ST. MARY'S UNIVERSITY
SCHOOL OF GRATUATE STUDIES
INSTITUTE OF BUSINESS
DEPARTMENT OF BUSINESS ADMINISTRATION
MBA PROGRAM

Factors Affecting the Performance of Public Construction Projects: The Case of Addis Ababa Roads and Condominium Projects

By

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A thesis submitted to St. Mary's University School of Graduate Studies Department Of Business Administration in partial fulfillment of the requirements for the Degree of Master of Business Administration (MBA)

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DECLARATION

I hereby confirm that the thesis titled "Factors Influencing the Performance of Public Construction Projects: A Study of Addis Ababa Roads and Condominium Projects" is my own work. It has not been submitted to any other university and is not being considered for any other degree simultaneously. All sources used in the thesis have been properly cited.

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ABSTRACT

Despite significant public investment in construction projects, they rarely meet planned schedules, costs, and quality standards. This study assesses the performance of public construction projects in Addis Ababa across three dimensions: schedule, cost, and quality. Data was collected via questionnaires from 122 respondents, including project managers, resident engineers, and counterpart engineers. The Relative Importance Index (RII) identified critical factors affecting performance gaps, and ANOVA, correlation, and multiple regressions were used for analysis.

Findings reveal average variances of -117.84% in schedule, -32.37% in cost, and -17.95% in quality, with statistically significant differences among project types. Schedule variance positively impacts cost variance, and quality variance positively affects schedule variance. Key factors contributing to performance gaps include ineffective planning, poor site management, financial difficulties, delays in payment and site delivery, low-price bidding reliance, design approval delays, and external issues like price escalation and utility unavailability.

Key words: project performance, schedule variance, cost variance, quality variance

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ABBREVIATION

AAHPO	=	Addis Ababa House Development Project Office
AACRA	=	Addis Ababa city Roads Authority
E.C	=	Ethiopian Calendar
GDP	=	Gross Domestic Product
GTP	=	Growth and Transformation Plan
KPI	=	Key Performance Indicator
NBE	=	National Bank of Ethiopia
NPC	=	National Plan Commission
RII	=	Relative importance index
RSDP	=	Road Sector Development Program
SD	=	Standard deviation
RSDP	=	Road Sector Development Program
ETB	=	Ethiopian Birr
SPI	=	Schedule Performance Index
CPI	=	Cost Performance Index
PMI	=	Project Management Institute

CHAPTER-ONE

INTRODUCTON

1.1. Background of the Study

The construction sector is a key driver of economic growth and development, particularly in developing countries like Ethiopia (Anaman & Osei-Amponsah, 2020). It leverages local human and material resources effectively and creates numerous job opportunities for workers of all skill levels. Additionally, the sector fosters extensive backward and forward linkages with other economic sectors, resulting in one of the highest multiplier effects (Khan, 2022). Research shows that the construction sector accounts for a substantial portion of fixed investment and is a major contributor to national output in many countries (Walker and Flanagan, 1991, as cited in Desta, 2015).

The construction industry and infrastructure development in Ethiopia, which includes transport infrastructure, road construction, railway, sewage and energy projects, real estate and industrial parks.

Small and medium construction companies operate in the informal market and local and foreign companies operate in the formal market. The involvement of foreign companies is dominated by Chinese companies, which are undertaking large projects. The construction market is projected to grow at an annual average growth rate of more than 8% from 2023 to 2026. The country's 10-year development plan touches all aspects of development, including infrastructure development and the objective of public-private partnerships.

Ethiopia the construction sector is the major catalyst of growth and the industry sector growth has been largely driven by the construction sub-sector (NPC, 2016). The construction sub-sector share in the industry sector increased from 54.8 percent in 2015 to 71.4 percent in 2018. In addition the construction sector share in the GDP raise from 4 percent in 2010 to 8.5 in 2015 and 19.28 in 2018(NBE, 2018) . And from the year 2014 to 2018 the construction sector average annual growth rate was 23.38 percent (*ibid)*. The Ethiopian construction industry is expected to expand by 4.7% in real terms in 2021 - up from a growth rate of 3.1% in 2020. Construction activities held up relatively well despite the outbreak of the Coronavirus (COVID-19) pandemic. The government did not impose a strict lockdown in response to the outbreak, and although it imposed a state of emergency in early April 2020, construction activity was encouraged to continue during the crisis, which helped industry output growth in 2020.

In June 2020, the Ethiopian Council of Ministers approved a budget of over ETB476 billion (US$13.7 billion) for the Financial Year (FY) 2020/2021 (which runs from July 8th, 2020 to July 7th, 2021). The government allocated ETB160.3 (US$4.6 billion) towards capital expenditure, which marks an increase of 22.7% compared to the previous fiscal year's allocation of ETB130.7 billion (US$4.5 billion). Although the construction industry is forecast to grow this year, a downside risk could arise from the unstable political environment created due to the conflict between the federal government of Ethiopia and the armed group of the Tigray region, that erupted in November 2020. This could weigh on investor confidence, thereby affecting the economy and the construction industry.

The publisher expects the industry to register an annual average growth of 8.3% between 2022 and 2025, supported by investments in transport, electricity, tourism, manufacturing, and industrial park projects. The country aims to become a light manufacturing hub in Africa and a lower-middle-income economy by 2025. To achieve this, it plans to increase the number of operational industrial parks in the country from five in 2018 to 30 by 2025. In June 2020, the government unveiled its 10-year economic development plan, which mainly focuses on the agriculture, tourism, manufacturing, Information and Communication Technology (ICT) and mining sectors. The construction industry's growth over the long term will also be supported by the government's focus on improving ease of doing business in the country, with a specific focus on improving the processes involved in obtaining construction permits and getting credit.

In Africa, governments own the largest share of construction projects (Deloitte, 2016). Similarly, in Ethiopia public owned construction projects like roads, railways, dams and residential house take the leading share in the construction sector of the country (NBE, 2018).

In Ethiopian, infrastructure development projects is one of the priorities identified as the essential catalyst in order to achieve fast economic growth and realize the country vision, to become middle income country by the year 2025 E.C (NPC, 2016). For this reason, the Ethiopian government remains to be the largest client in the construction industry especially for heavy construction projects focusing on expansion of economic infrastructure (railways, roads, telecom, power, irrigation) and other physical foundations and significant amount of the country's budget is allocated to economic development through financing these infrastructure development projects being critical to achieve development and improve the living standard of the public.

Despite the industry prominent role, several studies in the area found that the industry is highly challenged by project overruns, poor quality, inappropriate procurement systems, and a failure to cope with project requirements and the inability to adopt best practices (Assefa, 2008; Zewdu and Aregaw, 2015).These findings indicated that the performance of the majority of the public construction projects in Ethiopia is poor as defined in terms of golden triangle namely time, cost and quality (Abdullah, Aftab, Azis & Rahman, 2010; Endut, Akintoye & Kelly, 2005; Le-hoai, Dai & Lee, 2008; Ogunlana & Promkuntong, 1996; Sambasivan and Soon, 2007).

In Addis Ababa one of the huge public construction investments that have been made since 2005 is low cost house (condominium house) construction for middle and lower income dwellers of the city (French, 2011). According to Addis Ababa Housing Development Project Office (AAHPO) report since 2005 up to 2016 the project office constructed and transferred over more than 179,000 condominium houses to the city residents (Elias, 2016). In addition, the condominium units built until April 2019, approximately 175,000 units. However, a number of unanticipated challenges facing the construction project. The most critical issue is the late completion of houses with the continuous cost escalation in the price of condominium houses deeming them no longer an option for many low-income households (French, 2011).

The Ethiopian Government gives proper attention on developing of the quality and size of road infrastructure in the country by acknowledging the role of the sector in the country social and economic growth and its role as a catalyst to meet poverty reduction targets. According to Ethiopian Road Authority (ERA) (2013), since 1997, the establishment of Road Sector Development Program (RSDP), physical works have been undertaken on a total of 81363km of roads excluding routine maintenance work and community roads. The total budget for the planned works during this period amounted to ETB
107.8 billion (USD 6.4 billion) and the total amount disbursed in the same period, is 101% of the planned target. Though government put huge investment on road projects, majority of the projects suffer from schedule, cost and time performance gap (Getahun, 2016).

Therefore, this study was conducted to identifying critical factors that cause performance variation in public construction projects particularly road and condominium house construction projects found in Addis Ababa.

1.2. Statement of the Problem

A study conducted on selected 33 countries around the world including 7 African countries to assess performance management practice, Ethiopia stood second from the last followed by Mozambique in its management practice (Bloom, Sadun & Reenen, 2014). This inefficiency is also reflected in the country construction sector performance. The country construction sector competitiveness as a whole when measured in terms of its ability of delivering projects successfully is argued to be poor and construction projects significantly fail under the conventional project performance measurement criteria of on time, within budget and meet quality specification (Desta, 2015). For example, out of the twenty-four rehabilitation and trunk road upgrading projects completed up to 2009 under the RSDP, only seven were completed within budget. The remaining seventeen were completed, on average, 165% over budget (ERA, 2009).

The study conducted by Ayalew, Dakhli and Lafhaj (2016) indicated that construction projects' deviation from predetermined schedule ranges between 61 to 80% and the deviation from predetermined costs and quality ranges between 21 to 40%. This deviation is found to be high when we compare it with other African countries. According to Rwakarehe & Mfinanga, (2014) in many African developing countries such as Nigeria, Kenya, Ghana, Uganda and Tanzania the total cost and time overrun rates on average is found to be 44% and 26% respectively.

As far as the researcher's knowledge concerned, most of the existing researches in the area tried to investigate the relative importance of factors that affect construction project performance using a methodology of Relative Importance index. In addition, majority of the studies focused on single type of construction project (Nguyen & Ogunlana, 2004; Sambasivan & Soon, 2007; Gudiene, Banaitis, Banaitiene & Lopes, 2013; Getahun, 2016;Yohannes, 2017; Belay, Tekeste & Ambo, 2017). Hence, there is lack of sufficient empirical evidence to understand the relationship among the three basic project performance measurement dimensions i.e. time, cost and quality, and there is also gap in investigating the whether the critical factors of project performance varies across different types of construction projects. And this study will contribute to the existing literature by bridging this theoretical gap.

Therefore, this study was undertaken to investigate the relationship among the three performance measures namely, time, cost and quality variables and identify critical success factors of road, 20/80 condominium house, and 40/60 condominium house construction projects. To address the above problem statement, the following research questions were set.

