in terms of days.

$$Time\ Overrun = \frac{Time\ Taken\ to\ Complete\ Project - Contact\ Duraction}{Contract\ Duration} \quad \ldots\ldots\ldots \text{(Eq. 2)}$$

2.4.2 Cost Overrun

• Cost overrun is defined by (Avots, 1983) as the difference between the original cost and the actual cost when the project is completed.
• A cost overrun is defined as the difference between the actual cost and the budgeted cost. Cost overrun can also be referred to as "cost escalation," "cost rise," or "budget overrun." (Zhu. K., 2004)

$$Cost\ Overrun = \frac{Cost\ at\ Completion - Contract\ Cost}{Contract\ Cost} \quad \ldots\ldots\ldots \text{(Eq. 3)}$$

2.5 Causes of Time and Cost Overruns

2.5.1 Causes of Time Overrun

Several research and studies have been done in different countries at different time to identify the causes of construction project delay. (Aftab and Memon, 2011) was identify the cause of time overrun, design changes/change order, delay in progress payment, ineffective planning and scheduling of project, poor site management and supervision, Shortage of labors and difficulties in financing project by contractor, design changes by owner or agent during construction, late delivery of materials, unreliable subcontractors, delay in performing inspection and testing, unqualified/inexperienced workers, delay in site delivery, delay in approving design documents, poor communication and coordination, Unforeseen ground condition, Low speed of decision making, and Client-initiated variation and Necessary variations of works were found as the most critical factors responsible for this time overrun.

According to (Subramani et al., 2014) note in Insufficient equipment, inaccurate time estimates, monthly payment troubles, modification orders, and erroneous cost estimates are the top five most critical variables that contributed to the causes of delays.

According to Construction Sector Transparency Initiative (CoST-Ethiopia) study the main cause of Time overrun in Ethiopia construction industry are: (Asmeron et al., 2016)

- Incomplete design
- Design change (though variation)
- Scope change
- Change in quantity (up on re-measurement)
- Force majeure and adverse weather conditions
- Poor completion time estimation
- Other reasons such as contractor's low capacity, Employer's inactions, shortage of materials, and construction difficulty.

From the above lists of reason for time overrun in road subsector, design change and force majeure (including inclement weather condition) each share 22%. While other reasons such as contractors'

low capacity, land acquisition related problems (Employer's contractual obligation), etc. constitute the major reasons of time overrun with 26% share.

2.5.2 Causes of Cost Overrun

In Construction project, cost overrun happens by numerous causes and several research and studies have been conducted to solve these causes. (Kaming et al., 1995) did a study on several projects in Indonesia, and the study discovered that cost overruns are more likely to occur than time overruns, implying that the cost issue is more relevant and prevalent than project delays. He discovered that the majority of the issues creating cost overruns are the result of increases in material prices and currency inflation.

(Mansfield, 1994) Also carried out a questionnaire survey among key stakeholders (contractor, consultant and client organizations) in Nigeria. According to the study, the main causes of construction delays and cost overruns were poor planning, material shortages, imported supplies, changes in site conditions, and design revisions.

According to (Savita and Pradeep , 2014)cost overruns are a major problem in both developing and developed countries. The trend is more severe in developing countries where these overruns sometimes exceed 100% of the anticipated cost of the project.

According to Construction Sector Transparency Initiative (CoST-Ethiopia) study the main cause of Cost overrun in Ethiopia construction industry are; (Asmeron et al., 2016)

- Incomplete design
- Design change (though variation)
- Project Scope change
- Change in quantity (up on re-measurement)
- Force majeure (events not caused by contracting parties)
- Price hike/ inflation
- Other reasons such as construction difficulty, employer's inactions, shortage of materials, etc. that increased cost of the project.

From those causes of cost overrun in the road subsector only six of them have impact on the road subsector. Design change is the main reason for cost overrun in road sector.

2.6 Contractor Related Cause of Time and Cost Overruns

(Aftab and Memon, 2011)Showed that ineffective planning and scheduling by contractors as a quite significant cause of time overrun. This issue seems to be true as it is highly related to cash flow and financial difficulties faced by contractors. Time overruns are also caused by a shortage of site employees, poor site management by the contractor, insufficient contractor experience, a lack of communication among construction parties, problems with subcontractors, and frequent change management. Cause of time overrun from contractor side are: (Amare, 2006)

- Delay in site mobilization.
- Poor contractor site management and supervision
- Ineffective project planning and scheduling.
- Breakdowns in equipment.
- Difficulties in financing the project by the contractor.
- Lack of essential equipment.
- Late material procurement by the contractor.
- Type of project bidding and award (selection based on lowest evaluated bidder).
- Shortage of technical personnel in the contractor's organization, and
- Cash flow issues encountered by the contractor are acknowledged as the most serious reasons of time overruns by the contractor, consultant, and client.

Poor contractor site management and supervision, as well as insufficient contractor experience, are the major causes of cost overruns in road construction projects.(Pal & Pandey, 2017)
Contractor related cause of time and cost overruns are summarized in the table: 1 below.

Table 1: summary of contractor related cause of time and cost overruns

Authors	Country	Time or Cost Overruns	Factor time and cost overruns
Niazia & Painting (2017)	Afghanistan	Cost Overrun	1. Poor coordination and communication because of contractor and other parties 2. Financial difficulties by contractor 3. Delay in site mobilization 4. Often changing sub-contractors 5. Mistake during construction by contractors 6. Poor contractors experience 7. Ineffective planning and scheduling 8. Lack of sub-contractor skills
Memon et al. (2014)	Malaysia		1. Incorrect planning and scheduling by contractors 2. Inadequate contractor experience 3. Low speed of decisions making 4. Cash flow and financial difficulties faced by contractors 5. Contractor's poor site management and supervision
Sambasiyan & Soon (2007)	Malaysia	Time Overrun	1. Contractor improper planning 2. Contractor's poor site management 3. Problems with sub-contractors 4. Shortage in material 5. Labor supply 6. Lack of communication between parties 7. Mistake during the construction stage
Sweis et al. (2008)	Egypt		1. Financial difficulties faced by the contractor 2. Poor planning and scheduling of the project by the contractor

2.7 The effect of time overrun and cost overrun

Completing a project on time and within budget is a major indicator of project success in the construction business. Time and Cost overruns have an obvious impact for the key stakeholders in particular, and in the construction industry in general (Arditi , 1885). Cost overruns affect not just the parties directly involved in the construction of a project, but also the construction sector as a whole and, as a result, the country's national economy. (Fetene, 2008).

(Aibinu and Jagboro , 2002) investigated the effects of construction time overruns on project delivery in Nigeria and identified five consequences: cost overrun, disagreement, arbitration, outright abandonment, and litigation. Cost overruns in the sector as a whole could result in project abandonment, a decline in construction activities, a negative reputation, and an inability to acquire project finance or securing it at higher costs due to extra risks. All these consequences undermine the viability and sustainability of the construction industry.

2.7 Summary of Literature Review

The literature review was done through previous studies, journals, construction management books, and engineering journals. By referring to previous literature, information on Construction Industry Institute (CII) best practices of contractors on road projects, as well as time and cost overruns in the construction industry, has been observed. This would be used to create the questionnaire survey that would be used to collect data from the targeted respondents.

According to the literature review, the main CII best practices are front end planning, alignment, constructability, material management, team building, partnering, quality management, change management, dispute prevention and resolution, and zero accident techniques. These best practices are a process or method that aids in the effective execution of projects in order to improve project performance. (CII, Improving Project Performance, 2012)

These best practices aid in overcoming major time and cost overruns caused by incomplete design, design change, project scope change, change in quality, force majeure and adverse weather conditions, poor completion time estimation, contractor's low capacity, and material shortage in

Ethiopia road projects, according to a Construction Sector Transparency Initiative (CoST-Ethiopia) study. (Asmeron et al., 2016)

This study focuses on the contractor's CII best practices on ERA road projects to overcome contractor-related time and cost overruns such as site mobilization delays, poor contractor site management and supervision, ineffective project planning and scheduling, equipment breakdowns, difficulties in financing the project by the contractor, lack of essential equipment, shortage of technical personnel in the contractor's organization, and so on. (Amare, 2006)

3 RESEARCH METHODOLOGY

3.1 Introduction

According to (Walliman, 2011) Research, is defined, any type of investigation designed to uncover interesting or novel facts. The systematic method of enunciating the problem, formulating a hypothesis, collecting facts or data, analyzing the facts, and reaching certain conclusions, either in the form of solutions(s) to the concerned problem or in certain generalizations for some theoretical formulation, is also defined as research (Kothari, 2004).

3.2 Type of Research

This study employs Descriptive vs Analytical and Quantitative research methods. According to (Kothari, 2004) Descriptive vs. Analytical type of research were Surveys and fact-finding inquiries of various kinds are examples of descriptive research. The main feature of this method is that the researcher has no control over the variables; he can only report what has occurred or is occurring. The researcher, on the other hand, must use facts or information that are already available and analyze them in order to make a critical evaluation of the material. Analytical research, on the other hand, requires the researcher to use pre-existing facts or information and analyze it in order to make a critical evaluation of the material. Based on the above definition, this research is descriptive research because the researcher describes and collect objective data about road projects completed in the last ten years with the least amount of time and cost overrun; it is analytical because the researcher use ERA data and analyze it to find the least amount of time and cost variations. It is also quantitative because it attempts to quantify in numbers the responses of contractors, ERA experts and client engineers via questionnaires.

3.3 Research Process

The research process consists of a series of actions or steps required to carry out research effectively, as well as the desired sequencing of these steps. Before hollow out into the specifics

of research methodology and techniques, a brief overview of the research process seems appropriate (Kothari, 2004).

A six-step research process was established to satisfy the goals and objectives of this thesis. The first was a survey of literature on time and cost overruns, best practices in construction, and project performance. The second task is to collect secondary data from Ethiopian Road and identify the projects with the minimum time and cost overruns. Next, a questionnaire survey was designed to collect primary data from client, consultant, and contractor specialists. The acquired data was then quantitatively evaluated using SPPS software version 26 and MS-Excel 2013. The fifth procedure was used to interpret and discuss the research findings. Finally, conclusions and recommendations were formed based on the outcome. This thesis research process are conclude by the fig.1 below;

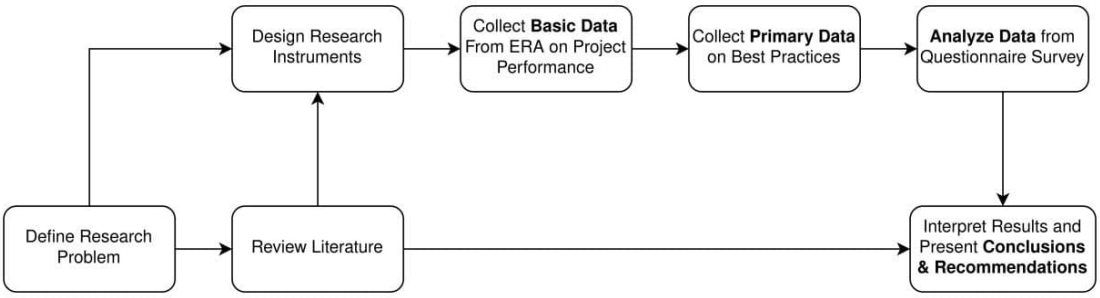

Fig. 1: Research Process

3.4 Research Design

3.4.1 Research Methods and Strategy

The research method is a method of carrying out research that is determined by the nature of the problem. Methods of research can be divided into three categories (Singh, 2006).

1. Theoretical issue – survey and experimental approach
2. Historical, case study, and genetic methodologies to solve a factual problem
3. Problem of application - Action Research

For this study, the survey and case study methods were chosen. The survey method of research seeks to ascertain the current state of the phenomenon under investigation. The primary goal of the survey method in research is to determine "what is"? i.e., to describe the problem or phenomenon; however, many surveys go beyond a simple description of the current situation. This study used the survey method to answer the research question by distributing two different questionnaires to contractors, clients, and consultants. As a source, this study relies on ERA road construction projects completed between 2009 and 2019GC reports.

3.4.2 Study Focus Area and Selection Criteria

The study's main focus is on contractor best practices for completing road construction projects in the ERA in the last ten years (2009-2019GC).Ethiopian Road Authority is selected for two main reasons.

1. ERA constructs large and complex road projects across the country by partnering with high-performing contractors, which helps the thesis to achieve one of the research's goals of recommending the best construction practices of contractors in terms of time and cost.
2. ERA has more machinery and well-experienced professionals, as well as organizational and financial capacity, than any other client in the country; they are better suited for studying contractor best construction practices in terms of time and cost.

3.4.3 Sampling Design

A sample design is a specific plan for extracting a sample from a given population. It refers to the method or procedure used by the researcher to select items for the sample.

The sampling technique is determined by two factors: the representation basis and the element selection technique. On the basis of representation, sampling can be classified as probability or non-probability sampling, and on the basis of element selection, the sample can be either unrestricted or restricted. Probability sampling is a sort of sampling in which every item in the

universe has an equal probability of being included in the sample. It is also known as "random sampling" or "chance sampling" (Kothari, 2004).

Non-probability sampling is also known as deliberate sampling, purposeful sampling, and judgment sampling. The researcher chooses the items for the sample on purpose in this type of sampling. When each sample element is drawn from the entire population, the sample is referred to as a "unrestricted sample" (Kothari, 2004).

Taking into account the aforementioned methods, ERA is selected as the sole subject of this research due to its significant role in the development of Ethiopia's road network. The Ethiopian Road provided a list of 156 projects, together with the requisite cost and schedule performance statistics. From this list, 74 new road construction projects were found to satisfy the previously defined scope, and a total of 33 were chosen as the best performing using a 25 percentile cutoff, resulting in 33 projects. The top 25% cutoff was selected in order to identify the top performing projects. While an attempt was made to use a higher cutoff level, the number of projects would have fallen below recommended thresholds for use of questionnaires. Following the determination of the research sample size, respondents were chosen on purpose to gather the desired information via questionnaires.

3.4.4 Structural Questioners

In order to answer the study question, two types of questionnaires are produced for contractor's experts, client's experts, and consultant's experts. The structures of the client and consultant questioners are the same. The questions include a list of projects in which the respondent has participated, and the questionnaires are divided into seven sections. Part one of the questioners is about the respondent's information such as education level, educational area, work experience, and so on. Part two of the questioners is about consultant or contractor information such as type of firm, grade of firm, experience of firm, owner of firm, and so on. Part three of the questioners is about project related information such as location of the project, who finances the project, and so on. Part four of the questioners is about construction best practices information such as CII construction best practices, Part five of the questioners is about the impact contractor related causes

have on construction projects, Part six of the questioners is about consultant and client related causes that have a negative impact on construction projects, and Part seven is about general causes that have an impact on construction projects.

The contractor questionnaires are intended to learn about their construction best practices in terms of time and cost of road projects. Respondents were asked to answer a different question by choosing one of five alternatives and rating the application of best practices on construction projects as very rarely, rarely, neutral, often, or very often, as well as rating the impact of contractor-related causes on construction projects as very low impact, low impact, no impact, high impact, and very high impact. Also, the client and consultant analyze the contractor's implementation of construction best practices tradition by grading and rating the impact the client and consultant linked causes on the construction projects as very low impact, low impact, no impact, high impact, and very high impact. The questionnaires utilized in this thesis are included as an addendum to this thesis.

3.4.5 Target Population

The objective for this study was the contractor who finished their road construction project in Ethiopian Road Authority Projects with the minimum of time and cost overruns in the last ten years (2009 to 2019GC). As a consequence, 74 road construction projects were sampled by construction project and year of construction from report of the Ethiopian Roads Authority. A total of 33 projects were chosen from among those that had the least amount of time and cost overrun. As previously stated, a 25^{th} percentile cutoff was utilized because other options such as use of standard deviations yielded a very small set of projects, mainly due to outliers influencing the mean and standard deviation.

From these 33 projects, two contractors are no longer in operation, and 5 projects under these two contractors are no longer under research, bringing the total number of projects for this thesis to 28. As a result, 28 projects with the best schedule and cost performance were included in the survey.

3.5 Data Collection and Source

Following the definition of the research problem and the design of the research, the next task is to collect the necessary data. Data are classified as primary or secondary based on the source. Primary data are those that are collected for the first time and thus are unique. Secondary data, on the other hand, are those that have already been gathered by someone else and have been subjected to the statistical process (Kothari, 2004).

Primary data, on the other hand, are defined as information gathered from primary sources such as observation, interviews, and questionnaires, whereas secondary data are gathered from secondary sources such as government publications, previous research, census, personal records, client histories, and service records (Kumar, 2011).

This study gathers information from both primary and secondary sources. The term "primary data" refers to information acquired through questionnaires from the contractor, consultant, and client. For this study, open-ended and closed-ended questionnaires were used as primary data collection tools. Secondary data was gathered from Ethiopian Road Authority company records and reports. Secondary data collection gathered real information about a list of road projects built in the last ten years, including project duration, project budget, contractor and consultant names, and so on.

The following histograms present the distribution of the delay, in days and cost overrun in million ETB experienced by the population. Some missing data points mean that the total number of projects isn't 74 in the following charts. The following table provides a statistical summary, and the high standard deviation shows that there is significant variability in the delays experiences by construction projects.

Table 2: Summary Statistics of Delays

Min (Days)	0
Max (Days)	2050
Median (Days)	281
Mean (Days)	439.554
St Dev (Days)	463.180

The histogram below shows that most delays (61.6%) are below 410 days, with the number of projects expereiencing greater delays dropping.

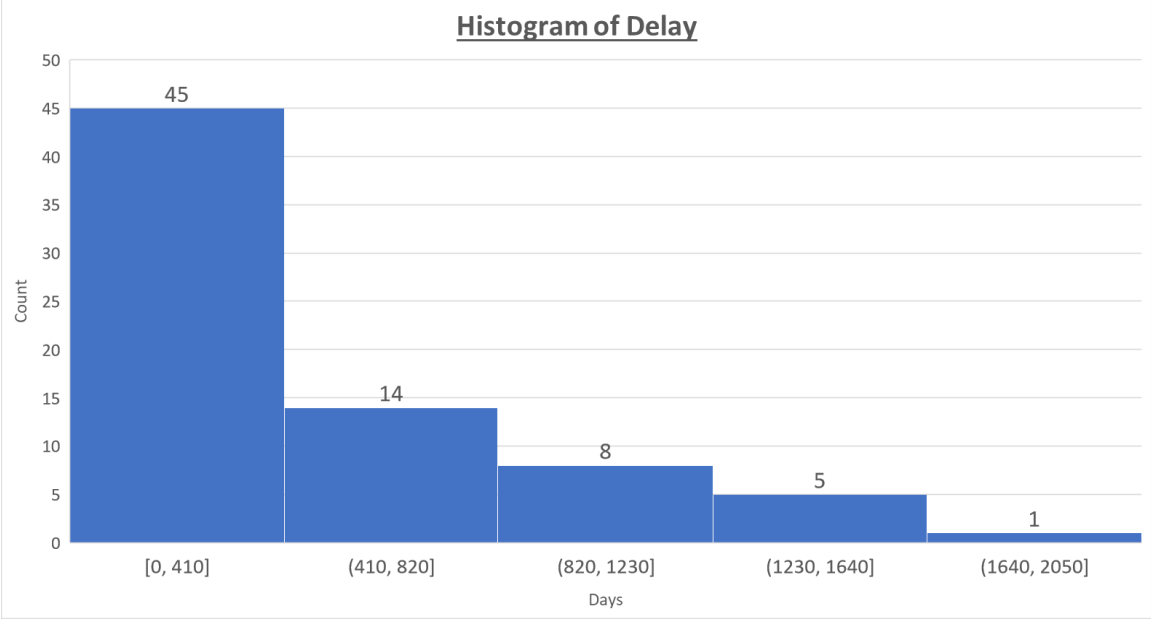

Fig. 2: Histogram of Delay Distributions

The summary statistics of the delays show that again, there is significant variability in the cost overrun, with the standard deviation exceeding the mean. The maximum cost overrun experienced also shows that the levels of cost overrun experienced are high.

