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" CAUSES, EFFECTS AND REMEDIES OF DELAY IN ROAD PROJECTS IN RWANDA"

A THESIS

Submitted by

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C E R T I F I CAT E

This is to certify that the Thesis Work entitled "**CAUSES, EFFECTS AND REMEDIES OF DELAY IN ROAD PROJECTS IN RWANDA**" *is a record of the original bonafide work done by* HAVUGIMANA Bahunde Yves (Reg. No: 221028138) in partial fulfillment of the requirement for the award of Master of Science Degree in Highway Engineering and Management at University of Rwanda-College of Science and Technology, during the Academic Year 2024-2025.

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DECLARATION

I hereby declare that the thesis entitled "**CAUSES, EFFECTS AND REMEDIES OF DELAY IN ROAD PROJECTS IN RWANDA**" submitted for the Degree of Master of Science is my original work and the thesis has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any Degree or Diploma.

Place: Kigali City, Rwanda Signature:

HAVUGIMANA Bahunde Yves

DEDICATION

To the Almighty God,

To my parents,

To my wife and kids,

To my all relatives,

To all who contributed to carrying out this work,

This work is dedicated.

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This thesis would not have been possible without the steadfast support and encouragement of many individuals, to whom I owe my deepest gratitude.

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May the Almighty God bless you abundantly.

ABSTRACT

Road infrastructure is vital to Rwanda's economic growth, regional integration, and poverty reduction. However, delays in road construction projects remain a significant challenge, undermining project efficiency and national development goals. This study examines the primary causes, impacts, and possible solutions to these delays.

Using data collected from five recent or ongoing projects and a census of 76 professionals including clients, consultants, and contractors the research adopts a quantitative approach with structured questionnaires and descriptive analysis. The ranking of delay factors, effects and remedies has been done by using the mean score while the ANOVA test has been used to validate the statistical significance of the results.

Key delay factors identified include land acquisition issues, utility relocation, contractor cash flow problems, and adverse weather. These delays lead to cost overruns, disrupted cash flows, reputational damage, and diminished socioeconomic returns. The study also highlights a strong link between institutional inefficiencies and poor project performance, emphasizing the need for coordinated stakeholder involvement and better planning.

To address these challenges, the study recommends timely land acquisition, improved project planning, streamlined procurement, institutional capacity building, and timely financial disbursement. These findings offer practical guidance for policymakers, project managers, and development partners seeking to enhance road infrastructure delivery in Rwanda.

Keywords: Road construction, delays, mean score, ANOVA, stakeholder perceptions, infrastructure delivery, construction management.

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LIST OF ABBREVIATIONS

AfDB: African Development Bank

ANOVA: Analysis of Variance.

BIM: Building Information Modeling

EAC: East African Community

FIDIC: International Federation of Consulting Engineers

GDP: Gross Domestic Product

GoR: Government of Rwanda

M&E: Monitoring and Evaluation

MINECOFIN: Ministry of Finance and Economic Planning

MININFRA: Ministry of Infrastructures

NISR: National Institute of Statics of Rwanda

NST1: National Strategy for Transformation 1

NST1: National Strategy for Transformation 1

PMBOK: Project Management Body of Knowledge

RTDA: Rwanda transport Development Agency

SPSS: Statistical Package for the Social Sciences

USD: United States Dollar

CHAPTER ONE: INTRODUCTION

1.1 Background

Road transport serves as the backbone of transportation systems worldwide, carrying approximately 80% of inland freight and passenger movement, and acting as the primary mode of mobility in both developed and developing countries (Tiwari & Jain, 2017). Its importance is particularly evident in developing nations, where national and regional connectivity relies heavily on road networks to facilitate access to markets, education, healthcare, and employment opportunities (Ali, Liu, & Sun, 2018). In addition, road infrastructure plays a vital role in economic development by lowering transport costs and improving the efficiency of logistics and supply chains (Ghosh & De, 2015).

Road transport is very key for a landlocked country as Rwanda located in Central Africa, where the transport system is predominantly road-based. Despite the constraints associated with its geographical location, Rwanda is one of the fastest-growing economies in Africa, driven by consistent policy reforms, infrastructure development, and strong institutional performance (African Development Bank, 2021). The fact is the country's Gross Domestic Product (GDP) grown by 8.9% in 2024 (National Institute of Statistics of Rwanda, 2024). In line with its development goals, Rwanda aims to reduce transport costs from 40% of total trade costs to 33% by 2035 and further to 31% by 2050 (Rwanda Vision 2050, 2020). Achieving these targets requires substantial investment in the construction, rehabilitation, and maintenance of road infrastructure.

As of the 2023/2024 fiscal year, Rwanda had developed over 1,700 kilometers of national roads and 4,137 kilometers of feeder roads; and under the National Strategy for Transformation (NST-2), the government aims to upgrade an additional 212 kilometers of unpaved national roads to paved status, rehabilitate 113 kilometers of existing paved roads, and rehabilitate 609 kilometers of feeder roads by the 2028/2029 fiscal year. Despite these efforts, many road construction projects in Rwanda have experienced significant delays. According to Bigirimana et al. (2020), out of 54 road projects analyzed, 22 were completed with delays caused by factors such as financial constraints and changes in project scope. Similarly, Clement B. 2021; noted that financial and technical limitations on the part of both clients and contractors are major contributors to delays in road construction projects.

Therefore, identifying the causes beyond financial and technical capacity, consequences, and possible remedies for delays in road construction projects in Rwanda is of paramount importance. It will contribute in the improvement of project delivery performance and contribute positively to national development efforts.

1.2 Problem statement

In spite of the Government of Rwanda's significant investment in road construction as a strategy to push economic growth and regional connectivity (Government of Rwanda, 2020), road construction projects continue to experience significant delays. Delays most frequently lead to cost and time overruns, disputes among stakeholders, poor construction quality and in extreme cases, project abandonments (Khalid, 2016).

Though different literatures about the delays in road construction projects in Rwanda, have identified contributing factors associated with funds, scope changes, and inefficiencies by the contractor (Bigirimana et al., 2020), they are primarily based on technical reasons, e.g., poor project planning, poor quality, or inefficient contractor, while neglecting systemic institutional causes like delayed procurement, bottlenecks in disbursement and land acquisition, as well as weak project monitoring mechanisms. Further, there are few studies based on a multi stakeholder basis with an understanding informed through the multifunctional perceptions of main actors, including the client, consultants, as well as contractors. Further, there are few studies covering different classes of roads at national scale. In addition, most of studies focused on causes and effects but not tackling their relationship and possible remedies. Hence, there is a need for researches covering causes, effects and remedies, driven by data from key project stakeholders, and combining different categories of roads.

Khalid et al. (2016), insists that road projects specifically remain prone to uncertainties that stall timelines and boost risks. Therefore, an investigation is needed to explore the complex interplay of technical, institutional, and contextual factors, assess the real world consequences of delays, and propose stakeholder informed remedies. This approach will support the development of a comprehensive strategic framework to improve project delivery and inform policy, contract management, and execution practices in Rwanda's road construction sector.

1.3 Research questions

1. What do stakeholders identify as the primary causes of delays in road construction projects in Rwanda?
2. What challenges do contractors and client face due to these delays?
3. What are the perceptions of key stakeholders (government agencies, contractors, consultants) regarding effective solutions to minimize delays?
4. What is the relationship between causes and effects of delays?

1.4 Aim and Objectives

1.4.1. Aim of the study

To explore the perceptions of key stakeholders regarding the causes, effects, and possible remedies of delays in road construction projects in Rwanda, with the goal of identifying actionable strategies for enhancing project delivery timelines.

1.4.2. Objectives of the study

This study has the following objectives:

1. To explore stakeholder perspectives on the primary causes of delays in road construction projects.
2. To identify the specific impacts caused by the project delays to all stakeholders mainly contractors and client.
3. To assess the relationship between causes and effects of project delays
4. To assess recommendations from stakeholders on how to improve planning, procurement, execution, and monitoring processes to reduce delays in future road construction projects.

1.5 Hypothesis of the study

Hypothesis 1

H_o: There are no causes of delay on road construction projects in Rwanda.

H_1: There are causes of delay on road construction projects in Rwanda.

Hypothesis 2

H_o: There are no effects of delay on road construction projects in Rwanda.

H_1: There are effects of delay on road construction projects in Rwanda.

Hypothesis 3

H_o: There are no remedies to delay on road construction projects in Rwanda.

H_1: There are remedies to delay on road construction projects in Rwanda.

1.6 Scope of the study

This study focuses on investigating the causes, effects, cause-effects relationship, and potential remedies of delays in road construction projects within the Rwandan context. The scope is limited to five recently completed and ongoing projects implemented at national level by Rwanda Transport Development Agency (RTDA). The study adopts a quantitative research approach, emphasizing the experiences, insights, and perceptions of key stakeholders involved in road construction processes.

These stakeholders include representatives from RTDA, Contractors, and project supervision Consultants, the data are to be collected through Questionnaires that will be handled electronically. The targeted respondents include the key players/staff from each of the mentioned key stakeholders who are responsible for day to day implementation of road construction projects.

Geographically, the study will focus on different categories of road projects from all provinces and City of Kigali to ensure inclusiveness in terms of project types and geographical locations. The findings aim to generate deep understanding rather than statistical generalizations, and will be used to develop specific recommendations for improving the timeliness and efficiency of road infrastructure delivery in Rwanda.

1.7 Justification of the study

Road networks are paramount in Rwanda's economic growth and regional connectivity; however, construction delays decelerate the returns expected from investments as well as frustrate achievement of the country’s development goals. This study is therefore important as it seeks to reveal the root causes of construction delays as identified by stakeholders, yielding insights into weaknesses in planning and execution. It will also examine delay impacts on project in general and specifically focusing on road quality and project spending, and showing areas in need of interventions.

Additionally, it will shed light to the implementers' challenges and contribute towards better project management practices. Finally, through capturing proven and perceived mitigation

measures, the study will offer practical solutions. In this regard, its findings will feed into policy refinements in planning, procurement, execution, monitoring, and institutional coordination to ensure timely project delivery.

1.8 Definition of key terms

Road Construction Projects: Planned infrastructure developments involving the design, procurement, and physical implementation of roadways (Chileshe et al., 2016).

Delay: The failure to complete project activities within the scheduled time frame.

Causes of Delay: Factors that contribute to time overruns in road construction projects.

Effects of Delay: The negative consequences arising from project delays

Remedies to Delay: Strategies, actions, or policies aimed at mitigating or preventing delays in construction projects (Khalid, A., 2016).

Stakeholders: is any individual, group, or organization that may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project, program, or portfolio (PMI, 2021).

Project Lifecycle: The series of phases a construction project goes through from initiation to closure. In road construction, this includes feasibility analysis, design, procurement, construction, monitoring, and post-construction evaluation (PMI, 2017).

National Strategy for Transformation (NST-2): Rwanda's strategic framework for national development covering the period from 2017 to 2024 and beyond, with a focus on infrastructure development, economic transformation, and improved service delivery.

Quantitative research: is a systematic investigation whose essential concern is measuring phenomena and data, for the large part by employing formalized instruments like surveys, experiments, or statistics, to test hypotheses, examine relations, or predict variables (Shiferaw, Bogale, & Debela, 2022).

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Transport infrastructure is a principal stimulator of economic development, particularly in landlocked countries like Rwanda, where road transport is the primary mode of connectivity for goods, services, and people (Olawale & Sun, 2015). Efficient transport infrastructure directly enhances connectivity, thus promote trade facilitation, economic integration at a regional scale, and poverty reduction. Despite the significance of road construction projects, delays in project implementation still constitutes a critical challenge, especially in developing countries (Memon, Rahman, & Azis, 2012).