1.3. Research Questions

The study addressed the following research questions.

1. What are the schedules, cost, and quality performance variations of the sampled construction projects?
2. Is there factors affecting related to contractor, consultant, client and external factors the 3 (Road, 20/80 condominium house, and 40/60 condominium) types of construction performance?
3. How the variables; schedule, cost, and quality variances relate each other?
4. Does the variable schedule variance mediate the relation between the cost variance and quality variance?
5. What are the critical factors causing performance variation in the sampled construction projects of Addis Ababa?

1.4. Objective of the study

1.4.1. General Objective

The general objective of this study was to analyze the performance variations and the critical factors causing performance variations on road, 20/80 condominium house and 40/60 condominium house construction projects in Addis Ababa.

1.4.2. Specific objectives

The specific objectives of the study:

1. Identify the schedule, cost, and quality performance variations of the sampled construction projects
2. Assess factors affecting related to contractor, consultant, client and external factors in Road, 20/80 condominium house, and 40/60 condominium house construction projects
3. Assess the relationship among schedule, cost, and quality variations
4. To examine the mediation effect of schedule variance between the cost variance and quality variance, and
5. To analyze the critical factors causing performance gap in road and condominium house construction projects in Addis Ababa.

1.5. Scope and Limitation of the Study

Road and condominium house projects are the two huge public construction projects found in Addis Ababa region. For this reason, in this study, road and condominium housing projects found in Addis Ababa were included as target population.

Though there are different dimensions to measure the performance of construction projects, this study was only measured the performance from the 3 predominant performance evaluation dimensions, time, cost and quality (Chan and Chan, 2004). In addition, even though there exist number of factors that affect construction project performance categorized in quite different way in different studies, in this study only those factors related to contractors, consultants, clients and external factors were included.

For the purpose of the study, data was collected from contractors, consultants and clients particularly from project managers: from the side of contractor, resident engineers: from the side of consultant and counter-part engineers: from the side of client. Since it was difficult to collect performance data on finalized projects from the 3 parties, contractor, consultant and client, the study only considered projects that are ongoing during the data collection period.

1.6. Significance of the Study

This study was very important to identify critical contributing factors causing performance gap of road and condominium housing construction projects found in the Addis Ababa. Besides, the study was helpful for the construction project stakeholders to clearly understand the relationship between the 3 critical of project performance. The findings of the study will be to provide insight for public construction project stakeholders like project managers, project consultants and project clients and policy makers to further understand the contributing factors causing performance gap and their extent of contribution so that they can take successful mitigation measures. In addition, this study may contribute its share to the existing knowledge by identifying critical decisive factors to the success of construction projects.

CHAPTER-TWO
REVIEW OF RELATED LITERATURES

2.1. The Theory of Triple Constraint

The Triple constraints which is the bases of this study specifies the environment in which any project operates consisted of the scope of projects, the schedule of the project and finally the cost of a project. According to Dobson (2004) the three type of triangular constraint are; time, cost and scope that limits the extent within which every project must be achieved.

According to Van Wyngaard (2011) the theory of triple constraint states that there are three variables of a project to be managed for its successful completion;

- **Scope**: refers to the work that is expected to be delivered by a project,
- **Time**: refers to the time of a project that is required for the delivering the specified deliverables and
- **Cost:** refers to the amount of money allocated for a project to execute what is there in the Scope in the given Time.

The triple constraint in project management shows the interdependence of the three essential goals of project management which includes the Project Scope, Time and Cost Management. A project has a distinct scope, schedule, and budget, and the triple constraint of project management portrays the marvel that, an adjustment in one of the three, will influence the other two components (Van Wyngaard, 2011). For example, variance in cost of work will affect the scope and time or change in scope will affect the other two factors.

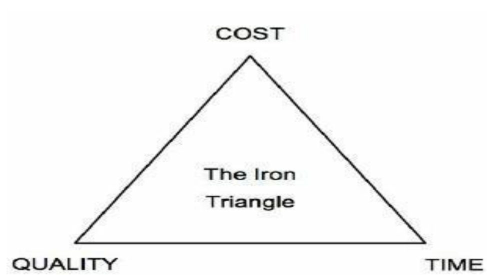


Figure 2.1 Triple Constraint Triangle (Atkinson,1999)

Accomplishing project objective successfully heavily relay on the factors including, schedule, budget, scope, quality, risks, customer satisfaction, and stakeholder support (Gido & Clements, 2015).

2.2. The Project Management and Project Manager Role in Balancing the Triple Constraint

Project Management Institute (P M I) (1987) defined project management as an application of skills, knowledge, tools and techniques to project tasks in order to attain or surpass stakeholder expectations and needs from the initiative. Exceeding or meeting stakeholder requirements involve corresponding the competing project demands specifically on project or program scope, timing, costing, and quality attributes. Project Management Triangle is a concept, which shows the inter-relationship between project scope, time and cost.

A project manager is the one who took the responsibility for achieving the project objectives given the project constraints (Chiu, 2010). The goal of projects may differ, yet the ultimate responsibility for project success rests on the shoulders of the project manager (Shenhar & Dvir, 2007). Project managers must focus on three dimensions of project success that is finishing all project deliverables on time, within cost and to the level of quality that is acceptable to sponsors and stakeholders (Greer, 2008).

2.3. The Theory of Performance

To clarify performance and performance improvements the theory of Performance developed having six foundational concepts to structure a framework. To perform is to generate valued outcome. A performer can be an individual or a group of people engage in a shared effort. Developing performance is a step-by-step process, and level of performance describes location in the step. Current level of performance depends on 6 components: context, level of knowledge, levels of skills, level of identity, personal factors, and fixed factors (Mbugua, Harris, Holt & Olomolaiye 1999).

According to Elger (2007), effective performance improvement has three axioms: engagement in reflective practice, immersion in an enriching environment and a performer's mindset. Performances advance through number of levels that characterize the effectiveness of performance. The high performing level can produce the following categorized:

(i) Increment of quality; its related to meeting or exceeding the expectations of stakeholders and amount of waste/ complaints goes decrease,

(ii) Increment of capability; it is ability to undertake more difficult performances or projects enhance,

(iii) Increment of capacity; that ability to create more throughput increases,

(iv) Increment of knowledge; depth and breadth of knowledge increases,

(v) Increment of skills level; increase in span of application and effectiveness through enhancing abilities to set goals and by maintain a positive outlook.

(vi) Increment of motivation; individuals develop professionalism.

2.4. Performance Measurement Theory

Mbugua et al., (1999) and Love and Holt, (2000) have acknowledged a difference between the indicators, the measures and the measurement of performance. According to Mbugua et al., (1999), performance indicators show the measurable confirmations that verify a planned activity has achieved the desired result. And when indicators can be measured with high degree of precision they are called measures. Yet it is very difficult to find a precise measurement or indicator. Performance measures are numerical/quantitative indicators (Sinclair & Zairi, 1995). As Sinclair and Zairi, (1995); Mbugua et al., (1999) definition performance measurement is a systematic way of evaluating the process from input to output that serve as tool for continuous improvements.

To make performance continuously improve, numerous performance measurements have emerged in literature. That includes the financial (Brown and Lavenrick 1994; and Kaka & Alsharif, 1995), client satisfaction (Chinyio & Olomolaiye, 1998), industry (Construction Industry Board, 1998) employee (Abdel-Razek, 1997), and project performance measures (Belassi and Tukel, 1996) as cited in (Mbugua et al., 1999).

Cordero (1990) classifies performance measurement based on the method of measurement and area of measurement. The methods of measurement of performance categorized as the commercial performance, the technical performance, and the overall performance. The areas of performance measurement are at the planning & design level, the marketing level and manufacturing level etc., and for the overall performance are at the level of a firm or strategic business unit. Furthermore, he proposes a model of performance measurements in terms of outputs and resources to be measured at different levels. Outputs are measured to verify successful accomplishment of the objectives and resources are measured to make sure efficiency that minimum amount of input utilized to produce maximum amount of output. However, in his model, Cordero (1990) failed to reflect the interests of stakeholders, their needs and expectations.

2.5. Key Performance Indicators to Measure Project Performance

The performance of the construction industry is considered as a source of concern to both public and private sector clients (Okuwoga, 1998). Karim and Marosszeky (1999) measured project performance by using Key performance indicators (KPI). KPIs enable to compare between different projects and enterprises to identify the existence of particular patterns. The specialist contractors hoped that the data trends observed will provide insight into certain inefficiencies that are prevalent in the market. They aim to use the data expose the inefficiencies and as a basis for industry development (Karim & Marosszeky, 1999).

The key performance indicators (KPIs) used to measure project performance include factors such as time, cost, quality, client satisfaction; client changes, business performance and safety in order to enable measurement of project and organizational performance throughout the construction industry. This information can then be utilizing for benchmarking purposes, and will be a critical component of any organization move towards achieving best practice (DETR, 2000). Lehtonen (2001) confirmed that performance measurement is a pressing issue both in academics and in business. Samson and Lema (2002) stated that KPIs are very imperative in order to bring value to stakeholders. For these, should be equipped with the right processes and capabilities. The KPIs also serve to trace the most competitively and distinctive processes and capabilities from which purely need improvement or maintenance.

2.6. Construction Project Performance

Constriction performance can be evaluated though various dimensions of performance indicators such as time, quality, cost, client satisfaction, health, safety and overall business performance (Enshassi, Mohamed & Abushaban, 2009). They further argue that time, cost, and quality are the 3 predominant performance evaluation dimensions. Chan and Chan (2004) also agreed with Enshassi et al. (2009), that both point out that cost, time and quality are the three basic and most important performance indicators in construction projects.

According to Chan and Chan (2004), different parties such as client, consultant, contractor, and sub-contractor have their own understanding and interpretation to project performance. However, researchers in construction projects agree time, cost and quality project success indicators sometimes called the golden triangle, as basic performance measures (Othman, Torrance & Hamid, 2006; Sambasivan & Soon, Le-hoai, Dai & Lee, 2008; Abdullah et al., 2010).

King (2015), on the other hand stated sound Project Management practices in line with stakeholder's interest described in terms of meeting the intended, purpose, the level of quality, time, cost; and safely and while protecting the environment. According to (Okoye, Ngwu, & Ugochukwu, 2015; Gwaya, Masu, &Wanyona, 2014; Amalraj & Doucet, 2007), the success of a project is measured by the extent to which it meets the predetermined criteria of cost, time, safety, resource allocation, and quality as determined by the owner which are quite difficult to meet in most construction projects.

