



**Contribution of Determinant factors at Various Life Cycle Stages on Time Overrun of Road Construction Projects in Ethiopia: Case of projects Administered by Ethiopian Roads Authority**

A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for Master of Business Administration.

By: Biruk Adane

**ADVISOR: Tilahun Teklu (PHD)**

September, 2023

ADDIS ABABA

**ADDIS ABABA UNIVERSITY**  
**Faculty of Business and Economics**

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Administration**

**APPROVED BY BOARD OF EXAMINERS**

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**Advisor**

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**Internal Examiner**

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**External Examiner**

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## DECLARATION

This research project report is my original work and has not been presented for the award of any degree. All sources of material used for the thesis have been duly acknowledged.

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Biruk Adane: GSD/9983/11  
Email: birukadane@gmail.com  
Date: September 15, 2023  
Addis Ababa  
Ethiopia

## ENDORSEMENT

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

Signature\_\_\_\_\_

Date.\_\_\_\_\_

Advisor: Tilahun Teklu (PhD)

Addis Ababa University, Faculty of Business and Economics

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## List of Abbreviations/Acronyms

ANOVA	Analysis of variance
BOQ	Bill of Quantities
COVID-19	<b>C</b> orona <b>v</b> irus <b>D</b> isease 2019
DB	Design-Build
DBB	Design- Bid- Build
GDP	Gross Domestic Product
NBE	National Bank of Ethiopia
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
ROW	Right of Way
RSDP	Road Sector Development Program
SPSS	Statistical Package for Social Sciences (23)
USD	United States Dollar

## *Abstract*

*This research attempts to assess the extent of effect of determinants of time overrun in road construction projects at various life cycle stage by analyzing the compound effect of impact and frequency of occurrence of 12 determinant factors composed of sixty-eight (68) time overrun factors identified from literature. Two determinant factors composed of 11 individual time-overrun factors during project initiation life cycle stage, two determinant groups consisting 11 factors during project planning life cycle stage and eight determinant groups comprising the majority 46 delay factors during project execution life cycle stage. Primary data was collected using questionnaire and SPSS 23 used for analysis. The study finds out the top three determinants of time overrun are Inefficient/insufficient Material and Machinery Management and Utilization and Poor Financial management System during execution lifecycle stage and Poor Data Collection during planning life cycle stage. The criticalness of the delay factors leading into time overrun increases as the project progresses; proportion of critical nature of delay factors leading into time overrun increases from 45.5% at project initiation stage to 67.5 % at project execution life cycle stage. The study also reveals, the responsible stakeholder for the delay causes varies for the different life cycle stages client being responsible during initiation and contractors during execution life cycle stage. Moreover, the researcher used ANOVA, Pearson's Correlation Coefficient and regression analysis to test the relationship between variables and to suggest alternative hypothesis. The research also conducts secondary data analysis between 2016 and 2020 and find the number of projects getting into time overrun increase as the projects progress further.*

## **KEYWORDS**

*Road construction projects, Project life cycle stages, planning, initiation, execution and time overrun.*

# Chapter One: Introduction

## 1.1 Background

The construction industry plays an important role in a nations' social, economic and political development. The industry in many countries accounts from 6-9 percent of the Gross Domestic Product (GDP) (Challal & Tkiouat, 2012). Moreover, in developing nations construction provides a huge employment opportunity, in India around 16 percent of working population depends on construction for living (Vaid, 1999).

Developing countries around the world are prioritizing their limited financial resources on improvement of their road network, expanding, and integrating their road networks to provide accessibility and mobility. Currently, developing countries around the world are prioritizing their limited financial resources on improvement of their road network and expanding and integrating their road networks (Ludwig et.al 2020).

Construction of public projects in Ethiopia also play huge role in implementation of government's development initiative. Annual budget spending amount for the construction sector in Ethiopia accounts roughly 60% of the government's capital budget (Koshe, 2016). According to Ambaw, the total expenditure on infrastructure accounts for 15% of the GDP and on average about 62% of the annual budget is allocated for various infrastructure development projects in transport, energy, water, agriculture, education, health and other sectors. From the annual budget expenditure, about half of it assigned for transport infrastructure projects amounting around 30% of the annual budget (Ambaw, 2017).

In order to satisfy the huge attention by the government and financers, road sector development program (RSDP) was launched in 1997. RSDP focus on expansion of the road sector of the country and improvement of the poor road network. So far, the government has executed five consecutive RSDPs. At the end of the fourth RSDP, in 2016 a total of ETB 266.2 billion (USD 17.4 billion) was allocated. During this period the road network in the country has expanded from 26,550 km in1997 to 113,066 km, with an average annual increment of 8 % (ERA, 2016).

According to ERA annual report for year 2016, overall progress up to June 2016 indicated 49% physical progress and 102% financial accomplishment (Kaleab, 2018). The huge disparity of the performance indicates the gap between the planned and accomplishment observed in the sector. Generally speaking, road construction projects are not executed as planned and delayed suffering in cost and time overrun. For instance, projects which were under construction between 2016 and 2020, at their originally envisaged completion date, none of them were completed and they have faced on average time-overrun of 51.87%.

This study aims to investigate the root-causes of this time overrun of road construction projects administered under ERA at various lifecycle stage of the projects.

## **1.2 Road Construction Projects in Ethiopia**

After becoming Landlocked in 1991, road transportation has become the main mode of transportation for Ethiopia and plays a vital role in the governments strive to attain sustainably growing economy of the country. All productive sectors of the economy highly rely on the availability and efficiency of our roads (ERA,2023).

The road condition in Ethiopia was in harsh condition, only 22% of the road was in a good state and 79 % of the country was not accessible by road transportation. The government has taken initiative to expand the then 26,550 km road network and improve state of the road network. Consequently, the RSDP program launched in 1997 (ERA,2023).

Even though to avert the road network problem the program targets were stretched and demand huge financial resources and implementation capability, RSDP has helped attainment of 126,773 kilometers of all weathered roads at the end of Fiscal Year 2017/18, despite all effort the road length is about 37% of the required road network in the country. The government committed investment for further improvement 33.1 billion ETB (1.14 billion USD) for road construction (Road Safety Performance Review Ethiopia, United Nations Economic Commission for Africa, 2020).

The federal government of Ethiopia has been allocating around 30% of the annual budget for transportation infrastructure projects (Ambaw, 2017). Governments firm stand on improving and expanding the road infrastructure still continues and has allocated more than 33% of the capital budget building new main and feeder road infrastructure and repairing older roads (Ministry of finance, 2023).

Currently in addition to road construction for basic access, the government engaged in constructing express ways for rapid mobility of road users. So far construction of 171.6 km expressway is completed and has become operational as toll roads. Even though a lot of improvements on the road sector is attained, still thousands of rural kebeles are not connected using all weathered road to main road network grid (ERA,2023).

## **1.3 Statement of the problem**

Construction projects commences with the aim of fulfilling the objectives set by the owner. As key performance indicators any project completed within the cost, schedule and quality set initially can be regarded as successful (Rahel,2016). However, since construction industry involves; huge amount of workforce and resources (such as finance, machinery, raw materials and technology), engagement of several major

stakeholders (clients, consultants, designers, contractors, subcontractors and suppliers) and different working scenarios construction project management is complicated (Mahamid, 2021).

Delays in road construction projects due to various reasons are a global phenomenon and it is a massive challenge. Even though most causes are universal to developing countries, there are always causes unique to the local sector (Ludwig,2020).

Time and cost have strong relationship; the increase in time will tend to lead in cost overrun. Delay will also have financial impact both on the contractor and end user/public and cause discomfort and negative perception from road users and will create friction between the public and the government and becomes an issue of bad governance (Yahya et al 2013).

The majority of delay causes studies that were reported from developed nations (like USA) focused on delay factors due to uncontrollable causes; whereas developing countries have mainly face factors related with resource shortage (i.e. manpower, material and financial) and political causes (Dureyev,2018).

When we come to the case of road construction projects administered by ERA, due to projects whereabouts in various location in the country, the different combination of socio-economic scenarios, the different regional administration rules, difference of commitment and enthusiast assistance from regional governments and strength and experience of the different construction companies will further complicated the working environment.

In Ethiopia, due to high rate of inflation, the more the construction project stays; the client will face up with requirements of providing additional budget from the government for settling price escalation, supervision cost, right of way clearing cost, etc... In other words, delayed projects are taking money from newly established or supposed to be established projects; and put the client in financial distress. The contractor on the other hand will also face time related indirect costs and resource tie up and makes it difficult to enter new venture. The general public will suffer from temporary transportation cost due to the poor conditions of roads under construction and various socioeconomic problems.

On study to determine effect of project delivery method on cost and time overrun of projects under ERA, Rahel in 2016 has shown that among six road construction projects five of them has delayed and suffered a huge time overrun ranging from 38% to 98.5% of their respective contract duration (Rahel, 2016). On another study conducted for analyzing factors contributing to time overrun on 16 road Construction projects under Addis Ababa City Administration, 80% of the projects has suffered time overrun (SirawY. 2014).

On another study for Investigating Causes of Construction Delay in Ethiopian Construction Industries in Ethiopia, Koshe has indicated that only 8.25% of projects finished on the initially envisaged completion date. The remaining 91.75% delayed 352% of original time period (Koshe,2016).

The extent of the problem reflected on the evaluation criteria of ERA which expects accomplishment of 70% (30% of time overrun) at the completion date of the contract period. According to the performance rating, only construction firms who fail to meet this minimum requirement will be disqualified/penalized from attending in bidding process for new projects (ERA monthly evaluation report published online).

As projects delayed and with the current inflation trajectory, it will not be possible to finance projects. The government's decision not to start any new capital projects in 2023/24 Ethiopian fiscal year and focusing only committing resources to complete ongoing projects an alarming news (UNICEF,2023).

Most researches focus on the general causes of delay however, causes of delay in construction process, the tie between the main stockholder's responsibility and resource, contractual conditions and relation with contracting organizations has to be investigated (Gebrehiwot,2017).

The major cause of project failure is the lack of adoption of a formal project methodology. Without adopting a clear and repeatable project methodology, integrated with project processes for initiating, planning, executing and closing projects effectively, it is inevitable projects fate in suffering from scope creep, milestone delays, poor deliverable a lack of customer satisfaction (Westland,2017).

However, no researchers investigate this problem according to the phases of construction even though this arrangement could give better insight to practitioners (Ismail et.al,2013). Most studies previously made on time overrun mainly focus on identification of delay factors leading into time overrun at the project level. Dismembering the project into smaller stages/phases help to see the issue clearly and assist for managing the problem with ease. This approach is also helpful as the definition and scope of project output might changes as a project progress, and the possibility of adjustment preferred at the project beginning than latter stages, at which cost of change will be costly. Therefore, early project management efforts aiming on rectifying problems, are advisable for proper benefit with minimal cost (Archibald,2015).

Therefore, exploring identified time overrun factors at various life cycle stages and studying their contribution to the overall time overrun of projects and studying attribution of responsible stakeholders to know key determinants is important.

## **1.4 Research questions**

Specifically, this study is to determine

- How do delay determinant factors during project initiation attributed to different stakeholders involved in construction, contribute to time overrun of road construction projects administered by ERA?
- How do delay determinant factors during project planning attributed to different stakeholders involved in construction, contribute to time overrun of road construction projects administered by ERA?
- How do delay determinant factors during project execution attributed to different stakeholders involved in construction, contribute to time overrun of road construction projects administered by ERA?

## **1.5 Objectives of the study**

This paper empirically analyses the correlation and the relationship between time overrun of road construction projects and determinant factors taking into consideration various life cycle stages by different stakeholders and identify influential factors.

The objectives of this research are:

- a. Identification of determinant factors of time overrun at various lifecycle stage applicable from literature
- b. study how the determinant factors, at various project life cycle stages, contribute to time overrun of using their impact and probability of occurrence
- c. study the trend of changes in nature of determinant effects on time overrun against progress of projects
- d. To understand how different stakeholders at various lifecycle stage can contribute to time overrun of projects

## **1.6 Significance of Study**

The findings from this paper will serve as a guideline to construction project stakeholders, i.e., the Road administrators (Ethiopian Roads Authority, Central and Rural Roads Authority...), contractors, consultants, and the community at large.

Road administrators can use the findings to correct the current working methodology in order to adjust their way of working, assess the specific stakeholder groups which need capacity building, the legislation which are source of time overrun, what measures to be taken for earlier intervention at various life cycle stage etc...

Other stakeholders will be benefited to look into shortcomings from their perspective which leads into time overrun and come up with appropriate remedy and finally the general public will be in a position to get the projects at planned time schedule.

## **1.7 Scope of Study**

This research examines recent public road projects administered by ERA and construction projects handled by local contractor's new construction, rehabilitation and upgrading road construction projects. Existing project data reviewed for construction projects evaluated monthly by ERA from fiscal year 2016 up to end of 2020. Professionals working with Client, Consultants and Contractors and other road construction professionals who have involved in construction of Federal road projects were used for the study.

## **1.8 Limitation of the Study**

While analyzing secondary data, unless termination of the contract is specified, all projects under revision was considered to be actively working.

## **1.9 Operational definitions**

**Project :-** a unique endeavor for the sake of producing deliverables with initially specified time, cost and quality constraints (PMI 2017).

**Project life cycle stages: -** series of phases that a project has to pass through from its start to its completion (PMI, 2017).

**Initiating life cycle stage:** First stage of project lifecycle, which involves creating a new project by defining the problem or opportunity to be addressed, the solution to be delivered and the scope within which the project will be undertaken (Westland,2006).

**Planning life cycle stage: -** second project life cycle stage, where the baseline for the whole project prepared, time schedule/plan prepared for proper implementation (Archibald,2015).

**Executing life cycle stage: -** Third project life cycle stage, where the physical works begin, it involves from mobilization of resources to site up to implementing the plans created during the project planning phase (Bennett,2003).

**Monitoring and controlling:** -Integral part of all stages and data collection, critical issues and variances analysis against plan and corrective actions by managing change (Archibald,2015).

**Project closure life cycle stage:-** The fourth stage which consists of activities targeting returning back the project output to the owner (Bennett,2003).

**Time overrun:-** time overrun is late completion of works from what was envisaged in initial planned schedule, contract schedule or time extension from the time frame what was agreed during tender process (Othman, 2017).

## **1.10 Organization of the Study**

The study is organized in five major chapters. The first chapter discussed about the problem and proposed approaches to conduct the study. The second chapter is the theoretical framework of the study which discuss about the concept of projects, delay factors, project management topics and the previous study results delay factors. The research design and methodology are discussed in chapter three. Empirical data presentation and analysis is included in the fourth chapter. The fifth chapter includes the result and discussions. The last part included conclusions, recommendations, references used and appendixes.

## **Chapter Two: Literature Review**

### **2.1 Theories and concepts**

This chapter review different literatures which address about time-overrun of projects at the different project lifecycle stages. Most of the literatures' discussed hereunder conducted on different countries and situations; signifying the fact that severity of delay and time overrun factors and to grasp as much as possible various scenarios in different countries which our local industry can associate with. Purpose of this chapter is to investigate reference literature and integrate with the findings of this study.

#### **2.1.1 project**

Project is a unique endeavor for the sake of producing deliverables with initially specified time, cost and quality constraints (PMI 2017). Projects are different from standard business routine operational activities as they are unique in nature and occur only once. Even though, the scopes of two or more projects are similar; the different geographical locations they are being constructed, socio economic conditions of their location, environmental issues, etc... will make them unique. On the other hand, operational activities often involve undertaking repetitive (routine) processes and there will not be major difference from one location to another.

Moreover, unlike operational activities, projects are time bounded with a predefined commencement and completion dates and definite customer requirements. Projects have predefined budgeted cost which has to be attained without compromising the quality requirements; which makes the projects to work within an environment involving huge risk, demanding detail risk analysis (Erik, 2018).

#### **2.1.2 Project life cycle stages**

Project life cycle is the series of phases that a project has to pass through from its start to its completion (PMI, 2017). For proper completion of projects, series of groups of activities and tasks categorized in each lifecycle stage has to be completed. Each phase incorporates sequentially interrelated activities which concludes with the delivery of one or more deliverables.

The phases can be sequential, iterative or overlapping. Phases are time bound, with a start and end or control point (milestones). Properly defined Project life cycle helps to provide the basic framework for managing the project by splitting a into manageable phases and denote the milestones or decision points throughout the project lifespan (Westland, 2017).

According to the Project Management Book of Knowledge (PMBOK), the Project Management life cycle should define explicitly the activities (tasks) expected to be achieved, whom will participate in the activities,

main expected deliverables of the activities and how performance of each phase will be monitored (PMI, 2017).

Understanding project life cycle helps stakeholders to analyse, allocate resources timely and monitor usage of resources and achievements with respect to goals. Project life cycle management also useful for recognizing the different level of effort requirement from different teams or team members throughout the project lifespan. Moreover, it will be helpful for organizations running several projects simultaneously to effectively assign and manage resources across different projects (Bennett, 2003).

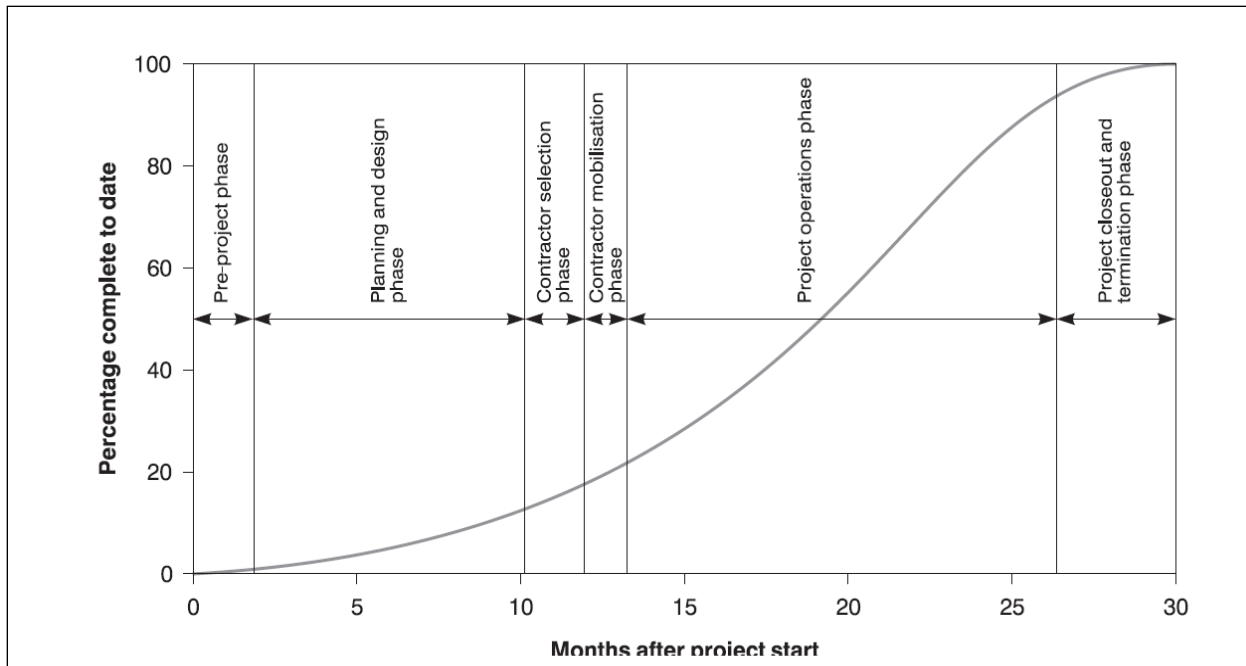
Regarding the number of cycles for project management, there are various schools of thoughts. Some literatures specify project life cycles to be five, i.e. project Initiating, Planning, executing, monitoring and controlling and closing stages. Other literatures state a four-life cycle stage since monitoring and controlling is an integral part of the life cycle stages (Westland, 2006). For this research, it is considered a project to have four lifecycles stages; Project initiation, planning, execution and closure by considering monitoring and controlling as an integral part of each life cycle stage (Westland, 2006), (Mikiyas ,2018), (Archibald,2015).

Bennett as shown in Figure 2.1, has indicated the expected project accomplishment and time elapsed at the end of project life cycle stage for ideal project having duration of 30 months. From the figure it can be seen that the initiation and planning phase (up to end of contractor's mobilization period) roughly takes 43% of the total duration of the project and the execution phase consumes around 46% of the contract duration. However, the percentage completion during these stages of the project is roughly 20% and 75 % for initiation and planning and execution phase respectively (Bennet, 2003).

This figure signifies the importance of proper effort during project initiation by envisaging scenarios seriously prior to getting into the execution stage. Moreover, the graph also depicts, even though equivalent duration of time required by the preconstruction activities and execution stage; the expected project accomplishment at the end of initiation and planning stage is only 26% of that of project accomplishment during the execution stage.

Thus, activities performed during project initiation and planning stages should be performed with precision taking sufficient time before getting into execution stage. It is possible to say overlooking the early stages and commencing execution in hurry will put projects in jeopardy their chance of completing on time and at cost. Moreover, projects will be exposed to several setbacks such as scope change, milestone delays, poor quality of deliverables and frustration from the stakeholders in due process (Westland, 2006).

Figure 2.1. life cycle stages of a typical project with duration of 30 months



Source: Bennet, 2003.

### 2.1.2.1 Project initiation

The first phase in the project life cycle stage is project initiation. This phase involves creating a new project by defining the problem or opportunity to be addressed, the solution to be delivered and the scope within which the project will be undertaken (Westland,2006).

Project initiation includes all activities at the commencement of project from Conception (starting of an idea), identification of the product /service, Pre-feasibility, Feasibility studies and Appraisal and Approval, tendering and awarding contract to construction companies.

Although the project initiation phase is by far the most critical phase in the project life cycle, clients fail to initiate projects properly by defining scope, conducting benefit cost analysis and feasibility study. A large number of projects quickly pass this phase and later they will face the consequences (Westland, 2006).

According to Bennett, the project initiation phase can be classified further into the following sub groups.

#### ➤ Pre-project stage

This is the stage the idea driving the need of the project originated. The need for project can rise from a perceived need, a desire to improvement from internal or external environment, political decisions and other factors. The client has to study viability of the project idea and decides to go to the next steps by selecting appropriate project delivery system (Bennett, 2003).

For a project based on competitive bidding, the conceptual phase should clearly indicate the decision of whether to bid or not (based on feasibility study output) and the planning phase would include the development of the total bid package (i.e., time schedule, cost, and performance) (Erik 2018).

➤ Planning and design stage

In this stage, the objectives of the project will be refined by evaluating the alternative ways the project objectives can be achieved. This stage can be properly achieved by refining the vaguely defined initial objectives by taking into consideration possible alternative ways. Financially viability of the projects will be ascertained at this stage (Bennett,2003).

➤ Contractor selection Stage

Once the cost estimate of the project after completion of the design is done; the client will check the cost against the budget. If it is decided on pursuit of the project, the next step will be tendering out for hiring contractor and supervising consultant.

The client will decide which procurement process to follow for the selection process. If the project nature needs expertise or there is hardly ample time for tendering; the client can shortlist and invite specific participants satisfying the requirements to submit their bid. On the other hand, if the project does not need special attention, open invitation will be issued to all possible bidders (George, 2013).

If bidders are interested in the project they will reconnaissance the project vicinity and will decide on the appropriate working methodology and offer a price quote including direct costs of labor, materials, plant and subcontractors, various overhead charges and a sufficient added amount for profit and submit the tender document to the client.

The client will evaluate the bid based on the evaluation criteria and will present the results to the board approval. Once approval obtained from the board, the selection process will be concluded by signing a contract agreement. The client will issue formal commencement letter to the contractor and the selection process will be finalized (Bennett, 2003) (Gorge, 2013).

➤ Project mobilization phase

This phase incorporates activities that take place between the award of the construction contract and the commencement of construction work in the field. If the selected contractor is certain about signing of the contract, he might start performing activities before official commencement (Bennett,2003).

Once the selection of parties, contractor and consultant is completed; a series of activities required for validating the contract has to be completed before commencement execution stage of a project. Requirements of the contract guarantees such as performance guarantee, advance payment guarantee, etc ...and other required licenses, permits and insurances must be secured and presented to the client. Moreover, the contractor has to prepare Master work program along with project cash flow estimated (based on project cost during contract signing) and his method statement within few weeks based on quantities in the bill of quantities.

*2.1.2.2 Project planning life cycle stage*

The planning stage aims on creating output in the form of various documents which will guide the project team through the remaining phases of the project. Project planning comprises of processes required to establish the scope of the project by refining the initially envisaged objectives and define the course of action required to attain the objectives the project (PMI, 2017).

The project planning document will be based on project appraisal and includes detailed plans for activities, corresponding financial plans, required resources to be deployed in conjunction with the required quality parameters.

Generally, the document should identify activities and their sequencing, planned time frame for execution, estimated cost (including labor, material, equipment, overhead and profit), staffing requirement with mobilization and demobilization schedule incoherence with milestones set in the master work program.

Westland, elaborated the detail schedules to be prepared as indicated in the table 2-1 below.

Table 2-1. Detail schedules to be prepared.

<b>Type of plan</b>	<b>Contents</b>
Project Plan	activities, tasks, dependencies and envisaged timeframes
Resources Plan	listing the labor, equipment and materials required with time frame
Financial Plan	plan identifying the labor, equipment and materials costs, overhead
Quality Plan	quality targets, assurance and control measures
Risk Plan	potential risks and actions to be taken to mitigate those risks
Communication plan	the information and timeframe, means of communication interval needed to inform stakeholders
Acceptance Plan	listing the criteria to be met to gain customer acceptance
Procurement Plan	Identifying products to be sourced from external suppliers.

Source: Westland, 2006.

The planning document will be referred to frequently throughout the execution phase of the project to ensure that the project is on track. Moreover, if things do not go as planned due to reasons not caused by the contractor, this document will help to prepare claim for the lost time and cost. Properly done scheduling document will guide and help the project manager to have a clear view of the activities and milestones required to meet the stakeholder's expectations (Westland, 2006).

### *2.1.2.3 Project execution*

This is the phase at which the physical works begin, it involves from mobilization of resources to site up to implementing the plans created during the project planning phase. While routine activities defining the project being executed, a series of management processes will be undertaken to monitor and control the deliverables being in accordance with initially set plan for the project (Bennett, 2003).

This life cycle stage requires deployment of huge amount of resources (equipment, human resource and material). This stage requires close follow-ups and evaluation of progress of activities and initially stated risks and issues. All of the deliverables will be subjected to quality tests which are set initially to agreed standards and approval of owner's/owner's representative.

According to Bennett, the major activities to be executed at this stage are discussed below

#### ➤ Monitoring and control

Throughout the execution stage, the physical progress of the project has to be evaluated against the plan and appropriate measure has to be taken regularly, if it is necessary. Moreover, cost of the executed works has to be in conformity with the plan for the sake of the projects being cost effective.

While comparing the actual performance of all activities with planned performance monitoring criteria set during planning stage; if there are backlogs, appropriate remedial actions has to be taken. This responsibility is termed as monitoring and controlling. Monitoring refers to methods for comparing actual accomplishment with planned performance and controlling denotes the remedy taken to rectify the observed deficiency (Bennett, 2003).

#### ➤ Schedule updating

During monitoring and controlling if the observed discrepancy between the plan and accomplishment exceeds certain threshold, the work schedule has to be revised and updated. Another use of the updating of the schedule is to incorporate any new information deviating from initially planned activities caused due to variations, change orders, etc... Updating the schedule will indicate the magnitude of the effect of the change order on previously set plans and to determine their impacts on other activities and on the overall project completion date (Bennett, 2003).

➤ Cost control

Cost control has to be done by either comparing the actual cost with the budgeted expense regularly or by developing database of productivity and actual cost to be used for estimation and monitoring future projects. The cost control also helps the contractor to generate data when situations vary from originally made assumptions so that he will substantiate his loss, potential claims for additional payments.

The outcomes from the periodic monitoring of costs also help identification of any work items whose actual costs are exceeding their budgeted costs, demanding subsequent actions to try to bring those costs into conformance with the budget. The estimate total cost of the project at completion by analyzing the cost record for completed activities and projection of cost to complete unfinished items (Bennett 2003).

#### *2.1.2.4 Project closure*

Project closure consists of activities targeting returning back the project output to the owner. This stage involves activities such as assuring the outcomes/deliverables being as per the initially set requirement and handing to the customer (owner), handing over project documentation, terminating various contracts made for the execution of the project, discharging resources deployed for the project and communicate all stakeholders on the project status (Benneett 2003).

According to Erik 2018, there are three major deliverables expected during project closure; formal closure report, auditing report and analyzing of lessons learnt they are discussed briefly hereunder.

Proper closure is when the project is completed as per agreed conditions of the client and provided with acceptance certificate. The contractor will settle outstanding issues, contracts and bills which have been used for the use of project and finally demobilize its resources to another engagements. The other major deliverable is lesson learned documentation for the completed project. Report on success factors of the project by analyzing the lessons learned integrated with opinion of stakeholders for any missing issues. The final deliverable is Auditing of the whole project history for analyzing how successful was the project and discussion with the project team staff for any observed missing issues, challenges on workflows and gaps.

The need for project closure can be derived either from successful completion of the project by satisfying originally set objectives or premature conclusion when there is change of scope (omission of some parts of the project). Generally, projects which are not initiated properly will face difficulty to complete; their probable fate will be termination. Other cause project closure without completion can be due to frequent change in project scope with addition and deduction or other extraordinary situations preventing execution of projects can be also main reasons (Bennett, 2003).

## **2.2 Project management**

“Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the project management processes identified for the project. Project management enables organizations to execute projects effectively and efficiently.” (PMI, 2017 pp10).

Properly managed project will meet initially set objects and satisfy the stakeholder’s expectation. The projects will be transparent as they are planned properly by considering project constraints (i.e. Scope, cost and time) and have clear communication plan with all stakeholders. With the help of proper risk management, all scenarios will be envisaged and responded timely before causing major setback on the project progress. On the other hand if a project is poorly managed, there will be cost and time overruns, unsatisfactory quality issues, frequent reworks and stakeholder dissatisfactions (PMI, 2017).

According to PMBOK, in order to effectively and efficiently execute project management there are 10 project management knowledge areas. These knowledge areas in synchronization with the project life cycle stage discussed earlier; will enable a holistic approach to manage a project. Even though knowledge areas are interrelated, according to PMBOK they are defined separately from project management perspective as discussed below (PMI, 2017).

### **2.2.1 Project Integration Management**

Project integration management includes all processes and activities to be executed for attainment of the project by identifying, defining, grouping and combining activities and processes (PMI,2017). These defined actions should be applied from the start of the project up to project completion and have to be clearly stated in the project charter. According to PMBOK, Project charter is a document prepared by project sponsor/client clearly addressing scope, objectives of the project and persons who are participating in the project.

A project charter shall include general information of the project stating all parties with their duties and responsibilities, envisaged plans and goals of the project with major milestones, expected financial needs and economic gains at the end of the project for the stakeholders and project success criteria agreed by all parties for evaluation and monitoring throughout the project (PMI, 2017).

Once project charter is established; the integration process group will help coordination of all discrete plans and integrate them into a solid project plan. The integrated unit will allow smooth directing, managing, controlling and monitoring.

### **2.2.2 Project Scope Management**

This knowledge area assure execution of all processes and activities will guarantee attainment of the desired output of the project, i.e the project scope. The Project scope management is the process of closely following up the project with originally placed reference and mitigates possibility of major deviation from the scope statement. It will also create consensus among stakeholders about the work that must be done in order to meet project objectives.

The scope statement has to express what is the scope of the project implicitly. Everything else out of scope statement has to be avoided, for preventing unnecessary additions and omissions which ultimately leads into scope creep (PMI, 2017).

### **2.2.3 Project Schedule Management**

Schedule management can be described as expression of the serious of activities with required resources along with priory established policies and documentation for managing and controlling performance against project milestones. The main benefit of project schedule is for monitoring, evaluating and managing throughout the contract duration. Proper Schedule has chronological order of processes required for managing and timely execution and conclusion of the project activities at the end of respective tasks completion dates, due dates of deliverables and end of the contract duration (PMI,2017).

Project schedule should also portray logical relationship between activities and their impact on the completion of the project as whole, in other words whether they are critical activities or they have a time float not. Erik has defined Critical Path as the longest duration through the network and if an activity on the path is delayed, the project will be delayed the same amount of time. On the other hand, time float is the amount of time an activity can be delayed without delaying any immediately following activities. Schedule management mainly focuses on identifying and managing critical activities closely and preventing other activities from becoming critical (Erik, 2007).

### **2.2.4 Project Cost Management**

Projects have cost set at the beginning; the cost of the project has to be monitored throughout the contract duration. Project cost management predict, estimate and control costs throughout the project duration. When things are going against initially envisaged cost plan, appropriate measure will be taken to meet the assumptions in project charter (PMI, 2017).

### **2.2.5 Project Quality Management**

Quality can be defined as compliance of requirements of objectives of the project and avoid any defects on the intended purpose and quality management also associated with the customer and stakeholder satisfaction. According to Fewings, Project quality management is establishment of systems focusing on controlling and monitoring processes so that the quality of the works perform is in conformity with the pre-defined project quality requirements (Fewings, 2005).

### **2.2.6 Project Resource Management**

Every construction project demands resources in the form of Manpower, equipment, and materials. For proper completion of project timely deployment and close management attention towards resources is mandatory (Fewings, 2005).

Supply and availability of resources will not be as per the demand all of the time; as there will be shortages due to seasonal factors, labor strikes, breakdown of equipment and various unforeseeable factors. In spite of these challenges, projects have to proceed as per the schedule. Thus, project resources management addresses processes to identify, acquire and manage all the resources for the successful completion of the project (PMI,2017).

### **2.2.7 Project Communications Management**

Communication plays a key role in coordinating, monitoring and controlling a project. Communication management includes systems focusing on smoothening communication within the project and with various stakeholders (Erik, 2007).

Project communication management clearly address on what, who, how, and when information will be transmitted with defined time frame, and communication channel for distribution of project information for all stakeholders. (Erik 2007, PMI 2017)

### **2.2.8 Project Risk Management**

Risk in the project management sense is an uncertain event or condition if it occurs has a positive or negative effect. Some risks can be identified earlier (even before project commencement) with their potential consequences; whereas some risks could not be identified earlier (Erik, 2007). Project Risk Management include conducting risk management planning, identification, analysis, response planning. It should also include implementation plan in case risk occur and monitoring risk (PMI 2017).

### **2.2.9 Project Procurement Management**

Procurement management deals with contractual agreement with other parties starting form planning (what to procure, when and how) based on the project schedule, selecting procurement method with appropriate

contractual agreement for administering the contract until the required goods and services are provided (Erik, 2007).

## **2.2.10 Project Stakeholder Management**

According to PMBOK, project stakeholder management is “the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution” (PMI, 2017, pp47).