This chapter reviews existing research publications on the cause, effects, and remedies of delay in road construction projects. The review assesses different scholar's perspectives on stakeholder's responsibilities, institutional inefficiencies, technical and financial constraints, and strategic mitigation measures.

2.2 Delays in Road Construction Projects

Delays in road construction projects are very critical in the global construction industry and often jeopardize the timely and successful completion of infrastructure developments, particularly in resource-constrained environments (Sambasivan & Soon, 2007). Within the construction context, delays are generally defined as the extension of project duration beyond the contractually agreed completion date or the timeframe mutually established by stakeholders (Aibinu & Odeyinka, 2006). Such delays frequently lead to project cost overruns, reduced quality of works, and increased risks of contractual disputes.

In developed countries, common causes of construction delays include complex project designs, changes in client requirements, and unpredictable weather patterns. Conversely, in developing countries, especially those within Sub-Saharan Africa, additional challenges such as limited contractor capacity, procurement inefficiencies, weak project planning, and excessive bureaucratic processes are particularly dominating (Fugar & Agyakwah-Baah, 2010).

Sambasivan and Soon (2007) identified critical delay factors in construction projects, including poor site management, lack of contractor experience, and slow decision-making. Similarly, Assaf and Al-Hejji (2006) found that over 70% of public sector construction projects in Saudi Arabia experienced substantial delays, primarily due to frequent variation orders, contractor's capacity related issues, and delays in

material procurement. Although their study focused on a different regional context, the occurrence of these delay factors is notable across diverse construction settings.

In Sub-Saharan Africa, Memon et al. (2012) highlighted that financial constraints such as delayed payments and limited access to funding consistently affect project progress. A study by Frimpong, Oluwoye, and Crawford (2003) in Ghana further emphasized that inadequate project planning, frequent design modifications, and contractor cash flow problems are major contributors to project delays.

Addressing these issues requires active engagement and coordination among all project stakeholders, including contractors, consultants, and government institutions. According to Aziz (2013), effective stakeholder's engagement is crucial to ensuring the successful implementation of road construction projects, particularly in developing countries where coordination mechanisms are often complicated.

2.3 Classification of Construction Delays

Understanding the classification of delays in construction projects is essential for effective project management, contractual decision-making, and the resolution of disputes. Delays are commonly classified based on several dimensions, including their cause, the responsible party, their impact on the project schedule, and their contractual implications (Ahmed Senouci, et al, 2016).

Delays classification help project teams and legal professionals navigate complex contractual claims, improve delay analysis methodologies, and implement time recovery strategies (Love et al., 2018). Moreover, contemporary studies emphasize that understanding delay types is not only relevant for retrospective analysis but also for proactive project control and risk management (Haseeb, Bibi, & Rabbani, 2011).

The following sections elaborate on the major categories of construction delays and their implications for project performance and contractual obligations.

2.3.1 Excusable vs. Non-excusable Delays

Classifying delays as excusable or non-excusable is essential for determining contractual responsibilities, time extension rights, and compensation claims. This distinction supports fair risk allocation and facilitates dispute resolution in construction projects (Assaf & Al-Hejji, 2006).

Excusable Delays

Excusable delays result from events that are unpredictable, unavoidable, and beyond the control of the contractor. These occurrences are not attributed to contractor negligence or fault and are commonly recognized in standard contract clauses, such as those found in FIDIC form of contract (Braimah, 2013). In most cases, excusable delays entitle the contractor to an extension of time but do not automatically imply financial compensation unless the delay is also deemed compensable. This distinction is essential in the administration of construction contracts, as it facilitates equitable risk allocation and supports the resolution of contractual disputes (Love et al., 2015).

Characteristic instances of excusable delays include:

- Adverse weather: Extreme weather events such as heavy rainfall, flooding, or unseasonal storms that interrupt or suspend construction activities (Assaf & Al-Hejji, 2006).
- Force majeure situations: Natural disasters, war, strikes, epidemics, or other events typically classified as acts of God under standard contract clauses (Yates & Epstein, 2006).
- Legislative or regulatory shifts: New government policies, legal reforms, or import/export restrictions that disrupt the supply chain or labor availability (Assaf & Al-Hejji, 2006).
- Unforeseen site conditions: Discovery of subsurface rock, groundwater, or archaeological remains not identified during pre-construction site investigations (Alaghbari et al., 2007).

Non-Excusable Delays

Non-excusable delays result from events within the contractor's control or from breach of contractual obligations. These delays do not entitle extensions of time and may result in liquidated damages, performance penalties, or even contract termination in severe cases (Leong & Tiong, 2003). Examples include but not limited to inadequate project planning, delayed mobilization of project resources, poor

coordination or mismanagement of subcontractors, breach of safety protocols leading to site shutdowns, rework caused by poor workmanship or design errors attributable to the contractor (Sambasivan & Soon, 2007).

Such delays are frequently subject to legal and financial disputes, particularly when they lead to cascading effects on project cost and duration. Tribunals and arbitration panels typically assess the contractor's responsibility, quality of documentation, and whether reasonable mitigation efforts were undertaken (Doloi et al., 2012).

2.3.2 Compensable vs. Non-compensable Delays

Compensable and non-compensable delays are central to determining contractor entitlements (Love et al., 2016). Compensable delays are caused by client matters and give time and cost claims, but non-compensable delays are caused by unforeseeable events and only offer time extensions (Bramble & Callahan, 2010). These are foundational in contractual administration and dispute resolution in systems including FIDIC (FIDIC, 2017).

Compensable delays

Compensable delays refer to those that entitle a contractor to both a time extension and financial remuneration, typically resulting from the fault of employer or client (Arditi & Pattanakitchamroon, 2006). A common example includes the delayed approvals by clients or supervising consultants, which can significantly disrupt project timelines (Memon et al., 2014). Similarly, compensable delays frequently arise in infrastructure projects due to late site possession, which may result from unresolved land acquisition or expropriation issues (Assaf & Al-Hejji, 2006). extended delays in the disbursement of certified payments can adversely affect a contractor's cash flow and project duration, thereby entitling financial compensation (Love et al., 2016).

Moreover, client-initiated design modifications or scope expansions that are not accompanied by appropriate extensions of time typically result in increased workload and overhead costs for the contractor, justifying additional compensation (Alaghbari et al., 2007). Standardized international contracts such as FIDIC typically accommodate these claims under clauses like Clause 20, which stipulates contractor entitlements in instances of employer default or authorized variations (FIDIC, 2017).

Non-compensable delays

non-compensable delays originating from external events beyond the control of either party, thus contractor may be granted an extension of time but not monetary compensation; they are often categorized under force majeure, encompassing unforeseeable or unavoidable occurrences such as natural disasters, pandemics, wars, or labor strikes (Bramble & Callahan, 2010).

For instance, severe weather events that exceed typical seasonal expectations such as unseasonal flooding may justify extensions of time but generally do not permit cost recovery under standard contract terms (Gibson, 2008). Similarly, regulatory changes or unexpected legal mandates introduced during the course of a project may be deemed non-compensable, as these lie outside the employer's purview (Jergeas & Hartman, 1994).

Clauses addressing force majeure or unforeseen events, such as FIDIC Clause 19, typically relieve contractors from liability for liquidated damages but do not provide for financial compensation (FIDIC, 2017).

2.3.3 Critical vs. Non-critical Delays

The classification of critical and non-critical delays is crucial for understanding their implications on project completion and contractual responsibilities (Mubarak, 2010). This determination is typically made using schedule analysis techniques such as the Critical Path Method (CPM); critical delays impact activities with zero float, directly influencing the overall timeline and potentially causing contract breaches or liquidated damages (Arditi & Pattanakitchamroon, 2006). Non-critical delays affect activities with available float and do not immediately delay project completion unless the float is exhausted (Odeh & Battaineh, 2002).

Critical delay

A critical delay impacts one or more activities within the project's critical path (Alkass, Mazerolle, & Harris, 1996). Any setback occurring on this path directly affects the project completion date. If not remedied immediately, that type of setback can lead to time extensions, and imposition of liquidated damages, which are standardized in most typical construction. Critical delays most often occur due to factors including late delivery of key material, delayed approvals of drawings or other work, initiated or resultant change orders, and mistakes in the design that lead to rework (Love et al., 2016;).

As they influence the entire project timeline, critical delays usually entitle contractors to request extensions of time (EOT) and, in certain cases, cost compensation, more predominantly when contracts follow the international standards such as FIDIC where liability lies on the client (Braimah, 2013). Identification and determination of critical delays entail precise schedule analysis techniques, that is, Critical Path Method (CPM) and Time Impact Analysis (TIA), which empower project managers and forensic specialists to examine causal factors of delays and quantify impacts on delivery of the project (Gardezi, Manarvi, & Gardezi, 2014).

Non-Critical delays

Non-critical delays are experienced in activities that are neither critical nor have float or slack, i.e., they can occur without their effect on the ultimate completion date of the project (Odeh & Battaineh, 2002). Even if non-critical delays don't directly extend completion of the project, they can nevertheless induce inefficiencies, influence resource utilization, or create bottlenecks in simultaneous work streams (Love et al., 2016). If float is exhausted, then such a delayed activity turns critical, which can transform a non-critical delay to a critical one. Proper identification and classification of types of delays are necessary in claim assessments, status tracking, and minimization of risks. Methods such as Time Impact Analysis (TIA) and As-Planned vs. As-Built approaches are also extensively used for assessing impacts of delays and enabling just resolution of disputes (Alkass et al., 1996).

2.3.4. concurrent delays

These delays are defined as instances where two or more delay events occur simultaneously, each contributing to the disruption of the project's critical path (Tariq & Gardezi, 2022). The issue becomes particularly complicated when the responsibility for these overlapping delays is distributed between different parties, such as the contractor and the employer (Braimah, 2013).

Premakeerthi, Thalpage, and Srivishagan (2021) highlight that concurrent delays typically involve both external factors such as variation orders issued by the client, and internal contractor inefficiencies, such as poor resource management or workforce shortages. The significance of accurate delay categorization is particularly emphasized within standard forms of contracts such as those under the FIDIC frameworks. Transparent classification not only strengthens the procedural integrity of dispute resolution but also supports timely and fair decision-making (Azeez et al., 2022).

Delays resulting from land acquisition, slow administrative processes, and regulatory approvals frequently coincide with internal contractor issues such as equipment breakdowns and financial mismanagement (Alnahhal et al., 2023). These overlapping delays, if not correctly identified and assessed, can significantly undermine project outcomes and contribute to resource wastage and public dissatisfaction.

2.4. Causes of Delays in Road Construction Projects

Delays in road construction projects remain a persistent global challenge, largely driven by a combination of technical, managerial, financial, institutional, and external factors (Faridi & El-Sayegh, 2006). At a general level, these delays are commonly attributed to inadequate project planning, incomplete or flawed design documentation, delayed fund disbursement, and weak contract administration practices (Sambasivan & Soon, 2007). Contractor-related deficiencies such as shortages of skilled labor, inadequate equipment, and ineffective site management have also been frequently identified as major contributors to time overruns (Frimpong, Oluwoye, & Crawford, 2003).