2.7. Factors affecting the construction project Performance

Though the factors that affect the cost, time and quality performance of construction projects are classified in different classification in different literature. One of the categorization of factors that affect the performance of construction projects is categorization of factors by their outcome as: cost, time and quality factors. But categorizing factors by their outcome could have some limitation. Since cost; time and quality are the triple constraints of a project which are interdependent of each other it is difficult to set factors exclusively as cost, time or quality factors. Thus factors that has an impact on one constraint is likely to have an impact on the remaining two constraints. Based on this categorization, factors that affect project performance were categorized in to 3 categories as follows:

Cause effect of factors on project performance

The performance of a project can be significantly impacted by various factors. Here are some common factors and their effects on project performance:

1. Resource availability: The availability of resources such as funding, skilled personnel, equipment, and materials can have a direct impact on the project's performance. Insufficient resources can lead to delays, cost overruns, and quality issues.

2. Stakeholder involvement: The level of stakeholder involvement and support can influence project success. Engaged stakeholders can provide valuable input, resources, and support, while disengaged stakeholders can hinder progress and create obstacles.

3. Project management: The effectiveness of project management practices, including planning, monitoring, communication, and risk management, can greatly affect project performance. Strong project management can help ensure that the project stays on track and meets its objectives.

4. External factors: External factors such as market conditions, regulatory changes, and geopolitical events can impact project performance. These factors are often beyond the control of the project team but must be considered and managed to minimize their negative effects.

5. Team dynamics: The cohesion and effectiveness of the project team can also influence project

performance. A well-functioning team with clear roles, good communication, and strong collaboration can lead to better outcomes, while conflicts, turnover, or lack of motivation can hinder progress.

Time Factors

Time factors is one category of factors that contain factors particularly affecting the project time performance. These are factors that have an impact on the project time performance. For these the contractors' management capability has significant impact on cost and time performance of building projects (Aje, Odusami and Ogunsemi, 2009). Another study done by Wiguna and Scott (2005) showed the critical risks affecting both project time and cost perceived by the building contractors were similar. They were: inflation on material price, owners design change, faulty design, delayed payments on contracts, weather conditions, and defective construction work. The most considerable contributing factor for time delays of global projects was delay in payments whereas design-related factors also caused the most delays.

Quality Factors

Quality factor is a category that contain factors particularly affecting the project quality performance. According to Curt (2005), the quality management system monitors and analyzes quality of the constructed project and predicts quality problems and issues. There are distinctive quality measures are; the first one is quality control tests: tasks performed in number, frequency of non-conformance issues, frequency of change requests and root causes, percentage of passed/failed, turnover, cost of rework, and cost of quality (ii) Quality Assurance Cost (cost of resources): quality assurance cost as a percentage of construction cost, cost of quality and Cost of quality as percentage of construction cost. Lepartobiko (2012) stated that quality can be assured by identifying and eliminating the factors that cause poor project performance. Jha and Jha (2006) found that the project manager’s competence and top management support are found to contribute significantly in enhancing the quality performance of a construction project. Lack of contractor experienced topped the quality related cause of project failure.

Chan and Kumarswamy (1997) also proposed different categorization of those factors that affect project performance. These scholars categorized factors into eight major factor categories: project related, client related, design related, contractor related, material, labor, equipment and external factors.

According to Chan and Kumarswamy (1997) Project related factors include project characteristics, necessary variation, communication among various parties, speed of decision making involving all project teams, and ground conditions. Client-related factors include client characteristics, project financing, client variations and requirement and interim payment to contractors. Design-team related factors consist of design team experience, project design complexity, and mistakes and delay in producing design document. Contractor-related factors comprise factors related to: contractor experience in planning and controlling the project, site management and supervision, degree of subcontracting, and contractor's cash-flow. Material factors include material shortage, material changes, procurement programming, and proportion of off-site prefabrication. Human factors encompass: labor shortage, low skill levels, weak motivation, and low productivity. Equipment factors include equipment Shortages, low efficiency, breakdown, and wrong selection. The last one is External factors comprise those such as: waiting time for approval of drawings and test samples of materials, and Environmental concerns and restrictions.

2.8. Empirical Evidence

A study conducted by Chala (2017) on delay factors of condominium construction projects identified the major factors for condominium construction projects delay as late delivery of construction materials, shortage of construction materials, insufficient skill of labors on construction site, delayed procurement of materials, delay in revising and approving design documents, poor communication and coordination of project parties, dispute, total abandonment and arbitration. Similar study conducted by Koshe and Jha (2016) in title "Investigating Causes of Construction Delay in Ethiopia" identified that more than 90% of the sampled construction projects delayed 352 % of its contractual time. Besides, the study identified major factors like; difficulties in financing project by a contractor, escalation of the materials price, infective project planning, scheduling or resource management, delay in progress payments for completed work, lack of skilled professionals in the field of construction management, and fluctuation labor availability as a critical factor for construction delay in Ethiopia (Koshe & Jha, 2016).

A study done on time and cost performance assessment of public building construction in Addis Ababa identified that 100% of the sampled projects were delayed and the delay ranges from 10% up to 250% (Yonnas, 2017). The study also identified the major factors that affect public building construction project time performance as; contractor's organizational structure, project team work experience, test samples of material, Labor deployment of contractor and productivity of labor, and project team turn over (Yonnas, 2017). Similar study conducted on major success factors on building Construction Projects in Addis Ababa, identified critical success factors like: leadership skills of project manager, project clear objective, adequacy of funding, decision, making effectiveness, project monitoring, project manager's commitment to meet quality, cost & time, project manager's early & continued involvement in project, contractor's cash flow, site management, coordinating ability and rapport of project manager with contractors/ subcontractors, project manager’s authority to take financial decision and organizing skills of project manager as a key success factor for the success of public construction projects (Belay, Tekeste, & Ambo, 2017).

Study conducted by Getahun (2016), on the factors affecting performance of road construction project identified the major factors that contribute for delayed road construction projects as to right- of-way problem, delay due to claim approval, poor project time estimation, lack of enough capital base and proper cash flow to execute the works and practice of diverting particular project fund to other projects non-project activities, lack of adequate experience for the required assignment, poor planning and scheduling of works and in effective site management and in adequate supervision of work. Similarly, the study done by Mengistu, Quezon and Kebede (2016) identified equipment shortage, poor site management, lack of labour surveillance, payent delay as the most critical factors that affect road construction projects.

2.9. Measurement Techniques of Project Cost and Schedule Performance

Earned Value Management is a management technique that brings cost and schedule variance analysis together to provide accurate status of a project (EunHong, William, Wells & Michael, 2003).

Schedule variation (SV) is the difference between planned and actual duration. When schedule variation assumes negative value it means the project is late and when schedule variation assumes positive value it means the project has been completed before scheduled time. Similarly cost variation (CV) is measured as the difference between planned cost and actual cost. When cost variation assume negative value it means over budget or overspent project and when cost variation assume positive value it means under budget project. Performance can be also determined using SPI (schedule performance index) and CPI (Cost performance index) (Rathi, 2015).

According to Rathi (2015) project performance can be measured using variances which represent the difference between the current status of the project and its baseline. A The Cost Variance (CV) is an indicator that provides value that represent whether the project is on budget or not. Negative value shows more has been spent for the executed activities and the positive value point out less has been spent for the executed activities than what was originally planned. The **Schedule Variance (SV)** is an indicator that provides with a value that represents whether the project is on schedule or not. Negative value shows the project is behind schedule and the positive value point out ahead of the originally plan schedule.

2.10. Quality Measure

Managing quality in projects must be addressed from two different perspectives: the quality of the product of the project, and the project quality management process. Issues associated with product quality, such as quality metrics and required tools and techniques, are very specific to the nature of the product. For example, the quality issues to be addressed and approaches to be used in building a convention center will be significantly different from those of manufacturing a jet engine. On the other hand, the project quality management process is applicable to a whole range of projects with different nature. It includes all necessary activities carry out fully met the project goal, such as setting quality policies, objectives, and responsibilities. The project quality management process enables the implementation of a quality management system through policies, procedures, and the sub processes of quality planning, quality assurance, and quality. (Hedre, 2010).

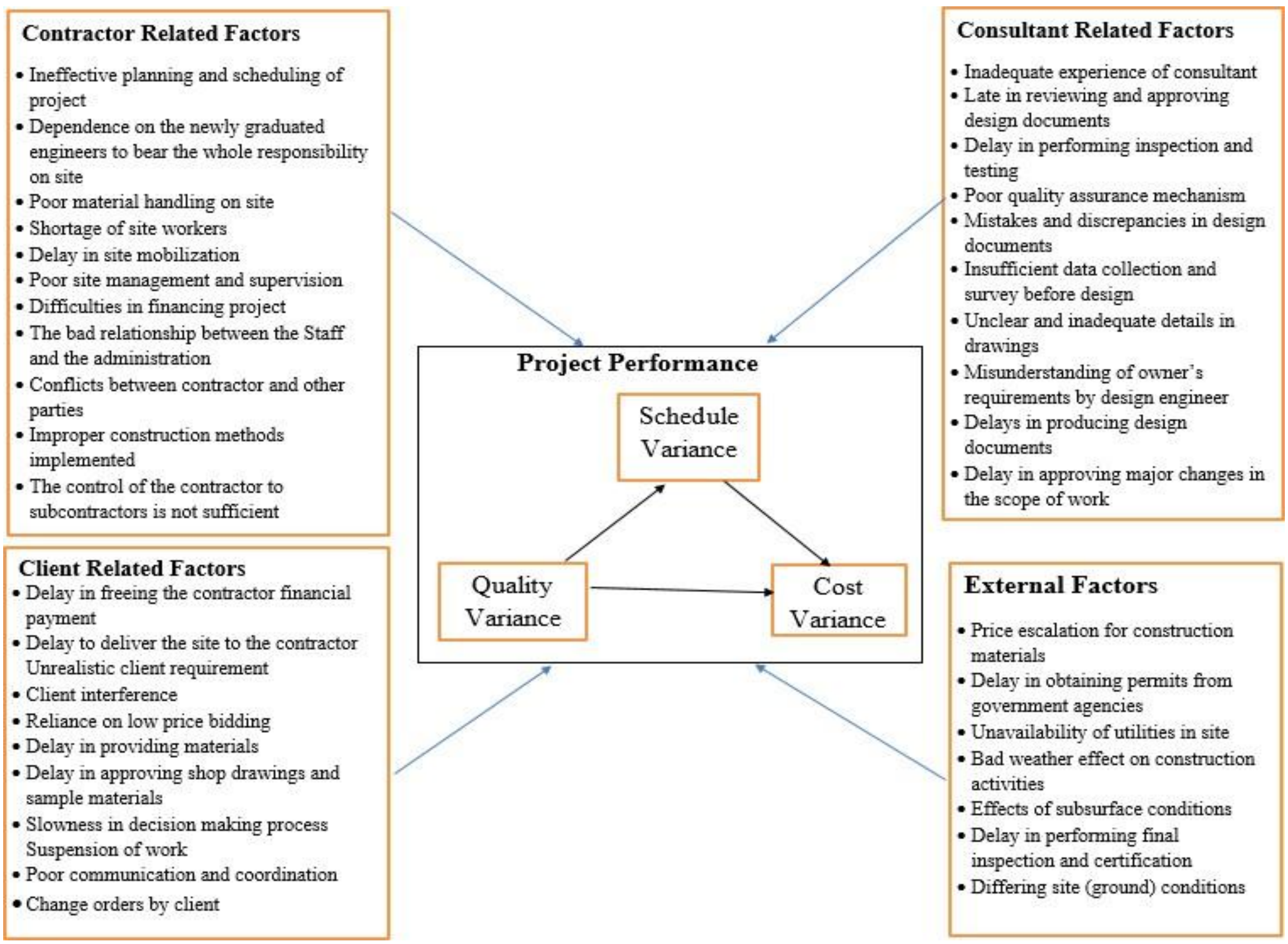
In this study, it is a continuous variable measured as percentage of each project deviation from its planned Specification. Since it is difficult to measure quality variance like that of schedule and cost variance in this study it was measured as perceived by respondents.