Table 3: Summary Statistics of Cost Overruns

Min (ETB)	0.57
Max (ETB)	1,026,827,645.43
Median (ETB)	92,609,672.56
Mean (ETB)	133,145,017.42
St Dev (ETB)	172,934,727.00

The following histogram, in Million ETB summarizes the distribution of the cost overruns, with most cost overruns again being concentrated in the lower end of the ranges.

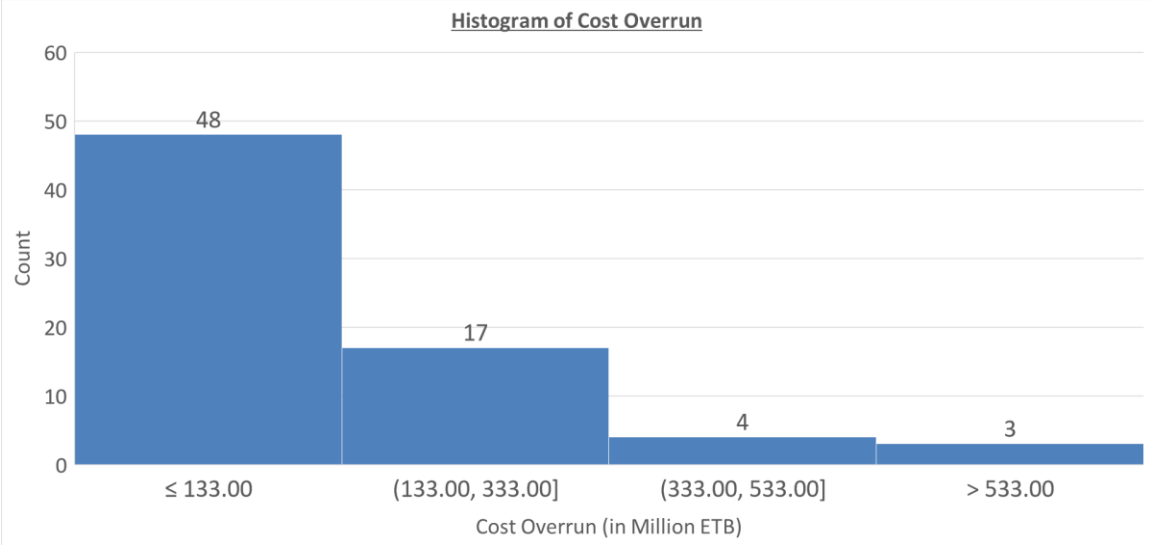

Fig. 3: Histogram of Cost Overruns

A literature review was also used as a secondary data collection method to gather information about the concept, type, techniques, and best practices in construction, as well as other data. As a result, the study drew on a variety of literature sources, including relevant books, journals, related websites on the internet, and other documents related to the topic under study.

3.6 Research Instruments

Data was gathered through the use of questionnaires and a case study of the company's reports. The study's goal is to look into the best construction practices of contractors who completed road projects with minimum time and budget. The questionnaires was created to answer the research questions. Sections of questions were created to answer the following:

- Whether or not the company's professionals are knowledgeable about construction best practices.
- The contractor's methods for minimizing time and cost overruns in order to complete road projects on time and within budget.

- To identify the methods or techniques used by contractors to implement construction best practices for ERA road projects.

The questionnaire was chosen for its effective method of gathering reliable data that can be quantitatively analyzed. The questionnaires will include both closed and open-ended questions. In an open-ended questionnaire, the respondent writes down his or her responses in his or her own words. In contrast, in a closed-ended questionnaire, the possible answers are listed on the questionnaire, and the respondent checks the box next to the category that best describes the respondent's response. It is usually a good idea to include a category called "Other/please explain" to accommodate any responses that aren't listed. In this study, the questionnaire was distributed to professionals from the contractor, consultant, and client sides.

3.7 Research Validity and Reliability

Validity is a critical and useful concept in all forms of research methodology because it is used to assess the quality of the research. The ability of an instrument to measure what it is designed to measure is referred to as its validity. (Kumar, 2011) Its primary goal is to improve the accuracy and usefulness of findings by removing or controlling as many confounding variables as possible, allowing for greater confidence in a given study's findings (Barry & Brooke, 2005). The ability of an instrument to produce consistent measurement is the focus of reliability. When a researcher obtains the same result using the same instrument under similar conditions more than once, the instrument is considered reliable.

Face and content validity, concurrent and predictive validity, and construct validity are the three types of validity. When each question or item on the research instrument has a logical link to objective face validity, the research instrument will be considered valid. The extent to which the measurement covers all aspects of the concept being measured is referred to as content validity. The degree to which an instrument can forecast an outcome is referred to as predictive validity. Concurrent validity is determined by how well an instrument compares to a second evaluation. Construct validity is determined statistically by determining the contribution of each construct to the total variance observed in a phenomenon. The reliability and validity of a research results depends on creating strong research design, choosing appropriate methods and samples, and

conducting the research carefully and consistently (Kumar, 2011). In this research the face validity has been maintained.

To ensure validity and reliability, this study employs a standardized questionnaire based on established theories or findings from previous studies, and it is designed to measure precisely what the research seeks to discover. Furthermore, this study employs an appropriate sampling method in order to select a sufficient number of participants who are representative of the population and to apply the method consistently.

While additional data collection instruments such as interviews and focus group discussions with key project implementers would have added to the reliability and validity, it is impossible to track the key personnel involved in the projects.

3.8 Data Analysis and Presentation

A mixed data analysis method has been used in this study. First, by using the appropriate frequency table to represent the findings, quantitative data was analyzed. Computers are used to ensure that data is processed accurately and quickly. Qualitative data from company records and reports are analyzed by using MS-Excel 2013 and presented in diagrams and tables for compilation. Secondly, research studies have an inherent risk of concluding that misrepresentations such as coincidences are based on; therefore, SPSS software version 26 and MS-Excel 2013 was used to increase data analysis accuracy Conclusion of questionnaires results with survey data will then discuss the findings. Finally, based on the findings, conclusions and recommendations will be made depend on the research finding.

4 DATA ANALYSIS

4.1 General Information

The data acquired by the questionnaire was analyzed in this chapter. The questionnaire was distributed to all project stakeholders, including consultants, clients, and contractors involved in the selected projects, which is the reason for the number of questionnaires exceeding the number of projects. This resulted in a total of 50 questionnaires being distributed to available staff. Those who responded worked on the selected road projects as a supervisor, project manager, site engineer, resident engineer, contract engineer, and had a minimum of a first degree in the field. The response rate and study findings from the analysis will also be discussed in this chapter. The full set of questionnaires can be found in the Appendix.

Table 4. Name of party of the respondent with their frequency

Name of the Party	Number of respondents	Percent (100%)
Clients (ERA)	9	27.3%
Consultant	10	30.3%
Contractors	14	42.4%
Total	33	100%

A total of fifty questionnaires were issued to construction sectors, with fifteen distributed to each client and consultant and twenty distributed to contractor's professionals who participated. The total respondent rate was determined to be 66%, with thirty-three respondents from the customer, ten from the consultant, and fourteen from the contractor's sides.

4.2 Research finding and data analysis

4.2.1 Respondent Profile

Out of the total of 33 respondents, 19 (57.6%) have a B.Sc. degree and 14 (42.4%) have a M.Sc. degree. The below table reveals the respondent's educational background.

Table 5: Educational Background of Respondents

Educational background	Number of respondents	Percent	Valid percent
B.Sc.	19	57.6%	57.6%
M.Sc.	14	42.4%	42.4%
Total	33	100%	100%

According to Fig.1, out of 32 responders, 9 or 28.1% are road or transportation engineers, and 12 or 37.5% are structural, geotechnical, and so on. Engineers, of which 3 or 9.4% are CoTM and 8 or 25% are in other engineering professions. From a total of 33 responders, one or three percent of respondent are missing the question.

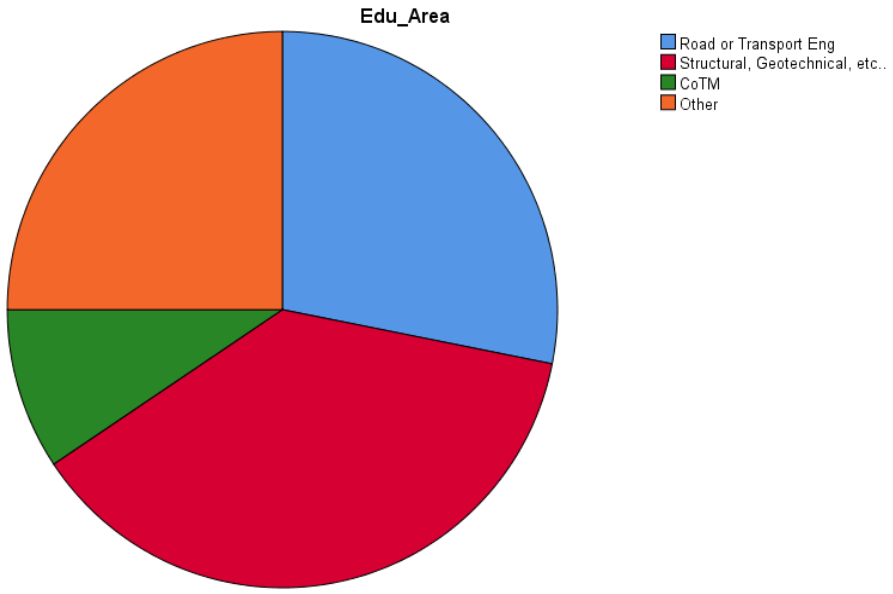

Fig. 4. Educational Area of respondents

As shown in the table, of the total 33 respondents, 6 or 18.2% have 1 to 4 years of work experience in the construction sector, 7 or 21.2% have 5 to 10 years of work experience in the construction sector, 12 or 36.4% have 10 to 15 years of work experience in the construction sector, and 8 or 24.2% have more than 15 years of work experience.

Table 6. Respondent works experience in construction industry.

Work Experience	Number of respondents	Percent
1 to 4 years	6	18.2%
5 to 10 years	7	21.2%
10 to 15 years	12	36.4%
Above 15 years	8	24.2%
Total	33	100%

The respondents' experience in the road industry ranged from 6 to 18. 2% have 1 to 4 years' experience in sectors, 11 or 33.3% have 5 to 10 years' experience, and 10 to 15 years' experience in the road sector includes 10 or 30.3% respondent numbers, as well as 6 or 18.2% Only of them have more than 15 years of experience in the road sector.

Table 7. Respondent work experience in road sectors

Work Experience	Number of respondents	Percent
5 to 4 years	6	18.2%
5 to 10 years	11	33.3%
10 to 15 years	10	30.3%
Above 15 years	6	18.2%
Total	33	100%

4.2.2 Contractor’s Profile

In contractor’s profile from a total of 33 respondent, 31 of them answered the contractor-related questions and two of them of did not. Contractors who construct those designated projects include 26 or 83.9% general contractors and 2 or 16.1% road contractors.

Table 8. Type of contractor participating on the road projects.

Contractor type	Number of Respondent	Percent	Valid percent
G.C	26	78.8%	83.9%
R.C	2	15.2%	16.1%
Total	31	93.9%	100%
No. of respondent missing question	2	6.1%	
Total	33	100%	

From the total of 22 respondents, 22 or 100% of data demonstrate that the contractor of selected road projects was classified under grade one contractor, while 11 or 33.3% of the total of 33 respondents are missing the question.

Table 9. Contractor grade

Contractor grade	Number of Respondent	Percent	Valid percent
G1	22	66.7%	100%
No. of respondent missing question	11	33.3%	
Total	33	100%	

According to the response frequency, the majority of contractors have more than 15 years of experience in the construction sector. 3 or 10.3% of contractors have 1 to 4 years of work experience, 5 or 17.2% have 5 to 10 years of work experience, 3 or 10.3% have 10 to 15 years of work experience, and 18 or 62.1% have more than 15 years of work experience in the construction

business. In the case of 29 respondents, 4 (12.1%) are missing the questions. The frequency of respondents is depicted in the Fig. below.

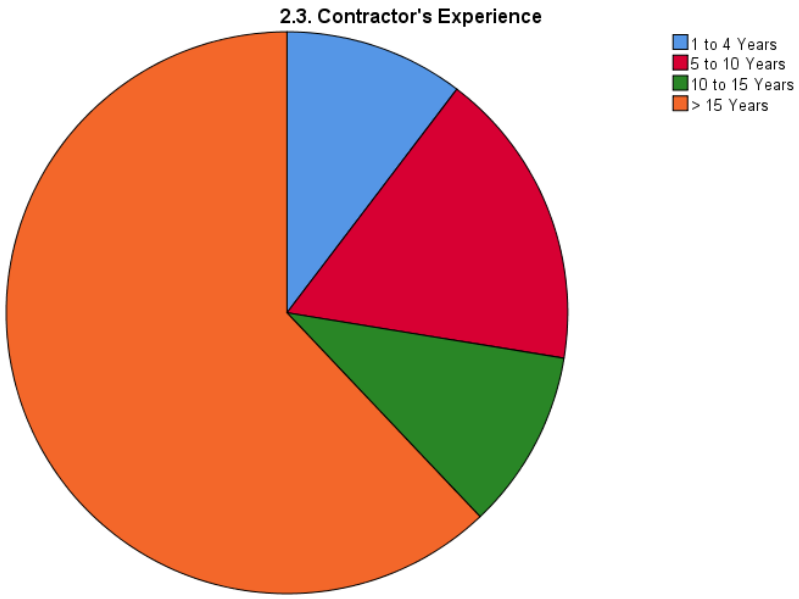

Fig. 5. The contractors experience in construction industry.

The majority of contractors who participate in those projects are privately owned. From a total of 31 responders, 21 or 67.7% of contractors are privately owned, while 10 or 32.3% are publicly owned. Two respondents, or 6.1%, out of a total of 33, failed to answer the question.

Table 10. Contractor ownership

Contractor ownership	**Respondent number**	**Percent**	**Valid percent**
Private	21	63.6%	67.7%
Public	10	30.3%	32.3%
Total	31	93.9%	100%
No. of respondent missing question	2	6.1%	
Total	33	100%	

According to the data, the majority of contractors involved in the construction of this particular road project are of local origin. Local contractors account for 19 or 63.3% of the total, while international contractors account for 11 (36.7%). The question is missed by 3 people, or 9.1% of the time. We have 30 respondents in this case.

Table 11. Contractor origin

Contractor origin	**Respondent number**	**Percent**	**Valid percent**
Local	19	57.6%	63.3%
International	11	33.3%	36.7%
Total	30	90.9%	100%
No. of respondent missing question	3	9.1%	
Total	33	100%	

Subcontractors are used on 20 or 64.5% of the total selected road projects, while 11 or 35.5% of the total selected road projects do not use subcontractors. The question was missed by 2 or 6.1% of respondents, resulting in 31 respondents in this example.

Table 12. Participation of subcontractors on the project.

Subcontractors	**Respondent number**	**Percent**	**Valid percent**
Yes	20	60.6%	64.5%
No	11	33.3%	35.5%
Total	31	93.9%	100%
No. of respondent missing question	2	6.1%	
Total	33	100%	

4.2.3 Consultant's profile

According to the respondent frequency, the vast majority of consultants are class one consultants. Six of the eight respondent, or 75%, are class one consultants, while the other two, or 25%, are class two consultants. From total of 33 or 100% of respondents the question is missed by 25 or 75.8% of respondents.

Fig. 6. The consultant's class

The 5 or 25% consultants who engage in the selected road project have an experience of 5 to 10 years, 4 or 20% have an experience of 10 to 15 years, 11 or 55% have an experience of more than 15 years, and 13 or 39.4% of miss the question from total 33 respondents.

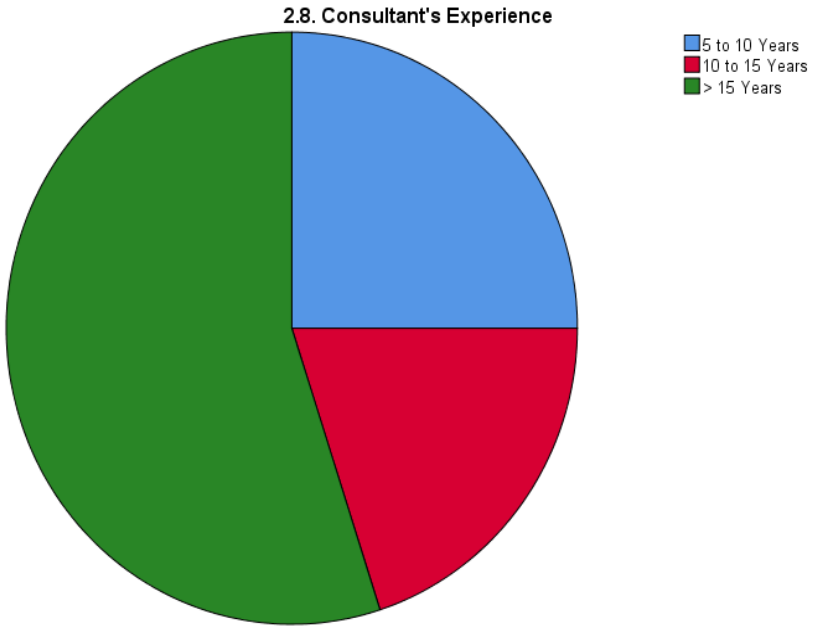

Fig. 7. Consultant's experience

According to the questionnaire study, the majority of consultants who engage on those selected road project owners are private companies. From a total of 23 respondents, 19 or 82.6% answered that consultants are owned by private companies, 4 or 17.4% answered that consultants are owned by public companies, and 10 or 30.3% of respondents missed the question from a total of 33 respondents.

Table 13. Ownership

Consultant ownership	**Respondent number**	**Percent**	**Valid percent**
Private	19	57.6%	82.6%
Public	4	12.1%	17.4%
Total	23	69.7%	100%
No. of respondent missing question	10	30.3%	
Total	33	100%	

According to the facts provided by the 23 respondents, 19 or 82.6% of the consultants participating on the selected road projects are of local origin, 4 or 17.4% are of international origin, and 10 or 30.3% are missing the question from a total of 33 respondents.

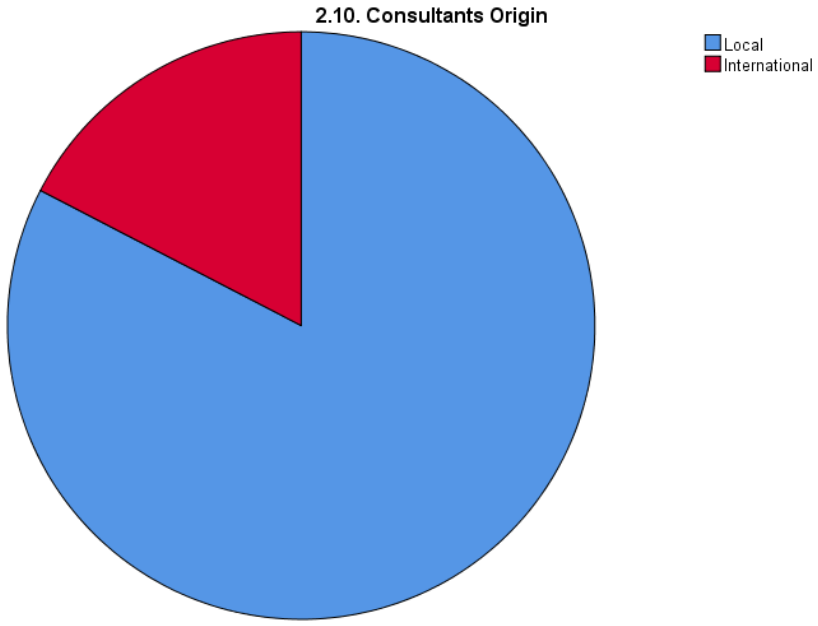

Fig. 8. Consultant's origin

4.2.4 Project's profile

Those road construction projects chosen in the last ten years (2009-2019GC) with the least amount of time and cost overrun are spread among ten regions and one city municipality around the country. Accordingly, 8 or 25.0% of such road projects are in the Amhara area, while 7 or 21.9% are in the Oromia region. In this example, barely one or three percent of the 33 respondents missed the question. The region of such road construction projects is depicted in detail on the bar charts below.