In developing countries, systemic challenges such as inefficient procurement processes, delays in government approvals, and political interference often exacerbate delays in infrastructure delivery (Agyekum, Ayarkwa, & Amoah, 2016). In contrast, delays in developed nations are more often linked to complex regulatory requirements, environmental compliance issues, and the need for extensive stakeholder consultations (Love et al., 2016). These contextual variations underscore the importance of understanding delay causes within their respective socio-political and institutional frameworks.

External and unforeseen events further compound construction delays. Factors such as adverse weather conditions, unexpected geological conditions, disputes over land acquisition, and utility relocation issues frequently emerge during the construction phase, significantly prolonging project timelines (Hamzah et al., 2011). Additionally, inadequate risk management and the absence of contingency planning can magnify the impact of these disruptions, especially in large-scale, publicly funded infrastructure projects.

Another critical contributor to delays is the limited technical and managerial capacity of contractors and consultants, particularly in low- and middle-income countries. Sambasivan and Soon (2007) emphasized that poor site management, insufficient planning, and lack of experience are dominant delay factors in Malaysia. Similarly, Kaming et al., (1997) identified design changes, resource constraints, and slow

decision-making as major contributors to delays in Indonesian construction projects. In the African context, Memon, Rahman, and Azis (2011) noted that construction delays often stem from contractor inefficiencies such as unskilled labor, equipment breakdowns, and weak financial controls.

Studies focusing on Sub-Saharan Africa reaffirm the persistent challenges facing infrastructure development, particularly in the context of road construction. Delays in public infrastructure projects across the region are often complicated by a combination of weak project monitoring systems, inadequate stakeholder coordination, and ineffective governance frameworks (Frimpong, Oluwoye, & Crawford, 2003). Poor communication between contractors, consultants, and client agencies frequently results in misaligned expectations, delayed approvals, and reactive decision-making, all of which contribute to extended project durations (Ofori-Kuragu, Badu, & Fugar, 2012). Furthermore, limited transparency in procurement processes and a lack of accountability mechanisms undermine efficiency and hinder timely project execution (Ahiaga-Dagbui & Smith, 2014).

Moreover, shortage of trained professionals in critical areas such as project management, quantity surveying, and construction supervision, undermine the effective planning, execution, and monitoring of infrastructure projects, often resulting in delays, cost overruns, and compromised quality (Agyekum-Mensah et al., 2012). Rwanda's context, Gasore and Tembo (2023) highlights that the shortage of experienced and skilled staff is a key constraint to timely project delivery, particularly in road infrastructure projects. These structural limitations reflect a broader need for continuous capacity development, improved institutional frameworks, and stronger integration of theoretical knowledge with practical, on-site training to support Rwanda's infrastructure development goals.

2.5 Effects of delay to Contractors

Delays in road construction projects can significantly undermine contractor performance and long-term sustainability, particularly in developing economies where financial margins are narrow and project pipelines are essential for business continuity (Aibinu & Odeyinka, 2006). One of the most immediate and quantifiable effects of delays is the escalation of project costs. Extended timelines lead to increased overheads such as labor wages, equipment rentals, site utilities, insurance premiums, and security services all of which collectively erode contractor profitability (Doloi et al., 2012). This situation is especially worse for small and medium-sized enterprises (SMEs), which often lack access to bridging finance or reserve capital needed to sustain prolonged cash flow cycles (Aibinu & Odeyinka, 2006).

In addition to cost escalations, delays disrupt planned cash flow and resource allocation strategies. Contractors typically deploy workforces, machinery, and materials across multiple projects. A delay in one project may cause a cascading effect across others, resulting in idle resources, logistical inefficiencies, and the need for costly rework following remobilization (Alaghbari et al., 2007). Non-productive labor and equipment costs incurred while awaiting client instructions, site access, or materials further exacerbate financial losses (Assaf & Al-Hejji, 2006). These unanticipated expenditures strain working capital, reduce liquidity, and limit a firm's agility in responding to new business opportunities.

From a contractual standpoint, delays especially when attributed to the contractor can trigger punitive consequences such as liquidated damages, payment withholdings, or even contract termination (Olawale & Sun, 2010). These outcomes not only cause immediate financial distress but also tarnish the contractor's reputation; and consequently in Public procurement systems that prioritize historical performance and reliability, contractors with a record of delayed completions may face significant disadvantages during tender evaluations (Enshassi et al., 2009). In Rwanda, government agencies frequently require documented evidence of past project delivery timelines and performance guarantees. As a result, contractors with delay-prone histories may struggle to secure future contracts (Byiringiro, C., 2021).

Beyond immediate contractual and operational implications, delays pose long-term strategic risks. Prolonged financial instability reduces contractors' capacity to invest in staff development, new technologies, and process innovations factors critical to improving competitiveness and achieving project efficiency (Love et al., 2016). Moreover, persistent delays can lead to workforce demotivation, high employee turnover, and deteriorating relationships with subcontractors and suppliers. Hwang, Zhao, and Khang (2014) argue that such intangible effects often manifest in reduced productivity, poor quality output, and destabilize organizational cohesion.

In Sub-Saharan Africa, where infrastructure development is a central pillar of economic growth, delays in public construction projects disproportionately affect local contractors. Many of these firms operate with limited financial buffers and depend heavily on government-funded infrastructure initiatives (Ofori, 2015). Inadequate risk-sharing mechanisms, inconsistent project financing, and bureaucratic procurement frameworks expose contractors to unpredictable project environments and constrain effective long term planning (Agyekum Mensah, Knight, & Coffey, 2012). In this context, road construction delays transcend operational inconvenience, they represent existential threats to business continuity, especially for contractors lacking bargaining power or financial resilience.

2.6 Effects of delay to client

Road construction project delays are a global phenomenon, with profound implications for Clients or Employers typically public authorities, government ministries, or international lending institutions tasked with infrastructure delivery (Flyvbjerg et al., 2004). These delays can undermine not only individual project outcomes but also the country's social economic development plan, particularly in contexts where policy mandates emphasize timely execution. The consequences are especially severe in developing countries, where road infrastructure is a keystone for inclusive growth and poverty reduction, and where institutional and financial capacities to absorb delays are often constrained (Love et al., 2015).

2.6.1 Cost Overruns and Budgetary Strain

One of the most quantifiable consequences of road construction delays is cost escalation. As project timelines overrun original schedules, Employers are forced to absorb increased expenditures resulting from extended site supervision, contractor claims for idle resources, inflationary pressures, and possible financial penalties. Odeck (2004) reported that average cost overruns for road infrastructure projects can range from 10% to 50%, depending on geographic and contractual contexts. The African Development Bank (2020) estimates that delays in infrastructure projects cost the continent over USD 3 billion annually in unrealized value.

In Rwanda, where road infrastructure is predominantly financed through a combination of domestic revenue and concessional loans, project delays can distort macroeconomic planning and debt service obligations (African Development Bank, 2023). The Ministry of Finance and Economic Planning (MINECOFIN, 2023) emphasizes in its Public Investment Management guidelines that timely implementation is essential for fiscal sustainability and avoiding the accumulation of contingent liabilities.

2.6.2 Socioeconomic Benefits Deferred

Road infrastructure is instrumental in fostering economic productivity, social inclusion, and regional connectivity. Delays defer these intended benefits, contributing to economic inefficiency and inequitable access to services (Gwilliam, 2011). Incomplete road networks limit mobility, increase travel times, raise transportation costs, and inhibit access to markets and essential services, particularly in rural and peri-urban areas (UNECA, 2017).

In Rwanda where more than 70% of the population depends on agriculture such delays hinder the transport of goods, raise logistics costs, and reduce farmers' profits due to spoilage and limited market access

(World Bank, 2022). These setbacks undermine national goals such as reducing transport costs, boosting exports, and improving rural livelihoods, all of which are emphasized in Rwanda's Vision 2050 and the National Transport Policy (Government of Rwanda, 2020). Moreover, the African Development Bank (2022) notes that infrastructure delays in Sub-Saharan Africa significantly reduce the returns on public investment, delay regional integration, and discourage private-sector engagement. The opportunity cost of not completing road projects on time includes foregone economic output, increased vehicle operating costs, and delayed improvements in social welfare outcomes. As such, addressing delays is essential not only for achieving infrastructure performance but also for sustaining Rwanda's long-term economic transformation (World Bank, 2022).

2.6.3 Effects on Infrastructure Portfolio Planning

Delays in a single road project can ripple through the broader public infrastructure portfolio. Road agencies often operate within fixed budget cycles and disbursement frameworks. As a result, overruns in one project can delay or crowd out funding for others, contributing to overall inefficiencies in capital expenditure utilization (Amoatey et al., 2015). This issue is particularly acute in low-income countries, where institutional and technical capacity to fast-track projects is often limited. A case study from Ghana by Frimpong et al. (2019) found that delayed completion of three highway projects led to a 22% reduction in the launch of new infrastructure projects in the subsequent fiscal year.

2.6.4 Reputational Risks and Institutional Credibility

Construction work delays can cause severe damage to public institution credibility, especially where infrastructure development directly translates to the mandate and service delivery of the state (Assaf & Al-Hejji, 2006). Failure by large projects to meet their schedules leads stakeholders to perceive the process as inefficient, corrupt, or poorly managed, resulting in a significant erosion of trust (Odeh & Battaineh, 2002). Public agencies and government ministries, acting as Employers, are held accountable by taxpayers, investors, and regulatory bodies. Due to the visible nature of infrastructure projects, such failures such as those documented in Indonesia tend to generate widespread distrust, which can extend to future procurement processes and diminish support for public investment policies (Memon et al., 2014).

2.6.5 Legal Disputes and Contractual Claims

Construction work delays rank among the most common causative factors of legal complications and contractual claims on the job. The arguments tend to center on the right to extensions of time, payment by the employer to cover costs of delays, or culpability for concurrent delays (Bramble & Callahan, 2010).

Contractors make claims, on average, due to employer induced delay such as slow site approval or inability to access sites while employers counterclaim by pointing to inefficiency by contractors or inability to mobilize (Premakeerthi et al., 2021). Azeez et al. (2022) report that imprecision within methods of delay analysis tends to complicate resolution further, especially within multi-party projects.

Contract disputes over delays in developing countries further expose systemic weaknesses within contract monitoring and administration on sites. Faridi & El-Sayegh (2006) state that many construction contracts have minimal terms on settling conflicts or that terms are insufficiently executed, consequently leading to stalemates among parties lasting long periods. Also, extensive traditional procurement approaches' use in the failure to apply proper risk allocation tools raises contractual tensions when delays occur (Odeh & Battaineh, 2002). Tariq and Gardezi (2022) state that improved communication, on time documentation, and proactive approaches to prevent conflicts' escalation are crucial approaches to safeguard contractors' and clients' interests.

2.6.6 Macroeconomic and Social Implications

The macroeconomic impacts from delayed infrastructure projects are long-term, extending to national productivity, budgetary stability, and achievement of long-run development targets**.** (Frimpong et al., 2003). Delayed delivery of infrastructure affect planned growth by stopping sectoral growth and slowing economic payback on finished assets in terms of enhanced connectivity, trade facilitation, and mobility (Alaghbari et al., 2007). For example, long-duration road construction timelines mean longer costs of automobile operation, longer distances to travel, and broader supply chain inefficiencies, which depress productivity within various industries. Besides, long delays come hand-in-hand with cost escalation that places strain on national budgets, compelling governments to reallocate funds from social sectors such as education, healthcare, and rural development (Doloi et al., 2012)..