2.11. Relationship between Quality, Schedule and Cost variance

In pubic construction project management, one of the role of the project consultant is to check and approve the work of contractor for any negative quality variance from the pre-defined specification. Having this in mind let us consider first the direct relationship between quality variance and cost variance. From the triple constraint theory, it is understood that in a project if there is negative quality variance, it leads to positive cost variance and vis versa. However, in reality when negative quality variance occurred in a project, that variance will be identified by the project consultant and automatically leads to correction or rework. This correction/ rework in the project require the longer time and additional resources, and budgets and this increases labor, material, machinery and equipment cost. From this explanation, the researcher proposed the mediation role of schedule variance between the relationship quality variance and cost variance.

2.12. Conceptual Framework of the Study

From the above reviewed literature, the researcher proposed the following relationship about the three basic performance measures; quality, schedule and cost variances and about the overall factors that contribute for the construction project performance gap. This proposition was diagrammatically represented as follows:



Source: Own Model

CHAPTER-THREE
RESEARCH METHODOLOGY

3.1. Research Design

The study adopted an explanatory approach as it focuses on *what* questions (de Vaus, 2001) and the study employed survey design. The term survey refers to a sample survey, meaning that information is gathered from only a part of the population (Vogt, Gardener, & Haeffel, 2012).Since data was collected once in a particular period of time the study was a cross sectional by its time horizon. In addition, the study employed quantitative research approach to analyze data.

3.2. Target Population

The target population of the study was project managers, resident engineers, and counter-part engineers actively working on ongoing road, 20/80 condominium housing and 40/60 condominium housing projects in Addis Ababa when the study was conducted. The study selected road and condominium house construction projects, since these two types of construction projects were the major public construction projects found in the study area, Addis Ababa. Based on the data obtained from Addis Ababa City Road Authority and Addis Ababa Housing development Agency there were 155 project managers, 92 resident engineers and 76 counter-part engineers actively working on ongoing road and housing construction projects in Addis Ababa during the study period.

3.3. Sample Size and Sampling Procedure

In order to determine the sample size, the formula proposed by Palestinian Contractors Union in Gaza strip was employed (Kish, 1965). The sample size was calculated using the following equation for 95% confidence level:

$$n= n'/ [1+ (n'/N)]$$

Where:

N = total number of population

n = sample size from finite population

n' = sample size from infinite population = S^2/V^2; where S2 is the variance of the population elements and V is a standard error of sampling population. (Usually S = 0.5 and V = 0.05)

Based on this sample size formula the following sample respondents were selected from each group.

Table-3.1 Sample Size Selected from each Group of Respondent

Group of respondent	Population size	Sample size from each type of project
Project Managers	155	61
Resident engineers	92	48
Counter-part engineers	76	43
TOTAL	**323**	**152**

Source: own survey 2023

In order to get balanced data from the selected type of construction projects i.e. road, 40/60 and 20/80 condominium house construction projects the number of samples from each types of construction project were taken by using probability proportional to sample size sampling technique as indicated on the following Table-3.2.

Table-3.2 Sample Distribution by Project Type and Responsibility

Project Types	Project Managers	Resident engineers	Counter-part engineers	Total
Road	*10*	*10*	*9*	29
40/60 condominium	*18*	*16*	*14*	48
20/80 condominium	*33*	*22*	*20*	75
TOTAL	**61**	**48**	**43**	**152**

Source: own survey 2023

After the sample size determined, individual respondents were selected using simple random sampling by using lottery method after developing the sampling frame by obtaining list of active project managers, resident engineers and counter-part engineers currently working on ongoing road and condominium house construction projects from Addis Ababa City Road Authority and Addis Ababa Housing Development Agency.

3.4. Types and Sources of Data

For the purpose of addressing the study objectives, primary data was used. The primary data was collected from contractors (project managers), consultants (resident engineers) and clients (Counter-part engineers). The data used in this study was both quantitative and qualitative in nature. Quantitative data was collected on time, cost and quality performance deviations of the sampled projects and qualitative data was collected on the factors that affect construction project performance.

3.5. Data Collection Tools

Structured questionnaire was employed both from theory and empirical studies as stated in variable definition and measurement part under this session below and data was collected from sampled project managers, resident engineers and counter-part engineers. In order to improve the quality of the questionnaire, before collecting data from actual sample the questionnaire was pretested on few non sampled respondent and necessary modifications was made on the questionnaire based on the feedback obtained.

3.5.1. Variable Definition and Measurement

Measurement of Construction Project Performance Gap

Project Performance Gap: The deviation of the project actual implementation forms the initial approved plan. This deviation can be measured in terms of schedule, cost and quality variation.

Factors Affecting Construction Project Performance

In this study factors that affect construction projects was categorized as: factors related to contractors, factors related to clients, factors related to consultant and external factors (Ahmed et al, 2003 and Alaghbari, 2005).

Factors Related to Contractor: Refers to factors caused by contractors and have an effect on the performance of the project. In order to measure the concept, 18 items from Taha, Badawy and El-Nawawy (2016) and Enshassi et al. (2009) were adopted. Respondents were asked to rate the occurrence of such factors on the particular project on a five-point Likert type scale.

Factors Related to Consultants: Refers to factors caused by consultants and have an effect on the performance of the project. In order to measure the concept, 10 items adopted from Taha, Badawy & El-Nawawy, (2016) and Enshassi et al. (2009). Respondents were asked to rate the occurrence of such factors on the particular project on a five-point Likert type scale.

Factors Related to Clients: Refers to factors caused by clients and have an effect on the performance of the project. In order to measure the concept, 11 items were adopted from Taha, Badawy & El-Nawawy, (2016) and Enshassi et al. (2009). Respondents were asked to rate the occurrence of such factors on the particular project on a five-point Likert type scale.

External Factors: Refers to factors caused by external conditions and have an effect on the performance of the project. In order to measure the concept, 12 items were adopted from Taha, Badawy & El-Nawawy, (2016) and Enshassi et al. (2009). The sampled respondents were asked to rate the happening of external factors on the particular project they involved on a five-point Likert type scale.

3.6. Methods of Data Analysis

For the purpose of analysis, quantitative data analysis methods were applied. The quantitative analysis includes both descriptive and inferential statistics. Descriptive statistics like frequency mean and standard deviation were used to describe the collected data. In order to determine the perception of project managers, resident engineers, and counter-part engineers about the relative importance of the identified factors that affect construction project performance, the Relative importance index (RII) was computed based on the following formula (Iyer and Jha 2005; Ugwu and Haupt 2007):

$$\mathrm{RII} = \frac{\sum W}{A \times N}$$

Where;

W = weight given to each factor by the respondents and ranges from 1 to 5;
A = the highest weight = 5; and
N = the total number of respondents.

Inferential statistics, independent samples correlation, t-test, ANOVA with Post Hoc test were used to test relationship between variables and differences between or among groups. Multiple regression analyses using SPSS using Hayes Process macro were conducted to assess each component of the proposed mediation model that explain the causal relationship among triple constraints, specifically the mediation effect of schedule variance between quality variance and cost variance. During data entry and analysis statistical package for social scientists (SPSS) version 25.0 was used for the purpose of data management.

3.7 Data Validity and Reliability

Validity

In this study, content and face validity were done to check whether the measure is reflecting the meaning of the construct and this was done through the review of literature and adapting instruments which was used from previous studies as shown on the variable definition and measurement section of this document.

In addition, construct validity of the measures was checked using corrected item – total correlation and critical value 0.1946 of the correlation table for 120 degree of freedom (122-2), at 5% level of significance (Ferketich, 1991). Ferketich (1991) recommended that if the corrected item-total correlations should be greater than the critical value for the item to be considered as valid otherwise the item not valid and should be removed. Based on the test result, items that were having corrected item-total correlation value less than the critical value were removed to improve the construct validity.

Reliability

There are three methods that can be used simultaneously to evaluate the internal consistency reliability of a scale: inter item correlations, Cronbach's alpha, and corrected item-total correlations. To ensure internal consistency the minimum value of Cronbach's alpha (α) for all items found under the same construct must be at least 0.70 (Nunnal & Bernstei,1994). On the other hand, according to Lance, Butts, & Michels (2006), this often cited criterion could be misleading and basic research should rely upon scales that yields scores with a minimum reliability of 0.80.

Based on the reliability test, items that significantly improve the construct Chronbach’s alpha values when deleted were identified and remove in order to improve the data reliability. After items removal the values of Chronbach's Alpha (α) for each construct range from 0.803 to 0.888 that indicated good internal consistency of items.