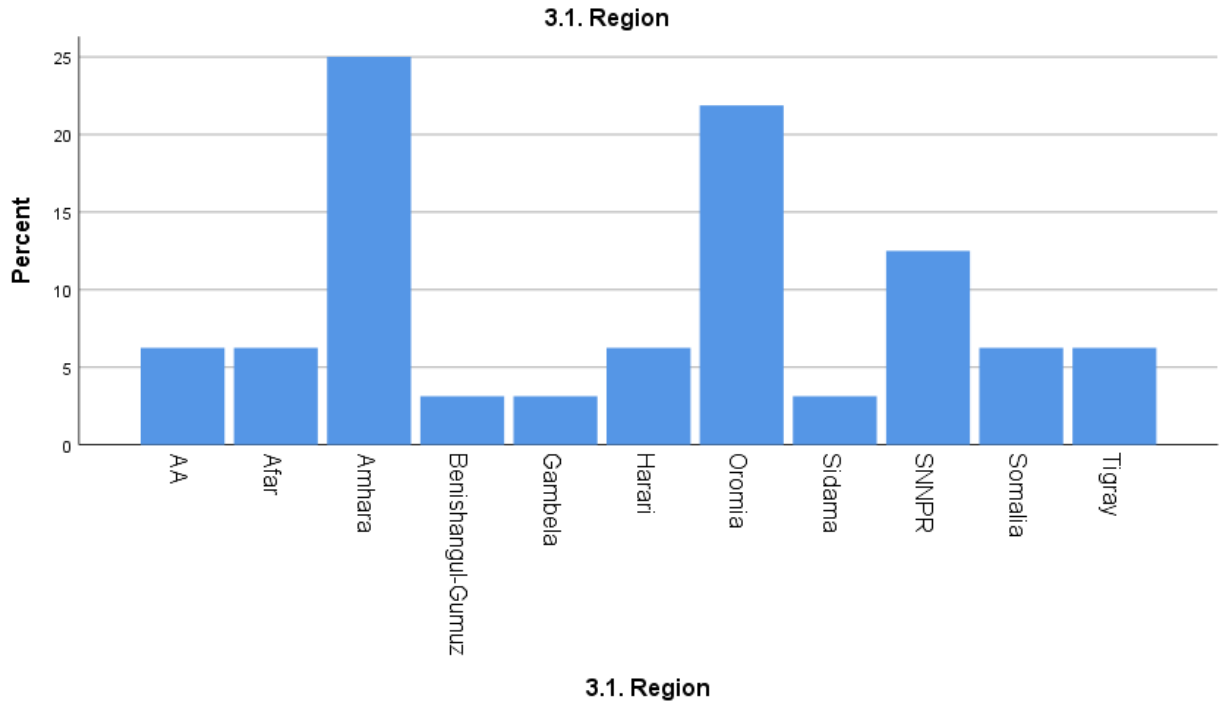

Fig. 9. Region Where Projects are Located

Out of 30 respondents survey 29 or 96.7% of projects are funded by the Ethiopian government, 1 or 3.3% are funded by international loans, and 3 or 9.1% of respondents skipped the question.

Table 14. Project Financer

Financer	**Respondent number**	**Percent**	**Valid percent**
GoE	29	87.9%	96.7%
International loan	1	3.0%	3.3%
Total	30	90.9%	100%
No. of respondent missing question	3	9.1%	
Total	33	100%	

According to questionnaire results from 29 respondents, 24 or 82.8% of those road projects utilize open bid procurement, 5 or 17.2% use direct award procurement, and 4 or 12.1% of respondents (out of 33 total respondents) miss the question.

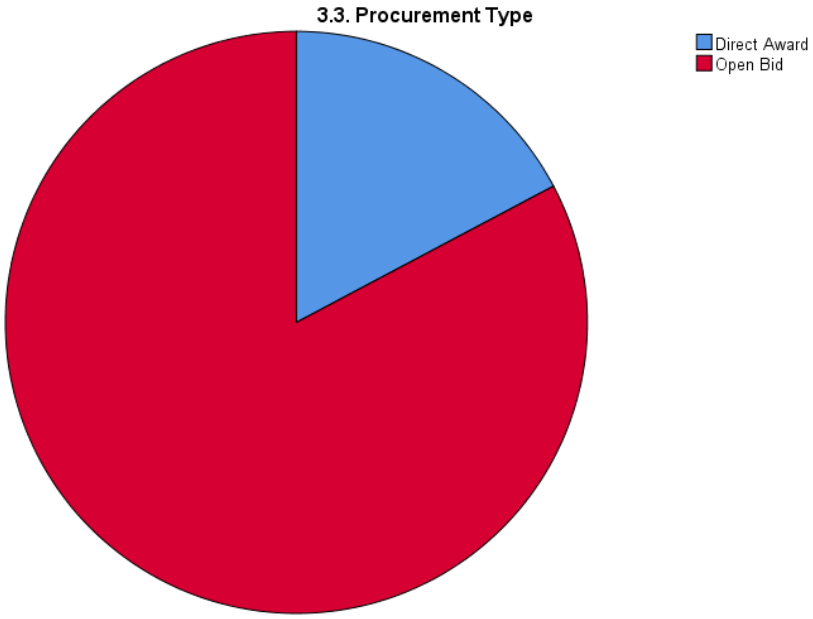

Fig. 10. Procurement type

When we look at the bid types, we observe that 15 or 53.6% are NCB (National Competitive Bidding) bid types and 13 or 46.4% are ICB (International Competitive Bidding) bid types. From a total of 33 responders, 5 or 15.2% were unable to answer the question.

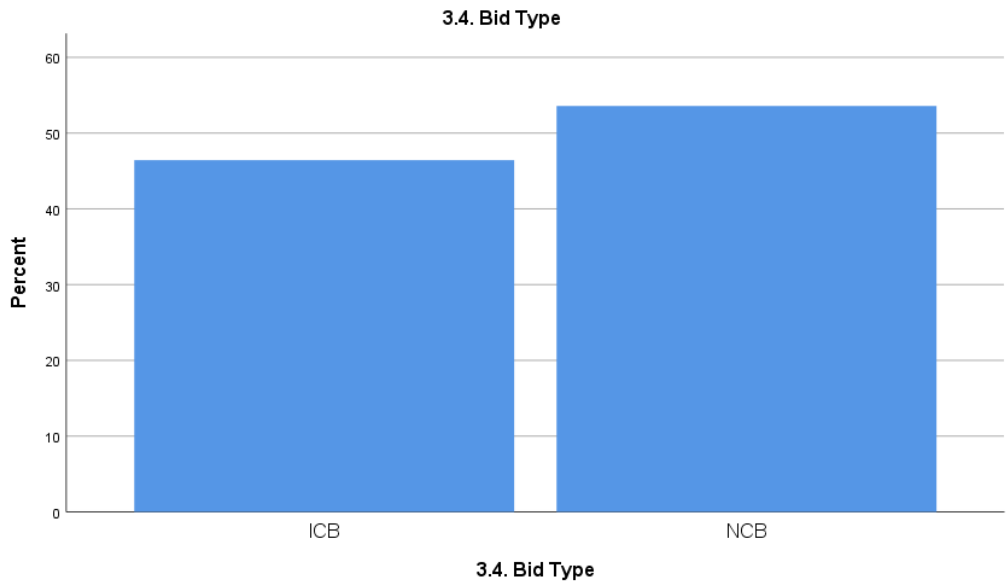

Fig. 11: Bid type

4.2.5 Summary of Survey Results

According to questionnaire survey results, 8 or 25.0% of selected road construction projects are located in Amhara and Oromia (7 or 21.9%), and practically all of the selected road construction projects (29 or 96.7%) are funded by the Ethiopian government. The majority of the projects use open bid procurement (24 or 82.8%) and national competitive bid (NCB) bid types (15 or 53.6%).

The Ethiopian Road Authority is the client of the selected road construction projects, and its details and background were briefly discussed in the introduction of this thesis. The questionnaire's survey is used to collect information about the contractors and consultants who work on the selected road building projects.

According to the results of the questioner survey, the majority of those projects are constructed by general contractors (26 or 83.9%). The majority of the ERA roadwork project contractors and consultants picked are grade one and class one, respectively. Furthermore, both contractors (18, or 62.1%) and consultants (11, or 55%) who participate in those project construction have more than 15 years of work experience in the construction sector. These contactors (21 or 67.7%) and consultants (19 or 82.6%) are owned by privates, the majority of which are local companies.

Despite this, the majority of employees from the three companies involved in the selected road construction projects have a B.Sc. degree (19 or 57.6%) and 10 to 25 years of experience in the construction business.

4.3 Construction best practice related data and analysis

Professionals should be aware with CII (Construction Industry Institute) construction best practices in order to execute them on road building projects. The respondents were asked whether they were familiar with CII best practices or not. As shown in pie chart 5, among a total of 20 respondents, 19 or 95% of professionals are familiar with the CII best practices, whereas 1 or 5% are not. This shows that CII construction best practices are extensively known in the road construction industry. From a total of 33 responses, 13 or 39.4% miss the question in this section of the inquiry.

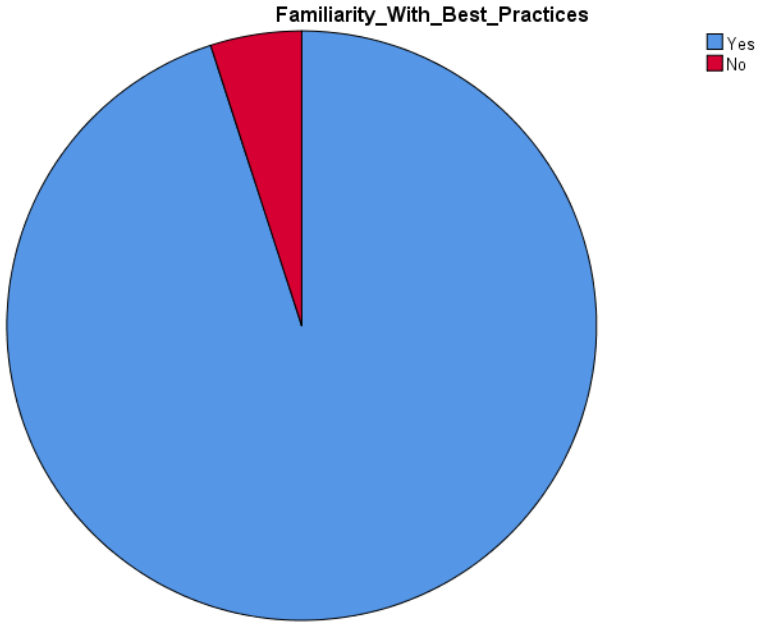

Fig. 12. Familiarity with best practices

Following a check for professional familiarity with CII best practices, the next type of question asks the respondent to rank how much the CII best practices were used by the contractor in the selected road project using a Likert scale.

A Likert scale inquiry is one with a five- or seven-point scale. The options span from strongly Agree to strongly Disagree, allowing the survey creator to gain a comprehensive picture of people's thoughts. For people who are indifferent on the subject, all Likert scales provide a mid-point, e.g., neither agree nor disagree. Rensis Likert, a social psychologist, invented it in 1932.

Table 15. Likert scale for ranking CII construction best practices

Description of weightings	**Scale**
Very Rarely	1
Rarely	2
Neutral	3
Often	4
Very Often	5

The results have been split and discussed separately for each portion of the questioner. Each Construction best practices method is discussed and ranked independently. As a result, the results and analysis were completed independently. The Relative Importance Index was used to rank the construction practices applying degree (RII). The relative Importance Index (RII) is an approach used to describe the relative importance of individual causes and consequences based on the likelihood of occurrence and effect on the project using a five-scale Likert scale, according to (Aibinu and Jagboro 2002). The critical cause or impact component has a higher RII value, which is calculated by;

$$Relative\ Index\ of\ Importance\ (RII) = \frac{\Sigma W}{A*N} \ldots\ldots \text{(Eq. 4)}$$

Where: RII: - is Relative Importance Index.

W: - is the weight given to each factors by the respondents from 1,2,3,4, and 5 for very rarely (very low impact), rarely (low impact), Neutral (no impact), often (high impact) and very often (very high impact), respectively.

A: - is the highest weight (i.e., 5 in this case).

N:-is the total number of respondents.

4.3.1 Front end planning or pre project planning

From the total of 31 responses, 11 or 35.5% of contractors utilize the front-end planning feasibility study phase frequently, 8 or 25.8% of contractors are neutral in their usage of best practices, and 2 or 6.1% of the 33 respondents miss the question. The table below illustrates the contractors' rates in detail from the feasibility study.

Table 16. The Feasibility Study of Contractors

Description of weightings	**Respondent number**	**Percent**	**Valid percent**
Very Rarely	5	15.2	16.1
Rarely	2	6.1	6.5
Neutral	8	24.2	25.8
Often	11	33.3	35.5
Very often	5	15.2	16.1
Total	31	93.9	100
No. of respondent missing question	2	6.1	
Total	33	100	

In front end planning practices, the contractor used project concept phases such as initiate phase, analyze alternative, conceptual scope and estimates, evaluate and select best alternatives, and so on. Of the total 31 respondents, 15 or 48.4% often used project concept phases, while 9 or 29% were neutral. And 2 or 6.1% of those surveyed failed to answer the question.

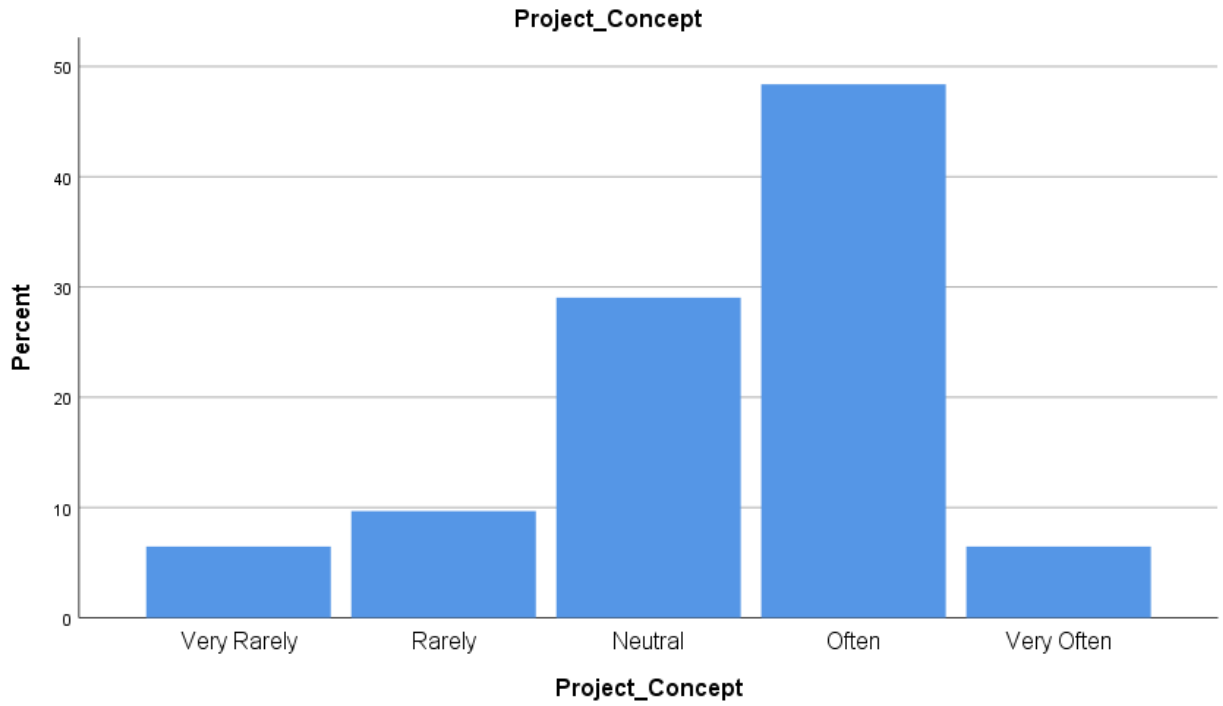

Fig. 13. Project concept phases during front end planning

The contractor creates the project's detailed scope. From a total of 30 respondents, 18 or 60% said the contractor used a very rarely prepared detailed scope of the project. 1 or 3.3 respondents said the contractor used a very rarely prepared detailed scope of the project. The Fig. below illustrate the front-end planning detail scope phases.

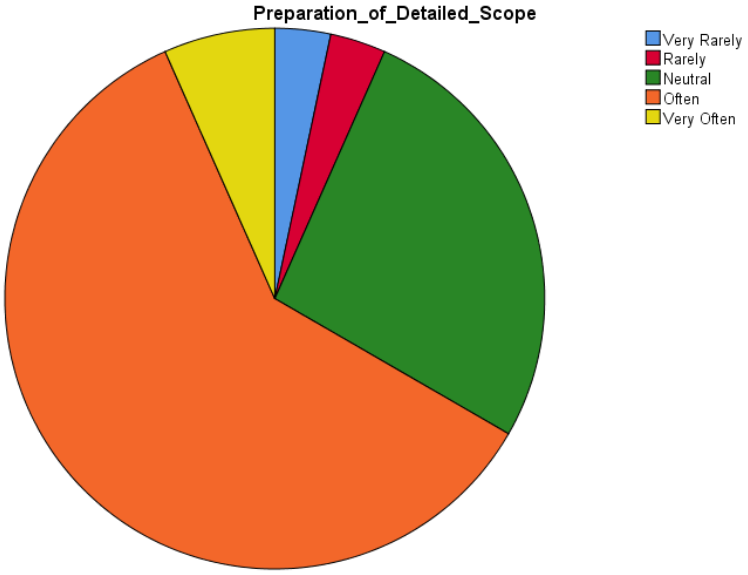

Fig. 14. Preparation of detailed scope

After analyzing the results of these three front end planning or pre project planning phases, the study indicates that the contractor employs front end methods that are frequently used.

4.3.2 Alignment

From the total of 30 contractors, 15 or 50% use the Top-to-Bottom alignment (vertical alignment) phase often to generate and accomplish a universally defined and understood set of project objectives by participants. In response to this question, 3 or 9.1% of respondents miss the question. The charts below provide more information regarding vertical alignments.

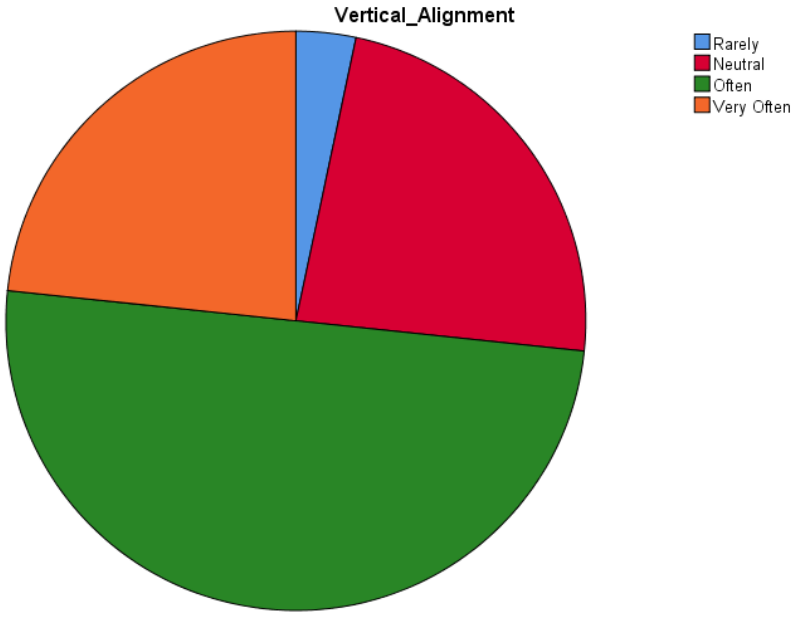

Fig. 15. Vertical alignment of the contractor

The horizontal alignment phases or alignment between functional groups with organizations are frequently used in the project, accounting for 13 or 43.3% of the total 30 or 100%, whereas the phases that do not apply are used by 11 or 33.3% of the contractors. The bar charts below contain more detail.