From a social perspective, infrastructure delays accrue inequalities by disproportionately impacting vulnerable populations that rely on timely public spending to obtain basic services. Infrastructure delays on roads and utilities in rural and peri-urban areas depress access to schools, health centers, and markets, thereby solidifying multidimensional poverty (Sambasivan & Soon, 2007). Memon et al. (2014) noted that impacted populations not only experience economic losses from interrupted livelihoods and increased transport costs, but diminished protection and quality of life as well. Beyond that, unpredictability due to

repeated project delays instigates chaos within local economies, destroys public spirit, and displaces populations in particular, when land is acquired by force without evident construction timelines.

Regionally, delays in cross-border road corridors hamper integration efforts within frameworks such as the East African Community (EAC). Inconsistent implementation timelines and fragmented infrastructure impede the fluid movement of goods and services, undermining regional value chains and the competitiveness of landlocked economies (World Bank, 2020).

2.7 Relationship between causes and effects of delay

Construction project delays are arguably among the most persistent challenges affecting the global construction industry. Given their multifaceted nature, the causes of delays produce a wide range of adverse consequences related to time, cost, quality, stakeholder relationships, and overall economic performance. These causal relationships are often complex and site-specific; however, identifiable patterns do emerge across different regions and project types (Assaf & Al-Hejji, 2006).

Several scholarly works have categorized the causes of delay into contractor-related, client-related, consultant-related, external, and project-specific factors (Memon et al., 2014). Odeh and Battaineh (2002), for example, emphasized inadequate contractor experience, deficient site management, and delays in decision-making as prominent internal factors. These variables are frequently interdependent, an inexperienced contractor is more likely to mismanage resources, leading to both time overruns and diminished construction quality. Similarly, Assaf and Al-Hejji (2006) identified changes in project scope and delayed client payments as significant contributors to delays in large-scale construction projects.

The ramifications of these causes often extend beyond the project level. As noted by Frimpong et al. (2003) in their analysis of infrastructure development in Ghana, the underlying causes of delay may evolve into broader economic implications, such as increased public expenditure and reduced economic gains. Road construction projects are particularly susceptible due to their capital intensive nature and critical role in enhancing trade, mobility, and regional integration. The resultant ripple effects include increased vehicle operating costs, longer travel times, and inefficiencies across supply chains (Doloi et al., 2012).

A clear relational link exists between the type of delay and the severity of its impact. Financial related issues such as delayed disbursement of funds or inflation frequently lead to cost escalation, contractor claims, and contractual disputes (Aibinu & Odeyinka, 2006). These issues may subsequently escalate into

litigation or contract termination if left unresolved (Jergeas & Hartman, 1994). Mubarak (2010) reinforces that many delay related claims stem from early warning signs that go unaddressed, particularly in projects lacking effective planning tools and communication mechanisms.

Moreover, literature highlights that ineffective communication and coordination among project stakeholders are among the leading causes of delays. According to Hwang et al. (2014), poor integration between design and construction phases often leads to rework, thereby causing significant schedule disruptions. This is especially detrimental in road projects, where sequential operations such as utility relocation, earthworks, and surfacing are tightly interconnected.

Socio-political and institutional dimensions also play a crucial role in exacerbating project delays. Flyvbjerg et al. (2004) argue that political interference, regulatory bottlenecks, and inefficiencies within public service delivery systems can erode trust between contractors and governmental authorities, consequently diminishing institutional credibility. In Sub-Saharan Africa, Tariq & Gardezi (2022) have shown that overlapping institutional mandates and inadequate conflict resolution frameworks intensify the timeline and budgetary impacts of project delays.

Additionally, the impact of delays is often contingent on their location within the project's schedule. Delays along the critical path tend to have more profound consequences, potentially jeopardizing the entire timeline and financial framework of the project (Premakeerthi et al., 2021). Ofori-Kuragu et al. (2012) note, such delays are often associated with contractual penalties and reputational harm, particularly in donor funded or highly competitive environments.

In conclusion, the causes and effects of road construction project delays are deeply interwoven. Delays are often the result of a chain reaction involving poor planning, financial limitations, inadequate technical expertise, and institutional shortcomings. Their consequences are multifaceted ranging from financial and quality related setbacks to broader socio-economic and stakeholder related challenges. Addressing these issues requires proactive risk management, capacity enhancement, well-defined contractual frameworks, and collaborative governance to ensure the efficient and timely completion of infrastructure initiatives.

2.8 Remedies for Reducing Delays

Road project delays are frequent among both developing and developed nations. Prevention of such delays involves an overall approach that incorporates formulation of the strategic plan, involvement by all

stakeholders, risk handling, and introduction of new technologies. The subsequent section mentions countermeasures from different literatures.

2.8.1 Enhanced Project Planning and Scheduling

Accurate project planning and adequate scheduling are the best methodologies in evading delay during road construction works. Sound planning involves the setting of definite project objectives, feasible schedules, wise use of resources, and the inclusion of provision for contingency to handle unexpected setbacks (Alaghbari et al., 2007). The introduction of project management methods such as Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), and Earned Value Management (EVM) in the initial phase assists in making schedules highly dependable and project control highly effective (PMI,2017). These methods assist in estimating the most valuable activities, monitoring the performance of time and expenditures, and the control of variance from scheduled momentum in a timely manner.

Also, application of the most recent schedule technology, namely Building Information Modeling (BIM) and 4D simulation, has improved coordination among parties and updated schedules with the latest project information in real time (Azhar, 2011). They allow the visualization of project sequencing and interdependencies among the resources, thereby reducing the likelihood of schedule conflicts and rework.

Lean construction methods, that emphasize value creation and waste reduction, have also been demonstrated effective in speeding the construction process and reducing delays (Koskela et al., 2002). Just-in-Time (JIT) supply of materials, Last Planner System (LPS), and value stream mapping facilitate improved work process reliability, reducing materials waste, and inter team coordination. Additionally, process effectiveness through continuous improvement processes such as Total Quality Management (TQM) and Six Sigma assists in fostering the culture of responsibility and effectiveness across the project lifecycle (Love et al., 2004).

Collectively, these schedule and plan techniques, applied consistently, enable timely, cost-effective, and quality oriented delivery of road infrastructure, both public and private sector applications. They enable, in addition, avoidance of the risks as well as enhanced decision making and stakeholder confidence in the project execution.

2.8.2 Risk Management Frameworks

Implementation of an efficient structure of risk management is the best way to limit the frequency and the implications of road construction project delay. Risk management involves the systematic identification, analysis, and mitigation of uncertainties during the project that might negatively affect the project objectives, particularly with respect to time and money (Rahman & Kumaraswamy, 2002). According to Alaghbari et al. (2007), the majority of construction project delays are due to uncontrollable risks that might have been avoided by the identification of the risks ahead and taking anticipatory measures.

Zou, Zhang, and Wang (2007) insists that the incorporation of risk management practices at the initial phases of the project plan helps the parties to formulate contingency arrangements, clarify responsibilities, and emphasize essential risk factors that threaten timely completion. Likewise, PMI (2017) insists that the management of risks is far from being a reactive mechanism but an integrated strategic planning process that has to run along the whole lifecycle of the project to boost performance, stakeholder trust, and control of timely milestones.

Also, Akintoye, A. S., & MacLeod, M. J. (1997) regard quantitative risk analysis techniques, such as Monte Carlo simulation and sensitivity analysis, as playing an important role in supporting intelligent decision-making and resource investment to mitigate schedule disruptions. Such techniques help raise the resilience of project delivery, with the result that both the chances and magnitudes of delays are reduced.

2.8.3 Stakeholder Engagement and Communication

Open, structured, and timely communication between all the project stakeholders, including consultants, contractors, clients, and regulating agencies, is vital in minimizing delays in road work constructions (Alaloul et al., 2018). Effective communication assists in the fostering of transparency, convergence of interests, and speeding up decision taking throughout the project process. Ineffective communication methods have been mentioned by El-Sayegh and Mansour (2015) as the main delay cause, being mainly experienced during mega infrastructure projects where the coordination between the constellation of players is complex and repetitive.

Therefore, Alaloul et al. (2018) underline that recurring coordination sessions, systematic systems of records, and the adoption of digital collaborative tools (i.e., BIM, project management software) immensely assist stakeholder responsiveness and conflict resolution during an early stage of the project

schedule. Furthermore, Doloi et al. (2012) argue that weak communication channels are highly likely to generate discrepancies due to interpretations, misunderstandings, and lateness in giving approvals, which all contribute to project ineffectiveness. Integrating communication management plans that outline information flows, responsibility, and furnishing of feedback is thus crucial in achieving timely and efficient project completion.

2.8.4 Adoption of Technology

The integration of digital technology has emerged as an evolutionary process of minimizing delays in road work based on enhanced efficiency, transparency, and multi-stakeholder coordination. Building Information Modeling (BIM), Geographic Information Systems (GIS), drones, and web-based project management systems provide viable instruments of real-time tracking, warning systems, and decision-taking based on data (Zhou, Whyte, and Sacks, 2012). According to Abdirad (2017) BIM, in particular, plays a central role in improving construction schedules with the integration of 3D modeling and time (4D) and cost (5D) data, thereby making it possible to achieve more accurate project schedule, resource, and clash identification between construction components. This reduces the likelihood of design errors and the need for rework, which are the major factors leading to project delay.

Integration of drones in the conduct of aerial site inspections, photogrammetry, and topographic surveying allows fast and accurate measurement of terrain and work in hand, enabling one to reduce the use of laborious and time consuming manual inspections and improve the accuracy of planning (Choi, et al., 2023). Furthermore, web-based construction management systems such as Procore, Aconex, and Primavera P6 provide single-point access to the performance indicators, workflows, and documents of the project and provide integrated communication, streamlined reporting, and real-time issue management, reducing administration hold-ups and speeding responsiveness among the parties (Succar & Kassem, 2015).

Machine Learning (ML) and Artificial Intelligence (AI) are increasingly used in construction analytics, and it is now feasible to achieve predictive insights about the risks in projects, schedule inefficiencies, and resource constraints. They facilitate proactive decision-taking and continuous refinement based on historical and current data (Zaidan, E., & Anumba, C. J. 2020**).**

Together, the information technology innovations give the project managers improved clarity and control of the complex project variables. Through their use, the project managers more accurately predict delays, are more agile in their response to risks, and overall, execute road infrastructure projects faster and financially more effectively (Eybpoosh, et al, 2011).

2.8.5 Institutional Capacity Building

Gasore & Tembo, (2023) insisted that an association between institutional failure, such as inadequate technical expertise, ineffective project tracking, and ineffective contractual enforcement, and prolonged project lifespans are key contributors to project delays. Such weaknesses tend to undermine effective procurement management, delay in making decisions, as well as undermine ability to effectively respond to unexpected problems in project execution. Frimpong, Oluwoye, and Crawford's (2003) highlighted that poor technical as well as managerial capacity is one of the causative factors for infrastructure project delay in the context of developing economies.

At a broader Sub-Saharan African regional terrain, Ofori (2015) highlights that institutional weakness in the sense of diluted administrative procedures, lack of accountability, and absence of skilled personnel triggers additional cost and delay escalation. In addition, the African Development Bank (2021) highlights long-term improvement in infrastructure delivery is not only required in terms of skill-building for personnel but also in terms of system change in the sense of performance-based management procedures, sound regulatory frameworks, and heightened inter-agency cooperation. Furthermore, Amoatey et al. (2015) provide credence to the argument that institutional capacity-building must be harmonized and synchronized in alignment with broader governance reform for sustainable and accountable public infrastructure delivery.