Table-4.3 Reliability Test Using Chronbach's Alpha (α)

No.	Name of the construct	Items initially included	Chronbach's Alpha (α) at the beginning	Problematic items removed	Chronbach's Alpha (α) after deletion
1	Contractor related factors	18	0.657	7	0.832
2	Consultant related factors	10	0.888	no	0.888
3	Client related factors	11	0.858	no	0.858
4	External factors	12	0.777	4	0.803

Source: own survey 2024

CHAPTR-FOUR
RESULT AND DISCUSSION

4.1. Response Rate and Respondent Background

In order to collect primary data, 152 questionnaires were distributed to the sampled respondents i.e. 61 project managers, 48 resident engineers and 43 counter-part engineers. As depicted on Table-4.1 out of the total distributed questionnaires 122; 48 from project managers, 39 from resident engineer and 35 from counter-part engineers were returned and the response rate was 80.26%. The distribution of the returned questionnaires by project types and respondent's responsibility are shown on the following Table-4.1.

Table-4.1 Returned Questionnaires by Project Type and Responsibility

Project Types	Project Managers	Resident engineers	Counter-part engineers	total
Road	***10***	***10***	***9***	**29**
40/60 condominium	***14***	***12***	***11***	**36**
20/80 condominium	***25***	***17***	***15***	**56**
TOTAL	**48**	**39**	**35**	**122**

Source: own survey 2024

As shown on the above Table-4.1; out of the total 122 respondents 48, 39, and 35 were project managers, resident engineers and counter-part engineers respectively. And out of 122 respondents, 29, 36, and 56 were from Road, 40/60 condominium, and 20/80 condominium construction projects.

4.2. Preliminary data analysis

In quantitative research, particularly when primary data is collected from surveys, a preliminary analysis or data screening is a critical step required in order to make sure that the data is usable, reliable and valid for subsequent analyses (Roni, 2014; Lowry & Gaskin, 2014). In this study preliminary data analysis was carried out by using appropriate statistical methods to check unengaged respondents, missing values outliers and normality assumption.

4.2.1. Missing Data

Case wise missing data were identified by running descriptive statistics, frequency table in SPSS. Then percentages of missing variables per case were calculated. Based on the finding, 31 cases had missing values but the maximum missing value found to be 8.475% of the total variables, which is, less than 10% of the variables. Lowry and Gaskin (2014), recommends to drop cases from the data set if missing is more than 10% since these observations don't have major effect on the analysis; accordingly, 31 cases which have missing values on less than 10% of the variables, were treated by imputation. For continuous scales like schedule, cost, quality variances, missing values were replaced with mean and for ordinal scales like Likert scale missing values were replaced with median with nearby points (Lynch, 2003).

The data set also checked for variable with missing data and the maximum percentage of missing were 7%. Since the missing values in each variable were less than 10%, all variables in the data set were retained (Lowry & Gaskin, 2014).

4.2.2. Unengaged respondents

The data was checked for unengaged respondents by examining the standard deviation of each case and the minimum standard deviation was 0.464. Since the minimum standard deviation (SD) was above the cut point of 0.2 that indicated the absence of unengaged cases in the data set (Lowry & Gaskin, 2014).

4.2.3. Assessment of Outliers

Outliers can influence analysis results, pulling the mean away from the median, also affect distributional assumptions, and often reflect false or mistaken responses (Lowry & Gaskin, 2014). Outliers were checked by using the standardized value (Z score) of the variables and Z score value greater or less than ±3.29 indicating that the existence of outlier in the data set (Tabachnik& Fidell, 2013). Table-4.2 below shows that the minimum value of the Z score ranges from negative 0.648 to negative 3.029 and the maximum Z score value ranges from positive 0.913 to positive 3.192 indicating that there was no outlier existed in the data set.

Table-4.2 **Minimum and Maximum Value of Standardize value of the variables**

Variables	N	Minimum	Maximum
Zcont_related1	122	-2.57800	.93615
Zcont_related2	122	-2.40338	1.17238
Zcont_related3	122	-1.95914	1.33762
Zcont_related4	122	-2.35203	1.16880
Zcont_related5	122	-2.05196	1.35401
Zcont_related6	122	-2.41523	1.20021
Zcont_related7	122	-2.49885	1.26485
Zcont_related8	122	-1.63466	1.18744
Zcont_related9	122	-1.87261	1.24273
Zcont_related10	122	-2.17564	1.80578
Zcont_related11	122	-2.32789	1.87955
Zcont_related12	122	-2.08060	1.82453
Zcont_related13	122	-2.46218	2.15915
Zcont_related14	122	-1.56399	1.68840
Zcont_related15	122	-2.48684	1.72697
Zcont_related16	122	-2.09659	1.45597
Zcont_related17	122	-1.91925	1.42573
Zcont_related18	122	-1.86079	1.68634
ZConslt_related1	122	-2.26383	1.62613
ZConslt_related2	122	-2.67141	1.25524
ZConslt_related3	122	-2.57788	1.45419
ZConslt_related4	122	-1.97860	1.75423
ZConslt_related6	122	-1.72248	1.59556
ZConslt_related5	122	-1.74902	1.42000
ZConslt_related7	122	-1.77757	1.32048
ZConslt_related8	122	-1.34506	2.17131
ZConslt_related9	122	-2.53656	1.28394
ZConslt_related10	122	-2.60988	1.04995

Source: own survey 2024

Variables	N	Minimum	Maximum
ZClient_related1	122	-2.54754	1.04552
ZClient_related2	122	-2.24371	1.05427
ZClient_related3	122	-2.41031	2.04511
ZClient_related4	122	-2.31205	2.06113
ZClient_related5	122	-2.42624	1.09758
ZClient_related6	122	-2.43563	.94104
ZClient_related7	122	-2.38528	1.39400
ZClient_related8	122	-2.04870	1.15568
ZClient_related9	122	-1.54405	1.52727
ZClient_related10	122	-2.40148	1.33076
ZClient_related11	122	-1.92138	1.52581
ZExt_related1	122	-2.31949	1.93581
ZExt_related2	122	-2.36197	.91258
ZExt_related3	122	-1.62525	1.77384
ZExt_related4	122	-2.30837	2.42476
ZExt_related5	122	-2.44607	1.14936
ZExt_related6	122	-2.10819	2.10819
ZExt_related7	122	-2.11086	2.14576
ZExt_related8	122	-2.06871	2.00198
ZExt_related9	122	-2.42428	2.54652
ZExt_related10	122	-2.19567	1.57717
ZExt_related11	122	-2.64513	1.60100
ZExt_related12	122	-2.57001	1.69586
ZPtimeperformP	122	-2.28782	2.55953
ZPtimeperformA	122	-2.44118	1.94919
ZPcostperformP	122	-.64787	3.15799
ZPcostperformA	122	-.68738	3.19189
ZPqualityperform	122	-3.02896	1.65238
Valid N (listwise)	122		

Project Performance Variation

The performance variation in the 3 types of construction projects i.e. Road, 20/80 and 40/60 condominium houses development projects were assessed from the perspective of the three iron triangle i.e. time or schedule, cost and quality.

The descriptive statistics result depicted that the mean schedule, cost and quality variances for all types of sampled projects was found to be -117.84%, -32.37% and -17.95% respectively (Table-4.4). As indicated on Tabel-4.4, the minimum and maximum performance variation of the sampled construction projects ranges from-11.11 to -300.00 for schedule variation, from -16.37 to -127.27 for cost variation and from -2.00 to -50.00 for quality variation. Based on this result 100% of the sampled construction projects had performance variation with regard to all the three performance dimensions. The schedule variance was the highest performance variation in the sampled construction projects followed by cost and quality variation.

The results of the correlation analysis on Table-4.4 depicted that the variables, cost variance and schedule variance had a statistically significant positive linear relationship at 1% level of significance. In addition, the correlation coefficient with the value of 0.536, indicated that the relationship between the cost and schedule variance was considered to be moderate based on the cut point proposed by Evans (1996).

Schedule variance and quality variance had a correlation coefficient value 0.328, indicated that the two variables had positive linear relationship that was statistically significant at 1% level of significance (Table-4.4). Based on the cut point proposed by Evans (1996), the coefficient value 0.328, was found to be between the absolute value 0.20 and 0.39 that indicate the relationship between schedule variance and quality variance is considered weak.

As shown on Table-4.4 quality variance and cost variance had a correlation coefficient value 0.131. The coefficient indicated that the existence of very weak positive relationship between quality and cost variance and the correlation was not statistically significant. This result indicated that there is no linear association between the variables quality variance and cost variance.

Table-4.4 Descriptive Statistics and Inter-correlations of the Performance Variables

	Item	N	Mean	Std.	Min	Max	Inter-Correlations		
							1	2	3
1	Schedule Variance	122	-117.84	72.59	-11.11	-300.00	1		
2	Cost Variance	122	-32.37	28.87	-16.37	-127.27	0.536	1	
3	Quality Variance	122	-17.95	8.76	-2.00	-50.00	0.328	.131	1

** Correlation is significant at the 0.01 level (2-tailed).
Source: own survey 2024

4.2.4. Project performance variance by project type

Project performance variances across the 3types of construction projects i.e. Road, 20/80 Condominium, and 40/60 Condominium projects were tested using analysis of variance (ANOVA) with post Hoc analysis. Before running the analysis, the assumption of normality was evaluated by assessing kurtosis and skewenss values of each variable included in the analysis. According to Sposito and Skarpness (1983), the kurtosis and skewness values greater than positive 2.2 or less than negative 2.2 is indicator of departure from normality. Table-4.5 depicted that the value of skewness ranges from positive 0.792 to negative 1.279 and kurtosis value ranges from positive 1.525 to negative 0.514, this indicated that all the three variables fulfill the assumption of normality.

Table- 4.5 Normality Test Using Skewness and kurtosis

Variables	Valid	Skewness	Kurtosis
Schedule variance	122	-.494	-.514
Cost Variance	122	-1.279	1.525
Quality Variance	122	-.792	1.122

*p<0.05, **p<0.01, ***p<0.001
Source: own survey 2024

4.2.4.1. Project schedule variance by project types

The descriptive statistics indicated that the mean schedule variance of Road, 20/80 Condominium, and 40/60 Condominium were found to be -69.07, -148.34, and -106.74 respectively. Based on the analysis of variance result, the mean schedule variance difference among the 3 types of construction projects were statistically significant at 0.1% level of significance (Table-4.6).