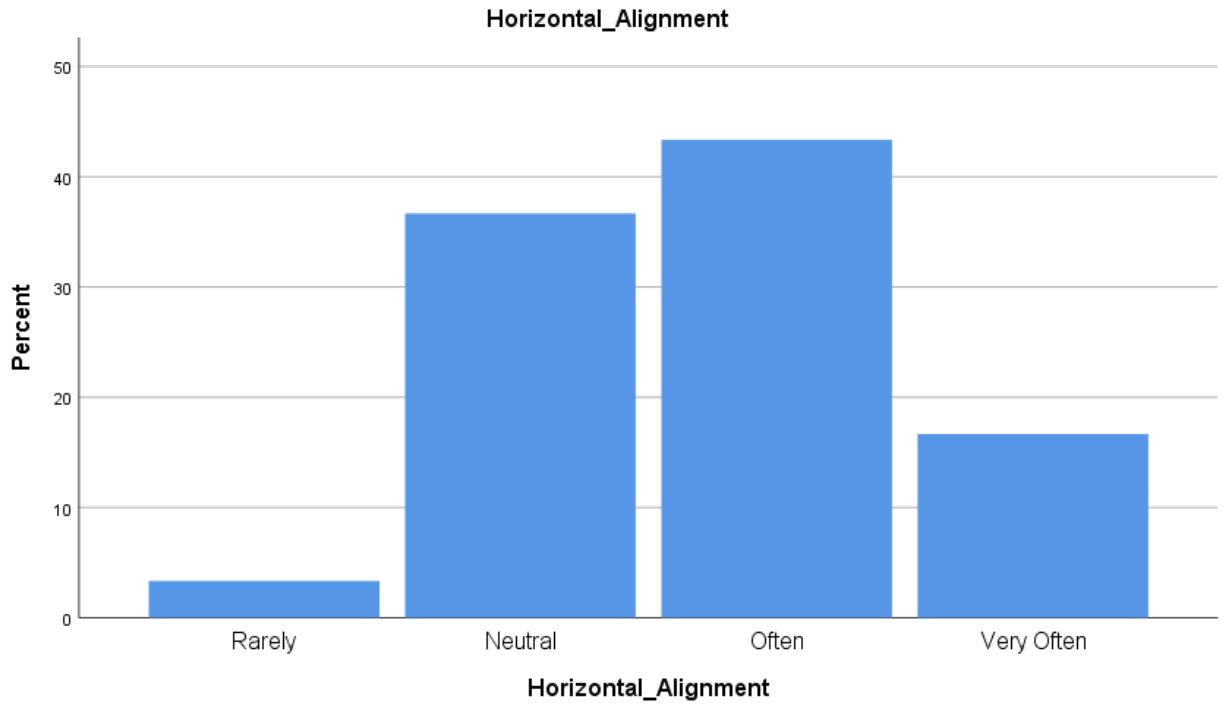

Fig. 16. Horizontal Alignment

The Longitudinal Alignment objectives entail throughout the project life cycle were used by contractors on the projects frequently 10 or 33.3% of total contractor 30 or 100%. 8 or 26.7% of contractors use longitudinal alignments very often, 5 or 16.7% use this phase alignment rarely, and 7 or 23.3% are neutral about using this alignment. The pie charts below demonstrate the level of longitudinal alignment used by each contractor.

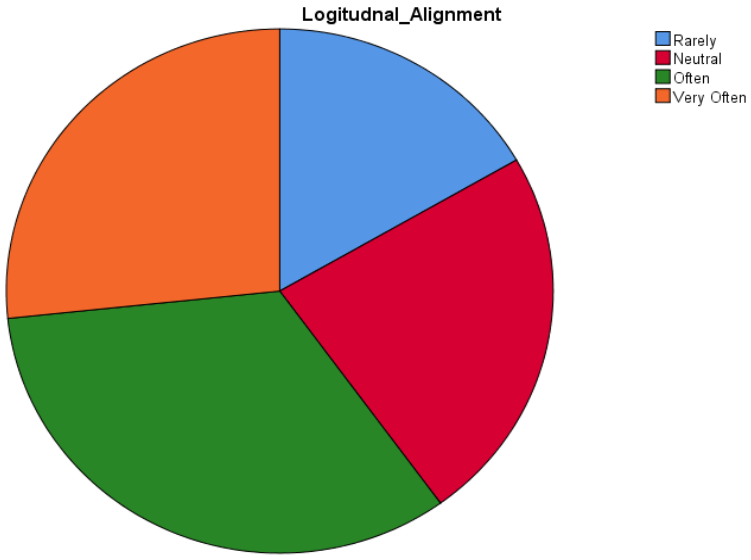

Fig. 17. Longitudinal Alignment

Comparing those above alignment practice phases application rate by the contractor on the selected road construction projects using their Relative Importance Index (RII) value, vertical alignment have 0.79375 RII value which exercise highly by the contractor then other alignment phases. The horizontal alignment and longitudinal alignment have o.746667 and 0.74 RII value respectively.

4.3.3 Constructability

The table below displays the contractor's expertise in applying the constructability construction practice phases on its projects based on the questions received.

Table 17. Summary of the contractor's constructability practice level

Constructability		**Very Rarely**		**Rarely**		**Neutral**		**Often**		**Very Often**		**Total**		**Missing system**		**Total**	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1.	Plan Constructability Implementation	-	-	6	19.4	6	19.4	17	54.8	2	6.5	31	100	2	6.1	33	100
2.	Implement Constructability	-	-	4	13.3	8	26.7	12	40.0	6	20.0	30	100	3	9.1	33	100
3.	Update Corporate Program	1	3.2	9	29.0	6	19.4	11	35.5	4	12.9	31	100	2	6.1	33	100

As shown in the above table, contractors use the plan constructability implementation constructability phases 17 or 54.8% of then often from a total of 31 respondent facts, the implement constructability phases 12 or 40% of them often from a total of 30 respondent facts, and also the

update corporate program the constructability were used by contractors 11 or 35.5% of them apply often from a total of 30 respondent facts.

The Relative Important Index (RII) of the constructability phases indicates that contractors apply highly the implementation of constructability phases with 0.73333 RII when compared to the other two phases of plan constructability implementation with 0.696774 RII and the Relative Important Index of update corporate program with 0.651613. The computed and ranked RII outcomes of each CII construction practice are included to this thesis as an annex.

From the constructability practices the contractors implement constructability well, so the below bar charts show the rate of constructability implementation.

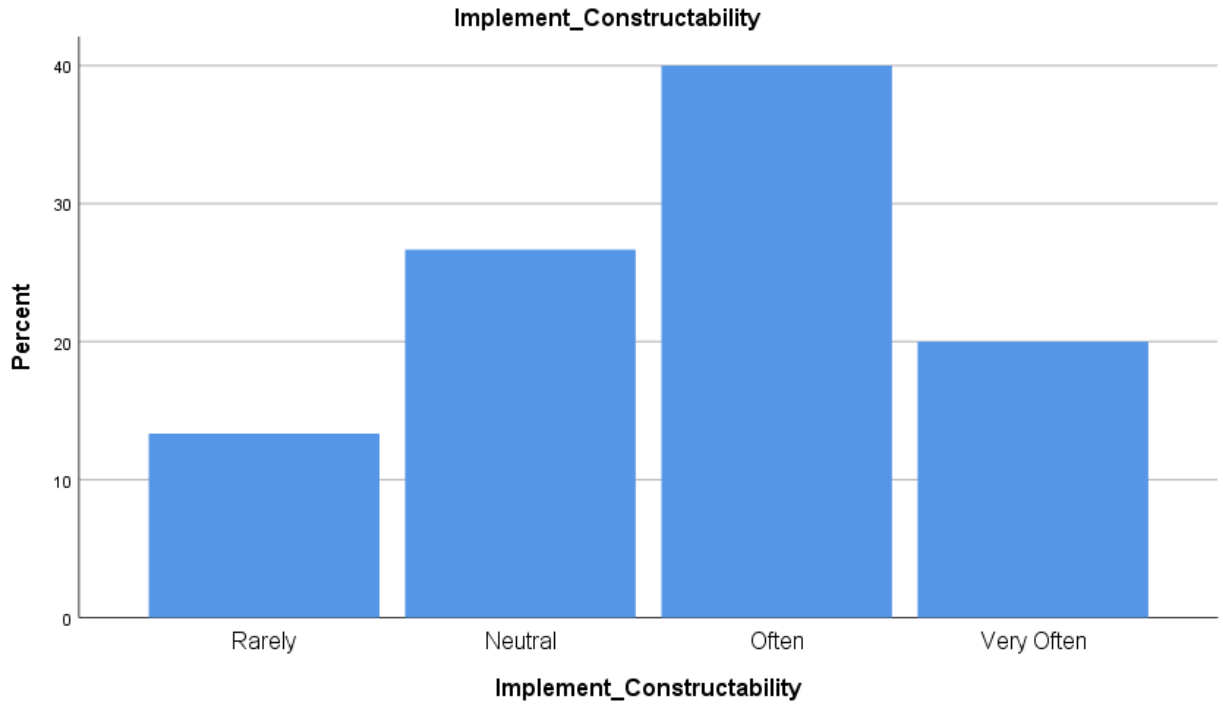

Fig. 18. Contractor's constructability implementation rate.

4.3.4 Material management

Material management practices applied into the construction projects using those main three phases listed in the below table.

Table 18. Summary of the contractor's material management practice tradition

Material Management		Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing system		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Corporate Strategy	1	3.2	8	25.8	10	32.3	9	29.0	3	9.7	31	100	2	6.1	33	100
2	Personnel and Organization Commitment	-	-	5	15.6	6	18.8	17	53.1	4	12.5	32	100	1	3.0	33	100
3	IT System	7	22.6	11	35.5	5	16.1	6	19.4	2	6.5	31	100	2	6.1	33	100

As demonstrated in the table above, each phase of material management has a varied size in terms of contractor consumption in the project. When we compare their rank with RII, the personnel and organizational commitment are highly exercised by contractors during material management, with a value of 0.725RII, followed by the use of corporate strategy in material management, with a value of 0.632258 RII, and using IT system in material management, with a value of 0.503226 RII as the respondent Likert scale is ranked. The computed and ranked RII outcomes of each CII construction practice are supplied as an annex to this thesis. In the contractor's material management practice, the personnel and organizational commitment were exercised well, thus are represented it by utilizing charts as follows.

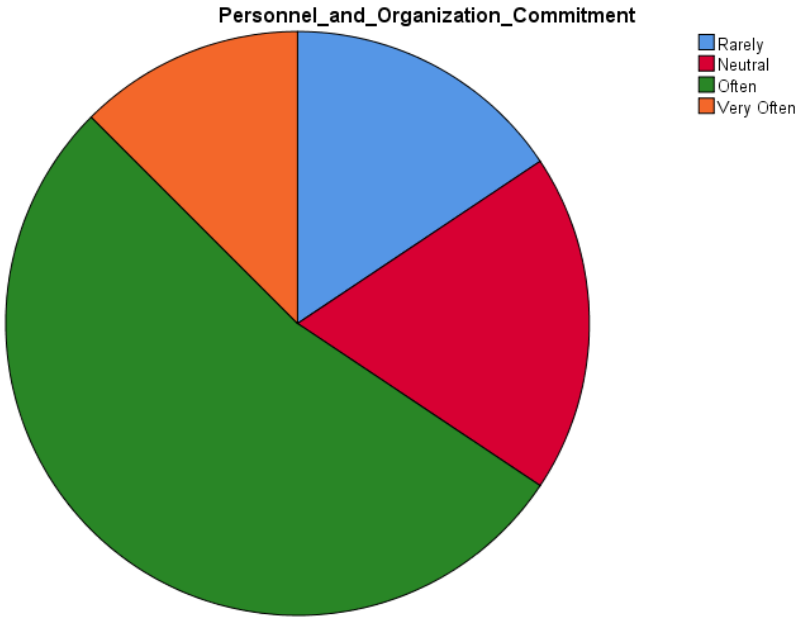

Fig. 19. Contractor's personnel and organizational commitment

4.3.5 Team building

From team building practice, 11 or 33.3% of the contractors (out of a total of 32 respondents) used trust between teams on a frequent basis, while 10 or 31.3% of the contractors used the phase on a very frequent basis. The table below describes in detail how many contractors use the practices on a very rarely, rarely, and neutral scale.

Also, of the total 30 respondents, 12 or 40% are facts that contractors make a list of shared goals for the project frequently, 10 or 33.3% are very frequently, and some are used on the other scale.

Making an independent relationship among team members is one of the contractors' responsibilities when it comes to team building during road project construction. 11 or 36.7% of contractors use an interdependent relationship among team members frequently, 9 or 30% of contractors use this practice extremely frequently, and 5 or 16.7% of contractors use this practice infrequently, which is the same as the neutral rate.

Table 19. Summary of the contractor's team building practice

Team building		Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Trust between team	2	6.3	2	6.3	7	21.9	11	33.3	10	31.3	32	100	1	3.0	33	100
2	A set of shared goals for the project	1	3.3	4	13.3	3	10.0	12	40.0	10	33.3	30	100	3	9.1	33	100
3	An interdependent relationship among team members	-	-	5	16.7	5	16.7	11	36.7	9	30.0	30	100	3	9.1	33	100

When we assess the utilization level of those team building phases by Relative Importance Index (RII), having a set of shared project goals ranks higher than the other two by 0.773333 RII value. The RII rank for an interdependent relationship among team members and trust amongst team practices is 0.76 and 0.75625, respectively. The computed and ranked RII outcomes of each CII construction practice are included to this thesis as an annex. There is a set of shared project goals within the team, which were expressed using pie charts as seen below.

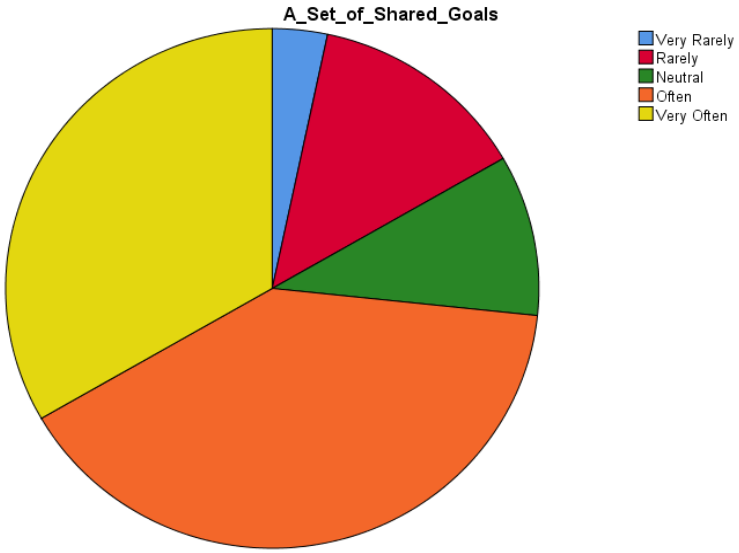

Fig. 20. A set of shared goals for the projects in team

4.3.6 Partnering

In partnering practice from total 31 respondent response 16 or 51.6% of the contractors trust between partners in often rate, 7 or 22.6% of contractors are forming trust between partners in very often rate.

13 or 40.6% of the contractor's top management give often support for other staff member and 10 or 31.3% of them give very often from total 32 respondent survey.

Those contractor participate in selected road projects have establishing Win-Win objective in staff often and rarely rate are 9 or 29% of them, also 6 or 19.4% of them are in very often rate from total 31 respondent facts.

Table 20. Summary of the contractors partnering practices.

Partnering		Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Establishing trust	1	3.2	2	6.5	5	16.1	16	51.6	7	22.6	31	100	2	6.1	33	100
2	Getting top managements support	-	-	2	6.3	7	21.9	13	40.6	10	31.3	32	100	1	3.0	33	100
3	Establishing Win-Win Objectives	-	-	9	29.0	7	22.6	9	29.0	6	19.4	31	100	2	6.1	33	100

Ranking the above main partnering phases application using relative importance index, getting top management support was the most applied on the project by contractor within 0.79375 RII factor, and establishing trust and establishing win-win objective had 0.767742 and 0.677419 RII factor, respectively. Fig.18 below shows the contractors' top management's support for their employees.

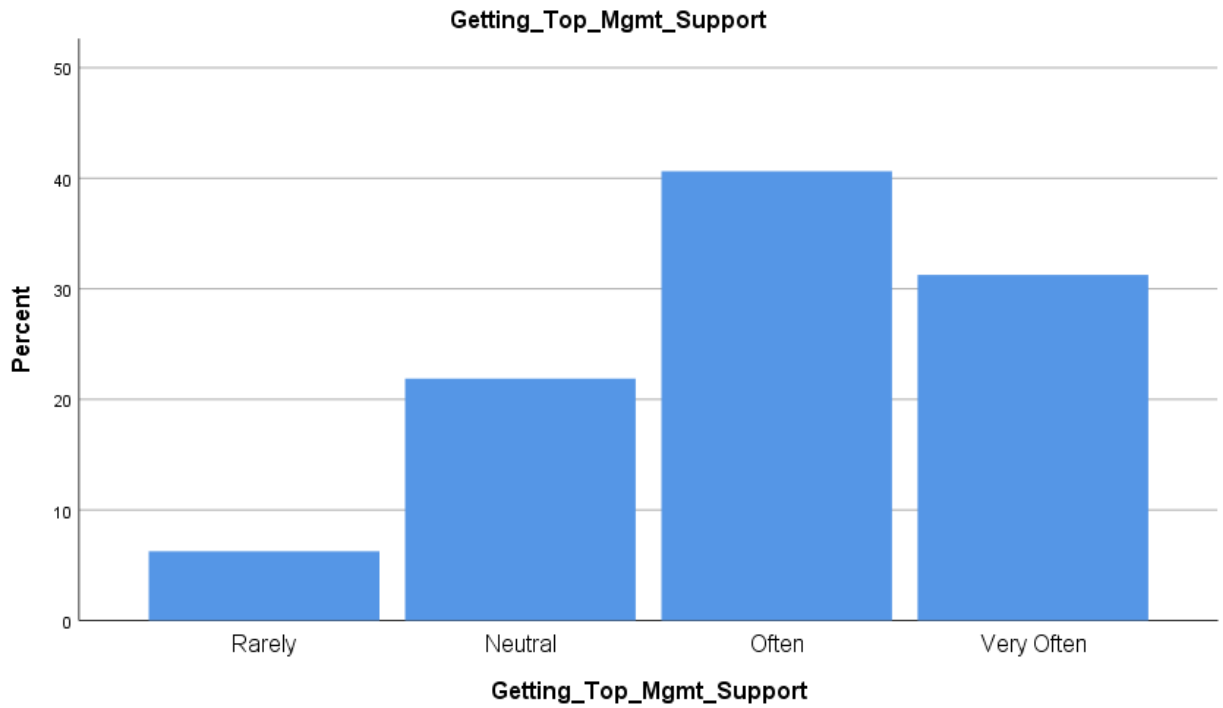

Fig. 21. Contractors top management support

4.3.7 Quality management

According to respondent responses, 11 or 35.5% of contractors use ISO 9001 certified principles for quality management on an often basis, 5 or 16.1% on a neutral basis, and 5 or 16.1% on a rarely basis, out of a total of 31 respondents.

When we cross-check the contractor use rate of modern quality management system in selected road construction projects, we find that 11 or 35.5% of contractors use it rarely, 7 or 22.6% use it very rarely, and 6 or 19.4% use it both neutral and often.

Table 21. Summary of the contractor's quality management practices

Quality management		Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	ISO 9001 Certificated	7	22.6	5	16.1	5	16.1	11	35.5	3	9.7	31	100	2	6.1	33	100
2	Apply modern QM Systems	7	22.6	11	35.5	6	19.4	6	19.4	1	3.2	31	100	2	6.1	33	100

When comparing the two quality management systems of contractors using their RII factors, the ISO 9001 certificated system has 0.587079 RII value and the modern QM system has 0.490323 RII value, which are smaller than the ISO 9001 certificate value.

The rate of adoption of ISO 9001 certified principles in quality management procedures by contractors is depicted in the Fig.19 below.