## **2.3 Project Time overrun and its causes**

### **2.3.1 Project Time overrun**

Time overrun can be defined as a situation when a construction project fails to complete on the initially stipulated contract duration (Akhund, 2017). Othman defined time overrun as late completion of works from what was envisaged in initial planned schedule, contract schedule or time extension from the time frame what was agreed during tender process. The term overrun indicates that the project failure to complete within the time stipulated initially due to delay on the critical path of the project (Othman, 2017). From the definitions, even though a project is not completed yet, due to delays of critical activities time overrun can occur. Delays are root cause of time and cost overrun of projects.

### **2.3.2 Delay**

Syed et al. 2016, defined delay as slowing down of work without complete suspension of construction entirely, with possible consequence of time overrun, i.e. extension of the project completion beyond the contract end or beyond the date that the parties have agreed upon for the delivery of the project (Syed et.al, 2016). Mubarak describes delay as failure of starting or finishing a specific activity later than the planed schedule (Mubarak, 2014).

Lo et.al have defined delay as the slowing down of work without complete suspension entirely and that can lead to time overrun beyond the contract completion date (Lo, Fung and Tung 2006). Delay has adverse effects on the owner, stakeholders and contractor (either in the form of lost revenues or extra expenses). Various legal issues will be raised among parties regarding who is the responsible for the delay and whose responsibility for compensating the damage (Mubarak, 2014).

### *2.3.2.1 Types of delays*

Generally speaking based on their occurrence delays can be classified as excusable, in-excusable and concurrent. On the other hand, based on entitlement delays further classified as non-compensable and compensable (Mubarak, 2014).

Excusable delays are those caused by factors, which are not foreseeable and beyond the capacity of the contractor. Some of the reasons are beyond capacity of all parties such as adverse weather condition; in contrary some can be attributed to the contracting parties fault such as late possession of site and late design provision. If the disrupted activities lies on the critical path, the delay will be compensable. On the other hand if the disrupted activities are not part of the critical path, the delay will be non-compensable (Mubarak, 2014).

In-excusable delays are those caused by the contractors' own or his subcontractors' fault. The situations are mitigable and foreseeable under normal conditions. Delays caused due to factors such as poor mobilization of resources, labor strike due to unfair contractor treatment, poor quality assurance plan and methodology and weather condition that can be easily predicted from previous weather data. In these situations, the contractor will not have any entitlement are inexcusable (Mubarak, 2014).

Concurrent delays are caused due to two or more interdependent causes simultaneously. Often concurrent delays are a combination of excusable and non-excusable delays. In these situations, identification and assessment of delay entitlement is a complicated and time taking. For carrying out of successful delay analysis, comparing as-planned program (original work program) and accurate as-built program is required. The effectiveness of delay analysis techniques greatly increases when the as-planned program was reasonable (Keane and Calettra, 2007).

While assessing delay for entitlement, if the activity fails on critical path, the entitlement will be automatic. On the other hand, if the activity found to have slack (time float) larger than the delay suffered, there will not be any compensation. The float loss will reduce a contractor's contingency time and increases the probability of getting into critical delay to the project (Keane and Calettra, 2007).

### **2.3.3 General Factors contributing to time overrun of road projects**

Infrastructure projects become more complex, the working environment is getting tougher, and as a result, construction managers are facing challenges to deliver projects within the control frame i.e. quality, cost and time (Omoregie, 2006).

Construction industry also involves a huge amount of work force and resources such as finance, machinery, raw materials and technology. Moreover, participation of several major stakeholders such as; clients,

consultants, designers, contractors, subcontractors and suppliers has made the construction project management complicated (Mahamid, 2021).

Nicklas G et al, (2015) has discussed generally the main reasons why projects go bad and get into default (failure to meet the target) at various project stages. The first reason is over-optimism while getting into construction, underestimating the potential threats and overestimating the benefits, without conducting proper feasibility study is the major cause at Initiation life cycle stage. Moreover, underestimating the unique nature of projects and initiating projects based on past experience will lead into faulty assumption by preventing companies from conducting detail investigation.

During execution of projects, low productivity rates due to various regulations posing a huge challenge. For instance, low productivity due to various compulsory regulations (environmental guidelines, city administration bans on traffic movement, etc..), prohibition of heavy trucks working during working hours in cities, etc... demanding special working methodologies.

When economic reasons govern and low cost is set as basic qualification criteria and inflation in macro economy is high, there will be temptation undermine quality in order to finish the project within cost to attain originally assumed profitability. This desire will lead companies into Poor Project execution performance with problems such as incomplete (faulty) design, vague scope, ill-advised shortcuts and even mathematical errors in scheduling and risk assessment.

In addition to the external factors, Firm's poor capacity especially in non-project-oriented companies with stiff bureaucracy, where decision making personnel sits far from the project, also impose challenge on giving timely and accurate decisions plays role in causing time overrun (Nicklas G et al, 2015).

While comparing the delay causes with respect to economic status of nations, delay factors from developed nations (like USA) focused on delay factors due to uncontrollable causes; whereas papers from developing countries have mainly due to factors related with resource shortage (i.e. manpower, material and financial) and political causes (Dureyev,2018).

#### **2.3.4 Causes of time overrun during project initiation phase**

Initiation phase is first stage during which projects will be conceptualized in order to exploit opportunities or overcome challenges. Economic viability of the project will be studied and solution will be proposed. If owner accept the analysis, then a project said to be initiated. Then required documents indicating appropriate information regarding the project will be prepared and project manager will be hired (westland,2004). The

following sections discuss identified individual activities conducted in this life cycle stage and identified delay causative factors obtained from various researches.

#### *2.3.4.1 project selection:*

When projects are selected without feasibility study, the scope of the project will be vague and there will be various ideas coming along the project duration. This vaguely defined project scope will force various changes (omissions and additions) along the project and will be a source of conflict (Duryev,2020) The common encounter of destruction of road pavements by various infrastructure companies (ethiotelecom, Ethiopian electric, etc..) can be taken as an instance.

Sometimes projects follow a top down project initiation and fail to engage concerned stakeholders during project formulation. This approach will result in several requests from the public once they know the project scope does not cover their demand. This disparity between the project scope and public interest will result in several variations order during project execution; which ultimately will force either scope change to be induced or public refusal on the intended project. Some projects will suspend at late stages to study and incorporate stakeholders' interest with an expense of time and cost overrun on the projects (Mahamid et al., 2012).

On the other hand, if all stakeholders do not have detail information on proper strategic plans the public demand will not converge and there will be unrealistic demands to manage. This situation will lead into impractical expectations, which is difficult and leads into un-attainable projects.

For projects needing specialty and the selection process opts for the lowest bid price, the contractor selection might result in hiring incapable construction companies. When the lowest bidder is not a qualified contractor, the poor performance will affect the project schedule (Mahamid et al., 2012).

#### *2.3.4.2 Contract administration and design*

Once the project is selected the expected delivery method should be selected. By following traditional project delivery system, DBB the client will absorb all risk and as a result frequent problem will occur whenever things differ from original assumptions made. As various papers acknowledge frequent design change considered as a significant delay factor, projects executed by DB are found to be less susceptible to cost overrun and resulted in fast delivery than DBB projects. Moreover, since the construction can commence without waiting finalization of the design, the pressure on designer is limited (Rahel 2016). Moreover, since the time gap between design and execution is small, the DB approach will also help for quicker right of way (ROW) clearance as there will not be severe change in land-use.

The following stage is lengthy and tedious process of bidding and evaluation will take significant time and create change between the scenario during the design phase and execution phase. In cases' where the tender has to be evaluated by the board, ministry of finance, etc... the delay will be further exaggerated and project commencement date will be further pushed away (George, 2017).

When the duration of construction project is set by clients or their representatives, common practice, the contractor has to abide by duration for planning in order to prevent any penalty due to late delivery. However, if the contract duration set does not take into consideration the constructability of the project, non-practical/unattainable working methodology will be adopted by the construction company; targeting overambitious accomplishment rate to meet the deadline (Rahman et.al., 2017).

The Contract durations set by ERA for projects by local contractors between the years 2016 and 2020, 54% of the projects have an initial estimate of 3 years irrespective of various factors having huge impact. This unrealistic way of determining contract duration will put the stakeholders into frustration and put the government on poor management of budget.

➤ Faulty and incomplete designs and documents:

Faulty design will force the stakeholders to plan and prepare on wrong assumptions. From budget, allocation to assumption of crew adjustment will be based on wrong assumptions and the construction companies will face financial burden. Regression analysis from 36 building projects in Palestine shows a good correlation between design quality and delay in projects (Mahamid, 2021)

The shorter duration given for design, limitation on in capabilities on the client side to participate phase by phase on the design of the project on site (for DBB scheme) play as an important cause for the problem. This short coming will be manifested by the occurrence of variation orders at the execution phase.

### **2.3.5 Causes of time overrun during project planning lifecycle stage**

As the planning stage commences, it is believed clear and concise understanding of the project's objectives, purposes, scope and who is responsible for carrying out the work are identified. Along with beginning of preliminary planning, site investigation will be conducted in order to investigate general site condition, access, cost, material source and other relevant issues (Bennet 2003).

Once construction company becomes successful on the bidding process and receive commencement letter, the next step will be planning. However, as discussed in the sections above, design made can be based on rough assumptions and the data collected previously for tendering process can be inaccurate since there is high

probability the design made is based on reconnaissance site visit. Usually based on the interest of the stake holder, three levels of planning will be performed. The first one is on higher level for client/end user) focusing mainly on functionality. The next layer of planning is to create product which satisfy the project requirement and the final one is at the project management level, in order to plan and activities and processes to allow and follow day to day actions (Dvir,2003).

Therefore, construction companies have to deploy their staff to study the project location for getting realistic information on site condition, available material sources (such as sand, stone, ...) and their locations, construction sites for establishment of camp facility and installation plants as soon as possible.

However, during this site visit, overlooking the challenges and realities will make the construction companies to engage into the project with unrealistic assumptions. During this stage the contractors have to get historical weather data to determine their working calendars and working time. This data will help for preparation of realistic work program and method statement.

While preparing the work program and method statement, the contractor has to take into consideration the resources to use and their productivity considering their projected availability (as the machineries might not be available the whole time). For instance, while constructing in upgrading and rehabilitation of existing roads there should be consideration for managing traffic and working in town sections will need additional safety and working time considerations.

Planning reduces uncertainty and increases the likelihood of project success, although planning does not guarantee project success, lack of planning will probably guarantee failure (Dvira, 2003). In effective planning and scheduling by contractors as quite significant cause of time overrun and identified in the top 5 rank for Malaysian construction sector (Memon,2011).

### **2.3.6 Causes of time overrun during project execution life cycle stage**

The execution stage is the third phase which requires longer period of time and consumes significant amount of the budget and all activities expected to complete which was defined during the planning and design stage. In this stage in addition to execution monitoring and controlling of the performance also executed. it is very imperative to control the factors of time and cost overrun at this stage. Poor site management and supervision, Inadequate planning and scheduling, Incompetent subcontractors, Poor project management, Schedule delay, Mistakes during construction, Cash flow and financial difficulties faced by contractors, Delay payment to supplier/ subcontractor are stated as major factors leading into time and cost overrun (Roslan,2014). The underlisted sections indicate the major activities and causes of delay in the execution stage.

### *2.3.6.1 Poor Site Management*

Site management includes resources management in coherence with the schedule of the project, coordination with construction parties, procurement management, labor management and construction activities management. In many cases due to contractor's lack of experience, the construction site faces obstacles that lead to poor site management (Mahamid, 2012). Poor site management can be caused due to various factors such as inappropriate construction techniques (method statement), poorly established working crew arrangement, poor quality assurance system leading into reworking, poor delegation of jobs leading into frequent misunderstanding and disputes among various parties and within the members of the construction company.

The effect of poor site management will be manifested by bad labor morale, poor productivity, bad relation between labors and management team, misuse of time schedule, interrupting construction activities and bad relation between construction parties (Mahamid,2012).

### *2.3.6.2 Poor communication system*

Communication is among the 10 project management knowledge areas discussed by PMBOK. According to PMBOK, proper project communications management is required to ensure smooth flow of project activities with free flow of project information. Since there are many parties and stakeholders involved in any construction project; defined and timely communication is important and mandatory. Proper communication channel with clear and understandable form has to be established in the early stages of projects. Usually in road construction projects there are time frames stipulated for notifying the other party and the maximum time frame for replying (PMI,2017).

In cases where there is no properly defined communication channel and strategy, there will be information gap between parties and within the construction company. This gap will create frequent misunderstanding and can be point of conflict. There will be also reduction in productivity, frequent formal communication, reworking and wastage of resources and loss of valuable time (Mahamid, 2013).

Local communities, local government and other stakeholders should also be incorporated in the communication plan for the sake of updating the progress of the project. The communication has to be multilateral to properly address any complaints and misunderstanding.

### *2.3.6.3 Weakened Project Management and Contract Administration*

Any project, depending on the contract delivery system, will involve several parties; major parties being contractors, consultants and clients. Their relation will be governed by the contract document they sign and

each party has its own obligations and rights. All works and activities have to be administered in accordance to the contract specifications, terms and conditions, and applicable laws. Failure by one party to perform its duty as per the contract will put the project progress in jeopardy (Rahel,2016).

The contractor prior to commencing permanent works, has contractual obligation to establish facilities for its own staff and the consultant. Generally, the contractors have to be granted by the client land for constructing its camp within few weeks after receiving of commencement letter. However, the legal requirement for the land to be cleared from obstruction as per proclamation NO.1161/2019 demands a minimum of 3 months after compensation paid for displace (land holders). This makes it be highly improbable for the contractor to possess sites as per his schedule.

Construction companies put aside and fail to address their contractual obligations on matters regarding environmental, social and health issues at the commencement stages of the project. The poor precautionary measures can result in grievance to the general public by causing dust pollution on the surrounding, interruption of flow of water for the sake of construction, competition on locally available resource such as drinking water, accident from sudden traffic increase in the project area, etc.. This negligence will create non-smooth relation between the project and the local society and results in frequent interruption of the project and will have negative impact on the progress.

#### *2.3.6.4 In effectiveness in managing multiple projects simultaneously*

“When a portfolio gets bloated with too many projects, problems start to pop up and roll at a lightning speed, threatening the health of every project. “<https://www.pmcolum.com/too-many-projects/> accessed on May 20 2022 at 4:31 pm. As companies grow in size and the number of projects increases, it will be difficult for the general manager act as the focal point for all projects and accordingly new positions has to be created that manage of programs or projects, who is responsible for all program management (Kerzner, 2009).

On the other hand, if the top management is lenient on giving immediate response on the requests from the projects the progress will be affected severely. If the construction company does not adjust itself accordingly and starts delegation given to projects, projects will face lengthy and bureaucratic process to smoothly progress on the day to day project activities (Kerzner, 2009).

If the construction company does not have a clear strategy on handling and managing several projects, resources management will be tough and will be forced to have huge number of idle resources. When more projects are located sparsely and if there is poor project management office or experienced planning crew at

the headquarters level, there will be high cost of mobilization and idle time on the equipment due to the frequent movement.

Fekadu, has stated ERA selection criteria for contractors do not have any mechanism for limiting the number of projects to be handled by a single contractor. He also recommends when the number of projects to be handled by a contractor increases, there should be adjacent change in project management strategy otherwise the fate of the projects will be suffering significant losses (Fekadu 2013). When projects are awarded to contractors without considering their available resources and efficiency, the effect will be devastating and contractors will be forced to withdraw equipment from other projects.

#### *2.3.6.5 Labor related factors (Ineffectiveness and Inefficiency)*

Construction companies should be capable to administrating and motivating labor for smooth execution of the project. Moreover, contractors should come up with making the work force productive and measuring the productivity and compare it with the standard (Moursi,2017).

Poor human resource management will result in frequent labor strike, absenteeism and labor turnover. On the other hand, due to current technological advancement, work force of local construction industry without proper training, can face difficulty to meet the required productivity rate used in the planning stage.

The various issues regarding the labor affect every activity and consequently will result in high surge of the total project duration. Poor productivity will increase the actual time for a specific activity to be completed and projects will face reworking due to the skill gap. Due to poor labor management there will be accidents and dissatisfaction of workers and they will tend to be absent from working, turnover of key personnel from the project (Dureyev et.al, 2018).

#### *2.3.6.6 Poor Material and Machinery Management and Utilization*

Due to the technological advancements and the need for faster completion of works construction equipment preferred instead of relying on manual labor. Road construction involves heavy machineries and plants from earthmoving machineries to asphalt and concrete batching plants. The respective equipment is chosen based on its capacity, productivity, cost, etc...Even though these equipment improve progress of projects, there are also can be causes of project failure if they are not managed properly (Indhu et. Al, 2020).

Projects and construction companies using heavy equipment, has to employ scientific equipment scheduling and productivity analysis instead of sticking to data obtained from direct site observation or past record. In the case of Equipment maintenance in developing countries due to the poor attention given frequent breakdown is a common encounter (Indhu et. Al, 2020).

Indhu has studied 76 delay causes associated with equipment extracted from 29 different journals and the 13 most factors were Shortage of equipment, Equipment failure/Breakdown, Inadequate advanced equipment, Improper Maintenance, Low productivity/efficiency, Unavailability of equipment, Lack of tool availability, demand of skilled operators for specialized equipment, poorly trained equipment operators, Equipment allocation problem, Improper equipment planning and Untimely mobilization leading to equipment idleness and High equipment cost (Indhu et. Al, 2020).

For this research equipment associated factors classified into sub-groups. The first group is equipment/plant shortage addressing unavailability of equipment considering factors such as inadequate equipment availability due to improper equipment planning and the second factor poor performance of available equipment. These are attributed capability towards rectifying the problems with preventive and breakdown maintenance categorized under frequent equipment breakdown for addressing the poor efficiency of the equipment despite their availability on site.

#### *2.3.6.7 Material management*

Constructions companies start projects based on assumptions that projects will be completed on time and budget. However, with poor material management the outcomes from projects can be the opposite. In Nigeria, construction projects suffer from reduced profitability due to excess waste generation from poor materials management and results in project delay. Careless procurement and supply departments, site supervisors and construction staffs play huge role for the poor control of materials. Moreover, materials may be damaged or stolen during storage, unless special care is taken, delays and extra cost will be incurred and these reduce profitability (Idowu et.al, 2022).

Rahman, has studied and categorized causes of shortage and delay in materials supply in Brunei. The study identified the main bottlenecks for proper material management are Government restrictions on Certain materials requiring permit and approvals placing import orders, Slow decision-making and change the scope of work during execution phase demanding late change orders, especially if the materials have to be order from overseas, Shortage of raw materials of certain materials are sometimes ordered and collected from some other countries and logistics problem for transportation and shipping (Rahman 2017).

The quality of materials can also cause delay if the materials do not meet the standard or contain defects. The defect can be due to improper handling during packaging, shipment or delivery. If specification used for the road construction being adopted from other countries with different geological natures, finding a material source can be difficult. As a result, contractors in order to satisfy the general requirements set by the

specifications, instead of using local materials, they will be mobilizing materials from further locations (Alade et.al, 2018).

In cases where procurement of materials delayed, it will have several effects on the progress of the project. When the materials procured are intended for activities on the critical path, they will have direct effect on the project progress. On the other hand, due to the delay the material cost will increase and as result construction companies tend to buy cheaper quality of materials to cut cost. This will result increased safety incidents, which leads to delay, damaged materials, shortage in materials, delay in material delivery, changes in material specifications during construction (Albert et. Al. 2021)

In recent years, the cement production in Ethiopia is not compatible with the demand of the construction industry. From 2004 to 2012 there was a shortage of cement in Ethiopia due to the boom in the construction industry, the current cement production capacity utilization rate in Ethiopia is only 50% (Mulatu et.al,2018). As cement is among main material requirements of the road construction, projects might face delay a result of cement shortage.

For the research, the issues were sub classified into Delayed mobilization/commencement of procurement process for addressing and commencing the logistics and handling all preconditions such as getting Letter of Credit for foreign currency for materials to be imported, failure to timely procure and create a reliable inventory system can be the most important cause of delay in materials supply.

#### *2.3.6.8 Poor Financial management System*

Financial management is the use of financial resources. It includes estimating anticipated construction costs, cost control, cash flow projections and management, Processing invoices from subcontractors and suppliers, processing pay requests to the project owner and Managing change orders (Holm,2019).

Financial manager responsibilities include but not limited to monitoring and controlling project costs, profitability tracking overhead budgets, setting the minimum profit margin for use in bidding, analyzing the profitability of different parts of the company and making the necessary changes to improve profitability, ensuring liquidity, preparing an income tax projection for the company, annual cash flow projections for the company, deciding in which areas of the business to invest (<https://www.pearsonhighered.com/assets/samplechapter/0/1/3/5/0135232872.pdf> accessed 20 may 2022 at 3:46 pm)

For this research, improper utilization of Advance Payment, late collection of payments, poor financial management system and poor Inventory Management are considered.

### *2.3.6.9 Challenging external factors*

Projects are unique by nature and executed at various scenarios and different geographic locations, climate conditions and socio-economic conditions. The assumptions made at the initial life cycle stage initially can significantly vary with the situation on the ground. The devaluation of birr to dollar exchange rate, the occurrence global pandemic of Covid 19, the outbreak of war in the northern Ethiopia are situations which cannot be predicted few years ago. These changes in the external environment will affect the smooth progress of projects and will lead into time overrun of projects. Eight factors were selected from literature review viz., corruption/fraud, unexpected subsurface condition, macro-economic conditions, unforeseen events, lengthy bureaucratic processes, strikes and political factors, adverse weather conditions and changes in rules and regulations are considered (Koshe,2016) (Duryev,2018).

## **2.4 Empirical Review**

This section will try to review studies previously made on subject matter of the study. The researcher only finds very few studies made on determinants of time overrun of projects by defragmenting the overall time overrun causing factors at various life cycle stages and responsible stakeholders for causing them.

Gebrehiwot et. al, study responsible contracting party and critical factors at different stages of construction stages (pre-construction, construction and post construction) for construction projects in Ethiopia. Questionnaire with 52 causes (similar delay causes assigned to each stage without no justification how similar factors reccur in all the three stages) and 5 effects of delay, were distributed to 77 participants selected based on purposive sampling from the different contracting organizations and rank the impacts using relative important index (RII).

Ineffective project planning and scheduling, Late design and design documents and Improper project feasibility study are identified top three factors for the pre-construction stages and Designers are identified as highly related with causes. During construction stage; Poor site management and performance by contractors, Late design and design documents by designers and Late in approving and receiving of complete work by consultants were the top three causes. In the construction stage designers once again to be highly associated with delay. On the last stage considered, late in approving and receiving of complete work by consultants, Poor site management and performance and Subcontractors related problems by contractors are the top three factors. The overall result shows designers, consultants, contractors and the client ranked from 1 to position 4 (Gebrehiwot et. al, 2017).

Ismail et. al conducted a study on factors causing time and cost overrun in planning phase, design phase, construction phase and finishing phase. Thirty-Five delay factors were identified and classified according to

degree of occurrence of the factors at each phase and the life cycle stage based on frequency their appearance in previous studies analyzed. Based on the analysis, Delay factors occur along all life cycle stages and most delay factors were observed in the construction (execution) phase of projects accounting 75% of the observed frequency. Subsequently, 20% of the delay factors were during the design stage (initiation stage) and 12% during planning stage (Ismail, 2013).

However, most studies made focus on studying delay causes and their impact and frequency of occurrence towards causing time overrun and other effects. For instance, Ludwig studies causes of delays in road projects in 25 developing countries finds out the causes to be quite comparable across countries. Based on the finding of the study, the 10 most common causes of delay are Lack of an experienced construction manager in skills of proper budgeting, organizing, implementation, and schedule of the projects; Influence on people's land along with the road construction project, failure of the client on settling Right of way issues before commencement of the project; Poor communication between construction parties; Frequent changes in design; Shortage of equipment; Force majeure; Contract modification; Delays in execution of progress billing, Shortage of construction materials and Poor labor productivity (Ludwig et.al 2020).

Moreover, after analyzing papers from 10 countries on construction delays from the year 1985 to 2018, Dureyev has come up with 98 prominent delay factors. Based on the frequency of appearance of the factor's citation in the papers, the ten most common delay factors were adverse weather/climate conditions, poor Communication and project coordination among various stakeholders, ineffective/improper planning, material shortage and inconsistent flow of material to site, financial problems, lack of stakeholder experience/qualifications/competence, problems associated with construction equipment, labor associated issues and poor and ineffective site management (Dureyev et.al,2018).

After studying causes of construction delay for housing projects in Nigeria Client-related delays such as variation in orders slow decision-making and cash flow problems, Contractor-related delays due to financial difficulties, material management problems, planning and scheduling problems, inadequate site inspection, equipment management problems and shortage of manpower; and Extraneous causes associated with extreme weather, acts of nature, labor disputes and strikes are identified as major causes for time overrun of projects (Odeyinka and Yusif ,1997).

On study conducted to study determining delay factors for construction projects in Nepal during execution phase using secondary data sources, sha et. al selected fifty-seven major factors that contributed to causes of delays; which further grouped into eight major groups viz. material related; labor-related; equipment-related; finance-related; contractor-related; client related; consultant-related and external factors. Based on ranking of

the analysis, group of contractor-related delays, group of equipment-related delay and client related delays were the top groups. While observing the individual factors, Insufficient Number of Equipment, Inaccurate Time Estimate Monthly payment, Difficulties, Change Orders and Inaccurate Cost Estimate identified as the top five delay factors (Sha,2017).

On study to examine the major factors that influence delay in construction projects in Hargeisa, Fashina employed quantitative research approach for the 51 identified factors selected from literature review that causes delay in construction projects. The factors were categorized into seven major groups namely owner-related, contractor-related, consultant-related, labor-related, materials-related, equipment-related, and external factor-related delays. Relative Importance Index (RII) used to analyze the ratings received; accordingly, Contractor-related delays are found to be the most significant category that causes construction delays, followed by the owner-related delays, consultant related delays, and material-related delays. Whereas, Delay in honoring payment progressively, Underestimation or overestimation of the project cost and Delay in the approval of major changes in the work scope are identified as the top three individual factors (Fashina,2021).

Forty-two causes of time overrun in Iraq were analyzed statistically using relative importance index method. It was found that five most significant factors causing time overruns in construction project in Iraq are (Contractor's financial difficulties, Shortage of skilled manpower, Change in economic conditions, Consultant lack of judgment and experience, Unavailability of equipment. From the five factors, them of them are caused by the contractor (Khaleel,2017).

Koshe et.al has identified 88 key factors causing delay in Ethiopian construction sector and the most factors resulting in delay were analyzed using data collected from construction professionals and by interviewing senior professionals; the main factors were Difficulties in financing project by a contractor; Escalation of the materials price; Infective project planning; Scheduling or resource management and Delay in progress payments for completed works. From the five critical factors, three of them associated with Contractors and the rest with materials and clients (Koshe,2016).

Most of the delay factors from literature review are found to be similar and either focusing on grouping based on responsible stakeholder or the generalized factors without specifying the lifecycle stage they are occurring. Therefore in order to identify delay factors at each lifecycle stage and , the researcher studied activities to be done in each activities and select corresponding individual factors leading into time overrun from literature and classify them into respective lifecycle stages. To begin with, the current high-level work flow at ERA

observed so that delay factors from research which closely associated with the activities associated with the work flow are considered for the study.

### **2.4.1 Project Management practice at ERA**

According to George, ERA identifies the road project needs by its Planning and Programming Directorate based on the priority of the roads and the availability of budget. Design Consultant will also prepare detail scope of the project, tender document and appropriate project delivery method by consulting ERA (George, 2016).

If the client decides to engage a separate consultant for the preparation of design with proper plans and specification he will chose the design-Bid-Build (DBB) approach. On the other hand, if the client wants to give the whole design and construction to the same company, it will use the Design and Build (DB) approach; a single construction company will be responsible for the whole design and construction works of the project. The client also, if deemed necessary, can use of its own construction department directly to commence construction in certain locations without waiting to the completion of all design work for the whole stretch.

Feasible Projects will be selected among other factors, according to requirement of route selection manual 2013, at least three alternative routes have to be selected with selection criteria including; Road Length (km) (the shortest route length the maximum score), Terrain (the flatter the terrain the maximum score), Earthworks (The maximum score should be given for the route with the lowest earthwork cost), Community Access, development potential, effect on Resettlement and other relevant factors. After analyzing various alternatives more details will be set forth in the project statement, various alternative routes may be investigated, public input with proper consultation may be sought, preliminary cost estimate will be prepared and funding sources will be identified (ERA, 2013).

Once the most feasible routes are selected, the detail design and tender document preparation will commence. In this stage, the design professional will prepare detail engineering design documents including schematic diagrams, technical specifications stipulating the materials and the manner in which they shall be installed, bill of quantities (BOQ) and contract conditions containing legal requirements to be used in the execution of the project.

The client will decide which procurement process to follow for the selection process. If the project nature needs expertise or there is hardly ample time for tendering; the client can shortlist and invite specific participants satisfying the requirements to submit their bid. On the other hand, if the project does not need special attention, open invitation will be issued to all possible bidders (George, 2013).

The client will evaluate the bid based on the evaluation criteria and will present the results to the board approval. Once approval obtained from the board, the selection process will be concluded by signing a contract agreement. The client will issue formal commencement letter to the contractor and the selection process will be finalized (Gorge, 2013).

In the meantime, the contractor has to acquire places for establishment of its temporary facilities (until establishment of permanent facilities) and expected to select site and start legal process for possession of the land to establish permanent facilities to the project. The process of acquiring materials and equipment to be used for the project works must be initiated and arrangements for labor and other essential resource (such as fuel, cement, bitumen, reinforcement bar) must be settled. The contractor based on his submitted master work program will start preparation of various working drawings for approval and will process clearance of obstructions within the right of way. The mobilization period ranges from 2 to 6 months and if things goes as planned, at the completion of this phase the contractor should be ready to begin the actual field construction.

On the other hand, at this stage the consultant will analyze the accuracy of design, bill of quantities and other documents used for the bid and made necessary revision if found not accurate. The project initiation life cycle stage will be concluded with this stage and based on the outcome of design review; all parties will start the detail planning and execution the construction works. The construction works will be handled by contractors and the consultant will supervise the activities. Details of the activities to be conducted in this stage are discussed in section 2.1.2.3.

From the empirical research review, the following major conclusions regarding the activities are drawn. The main activities in initiation life cycle stage are conception, validation and securing approval of the appropriate resources, prepare required documents and follow procedures to hire contractors and consultants. Similarly, during planning life cycle stage, the main objectives should be getting the appropriate current information and using proper techniques trying to estimate the future.

During execution, which require longer duration and resource, the main activities should be

- Planning on what construction methodology will be used and required resources adequate for the planned method statement. The next step shall be where to acquire resources to the new project (either by taking from other projects, by procuring, by subletting, etc...) and mobilizing and properly managing the resources (financial, equipment, labor, construction materials, etc..). There should be constant monitoring and evaluation of activities and performance of resources. If problems found in the resources which contradict to the original plan come up with appropriate methods.

- For smooth continuation of the project, appropriate inter and intra communication among the stakeholders taking into consideration the project management principles and requirements of the respective contract agreement is mandatory.
- There is always external factors which have severe effect on the performance of projects which has to be followed in caution and appropriate detail.

Accordingly, the researcher selects twelve determinant factors two at initiation and planning life cycle stage and eight at execution life cycle stage as shown Table 2-2. The identified determinants further divided into 68 factors. The identified determinant groups and factors which define these determinant groups are indicated in and the identified individual factors under them leading into time overrun from previously made researches discussed in the previous section.

Table 2-2. determinant factors of time overrun at various life cycle stage

project life cycle stage	No	time overrun factors	References
Project Initiation	<b>Determinant 1: Improper project selection</b>		
	1	Vaguely defined project scope	b,e,f,g
	2	Non involvement of all stakeholders in project initiation	,g
	3	Lack of stakeholder's experience / qualification / competence on defining project	e,g
	4	Non Feasibility / politically motivated projects	e,f,g
	5	Award project to the lowest bid price	f,g
	<b>Determinant 2: Poor/ inappropriate contract administration and design</b>		
	6	Inappropriate contract delivery method	f,g
	7	Bid related delays (process, type and evaluation method)	e,f,g
	8	Delay in project commencement/ late contract award	g
	9	Unrealistic contract duration and project scope	b,c,f,g
Project Planning	10	Design and contract document problems ( mistakes , being incomplete and inappropriate)	b,c,e,f,g
	11	Insufficient data collection before design	b,c,f,g
	<b>Determinant 3: Poor Data Collection</b>		
	12	Overlooking Site conditions (i.e. access, storage, obstructions, traffic and security)(ROW)	e,f,g
13	Poor information knowledge and survey of subsurface and ground conditions	b,c,e,d,f,g	
<b>Determinant 4: Unrealistic expectation/Assumptions</b>			

	14	unrealistic assumptions for planning( productivity of equipment , working culture in the project area,..)	a,g
	15	poor risk analysis	g
	16	unable to assess and predict the future socio economic condition	c,g
	17	ignoring the influence of stakeholders	g
	18	On availability of utilities on site	g
	19	procurement process and plan	d,g
	20	source and availability of construction materials	e,g
	21	weather and environmental conditions	g
	22	Inadequate method statement and execution strategy	d,f,g
<b>Project Execution</b>	<b>Determinant 5: Poor Site Management</b>		
	23	Improper Construction method / technique	a,b,g
	24	Poorly defined crew (workforce) definition	a,c,d,f,g
	25	Reworking (due to various reasons)	,c,d,f,g
	26	Poor coordination and management	,c,e,d,f,g
	27	Poor/ineffective/lack of quality Assurance System	,f,g
	28	Disputes on site, Work suspensions owing to conflicts	,d,f,g
	29	subcontractor related delays	a,b,c,f,g
	<b>Determinant 6: Poor communication system</b>		
	30	no defined communication strategy	a,e,g
	31	poor and delayed decision making	a,b,c,f,g
	32	inefficient communication plan/channel between parties	,b,c,d,f,g
	<b>Determinant 7: Poor Project Management and Contract Administration</b>		
	33	Right of way problems (access to site and quarry locations)	,c,d,f,g
	34	Contract disputes and negotiations	,d,
	35	Scope changes arising from redesign and extensive variation orders	a,f,
	36	Health , Safety and environmental issues	,b,e,f,
	37	non appropriate organizational arrangement for project execution	,e,f,
	38	delayed and ineffective Procurement of materials	,b,e,f,
	<b>Determinant 8: Ineffectiveness in Managing Multiple projects Simultaneously</b>		
	39	Unmanageable number of active projects	,d,
	40	Distance of projects from head quarters and their geographical disparity	
	41	poor top management support / improper delegation at project level	,f,g
42	Poor allocation of resources and not setting-out clear goals and priority to projects	,f,g	
43	unsuitable organizational culture and improper strategic plan for proper project management	,f,g	
<b>Determinant 9: Labor related factors (Ineffective and Inefficient)</b>			
44	labor strikes due to poor working condition, delayed payments	f,g	

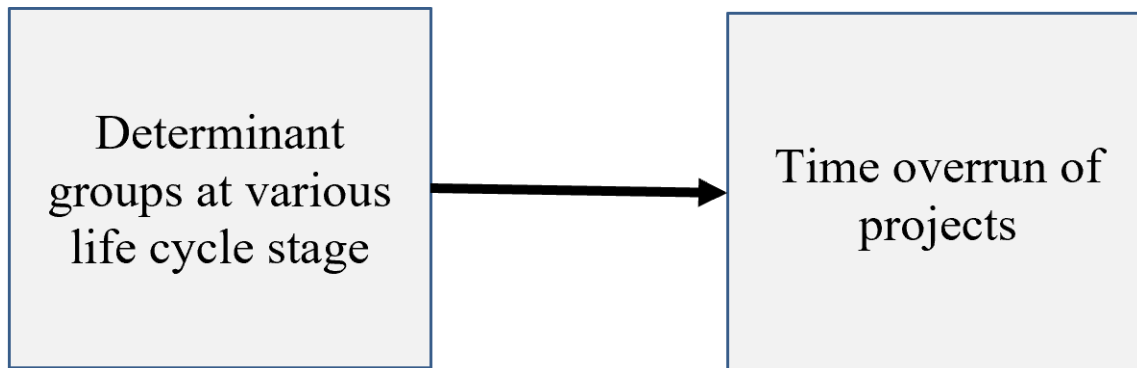
45	lack of skilled/qualified work force	b,c,d,f,g
46	un-skilled Labor shortage	d,f,
47	Absenteeism from work	f
48	Staff/labor turnover	f,g
49	Low/lack of motivation	a,f,g
50	absence of performance related payment	,f,g
<b>Determinant 10: Inefficient/insufficient Material and Machinery Management and Utilization</b>		
51	Equipment/Plant shortage	b,d,f,g
52	Delayed mobilization/commencement	c,f,g
53	Lack of knowledge of available local resources	f,g
54	Equipment/plant frequent breakdown	f,g
55	delayed and poor quality of material procurement	b,c,e,d,f,g
56	Inadequate/shortage production of materials in the country	a,b,c,d,g
<b>Determinant 11: Poor Financial management System</b>		
57	Improper utilization of Advance Payment	a,c,
58	late collection of payments	b,c,d,f,g
59	poor financial management system	b,f,
60	poor Inventory Management	a,g
<b>Determinant 12: challenging external factors</b>		
61	corruption/fraud	a,f,g
62	Unexpected subsurface conditions	d,f,g
63	Macro Economic factors/problems/conditions	b,e,f,g
64	Unforeseen events (Act of God)	d,f,g
65	lengthy Bureaucratic Process	a,f,g
66	Strikes, political factors	,f,g
67	Adverse Weather/climate conditions	,b,f,g
68	changes in rules, regulations	,e,d,f,g

Sources a: Sha,2017, b: Memon,2014,c: Fashina,2021,d: Khaleel,2017,e: Kikwasi,2013,f: Koshe,2016,g: Durdyev,2018

## 2.5 Conceptual Framework

The following framework shows how determinant factors at various life cycle stage caused by different stakeholders contribute to project time overrun. The conceptual frame work for the study shows the contribution of individual determinant factors on the overall time overrun of projects. For the study end of mobilization period is taken as end of project initiation and beginning of execution life cycle stage. Planning stage is considered to exist concurrently in both mobilization and execution stages.