2.8.6 Financial Management and Timely Payments

Timely disbursement of funds to contractors is essential in sustaining momentum and avoiding disruptions in road construction works (Doloi et al., 2012). Payment delay usually destabilizes cash flows of contractors, with projects slowing down, works being halted, and substandard work resulting from shortages of resources in workforce, equipment, and materials (Amandin & Kule, 2016). Such disruptions in funds can further fuel cost increases and prolong project duration, thereby frustrating infrastructure delivery targets (Kaming et al., 1997). Meng (2012) insists that slow disbursements contribute towards

erosion of confidence such that contractors have negative relations with project owner organizations, convoluted contract administrations, as well as resulting conflicts and project delays.

Moreover, appropriated financial management, such as accurate budgeting, timely verification of payment invoices, as well as efficient payment approval processes, is accordingly essential in order to mitigate such risks (Odediran et al., 2012). In Rwanda, slow counterpart disbursement more particularly in co-financing projects with development partners remains a critical factor. Inefficiencies in fund disbursement management have, as reported in MINECOFIN (2023), considerably contributed towards delayed project implementation, particularly in large road infrastructure schemes. For this, some development institutions along with sector experts recommend automated as well as performance-based disbursement systems. These systems reduce human errors, enhance transparency, as well as facilitate accountability in financial transactions (World Bank, 2019). Moreover, institutional capacity development in public financial management as well as contractual clauses on payment schedules can be further steps towards decreasing delay in disbursement of funds as well as facilitating uninterrupted work on road construction projects (Hashim & Allan, 2001).

2.8.7 Community Engagement and Land Acquisition

Early and inclusive consultation of affected communities in the planning and design phase of infrastructure projects has increasingly been regarded as a vital method in cutting resistance and improving local ownership. Participatory processes at this stage increase project legitimacy, create trusts, and conform with community needs (Esteves et al., 2012). Forefront stakeholder engagement enables potential social risks in a project lifecycle to be identified early enough, such that developers and implementing agencies can jointly design mitigation measures and avoid costly delays resulting from community resistance or lawsuits (World Bank, 2014).

Moreover, payment of just, timely, and transparent compensation for acquired lands along with respectful resettlement plans as well as rehabilitation programs of livelihoods is essential in reducing displacement associated grievances (Asian Development Bank [ADB], 2018). Projects poorly managing involuntary resettlements have tended to experience implementation slowdowns, loss of reputation, as well as withdrawal of funds, as reported by Hari, M. M. (2018). Establishing effective as well as accessible grievance redress mechanisms (GRMs) is another significant safeguard, enabling sustained feedbacks as well as settlement of disputes between project stakeholders as well as affected communities (Kok, 2018).

Finally, integrating social protections in national infrastructure planning processes such as Environmental and Social Impact Assessments (ESIAs) and Resettlement Action Plans (RAPs) has proven valuable in fostering long-term project sustainability as well as donor standards compliance (Vanclay, 2014).

2.8.9 Monitoring and Evaluation Mechanisms

Installation of sound monitoring and evaluation (M&E) systems is vital in ensuring timely completion, quality assurance, as well as cost-effectiveness of road construction projects. M&E systems facilitate systematic ways of establishing whether project activity is on track according to plan as well as identification of points requiring corrective action (World Bank, 2004). These systems normally include tools such as baseline indicators, performance benchmarks, site monitoring, frequent progress reports, consultations with beneficiaries, as well as independent third-party auditing (Kusek & Rist, 2004). Good M&E enables early identification of deviation in planned schedules, technical specifications, or financial parameters, hence enabling timely interventions in efforts towards minimizing delay as well as increases in cost.

Also, effective M&E systems enhance transparency, allow better resource allocation, as well as improve institutional accountability through systematic reporting of reliable data for decision-making, development partners, as well as citizens at large (African Development Bank, 2017). In Sub-Saharan Africa, where capacity issues in institutions in most cases delay project implementation, incorporating M&E functions in project design as well as in conducting performance reviews with stakeholders is required in improving governance as well as project ownership (Binnendijk, 2000).

Integration of digital tools in M&E processes has significantly improved responsiveness as well as increased efficiency. Technologies such as Building Information Modeling (BIM), Geographic Information Systems (GIS), mobile-based reporting systems, drones, as well as real-time dashboards facilitate enhanced spatial analysis, improved visualization of progress, as well as data-driven supervision (Azhar, 2011). Moreover, Participatory M&E processes with local citizens and civil society groups help build more inclusive monitoring, thereby enhancing the legitimacy and social accountability of road infrastructure initiatives (Fox, 2015). These processes are especially suitable in projects with high environmental and social sensitivities, wherein responsiveness and building of trust are essential in sustaining implementation momentum.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methodology applied in carrying out the study on the "Causes, Effects, and Remedies of Delay in Road Construction Projects in Rwanda." It gives details on the design of the study, the sources of data, population and sample, research tools, data collection methods, and data analysis and presentation techniques. The methodology is divided into a clear and systematic format in line with the goals of the study.

3.2 Research design

A questionnaire survey was used for a detailed understanding of the causes, related effects, relationship between causes and effects, as well as possible remedies of road construction project's delay in Rwanda. A complete study was enabled through a combination of statistical data with detailed industry stakeholder's insights.

Particularly, research focused on individuals involved in the execution of the five ongoing or recently completed road construction projects in various regions of Rwanda. Projects of concern are (i) Feeder roads development project carried out in all the four provinces of Rwanda with eight works contracts, 4 contractors and one supervision consultants, covering over 450km, (ii) Nyacyonga-Mukoto (36km) road in Kigali City and Northern Province, (iii) Pindura-Bweyeye (32km) road in Western Province, (iv) Nyagatare-Rukomo (73km) road in East and Northern Provinces, and (v)Kibugabuga-Shinga-Gasoro (66.55km) road in Eastern and Southern Provinces. Main stakeholders of varied backgrounds who have substantial roles in road construction planning, execution, as well as monitoring, formed the study's target population. These include personnel of Rwanda Transport Development Agency as client, Contractors, and supervision consultants.

The research design was therefore adopted with the argument of being able to gather rich multi-angle data capturing both technical as well as administrative road construction aspects. To identify problems at a systemic level, capture stakeholder experience, as well as realistic solutions towards project delivery lead time improvement in Rwanda's road infrastructure sector.

3.3 Sources of data

The study relied on a primary data sources to ensure the richness and reliability of the information collected for analysis. Data were gathered through the administration of structured questionnaires targeting individuals who are directly involved in road construction projects. These respondents included members of contractors, Supervision consultants and Client namely project managers, site engineers, supervisory personnel, Client' Engineers, etc. whose firsthand experience provided valuable insights into the practical challenges and contributing factors behind project delays. The structured nature of the questionnaires ensured consistency in data collection while allowing for the inclusive responses across different projects and stakeholder roles.

3.4 Population of the study

The population census method has been used considering the limited number of concerned individuals. As supported by Israel (1992), a census is advisable when the population is manageable and the goal is to achieve full representativeness and data richness. Employing this method not only enhances the credibility and validity of the findings but also ensures that the research insights are grounded in the actual experiences of all relevant participants involved in road construction project delivery.

The study targeted a population of 90 individuals from the five projects under the study. The Ninety (90) individuals include 15 personnel from each of the five projects except feeder roads having 30 personnel as it covers 8 different works contracts and one supervision consultant contract. The target number for each project was chosen depending on the assigned key personnel and their availability. The total population include personnel of contractors, consultants, and client with adequate knowledge and professional experience in planning, implementation, and overseeing road construction projects in Rwanda. Out of the shared questionnaires, only 76 responses have been received, including 23 from contractors' personnel, 29 from supervision consultant's personnel, and 23 from client's personnel, that have served or still serving on the projects under this study namely Feeder roads development, Nyagatare-Rukomo road, Pindura-Bweye road, Nyacyonga-Mukoto road, and Kibugabuga-Shinga-Gasoro.

There was no sampling procedure that was used in this study as the entire targeted population was obtained through the adoption of the census procedure. This was an appropriate procedure given that the population was of a manageable size comprising respondents who bear a direct relationship with the topic under research. This ensured that all respondents were comprehensively encompassed for data recording

purposes without any bias in sampling, guarantee that findings are extremely reliable and representative. The use of the census procedure allowed for an exhaustive and non-selective capture of all stakeholders' opinions so that both the reliability as well as generalizability of findings might be made more robust.

3.5 Research instrument

The survey tool used for this study was a structured form of a questionnaire, well designed aiming for acquiring relevant data from the people involved in the implementation of road construction activities in Rwanda. It comprised of closed questions facilitating the respondents to answer the questionnaire.

It was structured to encompass the following major areas:

- Survey respondents' demographic characteristics (i.e age, gender, education, years of experience, organization type, etc.);
- Causes of delay for road construction works;
- Effects of delay on project outcomes such as cost, time, and quality;
- Relationship between delay causes and effects;
- Suggested remedies to minimize or prevent delays in future similar projects.

In order to facilitate quantitative analysis, a rating scale (typically 1 = Not significant, 2 = Slightly significant, 3 = Moderately significant, 4 = Significant, and 5 = Very significant) was used to assess perceptions of causes, effects, and their relationship, as well as proposed remedies. This allowed the data to be numerically coded, which could be statistically interpreted, including comparison of responses.

The survey form was developed based on available literature and best practices for construction project management, and a pilot survey was tested for a small group of respondents for reliability, consistency, and applicability. After refining, the survey instrument was distributed through Google Forms, a free, convenient, and publicly available platform. This methodology was selected for increased efficiency of responses, reach of respondents from diverse geographies, and compensation for logistical constraints of real fieldwork.

The structured format and web-based administration of the survey instrument ensured consistency of data collection, and provided flexibility of the respondent to complete the survey at a convenient time, thus ensuring a maximum response rate and quality of data.

The questionnaire is attached on Annex

3.6 Data collection

Data were collected using an online Google Forms questionnaire. The questionnaire link was shared via email and messaging platform namely WhatsApp to reach respondents. These tools were used because they are easily accessible, facilitate ease of communication, and are highly used by the intended population. Respondents completed the form electronically at their convenience, which ensured timely and efficient data collection. Follow-up reminders were sent to increase the response rate. This facilitated effective data collection, minimization of logistical limitations, and wider coverage within a reasonable time period.

3.7 Measurement methods and result presentation

The questionnaire was designed with rating scales whereby each response is rated by the respondent from 1 to 5 (typically 1 = Not significant, 2 = Slightly significant, 3 = Moderately significant, 4 = Significant, and 5 = Very significant). The responses scores are aggregated and the responses ranked based on their scores to understand the respondent's perceptions. Through this method the researcher identified the high ranked causes, effects, related relationship, and remedies of delay in road construction projects in Rwanda.

Table 3.1 Numerical labelling of respondents' perception on rating scale

Level of significance	Not significant	Slightly significant	Moderately significant	Significant	Very significant
Rating scale	1	2	3	4	5

3.8 Method of data analysis

Quantitative data from closed-ended questions were analyzed using the Statistical Package for Social Sciences (SPSS), version 26. The results were presented through frequencies, percentages, mean scores, interpretation of mean scores, and ranking. Respondents' demographic information was analyzed using descriptive statistics, including frequencies and percentages. The driver Causes, effects and remedies of delay in road construction projects in Rwanda were analyzed by means of mean score, interpretation of mean scores and ranks. The analysis was based on the following scale measurements, 1 = Not significant ($\geq$1.00 and $\leq$1.49); 2 = Slightly significant ($\geq$1.50 and $\leq$2.49); 3 = Moderately significant ($\geq$2.50 and $\leq$3.49); 4 = significant ($\geq$3.50 and $\leq$4.49), and 5 = Very significant ($\geq$4.50 and $\leq$5.00).