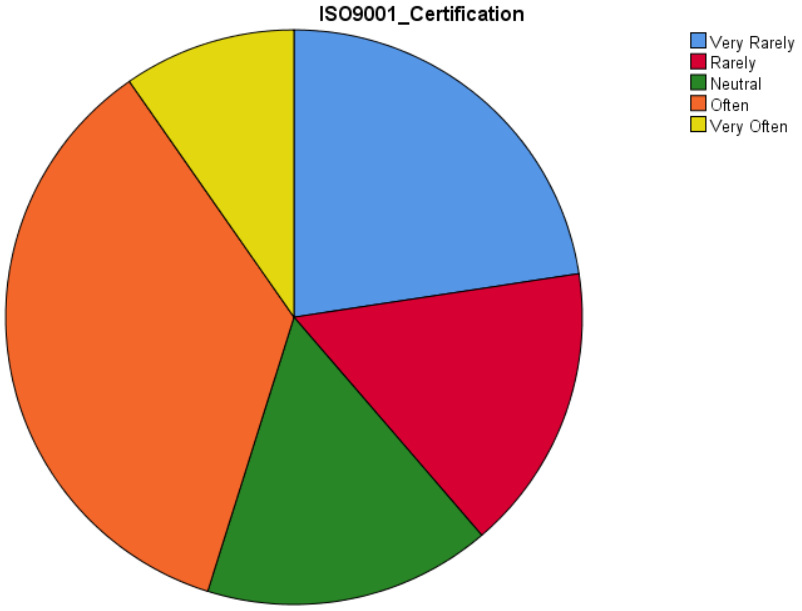

Fig. 22. ISO 9001 certification of contractors

To generalize from the other nine best construction practices, contractors' quality management practices are not good.

4.3.8 Change management

In the contractors' change management practices, structured change management approach was one of the change management practice phases, with 10 or 32.3 contractors in neutral application rate, 8 or 25.8% contractors in rarely application rate, and 6 or 19.4% contractors in frequently application rate from a total of 31 respondent responses.

From a total of 32 respondent facts, 13 or 40.6% of contractors interact frequently and openly in neutral rate, 9 or 28.1% communicate frequently and openly in rarely rate, and 6 or 18.8% communicate frequently and openly in often rate.

Table 22. Summary of the contractors change management practice.

	Change management	Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Apply structured change management approach	2	6.5	8	25.8	10	32.3	6	19.4	5	16.1	31	100	2	6.1	33	100
2	Communicate frequently and openly	3	9.4	9	28.1	13	40.6	6	18.8	1	3.1	32	100	1	3.0	33	100

The contractors' change management practices had a relative importance index (RII) of 0.741935 and 0.625806 for communicating regularly and openly and using a structured change management strategy, respectively. This suggests that contractors communicated at a higher rate than other change management techniques

As a result, the rate of contractors that communicate frequently and openly is indicated by the Fig.20 below.

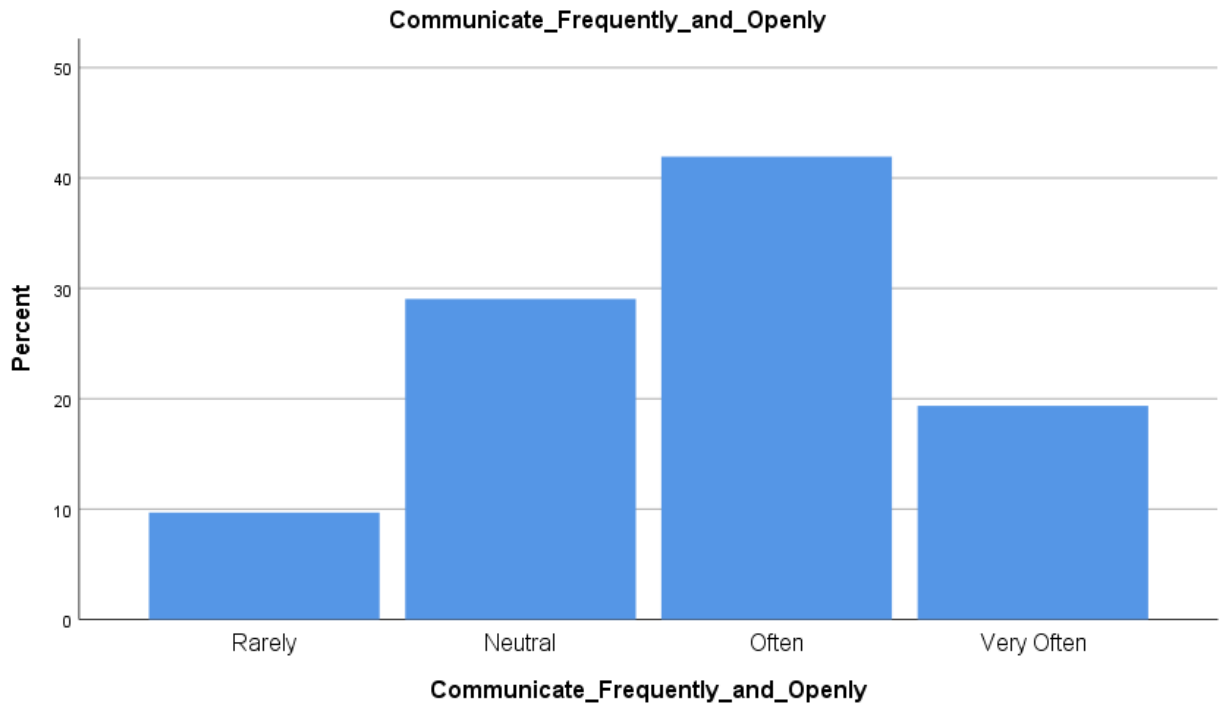

Fig. 23. Communicate frequently and openly by contractors

4.3.9 Dispute prevention and resolution

From the total of 28 respondent facts, 9 or 32.1% of contractors form a dispute review board on a frequent basis, while 6 or 21.4% construct a dispute review board on a very uncommon or seldom basis. When a conflict arises in a construction project, the contractors utilize dispute resolution methods; 11 or 39.3% of contractors use those methods on often basis, while 7 or 25% use dispute resolution on a rare or neutral basis, out of a total of 28 respondents.

Table 23. Summary of the contractor dispute prevention and resolution

Dispute Prevention and Resolution		Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Equation		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Dispute Review Board	6	21.4	6	21.4	5	17.9	9	32.1	2	7.1	28	100	5	15.2	33	100
2	Using Dispute Resolution Methods	2	7.1	7	25.0	7	25.0	11	39.3	1	3.6	28	100	5	15.2	33	100

The RII values for dispute prevention and resolution via dispute resolution procedures and dispute review board are 0.614286 and 0.564286, respectively. This indicates that the contractors chosen for the road construction projects were more comfortable with using conflict resolution methods than with establishing dispute review board. The contractors' use of dispute resolution procedures is depicted in the pie chart below.

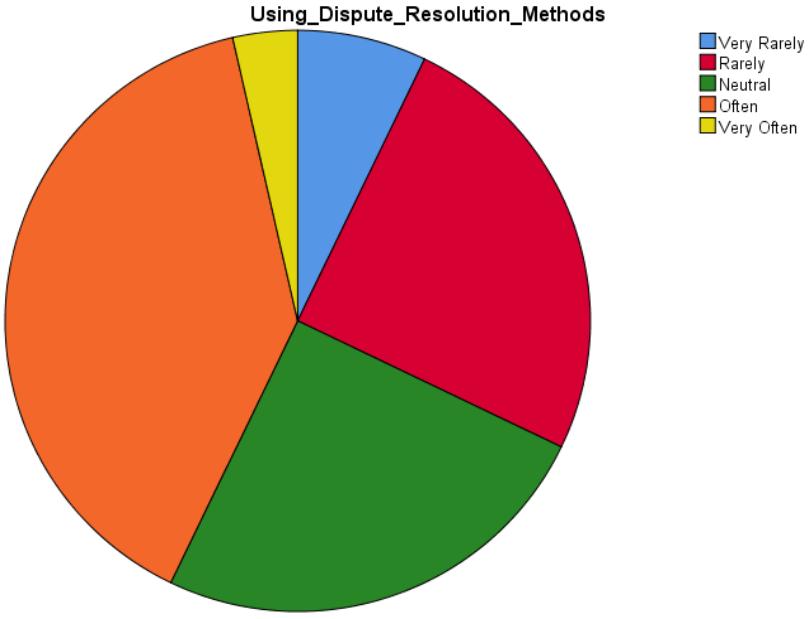

Fig. 24. Contractors rate in using dispute resolution methods

The questioner participant misses the question under the dispute prevention and resolution section more than the other CII (Construction Industry Institute) best practice questions.

4.3.10 Zero accident techniques

To prevent and control accidents during road construction, contractors and other construction parties should employ zero-accident techniques in their actions. The primary zero-accident techniques and their frequency rate by contractors are presented in the table below. From the total 31 responders, 10 or 32.3% increase safety awareness to their personnel on a frequent basis, with some frequency in the neutral range, and 5 or 16.1% develop safety awareness policies on a rare basis.

According to the facts provided by the 31 respondents, 12 or 38.7% of the contractors provide safety training to their employees on a rare basis, 7 or 22.6% of the contractors provide safety training to their employees on often basis, and 6 or 19.4% of the selected road construction projects contractor provide safety training to their employees on very rare basis.

From a total of 31 respondent responses, 12 or 38.7% of contractors offer personal protective equipment for their employers frequently, 10 or 32.3% providing it rarely, and 7 or 22.6% providing it neutrally.

The road construction project contractors are responsible for keeping the project site clean, storing materials safely, and disposing of waste materials on site, among other things. A total of 30 respondents rated the selected road construction project contractor's safety procedure at the construction site. 15 or 50% of the contractors rated often, 6 or 20% rated neutrally, and the other number of contractors rated scale and value are detailed in the table below.

Table 24. Summary of the contractors Zero Accident Techniques

	Zero Accident Techniques	Very Rarely		Rarely		Neutral		Often		Very Often		Total		Missing Equation		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Enhance Safety Awareness	4	12.9	5	16.1	10	32.3	10	32.3	2	12.9	31	100	2	6.1	33	100
2	Safety Training	6	19.4	12	38.7	4	12.9	7	22.6	2	6.5	31	100	2	6.1	33	100
3	Personal Protective Equipment	-	-	10	32.3	7	22.6	12	38.7	2	6.5	31	100	2	6.1	33	100
4	Site	2	6.7	5	16.7	6	20.0	15	50.0	2	6.7	30	100	3	9.1	33	100

Ranking the application level of these zero accident techniques by contractors using the relative important index with 0.666667 RII value the safety on site has a high rank, followed by 0.63871 for personal protective equipment, 0.606452 for enhanced safety awareness, and 0.516129 for safety training provided by contractors. The computed and ranked RII outcomes of each CII construction practice are included to this thesis as an annex. The two widely used zero-accident techniques are presented below in Fig.22 and Fig 23.

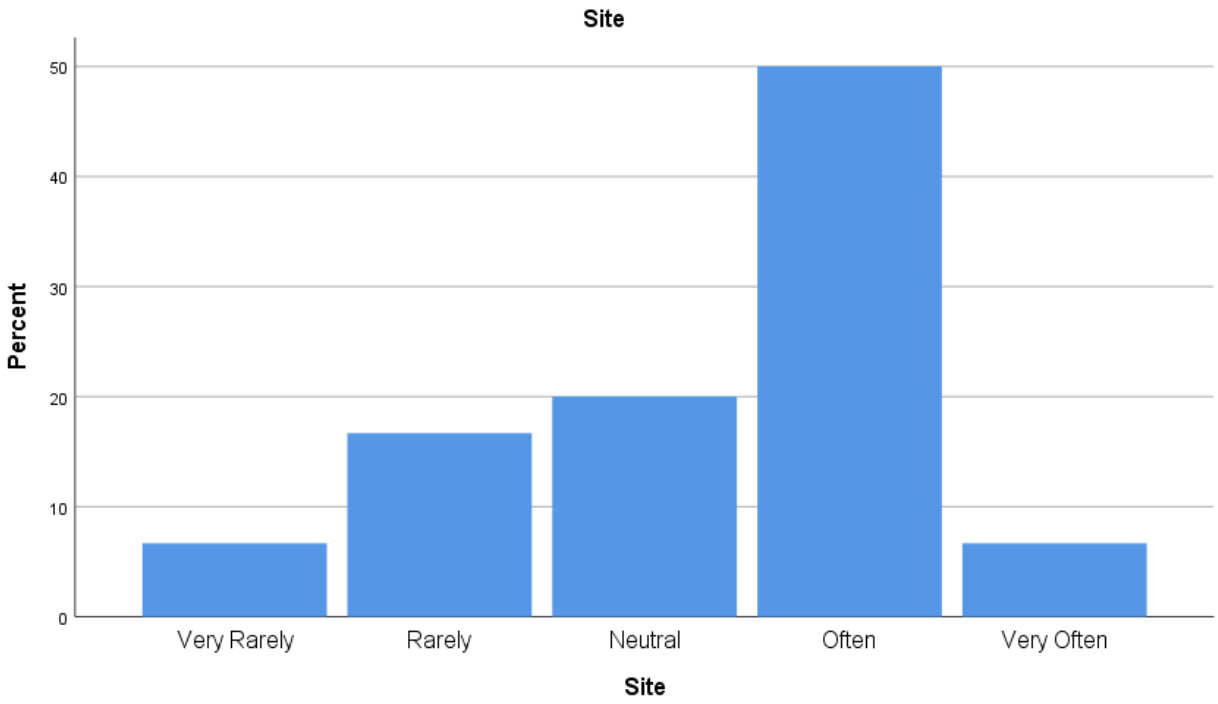

Fig. 25. Contractor's safety application in site

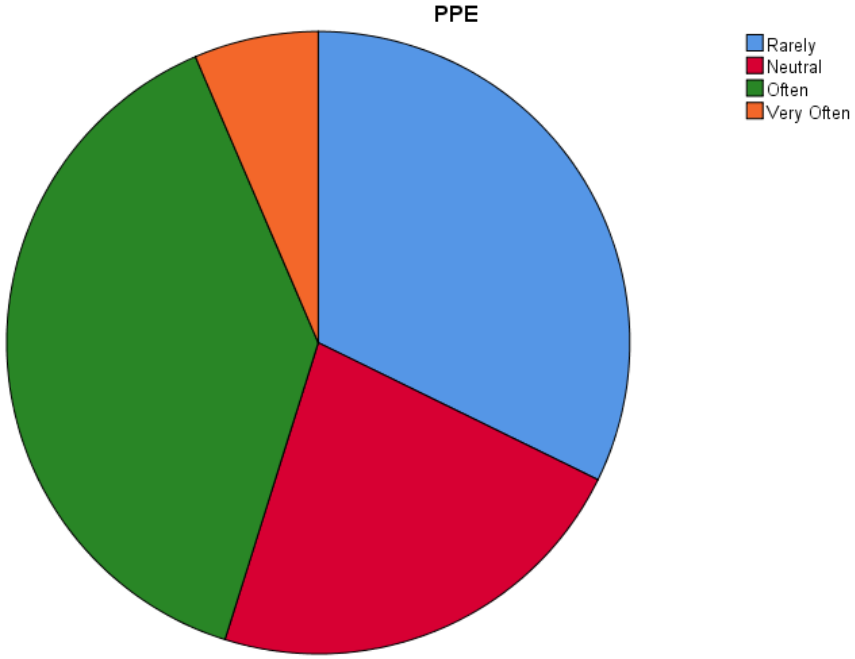

Fig. 23. Contractor provide Personal Protective Equipment

The contractor construction best practices for the selected road projects were ranked using the Relative Importance Index (RII) Value of each best practice phase and system. On the bar chart below, the calculated Relative Importance Index (RII) of each contractor construction best practice phase or system rank was depicted.

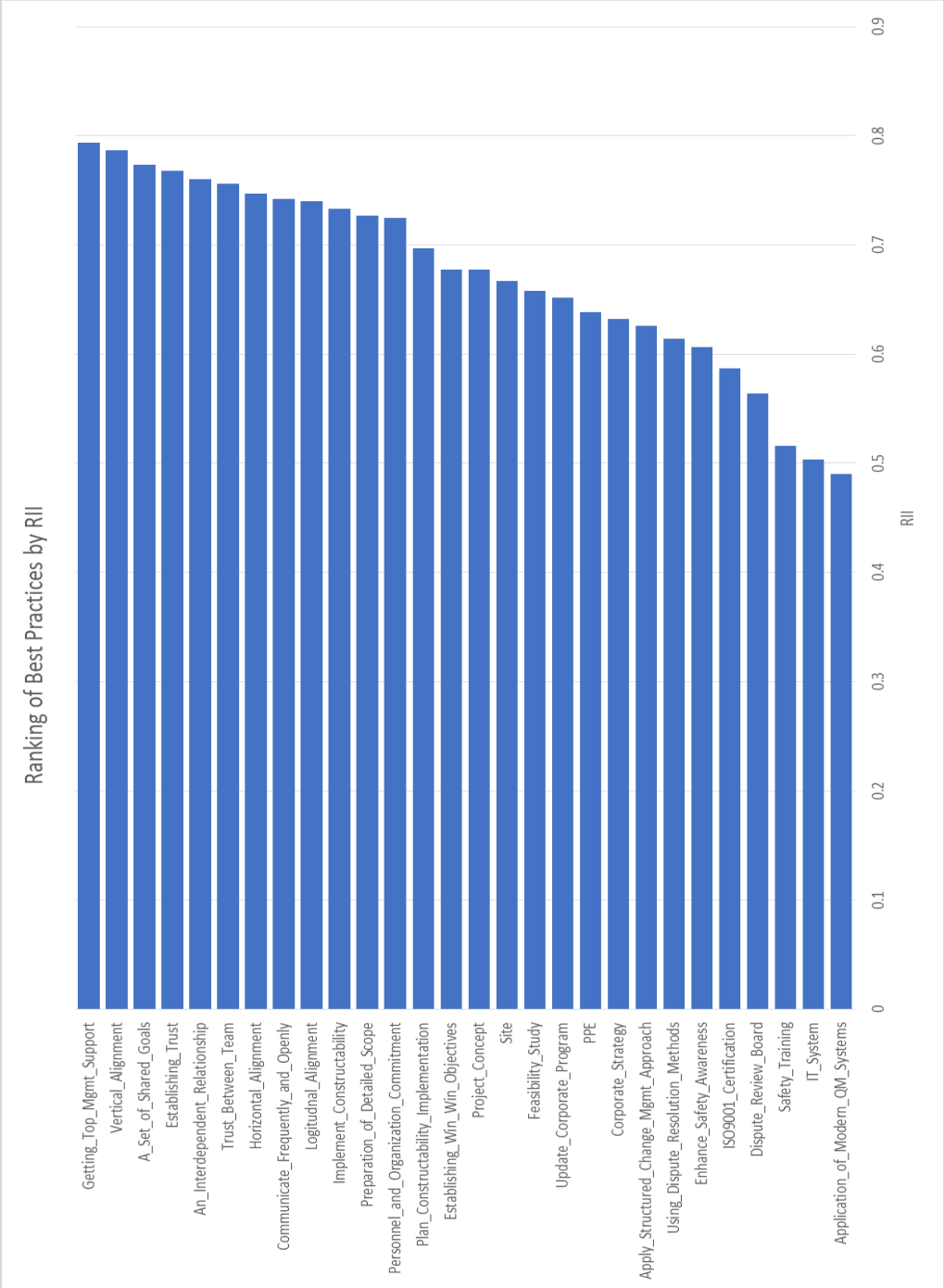

Fig. 26. Contractor's construction best practice rank by RII.

4.3.11 Summaries on the contractor construction best practices

As the survey results show, practically all selected road contractors are familiar with the CII (Construction Industry Institute) best construction practices. As previously stated, the contractor performs the majority of the practices in a frequent pace. In the medium level, the contractor only employs practices such as material management, quality management, dispute prevention and resolution, and zero accident approaches.

When we generalized about the contractor construction best practices utilizing tradition, it is good, but it is not enough; further work is required for the effect to improve.

4.4 Causes Affect the Road Construction Projects Negatively

After cross-checking employees' attitudes toward CII (Construction Industry Institute) construction best practices (client, contractor, and consultant), we approve indirectly the benefit of employing those best practices on construction projects by analyzing responder facts on contractor, client, and consultant related reasons (negatively affect a projects performance).