Figure 2.2. Conceptual framework showing relation between determinants at various life cycle stage and project time overrun.



Developed by the researcher (2023)

## 2.6 variables

From the literature reviewed and consecutive conceptual framework, this study identified the following independent and dependent variables. To measure the identified independent variable, a five point Likert scale was developed whereas the average value of product of the impact and probability of occurrence is used to determine value of determinant factor.

### 2.6.1 Independent variables

The independent variable used in the research are

- Determinant factors associated with Improper project selection
- Determinant factors associated with Poor/ inappropriate contract administration and design
- Determinant factors associated with Poor Data Collection
- Determinant factors associated with Unrealistic expectation/Assumptions
- Determinant factors associated with Poor Site Management
- Determinant factors associated with Poor communication system
- Determinant factors associated with Weakened Project Management and Contract Administration
- Determinant factors associated with Ineffectiveness in Managing Multiple projects Simultaneously
- Determinant factors associated with Labor related factors (Ineffective and Inefficient)
- Determinant factors associated with Inefficient/insufficient Material and Machinery Management and Utilization
- Determinant factors associated with Poor Financial management System
- Determinant factors associated with challenging external factors

## 2.6.2 dependent variable

The dependent variables as per the conceptual model developed by the researcher is project time overrun.

## 2.6.3 Hypothesis Design

Taking the objectives of the study, the following hypotheses based on other studies and empirical justifications clearly discussed in this document.

**Hypothesis One:** factors related with project selection during initiation life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Two:** factors related with procurement processes (contract formulation and design) during initiation life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Three:** factors associated with familiarization with the environment for proper planning during project planning life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Four:** factors associated with predictions made for planning during project planning life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Five:** determinant factors associated with site management during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Six:** factors associated with communication management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Seven:** factors associated with improper project and contract management during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis Eight:** factors associated with having several projects simultaneously during project execution life cycle stage have significant effects on time overrun of road construction projects administered by ERA.

**Hypothesis nine:** factors associated with labor mis-management on projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis ten:** factors associated with poor resource management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis eleven:** factors associated with improper financial management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

**Hypothesis twelve:** factors associated with external issues management of projects during project execution life cycle stage have significant effects on time overrun of road construction.

## **Chapter Three: Research approach and methodology**

### **3.1 Introduction**

Research can be defined a scientific and systematic search for relevant information on a specific topic. It strives to find out the hidden truth to discover answers to questions by the application of scientific Procedures (Kothari, 2004).

This chapter describes the various methodologies used in the study. The research Design, target population, sampling technique, data collection instrument, data collection procedures, data processing and data analysis will be discussed.

### **3.2 Research Design**

The purpose of the research design is to achieve greater control of the study in examining the research problem. Based on the research purpose, research design is designed for ease of collection of data or evidence with minimal effort, time and money (Kothari, 2004).

Research design should include the research methodology, describing the philosophy and general principle to be used with the tools to be employed for gathering the data that are best suited to answer the research question (Catherine, 2007).

For this study, explanatory research techniques used for background formation, problem identification, instrument development and research question setting. For this purpose, unstructured literature review, analysis of historical data obtained from the ERA monthly evaluation report published online for local contractors and informal discussion with professionals in the sector were conducted.

Based on the collected data and information a questionnaire was prepared. The researcher distributed questionnaires to project managers, Resident Engineers, construction engineers and other professionals engage in the road construction sector. Quantitative approach preferred for the research to obtain quantifiable scheme to get more assurance than a reasonable guess would do.

This research can also categorize as applied since the research is initiated from practical problems and existence of time overrun in road construction projects. The descriptive nature derived from its endeavor to identify significant delay determinant factors at various project lifecycle leading into time overrun of road projects constructed by local construction companies administered by ERA.

Primary data collected by purposive sampling method from professionals from the client, contractor, and consultant physically, in their offices and sites, and electronically via email and other social Medias.

Secondary data (document review) collected from the monthly performance evaluation list posted on the official website of ERA, <http://www.era.gov.et/web/guest/performance-rating> from the year January 2016 to December 2020.

Upon obtaining the desired data, checking and sorting of data has been done. The data were then analyzed for cross-checking the validity and conformity of the information obtained through the overall research work. Primary data analyzed and interpreted using SPSS version 23 and Importance Factor Index Importance Index (IMP.I) to identify frequency, rank and correlation of variables that affects project delay. Secondary data also analyzed using Microsoft Office Excel 2007 to rate actual time overrun of selected projects between 2016 and 2020. This was followed by thorough discussions in order to draw a conclusion and to forward recommendations based on the findings of the study.

### **3.3 Applicable variables**

Variable can be defined as a concept which can take on different quantitative values (Kothari, 2004). Variables can be imaginable, perception or conceptual that are capable of measurement; hence can have different values. Variables can be measured directly or indirectly through appropriate indicators.

The independent variables for the study are determinants of project time overrun caused by contractors, consultants, clients, external parties and conditions at various life cycle stage of the project and the dependent variable is Time overrun of road construction projects.

The researcher identifies and collect various delay factors from literature review leading into time overrun by categorizing them into the three project life cycle stages, i.e. project initiation, planning and execution phases.

Eleven (11) Factors during project initiation are identified and classified into two determinants. The first determinants deal with factors caused during pre-project stage i.e. during conceptualization stage and the second determinants incorporated factors occurring while establishing the project i.e bid tendering, evaluation for contractor selection and designing.

For the project planning life cycle stage, the variable obtained were sub grouped into two determinant groups. The first subgroup focusses on planning problems caused due to faulty data collection regarding the reality on the ground. The second sub group contains factors caused due to either planning based on unrealistic assumptions defying the reality on the ground or misinterpretation of the data.

Finally, on the execution phase, being the stage engaging/consuming huge amount of resources and time, a total of forty-six (46) factors divided into eight (8) determinants which can group better activities conducted

in the life cycle stage. The subdivisions are classified based on the 10 project management knowledge areas stated in PMBOK.

Table 3-1: Summary of Determinants compared with PMBOK.

<b>Project Management Knowledge areas</b>	<b>Determinants</b>
Project Integration, scope and quality Management	Weakened Project Management and Contract Administration, Poor Site Management, Ineffectiveness in Managing Multiple projects Simultaneously
Project communication management	Poor communication Management system
Project Resource Management	Labor related factors (Ineffective and Inefficient), Inefficient/insufficient Material and Machinery Management and Utilization, Poor Financial management System.
Project Stakeholder management	challenging external factors

Source: PMI 2017

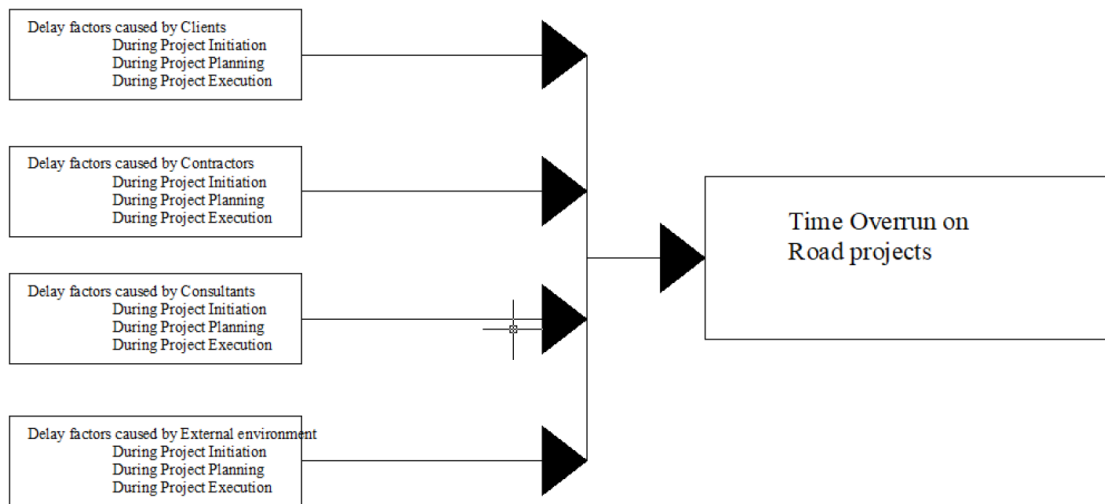
The delay causes are categorized into determinants discussed above were quantified based on their importance towards project time overrun by measuring severity of the factors and frequency of their occurrence. The responsible party for each delay factors case is also analyzed.

This research was done based on view point of causal relationship of variables. It has three sets of variables; independent, dependent, and extraneous. To analyze findings for this study, the researcher uses these variables.

The independent variables are delay causing factors at various life cycle stage of road construction projects caused by various parties involved. The Outcome or dependent variable is time overrun on road construction projects.

Extraneous variables are project size, project delivery method, geographical location, weather condition, project complexity, security conditions, work culture and availability of work force and other factors that may affect the dependent variable.

Figure 3.1: the causes and effects of applicable variables



<u>Causes of time overrun (Independent Variables)</u>	<u>Outcome(dependent Variables)</u>
<p>Delay Factors grouped into delay determinants at various life cycle stages with their frequency of occurrence and the severity of their impact on projects delay leading into Time overrun.</p>	<p>Time overrun of road construction projects</p>

Source: Desk Study

### 3.4 Research Instruments

Two research instruments were used for the collection of relevant information; literature review and structured questionnaires. Literature review was used to identify potential risk factors leading to time overrun to be used in questionnaire and distributed to professionals involved in the road construction sector. Judgmental or purposive sampling technique was applied to select primary respondents from construction companies. Purposive and/or expert sampling was a useful method which allows a researcher to get information from a sample of the population that one thinks knows most about the subject matter.

The questionnaire uses 5-point Likert’s scale (from 0-4) to collect data from respondents regarding frequency of occurrence for each variable during that particular project life cycle stage based on their experiences on an ordinal scale. For the frequency of occurrence, the following scale of measurements, 0- Never (0% probability to happen), 1- Unlikely = 25% probability to happen, 2- Likely = 50% probability to happen, 3- Almost certain = 75% probability to happen and 4- Certain =100% probability to happen is used.

Similarly, the questionnaire gave each respondent an opportunity to describe impact of the variables they perceived as likely to contribute to delays by responding on a scale from 5, 0-No impact,1-Minor impact,2-Average impact3-High impact and 4-Extreme impact are used. Respondents were also asked to state their perception which responsible party/ parties are more responsible for that particular delay causing factor. Finally, open ended questions with intentions of collecting additional delay factors and getting mitigation measures to be taken by each party forwarded to respondents.

Number of selected variables was 68 and factors having similar or close impact were categorized into 12 determinants. These factors were assessed based on the value given by the respondents for their frequency and severity in road construction projects. From these, delay factors calculated by multiplying the severity values with the corresponding frequency of occurrence.

For secondary data sources; the researcher considered projects which have been under construction 2016 to 2020. The data acquired from the monthly published online on ERA webpage for evaluating project performance. For secondary data analysis, projects which have started at January 2016 or later are considered.

## **3.5 Population and Sampling**

### **3.5.1 Target population**

Target population of the study was the number of road construction projects which has started after 2016 and whose completion date was before December 2020 and were active. Based on evaluation report of ERA, there were 78 projects between 2016 and 2020 as shown in Appendix 7.7. Since the projects might be terminated due to various reasons before continuing further, consideration taken a project which has passed one life cycle stage should have at least 20 % accomplishment. Based on ERA expectation accomplishment rates which demand 9% and 38% during elapse of 1/3 and 2/3of contract duration, these projects passing 20% which is considered the average performance are taken as target population. Therefore, from the 78 projects, only 59 of the projects attain accomplishment of more than 20% and taken as target population size.

### **3.6 Sample Size**

The sample size in research methodology described as the number of participants who are going to be selected as sample to obtain required information, usually denoted by the letter 'n' (Ranjit 2011). For this research purposive sampling technique was employed.

According to Ranjit 2011, the researcher can predetermine number of people; if in his view the number selected best positioned to provide the needed information for the study (Ranjit 2011). However, appropriate sampling has to applied in order to avoid the risk of underrepresentation due to small sample size and

economic disadvantages due to cumbersome effort due bulkiness of the sample. To get ideal sample size simplified approach by Yamane (1967) was employed.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n is sample size, N is the population size, and e is the level of margin error.

$$n = \frac{59}{1 + 59(0.05)^2} = 52$$

Accordingly, 53 questionnaires were distributed, 30 for contractors, 13 for the client and 15 for consultants. This arrangement was employed since contractors have significant involvement by deploying huge number of work force, resource and in addition they are highly responsible for execution of works to achieve the desired project outcomes.

### 3.7 Data Analysis and Findings

The collected data analyzed through combination of Statistical Package of Social since (SPSS) version 23, Importance Index factor (IMP.I), and Microsoft Window Excel 2007. Analyzed data communicated and displayed in the report in the form of text, graph, chart and table.

#### 3.7.1 To Test Reliability of Data

Reliability refers to the consistence, stability, or dependability of the data. A researcher has to measure reliability of a variable to be sure that the measurement provides dependable and consistent results. Reliability concerns often arise, due to external factors that can influence the power and significance of tests. Even for standardized instruments variations are possible, and they could seriously affect research results (Zaiet et.al,2015)

Cronbach’s alpha ( $\alpha$ ) was used to analyze using SPSS 23 packages for each determinant of factors. Overall value of determinants measured by Cronnbach’s alpha test was 0.961. According to Ursachi, Horodnic and Zait (2015) generally accepted rule is that  $\alpha$  of 0.6-0.7 indicates an acceptable level of reliability, and 0.8 or greater a very good level.

Table 3-2: results showing reliability test of time overrun determinants

Determinates of time_overrun	Cronbach’s alpha ( $\alpha$ )
Improper project selection	0.765
Poor/ inappropriate contract administration and design	0.773
Poor Data Collection	0.740

Unrealistic expectation/Assumptions	0.845
Poor Site Management	0.864
Poor communication system	0.866
Weakened Project Management and Contract Administration	0.801
Ineffectiveness in Managing Multiple projects Simultaneously	0.871
Labor related factors (Ineffective and Inefficient)	0.851
Inefficient/insufficient Material and Machinery Management and Utilization.	0.640
Poor Financial management System	0.855
challenging external factors	0.877
<b>Overall</b>	<b>0.961</b>

Source: desk Study 2023

Table 3-2 shows the value of each category determinants ranges from 0.640 to 0.877; this is higher than minimum range of values. Therefore, collected data are reliable and analyzable. Similarly, the delay factors for each life cycle stage are analyzed and the result obtained is shown in Table 3-3

Table 3-3: Reliability test of time overrun determinants for project life cycle stages.

<b>Project Life cycle Stage</b>	<b>Cronbach's alpha (α)</b>
Project Initiation	0.848
Planning	0.861
Execution stage	0.950

Source: Desk Study (2023)

### 3.7.2 Ranking effect of determinants on time overrun

SPSS version 23 used to determine frequency of probability of occurrence and impact of variables on time overrun of projects. Impact factors and Importance Index factor (IMP.I) used for analyzing the combined effect of the factors by multiplying the impact values and probability of occurrence of respective variables obtained from respondents. Similarly, respective determinants are created by grouping similar factors at various life cycle stage of projects as shown in equation 2.

$$\text{Effect}_n = (\text{probability of occurrence})_n \times (\text{impact on time overrun})_n \dots \dots \dots (1)$$

$$\text{Determinant}_n = (\text{Effect}_1 + \text{Effect}_2 + \dots + \text{Effect}_n) / n \dots \dots \dots (2)$$

The factors and determinants which have highest relative index are considered as the most influential factors, whereas those with smallest importance index can be considered as the least influential factors of time overrun of road projects. The collected data were analyzed and ranked through the statistical techniques and indices adopted from (Mahamid, 2013 and Tarigan, 2018).

**Frequency index:** this index used to show the probability of occurrence of factors causing time overrun on the projects. A formula used to rank factors affecting time overrun in road Construction projects based on frequency of occurrence as identified by the participants

$$\text{Frequency Index (F.I) (\%)} = \sum a_i (n_i / N) * 100 / 4 \dots \dots \dots (3)$$

Where,  $a_i$  is the constant expressing weighting given to each response (ranges from 0, for Never, to 4 for Certain).  $n_i$  is the frequency of the responses.  $N$  is total number of responses.

**Severity index:** this index used to rank the impact of identified factors based on their severity as indicated by the participants.

$$\text{Severity Index (S.I) (\%)} = \sum a_i (n_i / N) * 100 / 4 \dots \dots \dots (4)$$

Where,  $a_i$  is the constant expressing weighting given to each response (ranges from 0, for No impact, to 4 for Extreme Impact).  $n_i$  is the frequency of the responses.  $N$  is total number of responses

**Importance index:** Importance index shows the result of the multiplication between the frequency and the influence of the cause factors of the delay. The importance index of each factor is calculated as a function of both Frequency index and severity index, as follows:

$$\text{Importance Index (IMP.I) (\%)} = [(F.I) (\%) * (S.I) (\%)] / 100 \dots \dots (5)$$

Based on the values of the severity and frequency index, the risk map is identified by considering their combined effect on time overrun. Relationships of Variables

Pearson correlation coefficient ( $r$ ) used to assess the association between two categorized determinants of Time overrun. The selected 68 delay factors are categorized into 12 subdivisions determinants factors.

This analysis shows only the degree of association between two categorized variables. Pearson's correlation coefficient ( $r$ ) value lies between  $-1 < r < +1$ . The + and – signs are used for positive linear correlations and negative linear correlations, respectively. A perfect positive correlation the two variables in coefficient of

+1, a perfect negative correlation in a coefficient of -1, and a total absence of correlation in a coefficient of 0. Intermediate value between +1 and 0 or -1 is interpreted by degree of correlation (Turkey,2011).

### 3.7.3 Correlation between groups of respondents

According to Turkey, Spearman’s correlation coefficient is a statistical measure of the strength of a monotonic relationship between paired data. The result will always be between 1 and -1. And its interpretation is similar to that of the closer is to one is the stronger the monotonic relationship.

The conformity ranking between responding two groups between (Contractor and Consultants, Consultants and Client, Contractor and Client) is checked by comparing rank of importance factors from every group was calculated. This correlation has advantage since it does not require the assumption of normality and or homogeneity of variances (Turkey, 2011).

Correlation can be calculated by formula 6.

$$r_s = \frac{1 - [(6 \sum d^2)]}{n(n^2 - 1)} \dots\dots\dots(6)$$

(Turkey, 2010)

Where: d = difference between ranks given by two parties or respondents for each factor.

n = number of pairs of values in the data set.

### 3.7.4 Point-Biserial Correlation with Multiple Dichotomous Variables

The relationship between the responsible parties (dichotomous variables) and time overrun determinant factors (continuous variables) were determined with the point biserial correlation. The point-biserial correlation coefficient  $r_{pbi}$  is a measure to estimate the degree of relationship between a naturally dichotomous nominal variable and an interval or ratio variable (Brown, 2001).

According to Sheskin, (2000)

$$r_{pb} = \left( \frac{\bar{Y}_1 - \bar{Y}_0}{s_Y} \right) \sqrt{\frac{np_0(1 - p_0)}{n - 1}} \dots\dots\dots(7)$$

Where;  $r_{pbi}$  = point biserial correlation

$\bar{Y}_1$  =mean values of the continues variable when the value of dichotomous variable is 1

$\bar{Y}_0$  =mean values of the continues variable when the value of dichotomous variable is 0

$s_y$  =Standard deviation of continuous variable

$p_1$  =probability of element having the one

$p_0$  = probability of element having zero value

$n$  =total number of dichotomous variables

### 3.7.5 Data Analysis Techniques

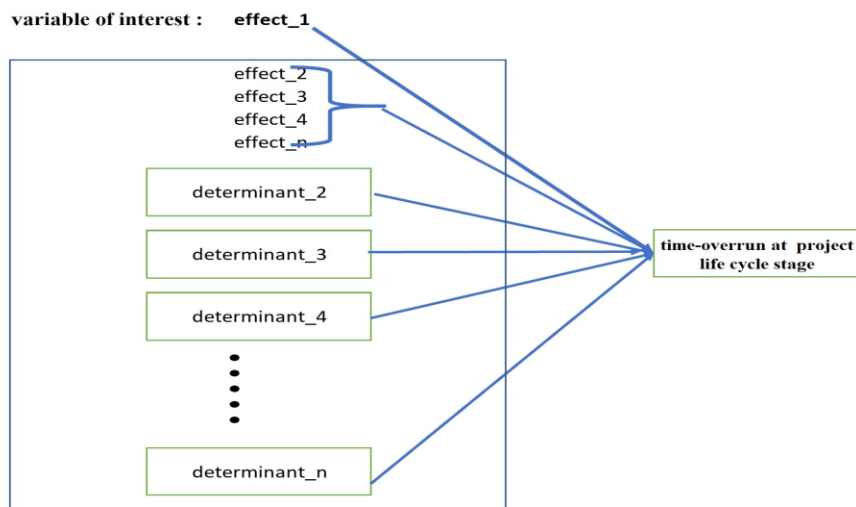
A multiple hierarchal regression model is used to test the hypotheses of the combined effect of the twelve independent variables determinants of time overrun at the three-life cycle stage on the dependent variable of time overrun. The regression performed using Statistical Package for Social Sciences (SPSS 23).

T – test and Analysis of variance (ANOVA) used to test for the significance of each predictor variables in the model. The null hypothesis (i.e. the model lacking explanatory power) were rejected when the significance value t – statistic is less than 0.05 (significance level).

#### 3.7.5.1 Effect of factors at different lifecycle stage on time overrun

The impact of the combined delay factors was checked against time overrun of respective life cycle stages. For this purpose, the following model was used, the effect of other factors and determinants affecting the time overrun of projects fixed so that the influence of the variable of interest can be evaluated against the dependent variable, as shown in Figure 3.2.

Figure 3.2: hierarchical regression model to determine effect of single variable on time overrun at lifecycle stage



3.7.5.2 *Effect of determinants of delay at various life cycle stage on time overrun of projects.*

The twelve determinant factors at various life cycle stage created by averaging the respective time delay factors determined as indicated in equation 8, were used to determine the relationship of factors with the overall time overrun variable created by averaging the whole factors. Multiple hierarchical regression analysis model was applied to give details of the relationship between independent variable dependent variables.

$$T_o = \alpha + \beta_1 (\text{init}_1) + \beta_2 (\text{init}_2) + \beta_3 (\text{plan}_1) + \beta_4 (\text{plan}_2) + \beta_5 (\text{exec}_1) + \beta_6 (\text{exec}_2) + \beta_7 (\text{exec}_3) + \beta_8 (\text{exec}_4) + \beta_9 (\text{exec}_5) + \beta_{10} (\text{exec}_6) + \beta_{11} (\text{exec}_7) + \beta_{12} (\text{exec}_8) \dots\dots\dots(8)$$

Where;  $\alpha$ =constant,  $T_o$  =Time overrun,  $\text{init}_1$  and  $\text{init}_2$  = determinant factors during project initiation life cycle stage,  $\text{plan}_1$  and  $\text{plan}_2$  = determinant delay factors during project planning life cycle stage,  $\text{exec}_1$  to  $\text{exec}_8$ = determinant delay factors during project execution life cycle stage.

Figure 3.3: list of determinant groups at each life cycle stage

<b>Categories of determinates</b>	<b>used designation</b>	<b>remark</b>
Improper project selection	init_1	from factors 1 to 5
Poor/ inappropriate contract administration and design	init_2	from factors 6 to 11
Poor Data Collection	plan_1	from factors 12 to 13
Unrealistic expectation/Assumptions	plan_2	from factors 14 to 22
Poor Site Management	exec_1	from factors 23 to 29
Poor communication system	exec_2	from factors 30 to 32
Weakened Project Management and Contract Administration	exec_3	from factors 33 to 38
Ineffectiveness in Managing Multiple projects Simultaneously	exec_4	from factors 39 to 43
Labor related factors (Ineffective and Inefficient)	exec_5	from factors 44 to 50
Inefficient/insufficient Material and Machinery Management and Utilization.	exec_6	from factors 51 to 56
Poor Financial management System	exec_7	from factors 57 to 60
challenging external factors	exec_8	from factors 61 to 68

Source: Desk study,2023.

**3.7.6 Secondary Data Review**

Secondary data analyzed by Microsoft Office Excel 2007 show the actual magnitude of time overrun of each project.

### **3.8 Ethical Consideration**

In this research, issues related to ethics were given more weight; mainly the two ethical considerations were consent and confidentiality. Firstly, every respondent participated in the survey were asked for their consent and all respondents were ensured that data obtained for the purpose of this study solely used for academic purpose & were kept confidential. The researcher publicly disclosed resource regarding projects information and acknowledge sources of the materials used.

# Chapter Four Results and Discussion

## 4.1 Introduction

This chapter explains the results obtained from desk study, questionnaire survey, interview and document review concerning time overrun factors affecting the performance of road construction projects administered by ERA.

Time performance influencing factors categorized in to Project life cycle stages and further sub divided into twelve determinant groups of causes of delays as discussed in chapter 3. For the desk study, Monthly project progress evaluation report published for public on ERA web page from the year 2016 to 2020 used to monitor projects which started from January 2016 onwards.

## 4.2 General Background of Respondents

The respondents are selected based their knowledge in the road construction industry, since most of the delay factors selected are from the execution life cycle stage, professionals from other specialties such as equipment administration and maintenance are also selected.

The detail discussion consists of general backgrounds of respondents and major determinants time overrun for roads administered by ERA presented in the following sub-sections.

### 4.2.1 Response rate

For this study, purposive sampling was used in selected respondents. 53 professionals having experience in the road construction projects administered by ERA were selected and distributed: 13 for clients, 30 for contractors and 10 for consultants. Based on the response obtained from Table 4.1, 54 % of client, 60% of contractors and 80% of consultants returned the questionnaires. In total 62% (33) of those distributed questionnaires were able to return. From the returned questionnaires 88% of respondents have returned as valid responses.

Table 4-1. Questionnaire response rate

Responding party	Number of Questionnaire			Percentage received	
	Distributed	Returned	Valid	Returned from distributed	Valid from Returned
Contractor	30	18	16	60	89
Client	13	7	7	54	100
Consultant	10	8	6	80	75
<b>Total</b>	<b>53</b>	<b>33</b>	<b>29</b>	<b>62</b>	<b>88</b>

Source: filed survey (2023)

### 4.2.2 Respondent Educational Levels

Table 4-2 shows that, one (1) of the respondents (3.4 %) is Diploma graduate, 56.7% (17) of the respondents are B.S.C /or Bachelor degree holders, and 40.0% (12) of the respondents are M.S.C /or Master degree specialized.

Table 4-2. Level of education

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Diploma	1	3.3	3.3	3.3
BA/BSC	17	56.7	56.7	60.0
MA/MSC	12	40.0	40.0	100.0
Total	30	100.0	100.0	

Source: filed survey (2023)

### 4.2.3 Respondents relevant work experience

Professional qualification of respondents by measuring their relevant work experience is indicated in the Table 4-3. More than 73% of respondents have working experience more than ten years, which would help them understand the complex questionnaire and provide response from experience.

Table 4-3. Relevant work experience of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid < Five Years	5	16.7	16.7	16.7
6-10 years	3	10.0	10.0	26.7
11-15 years	13	43.3	43.3	70.0
>15 years	9	30.0	30.0	100.0
Total	30	100.0	100.0	

Source Field study (2023)

## 4.3 Overall Assessment factors on time overrun of projects

This section deals with the analysis of the information gathered from the questionnaire survey using factors used identification of rate of occurrences (frequency index), impacts of the factors (Severity Index) leading

to time overrun and the importance fact. Mahamid classified the effect of the severity and frequency index as shown in Table 4-4 (Mahamid, 2013).

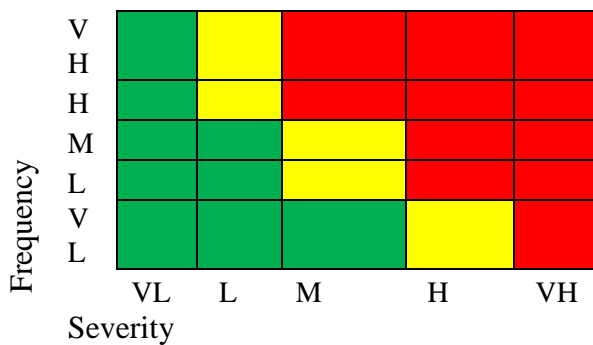
Table 4-4. Categories of the severity and frequency of occurrence

Index value	Severity level	Frequency level
≤ 20%	very low (VL)	very low (VL)
20% - 40%	low (L)	low (L)
40% - 60%	moderate (M)	moderate (M)
60% - 80%	high (H)	high (H)
80% - 100%	very high (VH)	very high (VH)

Source: Mahamid, 2013.

Based on the responses obtained, Mahamid has established risk matrix map as shown in Figure 4.1. The Risk map has three zones. The red zone indicates delicate factors which have critical impact on time overrun demanding critical attention and intervention, yellow zone shows factors which has moderate impact on the time overrun and the green zone shows factors without significant impact on the time overrun of moderate importance (Mahamid,2013).

Figure 4.1: The Risk Map



Source: Mahamid,2013.

The findings of the questionnaire are presented in Table 4-5. The result shows the identified project delay factors overall ranking along with the risk map zone.

Table 4-5: Summary of the project time overrun impact index based on the rank and identified risk mapping by respondents to questionnaire survey.