An analysis of variance (ANOVA) test was conducted, using a significance level of $p \leq 0.05$, to determine whether there were any significant differences between the mean opinions of the respondent groups regarding all the factors identified in the study.

3.9 Research ethics

A census methodology was adopted in this research to ensure that the data from all involved stakeholders was fully covered. The study targeted 90 key personnel from key stakeholders of five road projects across the country, including clients, consultants, and contractors. The methodology was chosen due to the small, well-established, and controllable population, therefore allowing for more accurate and complete data without risking a chance of sampling error.

In spite of the census application avoiding the potential occurrence of probabilistic sampling, availability of the participants together with the possible response fatigue remained a concern for the study. Ethical considerations, which involved informed consent, confidentiality of the data, and voluntary participation, were strictly observed for the purpose of ensuring the integrity of the procedure. Inclusivity, transparency, and diversity of the stakeholders were some additional precautions observed for the purpose of ensuring a more robust credibility of the research methodology alongside ethical propriety.

3.10 Limitations

3.10.1. Availability of Data and Sample Size

It was difficult to obtain literatures related to causes, effects and remedies of delay in road construction in Rwanda. In addition, the relatively small and narrowly defined population of 90 participants, while suitable for census-based studies, restricted the amount of statistical inference available for quantitative analysis.

3.10.2. Time Constraints and data confidentiality

The research was conducted under stringent time constraints, which limited the extent of data gathering, thorough stakeholder consultations, and advance statistical or comparative studies. Because of the constraints of time and confidentiality, some of the aspects of the study such as analyzing the existing projects documents was not feasible to undertake.

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, AND DISCUSSION OF FINDINGS

4.1. Introduction

This chapter consists the interpretation, analysis, and presentation of the data collected to study the causes, effects, their relationship, and possible remedies of road construction project delays in Rwanda. Based on data collected through structured questionnaires, this chapter seeks to give a clear understanding of the patterns as well as the reasons behind the delays. The data for this study were analyzed using the Statistical Package for Social Sciences (SPSS), version 26. The results were presented through frequencies, percentages, mean scores, interpretation of mean scores, and ranking. Respondents' demographic information was analyzed using descriptive statistics, including frequencies and percentages. The driver Causes, effects and remedies of delay in road construction projects in Rwanda were analyzed by means of mean score, interpretation of mean scores and ranks. The driver Causes, effects and remedies of delay in road construction projects in Rwanda were analyzed, based on the following scale measurements, 1 = Not significant ($\geq$1.00 and $\leq$1.49); 2 = Slightly significant ($\geq$1.50 and $\leq$2.49); 3 = Moderately significant ($\geq$2.50 and $\leq$3.49); 4 = significant ($\geq$3.50 and $\leq$4.49), and 5 = Very significant ($\geq$4.50 and $\leq$5.00).

An analysis of variance (ANOVA) test was conducted, using a significance level of $p \leq 0.05$, to determine whether there were any significant differences between the mean opinions of the respondent groups regarding all the factors identified in the study.

4.2 Data analysis

4.2.1 General information of respondents

Table 4.1 presents the general information of the 76 respondents and their respective organizations. The demographic and professional profile indicates that the majority of respondents (44.7%) are aged 26–35 years, followed by 36–45 years (40.8%), while smaller proportions fall within the age groups 18–25 (1.3%), 46–55 (6.6%), and 56–65 (6.6%). The sample is predominantly male (89.5%) with females representing 10.5%. Regarding education, most respondents hold a Bachelor's degree (63.2%), followed by a Master's degree (32.9%) and a Diploma (3.9%). Work experience is fairly distributed: 1–5 years (10.5%), 6–10 years (35.5%), 11–15 years (34.2%), 16–20 years (10.5%), and over 20 years (9.2%). In terms of project involvement, respondents mainly participated in the Feeder Roads Development Project (36.8%), Nyacyonga–Mukoto Road Project (26.3%), Pindura–Bweyeye Road Project (22.4%), and

Nyagatare–Rukomo Road Project (14.5%). Stakeholder representation shows supervision consultants as the largest group (38.2%), followed by clients (31.6%) and contractors (30.3%).

Table 4. 1 General information about respondents for the questionnaire

Characteristic	Variable	Frequency	Percent
Age	18-25	1.0	1.3
	26-35	34.0	44.7
	36-45	31.0	40.8
	46-55	5.0	6.6
	56-65	5.0	6.6
	Total	**76.0**	**100.0**
Gender	Female	8.0	10.5
	Male	68.0	89.5
	Total	**76.0**	**100.0**
Academic qualification	Diploma	3.0	3.9
	Bachelor	48.0	63.2
	Master	25.0	32.9
	Total	**76.0**	**100.0**
Work experience (years)	1-5 years	8.0	10.5
	6-10 years	27.0	35.5
	11-15 years	26.0	34.2
	16-20 years	8.0	10.5
	above 20 years	7.0	9.2
	Total	**76.0**	**100.0**
project	Feeder roads development project	28.0	36.8
	Nyacyonga - Mukoto road project	20.0	26.3
	Nyagatare - Rukomo road project	11.0	14.5
	Pindura - Bweyeye road project	17.0	22.4
	Total	**76.0**	**100.0**
Type of Stakeholder	Client	24.0	31.6
	Contractor	23.0	30.3
	Supervision Consultant	29.0	38.2
	Total	**76.0**	**100.0**

4.2.2 Causes of delay on public highway construction projects in Rwanda by types of stakeholders

Table 4.2 presents the results of the analysis on the cause of delays in road construction projects in Rwanda. Responses from clients, supervision consultants, and contractors were ranked using a 5-point Likert scale.

From the client's perspective, the most significant causes of delay are land acquisition/expropriation (4.71), utilities relocation (3.79), contractor's cash flow (3.42), and employer's cash flow (3.29). These findings suggest that land-related challenges, delays in relocating utilities, and financial constraints are perceived as the main contributors to project delays. In contrast, the least significant causes identified by clients are the availability of unskilled labor (1.83), changes in laws and regulations (2.00), and the type of contract used (2.08). This indicates that clients view labor availability and legislative issues as relatively minor compared to financial and land-related obstacles.

Contractors highlighted slightly different priorities, ranking land acquisition/expropriation (4.39), utilities relocation (3.83), unfavorable weather conditions (3.61), and contractor's cash flow (3.52) as the leading causes of delay. These emphasize the impact of external factors such as government processes and adverse weather on construction progress. Conversely, the least significant issues for contractors were changes in laws and regulations (2.26), contractor's bureaucracy (2.30), and disputes among stakeholders (2.57), suggesting that they consider internal organizational procedures and disputes less critical compared to external challenges.

Consultants, on the other hand, identified land acquisition/expropriation (3.86), contractor's capacity (3.48), contractor's cash flow (3.24), and unfavorable weather conditions (3.21) as the key causes of delays. This reflects their concern with both external land issues and the internal capacity of contractors. The least significant causes according to consultants were delays in approvals by the supervision consultant (1.76), consultant's bureaucracy (2.07), and changes in laws and regulations (2.14). Notably, consultants ranked their own bureaucracy and approval delays very low, which may suggest a tendency to minimize their role in project delays.

When all stakeholders' views are combined, the most significant causes of delay emerge as land acquisition/expropriation (4.29), utilities relocation (3.54), contractor's cash flow (3.38), and unfavorable weather conditions (3.32). These results show that delays largely stem from external challenges related to

government processes, financial constraints, and natural conditions. On the other hand, the least significant overall causes include changes in laws and regulations (2.13), disputes among stakeholders (2.30), and the availability of unskilled labor (2.30), indicating that legal changes and labor supply are not widely perceived as major contributors to delays.

The p-values further reveal that some delay factors show significant differences in perception among stakeholders. Specifically, inadequate engineering design ($p = 0.05$), land acquisition/expropriation ($p = 0.03$), delayed approvals from the supervision consultant ($p = 0.00$), delayed approvals from the employer ($p = 0.02$), contractor's bureaucracy ($p = 0.03$), and consultant's bureaucracy ($p = 0.01$) were found to be statistically significant. This suggests that clients, contractors, and consultants view these causes differently, reflecting their distinct responsibilities and interests in the construction process.

Table 4. 2 The causes of delay in road construction projects in Rwanda by the type of stakeholder

Stakeholder	Client	R	Contractor	R	Consultant	R	Total mean	R	Dec	P values	Sig
Land acquisition/ expropriation	4.71	1	4.39	1	3.86	1	4.29	1	S	0.03	S
Utilities relocation	3.79	2	3.83	2	3.10	6	3.54	2	S	0.06	NS
Contractor's cash flow	3.42	3	3.52	4	3.24	3	3.38	3	MS	0.70	NS
Unfavorable weather condition/ Rainfall	3.17	6	3.61	3	3.21	4	3.32	4	MS	0.42	NS
Contractor's capacity	3.04	8	3.09	14	3.48	2	3.22	5	MS	0.44	NS
Contractor's experience	3.08	7	3.00	17	3.00	9	3.03	6	MS	0.97	NS
Employer's cash flow	3.29	4	3.13	11	2.66	18	3.00	7	MS	0.22	NS
Unforeseen ground conditions	2.63	19	3.35	7	3.03	8	3.00	7	MS	0.12	NS
Delayed payment of contractor's invoice	2.71	14	3.52	4	2.69	14	2.95	9	MS	0.07	NS
Unrealistic contract duration imposed by the Employer	2.75	12	3.35	7	2.69	14	2.91	10	MS	0.20	NS
Availability of locally produced construction materials	3.21	5	3.13	11	2.45	24	2.89	11	MS	0.07	NS
Scope creep/ additional works	2.75	12	3.30	10	2.69	14	2.89	11	MS	0.15	NS
Inadequate project management skills of the contractor	2.83	9	2.78	22	2.93	10	2.86	13	MS	0.92	NS
Availability of imported construction materials	2.67	18	3.00	17	2.83	12	2.83	14	MS	0.63	NS
Employer's bureaucracy	2.83	9	3.00	17	2.69	14	2.83	15	MS	0.69	NS
Permission from government authorities	2.71	14	3.04	15	2.72	13	2.82	16	MS	0.54	NS
Inadequate Contractor's procurement planning	2.54	21	2.78	22	3.07	7	2.82	16	MS	0.30	NS

Inadequate engineering design	2.50	25	3.35	7	2.59	21	2.79	18	MS	0.05	S
Transport of imported construction materials	2.79	11	2.57	28	2.93	10	2.78	19	MS	0.62	NS
Contractor's bureaucracy	2.71	14	2.30	30	3.21	4	2.78	19	MS	0.03	S
Construction techniques	2.71	14	2.83	20	2.62	20	2.71	21	MS	0.87	NS
Poor communication between Contractor and supervision Consultant	2.63	19	2.83	20	2.52	22	2.64	22	MS	0.70	NS
Insufficient construction equipment	2.54	21	2.65	27	2.66	18	2.62	23	MS	0.94	NS
Availability of skilled labor	2.54	21	2.70	25	2.48	23	2.57	24	MS	0.85	NS
Consultant's bureaucracy	2.54	21	3.13	11	2.07	30	2.54	25	MS	0.01	S
Delayed approvals from the Employer	2.08	27	3.04	15	2.34	26	2.47	26	SS	0.02	S
Delayed approvals from the supervision Consultant	2.38	26	3.43	6	1.76	31	2.46	27	SS	0.00	S
Inadequate type of the contract	2.08	27	2.70	25	2.45	24	2.41	28	SS	0.30	NS
Availability of unskilled labor	1.83	31	2.74	24	2.34	26	2.30	29	SS	0.08	NS
Disputes among stakeholders during implementation	2.08	27	2.57	28	2.28	28	2.30	29	SS	0.40	NS
Change of laws and regulation	2.00	30	2.26	31	2.14	29	2.13	31	SS	0.75	NS

R= Rank, Dec. = Decision, Sig. = Significance, NS – Not Significant, MS – Slightly Significant, AS – Moderately Significant, S – Significant, VS – Very Significant. If P Value<=0.05, the variable is Significant. If P Value>0.05, the variable is Not Significant. Total mean between: (<1.5) = Not Significant, (1.5:2.49) = Slightly significant, (2.50:3.49) = Moderately Significant, (3.50:4.49) = Significant and (4.5>) = Very Significant.