4.4.1 Contractor Related Causes

When compared to other contractor-related causes included in the questioners, delay in mobilization had a high influence on the construction project when ranked Relative Important Index (RII). Contractors' delays in mobilization during construction have a RII factor of 0.774194, from causes contractors' poor site management have a RII value of 0.75625, and material shortages during construction have a RII factor of 0.722581, than other contractor-related causes. The computed and ranked RII results for each contractor-related reason are included to this thesis as an annex. The following are the key contractor-related causes that have an impact on rank with RII. The main contractor related causes impact rank with RII were represented by the following bar charts.

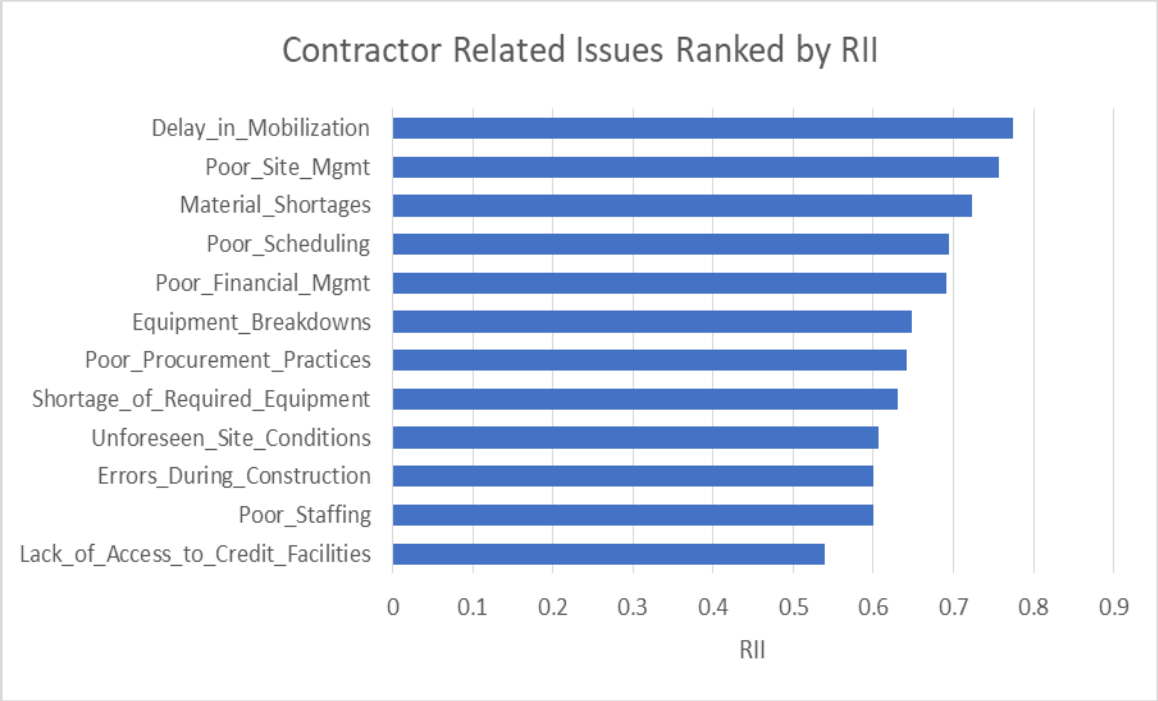

Fig. 27. Contractor related causes ranked by Relative Important Index

According to the above Fig.24, lack of access to credit facilities has a low influence on the construction project, with a RII factor of 0.539394. The three causes that impact highly and one very low impacted road construction projects are discuss in detail as follows.

4.4.1.1 Delay in mobilization

Delays during mobilization had a very significant influence on 13 or 41.9% of the projects, and it had a significant impact on 10 or 32.3% of the projects from the total of 31 responder facts. Even if the contractors adopt the best practices on the project, it will not be enough to reduce the impact of these reasons. The following Fig.25 show the impact rate of mobilization delay.

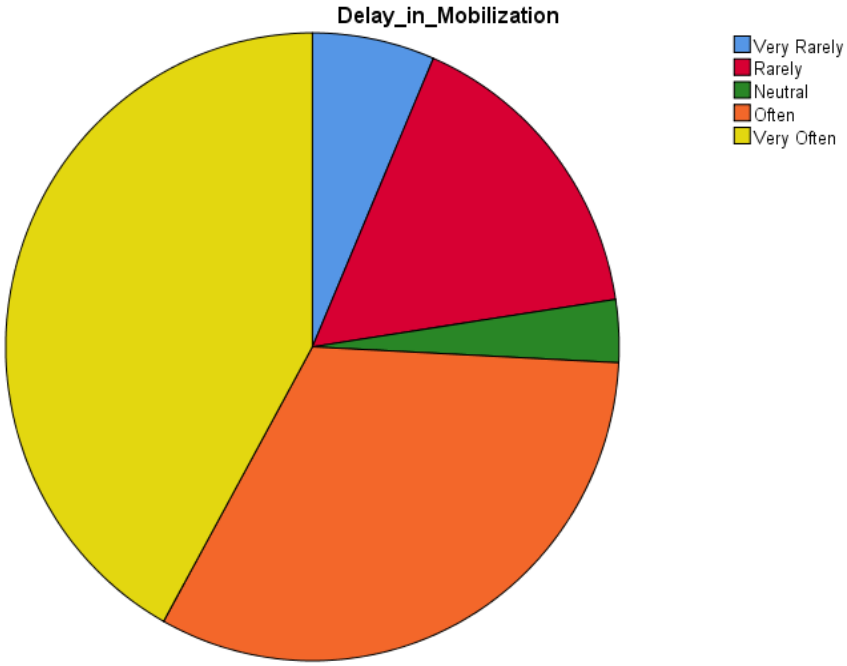

Fig. 28. Delay in mobilization

4.4.1.2 Poor site management

Contractor poor site management has a high impact on 12 or 37.5% of road construction projects, 11 or 34.4% of road construction projects have a very high impact on contractor poor site management activities, and 5 or 15.6% of projects have a low impact from the total 32 respondent survey. The bar chart below depicts the impact rate of the contractor's poor site management on road construction projects.

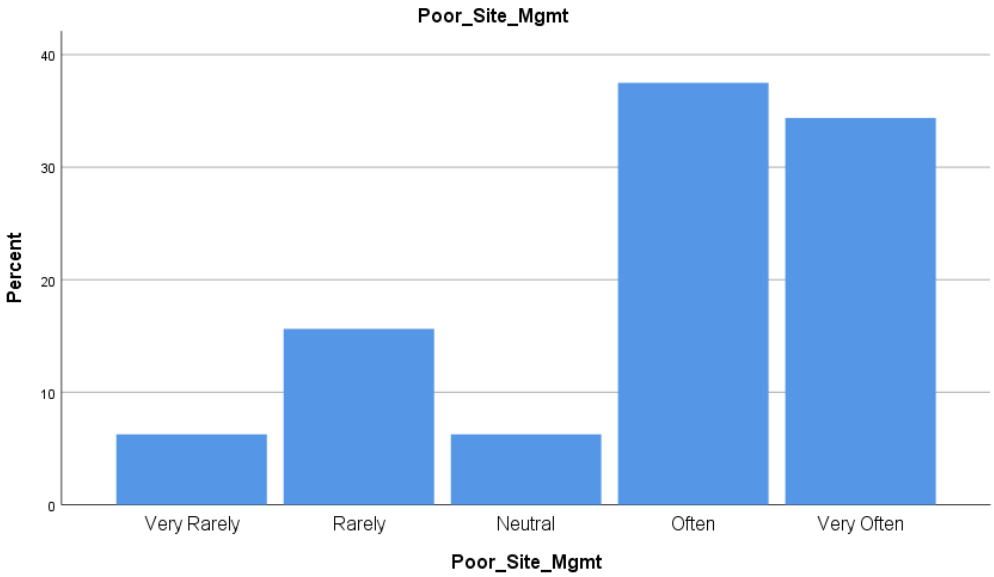

Fig. 29. Contractor's poor site management

4.4.1.3 Material Shortage

Material shortages caused by contractors during road construction had a high impact on 16 or 51.6% of road projects and 7 or 22.6% of projects were impacted in a very high rate from the total 31 respondent facts. The pie chart below depicts the contractor's impact rate of material shortage during road building.

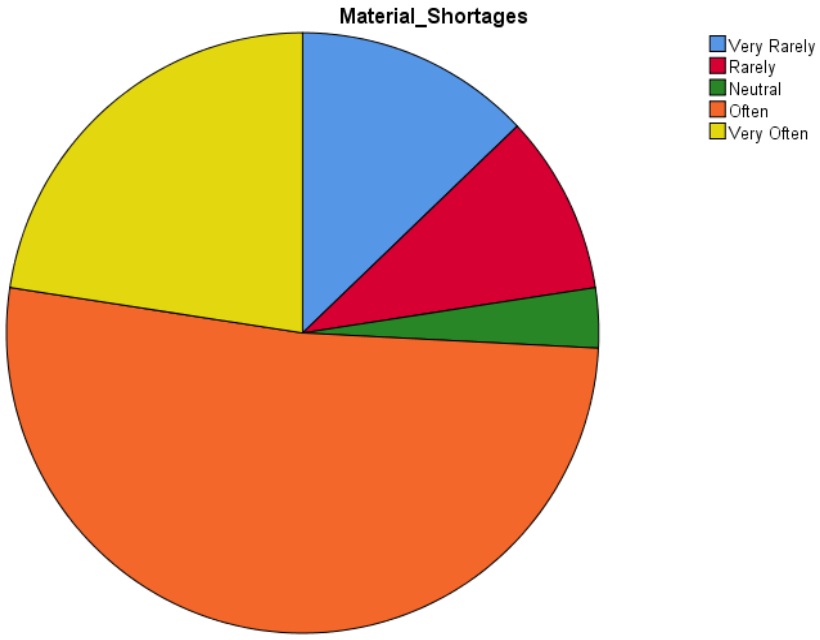

Fig. 30. Material shortage causes by contractor

4.4.1.4 Lack of Access to Credit Facilities

Contractors' lack of access to credit facilities has a very minimal influence on the selected road construction projects, indicating that the contractors for the selected road construction projects have access to credit facilities. From the total 33 respondent poll, lack of access to financing facilities has a low impact on 14 or 42.4% of road projects, no impact on 5 or 15.2% of road projects, and a significant impact on 8 or 24.2% of road projects. The impact rate of the contractor's lack of access to credit facilities and the frequency of road projects were depicted in the bar charts below.

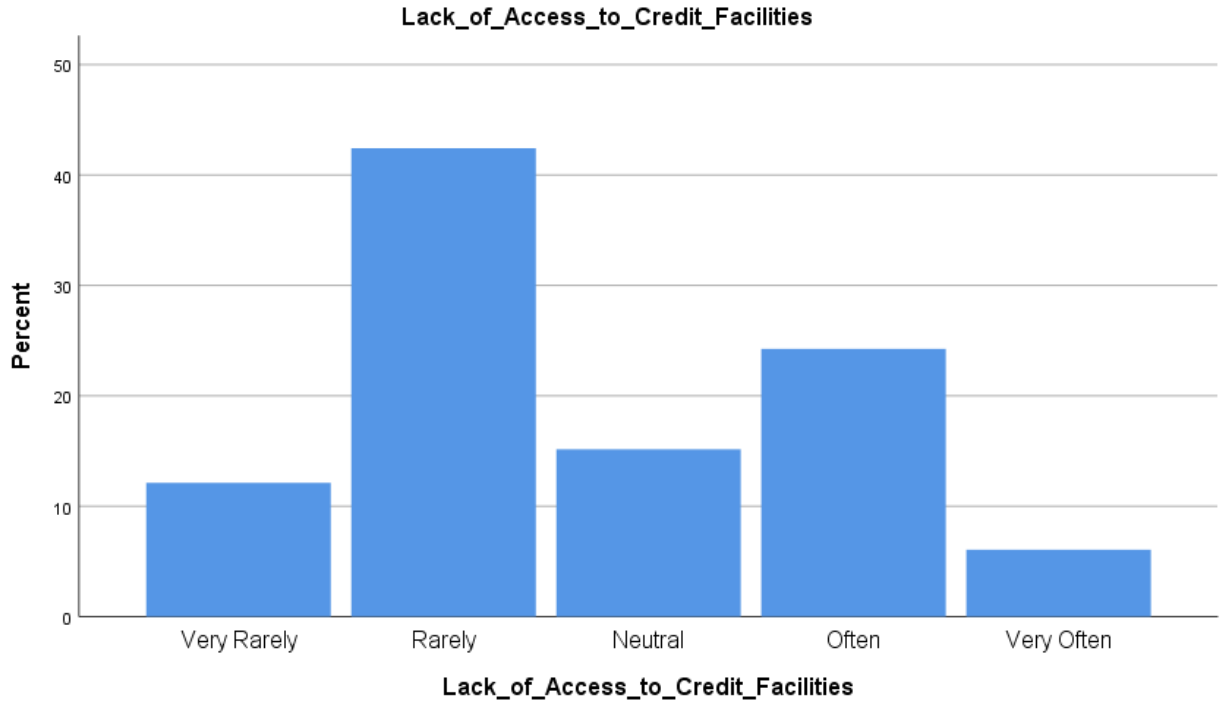

Fig. 31. Contractors lack of access to credit facilities

The causes effect the road construction project related to contractor were summarized under this table with their impact rate and project frequency.

Table 25. Summary of contractor related causes

Contractor related causes (negatively affect a project's performance)		Very low impact		Low impact		No impact		High impact		Very high impact		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Delay in Mobilization	2	6.5	5	16.1	1	3.2	10	32.3	13	41.9	31	100	2	6.1	33	100
2	Poor Site Management	2	6.3	5	15.6	2	6.3	12	37.5	11	34.4	32	100	1	3.0	33	100
3	Poor Scheduling	4	12.5	5	15.6	3	9.4	12	37.5	8	25.0	32	100	1	3.0	33	100
4.	Poor Financial Management	4	12.1	5	15.2	5	15.2	10	30.3	9	27.3	33	100	-	-	33	100
5.	Equipment Breakdowns	4	12.1	8	24.2	3	9.1	12	36.4	6	18.2	33	100	-	-	33	100
6.	Shortage of Required Equipment	8	24.2	4	12.1	3	9.1	11	33.3	7	21.2	33	100	-	-	33	100
7.	Poor procurement practices	4	12.1	9	27.3	4	12.1	8	24.2	8	24.2	33	100	-	-	33	100
8.	Poor Staffing	6	18.8	5	15.6	6	18.8	13	41.9	2	6.3	32	100	1	3.0	33	100
9.	Unforeseen Site Conditions	3	9.4	12	37.5	2	6.3	11	34.4	4	12.5	32	100	1	3.0	33	100
10	Material Shortages	4	12.9	3	9.7	1	3.2	16	51.6	7	22.6	31	100	2	6.1	33	100
11	Lack of Access to Credit Facilities	4	12.1	14	42.4	5	15.2	8	24.2	2	6.1	33	100	-	-	33	100
12	Errors During Construction	3	9.1	11	33.3	5	15.2	11	33.3	3	9.1	33	100	-	-	33	100

4.4.2 Consultant and client related causes

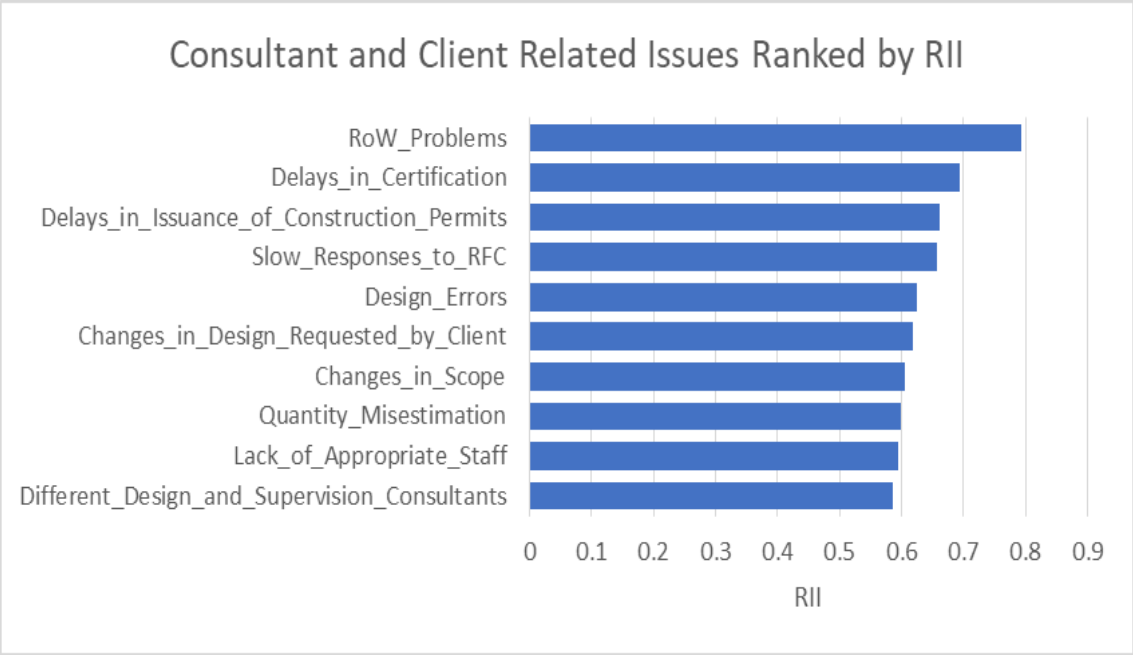

Fig. 32. Consultant and client related causes impact

As shown in the above bar charts, the RII rank of the main causes by consultant and client on the road projects construction right of way problems has a very high impact with 0.79375 RII value, delay in certification by client has a second-highest impact with 0.69375 RII value, and delays in issuance of construction permits has a third-highest impact and with 0.6625 RII value and different consultant for the design and supervision. The computed and ranked RII results for each consultant and client-related cause are included to this thesis as an annex.

Let discuss in detail this top three impact of consultant and client causes and the lowest impact causes on the selected road construction projects.

4.4.2.1 Right of way problems

Before beginning the road construction project, the customer must resolve any issues about the course of the road; if these issues are not resolved, the performance of the road projects suffers. Right of way problems had a very high impact on 14 or 43.8% of road projects and a high impact on 9 or 28.1% of road projects, according to a study of 33 respondents. The following bar chart

depicted the impact rate of right-of-way issues as well as the percentage of the project that was impacted.