Table-4.6 ANOVA Test Schedule Variance by Project Type

Schedule Variance	Sum of Squares	df	Mean Square	F
Between Groups	121943.54	2.00	60971.77	14.07
Within Groups	515665.31	119.00	4333.32	
Total	637608.85	121.00		

*p<0.05, **p<0.01, ***p<0.001
Source: own computation

The study further investigate between which types of construction projects the mean schedule variance had statistically significant difference, post Hoc test was conducted. Table-4.7 depicted that the mean schedule variance of road and 20/80 Condominium projects were found to have statistically significant difference at 0.1% level of significance. Based on this result, 20/80 condominium projects had greater schedule variance with the mean value of -148.34 than road construction project with the mean schedule variance of -69.07. This schedule variance difference between these construction projects could be due to delayed material supply and delayed payment from the side of the client and insufficient capability of the contractors. It is also found that the mean schedule variance of 20/80 Condominium projects (-148.34) and 40/60 Condominium projects (-106.73) were found to have statistically significant difference at 1% level of significance. Based on this result 20/80 Condominium projects had greater schedule variance than 40/60 condominium construction projects.

On the other hand, the mean schedule variance of Road and 40/60 Condominium projects had no statistically significant factor (Table-4.7).

Table-4.7 Multiple Comparisons (Schedule Variance by Project Type)

Dependent Variable	Project Type (I)	Project Type (J)	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Schedule Variance	Road	20/80 Condominium	79.28	15.38	42.77	115.78
		40/60 Condominium	37.67	16.57	-1.65	77
	20/80 Condominium	40/60 Condominium	-41.60	13.79	-74.32	-8.88

*p<0.05, **p<0.01, ***p<0.001

Source: own survey 2024

4.2.4.2. Project Cost variance by project types

The descriptive statistics indicated that the mean cost variance of the sampled Road, 20/80 Condominium, and 40/60 Condominium projects were found to be -19.69, -47.02, and -19.40 respectively. Based on the analysis of variance result, the mean cost variance difference among the 3 types of construction projects were found statistically significant at 0.1% level of significance (Table-4.8).

Table-4.8 ANOVA Test Cost Variance by Project Type

Cost Variance	Sum of Squares	df	Mean Square	F
Between Groups	22956.83	2.00	11478.41	17.540
Within Groups	77861.61	119.00	654.30	
Total	100818.44	121.00		

*p<0.05, **p<0.01, ***p<0.001

Source: own survey 2024

The study further investigate between which types of construction projects the mean cost variance had statistically significant difference, post Hoc test was conducted. As indicated on Table-4.9, the mean cost variance of road (-19.69) and 20/80 Condominium projects (-47.02) were found to have statistically significant difference at 0.1% level of significance. This result implies that the cost variance of 20/80 condominium projects was greater than that of road construction projects. This cost variance difference between road and 20/80 condominium projects could be caused due to poor cost management from the side of contractor and poor cost estimation during planning. Similarly, the mean cost variance of 20/80 Condominium (-47.02) and 40/60 Condominium projects (-19.40) had statistically significant difference at 1% level of significance. This result indicated that 20/80 condominium projects had greater cost variance compared to that of 60/40 condominium projects. On the other hand, there was no statistically significant difference in the mean cost variance between Road and 40/60 Condominium projects (Table-4.9).

Table-4.9: Multiple Comparisons (Cost Variance by Project Type)

Dependent Variable	Project Type (I)	Project Type (J)	Mean Difference (I-J)	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Cost Variance	Road	20/80 Condominium	27.32	5.98	13.14	41.51
		40/60 Condominium	-0.29	6.44	-15.57	14.99
	20/80 Condominium	40/60 Condominium	-27.61	5.36	-40.33	-14.90

4.2.4.3. Project Quality variance by project types

The descriptive statistics indicated that the mean quality variance of the sampled Road, 20/80 Condominium, and 40/60 Condominium projects were found to be -14.49, -18.27, and 19.91 respectively. Based on the analysis of variance result, there is statistically significant difference in the mean quality variance among the 3 types of construction projects at 5% level of significance (**Table-4.10**).

Table-4.10 ANOVA Test Quality Variance by Project Type

Quality Variance	Sum of Squares	df	Mean Square	F
Between Groups	475.81	2.00	237.91	3.25
Within Groups	8811.93	119.00	74.05	
Total	9287.74	121.00		

*p<0.05, **p<0.01, ***p<0.001
Source: own survey 2024

The study further investigate between which types of construction projects the mean quality variance had statistically significant difference, post Hoc test was conducted. As indicated on Table-4.11, the mean quality variance of road projects was (-14.25) and 40/60 Condominium projects were (-19.91) and the difference was statistically significant at 5% level of significance. This result indicated that quality variance of 40/60 condominium projects were greater than that of the road project quality variation. On the other hand, there was no statistically significant difference in mean quality variance between Road and 20/80 Condominium projects. Similarly, there was no statistically significant difference in mean quality variance between 20/80 Condominium and 40/60 Condominium projects (Table-4.11).

Table-4.11 Multiple Comparisons (Quality Variance by Project Type)

Dependent Variable	Project Type (I)	Project Type (J)	Mean Difference (I-J)	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Quality Variance	Road	20/80 Condominium	3.786	2.01	-0.986	8.557
		40/60 Condominium	5.42	2.17	0.28	10.56
	20/80 Condominium	40/60 Condominium	1.64	1.80	-2.64	5.92

*p<0.05, **p<0.01, ***p<0.001
Source: own survey 2024

4.3. The mediation effect of schedule variance on the relationship between quality variance and cost variance

Multiple regression analyses using SPSS using Hayes Process macro were conducted to assess each component of the proposed mediation model (Figure-1). Before running the regression model assumptions were checked. First both the dependent and independent variables i.e. quality variance, schedule variance and cost variance were cheeked for normality According to Sposito and Skarpness (1983), the kurtosis and skewness values greater than positive 2.2 or less than negative 2.2 is indicator of departure from normality. The above Table-4.5 depicted that the value of skewness ranges from positive 0.792 to negative 1.279 and kurtosis value ranges from positive 1.525 to negative 0.514, this indicated that all the three variables fulfill the assumption of normality. The independent variables, schedule variance and quality variance were evaluated for multicollinearity by using variance inflation factor (VIF). According to Lowry & Gaskin (2014), the VIF value for independent variables is recommended to be less than 5 to be free from the risk of multicollinearity. The model summary of the regression indicated that VIF value for both the independent variables were found to be 1.15 which is less than 5 indicating that there is no risk of multicollinearity. Finally, linearity of the relationship between the independent variables and dependent variable were checked using curve estimation and found p-value not significant which indicate there is a linear relationship between independent and dependent variables.

The ANOVA table of the mediation model showed the model is statistically significant at 0.1% level of significance (Table-4.12). In addition, the independent variables, schedule variance and quality variance can explain 29% of the variations in the dependent variable, cost variance.

Table-4.12 Model Significance ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29225.76	2.00	14612.88	24.29	
	Residual	71592.68	119.00	601.62		
	Total	100818.44	121.00			

R=0.538, R Square=0.290, Adjusted R Square=0.278, Std Error=24.53

a. Dependent Variable: Cost Variance

b. Predictors: (Constant), Quality Variance, Schedule Variance

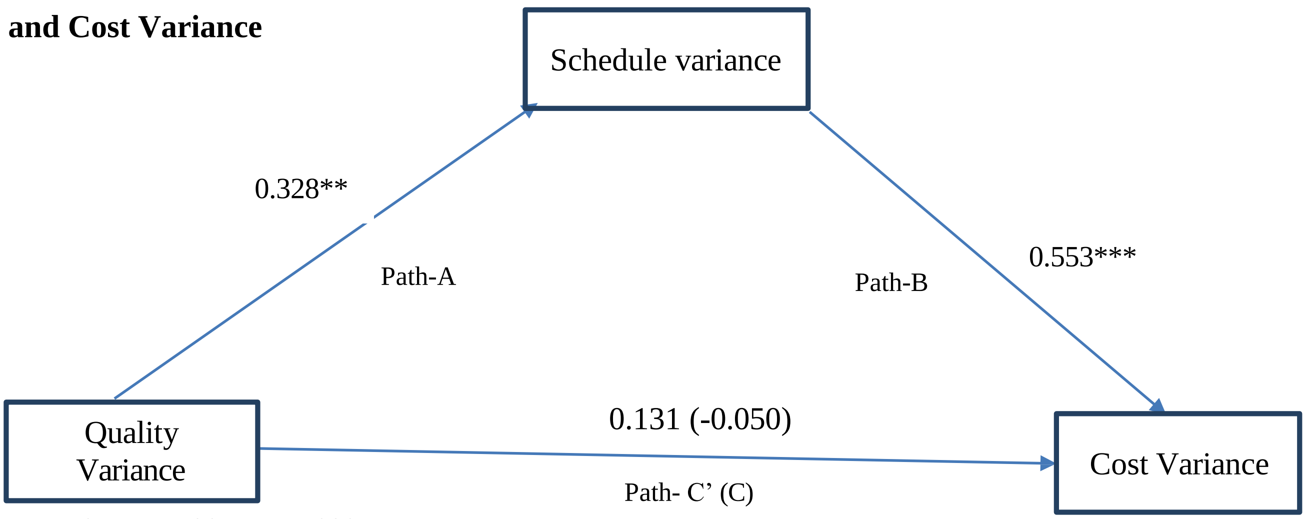
Source: own survey 2024

First it was found that quality variance had positive effect on schedule variance which was statistically significant at 0.1% level of significance (standardized B=0.328, t (120) = 3.81, p=0.000). This result indicated that one-unit increase in quality variance will lead to decrease in schedule variance by the coefficient 0.328. It was also found that without the mediator variable, quality variance had a direct negative effect on cost variance but the effect was not statistically significant (standardized B=-0.050, t (119) =-.614, p=0.54). Lastly, results indicated that the mediator, schedule variance, had positive effect on cost variance which was statistically significant at 0.1% level of significance (standardized B=0.553, t (119) = 6.76, p=0.00). This result indicated that one-unit increase in schedule variance will lead to increase cost variance by.553.

Since both the a-path and b-path were significant, mediation analyses were tested using the bootstrapping method with bias-corrected confidence estimates (Mackinnon, Lockwood, &Williams, 2004; Preacher & Hayes, 2004). In this study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap resample (Preacher& Hayes, 2008). Results of the mediation analysis showed that when the mediator variable, schedule variance introduced, quality variance had statistically significant indirect effect on cost variance (standardized B= 0.181, CI= -.0343 to -.076). The analysis result confirmed the mediating role of schedule variance in the relation between quality variance and cost variance. When the mediator variable introduced, the direction and magnitude of the direct effect of quality variance on cost variance was changed from -0.050 to 0.131 The Figure-1 displays the results.