Factors	Severity Index	Frequency Index	Overall

	<b>S.I</b> <b>%</b>		<b>F.I</b> <b>%</b>		<b>IMP.I</b> <b>%</b>	<b>Rank</b>	<b>Risk</b> <b>Map</b> <b>zone</b>
Right of way problems (access to site and quarry locations)	<b>77.50</b>	<b>H</b>	<b>85.00</b>	<b>VH</b>	<b>65.88</b>	<b>1</b>	<b>Red</b>
Equipment/Plant shortage	<b>79.17</b>	<b>L</b>	<b>80.00</b>	<b>H</b>	<b>63.33</b>	<b>2</b>	<b>Red</b>
Improper utilization of Advance Payment	<b>72.50</b>	<b>H</b>	<b>71.67</b>	<b>H</b>	<b>51.96</b>	<b>3</b>	<b>Red</b>
Delayed mobilization/commencement	<b>71.67</b>	<b>H</b>	<b>72.50</b>	<b>H</b>	<b>51.96</b>	<b>3</b>	<b>Red</b>
Equipment/plant frequent breakdown	<b>70.00</b>	<b>H</b>	<b>73.33</b>	<b>H</b>	<b>51.33</b>	<b>5</b>	<b>Red</b>
Unrealistic contract duration and project scope	<b>70.83</b>	<b>H</b>	<b>71.67</b>	<b>H</b>	<b>50.76</b>	<b>6</b>	<b>Red</b>
Poor coordination and management	<b>71.67</b>	<b>H</b>	<b>69.17</b>	<b>H</b>	<b>49.57</b>	<b>7</b>	<b>Red</b>
poor financial management system	<b>67.50</b>	<b>H</b>	<b>71.67</b>	<b>H</b>	<b>48.38</b>	<b>8</b>	<b>Red</b>
Insufficient data collection before design	<b>65.83</b>	<b>H</b>	<b>72.50</b>	<b>H</b>	<b>47.73</b>	<b>9</b>	<b>Red</b>
Scope changes arising from redesign and extensive variation orders	<b>72.50</b>	<b>H</b>	<b>65.00</b>	<b>H</b>	<b>47.13</b>	<b>10</b>	<b>Red</b>
Award project to the lowest bid price	<b>60.00</b>	<b>M</b>	<b>78.33</b>	<b>H</b>	<b>47.00</b>	<b>11</b>	<b>Red</b>
delayed and ineffective Procurement of materials	<b>65.83</b>	<b>H</b>	<b>70.00</b>	<b>H</b>	<b>46.08</b>	<b>12</b>	<b>Red</b>
poor and delayed decision making	<b>71.67</b>	<b>H</b>	<b>64.17</b>	<b>H</b>	<b>45.99</b>	<b>13</b>	<b>Red</b>
late collection of payments	<b>69.17</b>	<b>H</b>	<b>65.83</b>	<b>H</b>	<b>45.53</b>	<b>14</b>	<b>Red</b>

Design and contract document problems (mistakes, being incomplete and inappropriate)	<b>66.67</b>	<b>H</b>	<b>67.50</b>	<b>H</b>	<b>45.00</b>	<b>15</b>	<b>Red</b>
Improper Construction method / technique	<b>69.17</b>	<b>H</b>	<b>64.17</b>	<b>H</b>	<b>44.38</b>	<b>16</b>	<b>Red</b>
Overlooking Site conditions (i.e. access, storage, obstructions, traffic and security)(ROW)	<b>67.50</b>	<b>H</b>	<b>65.00</b>	<b>H</b>	<b>43.88</b>	<b>17</b>	<b>Red</b>
poor risk analysis	<b>68.33</b>	<b>H</b>	<b>64.17</b>	<b>H</b>	<b>43.85</b>	<b>18</b>	<b>Red</b>
Inadequate/shortage production of materials in the country	<b>64.17</b>	<b>H</b>	<b>67.50</b>	<b>H</b>	<b>43.31</b>	<b>19</b>	<b>Red</b>
Strikes, political factors	<b>67.50</b>	<b>H</b>	<b>62.50</b>	<b>H</b>	<b>42.19</b>	<b>20</b>	<b>Red</b>
Macro Economic factors/problems/conditions	<b>64.17</b>	<b>H</b>	<b>65.00</b>	<b>H</b>	<b>41.71</b>	<b>21</b>	<b>Red</b>
Poorly defined crew (workforce) definition	<b>70.00</b>	<b>H</b>	<b>58.33</b>	<b>M</b>	<b>40.83</b>	<b>22</b>	<b>Red</b>
source and availability of construction materials	<b>62.50</b>	<b>H</b>	<b>65.00</b>	<b>H</b>	<b>40.63</b>	<b>23</b>	<b>Red</b>
delayed and poor quality of material procurement	<b>65.83</b>	<b>H</b>	<b>61.67</b>	<b>H</b>	<b>40.60</b>	<b>24</b>	<b>Red</b>
Poor/ineffective/lack of quality Assurance System	<b>62.50</b>	<b>H</b>	<b>63.33</b>	<b>H</b>	<b>39.58</b>	<b>25</b>	<b>Red</b>
corruption/fraud	<b>62.50</b>	<b>H</b>	<b>63.33</b>	<b>H</b>	<b>39.58</b>	<b>25</b>	<b>Red</b>
unsuitable organizational culture and improper strategic plan for proper project management	<b>61.67</b>	<b>H</b>	<b>64.17</b>	<b>H</b>	<b>39.57</b>	<b>27</b>	<b>Red</b>
Unexpected subsurface conditions	<b>62.50</b>	<b>H</b>	<b>62.50</b>	<b>H</b>	<b>39.06</b>	<b>28</b>	<b>Red</b>
lengthy Bureaucratic Process	<b>61.67</b>	<b>H</b>	<b>63.33</b>	<b>H</b>	<b>39.06</b>	<b>29</b>	<b>Red</b>

Poor allocation of resources and not setting-out clear goals and priority to projects	<b>60.83</b>	<b>H</b>	<b>63.33</b>	<b>H</b>	<b>38.53</b>	<b>30</b>	<b>Red</b>
Disputes on site, Work suspensions owing to conflicts	<b>61.67</b>	<b>H</b>	<b>61.67</b>	<b>H</b>	<b>38.03</b>	<b>31</b>	<b>Red</b>
Unrealistic assumptions for planning( productivity of equipment , working culture in the project area,..)	<b>65.00</b>	<b>H</b>	<b>58.33</b>	<b>M</b>	<b>37.92</b>	<b>32</b>	<b>Red</b>
poor top management support / improper delegation at project level	<b>61.67</b>	<b>H</b>	<b>60.83</b>	<b>H</b>	<b>37.51</b>	<b>33</b>	<b>Red</b>
Adverse Weather/climate conditions	<b>61.67</b>	<b>H</b>	<b>60.83</b>	<b>H</b>	<b>37.51</b>	<b>33</b>	<b>Red</b>
Contract disputes and negotiations	<b>61.67</b>	<b>H</b>	<b>60.00</b>	<b>M</b>	<b>37.00</b>	<b>35</b>	<b>Red</b>
Lack of knowledge of available local resources	<b>62.50</b>	<b>H</b>	<b>59.17</b>	<b>M</b>	<b>36.98</b>	<b>36</b>	<b>Red</b>
inefficient communication plan/channel between parties	<b>60.00</b>	<b>M</b>	<b>60.83</b>	<b>H</b>	<b>36.50</b>	<b>37</b>	<b>Red</b>
Reworking (due to various reasons)	<b>58.33</b>	<b>M</b>	<b>61.67</b>	<b>H</b>	<b>35.97</b>	<b>38</b>	<b>Red</b>
Poor information knowledge and survey of subsurface and ground conditions	<b>63.33</b>	<b>H</b>	<b>56.67</b>	<b>M</b>	<b>35.89</b>	<b>39</b>	<b>Red</b>
Unmanageable number of active projects	<b>60.83</b>	<b>H</b>	<b>58.33</b>	<b>M</b>	<b>35.49</b>	<b>40</b>	<b>Red</b>
Inappropriate contract delivery method	<b>59.17</b>	<b>M</b>	<b>59.17</b>	<b>M</b>	<b>35.01</b>	<b>41</b>	<b>yellow</b>
procurement process and plan	<b>60.83</b>	<b>H</b>	<b>56.67</b>	<b>M</b>	<b>34.47</b>	<b>42</b>	<b>Red</b>
Noninvolvement of all stakeholders in project initiation	<b>60.00</b>	<b>M</b>	<b>56.67</b>	<b>M</b>	<b>34.00</b>	<b>43</b>	<b>yellow</b>

weather and environmental conditions	<b>61.67</b>	<b>H</b>	<b>54.17</b>	<b>M</b>	<b>33.40</b>	<b>44</b>	<b>Red</b>
labor strikes due to poor working condition, delayed payments	<b>55.83</b>	<b>M</b>	<b>59.17</b>	<b>M</b>	<b>33.03</b>	<b>45</b>	<b>yellow</b>
Vaguely defined project scope	<b>58.33</b>	<b>M</b>	<b>55.83</b>	<b>M</b>	<b>32.57</b>	<b>46</b>	<b>yellow</b>
Non-Feasibility / politically motivated projects	<b>56.67</b>	<b>M</b>	<b>56.67</b>	<b>M</b>	<b>32.11</b>	<b>47</b>	<b>yellow</b>
Inadequate method statement and execution strategy	<b>55.00</b>	<b>M</b>	<b>58.33</b>	<b>M</b>	<b>32.08</b>	<b>48</b>	<b>yellow</b>
lack of skilled/qualified work force	<b>55.00</b>	<b>M</b>	<b>58.33</b>	<b>M</b>	<b>32.08</b>	<b>48</b>	<b>yellow</b>
Delay in project commencement/late contract award	<b>55.83</b>	<b>M</b>	<b>56.67</b>	<b>M</b>	<b>31.64</b>	<b>50</b>	<b>yellow</b>
Bid related delays (process, type and evaluation method)	<b>55.00</b>	<b>M</b>	<b>57.50</b>	<b>M</b>	<b>31.63</b>	<b>51</b>	<b>yellow</b>
poor Inventory Management	<b>52.50</b>	<b>M</b>	<b>58.33</b>	<b>M</b>	<b>30.63</b>	<b>52</b>	<b>yellow</b>
no defined communication strategy	<b>54.17</b>	<b>M</b>	<b>54.17</b>	<b>M</b>	<b>29.34</b>	<b>53</b>	<b>yellow</b>
subcontractor related delays	<b>56.67</b>	<b>M</b>	<b>51.67</b>	<b>M</b>	<b>29.28</b>	<b>54</b>	<b>yellow</b>
ignoring the influence of stakeholders	<b>56.67</b>	<b>M</b>	<b>51.67</b>	<b>M</b>	<b>29.28</b>	<b>54</b>	<b>yellow</b>
On availability of utilities on site	<b>55.00</b>	<b>M</b>	<b>52.50</b>	<b>M</b>	<b>28.88</b>	<b>56</b>	<b>yellow</b>
Distance of projects from head quarters and their geographical disparity	<b>50.83</b>	<b>M</b>	<b>54.17</b>	<b>M</b>	<b>27.53</b>	<b>57</b>	<b>yellow</b>
changes in rules, regulations	<b>50.00</b>	<b>M</b>	<b>52.50</b>	<b>M</b>	<b>26.25</b>	<b>58</b>	<b>yellow</b>
Unforeseen events (Act of God)	<b>50.00</b>	<b>M</b>	<b>50.83</b>	<b>M</b>	<b>25.42</b>	<b>59</b>	<b>yellow</b>
non appropriate organizational arrangement for project execution	<b>48.33</b>	<b>M</b>	<b>51.67</b>	<b>M</b>	<b>24.97</b>	<b>60</b>	<b>yellow</b>
un-skilled Labor shortage	<b>46.67</b>	<b>M</b>	<b>53.33</b>	<b>M</b>	<b>24.89</b>	<b>61</b>	<b>yellow</b>

Staff/labor turnover	49.17	M	49.17	M	24.17	62	yellow
Lack of stakeholder's experience / qualification / competence on defining project	45.00	M	51.67	M	23.25	63	yellow
Low/lack of motivation	53.33	M	43.33	M	23.11	64	yellow
unable to assess and predict the future socio economic condition	43.33	M	51.67	M	22.39	65	yellow
absence of performance related payment	46.67	M	46.67	M	21.78	66	yellow
Health , Safety and environmental issues	45.00	M	47.50	M	21.38	67	yellow
Absenteeism from work	39.17	L	45.00	M	17.63	68	yellow

Source: field Survey (2023)

From the results the top ten (10) factors in Table 4-5, eight (8) of delay factors leading into time overrun occur during the project execution stage and two factors occur during project initiation life cycle stage. The overall results obtained indicates time overrun becoming severe during the execution stage. 67.4%,54.5% and 45,5% of delay factors in execution, planning and initiation phases respectively have critical effect on time overrun.

### 4.3.1 Top Ten Factors leading into time overrun

Based on the results of the survey, the most important delay causing factors are discussed as follows.

➤ Right of way problems: -

When Projects initiated and forced to start in a hurry due to various reasons such as stakeholder's pressure, the client will force starting of the project permanent works to calm the pressure. In these situations, the client will not have sufficient time to settle the right of way issues ahead and forced commencement of project without clearing the site from third party properties. The contractor will engage in places where the land is owned by the government, community etc with less resistance since following the legal procedure will demand several months. The requirements by the government under proclamation NO.1161/2019, Expropriation of Land Holdings for Public Purposes, Payments of Compensation and Resettlement of Displaced People, article 8: Procedure of the Landholding Handover clearly states "The land holder may be forced to handover the land within 120 (one hundred and twenty) days of the payment in cash or in-kind compensation; or after the cash is deposited in the bank. "(Page 11801).

According to the requirement of the proclamation, the clearing process will start by establishing right of way clearing committee at the wereda level incorporating various members from different sectors. The main duties of the committee include setting and getting approval of unit rates for the various properties in the wereda, measurement of properties on the demanded land upon receiving contractor's request and joint recording of properties. The measurement approved by the consultant will be sent to the client's approval and will be forwarded the authorized financial institutes to effect payment.

However, based on the financial constraints and the bureaucratic process for effecting the payment, the process will take several months. Ignoring the time taken at the financial institutions, the requirements set in the proclamation obliging the displace to evacuate after 120 days (4 months) will cost on average approximately 12% of the average contract duration of the projects.

Thus, those projects which begin quickly with available right of way obstruction free stretches will start to suffer once the project gets into action in the middle of the execution stage. From this one can say unless the right of clearance commences before starting of projects during the initiation stage, projects fate of suffering from time overrun is inevitable. However, during project initiation right of way clearance is executed properly, the contractor will be able to continue with its initial pace and the slowing in progress can be avoided.

Azeb has identified right of way problems being the number one factor affecting performance of both local and foreign construction firms working in road projects. In the study, lack of coordination between the clients, the public and the local governments on solving ROW issues are considered as the cause (Azeb, 2016).

➤ Equipment/Plant shortage

Indhu and Yogeswari (2020) has collected equipment related delay factors from 29 journals and extracted 76 delay causes associated with equipment and machineries. Furthermore, the factors were ranked based on their repetition. From there finding, Equipment and plant shortage becomes number one reason for projects delay and breakdown of equipment becomes the second most delay cause.

Rivera et.al 2020 has stated that shortage of equipment is a major problem in implementing road projects in all developing countries. The client's failure to assess contractor's available resource and their engagement in other obligations during the contractor selection stage in project initiation plays is the main reason. Expected completion dates and status of contractors' prior engagements has to be taken into consideration and must be reviewed properly.

As a result, when the new project commences, the contractor will not be able to mobilize as per the schedule and will start working with limited amount of resources no to face fines for not starting the project. Even if the contractor decides to procure new equipment, the time required for procurement shipping, shortage of foreign currency and other custom processes will seriously affect the new project.

➤ Improper utilization of Advance Payment

According to Public Procurement and Property Agency, an authorized governmental organization for setting laws for financial transaction for public procurement, advance payment shall not exceed 30% of the contract amount and the contractor shall use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract (Tadle,2017).

Since construction projects usually require various resources depending on the unique nature of the project, the client pay advance payment for the contractor to mobilize and start working. Therefore, contractor's failure of using the advance payment properly, will put proper starting of projects in jeopardy. Moreover, when the contractor deploys this payment for his other business ventures, he will not be able in a position start working. Usually advance payments are release in installments, and the subsequent installments will be released while he presents evidences that he has used the money solely for the project. The advance payment will be released in cash in phases upon submission of guarantee and proof of expenditure and repayment will commence, once the project starts execution in full capacity, i.e when attaining 30% and shall be completely recover before reaching the closing stage, usually 80% of the progress.

Due to the seriousness of the issue, ERA has started to pay advance payments to contractors in installments, half of it to be paid in cash and the rest directly to suppliers, upon submission of agreement with the suppliers. The remaining half portion will be paid for suppliers (such as fuel, reinforcement bar, Asphalt.) will be monitored closely, so that the contractors will not use the material for other business ventures or other financially troubled projects. The reason for this amendment rises from poor advance payment usage by contractors.

➤ Delayed mobilization/commencement

The poor utilization of advance payment has also impact on timely mobilization and establishment of new projects. Project initiation involves various establishments as result the cash demand is front loaded as result cash flow will affect project establishment. In cases the new project is planned to start using from ongoing projects, its schedule will be dependent on completion of the other project and early commencement will be difficult.

➤ Equipment/plant frequent breakdown

Indhu & Yogeswari (2020) has stated the reasons of equipment breakdown to be due to factors such as improper maintenance due to failure on conducting timely inspection of machineries and equipment due to the fact that main focus being given on breakdown maintenance than preventive maintenance. Breakdown maintenance, i.e. maintenance derived from sudden stoppage of machineries and plants, even though it is not avoidable, can be reduced significantly by properly implementing routine checking and inspection as per manufacturer's recommendation.

This unplanned breakdown of machineries will affect the momentum of the project progress and since most machineries are working as a crew; breakdown of a single machine might affect the whole project.

Not establishing well organized equipment maintenance team at the project location, poor allocation of funds for maintenance and improper storage of fast-moving parts at the project level for quick maintenance of equipment will further escalate the problem.

➤ Poor coordination and management

Projects are unique in nature and any method which has been effective previously might not work for the new project, even though all the works are similar. The material type, demographic conditions, local working culture, weather condition, e.t.c ...will demand preparation of new and appropriate work methods.

Poor site management and supervision attributed by factors such as poor coordination by the various parties, slow decision making, delayed availability of design inputs, coordination problems caused due to unrealistic time schedule as a result of poor project duration estimation are identified as setbacks for achieving success in Indian projects (Doloi,2011).

The work methodology prepared has to address all issues from crew arrangement to sequence of activities taking into consideration lead time required by other parties to execute their obligation. For instance, the time required to clear obstructions from third party by the client, time required for approval of working drawings and design has to be taken into consideration. Poorly prepared methodology will prevent having smooth working environment and frequent interruptions leading into argument among parties.

George in his study regarding the impacts of procurement process on contractor selection in Ethiopian Roads Authority, Poor Estimation of the project time and cost is identified as the major cause for projects delay, cost overrun and quality problems (George, 2013).

➤ Unrealistic contract duration and project scope

This issue occurs at project initiation life cycle stage. The duration of construction project is normally set by clients or their representatives before selection of the contractor. However, if the work breakdown used by the client and design consultant is varies from the actual workload, the assumption used for estimating the contract duration cannot be realistic.

For compliance, the contractor in order to satisfy his contractual obligation, will abide the contract duration for planning knowing the time allotted is not sufficient for mobilization (based on the distance from capital city), weather conditions preventing working in the project area, security condition in location and other reasons.

The client will also plan based on this duration for executing other activities to be done simultaneously such as right of way clearance, knowing the legal requirements demand longer time. Based on desk stud, 54% of the projects between year 2016 and 2020 have duration of 36 months.

➤ Poor financial management system

Financial management is all about the use of financial resources. It involves planning of financial flows of projects through various activities starting from estimation of anticipated construction costs, Cost control to Cash flow projections. During the course of project execution management of financial resources by processing invoices from subcontractors and suppliers, preparation of payment requests to the project owner and Managing change orders (Holm 2019).

Monitoring progress of projects alongside with the physical progress has to be done regularly by tracking general overhead budgets, financial tracking of the cash flow and making sure profitability by comparing against the minimum envisaged profit margin, analyzing the profitability of different parts of the company and making the necessary changes to improve profitability, ensuring that the company has sufficient cash to take on an additional project, Preparing an income tax projection for the company. If contractors fail to be financially sound, its liquidity will be in danger and unable to keep regular activities of the project and will result interruption of the progress frequently (Holm, 2019).

➤ Insufficient data collection before design and Scope changes arising from redesign and extensive variation orders

Design will be made based on data collected from site; if the collected data is not accurate, the outcome of the design will not be reliable. Moreover, this effect will be signified when the design works are awarded based

on least bidder scheme. The bidders for reducing cost will undermine the required technical procedures and come up with inferior quality design.

Moreover, when projects are not initiated properly and decided to get into execution in a hurry, the time given for the design will not be sufficient and the designer will use readily available data from satellite pictures and other less accurate sources. The client has to estimate the required time for preparation of appropriate design and means for checking the quality of the design. Formal review process of designs and specifications and checking process has to be established.

By studying the association of schedule delay of building projects in Palestine, Mahamid recommends the following four measures. Namely; timely effecting of payment for the design services, avoiding designers’ allocation for many projects simultaneously, prevention of copying of previously done designs for cutting cost and time and provision of ample time sufficient for the design. By properly implementing the above remedies, the schedule delay of the projects can be reduced significantly (Mahamid, 2021).

The design quality problems will be reflected by frequent scope change and quantity increment during the execution phase. A significant number of contract modifications can be avoided by proper implementation of the designing and planning stages. Moreover, having contractor’s constructability review prior to award will help to avoid frequent variation orders during construction stage (Rivera et.al 2020).

### 4.3.2 Delay determinant Factors at various project life cycle stages

One of the targets of this research is to identify factors affecting time overrun of projects from project lifecycle stages perspective. For this purpose, the 12 determinates created by categorizing the identified 68 delay factors, were subdivided into the three life cycle stages. The average importance factors of these determinants on time overrun are calculated and the results are indicated in the Table 4-6.

Table 4-6: Importance index of determinants of time overrun at various life cycle stages

Categories of determinates	SI %	FI %	IMP.I %	Rank	Risk map	Life cycle stage
Inefficient/insufficient Material and Machinery Management and Utilization	68.611	69.306	47.551	1	RED	Execution
Poor Financial management System	64.375	68.125	43.855	2	RED	Execution
Poor Data Collection	66.250	60.417	40.026	3	RED	Planning
Poor/ inappropriate contract administration and design	62.361	63.889	39.842	4	RED	Initiation
Poor Site Management	64.048	61.905	39.649	5	RED	Execution

Weakened Project Management and Contract Administration	62.639	61.944	38.801	<b>6</b>	RED	Execution
Poor communication system	63.056	58.056	36.607	<b>7</b>	RED	Execution
challenging external factors	59.792	60.313	36.062	<b>8</b>	RED	Execution
Ineffectiveness in Managing Multiple projects Simultaneously	59.000	60.667	35.793	<b>9</b>	RED	Execution
Improper project selection	57.500	58.333	33.542	<b>10</b>	yellow	Initiation
Unrealistic expectation/Assumptions	58.796	56.667	33.318	<b>11</b>	yellow	Planning
Labor related factors (Ineffectiveness and Inefficiency)	48.095	52.262	25.135	<b>12</b>	yellow	Execution

Source: Field Survey (2023)

From the results obtained and presented in Table 4-6, among the top Five (5) determinants three (3) of them occur in the project execution life cycle stage. From the 8 determinant factors during project execution life cycle stage, only one determinant factor has moderate effect on time overrun i.e 87.5 % of the determinants are critical. On the other hand, for the initiation and planning life cycle stage half of the determinants are critically influencing time overrun.

While assessing impacts of individual delay factors leading into time overrun, as shown in time overrun effects; the correlation between the responsible stakeholders and determinants of time overrun, was checked by point biserial correlation between variables.

Figure 4.2, by analyzing proportion of severe cases with total number of factors at various life cycle stage, proportion of severe factors increases as the project proceeds towards the execution, the proportion from 45.4% during initiation life cycle stage to 67.4% at the execution stage.

The result obtained is in conformity with the findings obtained during desk study discussed in section 4.4.5, that time overrun effects magnify during the execution stage.

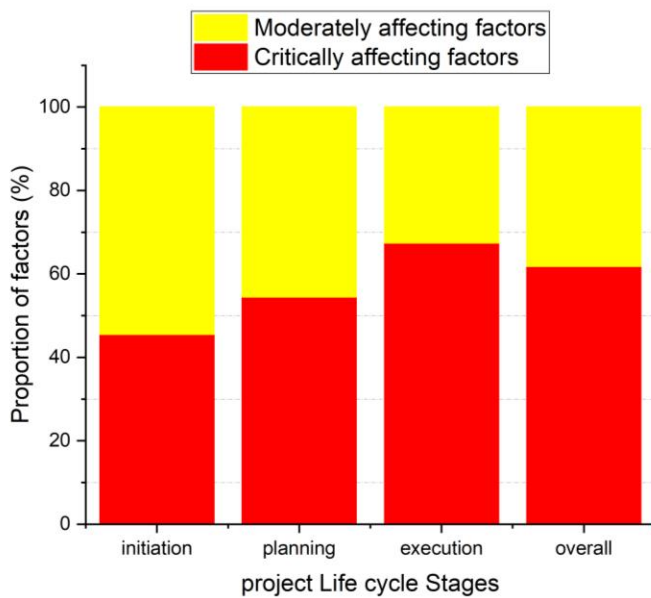
### 4.3.3 Responsible Stakeholders for project delay

The other purpose of the research is to identify role stakeholders towards contribution to the project delay factors. For analyzing and identification of responsible parties, the respondents were asked to specify responsible stakeholders for the creation of delay factors. Since there can be more than one responsible stakeholder for the delay factors, the respondents were asked to mark all responsible stakeholders responsible for the specific delay factors. The analysis was done by the SPSS multiple responses analysis option. The

obtained frequency from the questionnaire for the determinants of time overrun is indicated in Table 4-7. The most responsible stakeholder, if any, at each determinant stage is shaded for quick reference.

The overall values show Contractors are considered to be the most responsible for causing delay factors leading to time overrun. However, in order to study if there is a single stakeholder is mainly responsible for the time overrun effects; the correlation between the responsible stakeholders and determinants of time overrun, was checked by point biserial correlation between variables.

Figure 4.2. Proportion of critical and moderate delay factors at each life cycle stage



Source: research survey, 2023.

Table 4-7: Frequency for being Responsible stakeholders for delay determinants

Categories of determinates	Frequency of responsible stakeholders			
	Contractor	Client	Consultant	External
Improper project selection	24	113	32	22
Poor/ inappropriate contract administration and design	30	128	73	1
Poor Data Collection	23	23	39	4
Unrealistic expectation/Assumptions	170	100	85	23
Poor Site Management	179	33	72	9
Poor communication system	59	65	63	19
Weakened Project Management and Contract administration	109	83	82	17

Ineffectiveness in Managing Multiple projects Simultaneously	122	49	42	9
Labor related factors (Ineffective and Inefficient)	169	27	54	27
Inefficient/insufficient Material and Machinery Management and Utilization	150	18	24	19
Poor Financial management System	100	39	35	2
challenging external factors	94	104	81	110
<b>Total</b>	<b>1229</b>	<b>782</b>	<b>682</b>	<b>262</b>

Source: field survey 2023

The point-biserial correlation coefficient  $r_{pb}$  used to estimate the degree of correlation between a naturally dichotomous nominal variable and an interval or ratio variable. The values were calculated using Excel 2007, the obtained value is shown in Table 4-8.

According to Sheskin, for the case the categories are ordered, score 1 employed for the cases with higher correlation and 0 should be employed for the category associated with lower Quality (Sheskin, 2000). Therefore, from the results the important parties for each determinant factor is indicated in Table 4-8.

Table 4-8: Point-biserial correlation results between Responsible Stakeholders and delay determinants

delay factors	point-biserial correlation results				Categories of determinates
	Contractor	Client	Consultant	External	
factor 1	-0.29	0.52	-0.41	-0.37	Improper project selection
factor 2	-0.38	0.38	-0.39	-0.40	
factor 3	-0.23	0.27	-0.31	-0.24	
factor 4	-0.41	0.57	-0.41	-0.38	
factor 5	-0.37	0.30	-0.46	-0.29	
factor 6	-0.49	0.42	-0.59	-0.38	Poor/ inappropriate contract administration and design
factor 7	-0.63	0.54	-0.54	0.00	
factor 8	-0.40	0.52	-0.63	0.00	
factor 9	-0.53	0.54	-0.46	0.00	
factor 10	-0.48	0.11	0.56	0.00	
factor 11	-0.56	0.01	0.59	0.00	Poor Data Collection
factor 12	-0.28	0.11	0.19	-0.32	
factor 13	-0.24	-0.15	0.44	-0.25	

factor 14	0.46	-0.30	-0.23	-0.35	Unrealistic expectation/ Assumptions
factor 15	0.57	-0.29	-0.09	-0.35	
factor 16	-0.39	0.37	-0.17	-0.44	
factor 17	-0.08	0.36	-0.29	-0.47	
factor 18	0.20	-0.03	-0.21	-0.42	
factor 19	0.08	0.10	-0.51	0.00	
factor 20	0.55	-0.24	-0.37	-0.55	
factor 21	0.25	-0.52	-0.32	-0.16	
factor 22	0.60	-0.57	-0.47	-0.37	
factor 23	0.00	-0.36	-0.25	0.00	
factor 24	0.39	0.00	-0.50	0.00	
factor 25	0.00	-0.37	-0.29	0.00	
factor 26	0.00	-0.48	-0.45	0.00	
factor 27	0.54	-0.50	0.31	-0.35	
factor 28	0.49	-0.10	0.29	-0.52	
factor 29	0.50	-0.41	-0.50	-0.48	
factor 30	0.31	0.31	0.23	-0.35	Poor communication system
factor 31	0.10	0.36	0.29	-0.38	
factor 32	0.28	0.40	0.29	-0.31	
factor 33	-0.48	0.46	0.11	-0.49	Weakened Project Management and Contract administration
factor 34	0.59	0.57	0.28	0.00	
factor 35	-0.63	0.56	0.64	-0.57	
factor 36	0.64	-0.46	0.11	-0.51	
factor 37	0.69	-0.68	-0.32	-0.45	
factor 38	0.46	-0.60	-0.58	-0.46	
factor 39	0.21	0.23	-0.52	-0.35	Ineffectiveness in Managing Multiple projects
factor 40	0.48	-0.21	-0.42	-0.50	
factor 41	0.00	-0.43	-0.10	-0.48	
factor 42	0.47	-0.09	-0.42	0.00	
factor 43	0.49	-0.18	-0.33	-0.36	
factor 44	0.30	-0.27	-0.37	0.00	Labor related factors (Ineffective and Inefficient)
factor 45	0.37	-0.28	-0.18	-0.42	
factor 46	0.42	-0.36	-0.40	-0.35	
factor 47	0.41	-0.39	-0.39	-0.41	
factor 48	0.43	-0.28	-0.26	-0.40	
factor 49	0.29	-0.40	-0.36	-0.43	
factor 50	0.43	-0.38	-0.22	-0.29	
factor 51	0.00*	0.00	-0.55	0.00	Inefficient/insufficient Material and Machinery Management and Utilization
factor 52	0.57	-0.81	-0.74	0.00	
factor 53	0.77	-0.88	-0.18	-0.75	
factor 54	0.58	-0.76	-0.55	-0.58	
factor 55	0.58	-0.75	-0.78	-0.69	

factor 56	0.02	-0.78	-0.72	0.16	Poor Financial management System
factor 57	0.30	-0.26	-0.32	0.00	
factor 58	0.36	0.30	-0.06	0.00	
factor 59	0.30	-0.25	-0.26	-0.30	
factor 60	0.37	-0.08	-0.17	0.00	challenging external factors
factor 61	0.56	0.48	0.60	-0.38	
factor 62	-0.02	0.08	0.32	-0.46	
factor 63	-0.47	0.12	-0.42	0.18	
factor 64	-0.49	-0.23	-0.49	0.18	
factor 65	0.13	0.59	0.33	-0.06	
factor 66	-0.38	-0.27	-0.42	0.34	
factor 67	-0.21	-0.33	-0.42	0.27	
factor 68	-0.50	0.04	-0.42	0.26	

\* Contractors are sole responsible

Source: research study

Based on the values indicated in Table 4-8, the client is selected as prominent responsible stakeholder for almost all determinant factors during project initiation life cycle stage except for delay factors associated with data collection before design, which consultants are held responsible.

While analyzing responsible stakeholders associated with planning, consultants identified as major cause for the first determinant of time-overrun, i.e. data collection for planning. For the second determinant contractors are identified as responsible for being ambitious and planning with unrealistic expectation. On the other hand, client is responsible unable to assess and predict the future socio economic and ignoring stakeholders influence while planning.

For the execution lifecycle stage, the first determinant regarding site management, except poor coordination and reworking, contractors are identified the main responsible stakeholder. Consultants are also identified as responsible for factors addressing dispute at working place and quality assurance system failure. The overall finding is indicated in Table 4-8; from the 46 delay factors at execution life cycle stage, contractors, the client, consultants and external parties are identified influential party for 31,11,12 and 6 of the factors respectively. External parties held responsible for Inadequate/shortage production of materials in the country and major proportion of challenging external conditions.

In order to identify the effect of parties on high impact delay factors leading into time-overrun, responsible parties for the top 15 factors in Table 4-5 were observed and it was found contractors and the client are identified as responsible for 7 factors. Consultants are identified responsible for only 5 of delay factors.

External parties are not identified as cause of any factors. However, for the number one delay factor associated with right of clearance, both consultants and the client are identified as the major responsible parties.

Table 4-9: overall summary of effect of determinant factors and contribution of stakeholders

Determinants of time overrun	Impact on time overrun		Contractor		Client		Consultant		External	
	Moderate	High								
Improper project selection	60.0%	40.0%			100%	100%	-			
Poor/ inappropriate contract administration and design	50.0%	50.0%			100%	50%	-			
Poor Data Collection	0.0%	100.0%				33%				
Unrealistic expectation /Assumptions	55.6%	44.4%	50%	100%	50%	-				
Poor Site Management	14.3%	85.7%	100%	60%	0%	-				
Poor communication system	33.3%	66.7%	33%	33%	33%	33%	0%			
Weakened Project Management and Contract administration	33.3%	66.7%	67%	29%	-	36%	0%			
Ineffectiveness in Managing Multiple projects	20.0%	80.0%	100%	75%	-	25%				
Labor related factors (Ineffective and Inefficient)	100.0%	0.0%	100%		-					

Inefficient/insufficient Material and Machinery Management and Utilization	0.0%	100.0%		80%		-				
Poor Financial management	25.0%	75.0%	100%	75%	-	25%				
challenging external factors	25.0%	75.0%	0%	18%	-	27%	-	27%	100%	27%
overall	38.2%	61.8%	53%	40%	33%	27%	7%	26%	7%	6%

Source: research study

From Table 4-9, it can easily be concluded that 62 % of the identified determinant factors have severe effect on time overrun and Contractors and the client held responsible for causing 67% and 86% of factors having moderate and severe time overrun respectively. Client are major responsible for causing delay factors during early stages and Contractors are responsible for late stage time overrun effects

#### 4.3.4 Agreements on Time overrun relative importance factors among different groups of Respondents

As discussed in chapter three section 3.6.5, the agreement in ranking of the factors between respondents in each category: contractors, consultants and clients was checked. For this purpose, Spearman rank correlation coefficient is applied to test the agreements.

Based on the rankings obtain as shown appendix 7.3, the ranking from each respondent group was checked using equation 6 for calculating spearman's correlation and the result is presented in Table 4-10.

A significance association between the sets of ranks from calculated Spearman's rank correlation coefficients ( $r_s$ ) is assessed, in order to see whether there is agreement between two groups of respondents in ranking the factors; the level of significance 95% ( $\rho = 0.05$ ) is used. This allows verifying whether there is "agreement" between respondents' response.

In this case, with a level of significance of 95% ( $\rho = 0.05$ ), the calculated values of  $r_s$  for all the three groups are greater than the critical values of  $r_s$  ( $SL = 0.201$ ) shown in Appendix 7.2, indicating that there is a significant agreement between the respondents in each group and the values are statistically significant.

Table 4-10: Spearman's rank correlation coefficients for importance index factors by different groups of respondents leading to time overrun

<b>Respondents Category</b>	<b>Contractor</b>	<b>Consultant</b>	<b>Client</b>
Contractor	1		
Pvalue= 0.00			
Consultant	0.618426	1	
Pvalue= 0.00			
Client	0.564733	0.668373	1
Pvalue= 0.00			
Number of pairs of values in the data set n=68			

Source: Field Survey (2023)

## 4.4 Magnitude of Time Overrun on Road Construction Projects Between 2016 - 2020

For this desk review projects which have been under construction between 2016 and 2020 were considered. During this period there were a total of 154 active projects as obtained from monthly contractor's evaluation report published online by ERA.

From the 154 projects, only 100 of them have commenced during this period. Further, 21 were started beyond July 2019 which makes their planned commencement date beyond December 2020 thus omitted from the analysis (the selected projects are required to have passed at least through two life cycle stage). Four projects were suspended / terminated and as a result they were not also considered for evaluation. Therefore, for the study 78 projects are used. The list of the projects with their basic info is shown in Appendix 7.7.