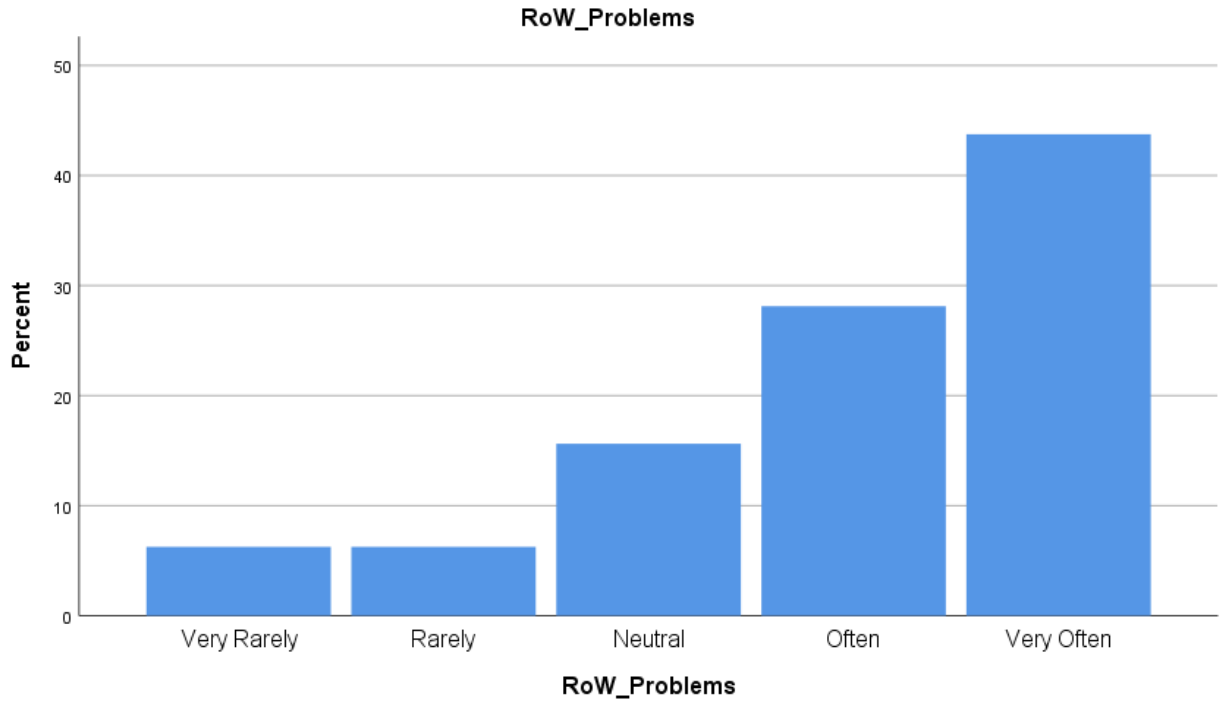

Fig. 33. Consultant and client caused Right of way problem

4.4.2.2 Delays in certification of payments

If the client's payment certification is delayed, the construction project's time and cost performance would suffer greatly. As evaluated by the RII value of consultant and client associated causes, delays in payment certification were one of the high impact factors on the selected road construction project as the 32 total respondent survey. By this cause, 14 or 43.8% of road projects were highly impacted, and 6 or 18.8% of road projects were very highly impacted by the client's late payments certification for contractors and consultants. The pie charts below show the detail impact rate of the client's delay in certification of payments on the projects.

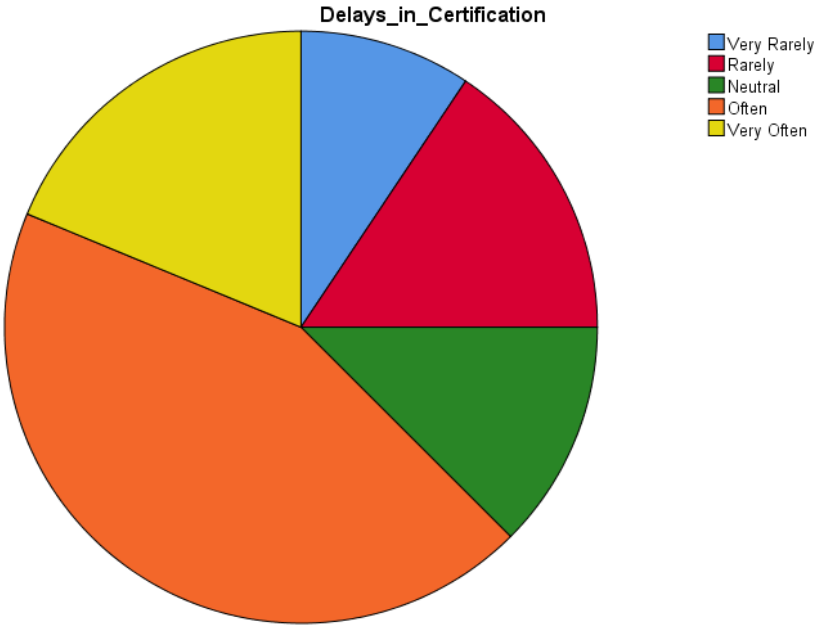

Fig. 34. Delay in certification of payments

4.4.2.3 Delays in issuance of construction permits

From a total of 33 participants, 32 responded to the impact of construction permit delays on the selected road construction projects. There is an 8 or 25% impact rate for both no impact and high impact rate road building projects, with 6 or 18.8 of them impacted in terms of schedule and cost performance in the extremely high impact rate due to delays in the issuance of construction licenses. Fig.32 below to depict the detail impact rate of delays in issuance of construction permits on the selected road construction projects.

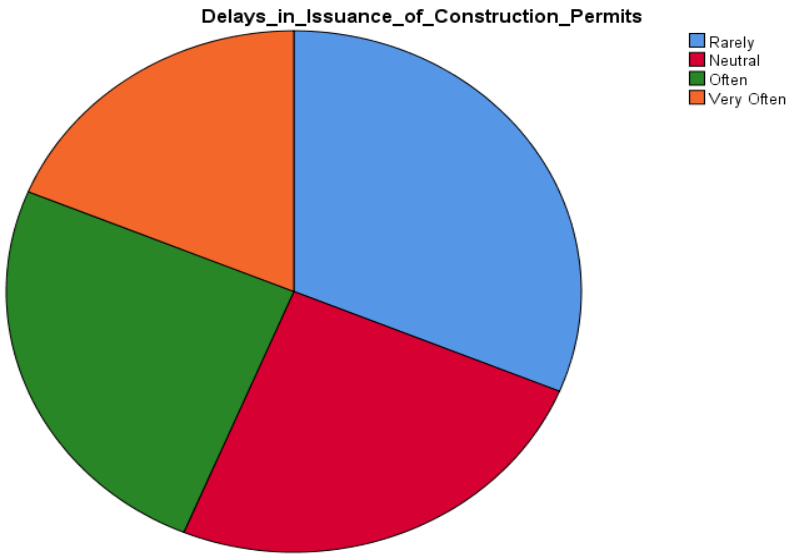

Fig. 35. Delays in issuance of construction permits

4.4.2.4 Different design and supervision consultants

Having diverse consultants for design and supervision of the projects for the specified road construction has a negligible impact on project performance. From the total of 31 respondent facts, 13 or 41.9% of road construction projects were low impacted and 9 or 29% were not influenced negatively by having various design and supervision consultants. On the bar chart, the rate of impact and project frequency were depicted as follows.

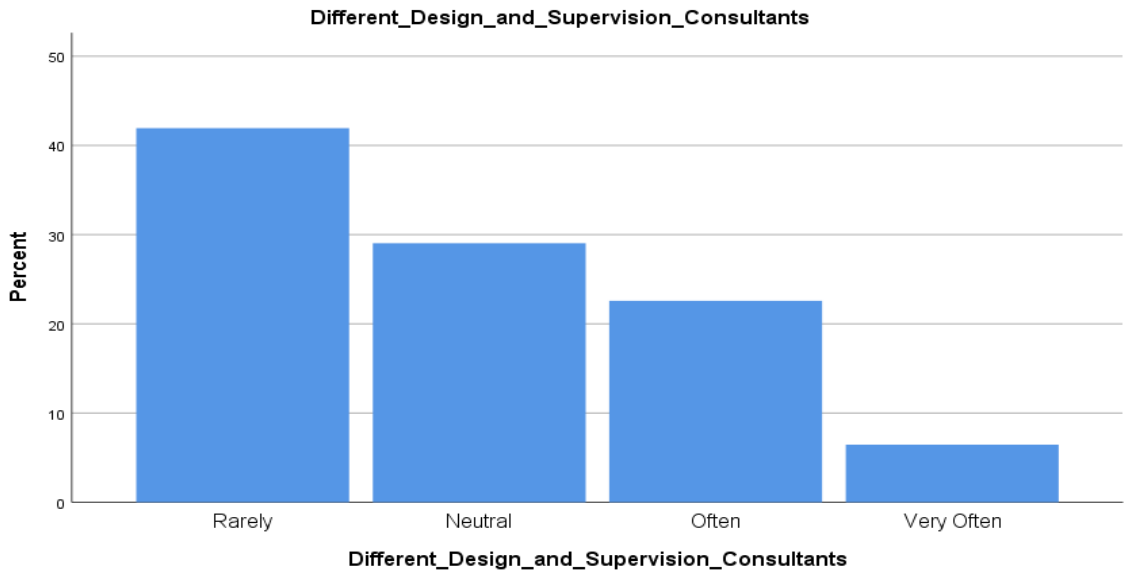

Fig. 36. Client having different design and supervision consultants

The following table summarizes the key causes consultants and clients their negative impact rate and frequency of road construction projects.

Table 26. Summary of consultant and client related causes

	Consultant and Client related causes (negatively affect a project's performance)	Very low impact		Low impact		No impact		High impact		Very high impact		Total		Missing Question		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Quantity Misestimating	3	9.4	11	34.4	7	21.9	5	15.6	6	18.8	32	100	1	3.0	33	100
2	Delays in certification of payments	3	9.4	5	15.6	4	12.5	14	43.8	6	18.8	32	100	1	3.0	33	100
3	Lack of Appropriate staff at the consultant for client offices	3	9.4	10	31.3	6	18.8	11	34.4	2	6.3	32	100	1	3.0	33	100
4	Different Consultants for Design and Supervision	-	-	13	41.9	9	29.0	7	22.6	2	6.5	31	100	2	6.1	33	100
5	Design Errors	1	3.1	9	28.1	9	28.1	11	34.4	2	6.3	32	100	1	3.0	33	100
6	Change in design requested by client	1	3.1	11	34.4	7	21.9	10	31.3	3	9.4	32	100	1	3.0	33	100
7	Change in Scope	3	9.4	8	25.0	10	31.3	7	21.9	4	12.5	32	100	1	3.0	33	100
8	Slow Responses to requests for clarifications	1	3.1	9	28.1	6	18.8	12	36.4	4	12.5	32	100	1	3.0	33	100
9	Right way of problems	2	6.3	2	6.3	5	15.6	9	28.1	14	43.8	32	100	1	3.0	33	100
10	Delays in issuance of construction permits	-	-	10	31.3	8	25.0	8	25.0	6	18.8	32	100	1	3.0	33	100

4.4.3 General Causes

The currency devaluation, right way of problems, poor security condition and poor communication among stakeholders are the main general causes affect the project time and cost performance.

The effect of those factors is graded using their relative importance index (RII) value, so right of way problems have a high rank with 0.818182 RII value, and poor security conditions in the workplace have a low rank with 0.727273 RII value. The calculated and rated RII results for each general cause are included to this thesis as an annex. The broad cause's influence RII value rank was also illustrated in detail on the following bar charts.

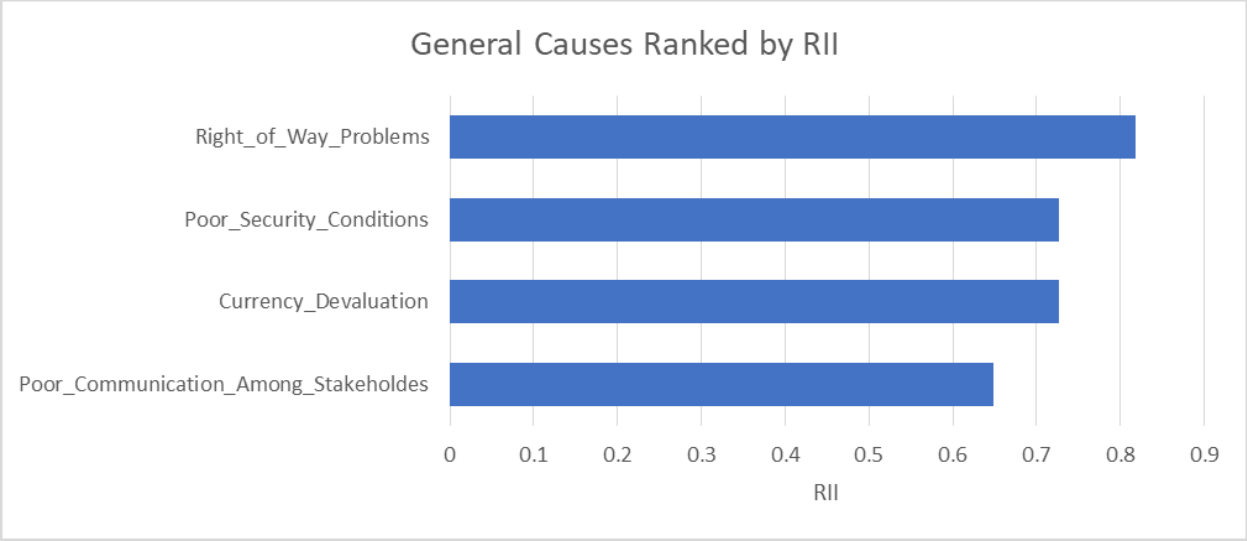

Fig. 37. General causes effect on the construction projects ranked by RII

4.4.3.1 Right of way problems

The right of way problem, or the problem causes during route clearance for total land area acquired for road construction, has a greater impact on road project performance than other general causes.

Right of way issues have a very high impact on 18 or 54.5% of road projects and a high impact on 7 or 21.2% of road projects. The impact rate and frequency of the projects' right of way difficulties were reflected on the pie charts below.

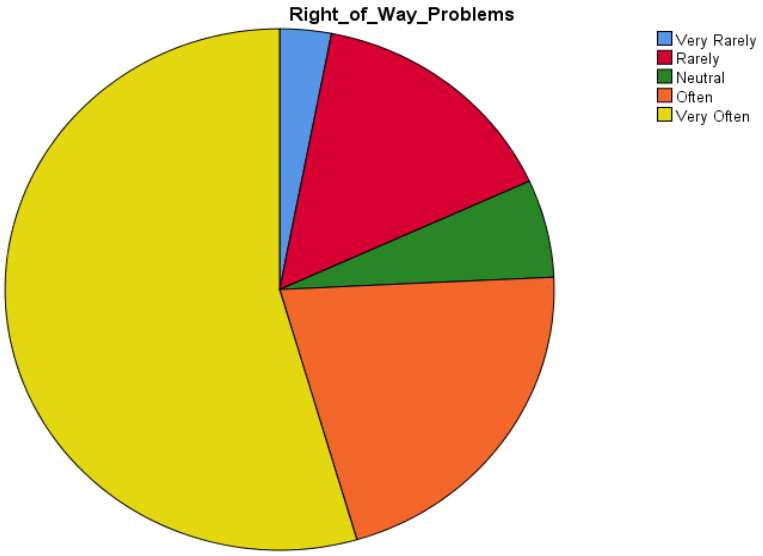

Fig. 38. Right of Way Problems

4.4.3.2 Poor security condition

When constructing any project, the site and location security conditions play a vital part in the project's performance. Poor security conditions have a strong influence on 12 or 36.4% of road project construction and a very high impact on 9 or 27.3% of chosen road project construction, according to general causes of project construction performance. The bar chart below depicts the detail bad security condition impact rate and project frequency in percent.

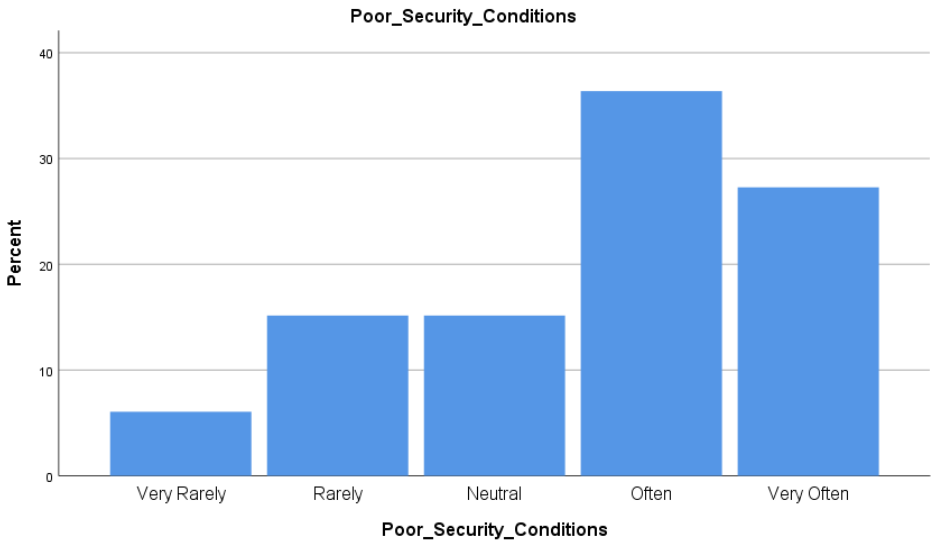

Fig. 39. Poor security condition

This table summarizes the general causes that affect negatively project performance, their frequency, and project frequency.

Table 27. General causes effect the project performance

	General Causes (negatively affect a project's performance)	Very low impact		Low impact		No impact		High impact		Very high impact		Total	
		No	%	No	%	No	%	No	%	No	%	No	%
1	Currency Devaluation	4	12.1	5	15.2	2	6.1	10	30.3	12	36.4	33	100
2	Right way of problems	1	3.0	5	15.2	2	6.1	7	21.2	18	54.5	33	100
3	Poor Security Conditions	2	6.1	5	15.2	5	15.2	12	36.4	9	27.3	33	100
4	Poor Communication Among Stakeholders	2	6.1	9	27.3	4	12.1	15	45.5	3	9.1	33	100

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The purpose of this research was to investigate best practices on selected road construction projects in Ethiopia, and determine what practices contributed to the improved performance in terms of cost and schedule performance. Road construction projects completed between 2009 and 2019 G.C. were targeted as the population, and best performing projects were selected. From a total of 76 projects, 33 were selected based upon previously identified criteria.

A questionnaire was distributed to the best performing projects, and respondents from the consultant, client, and contractor's sides were solicited. The respondents were made up of a diverse group, including local and international players in the industry, with a wide range of experience, with projects spreads throughout the country. The best practices were subsequently identified from the responses to the questionnaire.

The results showed that CII (Construction Industry Industry) best practices are important to project success, and project stakeholders must implement CII best practices, while eliminating the causes of project delays.

5.1.1 Discussion of CII Best Practices

It should be noted that 19 or 95% respondents were familiar with the CII Best Practices, which is important if project implementers are able to improve their performance. Looking specifically at the best practices ranked by RII (Appendix C), it can be seen that getting support from top management was the most important best practice, followed by vertical alignment, having a set of shared goals, establishing trust, and having an interdependent relationship among team members.

This shows that knowledge and application of CII best practices is beneficial to the project performance, even if the RII rankings show that now all of the best practices were found to be important to the project's performance.

5.1.2 Other Factors

Similar to other research works, including those which have been discussed in the literature review, it can be shown that there are numerous factors which negatively affected the best performing construction projects. The impacts of such factors were also assessed to be strong by the respondents.

Among contractors, the most influential factors tend to be related to planning issues, as the top ranked factors (Appendix D) showed that delays in mobilization, poor site management, poor scheduling and poor financial management are 4 of the 5 highest ranked causes. This indicates that in addition to implementing the CII best practices, projects should manage their projects based on PMBOK and Construction Extension to the PMBOK, which addresses all of the deficiencies.

Consultants and Clients are also responsible for some of the causes for delays. The primary cause according to respondents related to right of way problems, which are common in the construction industry. Delays associated with payment certification, and issuance of permits also related to poor project administration by the client. These responses all confirm the results from previous works.

Finally, there are general causes which cannot be attributed to a single party. For example, poor security conditions, and currency devaluation, which have been shown to cause significant problems upon project performance.

5.2 Recommendations

Based on the research finding the following recommendations are made:

- More work needs to be done in implementing the CII best practices, since respondents still believed that some of the best practices aren't particularly useful, despite their importance being shown by previous researchers.
- Implementation of CII best practices should be encouraged by the government, especially on government funded project.
- Construction best practices should be taught in classes at the university, and through short courses for graduates.
- Other contractors should implement the proposed CII best practice to mitigate the impact of various factors on the road project.

- Factors which led to failure of construction projects should be eliminated, and all stakeholders should work together to achieve this.
- Better information collection, particularly with regards to project performance should be mandated by the government, especially at institutions such as ERA, and made more easily available.

5.2.1 Recommendations for Future Research

- More research is needed in the construction best practices sector in Ethiopia, particularly the relationships between CII best practices, and poorly performing construction projects.
- The process and procedures used by the contractor, client, and consultant in accordance with CII best practices.
- The research into best practices should be extended to the other construction industry sectors.
- Factors which influence the uptake of best practices by firms should be studied.
- A large-scale investigation of construction project performance at ERA should be performed and projects which have either high or low performance should be identified for a case study-based research.