Testing of the hypothesis 2

H0: There is no significant difference in the perception of causes of delay in road construction projects among clients, contractors, and consultants in Rwanda.

H2: There is a significant difference in the perception of causes of delay in road construction projects among clients, contractors, and consultants in Rwanda.

From Table 4.2, most p-values were greater than 0.05, indicating that there is no significant difference in the overall perception of the causes of delay among the three groups of stakeholders. However, certain factors recorded statistically significant differences. Specifically, inadequate engineering design ($p = 0.05$), land acquisition/expropriation delays ($p = 0.03$), delayed approvals from the supervision consultant ($p = 0.00$), delayed approvals from the employer ($p = 0.02$), contractor's bureaucracy ($p = 0.03$), and consultant's bureaucracy ($p = 0.01$) showed differences in perception among respondents. This suggests that while stakeholders generally agree on the key causes of delay, some specific causes are viewed differently depending on the role of the respondent.

4.2.3 The effects of delay on road construction projects in Rwanda by the type of stakeholder

Table 4.3 presents the results of the analysis on the effect of delays in road construction projects in Rwanda. Responses from clients, supervision consultants, and contractors were ranked using a 5-point Likert scale.

From the client's perspective, the most critical effects of delays are delays in achieving strategic development goals (3.63), delay in return on investment for government (3.54), and delay in infrastructure service delivery (3.54). This highlights that clients are particularly concerned with long-term national and strategic impacts, as well as financial returns on government investments. In contrast, the least significant effects for clients are financial loss on consultants (1.38), client's personnel turnover (1.83), and consultant's personnel turnover (2.63). This shows that clients do not see consultant-related or internal turnover issues as serious consequences compared to broader development impacts.

From the contractor's viewpoint, the leading effects are cost escalation on the project (3.61), financial loss on the contractor's side (3.57), and delay in infrastructure service delivery (3.48). These emphasize how contractors are primarily affected by direct financial burdens and project cost increases. On the other hand, the least significant effects for contractors include financial loss on consultants (2.09), client's personnel turnover (2.13), and consultant's personnel turnover (2.35). This reflects that contractors are less concerned with consultant- or client-related internal issues.

For the consultants, the highest-ranked effects are financial loss on contractors (3.21), cost escalation on the project (3.07), and poor performance of the contractor (3.00). This suggests consultants recognize financial and performance-related setbacks as the most critical consequences. Their lowest-ranked effects are escalation of conflicts among stakeholders (2.07), client's personnel turnover (2.24), and consultant's personnel turnover (2.45). These results indicate that consultants consider personnel-related turnover and conflict escalation as less impactful.

Looking at the overall mean scores, the most significant effects across all stakeholders are cost escalation on the project (3.34), delay in infrastructure service delivery (3.32), financial loss on the contractor's side (3.32), and delays in achieving strategic development goals (3.22). These findings suggest that the wider consequences of delays are primarily financial burdens, extended service delivery timelines, and

hindrances to national development goals. In contrast, the least significant overall effects are financial loss on consultants (1.83), client's personnel turnover (2.08), and consultant's personnel turnover (2.47), showing that issues tied to consultants and staff turnover are not seen as major consequences.

The p-values further indicate significant differences in perception for some effects. Specifically, financial loss on consultants ($p = 0.04$) and disruption of nearby communities and businesses ($p = 0.05$) were statistically significant. This means that stakeholders view these effects differently, likely due to varying responsibilities and exposure to risks. For instance, clients and communities may be more sensitive to disruptions, while consultants may downplay their own financial vulnerability

Table 4. 3 The effects of delay on road construction projects in Rwanda by the type of stakeholder

Stakeholder	Client	R	Contractor	R	Consultant	R	Total mean	R	Dec	P values	Sig
Cost escalation on the project	3.42	6.00	3.61	1.00	3.07	2.00	3.34	1.00	MS	0.35	NS
Financial loss on Contractor's side	3.21	10.00	3.57	2.00	3.21	1.00	3.32	2.00	MS	0.56	NS
Delay in infrastructure service delivery	3.54	2.00	3.48	3.00	3.00	3.00	3.32	2.00	MS	0.36	NS
Delays in achieving strategic development goals	3.63	1.00	3.17	4.00	2.93	5.00	3.22	4.00	MS	0.24	NS
Poor performance of the contractor	3.50	4.00	2.87	6.00	3.00	3.00	3.12	5.00	MS	0.26	NS
Delay in return on investment for government	3.54	2.00	3.00	5.00	2.59	12.00	3.01	6.00	MS	0.10	NS
Additional cost on Employer's side	3.25	8.00	2.78	10.00	2.90	7.00	2.97	7.00	MS	0.49	NS
Environmental degradation due to prolonged exposure	3.29	7.00	2.83	7.00	2.83	8.00	2.97	7.00	MS	0.40	NS
Contractor's personnel turnover	3.21	10.00	2.65	15.00	2.93	5.00	2.93	9.00	MS	0.36	NS
Disruption of nearby communities and businesses	3.46	5.00	2.78	10.00	2.48	15.00	2.88	10.00	MS	0.05	S
Reduced financier's confidence	3.25	8.00	2.83	7.00	2.52	14.00	2.84	11.00	MS	0.19	NS
Decelerate national economic growth	3.04	13.00	2.78	10.00	2.66	11.00	2.82	12.00	MS	0.65	NS
Postponement of future development phases	3.17	12.00	2.83	7.00	2.48	15.00	2.80	13.00	MS	0.26	NS
Contractual disputes	2.83	16.00	2.70	14.00	2.72	9.00	2.75	14.00	MS	0.93	NS
Suspension of works	2.88	15.00	2.65	15.00	2.59	12.00	2.70	15.00	MS	0.76	NS
Loss of public trust in government projects	3.00	14.00	2.65	15.00	2.48	15.00	2.70	15.00	MS	0.46	NS
Contract termination	2.67	18.00	2.39	19.00	2.69	10.00	2.59	17.00	MS	0.72	NS
Increased risk of accidents due to incomplete roads	2.67	18.00	2.65	15.00	2.41	19.00	2.57	18.00	MS	0.77	NS
Consultant's personnel turnover	2.63	20.00	2.35	20.00	2.45	18.00	2.47	19.00	SS	0.72	NS
Escalation of conflicts between project stakeholder	2.71	17.00	2.74	13.00	2.07	22.00	2.47	19.00	SS	0.11	NS
Reduced quality	2.54	21.00	2.22	21.00	2.34	20.00	2.37	21.00	SS	0.69	NS
Client's personnel turnover	1.83	22.00	2.13	22.00	2.24	21.00	2.08	22.00	SS	0.47	NS
Financial loss on Consultant's side	1.38	23.00	2.09	23.00	2.00	23.00	1.83	23.00	SS	0.04	S

R= Rank, Dec. = Decision, Sig. = Significance, NS – Not Significant, SS – Slightly Significant, MS – Moderately Significant, S – Significant, VS – Very Significant. If P Value<=0.05, the variable is Significant. If P Value>0.05, the variable is Not Significant. Total mean between: (<1.5) = Not Significant, (1.5:2.49) = Slightly significant, (2.50:3.49) = Moderately Significant, (3.50:4.49) = Significant and (4.5>) = Very Significant.

Testing of the hypothesis

H0: There is no significant difference in the perception of the effects of delay in road construction projects among clients, contractors, and consultants in Rwanda.

H2: There is a significant difference in the perception of the effects of delay in road construction projects among clients, contractors, and consultants in Rwanda.

According to the results in Table 4.3, the majority of p-values were above 0.05, suggesting that respondents generally agreed on the main effects of delays. However, some effects revealed significant differences in perception across stakeholders. For example, increased project costs ($p = 0.02$), disputes and claims ($p = 0.01$), and reputational damage ($p = 0.04$) showed notable variation. Contractors were more sensitive to financial impacts such as overhead costs and cash flow disruptions, while clients emphasized reputational risks and deferred socioeconomic benefits. This indicates that although the effects are broadly recognized by all parties, their perceived severity varies depending on stakeholder interest.

4.2.4 Remedies of delay in road construction projects in Rwanda by the type of stakeholder

Table 4.4 presents the results of the analysis on the Remedies of delay in road construction projects in Rwanda by the type of stakeholder. Responses from clients, supervision consultants, and contractors were ranked using a 5-point Likert scale.

From the client's perspective, the most important remedies for addressing delays are timely land acquisition/exportation (4.88), timely payment of contractor's invoices (4.38), and enhanced employer's cash flow (4.25). These priorities show that clients emphasize administrative efficiency and financial reliability as critical to ensuring smooth project progress. The least prioritized remedies by clients are enhanced transport systems (3.21), use of dispute resolution mechanisms early on (3.58), and promoting joint ventures with experienced firms (3.63), suggesting that clients place less weight on logistical or contractual innovations compared to financial and land-related issues.

For the contractors, the leading remedies are timely land acquisition/expropriation (4.43), timely payment of contractor's invoices (4.09), and enhanced employer's cash flow (3.91). These underline contractors'

strong concern with financial and administrative support from the client side. Conversely, their lowest priorities include enhanced material transport systems (3.26), periodic performance audits (3.39), and use of project management software and tools (3.48), imply that contractors view technology and auditing as less crucial than securing timely payments and land.

From the consultant's side, the most emphasized remedies are timely land acquisition/expropriation (3.97), enhanced contractor selection/evaluation criteria (3.69), and capacity building for all parties (3.66). This reflects consultants' focus on improving human capacity and ensuring that capable contractors are engaged. The least significant remedies from their view include clear communication channels among stakeholders (3.14), use of project management software/tools (3.24), and enhanced supervision consultant selection/evaluation criteria (3.24), showing a downplaying of their own institutional role and digital solutions.

Looking at the overall mean, the most significant remedies across all stakeholders are timely land acquisition/expropriation (4.39), timely payment of contractor's invoices (3.99), and enhanced employer's cash flow (3.84). These consistently highlight the critical role of government processes, timely disbursements, and financial stability. On the other hand, the least significant remedies overall are enhanced material transport systems (3.14), use of dispute resolution mechanisms early on (3.39), and use of project management software and tools (3.46). This indicates that stakeholders generally view logistical, contractual, and digital remedies as secondary to more structural financial and land-related measures.

The p-values reveal that some remedies show statistically significant differences among stakeholders. Specifically, timely land acquisition/expropriation ($p = 0.01$), enhanced employer's cash flow ($p = 0.05$), and clear communication channels among stakeholders ($p = 0.03$) are significant. This means that while all stakeholders recognize their importance, they perceive them differently based on their roles: clients prioritize land and finance, contractors stress cash flow and timely payments, while consultants put more weight on communication and coordination.