### 4.4.1 Time overrun during project initiation phase

From the 78 projects under investigation, shown in Appendix 7.7, irrespective of the project delivery scheme and location of the project from the capital city, the mobilization period given is from Two to Six months. It is logical to take assumption that those projects furthest from the center will have difficulties to meet this schedule table.

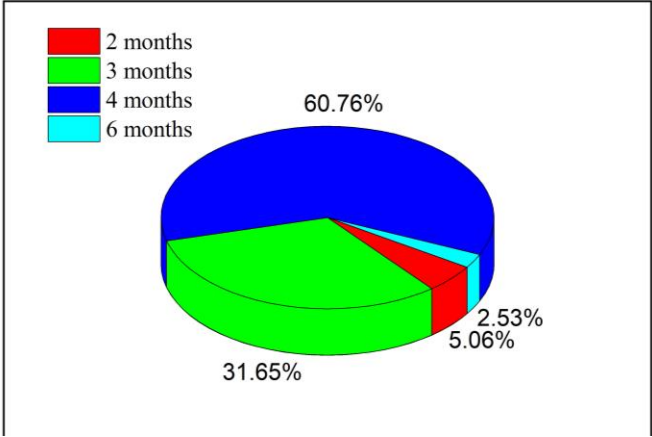
The values in the Figure 4.3 have depicted that more than 90% of the projects have either three or four-months of mobilization. Even though, the projects are located along various corner of the country, they are using

different contract delivery mechanism and their length is different. The average mobilization period given is 3.63 months.

One can say there is no clear way of determination of mobilization period of the projects based on their conditions. Similarly, the average contract duration of the projects found to be 32.87 months, the contract duration given for remote projects requiring extra time for mobilization, for DB projects which require additional time is similar with projects whose design is already completed and located near the capital city. Detail data of actual working dates starting is indicated in appendix 7.7.

As discussed in the literature review, the project initiation life cycle continues up to completion of contractors' mobilization and starting of permanent works of the project. For this purpose, as shown in Figure 4.4, progress of the projects checked at the end of mobilization period. From the mobilization periods stated in the document it was found the average time given for mobilization is 3.64 months and the time given for those projects whose design completed initially (DBB) scheme and for design built are found to be the same.

Figure 4.3. Allotted Mobilization period of projects

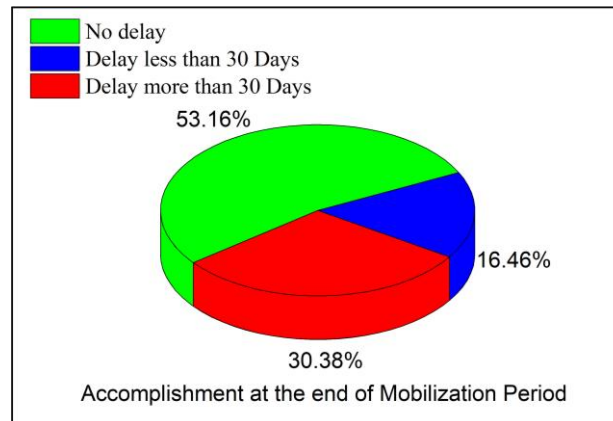


(Source: desk study 2023).

Based on the average values observed, mobilization period consists of 11.05 % of the contract duration. 37 projects out of the 78 projects commence permanent works, beyond the allotted mobilization period. The average delay of the contractors is twenty-four (23.25) days. Considering the average project duration, 32.87 months, these projects have suffered a time overrun of 2.35 % of the contract duration.

Those Projects have delayed from single (1) day to maximum of one hundred forty-two (142) days. On the other hand, while assessing forty-four (44) projects who have commenced on schedule, the minimum duration taken for mobilization was one (1) month.

Figure 4.4. Accomplishment at the end of mobilization period

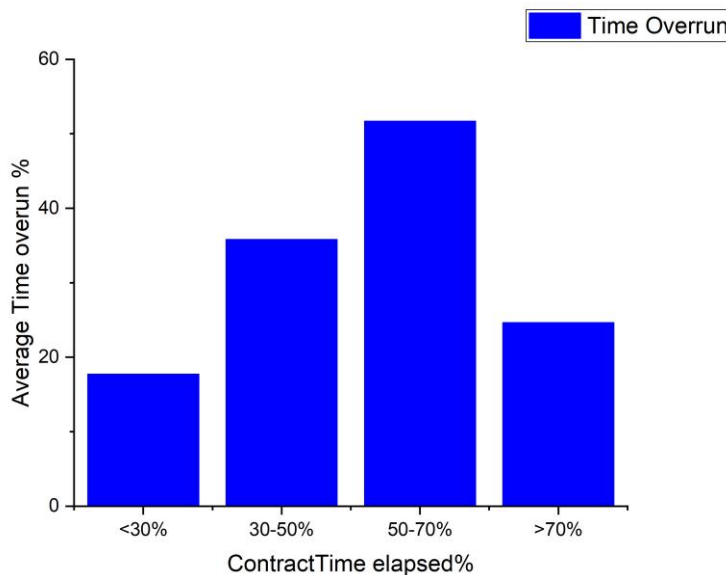


(Source desk study 2023)

#### 4.4.2 Performance for projects during mid duration

For this analysis projects which has begun after January 2016 but their expected completion beyond December 2020 are considered. These projects are in the middle of their execution period and will provide an insight about the mid schedule performance. The reported performance at the end of December 2020 of each project compared against the percentage of time elapsed from commencement date is used for calculating the time overrun.

Figure 4.5. Average time overrun of projects at the end of December 2020



(Source Desk study 2023)

The obtained delay was compared with average duration for checking the time overrun. A total of 34 projects were observed. Figure 4.5 shows average time overrun of the projects with respect to the average contract duration elapsed at the end of December 2020. The average time elapse at the end of December 2020 for 34 projects was 60.79 % and the average performance at the same time was 30.04%. The average time overrun of the projects found to be 29.0%.

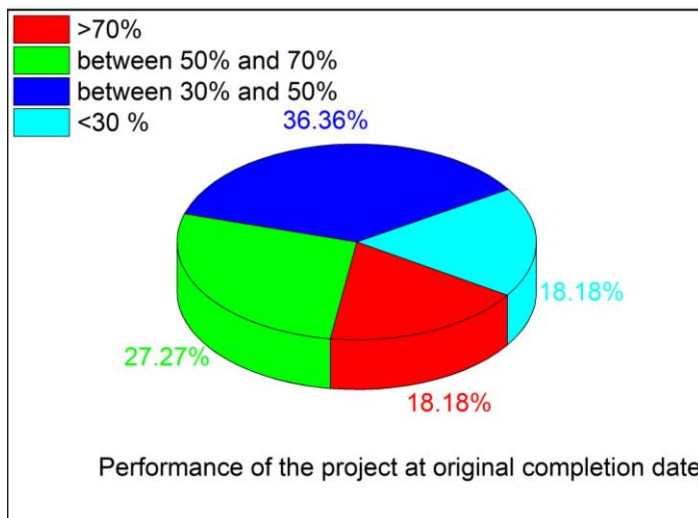
#### 4.4.3 Performance at the end of original project completion date

The time overrun of projects at the end of original completion period was observed. Between January 2016 and December 2020, 44 projects were expected to be completed before December 2020, list of projects is shown in Appendix 7.7.

From the 44 projects none of them were completed on the initially envisaged completion date. The average accomplishment at the completion month is 47.23%. The maximum performance at completion observed is 96.6% whereas the minimum performance was 2.3%. The performance data posted by ERA does not state whether the contract was terminated or not so that, the researcher take the value obtain considering all projects are active.

The values in Figure 4.6 among the 44 projects, 36 (81.82%) of projects have accomplishment less than 70% of the total workload least expected ERA’s assumed accomplishment at completion of a project. Based on findings of the desk study, the projects delayed on average 483.6 days; which makes the average time overrun to be 51.87 %.

Figure 4.6. Performance of projects at original completion date



(Source Desk study 2023)

#### 4.4.4 Performance beyond originally set contract completion date

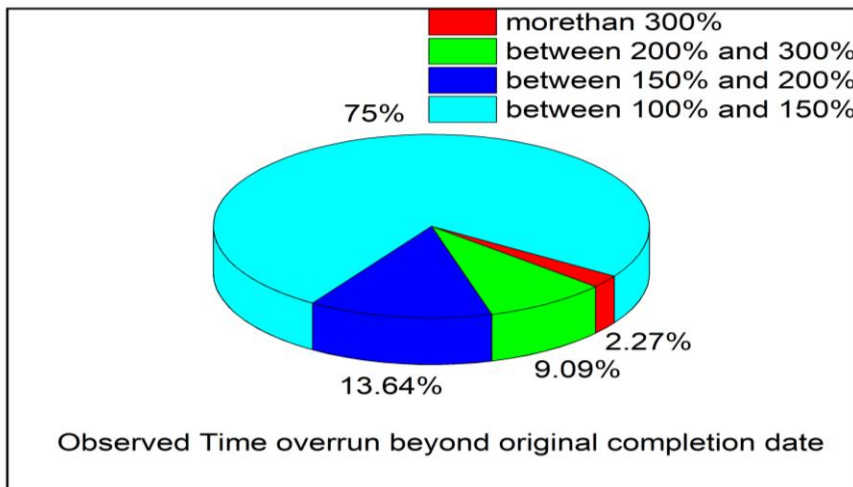
For those projects which were supposed to be completed before December 2020, the accomplishment at the project completion or at December 31, 2020, whichever comes first was observed. As shown in Figure 4.6, from the total of 44 projects were considered; the average time elapsed on December 31, 2020 with respect to projects commencement date is 145.4% and the corresponding average accomplishment is 57.38 %. The average delay of the projects is 327.75 days which makes the average time overrun to be 35.16%.

#### 4.4.5 Overall comparison of Time overrun of projects

The obtained result shows, at the end of mobilization period which is on average 3.63 months, i.e. 11.04 % of the contract duration, the number of projects suffering time overrun were 37 projects, (46.84 %) and corresponding time overrun is 2.33%.

On the other hand, from the results obtained for the 34 projects whose completion date is beyond December 2020, the average time elapsed from contract duration was 60.79 % and all projects were behind the schedule and the average time overrun was 29.00%.

Figure 4.7. Time overrun of projects beyond their original completion date



(Source: Desk study 2023)

On the other hand, from the results obtained for the 34 projects whose completion date is beyond December 2020, the average time elapsed from contract duration was 60.79 % and all projects were behind the schedule and the average time overrun was 29.00%.

For the data taken for the projects whose completion date was before December 2020, while observing the time overrun on the originally envisaged completion date, all of the projects have lagged from schedule and the average time overrun was found to be 51.87%. For the case of projects which are extended beyond their completion period the corresponding time overrun at December 2020 or during completion time is 35.16 % and time elapsed from contract duration is 145.4%. The summaries are shown in Table 4-11.

Table 4-11 Trend analysis of projects time overrun of projects with contract time elapse

<b>Milestone</b>	<b>Time elapsed (%)</b>	<b>Percentage of projects delay</b>	<b>Time overrun %</b>	<b>Increment %/ %</b>
Project Beginning	0	0	0	
Beginning of execution stage*	11.07	36	2.33	21.05%
Around midway (data from 34 projects)	60.78	100	29	53.65%
Completion of originally set deadline	100	100	51.87	58.31%
Beyond Contract completion period	145	88.64	35.16	37.13%

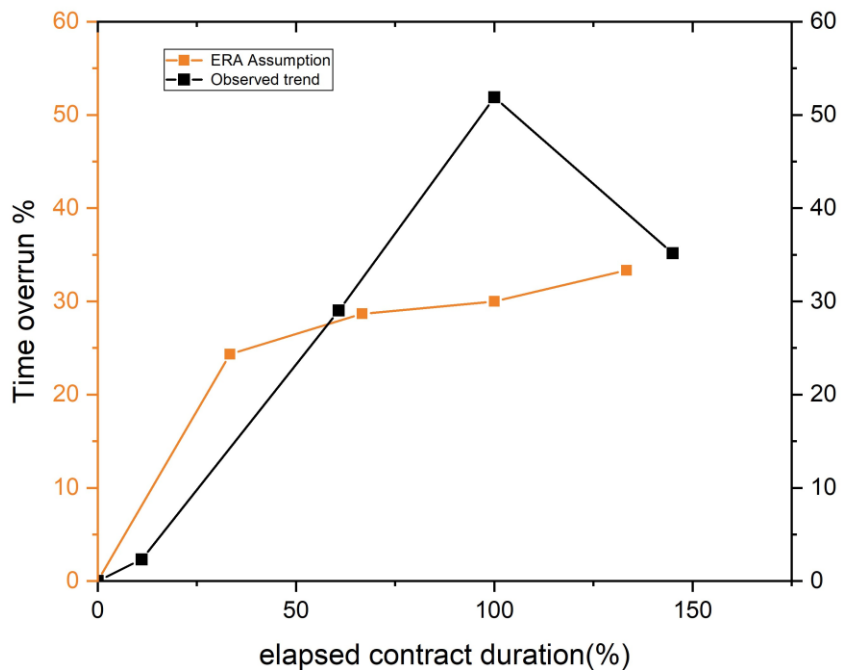
Source: Desk Study (2023)

The rate of increment of time overrun of projects increased once the execution life cycle stage started. From interview with senior Engineers the reasons explained was in order to react to the pressure from stake holders for quick commencement of projects, the client will force the contractor to start the construction without all required deliverables are provided.

Contractors might start construction based on clients request in stretches free from right of way obstruction or state possessed land, without getting all design documents are completed depending on the resource they got. However, when the deployed number of resources increases the project can stuck due to the overlooked conditions initially. On the other hand, if contractors do not have sufficient resources (equipment, manpower) or are waiting for completion of prior obligations, will start with limited capacity and failed to cope up as the project progress.

ERA monthly evaluation for progress of projects depicts at the end of 1/3 of project duration expects accomplishment of 9%, at the end of 2/3 of contract duration the envisaged progress is 38%, at the end of original contract duration the expected performance is 70% and finally after 133 % of time elapsed the expected accomplishment is 100%. (ERA monthly evaluation, <http://www.era.gov.et/web/guest/performance-rating>) The observed trend is shown in Figure 4.8, time overrun of projects steeply increase up to original completion date and start to decline once the originally envisaged completion date passes.

Figure 4.8. rate of increment of time progress versus with contract duration.



Source: Desk Study (2023)

## 4.5 Regression Analysis and Hypothesis Testing

Multiple hierarchical regression is a statistical technique that helps prediction of dependent variable at all levels, by taking into consideration the individual factors (Best, 2015). The discussion of relationships between time overrun of the projects and impacts of the delay factors at various life cycle stage tested by model of regression is presented in following sections.

### **4.5.1 Effect of determinants on time overrun of projects at various life cycle stage.**

A multiple hierarchical regression is used to test the hypotheses of effect of delay determinants on time overrun of the projects. For this evaluation, the effect of individual determinants delay factors was checked against the overall effect by keeping other affecting factors constant. The regression analysis is done using Statistical Package for Social Sciences (SPSS 23).

Before proceeding into regression, the following assumptions have to be satisfied. None of the independent variables must be a constant or a linear combination of the other independent variables; no perfect multicollinearity, the error terms (residuals) must follow a normal distribution referred to as a situation of homoscedasticity. And for each combination of independent variables the expectation of the error term has to be zero,  $E(\epsilon|x) = 0$  are of linearly related with dependent variable (Best,2015).

#### **Assumption 1: Normality,**

Normality describes the distribution of the residuals being uniformly distributed, not the independent variables. In this assumption, the values of residuals of the regression should follow a normal distribution. Using SPSS, this can be checked by plotting Predicted Probability (P-P) plot; we can determine if the residuals are normally distributed.

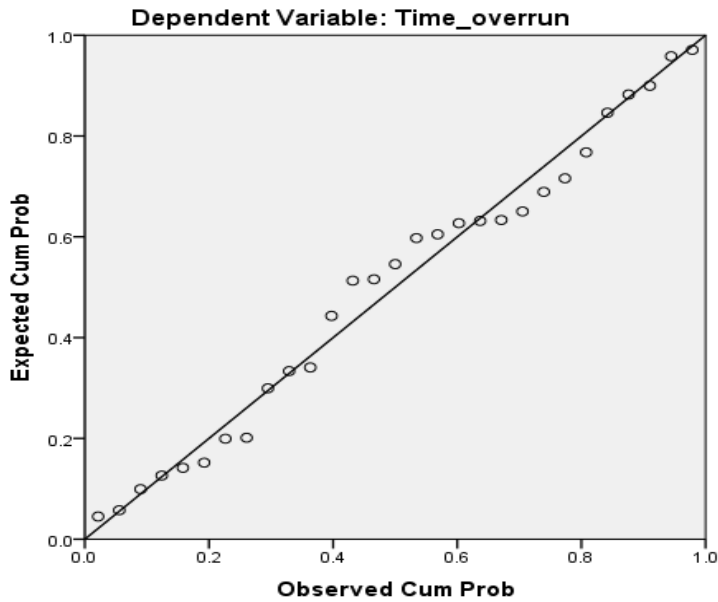
From Figure 4.9, it can be seen that observed and indicator variables follow the normality line, we can assume normality since there are no drastic deviations of the residual Time overrun and the delay factors at each project life cycle stage have linear relation.

The next assumption to check is homoscedasticity. Homoscedasticity can be defined as homogeneity of variances, is an assumption of having similar variances in different groups being compared. That means the error term is the same across all values of the independent variables Uneven variances in samples result in biased and skewed test results (Best,2015).

#### **Assumption 2; homoscedasticity.**

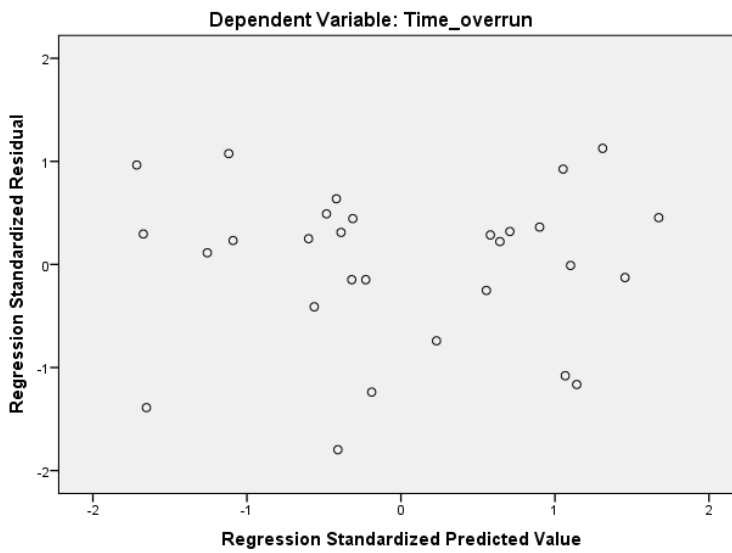
While plotting the parameters using SPSS, the scatter plot of the residuals will appear equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis randomly without any defined pattern. For this study the plot of the residuals indicated in Figure 4.10 and clearly there is no defined pattern.

Figure 4.9. Normal P-P Plot of regression Standardized Residuals



(source: Research Study)

Figure 4.10. Scatter Plot of the residuals



Source: Research data

**Assumption 3: no multicollinearity:**

The third assumption is absence of multicollinearity, i.e. the independent variables are not correlated. Multicollinearity among independent variables will result in less reliable statistical conclusion. To estimate multicollinearity the variance inflation factor (VIF) is used. According to Akinwande et.al, VIF assesses

increment of variance of an estimated regression coefficient increases when predictors are correlated. In cases where no correlation exists, VIFs will be 1. On the other hand, a VIF between 5 and 10 indicates high correlation that may be problematic and if VIF is greater than 10, the parameters used for regression are multicollinearity and their estimation is not reliable. However, if the value of VIF is between 1 and 5, the variables are moderately correlated to each other and there is no problem of collinearity (Akinwande et.al,2015). The obtained VIF values are indicated in Table 4-12 and the result shows, all VIF values are less than 10 there is no problem of multicollinearity.

Table 4-12: Observed variance inflation factor (VIF)

Model	(Constant)	init_1	init_2	plan_1	plan_2	exec_1	exec_2	exec_3	exec_4	exec_5	exec_6	exec_7	exec_8
Tolerance		0.292	0.145	0.174	0.313	0.162	0.31	0.175	0.289	0.255	0.229	0.349	0.27
VIF		3.427	6.916	5.743	3.2	6.181	3.224	5.725	3.462	3.923	4.37	2.868	3.701

Source: research data.

The researcher has summarized the results of Pearson’s correlation and multiple regression analysis to show relationships with variables and testing of the null hypothesis. The discussions refer the two tables namely, Impacts of delay determinants during project initiation life cycle stage on Time overrun of projects.

The delay factors at project initiation life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14 the two determinants of delay factors at initiation stage with time overrun of projects show Pearson’s Correlation of 0.691 and 0.778.

Table 4-13 Regression factors between Time overrun of projects and delay factors at various project management life cycle stage and Table 4-14 Pearson’s correlation between Time overrun and delay factor determinants at each project life cycle stages.

As can be seen from Table 4-14, all determinants of delay factors correlate with time overrun of projects. Thus, it is concluded that all the delay determinant factors identified in at each project life cycle stage; initiation, planning and execution life cycle stages have strong correlation with time overrun of the projects. The impact of the delay determinants on time overrun of projects, discussed based on the value of the beta coefficient as shown in Impacts of delay determinants during project initiation life cycle stage on Time overrun of projects.

The delay factors at project initiation life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14 the two determinants of delay factors at initiation stage with time overrun of projects show Pearson's Correlation of 0.691 and 0.778.

Table 4-13 is discussed as follows.

- a) Impacts of delay determinants during project initiation life cycle stage on Time overrun of projects.

The delay factors at project initiation life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14 the two determinants of delay factors at initiation stage with time overrun of projects show Pearson's Correlation of 0.691 and 0.778.

Table 4-13: Regression coefficients between Time overrun of projects and delay factors at various project management life cycle stage.

	Unstandardized Coefficients	P value.
	beta	
(Constant)	-.042	.861
init_1	.079	.000
init_2	.084	.000
plan_1	.026	.000
plan_2	.138	.000
exec_1	.112	.000
exec_2	.035	.000
exec_3	.093	.000
exec_4	.077	.000
exec_5	.093	.000
exec_6	.095	.000
exec_7	.095	.000
exec_8	.074	.000

Source: Research study.

Based on the regression values shown in Impacts of delay determinants during project initiation life cycle stage on Time overrun of projects.

The delay factors at project initiation life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14 the two determinants of delay factors at initiation stage with time overrun of projects show Pearson's Correlation of 0.691 and 0.778.

Table 4-13, the two determinants at the beginning of project accounts for 16.4 % of time overrun of projects. Improper project selection and initiation without due consult with concerned stakeholders accounts for 7.9 % of the time overrun and inappropriate and delay in floating tenders, selection project delivery schemes and failure to award the contract on time have an impact amounting 8.4%. the strong correlation between time overrun and inappropriate pre-procurement stages and procurement associated problems signify the finding. The t-test result shows the p value is it is less than 0.05 and the null hypothesis is rejected.

b) Impacts of delay factors during project planning life cycle stage on Time overrun of projects.

The delay factors at project planning life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14, the delay factors at planning stage with time overrun of projects show Pearson's Correlation of 0.741 and 0.777.

Planning life cycle stage, also accounts for 16.4% of the time overrun. However, unlike the initiation stage which all determinants have comparable effect; the second determinant in planning life cycle stage i.e. improper planning without having sufficient data and by overlooking the actual available resources plays a huge role in causing time overrun by being responsible for the 13.6 %. On the other hand, failure of acquiring appropriate data accounts for 2.6% of the time overrun of projects. The p-value result in Impacts of delay determinants during project initiation life cycle stage on Time overrun of projects.

The delay factors at project initiation life cycle stage have strong correlation with Time overrun of projects. As shown in Table 4-14 the two determinants of delay factors at initiation stage with time overrun of projects show Pearson's Correlation of 0.691 and 0.778.

Table 4-13 shows it is less than 0.05 and the null hypothesis is rejected.

c) Impacts of delay factors during project execution life cycle stage on Time overrun of projects.

The execution stage where most of the resources will be engaged accounts for the remaining 67.3% of delay causes. Of the total, 11.2% of the time overrun causes attributed to poor site management; i.e. inability of establishment of routine site management works and system usually performed at the commencement of projects. These activities include setting up works and creation of method statements. The delay factors at relatively early stages of execution life cycle stage have strong correlation with time overrun of projects. The t-test result shows it is less than 0.05 and the null hypothesis is rejected.

The  $\beta$  Coefficient results denote that a unit increase in the independent variable results in the designated amount of percentage change in the dependent variable. From the result 67.3 % of time overrun is caused due to factors causing delay during the project execution life cycle stage; similarly, both planning and initiation lifecycle stage accounts for 16.4 % of time overrun caused due to delay causing factors during the project execution life cycle stage.

Table 4-14: Pearson's Correlation between Time overrun and delay factors at various lifecycle stage

		Time_ overrun	init_1	init_2	plan_1	plan_2	exec_1	exec_2	exec_3	exec_4	exec_5	exec_6	exec_7	exec_8
	Time_ overrun	1.000												
init_1	Pearson Correlation	.691	1.000											
	sig.(1_tailed)	.000												
	N	29												
init_2	Pearson Correlation	.778	.734	1.000										
	sig.(1_tailed)	.000	0.000											
plan_1	Pearson Correlation	.741	.635	.865	1.000									
	sig.(1_tailed)	.000	0.000	.000										
plan_2	Pearson Correlation	.777	.460	.693	.692	1.000								
	sig.(1_tailed)	.000	0.000	.000	.000									
exec_1	Pearson Correlation	.875	.566	.704	.631	.691	1.000							
	sig.(1_tailed)	.000	0.001	.000	.000	.000								

exec_2	Pearson Correlation	.775	.505	.573	.539	.609	.726	1.000						
	sig.(1_tailed)	.000	0.003	.001	.001	.000	.000							
exec_3	Pearson Correlation	.895	.607	.675	.672	.714	.813	.714	1.000					
	sig.(1_tailed)	.000	0.000	.000	.000	.000	.000	.000						
exec_4	Pearson Correlation	.744	.570	.466	.453	.340	.649	.570	.601	1.000				
	sig.(1_tailed)	.000	0.001	.005	.007	.036	.000	.001	.000					
exec_5	Pearson Correlation	.783	.473	.484	.399	.509	.601	.637	.704	.688	1.000			
	sig.(1_tailed)	.000	0.005	.004	.016	.002	.000	.000	.000	.000				
exec_6	Pearson Correlation	.707	.208	.339	.314	.487	.675	.656	.663	.533	.512	1.000		
	sig.(1_tailed)	.000	0.139	.036	.048	.004	.000	.000	.000	.001	.002			
exec_7	Pearson Correlation	.739	.438	.403	.427	.423	.551	.398	.571	.555	.594	.492	1.000	
	sig(1_tailed)	.000	0.009	.015	.010	.011	.001	.016	.001	.001	.000	.003		
exec_8	Pearson Correlation	.668	.225	.310	.354	.418	.396	.405	.514	.512	.597	.634	0.702	1.000
	sig(1_tailed)	.000	.120	.051	.030	.012	.017	.015	.002	.002	.000	.000	.000	

Source: Research Data

### 4.5.2 Effects of delay factors of time overrun at various life cycle stage and stakeholders on time overrun of projects

In order to investigate the extent to which individual delay factors and responsible parties affect the determinant factors leading into time overrun of projects at every life cycle stage, hierarchical multi linear regression was conducted by keeping the effect of the other determinants as constant by taking the effects and stakeholders as a predictor variables and average of all the delay factors at the respected life cycle stage as dependent variable. Table 4-15, shows the arrangement of variables used for the study.

For the initiation life cycle stage, the second determinant was kept constant and individual factors of the first determinant, ini\_1 were regressed against time overrun at initiation life cycle stage.

Table 4-15: Regression between Time A table providing a summary of the hierarchical regression analysis between predictors and time overrun at each life cycle stage

<b>Model number</b>	<b>Reference determinant</b>	<b>variables considered</b>	<b>dependent Variables</b>
model 1	init_1	factors of init_1 and corresponding parties	time overrun at initiation life cycle stage
model 2	init_2	factors of init_2 and corresponding parties	
model 3	plan_2	factors of plan_1 and corresponding parties	time overrun at planning life cycle stage
model 4	plan_1	factors of plan_2 and corresponding parties	
model 5	all determinants in exception to exe_1	factors of exe_1 and corresponding parties	time overrun at execution life cycle stage
model 6	all determinants in exception to exe_2	factors of exe_2 and corresponding parties	
model 7	all determinants in exception to exe_3	factors of exe_3 and corresponding parties	
model 8	all determinants in exception to exe_4	factors of exe_4 and corresponding parties	
model 9	all determinants in exception to exe_5	factors of exe_5 and corresponding parties	
model 10	all determinants in exception to exe_6	factors of exe_6 and corresponding parties	
model 11	all determinants in exception to exe_7	factors of exe_7 and corresponding parties	

model 12	all determinants in exception to exe_8	factors of exe_8 and corresponding parties
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Reference: research study

As discussed in previous section, the effect of individual delay factors determinant to time overrun analyzed, the models used indicated below.

Table 4-16: Model Summary: determinant factors for project initiation life cycle stages (ini\_1 and ini\_2)

Model	steps	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
						R Square Change	F Change	Sig. F Change
1	1	.938 <sup>a</sup>	.879	.875	7.05082	.879	189.196	.000
	2	.946	.895	.865	7.32196	.016	.622	.685
	3	.973	.946	.909	6.00271	.051	3.049	.040
	4	.988	.976	.941	4.82001	.030	2.763	.074
	5	.992	.984	.930	5.28268	.008	.632	.685
	6	1.000	1.000	1.000	.09450	.016	3750.142	.012
2	1	.923 <sup>b</sup>	.852	.846	7.81221	.852	149.293	.000
	2	.936	.876	.841	7.94031	.025	.834	.540
	3	.970	.941	.907	6.07035	.065	4.733	.009
	4	.976	.952	.901	6.25326	.011	.755	.572
	5	.978	.956	.880	6.89832	.003	.227	.875
	6	.988	.975	.889	6.64610	.020	1.193	.402
	7	1.000	1.000	.999	.73813	.025	121.105	.008

a. Predictors: (Constant), ini\_2

b. Predictors: (Constant), ini\_1

Source: Research study

From Table 4-16, steps 3 and 6 from model one corresponding to delay factors regarding involvement of stakeholders and awarding projects to the lowest bidder have prominent effect when added to the regression on explaining time overrun effect. On the other hand, for the second determinant, bid related delays and inadequate data collection ahead of design have significant effect on the output.

On the other hand, when the model for the planning stage are analyzed as shown in Table 4-17 only the regression model incorporating factor 18, unrealistic assumptions on availability of utilities on site results in significant change in the regression model.

Table 4-17: Model Summary: determinant factors for project planning life cycle stages ( plan\_1 and plan\_2)

Model	steps	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
						R Square Change	F Change	Sig. F Change
3	1	.979 <sup>a</sup>	.958	.957	3.84808	.958	597.904	.000
	2	.987	.974	.966	3.40040	.015	2.459	.066
	3	.990	.980	.967	3.37602	.007	1.061	.418
4	1	.823 <sup>b</sup>	.677	.665	10.70626	.677	54.599	.000
	2	.871	.758	.689	10.32256	.080	1.394	.267
	3	.903	.816	.689	10.31370	.058	1.007	.445
	4	.927	.860	.655	10.86053	.044	.686	.644
	5	.959	.919	.636	11.16152	.060	.883	.545
	6	1.000	1.000	.999	.56587	.081	466.666	.035
	7	1.000 <sup>c</sup>	1.000			.000		

a. Predictors: (Constant), plan\_2

b. Predictors: (Constant), plan\_1

c. factors 19 to 22 are excluded from the model

Source: Research Study

### 4.5.3 Relation of delay factors of time overrun of lifecycle stages

In order to determine the relation of individual factors on the time overrun of respective lifecycle stages, the regression coefficient of delay factors as discussed in section 3.7.5.1 was used. The obtained result based on the regression beta values and responsible parties for each life cycle stage is discussed as follows.

#### 4.5.3.1 Effect of delay factors on during project initiation life cycle stage.

While observing the effect of all delay factors in the first determinant factors of time overrun of project initiation life cycle stage, all factors have significant effect on time overrun. Engaging in projects without any feasibility study, clear scope and awarding contract to lowest bidder have strong positive effect on time overrun. On the other hand, noninvolvement and luck of experience of stake holders have negative coefficient on time overrun. The parties involving having positive effect on time overrun are indicated in Table 4-18.

On the other hand, delay factors associated with poor procurement process of time overrun, lagging in

commencing projects after signing the contract and faulty design and contract documents have positive beta factors. Clients are taking main responsibility for the delay in commencement after signing the contract and contractors and consultants held responsible for the faulty design documents. The other factors have higher negative beta factors.

Table 4-18: impact of delay factors on determinants of time overrun during project initiation life cycle stage.

		Beta values					Remark
			Contractor	Client	Consultant	External	
Improper project selection	Effect_1	0.243 **	-13.349 **	4.941 **	-29.452 **	-8.856 *	
	Effect_2	-0.609 **	-17.905 **	-42.077 **	31.729 **	43.452 *	
	Effect_3	-0.619 **	-19.567 **	7.425 **	26.314 **	3.732 *	
	Effect_4	0.377 **	3.891	9.545	-29.468 **	11.089 **	
	Effect_5	0.168 *	-11.655 *	-13.833 *	-24.272 **	-80.39 **	
Poor/ inappropriate contract administration and design	Effect_6	-0.384 **	-9.045 **	14.846 **	-6.403 *	16.993 **	
	Effect_7	-0.104 *	-96.832 *	NA	-22.013 *	NA	
	Effect_8	0.603 **	-7.608 **	42.149 **	-14.805 *	NA	
	Effect_9	-0.25 **	-0.387	-12.992	1.312	NA	
	Effect_10	0.102 *	59.324 *	-27.483 *	12.46 **	NA	
	Effect_11	-0.123 *	-53.83 *	9.044 *	-124.929**	NA	

\*\* . Correlation is significant at the 0.01 level.

\*. Correlation is significant at the 0.05 level.

Source: Research Study.

#### 4.5.3.2 Effect of delay factors on during project planning life cycle stage.

As shown in Table 4-19, data associated problems do not have statistically significant relation with time overrun during planning stage. In contrary, factors associated with initial assumptions made for planning; inappropriate prediction of the future by the consultant, poor analysis on stake holders influence by client and assessment of availability of utilities by all three (contractor, consultant and client) have positive effect on time overrun. On the other hand, unrealistic assumptions used for machineries and equipment by client, poor risk analysis by contractors and external parties have negative effect on time overrun. On the other hand, Procurement planning, assessment of available construction materials, weather conditions and execution strategy doesn't have any relation with time overrun.