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APPENDIX A: COVERING LETTER

Dear Participant:

My name is Mebatsion Alemu G/Mariam and I am a graduate student at Addis Ababa University School of civil and Environmental Engineering doing a research entitled 'A Study on Construction Industry Institute (CII) Best Practice of Contractors with Minimum Time and Cost Overruns on Ethiopian Road Authority Road Projects' in fulfillment of M.Sc. Program in Construction Technology and Management. I have designed this questionnaire which I request you kindly take some time to complete.

Please note that you do not need to write your name in this questionnaire and your responses to this questions shall be treated confidentially. Please be assured that the information you give will be used for this research and will not be passed to any parties.

Sincerely,

Researcher's address	**Advisor's Address**
Name: Mebatsion Alemu G/Mariam	Name: Abraham Assefa Tsehayae (PhD)
Phone: +251933893176	E-mail: Abraham.aau@gmail.com
E-mail: mebatsionalemu@gmail.com	

PROJECT LISTS

Dear Participant, Please Indicate (Mark √) the project at which you were involved from the list below.

I/N	Project Name	Contractor Name	√
1.	Koka-Adulala- D/Zeyet Design and Build Road Project	Aser Construction	
2.	Construction Works of Yalo-Abala Road Project, Contract1: Yalo-Nehile ,Lot 1	Bridge Construction PLC	
3.	Construction Works of Aleta Wendo-Bensa-Daye Road projec	Alemayehu Ketema General Contractor	
4.	Construction Works of Semera-Didigsala-Yalo-Almata Road Project Contract 1: Yalo-Didigsala Road Project	SATCON Construction Pvt.Ltd.Co	
5.	Construction Works for Kombolcha -Gundewoin Road Project, contract 2: Mekaneselam- Gundewoin	CGC Overseas Construction Group Co Ltd.	
6.	Construction Works of Access Road to Kesem Sugar Factory Design and Build Road Project		
7.	Construction Works of Diredewa Industrial Park Access Road Project	China Civil Engineering Construction Corporation	
8.	Construction Number1-2 Sugar Factories-Hana Construction of Link Road Project Construction Contract.	China Communications Construction Company Limited (CCCC)	
9.	Construction Works of F6 Juction-F4 Junction Road Design and Build		
10.	Construction Addis Ababa - Adama Toll Motorway Design and Build Road Project		
11.	Construction Works of Omo F6 Junction (including Omo River Bridge) Design and Build Contract		
12.	Construction Works of Number3-4 Suger Factories Link Road Project.	China Railway No.3 Engineering GROUP Co.Ltd.	
13.	Construction works of Three Road Sections (31.5 Km) under Humbo-Arbaminch	DMC Construction PLC	
14.	Construction Works for Alaba-Sodo-Arbamich Road Project, Contract 2: Humbo-Arbamich		
15.	Construction Haregele-Km60 Construction of link Road Project Contract.	ENYI	
16.	Construction Chancho-Derba-Becho Road Project.	Ethiopian Road Construction Corporation	
17.	Construction Wezeka-Gidole Construction contract		
18.	Construction Chancho-Derba-Becho Road Project		
19.	Contract-1: Yabelo-Metagefersa-Oblo Lot 1 Yabelo-km36	GIGA Construction PLC	
20.	Construction work of Moricho-Dimtu-Bitana-Dilbo-Sodo Contract: 1 Moricho-Dimtu-Bitana-Sodo Design and Build Contract	Hunan Huada Road & Bridge Corporation	

I/N	Project Name	Contractor Name	√
21.	Design and Build of Hargele Dolobay Dolo Odo Road Project, Contract :2 Km 60+000-Dolobay-Dolo Odo	MACRO G.C & TRADING PLC	
22.	Construction Works of Seru-Shenen Wonz-Shekhussien Contract 1: Seru-Km20	Samson Cherinet General Contractor	
23.	Mombasa-Nairobi-Addis Ababa Raod Corridor Phase 3 Project: Hawassa-Ageremariam Section Lot 1:Hawassa-Chuko	SEW Construction PLC.	
24.	Constrution Works of Yabelo-Metagefersa-Shakiso Road Project Contract-1 Yabelo-Metagefersa-Oblo,Lot 3:km 75-Oblo	Shed General Contractors PLC.	
25.	Construction work of Moricho-Dimtu-Bitana-Dilbo-Sodo Contract 1: Moricho-Dimtu-Bitana Design and Build Contract	Sunshine Construction PLC.	
26.	Construction Works of Soroka-Ergoye-Abhajira/ Tele Tower Road Project.	SUR Construction	
27.	Design and Build of Fiyel Weha -Abi Road Project, Contract 2; Tekeze River Abi Adi		
28.	Construction Works for Dansha-Abdirafik-Mayikadura f Road Project		
29.	Construction Works of Abala-Shaigube Design and Build Road Project, Contract 1: Abala-Shaigube		
30.	Contruction Works Werabe-Bojere Design and Build Road Project	Yemane Girmay GC	
31.	Construction work of Guba-Begondi- Wenbera Link Road Project, Conract 1: Guba-Begondi /Aysid-Kong Design and Build Project		
32.	Construction Works of Modjo-Edjere-Arerti-Gobensa and Metahbila-Metahara Road Project,Contract 1: Modjo-Edjere-Arerti.	Yencomd Inc.Plc	
33.	Construction Works of Yalo-Abala Road Project, Contract1: Yalo-Nehile ,Lot 2	Zeluel Yohannes Bc	
	NONE OF ABOVE PROJECTS	----------	

APPENDIX B: QUESTIONNAIRES FOR THREE PARTIES

PART I: RESPONDENT'S INFORMATION

In this section, you will be asked to provide general information about yourself, as well as the firm you worked for during the selected project.

1.	Education Level	☐ High school or Lower ☐ Certificate or Diploma ☐ Bachelor's Degree ☐ Master's Degree ☐ PhD
2.	Area of Education	☐ Road or Transport Engineering ☐ Structural, Geotechnical Engineering, etc. ☐ CoTM ☐ Other
3.	Which participant of the project were you employed by?	☐ Client ☐ Consultant ☐ Contractor
4.	How many years of experience do you have in the **construction industry**?	☐ Less than 1 Years ☐ 1 to 4 Years ☐ 5 to 10 Years ☐ 10 to 15 Years ☐ More than 15 Years
5.	How many years of experience do you have in the **road construction area**?	☐ Less than 1 Years ☐ 1 to 4 Years ☐ 5 to 10 Years ☐ 10 to 15 Years ☐ More than 15 Years

PART II: CONSULTANT AND CONTRACTORS INFORMATION

1.	General or Road Contractor	☐ General Contractor ☐ Road Contractor
2.	Grade of Contractor that Undertook the Project	☐
3.	Contractor's Experience	☐ Less than 1 Years ☐ 1 to 4 Years ☐ 5 to 10 Years ☐ 10 to 15 Years ☐ More than 15 Years
4.	Is the Contractor a Private or Public Company?	☐ Private ☐ Public
5.	Is the Contractor local or international?	☐ Local ☐ International
6.	Were there any Subcontractors in the Project?	☐ Yes ☐ No
7.	Class of Consultant that Undertook the Project	
8.	Consultant's Experience	☐ Less than 1 Years ☐ 1 to 4 Years ☐ 5 to 10 Years ☐ 10 to 15 Years ☐ More than 15 Years
9.	Is the Consultant a Private or Public Company?	☐ Private ☐ Public
10	Is the Consultant local or international?	☐ Local ☐ International

PART III: PROJECT RELATED INFORMATION

1.	Region where the project is located	☐ Addis Ababa ☐ Afar ☐ Amhara ☐ Benishangul-Gumuz ☐ Dire Dawa ☐ Gambela	☐ Harari ☐ Oromia ☐ Sidama ☐ SNNPR ☐ Somalia ☐ Tigray
2.	Who financed the project?	☐ Ethiopian Government ☐ Local Lender ☐ International Lender	
3.	Procurement Procedure	☐ Direct Award ☐ Open Bid	
4.	Bidding Procedure	☐ ICB ☐ NCB	

PART IV: CONSTRUCTION BEST PRACTICES INFORMATION

In this section, you will be asked to rank various **Construction Best Practices** that were identified in the literature review. To have clarity about the practices they described as follows as CII Best Practices Guide 2012;

1. **Front End Planning (FEP):** is defined by the CII as the process of gathering sufficient strategic knowledge with which owners may handle risk and make decisions to commit resources in order to maximize the likelihood of a construction project's successful completion.
2. **Alignment**: is the circumstance under which eligible project participants work within acceptable tolerances to produce and fulfill a set of project objectives that is uniformly defined and understood.
    - Vertical Alignment: involve Top-to-Bottom with an organization.
    - Horizontal Alignment: involve the cross organizational alignment between functional groups with organizations.
    - Longitudinal Alignment: involves alignment of objectives throughout the project life cycle.
3. **Constructability**: is defined as the most effective application of construction knowledge and expertise in planning, design, procurement, and field operations to fulfill overall project objectives.
4. **Materials management**: used to manage the definition, sourcing planning, quantification, supplier qualification, purchasing, supplier QA/QC, expediting, transportation, logistics

and controlling of materials and associated information across the lifecycle of a capital project with consisting of people, organizations, technology, and processes.

5. **Team building:** is a project-focused process that builds and develops shared goals, interdependence, trust and commitment, and accountability among team members.
6. **Partnering:** is either a long-term commitment between two or more organizations taking the form of an alliance either for a single project or for a longer period.
7. **Quality Management:** The American society of quality (ASQ) glossary defines quality management as "the application of quality management in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process".
8. **Change management** is "the process of incorporating a balanced change culture of recognition, planning, and evaluation of project changes in an organization to effectively manage project changes".
9. **Dispute Prevention and Resolution** includes techniques to avoid the escalation of disagreement between project parties that require settlement beyond the jobsite, and avoid it transforming into a claim.
10. **Zero Accident techniques:** the techniques include the site-specific safety programs and implementation, auditing, and incentive efforts to create a project environment and a level of training that embraces the mindset that all accidents are preventable and that zero accidents is an obtainable goal.

Are you familiar with any of the best practices listed above?

Yes ☐	No ☐

If your answer is **yes** please rank how much they were used by the **Contractor** in selected road project you were involved in.

SCALE:

1 = Very Rarely; 2 = Rarely; 3 = Neutral; 4 = Often; 5 = Very Often

	CII Best Practice	1	2	3	4	5
1.	**Front End or Pre-Project Planning**					
a)	Feasibility Study					
b)	Project Concept					
c)	Prepare Detailed Scope					
2.	**Alignment**					
a)	Vertical Alignment					
b)	Horizontal Alignment					
c)	Longitudinal Alignment					
3.	**Constructability Review**					
a)	Plan Constructability Implementation					

	CII Best Practice	1	2	3	4	5
b)	Implement Constructability					
c)	Update Corporate Program					
4.	**Material Management**					
a)	Corporate Strategy					
b)	Personnel and Organization Commitment					
c)	IT System					
5.	**Team Building**					
a)	Trust between team					
b)	A set of Shared Goals for the Project					
c)	An interdependent Relationship among team members					
6.	**Partnering**					
a)	Establishing Trust					
b)	Getting Top Management's Support					
c)	Establishing Win-Win Objectives					
7.	**Quality Management (QM)**					
a)	ISO 9001 Certificated					
b)	Apply Modern QM Systems					
8.	**Change Management**					
a)	Apply Structured Change Management approach					
b)	Communicate frequently and openly					
9.	**Dispute Prevention and Resolution**					
a)	Dispute Review Board					
b)	Using Dispute Resolution Methods					
10.	**Zero Accident Techniques**					
a)	Enhance Safety Awareness					
b)	Safety Training					
c)	Personal Protective Equipment					
d)	Site					

If there are other best construction practice used by contractor to minimize time and cost overrun which weren't included in the list above, please list them below.

1	
2	

3	
4	
5	

PART V: CONTRACTOR RELATED CAUSES

In this section, you will be asked to rank various reasons which negatively affect a project's performance, and the impact they had on your project.

On a scale of 1 (Very Low Impact) to 5 (High Impact), please rate the impact each had on the high-performance of the project.

SCALE:

1 = Very Low Impact; 2 = Low Impact; 3 = No Impact; 4 = High Impact; 5 = Very High Impact

		1	2	3	4	5
1	Delay in Mobilization					
2	Poor Site Management					
3	Poor Scheduling					
4	Poor Financial Management					
5	Equipment Breakdowns					
6	Shortage of Required Equipment					
7	Poor procurement practices					
8	Poor Staffing					
9	Unforeseen Site Conditions					
10	Material Shortages					
11	Lack of Access to Credit Facilities					
12	Errors During Construction					

If there are other contractor related causes for the delay which weren't included in the list above, please list them below.

1	
2	
3	
4	
5	

PART VI: CONSULTANT & CLIENT RELATED CAUSES

In this section, you will be asked to rank various reasons which negatively affect a project's performance, and the impact they had on your project.

On a scale of 1 (Very Low Impact) to 5 (High Impact), please rate the impact each had on the high-performance of the project.

SCALE:

1 = Very Low Impact; 2 = Low Impact; 3 = No Impact; 4 = High Impact; 5 = Very High Impact

		1	2	3	4	5
1.	Quantity Misestimating					
2.	Delays in Certification of Payments					
3.	Lack of Appropriate Staff at the Consultant or Client Offices					
4.	Different Consultants for Design and Supervision					
5.	Design Errors					
6.	Changes in Design Requested by Client					
7.	Changes in Scope					
8.	Slow Responses to Requests for Clarification					
9.	Right of Way Problems					
10	Delays in Issuance of Construction Permits					

If there are other consultant/client related causes for the delay which weren't included in the list above, please list them below.

1	
2	
3	
4	
5	

PART VII: GENERAL CAUSES

In this section, you will be asked to rank various reasons that can't be attributed to specific stakeholders which negatively affect a project's performance.

On a scale of 1 (Very Low Impact) to 5 (High Impact), please rate the impact each had on the high-performance of the project.

SCALE:

1 = Very Low Impact; 2 = Low Impact; 3 = No Impact; 4 = High Impact; 5 = Very High Impact

		1	2	3	4	5
1.	Currency Devaluation					
2.	Right of Way Problems					
3.	Poor Security Conditions					
4.	Poor Communication Among Stakeholders					

If there were any **force majeure** causes for delays, please list them in the table below:

1	
2	
3	
4	
5	

APPENDIX C: CII Best Practice RII Rank

No.	CII Best Practice	Very Rarely	Rarely	Neutral	Often	Very Often	Total	(A x N))	RII= (∑w ÷ (A x N))	Rank
1	**Front End or Pre-Project Planning**									
(a)	Feasibility Study	5	2	8	11	5	31	155	0.658	17
(b)	Project Concept	2	3	9	15	2	31	155	0.677	15
(c)	Prepare Detailed Scope	1	1	8	18	2	30	150	0.727	11
2	**Alignment**									
a)	Vertical Alignment	-	1	7	15	7	30	150	0.787	2
b)	Horizontal Alignment	-	1	11	13	5	30	150	0.747	7
c)	Longitudinal Alignment	-	5	7	10	8	30	150	0.740	9
3	**Constructability Review**									
d)	Plan Constructability Implementation	-	6	6	17	2	31	155	0.697	13
e)	Implement Constructability	-	4	8	12	6	30	150	0.733	10
f)	Update Corporate Program	1	8	10	9	3	31	155	0.652	18
4	**Material Management**									
d)	Corporate Strategy	1	8	10	9	3	31	155	0.632	20
e)	Personnel and Organization Commitment	-	5	6	17	4	32	160	0.725	12
f)	IT System	7	11	5	6	2	31	155	0.503	27
5	**Team Building**									
d)	Trust between team	2	2	7	11	10	32	160	0.757	6

No.	CII Best Practice	Very Rarely	Rarely	Neutral	Often	Very Often	Total	(A x N))	RII= (∑w ÷ (A x N))	Rank
e)	A set of Shared Goals for the Project	1	4	3	12	10	30	150	0.773	3
f)	An interdependent Relationship among team members	-	5	5	11	9	30	150	0.760	5
6	**Partnering**									
d)	Establishing Trust	1	2	5	16	7	31	155	0.768	4
e)	Getting Top Management's Support	-	2	7	13	10	32	160	0.794	1
f)	Establishing Win-Win Objectives		9	7	9	6	31	155	0.677	14
7	**Quality Management (QM)**									
c)	ISO 9001 Certificated	7	5	5	11	3	31	155	0.587	24
d)	Apply Modern QM Systems	7	11	6	6	1	31	155	0.490	28
8	**Change Management**									
c)	Apply Structured Change Management approach	2	8	10	6	5	31	155	0.626	21
d)	Communicate frequently and openly		3	9	13	6	31	155	0.742	8
9	**Dispute Prevention and Resolution**									
c)	Dispute Review Board	6	6	5	9	2	28	140	0.564	25

No.	CII Best Practice	Very Rarely	Rarely	Neutral	Often	Very Often	Total	(A x N))	RII= (∑w ÷ (A x N))	Rank
d)	Using Dispute Resolution Methods	2	7	7	11	1	28	140	0.614	22
10	**Zero Accident Techniques**									
e)	Enhance Safety Awareness	4	5	10	10	2	31	155	0.606	23
f)	Safety Training	6	12	4	7	2	31	155	0.516	26
g)	Personal Protective Equipment		10	7	12	2	31	155	0.639	19
h)	Site	2	5	6	15	2	30	150	0.667	16

APPENDIX D: Contractor Related Causes RII Rank

Contractor Related Causes (Negatively Affect A Project's Performance)		Very low	Low impact	No impact	High impact	Very high impact	Total	(A x N))	RII= (∑w ÷ (A x N))	Rank
1	Delay in Mobilization	2	5	1	10	13	31	155	0.774	1
2	Poor Site Management	2	5	2	12	11	32	160	0.756	2
3	Poor Scheduling	4	5	3	12	8	32	160	0.694	4
4	Poor Financial Management	4	5	5	10	9	33	165	0.691	5
5	Equipment Breakdowns	4	8	3	12	6	33	165	0.648	6
6	Shortage of Required Equipment	8	4	3	11	7	33	165	0.630	8
7	Poor procurement practices	4	9	4	8	8	33	165	0.642	7
8	Poor Staffing	6	5	6	13	2	32	160	0.6	11
9	Unforeseen Site Conditions	3	12	2	11	4	32	160	0.606	9
10	Material Shortages	4	3	1	16	7	31	155	0.723	3

11	Lack of Access to Credit Facilities	4	14	5	8	2	33	165	0.539	12
12	Errors During Construction	3	11	5	11	3	33	165	0.6	10

APPENDIX E: Consultant and Client Related Causes RII Rank

	Consultant and Client Related Causes (Negatively Affect a Project's Performance)	Very low impact	Low impact	No impact	High impact	Very high impact	Total	(A x N)	RII= (∑w ÷ (A x N))	Rank
1	Quantity Misestimating	3	11	7	5	6	32	160	0.6	8
2	Delays in certification of payments	3	5	4	14	6	32	160	0.694	2
3	Lack of Appropriate staff at the consultant for client offices	3	10	6	11	2	32	160	0.594	9
4	Different Consultants for Design and Supervision	-	13	9	7	2	31	155	0.587	10
5	Design Errors	1	9	9	11	2	32	160	0.625	5
6	Change in design requested by client	1	11	7	10	3	32	160	0.619	6
7	Change in Scope	3	8	10	7	4	32	160	0.606	7
8	Slow Responses to requests for clarifications	1	9	6	12	4	32	160	0.656	4
9	Right way of problems	2	2	5	9	14	32	160	0.794	1
10	Delays in issuance of construction permits	-	10	8	8	6	32	160	0.663	3

APPENDIX F: General Causes RII Rank

General Causes (Negatively Affect a Project's Performance)		Very low impact	Low impact	No impact	High	Very high impact	Total	(A x N)	RII= (∑w ÷ (A x N))	Rank
1	Currency Devaluation	4	5	2	10	12	33	165	0.727	3
2	Right way of problems	1	5	2	7	18	33	165	0.818	1
3	Poor Security Conditions	2	5	5	12	9	33	165	0.727	2
4	Poor Communication Among Stakeholders	2	9	4	15	3	33	165	0.648	4