The mediation test result, implied that when quality variation increased in a given construction project, it will cause increase in cost variance but that will happen though increasing the schedule variance of the project.

Figure-4.1 Mediation Effect of Schedule Variance on the Relationship between Quality Variance and Cost Variance



Note: *p<0.05, **p<0.01, ***p<0.001

Source: own survey 2024

4.4. Factors Affecting Construction Project Performance

The major factors that affect construction projects were categorized under 4 major categories namely; contractor related factors, consultant related factors, client related factors, and external factors. The Relative Importance Index (RII) was used to determine the ranking of different factors based on their category that affect project performance. It is also used to compare the relative importance of the factors as perceived by the group of respondents (project managers, resident engineers and counter-part engineers). In addition to the analysis done. The perception of the entire respondent was aggregated to generate the overall RII and rank to show the overall picture of the factors that impact the performance of construction projects.

4.4.1. The relative importance index (RII) and rank of Contractor related factors affecting the performance of construction projects

Table-4.13 indicated that 8(72.72%) out of the 11 factors included under the contractor related factors category, even though these factors were given different RII value by different respondent group, they received the rank of 1 to 5 at least in one or more of the respondent groups. These factors include: ineffective planning and scheduling of project by contractor, dependence on the newly graduated engineers to bear the whole responsibility on site, poor material handling on site, delay in site mobilization, poor site management and supervision by contractor, difficulties in financing project by contractor, improper construction methods implemented by contractor, and insufficient control of the contractor to subcontractors. This result implies that at least one group of respondent perceived these contractors related factors to have very important contribution for the performance variation of construction projects.

From these 8 contractor related factors, 5(62.5%) of them (Ineffective planning and scheduling of project by contractor, Poor site management and supervision by contractor, Difficulties in financing project by contractor, Improper construction methods implemented by contractor, and The control of the contractor to subcontractors is not sufficient) took the overall rank that ranges from1 up to 11. This indicated that contractor related factor contribute 5(33.33%) the top 15 factors from all the 39 factors included in all the 4 categories as shown on the Table-4.13.

From this result, one can understand that stakeholders working on construction projects should give due emphasis in managing contractor related factors in general and particularly in managing the factors; ineffective planning and scheduling of project by contractor, poor site management and supervision by contractor, difficulties in financing project by contractor, improper construction methods implemented by contractor, and The control of the contractor to subcontractors is not sufficient so that to improve construction project performance.

Table-4.13 Contractors Related Factors Relative Importance Index (RII) and Rank Categorized by Groups of Respondents

No.	Factors	RII manager	Rank managers	RII resident	Rank resident	RII counter	Rank counter	Overall RII	Overall Rank
1	Ineffective planning and scheduling of project by contractor	0.86	1	0.84	1	0.71	3	0.79	2
2	Dependence on the newly graduated engineers to bear the whole responsibility on site	0.78	7	0.71	4	0.58	11	0.68	31
3	Poor material handling on site	0.81	4	0.75	3	0.67	7	0.73	16
4	Shortage of site workers	0.74	10	0.69	7	0.64	8	0.68	29
5	Delay in site mobilization	0.8	5	0.69	6	0.69	5	0.73	18
6	Poor site management and supervision by contractor	0.78	8	0.67	9	0.75	2	0.75	10
7	Difficulties in financing project by contractor	0.79	6	0.71	5	0.76	1	0.76	7
8	The bad relationship between the Staff and the administration	0.7	11	0.64	11	0.6	9	0.64	35
9	Conflicts between contractor and other parties	0.76	9	0.67	10	0.6	10	0.67	32
10	Improper construction methods implemented by contractor	0.83	2	0.76	2	0.69	6	0.75	8
11	The control of the contractor to subcontractors is not sufficient	0.82	3	0.71	6	0.7	4	0.74	11

Source: own survey 2024

4.4.2. Relative Importance Index (RII) and Rank of consultant Related Factors affecting the performance of construction projects

Table-4.14 indicated that 7(70%) of the 10 factors included under consultant related factors category, even though these factors were given different RII value by different respondent group, they received the rank of 1 to 5 at least in one or more of the respondent groups. These 7 factors include: late in reviewing and approving design documents by consultant, delay in performing inspection and testing by consultant, poor quality assurance mechanism, mistakes and discrepancies in design documents, insufficient data collection and survey before design, unclear and inadequate details in drawings, and delay in approving major changes in the scope of work by consultant. This result implies that at least one group of respondent perceived these consultants related factors to have very important impact on the performance of construction projects.

And from these 7 consultant related factors, 3(60%) of them (Late in reviewing and approving design documents by consultant, unclear and inadequate details in drawings, delay in approving major changes in the scope of work by consultant) took the overall rank ranges from1 up to 13. This indicated that consultant related factor contribute 3(20%) of the top 15 factors from all the 39 factors included in all the 4 categories as shown on the Table-4.14.

From this result one can understood that stakeholders working on construction projects should give due emphasis in managing the 7 consultant related factors that took the top rank of 1 up to 5. In addition, stakeholders should give a particular attention for the factors; late in reviewing and approving design documents by consultant, unclear and inadequate details in drawings, delay in approving major changes in the scope of work by consultant which are among the top 15 factors from all the 4 categories so that to improve construction project performance.

Table-4.14 Consultant Related Factors Relative Importance Index (RII) and Rank Categorized by Groups of Respondents

No.	Factors	RII manager	Rank managers	RII resident	Rank resident	RII counter	Rank counter	Overall RII	Overall Rank
12	Inadequate experience of consultant	0.72	9	0.60	8	0.65	9	0.67	33
13	Late in reviewing and approving design documents by consultant	0.83	2	0.64	4	0.72	2	0.74	12
14	Delay in performing inspection and testing by consultant	0.77	7	0.65	2	0.69	7	0.71	23
15	Poor quality assurance mechanism	0.76	8	0.64	5	0.71	5	0.72	21
16	Mistakes and discrepancies in design documents	0.78	6	0.65	3	0.68	8	0.71	24
17	Insufficient data collection and survey before design	0.79	4	0.64	6	0.72	3	0.73	19
18	Unclear and inadequate details in drawings	0.79	5	0.60	9	0.76	1	0.74	13
19	Misunderstanding of owner’s requirements by design engineer	0.64	10	0.56	10	0.65	10	0.63	37
20	Delays in producing design documents	0.81	3	0.64	7	0.71	6	0.73	20
21	Delay in approving major changes in the scope of work by consultant	0.87	1	0.69	1	0.72	4	0.77	5

Source: own survey 2024

4.4.3. The relative importance index (RII) and rank of Client related factors affecting the performance of construction projects

Table-4.15 indicated that 7(63.64%) out of the total 11 factors that were included under client related factors, even though these factors were given different RII value by different respondent group, they received the rank of 1 to 5 at least in one or more of the respondent groups. These 7 factors include: delay in freeing the contractor financial payment, delay to deliver the site to the contractor by the client, client reliance on low price bidding, delay in providing materials that the client agreed to provide, slowness in decision making process by client, poor communication and coordination by client and other parties, and change orders by client during construction. This result indicated that at least one group of respondent perceived these clients related factors to have very important impact on the performance of construction projects.

And from these 7 client related factors, 5(71.43%) of them (delay in freeing the contractor financial payment, delay to deliver the site to the contractor by the client, client reliance on low price bidding, delay in providing materials that the client agreed to provide, and slowness in decision making process by client) took the overall rank ranges from 3 up to 14. This indicated that client related factor contribute 5(33.33%) of the top 15 factors from all the 39 factors included in all the 4 categories as shown on the Table-4.15.

From this result one can understood that stakeholders working on construction projects should give due emphasis in managing the 7 client related factors that took the top rank of 1 up to 5. In addition, stakeholders should give a particular attention for the factors; delay in freeing the contractor financial payment, delay to deliver the site to the contractor by the client, client reliance on low price bidding, delay in providing materials that the client agreed to provide, and Slowness in decision making process by client which are among the top 15 factors from all the 4 categories, so that to improve construction project performance.

Table-4.15 Client Related Factors Relative Importance Index (RII) and Rank Categorized by Groups of Respondents

No.	Factors	RII manager	Rank managers	RII resident	Rank resident	RII counter	Rank counter	Overall RII	Overall Rank
22	Delay in freeing the contractor financial payment	0.92	2	0.71	7	0.67	3	0.77	6
23	Delay to deliver the site to the contractor by the client	0.85	5	0.73	5	0.66	4	0.74	14
24	Unrealistic client requirement	0.68	10	0.64	11	0.59	10	0.63	36
25	Client interference	0.67	11	0.71	8	0.55	11	0.62	38
26	Client reliance on low price bidding	0.88	3	0.73	6	0.66	5	0.75	9
27	Delay in providing materials that the client agreed to provide	0.94	1	0.76	3	0.66	6	0.78	4
28	Delay in approving shop drawings and sample materials	0.78	7	0.71	9	0.64	8	0.70	25
29	Slowness in decision making process by client	0.87	4	0.75	4	0.73	1	0.78	3
30	Suspension of work by client	0.77	8	0.69	10	0.65	7	0.70	26
31	Poor communication and coordination by client and other parties	0.80	6	0.782	1	0.62	9	0.71	22
32	Change orders by client during construction	0.76	9	0.782	2	0.69	2	0.73	17

Source: own survey 2024

4.4.4. The relative importance index (RII) and rank of External factors affecting the performance of construction projects

Table-4.16 indicated that 6(85.7%) of the 7 factors included under external related factors category, even though these factors assumed different RII value by different respondent group, they received the rank of 1 to 5 at least by one or more of the respondent groups. These 6 factors include: price escalation for construction materials, delay in obtaining permits from government agencies, unavailability of utilities in site (such as, water, electricity, telephone, etc.), effects of subsurface conditions (e.g., soil, high water table, etc.), delay in performing final inspection and certification by a third party, and differing site (ground) conditions. This result implied that at least one group of respondent perceived these external related factors to have very important impact on the performance of construction projects.

From these 6 external related factors, 2 (33.33%) of them (price escalation for construction materials, and unavailability of utilities in site such as, water, electricity, telephone, etc.) took the overall rank of 1 and 15 respectively. This indicated that external related factor contribute 2(13.33%) of the top 15 factors from all the 39 factors included in all the 4 categories as shown on the Table-4.16.

From this result one can understood that stakeholders working on construction projects should give due emphasis in managing the 6 external related factors that took the top rank of 1 up to 5. In addition, stakeholders should give a particular attention for the factors; price escalation for construction materials, and unavailability of utilities in site such as, water, electricity, telephone, etc. which are among the top 15 factors from all the 4 categories, so as to improve construction project performance.