Table 4-19: impact of delay factors on determinants of time overrun during project planning life cycle stage

		Beta values					Remark
			Contractor	Client	Consultant	External	
Data collection	Effect_12	0.037	-6.477 *	-4.982	-1.118	7.547	
	Effect_13	0.072	3.5	0.644	2.183	-6.293	
Poor/ inappropriate contract administration and design	Effect_14	-0.475 **	-19.078 **	4.339 **	-21.167 **	-0.126 **	
	Effect_15	-0.012 **	12.548 **	-13.964 **	-0.866 **	110.816 **	
	Effect_16	0.166 **	-7.832 **	1.323 **	6.611 **	-8.199 **	
	Effect_17	0.761 **	-5.785 **	17.004 **	-22.097 **	-24.428 **	
	Effect_18	0.178 **	33.285 **	20.998 **	8.512 **	-5.454 **	
	Effect_19						not used
	Effect_20						not used
	Effect_21						not used
Effect_22						not used	

\*\* . Correlation is significant at the 0.01 level.

\* . Correlation is significant at the 0.05 level.

Source: Research Study.

#### 4.5.3.3 Effect of delay factors on during project execution life cycle stage.

Individual delay factors of Communication and financial management do not have statistically significant impact on time overrun of projects. Whereas while we see other Factors, under site management of the projects except disruptions due dispute and subcontractor related delays have statistically significant impact on time overrun. Inappropriate construction methodology has negative effect on time overrun and the other factors associated with routine management of site works have positive effect on time overrun. All delay factors associated with weak project management and contract administration except those

associated with organizational arrangement and procurement, all have negative correlation with time overrun of projects.

Determinant factor associated with the number of projects running simultaneously have statistically significant relation with time overrun in exception to organizational culture. Having higher number of projects by contractors have positive correlation and other factors for addressing the location of projects and appropriate management arrangement have negative correlation with time overrun.

All factors determining allocation and efficiency of materials and equipment have significant relationship with time overrun. The overall result can be seen in Table 4-20.

Table 4-20: impact of delay factors on determinants of time overrun during project execution life cycle stage

		Beta Values				Remark	
			Contractor	Client	Consultant		External
Poor Site Management	Effect_23	-0.084 **	NA	-2.036 **	-0.381 **	NA	not used not used
	Effect_24	0.019 **	-0.916 **	NA	2.731 **	NA	
	Effect_25	0.016 **	NA	1.144 **	2.616 **	NA	
	Effect_26	0.032 **	NA	-4.818 **	0.51 **	-0.269 **	
	Effect_27	0.045 **	-0.438 **	3.068 **	-0.562 **	-8.34 **	
	Effect_28						
	Effect_29						
Poor communication system	Effect_30	-0.034	-1.239	0.879	0.857	2.553	
	Effect_31	-0.008	1.251	0.471	1.937	-4.724	
	Effect_32	0.021	2.246	-0.906	-4.852 *	2.157 *	
Weakened Project Management and Contract Administration	Effect_33	-0.008 **	2.428 **	32.668 **	-0.792 **	-0.839 **	Not used Not used
	Effect_34	-0.019 **	-3.101 **	-4.464 **	2.037 **	NA	
	Effect_35	-0.062 **	3.13 **	-1.083 **	-4.333 **	-2.216 **	
	Effect_36	-0.025 **	-10.305 **	8.768 **	-7.044 **	-7.912 **	
	Effect_37						
	Effect_38						
Ineffectiveness in Managing	Effect_39	0.158 **	0.24 **	-5.879 **	-4.753 **	-14.705 **	
	Effect_40	-0.153 **	2.063 **	0.548 **	3.482 **	3.753 **	

Multiple Simultaneously projects	Effect_41	0.223 **	NA	-14.031 **	3.501 **	0.323 **	Not used
	Effect_42	-0.148 **	3.446 **	7.121 **	6.591 **	NA	
	Effect_43						
Labor related factors (Ineffective and Inefficient)	Effect_44	0.08 **	-8.302 **	-1.64 **	1.457 **	NA	Not used Not used Not used
	Effect_45	-0.032 **	-0.901 **	3.477 **	0.435 **	2.452 **	
	Effect_46	0.046 **	-2.397 **	0.786 **	-2.45 **	-1.829 **	
	Effect_47	0.006 **	1.975 **	-4.193 **	0.886 **	-2.484 **	
	Effect_48	0.011 **	NA	NA	NA	NA	
	Effect_49						
	Effect_50						
	Effect_51						
Inefficient/insufficient Material and Machinery Management and Utilization.	Effect_51	0.077 **	NA	NA	-14.281 **	NA	
	Effect_52	-0.015 **	-0.556 **	3.512 **	-2.877 **	NA	
	Effect_53	-0.099 **	-10.009 **	-5.777 **	4.933 **	1.451 **	
	Effect_54	-0.01 **	15.684 **	4.752 **	NA	1.917 **	
	Effect_55	0.02 **	NA	-4.47 **	5.579 **	6.466 **	
	Effect_56	-0.029 **	NA	NA	NA	NA	
Poor Financial management System	Effect_57	0.07	-1.50	0.24	0.65	-10.102	
	Effect_58	0.08	1.94	0.96	3.31	NA	
	Effect_59	-0.01	1.85	6.18	5.25	-3.518	
	Effect_60	-0.12	-4.73	4.05	-6.99	NA	
challenging external factors	Effect_61	0.039 **	-0.375 **	-7.783 **	-6.757 **	8.527 **	Not used Not used Not used
	Effect_62	-0.053 **	-0.786 **	0.635 **	1.486 **	6.707 **	
	Effect_63	0.182 **	-18.448 **	7.367 **	6.841 **	4.738 **	
	Effect_64	-0.151 **	21.358 **	2.253 **	-13.439 **	-3.395 **	
	Effect_66						
	Effect_67						
	Effect_68						

\*\* . Correlation is significant at the 0.01 level.

\* . Correlation is significant at the 0.05 level.

Source: Research Study.

#### 4.5.4 Hypotheses Test Results

Based on the analysis presented under and the corresponding discussion in section 4.5.1, we can generate the following hypothesis test results.

**Hypothesis One:** factors related with project selection during initiation life cycle stage have significant effects on time overrun of road construction projects.

Beta for init\_1=0.079:  $p=0.00$ ;  $p<0.05$  Ho: Rejected

**Hypothesis Two:** factors related with procurement processes (contract formulation and design) during initiation life cycle stage have significant effects on time overrun of road construction projects.

Beta for init\_2=0.084:  $p=0.00$ ;  $p<0.05$  ,Ho: Rejected

**Hypothesis Three:** factors associated with familiarization with the environment for proper planning during project planning life cycle stage have significant effects on time overrun of road construction projects.

Beta for plan\_1=0.026:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis Four:** factors associated with predictions made for planning during project planning life cycle stage have significant effects on time overrun of road construction projects.

Beta for plan\_2=0.138:  $p=0.00$ ;  $p<0.05$  ,Ho: Rejected

**Hypothesis Five:** determinant factors associated with site management during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_1=0.112:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis Six:** factors associated with communication management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_2=0.035:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis Seven:** factors associated with improper project and contract management during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_3=0.093:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis Eight:** factors associated with having several projects simultaneously during project execution life cycle stage have significant effects on time overrun of road construction projects administered by ERA.

Beta for exec\_4=0.077:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis nine:** factors associated with labor mis-management on projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_5=0.093:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis ten:** factors associated with poor resource management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_6=0.095:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis eleven:** factors associated with improper financial management of projects during project execution life cycle stage have significant effects on time overrun of road construction projects.

Beta for exec\_7=.095:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

**Hypothesis twelve:** factors associated with external issues management of projects during project execution life cycle stage have significant effects on time overrun of road construction.

Beta for exec\_8=.074:  $p=0.00$ ;  $p<0.05$ , Ho: Rejected

From the results of hypothesis testing, all determinant factors have significance and caused significant variance in project delay. Finding of hypothesis 1 align with Memon, (2014), which have identified frequent change of scope ranked as second most severe cause of delay in Malaysia. One of the factors determinants with project selectin, selecting least bidder is identified as the number one ranked delay factor in Saudi Arabia Alfradi,2018.

Results of hypothesis 2 also align with finding of Marzouk, (2014) find out inappropriate project procurement process to have moderate effect on delay of projects in Egypt. In the document preparation, Conflict between contract documents and Inadequate design are identified as major causes of time overrun in Iraq (Khaleel,2017).

From the results of hypothesis testing for determinants during planning life cycle stage (hypothesis-3 and 4) , all determinant factors regarding data collection and making proper assumption for proper planning have caused significant variance in project time overrun. This finding is in conformity with Yap, (2018) has identified Lack of proper planning and scheduling as the most critical factor for delay in Malaysia. Akuhund, (2017) identified in developing countries inaccurate assumption of productivity and inadequate review of existing situations are as main cause of delay. Moreover, Unfamiliarity with local conditions and lack of required data for the consultant for proper assumption for planning as major cause of delay (khaleel,2017).

From the results of hypothesis testing for determinants during execution life cycle stage also have caused significant variance in project time overrun. Results of Hypothesis 6 is aligned with Akuhund,(2017) which identified Improper construction methods implemented by contractors as major cause of delay. Communication is critical for the success of any construction project and it promotes the successful implementation of a construction project in developing countries, and miscommunication ranked in top 5 delay factors in developing countries (Akuhund,2017), (Rivera et.al 2020).

Resource Management and Utilization associated with, Equipment/ Plant shortage are identified as the major factor on determining time overrun. This result are also in agreement with findings of (Indhu et. al, 2020), (Rivera 2020), (sah,2017). The next determinant which leads into time overrun of projects is associated with poor financial management is associated with improper handling of financial obligation by different stakeholders. Various studies have also indicated financial problems to be major cause of delay (Tadle,2017), (sah,2017), (khaleel,2017). Factor leading time overrun at this life cycle stage associated with incapability of project management is in conformity with other studies by (Memon,2014), (Dureyev,2014).

# Chapter Five: Conclusion and Recommendations

## 5.1 Introduction

The main purpose of this research is to identify major determinants of time overrun of projects at various life cycle stage. This chapter presents the summary of research findings, conclusions, recommendations and suggestions for further research.

## 5.2 Discussions

Based on the results of the analysis of secondary data and primary data conclusions are drawn. Time overruns have extreme challenges for road construction projects in the country and occurs at all stages of project life cycle.

The impact of Sixty-Eight (68) delay factors at various life cycle stage leading to time overrun analyzed and 45.5%, 54.5% and 67.5 % of the delay factors during project initiation, planning and execution life cycle stage respectively have critical impact on time overrun of road construction projects.

Secondary data analyzed for studying time overrun of 78 road construction projects which have started between January 2016 and December 2020. The average contract duration of the projects were 32.87 months and the corresponding mobilization period was 3.63 months. At the end of their mobilization, i.e. end of initiation stage, 37 projects (46.84% of the projects) suffer time overrun of 2.33%. Similarly, progress of 35 projects continuing beyond December 2020 whose average contract time elapse was around 60.79% on December 2020 (around their midlife span) shows all of the projects have delayed from initially set time frame and the average time overrun found to be 29 %. On the other hand, for 44 projects whose completion period was ahead of December 2020 the observed time overrun against time elapse is 51.87%. At the end of December 2020, 44 projects were under construction and their time overrun was 35.16 % respectively. The finding reveals similar to the research results, projects suffer from time overruns all construction life cycle stages across the country and the rate of time overrun will increase as the projects progress further.

The main influencing 10 factors identified are Right of way problems, Equipment/Plant shortage, Delayed mobilization/ commencement, Equipment/plant frequent breakdown, Unrealistic contract duration and project scope, Poor coordination and management, poor financial management system and Scope changes arising from redesign and extensive variation orders. Eight of highly influential factors occur during the project execution stage and the rest 2 factors occur at the initiation stage.

To get the general overview, the Sixty-Eight (68) influencing project delay factors were categorized into (Twelve) 12 determinants; the top 5 determinant factors identified as major cause of time overrun are; Inefficient/insufficient Material and Machinery Management, Poor Financial management System, Poor Data Collection, Poor/ inappropriate contract administration and design and Poor Site Management. Three out of the five determinant factors occur during the execution life cycle stage.

The major responsible parties for causing delay identified and for the project initiation lifecycle stage the client took major responsibility on causing time overrun for 11 factors out of 12. Whereas, from the project planning stage up to execution life cycle stage, contractors are responsible for 38 delay factors out of 57 factors which is more than two folds of the values given for the client and consultants,14.

The research also used inferential analysis to identify correlation between determinant factors at each life cycle stage with time overrun of projects using SPSS 23 software. The most critical determinant factor of time overrun of projects is planning based on unrealistic assumptions. The betta coefficient of the determinant is 0.138. This is qualified by number of researches. Mikiyas also found planning being the major component on making project effective correlation between the overall levels of planning applied to a project and the level of project effectiveness (Mikiyas,2018).

The second determinant for overall estimation of time overrun is poor site management during execution life cycle stage. In many cases due to contractor's lack of experience, the construction site faces obstacles that lead to poor site management (Mahamid, 2012). From the inferential analysis it was found 67.3% of the change in time overrun of projects are explained by determinants at the execution life cycle stage. Planning and initiation life cycle stage determinants each account for 16.4% change in time overrun.

### **5.3 Findings and Conclusions**

The purpose of this research was to identify the impact and frequency of occurrence of delay factors leading into time overrun of project at different project life cycle stages. Accordingly, the researcher analyzed the following research questions and reached to the corresponding conclusions.

The first research questions asked **“How does delay determinant factors during project initiation attributed to different parties involve in construction, contribute to time overrun of road construction projects administered by ERA?”** The key finding from the research in this aspect are:

Determinants during project initiation have 54.5% moderate and 45.5% high influence on time overrun. 86% of the factors are caused by the client and the remaining 14% by consultant's others stakeholders not identified as responsible.

The most severe factor leading into time overrun at this life cycle stage is unrealistic contract duration and project scope at the initial formulation of the project. This is in line with findings of Memon,(2014) not properly designed scope leading into frequent change ranked as second most severe cause of delay. Insufficient data collection before design and awarding project to the lowest bid price are also severe determinant causing factor at this life cycle stage. Alfardi, (2018) find out from contractors' viewpoint for delay causes in building construction projects in Saudi Arabia, awarding the bid to lowest price to have critical effect on time overrun.

In general, the following conclusions are made;

- From the eleven factors considered, five of them categorized under Poor/ inappropriate contract administration and design at initiation stage have critical impact on time overrun of projects. The major influential factors being unrealistic contract duration, insufficient data collection for formulation of projects, awarding the contract to the lowest bidder and mistakes in drawings and documents.
- The client can be said the sole responsible party for causing time overrun of projects at this life cycle stage.
- Based on the hypothesis testing results is it fair to conclude that there is positive relationship between delay factors during project life cycle management and project time overrun.
- According to correlation analysis, delay factors at the initiation life cycle stage positively correlated with time overrun of projects.
- There is significant relationship between delay factors at the initiation life cycle stage and time overrun of projects with correlation coefficient of 0.164.

These findings are similar with Dvir, which have found out sufficient effort should be made at initial project stage in establishment of project goals and deliverables with proper engagement of stake holders. Stakeholders should always be part of projects right from the beginning in order to realize projects objectives (Dvir,2001).

The second research questions asked **“How do delay determinant factors during project planning attributed to different parties involve in construction, contribute to time overrun of road construction projects administered by ERA?”** The key finding from the research in this aspect are:

- From the eleven delay factors considered at this life cycle stage six of them categorized under Poor data collection for proper planning during planning stage have critical impact on time overrun of

projects. The major influential factors being overlooking actual situations, poor risk analysis, over estimation of accomplishment plans and poor investigation.

- Consultants are responsible for poor collection of data for planning stage. On the other hand, contractors are identified as responsible for unrealistic expectation and assumptions for faulty preparation of project planning. The client responsible for underestimating the socioeconomic change furcating and involvement of stakeholders.
- Based on the hypothesis testing results is it fair to conclude that there is positive and strong relationship between delay factors during planning project life cycle management and project time overrun.
- According to correlation analysis, delay factors at the planning life cycle stage strongly correlated with time overrun of projects.
- There is fair relationship between delay factors at the planning life cycle stage and time overrun of projects with correlation coefficient of 0.164.
- Determinants during project planning life cycle stage, have 45.5% moderate and 54.5% critical influence on time overrun. Responsibility of the stakeholders is found to be 32% ,37% and 35% of the factors are caused by the client, consultants and contractors.

Overlooking Site conditions, poor risk analysis and source and availability of construction materials are the top three causes at this life cycle stage and this finding is in conformity with (Duryev, 2018) who has identified these factors as major causes of delay by analyzing various papers from 1980's to 2010's.

The third research questions asked “**How do delay determinant factors during project execution attributed to different parties involve in construction, contribute to time overrun of road construction projects administered by ERA?**” The key finding from the research in this aspect are:

The following are findings from the result of the study

- Contractors take the significant portion of responsibilities for causing delay during this life cycle stage. Based on the hypothesis testing results is it fair to conclude that there is positive and strong relationship between delay factors during execution project life cycle management and project time overrun.
- According to correlation analysis, delay factors at the execution life cycle stage strongly correlated with time overrun of projects.

- There is strong relationship between delay factors at the execution life cycle stage and time overrun of projects with correlation coefficient of 0.673.
- Determinants factors during project execution life cycle stage have 32.6% moderate and 67.4 % high influential. When we see the role of stake holders, client, consultants, external and contractors cause 16% , 6%, 7% and 61% respectively.
- Based on finding from the research, the most critical delay causing factors occur at the execution life cycle stage of the project. While considering categories of delay factors in the at each life cycle stage, 87.5% of the categories of delay factors during execution stage are critical against 50% of the other two life cycle stages.

Based on desk study, delay factors during project execution stage have strong effect on the time overrun of projects, as the time progresses, the number of projects being affected and the extent of delay factors on time overrun will get severe. From the forty-six delay factors considered at this life cycle stage, thirty-one i.e. 67.4 % of them have critical impact on time overrun of projects. Ismael, has found out construction phase is a major contributor on time and cost overrun in construction project, lack of communication among parties and scope change of the projects are stated as being major causes (Ismael,2013).

The most influential factors being inappropriate resource Management and Utilization associated with, Equipment/ Plant shortage when contractors engaged in a project are identified as the major factor. These results are also in agreement with findings of (Indhu et. al ,2020), (Rivera 2020), (sah,2017). The next determinant which leads into time overrun of projects is associated with poor financial management is associated with improper handling of financial obligation by different stakeholders. Various studies have also indicated financial problems to be major cause of delay (Tadle,2017), (sah,2017),(khaleel,2017). The third most influential factor leading time overrun at this life cycle stage is incapability of project management the finding is in conformity with other studies by (Memon,2014),(Dureyev,2014) .

## **5.4 Recommendations**

The finding of this study is significant for identifying the most important causes of time overrun in road projects at various life cycle stage. It also identifies stakeholders highly contribution in creation of delay causing actions at various lifecycle stage.

This study will give an insight towards where to look for timely mitigation measures by breaking down the big concept of time overrun into manageable pieces. The study will also help stakeholders to engage

better by looking into shortcomings associated with current way of working and practices for upcoming projects in advance.

Future researches can be done to study the root causes of these determinants taking into consideration various project specific factors such as geographical location of projects, weather condition of projects, project delivery method and to establish appropriate proactive measures with regard to initiation, planning, and execution.

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# Appendices

## 7.1 Questionnaire

### Section A: General background of respondents

Questions related to the respondent's educational backgrounds and professional experiences.

1.1. What is your level of Education?

Certificate       Diploma       BA/BSC       MA/MSc

1.2. Type or origin of your current organization?

Contractor       Consultant       Client       Other

If you select other, please specify \_\_\_\_\_

1.3 Relevant work experience

< 5 years       10 years       11-15 years       >15 years

1.3. Job title/designation, please specify \_\_\_\_\_

**Section 2: Basic Information on Causes of Time Overrun in Road Construction Project, probability of occurrence and responsible parties at various life cycle of projects**

**2.1. Factors influencing project time overruns**

Please indicate the significance of each factor by marking ✓ in the appropriate boxes. If there are more than one responsible party, please indicate all responsible parties.

A. Frequency of occurrence	B. For impact on time overrun
0- Never = 0% (probability to happen) 1- Unlikely =25% 2- Likely =50% 3- Almost certain = 75% 4- Certain =100% probability to happen	0-No impact 1-Minor impact 2-Average impact 3-High impact 4-Extreme impact

project life cycle stage	No	delay causes	Probability of Occurrence					Responsible party				Impact on time overrun				
			4	3	2	1	0	Contractor	Client	Consultant	External	4	3	2	1	0
Project Initiation	<b>Improper project selection</b>															
	1	Vaguely defined project scope														
	2	Non involvement of all stakeholders in project initiation														
	3	Lack of stakeholder's experience / qualification / competence on defining project														
	4	Non Feasibility / politically motivated projects														
	5	Award project to the lowest bid price														
	<b>Poor/ inappropriate contract administration and design</b>															
	6	Inappropriate contract delivery method														
	7	Bid related delays (process, type and evaluation method)														
	8	Delay in project commencement/ late contract award														
	9	Unrealistic contract duration and project scope														
	10	Design and contract document problems (mistakes, being incomplete and inappropriate)														
11	Insufficient data collection before design															
Project Planning	<b>Poor Data Collection</b>															
	12	Overlooking Site conditions (i.e. access, storage, obstructions, traffic and security)(ROW)														
	13	Poor information knowledge and survey of subsurface and ground conditions														
	<b>Unrealistic expectation/Assumptions</b>															
	14	unrealistic assumptions for planning( productivity of equipment , working culture in the project area...)														
	15	poor risk analysis														
	16	unable to assess and predict the future socio economic condition														
	17	ignoring the influence of stakeholders														
	18	On availability of utilities on site														
	19	procurement process and plan														
	20	source and availability of construction materials														
	21	weather and environmental conditions														
22	Inadequate method statement and execution strategy															

			Probability of Occurrence					Responsible party				Impact on time overrun				
project life cycle stage	No	delay causes	4	3	2	1	0	Contractor	Client	Consultant	External	4	3	2	1	0
<b>Project Execution</b>	<b>Poor Site Management</b>															
	23	Improper Construction method / technique														
	24	Poorly defined crew (workforce) definition														
	25	Reworking (due to various reasons)														
	26	Poor coordination and management														
	27	Poor/ineffective/lack of quality Assurance System														
	28	Disputes on site, Work suspensions owing to conflicts														
	29	subcontractor related delays														
	<b>Poor communication system</b>															
	30	no defined communication strategy														
	31	poor and delayed decision making														
	32	inefficient communication plan/channel between parties														
	<b>Weakened Project Management and Contract Administration</b>															
	33	Right of way problems (access to site and quarry locations)														
	34	Contract disputes and negotiations														
	35	Scope changes arising from redesign and extensive variation orders														
	36	Health , Safety and environmental issues														
	37	non appropriate organizational arrangement for project execution														
	38	delayed and ineffective Procurement of materials														
	<b>Ineffectiveness in Managing Multiple projects Simultaneously</b>															
	39	Unmanageable number of active projects														
	40	Distance of projects from head quarters and their geographical disparity														
	41	poor top management support / improper delegation at project level														
42	Poor allocation of resources and not setting-out clear goals and priority to projects															
43	unsuitable organizational culture and improper strategic plan for proper project management															

			Probability of Occurrence					Responsible party				Impact on time overrun				
project life cycle stage	No	delay causes	4	3	2	1	0	Contractor	Client	Consultant	External	4	3	2	1	0
<b>Project Execution</b>	<b>Labor related factors (Ineffective and Inefficient)</b>															
	44	labor strikes due to poor working condition, delayed payments														
	45	lack of skilled/qualified work force														
	46	un-skilled Labor shortage														
	47	Absenteeism from work														
	48	Staff/labor turnover														
	49	Low/lack of motivation														
	50	absence of performance related payment														
	<b>Inefficient/insufficient Material and Machinery Management and Utilization</b>															
	51	Equipment/Plant shortage														
	52	Delayed mobilization/commencement														
	53	Lack of knowledge of available local resources														
	54	Equipment/plant frequent breakdown														
	55	delayed and poor quality of material procurement														
	56	Inadequate/shortage production of materials in the country														
	<b>Poor Financial management System</b>															
	57	Improper utilization of Advance Payment														
	58	late collection of payments														
	59	poor financial management system														
	60	poor Inventory Management														
	<b>challenging external factors</b>															
	61	corruption/fraud														
	62	Unexpected subsurface conditions														
	63	Macro Economic factors/problems/conditions														
	64	Unforeseen events (Act of God)														
	65	lengthy Bureaucratic Process														
	66	Strikes, political factors														
	67	Adverse Weather/climate conditions														
68	changes in rules, regulations															

## 2.2. Additional Factors influencing project time overruns

Do you feel there are any factors that would have significant impact on time overrun of road construction projects other than that of questioned above? Please list them down and briefly explain how they affect time overrun.

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### **2.3 Mitigation Measures**

Please suggest your recommendations to minimize project delay. What you recommend clients, consultants and contractors in order to minimize or control causes of delay to projects

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## 7.2 Critical values for Pearson's correlation coefficient r

	.75	.90	.95	.975	.99	.995	.9975	.999	.9995
	<i>Directional alpha levels</i>								
	.25	.10	.05	.025	.01	.005	.0025	.001	.0005
	<i>Nondirectional alpha levels</i>								
<i>N</i>	.50	.20	.10	.05	.02	.01	.005	.002	.001
38	0.113	0.212	0.271	0.321	0.378	0.415	0.450	0.491	0.519
39	0.111	0.210	0.267	0.317	0.373	0.410	0.444	0.485	0.512
40	0.110	0.207	0.264	0.313	0.368	0.405	0.439	0.479	0.506
41	0.108	0.204	0.261	0.309	0.364	0.400	0.433	0.473	0.501
42	0.107	0.202	0.257	0.305	0.359	0.396	0.428	0.468	0.495
43	0.105	0.199	0.254	0.301	0.355	0.391	0.423	0.462	0.489
44	0.104	0.197	0.251	0.298	0.351	0.386	0.419	0.457	0.484
45	0.103	0.194	0.248	0.294	0.347	0.382	0.414	0.452	0.479
46	0.102	0.192	0.246	0.291	0.343	0.378	0.410	0.448	0.474
47	0.101	0.190	0.243	0.288	0.340	0.374	0.405	0.443	0.469
48	0.100	0.188	0.240	0.285	0.336	0.370	0.401	0.439	0.465
49	0.098	0.186	0.238	0.282	0.333	0.366	0.397	0.434	0.460
50	0.097	0.184	0.235	0.279	0.329	0.363	0.393	0.430	0.456
52	0.095	0.180	0.231	0.274	0.323	0.356	0.386	0.422	0.447
54	0.094	0.177	0.226	0.268	0.317	0.349	0.379	0.414	0.439
56	0.092	0.174	0.222	0.264	0.311	0.343	0.372	0.407	0.432
58	0.090	0.171	0.218	0.259	0.306	0.337	0.366	0.400	0.424
60	0.089	0.168	0.214	0.255	0.301	0.331	0.360	0.394	0.417
62	0.087	0.165	0.211	0.250	0.296	0.326	0.354	0.387	0.411
64	0.086	0.162	0.207	0.246	0.291	0.321	0.348	0.382	0.405
66	0.084	0.160	0.204	0.243	0.287	0.316	0.343	0.376	0.399
68	0.083	0.157	0.201	0.239	0.282	0.311	0.338	0.370	0.393
70	0.082	0.155	0.198	0.235	0.278	0.307	0.333	0.365	0.387
72	0.081	0.153	0.195	0.232	0.274	0.303	0.329	0.360	0.382
74	0.080	0.151	0.193	0.229	0.271	0.299	0.324	0.355	0.377
76	0.078	0.149	0.190	0.226	0.267	0.295	0.320	0.351	0.372
78	0.077	0.147	0.188	0.223	0.264	0.291	0.316	0.346	0.368
80	0.076	0.145	0.185	0.220	0.260	0.287	0.312	0.342	0.363
82	0.075	0.143	0.183	0.217	0.257	0.284	0.308	0.338	0.359
84	0.074	0.141	0.181	0.215	0.254	0.280	0.305	0.334	0.355
86	0.074	0.139	0.179	0.212	0.251	0.277	0.301	0.330	0.351
88	0.073	0.138	0.176	0.210	0.248	0.274	0.298	0.327	0.347
90	0.072	0.136	0.174	0.207	0.245	0.271	0.294	0.323	0.343
92	0.071	0.135	0.173	0.205	0.243	0.268	0.291	0.319	0.339
94	0.070	0.133	0.171	0.203	0.240	0.265	0.288	0.316	0.336
96	0.070	0.132	0.169	0.201	0.238	0.262	0.285	0.313	0.332

## 7.3 Summary of the project time overrun impact based on the rank

given by respondents to questionnaire survey

Factors	Client		Contractor		Consultant		Overall	
	IMP.I %	Rank	IMP.I %	Rank	IMP.I %	Rank	IMP.I %	Rank
Right of way problems (access to site and quarry locations)	64.45	1	59.38	2	72.46	1	65.88	1
Equipment/Plant shortage	63.28	2	72.92	1	63.28	2	63.33	2
Improper utilization of Advance Payment	49.41	8	56.08	6	56.03	4	51.96	3
Delayed mobilization/commencement	48.83	11	50.00	9	55.03	6	51.96	3
Equipment/plant frequent breakdown	56.15	5	47.22	10	53.91	7	51.33	5
Unrealistic contract duration and project scope	53.71	6	52.78	7	51.27	15	50.76	6
Poor coordination and management	51.56	7	43.75	13	51.64	12	49.57	7
poor financial management system	40.43	25	59.38	2	50.54	16	48.38	8
Insufficient data collection before design	49.41	8	44.27	12	51.44	14	47.73	9
Scope changes arising from redesign and extensive variation orders	60.94	4	38.89	19	45.46	22	47.13	10
Award project to the lowest bid price	48.44	13	56.25	5	45.04	25	47.00	11
delayed and ineffective Procurement of materials	48.83	11	52.78	7	45.14	23	46.08	12
poor and delayed decision making	42.97	19	38.89	19	53.54	8	45.99	13
late collection of payments	29.88	49	59.38	2	51.56	13	45.53	14
Design and contract document problems (mistakes, being incomplete and inappropriate)	47.17	15	47.22	10	45.12	24	45.00	15
Improper Construction method / technique	41.02	23	27.08	44	57.13	3	44.38	16
Overlooking Site conditions (i.e. access, storage, obstructions, traffic and security)(ROW)	49.41	8	41.67	14	45.04	25	43.88	17

poor risk analysis	47.27	14	41.67	14	44.92	27	43.85	18
Inadequate/shortage production of materials in the country	40.82	24	31.60	31	51.66	11	43.31	19
Strikes, political factors	35.25	35	38.89	19	49.22	18	42.19	20
Macro Economic factors/problems/conditions	35.16	36	36.46	23	49.41	17	41.71	21
Poorly defined crew (workforce) definition	43.07	17	35.42	26	43.36	29	40.83	22
source and availability of construction materials	31.25	47	39.06	18	48.29	19	40.63	23
delayed and poor quality of material procurement	42.97	19	41.32	17	40.82	37	40.60	24
Poor/ineffective/lack of quality Assurance System	42.97	19	34.03	27	41.99	33	39.58	25
corruption/fraud	23.24	60	29.17	40	55.08	5	39.58	25
unsuitable organizational culture and improper strategic plan for proper project management	34.86	40	20.83	55	52.64	10	39.57	27
Unexpected subsurface conditions	38.67	30	36.11	25	41.99	33	39.06	28
lengthy Bureaucratic Process	40.43	25	38.89	19	39.99	38	39.06	29
Poor allocation of resources and not setting-out clear goals and priority to projects	33.40	43	19.10	58	52.78	9	38.53	30
Disputes on site, Work suspensions owing to conflicts	40.43	25	41.67	14	36.91	45	38.03	31
Unrealistic assumptions for planning( productivity of equipment , working culture in the project area,..)	33.40	43	24.83	51	47.85	20	37.92	32
poor top management support / improper delegation at project level	37.11	32	31.25	34	42.04	32	37.51	33
Adverse Weather/climate conditions	35.16	36	33.85	30	41.99	33	37.51	33
Contract disputes and negotiations	61.04	3	22.92	52	35.16	48	37.00	35
Lack of knowledge of available local resources	34.86	40	26.04	49	43.95	28	36.98	36
inefficient communication plan/channel between parties	37.11	32	36.46	23	39.04	40	36.50	37

Reworking (due to various reasons)	<b>46.88</b>	<b>16</b>	<b>21.01</b>	<b>53</b>	<b>39.99</b>	<b>38</b>	<b>35.97</b>	<b>38</b>
Poor information knowledge and survey of subsurface and ground conditions	<b>35.16</b>	<b>36</b>	<b>26.74</b>	<b>48</b>	<b>41.89</b>	<b>36</b>	<b>35.89</b>	<b>39</b>
Unmanageable number of active projects	<b>37.11</b>	<b>32</b>	<b>29.34</b>	<b>37</b>	<b>37.94</b>	<b>41</b>	<b>35.49</b>	<b>40</b>
Inappropriate contract delivery method	<b>42.97</b>	<b>19</b>	<b>31.25</b>	<b>34</b>	<b>33.42</b>	<b>53</b>	<b>35.01</b>	<b>41</b>
procurement process and plan	<b>43.07</b>	<b>17</b>	<b>28.65</b>	<b>42</b>	<b>35.16</b>	<b>48</b>	<b>34.47</b>	<b>42</b>
Non involvement of all stakeholders in project initiation	<b>24.90</b>	<b>58</b>	<b>25.00</b>	<b>50</b>	<b>46.04</b>	<b>21</b>	<b>34.00</b>	<b>43</b>
weather and environmental conditions	<b>28.22</b>	<b>52</b>	<b>31.60</b>	<b>31</b>	<b>37.35</b>	<b>42</b>	<b>33.40</b>	<b>44</b>
labor strikes due to poor working condition, delayed payments	<b>29.88</b>	<b>49</b>	<b>34.03</b>	<b>27</b>	<b>36.18</b>	<b>46</b>	<b>33.03</b>	<b>45</b>
Vaguely defined project scope	<b>35.16</b>	<b>36</b>	<b>12.15</b>	<b>67</b>	<b>43.07</b>	<b>30</b>	<b>32.57</b>	<b>46</b>
Non Feasibility / politically motivated projects	<b>29.88</b>	<b>49</b>	<b>27.08</b>	<b>44</b>	<b>37.11</b>	<b>44</b>	<b>32.11</b>	<b>47</b>
Inadequate method statement and execution strategy	<b>38.67</b>	<b>30</b>	<b>31.25</b>	<b>34</b>	<b>32.52</b>	<b>55</b>	<b>32.08</b>	<b>48</b>
lack of skilled/qualified work force	<b>26.56</b>	<b>54</b>	<b>31.60</b>	<b>31</b>	<b>36.18</b>	<b>46</b>	<b>32.08</b>	<b>48</b>
Delay in project commencement/ late contract award	<b>39.06</b>	<b>28</b>	<b>15.63</b>	<b>63</b>	<b>37.13</b>	<b>43</b>	<b>31.64</b>	<b>50</b>
Bid related delays (process, type and evaluation method)	<b>25.00</b>	<b>56</b>	<b>34.03</b>	<b>27</b>	<b>34.28</b>	<b>51</b>	<b>31.63</b>	<b>51</b>
poor Inventory Management	<b>27.34</b>	<b>53</b>	<b>29.17</b>	<b>40</b>	<b>34.33</b>	<b>50</b>	<b>30.63</b>	<b>52</b>
no defined communication strategy	<b>33.40</b>	<b>43</b>	<b>21.01</b>	<b>53</b>	<b>33.33</b>	<b>54</b>	<b>29.34</b>	<b>53</b>
subcontractor related delays	<b>17.77</b>	<b>66</b>	<b>18.06</b>	<b>60</b>	<b>43.04</b>	<b>31</b>	<b>29.28</b>	<b>54</b>
ignoring the influence of stakeholders	<b>21.97</b>	<b>61</b>	<b>29.34</b>	<b>37</b>	<b>34.03</b>	<b>52</b>	<b>29.28</b>	<b>54</b>
On availability of utilities on site	<b>25.00</b>	<b>56</b>	<b>28.65</b>	<b>42</b>	<b>32.52</b>	<b>55</b>	<b>28.88</b>	<b>56</b>
Distance of projects from head quarters and their geographical disparity	<b>31.25</b>	<b>47</b>	<b>20.83</b>	<b>55</b>	<b>29.91</b>	<b>60</b>	<b>27.53</b>	<b>57</b>
changes in rules, regulations	<b>26.56</b>	<b>54</b>	<b>17.36</b>	<b>61</b>	<b>31.64</b>	<b>57</b>	<b>26.25</b>	<b>58</b>
Unforeseen events (Act of God)	<b>31.64</b>	<b>46</b>	<b>27.08</b>	<b>44</b>	<b>23.44</b>	<b>67</b>	<b>25.42</b>	<b>59</b>
non appropriate organizational arrangement for project execution	<b>38.96</b>	<b>29</b>	<b>29.34</b>	<b>37</b>	<b>30.76</b>	<b>58</b>	<b>24.97</b>	<b>60</b>

un-skilled Labor shortage	34.38	42	17.36	61	25.00	66	24.89	61
Staff/labor turnover	19.04	64	27.08	44	26.56	62	24.17	62
Lack of stakeholder's experience / qualification / competence on defining project	16.41	67	19.10	58	29.81	61	23.25	63
Low/lack of motivation	20.51	63	20.31	57	25.49	64	23.11	64
unable to assess and predict the future socio economic condition	24.90	58	15.28	66	25.29	65	22.39	65
absence of performance related payment	12.89	68	15.63	63	30.71	59	21.78	66
Health , Safety and environmental issues	19.04	64	15.63	63	26.56	62	21.38	67
Absenteeism from work	21.88	62	12.15	67	4.54	68	17.63	68

Source: field Survey (2023)

#### 7.4 Regression analysis and anova and t-tests of key variables at initiation lifecycle stage

Model Summary: Dependent Variable INT(time overrun of projects at initiation life cycle stage due to init\_1 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change

1	.938a	.879	.875	7.05082	.879	189.196	.000
2	.946b	.895	.865	7.32196	.016	.622	.685
3	.973c	.946	.909	6.00271	.051	3.049	.040
4	.988d	.976	.941	4.82001	.030	2.763	.074
5	.992e	.984	.930	5.28268	.008	.632	.685
6	1.000f	1.000	1.000	.09450	.016	3750.142	.012

- a. Predictors: (Constant), init\_2  
b. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1  
c. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2  
d. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2, Exter\_3, Clie\_n\_3, Contr\_3, Effect\_3, Consu\_3  
e. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2, Exter\_3, Clie\_n\_3, Contr\_3, Effect\_3, Consu\_3, Exter\_4, Clie\_n\_4, Consu\_4, Contr\_4, Effect\_4  
f. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3, Contr\_5, Effect\_5, Consu\_5, Clie\_n\_5, Exter\_5

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	10698.262	26	411.472	46080.917	.004c
	Residual	.009	1	.009		
	Total	10698.271	27			

a. Dependent Variable: INT

b. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3

c. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3, Contr\_5, Effect\_5, Consu\_5, Clie\_n\_5, Exter\_5

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	27.909	.463		60.336	.011
	init_2	1.186	.003	1.228	342.541	.002
	Effect_1	.243	.002	.466	111.773	.006

Effect_2	-.609	.005	-.774	-110.766	.006
Effect_3	-.620	.007	-.622	-87.485	.007
Effect_4	.377	.004	.602	86.476	.007
Contr_1	-13.350	.146	-.176	-91.180	.007
Clie_n_1	4.942	.173	.097	28.623	.022
Consu_1	-29.453	.193	-.618	-152.215	.004
Exter_1	-8.857	.284	-.117	-31.205	.020
Contr_2	-17.905	.239	-.397	-75.030	.008
Clie_n_2	-42.078	.377	-.554	-111.605	.006
Consu_2	31.729	.325	.803	97.737	.007
Exter_2	43.452	.398	.688	109.157	.006
Contr_3	-19.567	.329	-.468	-59.387	.011
Clie_n_3	7.426	.175	.186	42.537	.015
Consu_3	26.315	.276	.608	95.290	.007
Exter_3	3.732	.149	.089	25.032	.025
Contr_4	3.892	.340	.070	11.448	.055
Clie_n_4	9.545	.153	.221	62.207	.010
Consu_4	-29.469	.320	-.466	-92.113	.007
Exter_4	11.089	.183	.246	60.688	.010
Effect_5	.169	.004	.255	44.790	.014
Contr_5	-11.655	.200	-.154	-58.384	.011
Clie_n_5	-13.834	.430	-.131	-32.148	.020
Consu_5	-24.273	.357	-.384	-67.997	.009
Exter_5	-80.391	.857	-.763	-93.802	.007

a. Dependent Variable: INT

Model Summary: Dependent Variable INT(time overrun of projects at initiation life cycle stage due to init\_2 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.923a	.852	.846	7.81221	.852	149.293	.000
2	.936b	.876	.841	7.94031	.025	.834	.540
3	.970c	.941	.907	6.07035	.065	4.733	.009
4	.976d	.952	.901	6.25326	.011	.755	.572
5	.978e	.956	.880	6.89832	.003	.227	.875
6	.988f	.975	.889	6.64610	.020	1.193	.402
7	1.000g	1.000	.999	.73813	.025	121.105	.008

a. Predictors: (Constant), init\_1

b. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6

- c. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7
- d. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8
- e. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8, Contr\_9, Consu\_9, Effect\_9
- f. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8, Contr\_9, Consu\_9, Effect\_9, Consu\_10, Contr\_10, Effect\_10, Clie\_n\_10
- g. Predictors: (Constant), Consu\_10, Effect\_7, Consu\_6, Contr\_6, Exter\_6, Consu\_8, Clie\_n\_10, init\_1, Contr\_10, Consu\_9, Effect\_6, Contr\_9, Effect\_9, Effect\_8, Contr\_7, Clie\_n\_6, Clie\_n\_9, Effect\_10, Contr\_8, Consu\_7, Clie\_n\_8, Clie\_n\_11, Effect\_11, Contr\_11, Consu\_11

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	10697.181	25	427.887	785.340	.001c
	Residual	1.090	2	.545		
	Total	10698.271	27			

a. Dependent Variable: INT

- c. Predictors: (Constant), Consu\_10, Effect\_7, Consu\_6, Contr\_6, Exter\_6, Consu\_8, Clie\_n\_10, init\_1, Contr\_10, Consu\_9, Effect\_6, Contr\_9, Effect\_9, Effect\_8, Contr\_7, Clie\_n\_6, Clie\_n\_9, Effect\_10, Contr\_8, Consu\_7, Clie\_n\_8, Clie\_n\_11, Effect\_11, Contr\_11, Consu\_11

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	113.763	5.414		21.013	.002
	init_1	.877	.014	.984	63.882	.000
	Effect_6	-.384	.029	-.542	-13.466	.005
	Effect_7	-.105	.018	-.130	-5.910	.027
	Effect_8	.603	.033	.928	18.363	.003
	Effect_9	-.250	.018	-.358	-14.282	.005
	Effect_10	.103	.016	.153	6.409	.023
	Contr_6	-9.046	1.742	-.162	-5.192	.035
	Clie_n_6	14.846	1.768	.343	8.399	.014
	Consu_6	-6.404	1.055	-.142	-6.070	.026
	Exter_6	16.993	1.680	.161	10.114	.010
	Contr_7	-96.833	4.281	-1.733	-22.620	.002
	Consu_7	-22.013	2.796	-.462	-7.873	.016
	Contr_8	-7.609	1.209	-.176	-6.294	.024
	Clie_n_8	42.149	5.860	.555	7.193	.019
	Consu_8	-14.806	1.772	-.290	-8.355	.014
	Contr_9	-.388	1.361	-.006	-.285	.803

Clie_n_9	-12.992	2.845	-.171	-4.567	.045
Consu_n_9	1.313	.994	.029	1.321	.317
Contr_n_10	59.325	3.587	1.314	16.541	.004
Clie_n_10	-27.483	1.711	-.696	-16.065	.004
Consu_n_10	12.461	1.076	.244	11.582	.007
Effect_n_11	-.124	.018	-.174	-6.724	.021
Contr_n_11	-53.830	3.716	-.964	-14.486	.005
Clie_n_11	9.044	1.029	.231	8.787	.013
Consu_n_11	-124.930	5.988	-1.977	-20.864	.002

a. Dependent Variable: INT

**Model Summary: Dependent Variable INT (time overrn of projects at initiation life cycle stage due to init\_1 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.938 <sup>a</sup>	.879	.875	7.05082	.879	189.196	.000
2	.946 <sup>b</sup>	.895	.865	7.32196	.016	.622	.685
3	.973 <sup>c</sup>	.946	.909	6.00271	.051	3.049	.040
4	.988 <sup>d</sup>	.976	.941	4.82001	.030	2.763	.074
5	.992 <sup>e</sup>	.984	.930	5.28268	.008	.632	.685
6	1.000 <sup>f</sup>	1.000	1.000	.09450	.016	3750.142	.012

a. Predictors: (Constant), init\_2

b. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1

c. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2

d. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2, Exter\_3, Clie\_n\_3, Contr\_3, Effect\_3, Consu\_3

e. Predictors: (Constant), init\_2, Exter\_1, Contr\_1, Consu\_1, Effect\_1, Clie\_n\_1, Exter\_2, Clie\_n\_2, Effect\_2, Contr\_2, Consu\_2, Exter\_3, Clie\_n\_3, Contr\_3, Effect\_3, Consu\_3, Exter\_4, Clie\_n\_4, Consu\_4, Contr\_4, Effect\_4

f. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3, Contr\_5, Effect\_5, Consu\_5, Clie\_n\_5, Exter\_5

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	10698.262	26	411.472	46080.917	.004 <sup>c</sup>
	Residual	.009	1	.009		
	Total	10698.271	27			

a. Dependent Variable: INT

b. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3

c. Predictors: (Constant), Exter\_4, Effect\_2, Exter\_3, init\_2, Clie\_n\_2, Contr\_1, Contr\_4, Consu\_3, Consu\_1, Clie\_n\_1, Clie\_n\_4, Exter\_2, Effect\_1, Clie\_n\_3, Consu\_4, Exter\_1, Effect\_4, Contr\_2, Effect\_3, Consu\_2, Contr\_3, Contr\_5, Effect\_5, Consu\_5, Clie\_n\_5, Exter\_5

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	27.909	.463		60.336	.011
	init_2	1.186	.003	1.228	342.541	.002
	Effect_1	.243	.002	.466	111.773	.006
	Effect_2	-.609	.005	-.774	-110.766	.006
	Effect_3	-.620	.007	-.622	-87.485	.007
	Effect_4	.377	.004	.602	86.476	.007
	Contr_1	-13.350	.146	-.176	-91.180	.007
	Clie_1	4.942	.173	.097	28.623	.022
	Consu_1	-29.453	.193	-.618	-152.215	.004
	Exter_1	-8.857	.284	-.117	-31.205	.020
	Contr_2	-17.905	.239	-.397	-75.030	.008
	Clie_2	-42.078	.377	-.554	-111.605	.006
	Consu_2	31.729	.325	.803	97.737	.007
	Exter_2	43.452	.398	.688	109.157	.006
	Contr_3	-19.567	.329	-.468	-59.387	.011
	Clie_3	7.426	.175	.186	42.537	.015
	Consu_3	26.315	.276	.608	95.290	.007
	Exter_3	3.732	.149	.089	25.032	.025
	Contr_4	3.892	.340	.070	11.448	.055
	Clie_4	9.545	.153	.221	62.207	.010
	Consu_4	-29.469	.320	-.466	-92.113	.007
	Exter_4	11.089	.183	.246	60.688	.010
	Effect_5	.169	.004	.255	44.790	.014
	Contr_5	-11.655	.200	-.154	-58.384	.011
	Clie_5	-13.834	.430	-.131	-32.148	.020
	Consu_5	-24.273	.357	-.384	-67.997	.009
	Exter_5	-80.391	.857	-.763	-93.802	.007

a. Dependent Variable: INT

**Model Summary: Dependent Variable INT (time overrn of projects at initiation life cycle stage due to init\_2 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.923 <sup>a</sup>	.852	.846	7.81221	.852	149.293	.000
2	.936 <sup>b</sup>	.876	.841	7.94031	.025	.834	.540

3	.970 <sup>c</sup>	.941	.907	6.07035	.065	4.733	.009
4	.976 <sup>d</sup>	.952	.901	6.25326	.011	.755	.572
5	.978 <sup>e</sup>	.956	.880	6.89832	.003	.227	.875
6	.988 <sup>f</sup>	.975	.889	6.64610	.020	1.193	.402
7	1.000 <sup>g</sup>	1.000	.999	.73813	.025	121.105	.008

a. Predictors: (Constant), init\_1

b. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6

c. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7

d. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8

e. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8, Contr\_9, Consu\_9, Effect\_9

f. Predictors: (Constant), init\_1, Clie\_n\_6, Consu\_6, Effect\_6, Exter\_6, Contr\_6, Contr\_7, Effect\_7, Clie\_n\_7, Consu\_7, Effect\_8, Contr\_8, Consu\_8, Clie\_n\_8, Contr\_9, Consu\_9, Effect\_9, Consu\_10, Contr\_10, Effect\_10, Clie\_n\_10

g. Predictors: (Constant), Consu\_10, Effect\_7, Consu\_6, Contr\_6, Exter\_6, Consu\_8, Clie\_n\_10, init\_1, Contr\_10, Consu\_9, Effect\_6, Contr\_9, Effect\_9, Effect\_8, Contr\_7, Clie\_n\_6, Clie\_n\_9, Effect\_10, Contr\_8, Consu\_7, Clie\_n\_8, Clie\_n\_11, Effect\_11, Contr\_11, Consu\_11

#### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	10697.181	25	427.887	785.340	.001 <sup>c</sup>
	Residual	1.090	2	.545		
	Total	10698.271	27			

a. Dependent Variable: INT

c. Predictors: (Constant), Consu\_10, Effect\_7, Consu\_6, Contr\_6, Exter\_6, Consu\_8, Clie\_n\_10, init\_1, Contr\_10, Consu\_9, Effect\_6, Contr\_9, Effect\_9, Effect\_8, Contr\_7, Clie\_n\_6, Clie\_n\_9, Effect\_10, Contr\_8, Consu\_7, Clie\_n\_8, Clie\_n\_11, Effect\_11, Contr\_11, Consu\_11

#### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	113.763	5.414		21.013	.002
	init_1	.877	.014	.984	63.882	.000
	Effect_6	-.384	.029	-.542	-13.466	.005
	Effect_7	-.105	.018	-.130	-5.910	.027
	Effect_8	.603	.033	.928	18.363	.003
	Effect_9	-.250	.018	-.358	-14.282	.005
	Effect_10	.103	.016	.153	6.409	.023
	Contr_6	-9.046	1.742	-.162	-5.192	.035
	Clie_n_6	14.846	1.768	.343	8.399	.014
	Consu_6	-6.404	1.055	-.142	-6.070	.026
	Exter_6	16.993	1.680	.161	10.114	.010
	Contr_7	-96.833	4.281	-1.733	-22.620	.002

Consu_7	-22.013	2.796	-.462	-7.873	.016
Contr_8	-7.609	1.209	-.176	-6.294	.024
Clien_8	42.149	5.860	.555	7.193	.019
Consu_8	-14.806	1.772	-.290	-8.355	.014
Contr_9	-.388	1.361	-.006	-.285	.803
Clien_9	-12.992	2.845	-.171	-4.567	.045
Consu_9	1.313	.994	.029	1.321	.317
Contr_10	59.325	3.587	1.314	16.541	.004
Clien_10	-27.483	1.711	-.696	-16.065	.004
Consu_10	12.461	1.076	.244	11.582	.007
Effect_11	-.124	.018	-.174	-6.724	.021
Contr_11	-53.830	3.716	-.964	-14.486	.005
Clien_11	9.044	1.029	.231	8.787	.013
Consu_11	-124.930	5.988	-1.977	-20.864	.002

a. Dependent Variable: INT

## 7.5 Regression analysis and anova and t-tests of key variables at planning life cycle stage

Model Summary: Dependent Variable PLAN (time overrun of projects at planning life cycle stage due to plan determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.979a	.958	.957	3.84808	.958	597.904	.000
2	.987b	.974	.966	3.40040	.015	2.459	.066
3	.990c	.980	.967	3.37602	.007	1.061	.418

a. Predictors: (Constant), plan\_2

b. Predictors: (Constant), plan\_2, Contr\_12, Consu\_12, Effect\_12, Exter\_12, Clien\_12

c. Predictors: (Constant), plan\_2, Contr\_12, Consu\_12, Effect\_12, Exter\_12, Clien\_12, Consu\_13, Clien\_13, Exter\_13, Effect\_13, Contr\_13

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	10697.181	25	427.887	785.340	.001c
	Residual	1.090	2	.545		
	Total	10698.271	27			

a. Dependent Variable: INT

c. Predictors: (Constant), Consu\_10, Effect\_7, Consu\_6, Contr\_6, Exter\_6, Consu\_8, Clie\_10, init\_1, Contr\_10, Consu\_9, Effect\_6, Contr\_9, Effect\_9, Effect\_8, Contr\_7, Clie\_6, Clie\_9, Effect\_10, Contr\_8, Consu\_7, Clie\_8, Clie\_11, Effect\_11, Contr\_11, Consu\_11

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	-.848	2.535		-.334	.742
	plan_2	.972	.046	.932	20.914	.000
	Effect_12	.037	.025	.075	1.476	.159
	Contr_12	-6.477	2.997	-.171	-2.161	.046
	Clie_12	-4.983	3.223	-.137	-1.546	.142
	Consu_12	-1.118	2.071	-.029	-.540	.597
	Exter_12	7.547	4.093	.129	1.844	.084
	Effect_13	.072	.044	.099	1.624	.124
	Contr_13	3.501	2.481	.096	1.411	.177
	Clie_13	.645	2.187	.017	.295	.772
	Consu_13	2.183	2.102	.052	1.039	.314
	Exter_13	-6.293	4.934	-.064	-1.276	.220

a. Dependent Variable: INT

Model Summary: Dependent Variable PLAN(time overrun of projects at planning life cycle stage due to plan\_2 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.823a	.677	.665	10.70626	.677	54.599	.000
2	.871b	.758	.689	10.32256	.080	1.394	.267
3	.903c	.816	.689	10.31370	.058	1.007	.445
4	.927d	.860	.655	10.86053	.044	.686	.644
5	.959e	.919	.636	11.16152	.060	.883	.545
6	1.000f	1.000	.999	.56587	.081	466.666	.035
7	1.000g	1.000			.000		

a. Predictors: (Constant), plan\_1

b. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clie\_14

c. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clie\_14, Contr\_15, Exter\_15, Consu\_15, Effect\_15, Clie\_15

d. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clien\_14, Contr\_15, Exter\_15, Consu\_15, Effect\_15, Clien\_15, Clien\_16, Consu\_16, Contr\_16, Effect\_16, Exter\_16

e. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clien\_14, Contr\_15, Exter\_15, Consu\_15, Effect\_15, Clien\_15, Clien\_16, Consu\_16, Contr\_16, Effect\_16, Exter\_16, Clien\_17, Contr\_17, Exter\_17, Effect\_17, Consu\_17

f. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clien\_14, Contr\_15, Exter\_15, Consu\_15, Effect\_15, Clien\_15, Clien\_16, Consu\_16, Contr\_16, Effect\_16, Exter\_16, Clien\_17, Contr\_17, Exter\_17, Effect\_17, Consu\_17, Contr\_18, Exter\_18, Effect\_18, Consu\_18, Clien\_18

g. Predictors: (Constant), plan\_1, Contr\_14, Effect\_14, Exter\_14, Consu\_14, Clien\_14, Contr\_15, Exter\_15, Consu\_15, Effect\_15, Clien\_15, Clien\_16, Consu\_16, Contr\_16, Effect\_16, Exter\_16, Clien\_17, Contr\_17, Exter\_17, Effect\_17, Consu\_17, Contr\_18, Exter\_18, Effect\_18, Consu\_18, Clien\_18, Contr\_19

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	9056.220	11	823.293	72.234	.000d
	Residual	182.361	16	11.398		
	Total	9238.581	27			

a. Dependent Variable: PLAN

d. Predictors: (Constant), plan\_2, Contr\_12, Consu\_12, Effect\_12, Exter\_12, Clien\_12, Consu\_13, Clien\_13, Exter\_13, Effect\_13, Contr\_13

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	11.661	0.000			
	plan_1	-.156	0.000	-.242		
	Effect_14	-.476	0.000	-.612		
	Contr_14	-19.078	0.000	-.431		
	Clien_14	4.339	0.000	.098		
	Consu_14	-21.167	0.000	-.558		
	Exter_14	-.127	0.000	-.001		
	Effect_15	-.012	0.000	-.018		
	Contr_15	12.548	0.000	.242		
	Clien_15	-13.964	0.000	-.368		
	Consu_15	-.867	0.000	-.024		
	Exter_15	110.816	0.000	1.132		
	Effect_16	.167	0.000	.162		
	Contr_16	-7.833	0.000	-.195		
	Clien_16	1.324	0.000	.035		
	Consu_16	6.611	0.000	.182		

Exter_16	-8.200	0.000	-.116
Effect_17	.761	0.000	1.189
Contr_17	-5.786	0.000	-.159
Clien_17	17.005	0.000	.437
Consu_17	-22.097	0.000	-.594
Exter_17	-24.429	0.000	-.346
Effect_18	.178	0.000	.258
Contr_18	33.286	0.000	.878
Clien_18	20.998	0.000	.572
Consu_18	8.513	0.000	.219
Exter_18	-5.454	0.000	-.093
Contr_19	-1.256	0.000	-.034

a. Dependent Variable: PLAN

### 7.6 Regression analysis and anova and t-tests of key variables at execution life cycle stage

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_1 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.995a	.990	.987	1.77802	.990	293.146	.000
2	.996b	.992	.988	1.70316	.002	1.599	.227
3	.997c	.994	.989	1.65804	.002	1.313	.310
4	.998d	.996	.989	1.62529	.001	1.190	.358
5	.999e	.998	.993	1.25610	.003	2.854	.107
6	1.000f	1.000	.998	.65713	.002	4.715	.184
6	1.000g	1.000			.000		

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clien\_23, Effect\_23, Consu\_23

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clien\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clien\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clien\_25, Consu\_25, Effect\_25

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clien\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clien\_25, Consu\_25, Effect\_25, Consu\_26, Exter\_26, Effect\_26, Clien\_26

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clien\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clien\_25, Consu\_25, Effect\_25, Consu\_26, Exter\_26, Effect\_26, Clien\_26

g. Predictors: (Constant), Exter\_26, Clien\_25, Contr\_24, Clien\_23, exec\_5, Effect\_23, Clien\_26, Consu\_25, exec\_8, Effect\_26, Consu\_26, Consu\_23, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clien\_27, Exter\_27, Effect\_27

h. Predictors: (Constant), Exter\_26, Clien\_25, Contr\_24, Clien\_23, exec\_5, Effect\_23, Clien\_26, Consu\_25, exec\_8, Effect\_26, Consu\_26, Consu\_23, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clien\_27, Exter\_27, Effect\_27, Exter\_28, Consu\_28

ANOVAa

		Sum of Squares	df	Mean Square	F	Sig.
Model 5	Regression	6539.358	20	326.968	207.230	.000f
	Residual	11.045	7	1.578		
	Total	6550.403	27			

a. Dependent Variable: EXEC

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	-.043	0.000			
	exec_2	-.007	0.000	-.012		
	exec_3	.204	0.000	.223		
	exec_4	.082	0.000	.100		
	exec_5	.199	0.000	.212		
	exec_6	.316	0.000	.313		
	exec_7	.207	0.000	.328		
	exec_8	-.012	0.000	-.017		
	Effect_23	-.084	0.000	-.132		
	Effect_24	.020	0.000	.033		
	Effect_25	.017	0.000	.037		
	Effect_26	.032	0.000	.059		
	Clie_23	-2.036	0.000	-.025		
	Consu_23	-.381	0.000	-.012		
	Contr_24	-.916	0.000	-.011		
	Consu_24	2.732	0.000	.068		
	Clie_25	1.145	0.000	.014		
	Consu_25	2.617	0.000	.080		
	Clie_26	-4.819	0.000	-.110		
	Consu_26	.510	0.000	.015		
	Exter_26	-.269	0.000	-.003		
	Effect_27	.045	0.000	.075		
	Contr_27	-.439	0.000	-.011		
	Clie_27	3.069	0.000	.082		
	Consu_27	-.562	0.000	-.018		
	Exter_27	-8.341	0.000	-.101		
	Consu_28	-1.173	0.000	-.036		
	Exter_28	-1.396	0.000	-.035		

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_1 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.995a	.990	.987	1.77802	.990	293.146	.000
2	.996b	.992	.988	1.70316	.002	1.599	.227
3	.997c	.994	.989	1.65804	.002	1.313	.310
4	.998d	.996	.989	1.62529	.001	1.190	.358
5	.999e	.998	.993	1.25610	.003	2.854	.107
6	1.000f	1.000	.998	.65713	.002	4.715	.184
7	1.000g	1.000			.000		

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clie\_n\_23, Effect\_23, Consu\_23

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clie\_n\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clie\_n\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clie\_n\_25, Consu\_25, Effect\_25

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clie\_n\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clie\_n\_25, Consu\_25, Effect\_25, Consu\_26, Exter\_26, Effect\_26, Clie\_n\_26

f. Predictors: (Constant), Exter\_26, Clie\_n\_25, Contr\_24, Clie\_n\_23, exec\_5, Effect\_23, Clie\_n\_26, Consu\_25, exec\_8, Effect\_26, Consu\_26, Consu\_23, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clie\_n\_27, Exter\_27, Effect\_27

g. Predictors: (Constant), Exter\_26, Clie\_n\_25, Contr\_24, Clie\_n\_23, exec\_5, Effect\_23, Clie\_n\_26, Consu\_25, exec\_8, Effect\_26, Consu\_26, Consu\_23, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clie\_n\_27, Exter\_27, Effect\_27, Exter\_28, Consu\_28

#### ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6539.358	20	326.968	207.230	.000f
	Residual	11.045	7	1.578		
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_3, Clie\_n\_23, Effect\_23, Consu\_23, Contr\_24, Consu\_24, Effect\_24, Clie\_n\_25, Consu\_25, Effect\_25, Consu\_26, Exter\_26, Effect\_26, Clie\_n\_26

#### Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	-.043	0.000			
	exec_2	-.007	0.000	-.012		
	exec_3	.204	0.000	.223		
	exec_4	.082	0.000	.100		
	exec_5	.199	0.000	.212		

exec_6	.316	0.000	.313	
exec_7	.207	0.000	.328	
exec_8	-.012	0.000	-.017	
Effect_23	-.084	0.000	-.132	
Effect_24	.020	0.000	.033	
Effect_25	.017	0.000	.037	
Effect_26	.032	0.000	.059	
Clie_n_23	-2.036	0.000	-.025	
Consu_23	-.381	0.000	-.012	
Contr_24	-.916	0.000	-.011	
Consu_24	2.732	0.000	.068	
Clie_n_25	1.145	0.000	.014	
Consu_25	2.617	0.000	.080	
Clie_n_26	-4.819	0.000	-.110	
Consu_26	.510	0.000	.015	
Exter_26	-.269	0.000	-.003	
Effect_27	.045	0.000	.075	
Contr_27	-.439	0.000	-.011	
Clie_n_27	3.069	0.000	.082	
Consu_27	-.562	0.000	-.018	
Exter_27	-8.341	0.000	-.101	
Consu_28	-1.173	0.000	-.036	
Exter_28	-1.396	0.000	-.035	

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_2 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.998a	.996	.995	1.07490	.996	807.046	.000
2	.999b	.998	.996	1.00577	.001	1.569	.228
3	.999c	.999	.996	.98477	.001	1.129	.405
4	1.000d	1.000	.997	.78994	.001	2.108	.216

a. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3

b. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clie\_n\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30

c. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clie\_n\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30, Contr\_31, Clie\_n\_31, Effect\_31, Consu\_31, Exter\_31

d. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clie\_n\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30, Contr\_31, Clie\_n\_31, Effect\_31, Consu\_31, Exter\_31, Clie\_n\_32, Contr\_32, Exter\_32, Effect\_32, Consu\_32

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	6550.403	27	242.608		. <sup>d</sup>
	Residual	.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

d. Predictors: (Constant), Exter\_26, Clien\_25, Contr\_24, Clien\_23, exec\_5, Effect\_23, Clien\_26, Consu\_25, exec\_8, Effect\_26, Consu\_26, Consu\_23, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clien\_27, Exter\_27, Effect\_27, Exter\_28, Consu\_28

#### Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
4	(Constant)	-3.299	1.242		-2.656	.045
	exec_1	.158	.027	.200	5.862	.002
	exec_3	.150	.036	.164	4.210	.008
	exec_4	.151	.025	.183	6.047	.002
	exec_5	.187	.021	.200	9.016	.000
	exec_6	.180	.029	.178	6.112	.002
	exec_7	.154	.017	.244	9.051	.000
	exec_8	.112	.021	.158	5.459	.003
	Effect_30	-.035	.017	-.055	-2.042	.097
	Contr_30	-1.239	1.277	-.033	-.970	.376
	Clien_30	.879	.666	.027	1.320	.244
	Consu_30	.858	1.448	.024	.592	.579
	Exter_30	2.553	1.932	.072	1.321	.244
	Effect_31	-.008	.024	-.015	-.341	.747
	Contr_31	1.251	.846	.041	1.480	.199
	Clien_31	.471	.815	.011	.578	.589
	Consu_31	1.937	1.435	.055	1.350	.235
	Exter_31	-4.725	2.057	-.127	-2.297	.070
	Effect_32	.022	.020	.041	1.072	.333
	Contr_32	2.247	1.179	.060	1.906	.115
	Clien_32	-.906	.858	-.024	-1.056	.339
	Consu_32	-4.852	1.732	-.137	-2.802	.038
	Exter_32	2.157	1.041	.058	2.073	.093

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_3 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.997a	.994	.991	1.43927	.994	448.879	.000
2	.997b	.994	.990	1.58088	.001	.315	.896
3	.998c	.995	.989	1.64321	.001	.721	.595
4	.998d	.997	.986	1.83149	.001	.571	.722
5	1.000e	.999	.982	2.08243	.002	.728	.706
6	1.000f	1.000			.001		

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clien\_33

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clien\_33, Consu\_34, Clien\_34, Effect\_34, Contr\_34

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clien\_33, Consu\_34, Clien\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clien\_35

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clien\_33, Consu\_34, Clien\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clien\_35, Exter\_36, Consu\_36, Effect\_36, Contr\_36, Clien\_36

f. Predictors: (Constant), Exter\_36, Consu\_35, exec\_1, Contr\_35, Clien\_34, Contr\_33, Exter\_35, Effect\_34, exec\_8, Contr\_34, Contr\_36, Consu\_34, Consu\_36, Consu\_33, Exter\_33, Clien\_36, exec\_2, Effect\_36, Effect\_33, Effect\_35, exec\_4, exec\_5, exec\_7, Clien\_35, exec\_6, Clien\_33, Clien\_37

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	6547.283	22	297.604	476.929	.000e
	Residual	3.120	5	.624		
	Total	6550.403	27			

a. Dependent Variable: EXEC

e. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clien\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30, Contr\_31, Clien\_31, Effect\_31, Consu\_31, Exter\_31, Clien\_32, Contr\_32, Exter\_32, Effect\_32, Consu\_32

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	-22.055	0.000			
	exec_1	.239	0.000	.302		
	exec_2	.055	0.000	.095		
	exec_4	.061	0.000	.074		
	exec_5	.116	0.000	.123		
	exec_6	.535	0.000	.530		
	exec_7	.246	0.000	.390		
	exec_8	.019	0.000	.027		
	Effect_33	-.009	0.000	-.016		
	Effect_34	-.019	0.000	-.028		
	Effect_35	-.063	0.000	-.118		
	Effect_36	-.026	0.000	-.034		
	Contr_33	2.429	0.000	.069		
	Clie_33	32.668	0.000	.396		
	Consu_33	-.793	0.000	-.026		
	Exter_33	-.839	0.000	-.024		
	Contr_34	-3.102	0.000	-.092		
	Clie_34	-4.464	0.000	-.126		
	Consu_34	2.038	0.000	.065		
	Contr_35	3.130	0.000	.084		
	Clie_35	-1.084	0.000	-.032		
	Consu_35	-4.334	0.000	-.116		
	Exter_35	-2.217	0.000	-.037		
	Contr_36	-10.305	0.000	-.236		
	Clie_36	8.768	0.000	.248		
	Consu_36	-7.045	0.000	-.230		
	Exter_36	-7.913	0.000	-.198		

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_5 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.996a	.992	.989	1.64297	.992	343.810	.000
2	.997b	.994	.990	1.52035	.003	1.839	.171
3	.998c	.996	.990	1.51823	.002	1.009	.457

4	.999d	.999	.995	1.06831	.003	3.243	.092
5	1.000e	1.000	1.000	.16502	.001	50.091	.107

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clien\_44

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clien\_44, Contr\_45, Clien\_45, Consu\_45, Effect\_45, Exter\_45

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clien\_44, Contr\_45, Clien\_45, Consu\_45, Effect\_45, Exter\_45, Exter\_46, Clien\_46, Effect\_46, Contr\_46, Consu\_46

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clien\_44, Contr\_45, Clien\_45, Consu\_45, Effect\_45, Exter\_45, Exter\_46, Clien\_46, Effect\_46, Contr\_46, Consu\_46, Contr\_47, Consu\_47, Effect\_47, Clien\_47, Exter\_47