Table-4.16 External Factors Relative Importance Index (RII) and Rank Categorized by Groups of Respondents

No.	Factors	RII manager	Rank managers	RII resident	Rank resident	RII counter	Rank counter	Overall RII	Overall Rank
33	Price escalation for construction materials	0.92	1	0.82	1	0.77	1	0.83	1
34	Delay in obtaining permits from government agencies	0.69	6	0.74	2	0.66	3	0.69	28
35	Unavailability of utilities in site	0.85	2	0.64	6	0.71	2	0.74	15
36	Bad weather effect on construction activities	0.66	7	0.60	7	0.54	7	0.60	39
37	Effects of subsurface conditions	0.75	5	0.67	3	0.60	6	0.67	34
38	Delay in performing final inspection and certification	0.82	3	0.65	4	0.62	4	0.70	27
39	Differing site (ground) conditions	0.79	4	0.65	5	0.61	5	0.68	30

Source: own survey 2024

4.5. Group of Factors by Project type

The value of each factors found under the same group were aggregated to generate the average value of the 4 group of factors i.e. average contractor related factor, average consultant related factor, average client related factor, and average external related factor. And analysis of variance was used to test whether the mean value of each group of factor is different across the 3 types of construction projects (Road, 20/80 condominium, and 60/40 condominium projects).

Based on table-4.17, the ANOVA test indicated that there was no statistically significant difference in the mean value of all the 4 groups of factors across the 3 types of construction projects. This result indicated that the respondents of all the 3 types of construction projects have the same perception on the importance of the 4 groups of factors for the 3 types of construction projects performance.

Table-4.17 ANOVA Test Factors by Project Type

Dependent variable		**Sum of Squares**	**df**	**Mean Square**	**F**	**sig.(p valu**
Average Contractor related factor	Between Groups	1.23	2	0.62	1.55	0.22
	Within Groups	23.10	119	0.40		
	Total	24.33	121			
Average Consultant related factor	Between Groups	.93	2	.464	1.00	0.37
	Within Groups	26.83	119	.463		
	Total	27.76	121			
Average Client related factor	Between Groups	.08	2	.039	0.09	0.92
	Within Groups	26.03	119	.449		
	Total	26.11	121			
Average external related factor	Between Groups	.83	2	.417	0.99	0.38
	Within Groups	24.47	119	.422		
	Total	25.30	121			

Source: own survey 2024

This analysis suggests that regardless of the type of construction project, the perceptions regarding the importance of contractor-related, consultant-related, client-related, and external-related factors remain consistent. This information could be valuable for decision-makers in the construction industry to understand where focus and resources should be allocated across different types of projects.

CHAPTER-FIVE

CONCLUSION AND RECOMENDATION

5.1. CONCLUSIONS

Performance gap in terms of schedule, cost and quality variance is becoming a serious problem in all the 3 types of the construction projects (Road, 20/80 Condominium and 40/60 condominium projects). In all the 3 types of construction projects schedule variance was the highest variation followed by cost and quality variation. Construction project performance gap could be caused by multiple factors that can be broadly categorized as; contractor related factors, consultant related factors, client related factors and external related factors. From the study finding the following are the top critical factors under each category that were perceived to cause high performance gap in Road, 20/80 condominium and 40/60 condominium construction projects.

- From contractor related factors; ineffective planning and scheduling of project by contractor, poor site management and supervision by contractor, difficulties in financing project by contractor, improper construction methods implemented by contractor, and insufficient control of the contractor to subcontractors were found to be the top critical factors that contribute for construction projects performance gap.

- From consultant related factors; late in reviewing and approving design documents by consultant, unclear and inadequate details in drawings, and delay in approving major changes in the scope of work by consultant were found to be the top critical factors that contribute for construction projects performance gap.

- From client related factors; delay in freeing the contractor financial payment, delay to deliver the site to the contractor by the client, client reliance on low price bidding, delay in providing materials that the client agreed to provide, and slowness in decision making process by client were found to be the top critical factors that contribute for construction projects performance gap.

Finally, from external related factors; price escalation for construction materials, and unavailability of utilities in site such as, water, electricity, telephone, etc were found to be the most critical factors that contribute for construction projects performance gap.

5.2. RECOMMENDATION*S*

Based on the findings of the study, the following recommendations are forwarded:

For contractors:

In order to overcome top critical contractor related factors that highly contribute for the performance gap of construction projects, contractors should work on:

- Ensuring enough capital base and proper cash flow to execute the works as much as possible, minimize the practice of diverting particular project funds to non-project activities to avoid shortage of funding by contractors during the execution of the works.

- Establish a management system for continues improvement so that to acquire and develop the needed competency among project team members and to build a culture of learning from experience. This in turn will ensure adequate experience for a required assignment, deploy competent project team and employ appropriate construction methods for the required assignment.

- Ensuring effective site management and supervision of the works so as to keep watch on critical activities to minimize cost by continuously working on elimination non value adding activities and to complete projects within the specified time while meeting quality specification.

- Ensuring use of different technologies and modern techniques for proper planning and scheduling of the works.

For consultants:

In order to overcome top critical consultant related factors those highly contribute for the performance gap of construction projects, consultants should work on:

- Acquiring sufficient and competent consultant staff and continuously develop the competency of the consultants so that they can have the capability to give on time feedback and approval.
- Developing standard for detail drawing and develop a mechanism to jointly evaluate the detail drawings for its adequacy and clarity before submitting to contractors.

For Clients:

In order to overcome top critical client related factors those highly contribute for the performance gap of construction projects, Clients should work on:

- Enhancing payment system that reduce delay in freeing payment for contractors
- Recruiting competent contractors and consultant by properly investigate the technical aspects rather than relying on low price.
- Enhancing on time project site delivery by closely working with other concerned bodies.
- Stocking adequate constriction material or inter in to long term contract with reliable suppliers so that to provide constriction material on time when the contractor is responsible to provide constriction material

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APPENDICES

Research Questionnaire

Dear respondents!

This study is designed to gather information on **"Factor Affecting the Performance of Public Construction Projects: A Survey of Addis Ababa Road and Condominium house Projects"** in the completion of my Master's Degree in Business Administration (MBA) at St.Mary University. Your genuine voluntary response has significant value for the completion of this thesis and the information you provide will be only used for the purpose academic study and will be kept strictly confidential. You do not need to write your name or personal related issues. Finally, I would like to thank you for your cooperation

With best regards!

Yiftaalem Akelom (Civil Engineer)

Part-I: General Information:

Name of your organization: ____________________

Name of the project: ____________________

Responsibility on the project: Project Manager ☐ Resident Engineer ☐ Counter-part Engineer ☐

Sex: Female ☐ Male ☐

Part-II: Project Performance Status:

A) Project Time Performance

No.	Project Name	The planed amount of time the project expected to take to complete work done so far (in days)	The actual time spent on the project to complete the work done so far (in days)
1			
2			
3			

B) Project Cost Performance

No.	Project Name	The planed amount of budget the project expected to take to complete work done so far (in Birr)	The actual budget spent on the project to complete the work done so far (in Birr)

1			
2			
3			

C) Project Quality Performance

No.	Project Name	Estimated deviation of the project in meeting specifications and approved standard in percentage (%)
1		
2		
3		

Part-III: Factors affecting project Performance:

Instructions

The following are possible contributing factors for project performance gap taken from literature. From your experience, please express your opinion on the importance of the following factors in causing performance gap on your project. Please putting a tick (√) mark parallel to a number from 1 to 5 using the scale below.

1 = strongly disagree
2 = disagree
3 = undecided
4 = agree
5 = strongly agree

NO.	Items	Degree of Rank				
1	**Contractor related factors**	**1**	**2**	**3**	**4**	**5**
1.1	Ineffective planning and scheduling of project by contractor					
1.2	Unethical behavior used by contractors to achieve the highest possible level of profit					
1.3	Dependence on the newly graduated engineers to bear the whole responsibility on site					
1.4	Poor material handling on site					
1.5	Shortage of site workers					
1.6	Poor judgment in estimating time and resources					
1.7	Delay in site mobilization					

1.8	Poor site management and supervision by contractor					
1.9	Difficulties in financing project by contractor					
1.10	Inefficient pricing tender					
1.11	The bad relationship between the Staff and the administration					
1.12	Bad relationship between owner representatives and contractor representatives					
1.13	Disputes between labor in site					
1.14	Rework due to errors during construction					
1.15	Conflicts between contractor and other parties					
1.16	Improper construction methods implemented by contractor					
1.17	The control of the contractor to subcontractors is not sufficient					
1.18	Poor procurement programming of materials					
2	**Consultant related factors**	**1**	**2**	**3**	**4**	**5**
2.1	Inadequate experience of consultant					
2.2	Late in reviewing and approving design documents by consultant					
2.3	Delay in performing inspection and testing by consultant					
2.4	Poor quality assurance mechanism					
2.5	Mistakes and discrepancies in design documents					
2.6	Insufficient data collection and survey before design					
2.7	Unclear and inadequate details in drawings					
2.8	Misunderstanding of owner's requirements by design engineer					
2.9	Delays in producing design documents					
2.10	Delay in approving major changes in the scope of work by consultant					
3	**Client related factors**	**1**	**2**	**3**	**4**	**5**
3.1	Delay in freeing the contractor financial payment					
3.2	Delay to deliver the site to the contractor by the client					
3.3	Unrealistic client requirement					
3.4	Client interference					

3.5	Client reliance on low price bidding					
3.6	Delay in providing materials that the client agreed to provide					
3.7	Delay in approving shop drawings and sample materials					
3.8	Slowness in decision making process by client					
3.9	Suspension of work by client					
3.10	Poor communication and coordination by client and other parties					
3.11	Change orders by client during construction					
4	**External factors**	**1**	**2**	**3**	**4**	**5**
4.1	Changes in government regulations and laws					
4.2	Price escalation for construction materials					
4.3	Delay in obtaining permits from government agencies					
4.4	Effect of social and cultural factors					
4.5	Unavailability of utilities in site (such as, water, electricity, telephone, etc.)					
4.6	Delay in providing services from utilities (such as water, electricity)					
4.7	Bad weather effect on construction activities					
4.8	Traffic control and restriction at job site					
4.9	Accident during construction					
4.10	Effects of subsurface conditions (e.g., soil, high water table, etc.)					
4.11	Delay in performing final inspection and certification by a third party					
4.12	Differing site (ground) conditions					