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6546.067	26	251.772	58.059	.103f
	Residual	4.337	1	4.337		
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clien\_33, Consu\_34, Clien\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clien\_35, Exter\_36, Consu\_36, Effect\_36, Contr\_36, Clien\_36

#### Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	-2.200	0.000			
	exec_1	.301	0.000	.380		
	exec_2	.168	0.000	.291		
	exec_3	-.090	0.000	-.099		
	exec_5	.180	0.000	.191		
	exec_6	-.001	0.000	-.001		
	exec_7	.187	0.000	.296		
	exec_8	.132	0.000	.186		
	Effect_39	.158	0.000	.250		
	Contr_39	.241	0.000	.007		
	Clien_39	-5.880	0.000	-.190		
	Consu_39	-4.754	0.000	-.128		
	Exter_39	-14.706	0.000	-.178		
	Effect_40	-.153	0.000	-.166		

Contr_40	2.063	0.000	.052	
Clien_40	.548	0.000	.018	
Consu_40	3.482	0.000	.103	
Exter_40	3.753	0.000	.076	
Effect_41	.223	0.000	.315	
Clien_41	-14.032	0.000	-.376	
Consu_41	3.501	0.000	.114	
Exter_41	.323	0.000	.007	
Effect_42	-.148	0.000	-.226	
Contr_42	3.447	0.000	.070	
Clien_42	7.122	0.000	.223	
Consu_42	6.592	0.000	.177	
Consu_43	-2.948	0.000	-.090	
Exter_43	-1.760	0.000	-.021	

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_6 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.996a	.993	.990	1.55783	.993	382.736	.000
2	.999b	.997	.996	1.02344	.005	14.170	.000
3	.999c	.998	.996	1.00434	.001	1.173	.365
4	.999d	.999	.997	.89448	.001	1.730	.224
5	1.000e	.999	.995	1.11827	.000	.190	.934
6	1.000f	1.000	1.000	.19819	.001	39.544	.119
7	1.000g	1.000			.000		

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51, Contr\_52, Clien\_52, Effect\_52, Consu\_52

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51, Contr\_52, Clien\_52, Effect\_52, Consu\_52, Exter\_53, Clien\_53, Consu\_53, Contr\_53, Effect\_53

b. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clien\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clien\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clien\_54

c. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clien\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clien\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clien\_54, Consu\_55, Exter\_55, Effect\_55, Clien\_55

d. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clien\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clien\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clien\_54, Consu\_55, Exter\_55, Effect\_55, Clien\_55, Effect\_56

e. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_n\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_n\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_n\_54  
 f. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_n\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_n\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_n\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_n\_55  
 g. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_n\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_n\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_n\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_n\_55, Effect\_56

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	6550.403	27	242.608		.c
	Residual	.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

c. Predictors: (Constant), Exter\_36, Consu\_35, exec\_1, Contr\_35, Clie\_n\_34, Contr\_33, Exter\_35, Effect\_34, exec\_8, Contr\_34, Contr\_36, Consu\_34, Consu\_36, Consu\_33, Exter\_33, Clie\_n\_36, exec\_2, Effect\_36, Effect\_33, Effect\_35, exec\_4, exec\_5, exec\_7, Clie\_n\_35, exec\_6, Clie\_n\_33, Clie\_n\_37

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	10.337	0.000			
	exec_1	.104	0.000	.132		
	exec_2	.118	0.000	.204		
	exec_3	.161	0.000	.177		
	exec_4	.106	0.000	.129		
	exec_6	.129	0.000	.127		
	exec_7	.171	0.000	.271		
	exec_8	.092	0.000	.130		
	Effect_44	.080	0.000	.120		
	Effect_45	-.032	0.000	-.051		
	Effect_46	.046	0.000	.059		
	Effect_47	.007	0.000	.009		
	Contr_44	-8.303	0.000	-.101		
	Clie_n_44	-1.640	0.000	-.046		
	Consu_44	1.457	0.000	.029		
	Contr_45	-.902	0.000	-.015		
	Clie_n_45	3.478	0.000	.059		
	Consu_45	.435	0.000	.014		
	Exter_45	2.453	0.000	.056		
	Contr_46	-2.397	0.000	-.068		

Clie_n_46	.786	0.000	.013	
Consu_46	-2.450	0.000	-.056	
Exter_46	-1.829	0.000	-.054	
Contr_47	1.976	0.000	.058	
Clie_n_47	-4.194	0.000	-.105	
Consu_47	.886	0.000	.025	
Exter_47	-2.484	0.000	-.067	
Effect_48	.011	0.000	.017	

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_7 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.990a	.980	.973	2.57499	.980	138.273	.000
2	.993b	.987	.976	2.39112	.007	1.639	.210
3	.997c	.994	.985	1.91620	.007	3.089	.062
4	.998d	.995	.979	2.24874	.002	.397	.835
5	.998e	.996	.944	3.68131	.000	.060	.989

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clie\_n\_57, Consu\_57, Effect\_57

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clie\_n\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clie\_n\_58, Effect\_58

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clie\_n\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clie\_n\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clie\_n\_59, Effect\_59

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clie\_n\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clie\_n\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clie\_n\_59, Effect\_59, Clie\_n\_60, Effect\_60, Contr\_60, Consu\_60

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6523.299	25	260.932	19.254	.051f
	Residual	27.104	2	13.552		
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clie\_n\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clie\_n\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clie\_n\_59, Effect\_59, Clie\_n\_60, Effect\_60, Contr\_60, Consu\_60

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	-.647	20.139		-.032	.977
	exec_1	.069	.363	.088	.191	.866
	exec_2	.120	.259	.208	.463	.689
	exec_3	.336	.360	.369	.935	.448
	exec_4	.138	.168	.168	.825	.496
	exec_5	-.028	.459	-.029	-.060	.958
	exec_6	.061	.235	.060	.258	.821
	exec_8	.188	.076	.265	2.491	.130
	Effect_57	.067	.162	.125	.413	.720
	Contr_57	-1.504	3.271	-.026	-.460	.691
	Clien_57	.240	7.132	.006	.034	.976
	Consu_57	.648	3.241	.019	.200	.860
	Exter_57	-10.102	22.019	-.123	-.459	.691
	Effect_58	.076	.212	.119	.358	.755
	Contr_58	1.939	3.890	.055	.498	.668
	Clien_58	.957	4.123	.030	.232	.838
	Consu_58	3.312	5.643	.108	.587	.617
	Effect_59	-.014	.091	-.026	-.152	.893
	Contr_59	1.854	15.427	.022	.120	.915
	Clien_59	6.182	13.098	.175	.472	.683
	Consu_59	5.247	13.107	.141	.400	.728
	Exter_59	-3.518	10.248	-.043	-.343	.764
	Effect_60	-.119	.313	-.159	-.382	.739
	Contr_60	-4.732	15.176	-.080	-.312	.785
	Clien_60	4.047	14.718	.120	.275	.809
	Consu_60	-6.988	19.367	-.206	-.361	.753

a. Dependent Variable: EXEC

Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_8 determinant)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.996a	.992	.989	1.62595	.992	351.104	.000
2	.997b	.994	.990	1.56657	.002	1.309	.312
3	.997c	.995	.986	1.82870	.001	.202	.954
4	.999d	.997	.984	1.95549	.002	.749	.621
5	1.000e	1.000			.003		

- a. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1
- b. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61
- c. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clien\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62
- d. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clien\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clien\_63, Exter\_63
- e. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clien\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clien\_63, Exter\_63, Clien\_64, Consu\_64, Effect\_64, Exter\_64, Contr\_64

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6550.403	27	242.608		.f
	Residual	0.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

- f. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clien\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clien\_63, Exter\_63, Clien\_64, Consu\_64, Effect\_64, Exter\_64, Contr\_64

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	2.483	0.000			
	exec_1	-.107	0.000	-.135		
	exec_2	.063	0.000	.109		
	exec_3	.208	0.000	.228		
	exec_4	.117	0.000	.142		
	exec_5	.237	0.000	.253		
	exec_6	.401	0.000	.397		
	exec_7	.003	0.000	.004		
	Effect_61	.040	0.000	.085		
	Contr_61	-.376	0.000	-.009		
	Clien_61	-7.784	0.000	-.244		
	Consu_61	-6.757	0.000	-.181		
	Exter_61	8.528	0.000	.241		
	Effect_62	-.053	0.000	-.105		
	Contr_62	-.787	0.000	-.026		
	Clien_62	.635	0.000	.021		
	Consu_62	1.487	0.000	.048		
	Exter_62	6.708	0.000	.190		

Effect_63	.182	0.000	.368	
Contr_63	-18.448	0.000	-.563	
Clien_63	7.367	0.000	.240	
Consu_63	6.842	0.000	.184	
Exter_63	4.738	0.000	.153	
Effect_64	-.151	0.000	-.285	
Contr_64	21.358	0.000	.631	
Clien_64	2.253	0.000	.071	
Consu_64	-13.440	0.000	-.337	
Exter_64	-3.395	0.000	-.110	

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_2 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.998 <sup>a</sup>	.996	.995	1.07490	.996	807.046	.000
2	.999 <sup>b</sup>	.998	.996	1.00577	.001	1.569	.228
3	.999 <sup>c</sup>	.999	.996	.98477	.001	1.129	.405
4	1.000 <sup>d</sup>	1.000	.997	.78994	.001	2.108	.216

a. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3

b. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clien\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30

c. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clien\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30, Contr\_31, Clien\_31, Effect\_31, Consu\_31, Exter\_31

d. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clien\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_30, Contr\_31, Clien\_31, Effect\_31, Consu\_31, Exter\_31, Clien\_32, Contr\_32, Exter\_32, Effect\_32, Consu\_32

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	6550.403	27	242.608		. <sup>d</sup>
	Residual	.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

d. Predictors: (Constant), Exter\_26, Clien\_25, Contr\_24, Clien\_23, exec\_5, Effect\_23, Clien\_26, Consu\_25, exec\_8, Effect\_26, exec\_2, exec\_4, Consu\_24, exec\_3, exec\_6, exec\_7, Effect\_24, Effect\_25, Consu\_27, Contr\_27, Clien\_27, Exter\_27, Effect\_27

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.

		B	Std. Error	Beta		
4	(Constant)	-3.299	1.242		-2.656	.045
	exec_1	.158	.027	.200	5.862	.002
	exec_3	.150	.036	.164	4.210	.008
	exec_4	.151	.025	.183	6.047	.002
	exec_5	.187	.021	.200	9.016	.000
	exec_6	.180	.029	.178	6.112	.002
	exec_7	.154	.017	.244	9.051	.000
	exec_8	.112	.021	.158	5.459	.003
	Effect_30	-.035	.017	-.055	-2.042	.097
	Contr_30	-1.239	1.277	-.033	-.970	.376
	Clie_30	.879	.666	.027	1.320	.244
	Consu_30	.858	1.448	.024	.592	.579
	Exter_30	2.553	1.932	.072	1.321	.244
	Effect_31	-.008	.024	-.015	-.341	.747
	Contr_31	1.251	.846	.041	1.480	.199
	Clie_31	.471	.815	.011	.578	.589
	Consu_31	1.937	1.435	.055	1.350	.235
	Exter_31	-4.725	2.057	-.127	-2.297	.070
	Effect_32	.022	.020	.041	1.072	.333
	Contr_32	2.247	1.179	.060	1.906	.115
	Clie_32	-.906	.858	-.024	-1.056	.339
	Consu_32	-4.852	1.732	-.137	-2.802	.038
	Exter_32	2.157	1.041	.058	2.073	.093

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_3 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.997 <sup>a</sup>	.994	.991	1.43927	.994	448.879	.000
2	.997 <sup>b</sup>	.994	.990	1.58088	.001	.315	.896
3	.998 <sup>c</sup>	.995	.989	1.64321	.001	.721	.595
4	.998 <sup>d</sup>	.997	.986	1.83149	.001	.571	.722
5	1.000 <sup>e</sup>	.999	.982	2.08243	.002	.728	.706
6	1.000 <sup>f</sup>	1.000			.001		

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clie\_33

- c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clie\_n\_33, Consu\_34, Clie\_n\_34, Effect\_34, Contr\_34
- d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clie\_n\_33, Consu\_34, Clie\_n\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clie\_n\_35
- e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clie\_n\_33, Consu\_34, Clie\_n\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clie\_n\_35, Exter\_36, Consu\_36, Effect\_36, Contr\_36, Clie\_n\_36
- f. Predictors: (Constant), Exter\_36, Consu\_35, exec\_1, Contr\_35, Clie\_n\_34, Contr\_33, Exter\_35, Effect\_34, exec\_8, Contr\_34, Contr\_36, Consu\_34, Consu\_36, Consu\_33, Exter\_33, Clie\_n\_36, exec\_2, Effect\_36, Effect\_33, Effect\_35, exec\_4, exec\_5, exec\_7, Clie\_n\_35, exec\_6, Clie\_n\_33, Clie\_n\_37

#### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	6547.283	22	297.604	476.929	.000 <sup>e</sup>
	Residual	3.120	5	.624		
	Total	6550.403	27			

a. Dependent Variable: EXEC

- e. Predictors: (Constant), exec\_8, exec\_1, exec\_4, exec\_5, exec\_7, exec\_6, exec\_3, Clie\_n\_30, Consu\_30, Exter\_30, Effect\_30, Contr\_31, Clie\_n\_31, Effect\_31, Consu\_31, Exter\_31, Clie\_n\_32, Contr\_32, Exter\_32, Effect\_32, Consu\_32

#### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	-22.055	0.000			
	exec_1	.239	0.000	.302		
	exec_2	.055	0.000	.095		
	exec_4	.061	0.000	.074		
	exec_5	.116	0.000	.123		
	exec_6	.535	0.000	.530		
	exec_7	.246	0.000	.390		
	exec_8	.019	0.000	.027		
	Effect_33	-.009	0.000	-.016		
	Effect_34	-.019	0.000	-.028		
	Effect_35	-.063	0.000	-.118		
	Effect_36	-.026	0.000	-.034		
	Contr_33	2.429	0.000	.069		
	Clie_n_33	32.668	0.000	.396		
	Consu_33	-.793	0.000	-.026		
	Exter_33	-.839	0.000	-.024		
	Contr_34	-3.102	0.000	-.092		
	Clie_n_34	-4.464	0.000	-.126		
	Consu_34	2.038	0.000	.065		
	Contr_35	3.130	0.000	.084		

Clie_n_35	-1.084	0.000	-.032
Consu_n_35	-4.334	0.000	-.116
Exter_n_35	-2.217	0.000	-.037
Contr_n_36	-10.305	0.000	-.236
Clie_n_36	8.768	0.000	.248
Consu_n_36	-7.045	0.000	-.230
Exter_n_36	-7.913	0.000	-.198

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_5 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.996 <sup>a</sup>	.992	.989	1.64297	.992	343.810	.000
2	.997 <sup>b</sup>	.994	.990	1.52035	.003	1.839	.171
3	.998 <sup>c</sup>	.996	.990	1.51823	.002	1.009	.457
4	.999 <sup>d</sup>	.999	.995	1.06831	.003	3.243	.092
5	1.000 <sup>e</sup>	1.000	1.000	.16502	.001	50.091	.107

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clie\_n\_44

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clie\_n\_44, Contr\_45, Clie\_n\_45, Consu\_45, Effect\_45, Exter\_45

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clie\_n\_44, Contr\_45, Clie\_n\_45, Consu\_45, Effect\_45, Exter\_45, Exter\_46, Clie\_n\_46, Effect\_46, Contr\_46, Consu\_46

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_3, exec\_1, Consu\_44, Contr\_44, Effect\_44, Clie\_n\_44, Contr\_45, Clie\_n\_45, Consu\_45, Effect\_45, Exter\_45, Exter\_46, Clie\_n\_46, Effect\_46, Contr\_46, Consu\_46, Contr\_47, Consu\_47, Effect\_47, Clie\_n\_47, Exter\_47

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6546.067	26	251.772	58.059	.103 <sup>f</sup>
	Residual	4.337	1	4.337		
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_6, exec\_5, exec\_1, Contr\_33, Exter\_33, Consu\_33, Effect\_33, Clie\_n\_33, Consu\_34, Clie\_n\_34, Effect\_34, Contr\_34, Exter\_35, Contr\_35, Consu\_35, Effect\_35, Clie\_n\_35, Exter\_36, Consu\_36, Effect\_36, Contr\_36, Clie\_n\_36

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	-2.200	0.000			
	exec_1	.301	0.000	.380		
	exec_2	.168	0.000	.291		
	exec_3	-.090	0.000	-.099		

exec_5	.180	0.000	.191
exec_6	-.001	0.000	-.001
exec_7	.187	0.000	.296
exec_8	.132	0.000	.186
Effect_39	.158	0.000	.250
Contr_39	.241	0.000	.007
Clie_n_39	-5.880	0.000	-.190
Consu_39	-4.754	0.000	-.128
Exter_39	-14.706	0.000	-.178
Effect_40	-.153	0.000	-.166
Contr_40	2.063	0.000	.052
Clie_n_40	.548	0.000	.018
Consu_40	3.482	0.000	.103
Exter_40	3.753	0.000	.076
Effect_41	.223	0.000	.315
Clie_n_41	-14.032	0.000	-.376
Consu_41	3.501	0.000	.114
Exter_41	.323	0.000	.007
Effect_42	-.148	0.000	-.226
Contr_42	3.447	0.000	.070
Clie_n_42	7.122	0.000	.223
Consu_42	6.592	0.000	.177
Consu_43	-2.948	0.000	-.090
Exter_43	-1.760	0.000	-.021

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_6 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.996 <sup>a</sup>	.993	.990	1.55783	.993	382.736	7	20	.000
2	.999 <sup>b</sup>	.997	.996	1.02344	.005	14.170	2	18	.000
3	.999 <sup>c</sup>	.998	.996	1.00434	.001	1.173	4	14	.365
4	.999 <sup>d</sup>	.999	.997	.89448	.001	1.730	5	9	.224
5	1.000 <sup>e</sup>	.999	.995	1.11827	.000	.190	4	5	.934
6	1.000 <sup>f</sup>	1.000	1.000	.19819	.001	39.544	4	1	.119
7	1.000 <sup>g</sup>	1.000			.000		1	0	

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51, Contr\_52, Clie\_n\_52, Effect\_52, Consu\_52

- d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_7, exec\_3, exec\_5, exec\_1, Effect\_51, Consu\_51, Contr\_52, Clie\_52, Effect\_52, Consu\_52, Exter\_53, Clie\_53, Consu\_53, Contr\_53, Effect\_53
- b. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54
- c. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_55
- d. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_55, Effect\_56
- e. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54
- f. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_55
- g. Predictors: (Constant), Exter\_53, exec\_1, Contr\_52, Clie\_52, Effect\_51, Consu\_51, Consu\_53, Contr\_53, Consu\_52, Effect\_52, exec\_7, Effect\_53, exec\_4, exec\_5, exec\_8, exec\_2, Clie\_53, exec\_3, Exter\_54, Effect\_54, Contr\_54, Clie\_54, Consu\_55, Exter\_55, Effect\_55, Clie\_55, Effect\_56

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	6550.403	27	242.608		. <sup>c</sup>
	Residual	.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

c. Predictors: (Constant), Exter\_36, Consu\_35, exec\_1, Contr\_35, Clie\_34, Contr\_33, Exter\_35, Effect\_34, exec\_8, Contr\_34, Consu\_36, Consu\_33, Exter\_33, Clie\_36, exec\_2, Effect\_36, Effect\_33, Effect\_35, exec\_4, exec\_5, exec\_7, Clie\_35, exec\_6

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
2	(Constant)	10.337	0.000				10.337	10.337
	exec_1	.104	0.000	.132			.104	.104
	exec_2	.118	0.000	.204			.118	.118
	exec_3	.161	0.000	.177			.161	.161
	exec_4	.106	0.000	.129			.106	.106
	exec_6	.129	0.000	.127			.129	.129
	exec_7	.171	0.000	.271			.171	.171
	exec_8	.092	0.000	.130			.092	.092
	Effect_44	.080	0.000	.120			.080	.080
	Effect_45	-.032	0.000	-.051			-.032	-.032
	Effect_46	.046	0.000	.059			.046	.046
	Effect_47	.007	0.000	.009			.007	.007
	Contr_44	-8.303	0.000	-.101			-8.303	-8.303
	Clie_44	-1.640	0.000	-.046			-1.640	-1.640
	Consu_44	1.457	0.000	.029			1.457	1.457
	Contr_45	-.902	0.000	-.015			-.902	-.902
	Clie_45	3.478	0.000	.059			3.478	3.478

Consu_45	.435	0.000	.014		.435	.435
Exter_45	2.453	0.000	.056		2.453	2.453
Contr_46	-2.397	0.000	-.068		-2.397	-2.397
Clien_46	.786	0.000	.013		.786	.786
Consu_46	-2.450	0.000	-.056		-2.450	-2.450
Exter_46	-1.829	0.000	-.054		-1.829	-1.829
Contr_47	1.976	0.000	.058		1.976	1.976
Clien_47	-4.194	0.000	-.105		-4.194	-4.194
Consu_47	.886	0.000	.025		.886	.886
Exter_47	-2.484	0.000	-.067		-2.484	-2.484
Effect_48	.011	0.000	.017		.011	.011

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_7 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.990 <sup>a</sup>	.980	.973	2.57499	.980	138.273	.000
2	.993 <sup>b</sup>	.987	.976	2.39112	.007	1.639	.210
3	.997 <sup>c</sup>	.994	.985	1.91620	.007	3.089	.062
4	.998 <sup>d</sup>	.995	.979	2.24874	.002	.397	.835
5	.998 <sup>e</sup>	.996	.944	3.68131	.000	.060	.989

a. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1

b. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clien\_57, Consu\_57, Effect\_57

c. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clien\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clien\_58, Effect\_58

d. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clien\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clien\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clien\_59, Effect\_59

e. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clien\_57, Consu\_57, Effect\_57, Consu\_58, Contr\_58, Clien\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clien\_59, Effect\_59, Clien\_60, Effect\_60, Contr\_60, Consu\_60

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6523.299	25	260.932	19.254	.051 <sup>f</sup>
	Residual	27.104	2	13.552		
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_8, exec\_2, exec\_4, exec\_6, exec\_3, exec\_5, exec\_1, Contr\_57, Exter\_57, Clien\_57, Consu\_57, Contr\_58, Clien\_58, Effect\_58, Contr\_59, Exter\_59, Consu\_59, Clien\_59, Effect\_59, Clien\_60, Effect\_60, Contr\_60

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	-.647	20.139		-.032	.977
	exec_1	.069	.363	.088	.191	.866
	exec_2	.120	.259	.208	.463	.689
	exec_3	.336	.360	.369	.935	.448
	exec_4	.138	.168	.168	.825	.496
	exec_5	-.028	.459	-.029	-.060	.958
	exec_6	.061	.235	.060	.258	.821
	exec_8	.188	.076	.265	2.491	.130
	Effect_57	.067	.162	.125	.413	.720
	Contr_57	-1.504	3.271	-.026	-.460	.691
	Clien_57	.240	7.132	.006	.034	.976
	Consu_57	.648	3.241	.019	.200	.860
	Exter_57	-10.102	22.019	-.123	-.459	.691
	Effect_58	.076	.212	.119	.358	.755
	Contr_58	1.939	3.890	.055	.498	.668
	Clien_58	.957	4.123	.030	.232	.838
	Consu_58	3.312	5.643	.108	.587	.617
	Effect_59	-.014	.091	-.026	-.152	.893
	Contr_59	1.854	15.427	.022	.120	.915
	Clien_59	6.182	13.098	.175	.472	.683
	Consu_59	5.247	13.107	.141	.400	.728
	Exter_59	-3.518	10.248	-.043	-.343	.764
	Effect_60	-.119	.313	-.159	-.382	.739
	Contr_60	-4.732	15.176	-.080	-.312	.785
	Clien_60	4.047	14.718	.120	.275	.809
	Consu_60	-6.988	19.367	-.206	-.361	.753

a. Dependent Variable: EXEC

**Model Summary: Dependent Variable EXEC (time over run of projects at execution life cycle stage due to exec\_8 determinant)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.996 <sup>a</sup>	.992	.989	1.62595	.992	351.104	.000
2	.997 <sup>b</sup>	.994	.990	1.56657	.002	1.309	.312
3	.997 <sup>c</sup>	.995	.986	1.82870	.001	.202	.954
4	.999 <sup>d</sup>	.997	.984	1.95549	.002	.749	.621
5	1.000 <sup>e</sup>	1.000			.003		

a. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1

b. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61

c. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clien\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clien\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62

d. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clie\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clie\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clie\_63, Exter\_63  
 e. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clie\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clie\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clie\_63, Exter\_63, Clie\_64, Consu\_64, Effect\_64, Exter\_64, Contr\_64

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	6550.403	27	242.608		.f
	Residual	0.000	0			
	Total	6550.403	27			

a. Dependent Variable: EXEC

f. Predictors: (Constant), exec\_7, exec\_2, exec\_4, exec\_6, exec\_5, exec\_3, exec\_1, Clie\_61, Contr\_61, Consu\_61, Exter\_61, Effect\_61, Clie\_62, Contr\_62, Exter\_62, Consu\_62, Effect\_62, Contr\_63, Consu\_63, Effect\_63, Clie\_63, Exter\_63, Clie\_64, Consu\_64, Effect\_64, Exter\_64, Contr\_64

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	2.483	0.000			
	exec_1	-.107	0.000	-.135		
	exec_2	.063	0.000	.109		
	exec_3	.208	0.000	.228		
	exec_4	.117	0.000	.142		
	exec_5	.237	0.000	.253		
	exec_6	.401	0.000	.397		
	exec_7	.003	0.000	.004		
	Effect_61	.040	0.000	.085		
	Contr_61	-.376	0.000	-.009		
	Clie_61	-7.784	0.000	-.244		
	Consu_61	-6.757	0.000	-.181		
	Exter_61	8.528	0.000	.241		
	Effect_62	-.053	0.000	-.105		
	Contr_62	-.787	0.000	-.026		
	Clie_62	.635	0.000	.021		
	Consu_62	1.487	0.000	.048		
	Exter_62	6.708	0.000	.190		
	Effect_63	.182	0.000	.368		
	Contr_63	-18.448	0.000	-.563		
	Clie_63	7.367	0.000	.240		
	Consu_63	6.842	0.000	.184		
	Exter_63	4.738	0.000	.153		

Effect_64	-.151	0.000	-.285		
Contr_64	21.358	0.000	.631		
Clie_64	2.253	0.000	.071		
Consu_64	-13.440	0.000	-.337		
Exter_64	-3.395	0.000	-.110		

a. Dependent Variable: EXEC

## 7.7 Project data showing major milestones used for secondary data analysis

Number	Contract Name	commencement date	mobilization duration ( months)	Duration (months)	performance at end of original completion date(%)	performance at December 2020(%)
1	KIBRE Mengist -Shakiso	7/18/2016	2.00	8.9	76.8	98.00
2	Jinka -Hana DB Project Lot-1:	2/3/2016	3.00	24	32.2	56.11
3	Diredawa -Melka jebdu	10/6/2016	2.00	18	57.04	81.00
4	Hida - Yalo (Omitted Section)	2/15/2017	3.00	18	68.66	72.48
5	Ankober -Dulecha	3/17/2016	3.00	30	74.7	92.50
6	Debre Markos Town Road Upgrading	6/1/2017	3.00	17.8	23.1	94.71
7	Dalol/Musli-Bada	1/29/2016	3.00	36	80.5	89.05
8	Design and Construction Works of Hosana Town Section Road Project	10/11/2017	4.00	16.2	15.39	37.83
9	2:Dulecha-Awash Arba	9/12/2016	3.00	30	39.7	67.31
10	Dabat-Ajire	10/10/2016	4.00	36	78.08	80.13
11	Beles-Mekane Birhan Road	11/1/2016	4.00	36	33.7	42.03
12	Mekele-Dengolat-Samre-	11/1/2016	3.00	36	46.3	54.51
13	<i>Tikur Wuha - Awasa</i>	<i>11/9/2017</i>	<i>4.00</i>	<i>24</i>	<i>2.23</i>	<i>2.32</i>
14	Soroka-Ergoye-Abrehajira Road	11/30/2016	4.00	36	96.4	96.40
15	Quyha -Maymekden	6/14/2017	3.00	30	58.13	73.44
16	Babile-Fik Lot IV	5/31/2017	4.00	31.1	76.53	92.35
17	Omo-Maji Design and Build Road Project Contract II:Sai- Maji Omo-Maji Design and Build Road Project Contract II:	2/20/2017	4.00	36	62.5	67.79
18	Woldia Town Section Design and Build	2/26/2018	3.00	24	30.99	42.45
19	Assosa-daleti Lot 1	3/7/2017	4.00	36	55.75	65.68
20	Maichew - Mehoni	9/29/2017	3.00	30	57.96	60.59

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Number	Contract Name	commencement date	mobilization duration ( months)	Duration (months)	performance at end of original completion date(%)	performance at December 2020(%)
22	Degolo Kelela	4/8/2017	3.00	36	72.7	80.00
23	Alemketema-Degolo	4/28/2017	3.00	36	31.96	37.32
24	Fik-HameroLot I	5/2/2017	3.00	36	71.95	78.59
25	Babille-Fik Lot I	5/2/2017	4.00	36	55.11	68.10
26	Babille-Fik Lot II	5/2/2017	4.00	36	52.2	61.72
27	Babille-Fik Lot III	5/2/2017	4.00	36	65.44	75.43
28	Assosa-Daleti-Baruda, Contract 2: Km	5/2/2017	4.00	36	47.52	43.70
29	Gambella-Ilya	5/10/2017	4.00	36	24.82	26.77
30	Sansusi -Tatek Kella	11/15/2017	3.00	30	46.15	49.62
31	Melkasa-Sodere-Nuraera-Metehara	1/1/2018	4.00	29.7	21.24	28.37
32	Ginchi - Kachise -Chuleti Contract 1:	10/11/2017	3.00	33	37.29	43.58
33	Kunzila Horticulture Farm zebe Town	1/24/2018	4.00	30	35.55	38.21
34	Durgi - Gibe River	8/1/2017	4.00	36	60.04	62.64
35	Azezo-Gondar	8/14/2018	2.00	24	41.39	47.81
36	<i>Turmi -Omo</i>	8/31/2017	6.00	36	44.83	86.68
37	Diri - Masha Contract1: Diri - Km 78+000	9/15/2017	3.00	36	6.17	6.17
38	Addisabun - Rama - Mereb	10/3/2017	4.00	36	36.98	37.21
39	Debrebirhan - Ankober	10/23/2018	6.00	24	52.19	62.26
40	Adiremet - Kulita -Adigoshu	10/26/2017	4.00	36	57.45	57.77
41	<i>Robe -Gasera - Ginir (Contract 1: Robe -</i>	11/1/2017	4.00	36	45.6	46.88
42	Abomsa-Aseko-Dibu River	11/8/2017	4.00	36	24.45	24.45
43	Dibu River-Bedeyi-Cheleka	11/8/2017	4.00	36	32.81	32.81
44	Kelela-Akesta	1/22/2019	3.00	24		34.16

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Number	Contract Name	commencement date	mobilization duration ( months)	Duration (months)	performance at end of original completion date(%)	performance at December 2020(%)
45	Wukro – Abreha Weatsbha – Nebelet and Mykenetal Spur Road, Lot 1: Nebelet – Filafel and Mykenetal Spur Road Project	1/29/2018	4.00	36	*	95.76
46	Wukro-Abreha weatsbha-Neblet-Filafel and Mykentel Spur Lot 2: Wukro - Nebelet Road Project including Wukro Twon Road Spur	1/29/2018	4.00	36	*	76.32
47	Construction Works of Adiremet - Adihadri Baker Road Project	10/16/2017	4.00	42	*	84.10
48	Metema - Abrajira	10/19/2017	4.00	42	*	76.41
49	AbiAdi - Debre Genet - Benako -Endabaguna Design and Build Road Project, Contract 1: [km 0+000(AbiAdi)- km84+200 (Semema)] (84.2Km)	12/20/2017	4.00	42	*	72.97
50	Design and Construction of Abi Adi -Debre Genet - Semema - Endabaguna, Contract 2: Km 84+200 - Km 180+074[Endabaguna] Road Project (~95.87 Km)	12/20/2017	4.00	42	*	82.32
51	Yabelo Town Bypass	1/8/2020	4.00	18	*	7.75
52	Guguftu-Wereilu-Ankober	8/23/2018	3.00	36	*	19.05
53	Ajire-Keraker	9/21/2018	4.00	36	*	40.12
54	Oblo-Dermi	10/9/2018	4.00	36	*	64.07
55	Gonji Kolela (Korie - Addisalem) Road Project	4/15/2020	2.00	17.8	*	5.15
56	Robe -Gasera - Ginir (Contract II: k60+000-k120+870.41(Ginner)	11/9/2018	4.00	36	*	32.77
57	Taremaber-Meleya-Molale' Molale-Sefemeda	12/24/2018	3.00	36	*	7.88
58	Adiarkay-Telmet	1/17/2019	4.00	36	*	13.23
60	Dongoro-Kingi-Mekebilla	1/31/2019	4.00	36	*	46.06
61	Omorate-Omo Bridge -Gynayom-Kangaken	2/7/2019	3.00	36	*	39.36
62	Rama-Chilla	4/1/2019	3.00	36	*	28.70

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Number	Contract Name	commencement date	mobilization duration ( months)	Duration (months)	performance at end of original completion date(%)	performance at December 2020(%)
64	Continuation of Ambo - Wolliso Road Project	11/26/2019	4.00	30	*	10.11
65	Wukro-Atsbi-Koneba	12/17/2018	4.00	41.9	*	30.38
66	Bahirdar - Tis Esat	12/16/2019	4.00	30	*	3.35
67	Jijiga-Gelesh- Deghamdo - Segege, Lot 4	7/22/2019	4.00	36	*	27.15
68	Construction Works of Asaita- Afambo – Djibouti Border Road Project	8/26/2019	4.00	36	*	22.65
69	Ginchi - Kachise -Chuleti Contract 2: Shikute -	12/31/2019	3.00	32.6	*	6.45
70	Korem - Sekota - Abi Adi Road Project, Contract	9/26/2019	4.00	36	*	1.31
71	Korem – Sekota – Abi Adi Road Project, Contract III: Abergele - Agbe	10/1/2019	4.00	36	*	25.29
72	Continuation of Werabe - Bojaber	10/1/2019	4.00	36	*	13.15
73	Bishoftu -Chefe Donsa-Sendafa	11/27/2019	4.00	36	*	8.79
74	Gishen Junction – Km 14 road design and construion project	5/28/2020	3.00	30	*	0.00
75	Debre Markos -Debre Elias	9/18/2019	4.00	40	*	13.41
76	Edo-Serofta-Warqa	1/24/2019	4.00	48	*	20.40
77	Korem – Sekota – Abi Adi Road Project, Contract I: Korem- Lalibela Junction	2/14/2020	4.00	36	*	17.68
78	Warder - Kebridehar	6/10/2019	4.00	48	*	16.72
* Projects envisaged completion date is beyond Dec 2020 Source Desk Study (2022)						