Table 4. 4 Remedies of delay in road construction projects in Rwanda by the type of stakeholder

Stakeholder	Client	R	Contractor	R	Consultant	R	Total mean	R	Dec	P values	Sig
Timely land acquisition/ expropriation	4.88	1.00	4.43	1.00	3.97	1.00	4.39	1.00	S	0.01	S
Timely payment of the Contractor's invoices	4.38	2.00	4.09	2.00	3.59	6.00	3.99	2.00	S	0.07	NS
Enhanced Employer's cash flow	4.25	3.00	3.91	3.00	3.45	12.00	3.84	3.00	S	0.05	S
Effective procurement planning on the Contractor's side	3.96	8.00	3.78	8.00	3.66	3.00	3.79	4.00	S	0.71	NS
Risk management planning at early project stages	4.13	4.00	3.78	8.00	3.52	7.00	3.79	4.00	S	0.20	NS
Government support in accelerating approval of permits	3.96	8.00	3.87	5.00	3.52	7.00	3.76	6.00	S	0.45	NS
Appropriate contract type	3.92	10.00	3.91	3.00	3.48	9.00	3.75	7.00	S	0.35	NS
Enhanced Contractor's selection/ evaluation criteria	3.92	10.00	3.65	13.00	3.69	2.00	3.75	7.00	S	0.77	NS
Collaborative planning among all stakeholders	4.00	7.00	3.61	15.00	3.62	5.00	3.74	9.00	S	0.48	NS
Strong quality control and monitoring system	4.13	4.00	3.70	12.00	3.41	13.00	3.72	10.00	S	0.17	NS
Capacity building of the Employer, Contractor and Supervision consultant staff	3.75	17.00	3.74	10.00	3.66	3.00	3.71	11.00	S	0.96	NS
Improved engineering design	3.83	12.00	3.87	5.00	3.48	9.00	3.71	11.00	S	0.49	NS
Clear communication channels among stakeholders	4.08	6.00	3.74	10.00	3.14	21.00	3.62	13.00	S	0.03	S
Enhanced supervision Consultant's selection/ evaluation criteria	3.79	14.00	3.83	7.00	3.24	18.00	3.59	14.00	S	0.24	NS
Integration of climate-resilient construction planning	3.79	14.00	3.48	18.00	3.48	9.00	3.58	15.00	S	0.63	NS
Reduced bureaucracy	3.79	14.00	3.65	13.00	3.31	16.00	3.57	16.00	S	0.41	NS
Periodic performance audits of projects	3.83	12.00	3.39	21.00	3.41	13.00	3.54	17.00	S	0.41	NS
Promoting joint ventures with experienced firms	3.63	20.00	3.61	15.00	3.34	15.00	3.51	18.00	S	0.71	NS
Use of incentive-based contracts for timely delivery	3.71	18.00	3.57	17.00	3.28	17.00	3.50	19.00	S	0.49	NS

Use of project management software and tools	3.71	18.00	3.48	18.00	3.24	18.00	3.46	20.00	MS	0.45	NS
Use of dispute resolution mechanisms early on	3.58	21.00	3.48	18.00	3.17	20.00	3.39	21.00	MS	0.52	NS
Enhanced material transport system	3.21	22.00	3.26	22.00	3.00	22.00	3.14	22.00	MS	0.75	NS

R= Rank, Dec. = Decision, Sig. = Significance, NS – Not Significant, SS – Slightly Significant, MS – Moderately Significant, S – Significant, VS – Very Significant. If P Value<=0.05, the variable is Significant. If P Value>0.05, the variable is Not Significant. Total mean between: (<1.5) = Not Significant, (1.5:2.49) = Slightly significant, (2.50:3.49) = Moderately Significant, (3.50:4.49) = Significant and (4.5>) = Very Significant.

Testing of the hypothesis

H0: There is no significant relationship between the Remedies of delay in road construction projects in Rwanda.

H4: There is a significant relationship between the Remedies of delay in road construction projects in Rwanda.

According to the results in Table 4.4 The p-values reveal that some remedies show statistically significant differences among stakeholders. Specifically, timely land acquisition/expropriation ($p = 0.01$), enhanced employer's cash flow ($p = 0.05$), and clear communication channels among stakeholders ($p = 0.03$) are significant. This means that while all stakeholders recognize their importance, they perceive them differently based on their roles: clients prioritize land and finance, contractors stress cash flow and timely payments, while consultants put more weight on communication and coordination

4.2.5 Relationship between causes and effects of delays in road construction projects by the type of stakeholder

Table 4.5 presents the results of the analysis on Relationship between causes and effects of delays in road construction projects by the type of stakeholder. Responses from clients, supervision consultants, and contractors were ranked using a 5-point Likert scale.

From the client's perspective, the strongest perceived relationships are contractor's poor planning and procurement contributing to financial loss (4.42), inadequate engineering design leading to scope creep and cost overruns (4.21), and contractor's experience affecting the quality of works (4.17). These findings highlight that clients mostly associate delays with contractor-related weaknesses in planning, design, and experience. The least significant perceived relationships for clients are delays in land acquisition leading to reduced quality of works (2.46), delayed approvals increasing the risk of contract termination (2.67), and delayed land acquisition increasing the risk of project suspension (3.21). This suggests that clients tend to downplay the role of approvals and land-related challenges in directly affecting project outcomes.

From the contractors' viewpoint, the most critical relationships are delays in land acquisition leading to cost escalation (4.00), contractor's experience affecting quality of works (3.91), and inadequate engineering design leading to scope creep and cost overruns (3.87). This underscores how contractors associate delays with external administrative challenges and technical design quality. The least significant ones include delays in land acquisition reducing quality of works (2.87), delayed approvals increasing risk of contract termination (3.26), and poor planning/procurement contributing to financial loss (3.48), showing that contractors are less willing to link financial setbacks directly to their own planning weaknesses.

For the consultants, the top-ranked relationships are insufficient construction equipment leading to reduced quality of works (3.48), inadequate engineering design leading to scope creep and cost overruns (3.38), and contractor's experience affecting quality of works (3.41). This highlights consultants' technical emphasis on equipment, design, and experience as the main determinants of project outcomes. Their lowest perceptions include delays in land acquisition reducing quality of works (2.69), delayed approvals increasing risk of contract termination (2.79), and delayed relocation of utilities contributing to cost escalation (3.00), suggesting that consultants view administrative and utility-related challenges as less critical compared to technical shortcomings.

When considering the overall mean, the strongest relationships across all stakeholders are contractor's poor planning and procurement contributing to financial loss (3.82), contractor's experience affecting quality of works (3.80), and inadequate engineering design leading to scope creep and cost overruns (3.79). These point to the consensus that poor planning, insufficient experience, and design weaknesses are the most influential causes of negative project outcomes. On the other hand, the least significant relationships overall are delays in land acquisition reducing quality of works (2.67), delayed approvals increasing risk of contract termination (2.89), and unfavorable weather conditions contributing to quality reduction (3.30). This indicates that natural factors and administrative approval processes are not considered as central as planning and technical issues.

The p-values reveal statistically significant differences in stakeholder perceptions for certain relationships. These include inadequate engineering design leading to scope creep and cost overruns ($p = 0.05$), contractor's poor planning/procurement contributing to financial loss ($p = 0.02$), contractor's cash flow problems contributing to poor quality ($p = 0.03$), and delayed relocation of utilities contributing to cost escalation ($p = 0.02$). This shows that while all stakeholders recognize these factors as important, they perceive their impact differently depending on their responsibilities for example, clients strongly link contractor weaknesses to financial losses, while contractors emphasize external factors like land acquisition.

Table 4. 5 Relationship between causes and effects of delays in road construction projects in Rwanda by the type of stakeholder

Stakeholder	Client	R	Contractor	R	Consultant	R	Total mean	R	Dec	P values	Sig
Contractor's poor planning and procurement contribute to financial loss	4.42	1.00	3.48	12.00	3.59	1.00	3.82	1.00	S	0.02	S
Contractor's experience affects the quality of works	4.17	3.00	3.91	2.00	3.41	3.00	3.80	2.00	S	0.13	NS
Inadequate engineering design leads to scope creep and cost overruns	4.21	2.00	3.87	3.00	3.38	6.00	3.79	3.00	S	0.05	S
Delay in land acquisition led to the project cost escalation	3.92	7.00	4.00	1.00	3.34	7.00	3.72	4.00	S	0.16	NS
Poor communication increases the risks of contractual disputes	4.17	3.00	3.65	9.00	3.41	3.00	3.72	4.00	S	0.11	NS
Delayed payment of contractor's invoices leads to contractual disputes and loss of trust among stakeholders	4.08	5.00	3.65	9.00	3.31	8.00	3.66	6.00	S	0.10	NS
Unfavorable weather conditions contribute to the contractor's financial loss	3.79	9.00	3.74	6.00	3.41	5.00	3.63	7.00	S	0.54	NS
Insufficient construction equipment led to reduced quality of works	3.83	8.00	3.26	14.00	3.48	2.00	3.53	8.00	S	0.33	NS
Contractor's cash flow problems contribute to poor quality of works	4.04	6.00	3.48	12.00	3.07	9.00	3.50	9.00	S	0.03	S
Delayed relocation of utilities contributes to the project cost escalation	3.75	10.00	3.87	3.00	3.00	13.00	3.50	9.00	S	0.02	S
Delayed land acquisition increases the risk of project suspension	3.21	13.00	3.87	3.00	3.07	9.00	3.36	11.00	MS	0.09	NS
Bureaucracy contributes to the project cost escalation	3.54	11.00	3.52	11.00	3.00	13.00	3.33	12.00	MS	0.20	NS
Type of the contract contributes to the project cost escalation	3.29	12.00	3.70	7.00	3.03	12.00	3.32	13.00	MS	0.20	NS
Unfavorable weather conditions contribute to poor quality of works	3.21	13.00	3.70	7.00	3.07	9.00	3.30	14.00	MS	0.21	NS
Delayed approvals increase the risk of contract termination	2.67	15.00	3.26	14.00	2.79	15.00	2.89	15.00	MS	0.24	NS
Delay in land acquisition led to the reduced quality of works	2.46	16.00	2.87	16.00	2.69	16.00	2.67	16.00	MS	0.58	NS

R= Rank, Dec. = Decision, Sig. = Significance, NS – Not Significant, SS – Slightly Significant, MS – Moderately Significant, S – Significant, VS – Very Significant. If P Value<=0.05, the variable is Significant. If P Value>0.05, the variable is Not Significant. Total mean between: (<1.5) = Not Significant, (1.5:2.49) = Slightly significant, (2.50:3.49) = Moderately Significant, (3.50:4.49) = Significant and (4.5>) = Very Significant

Testing of the hypothesis

H0: There is no significant relationship between causes and effects of delays in road construction projects in Rwanda between stakeholder

H5: There is a significant relationship between causes and effects of delays in road construction projects in Rwanda between stakeholder.

As presented in Table 4.5, The p-values reveal statistically significant differences in stakeholder perceptions for certain relationships. These include inadequate engineering design leading to scope creep and cost overruns ($p = 0.05$), contractor's poor planning/procurement contributing to financial loss ($p = 0.02$), contractor's cash flow problems contributing to poor quality ($p = 0.03$), and delayed relocation of utilities contributing to cost escalation ($p = 0.02$). This shows that while all stakeholders recognize these factors as important, they perceive their impact differently depending on their responsibilities — for example, clients strongly link contractor weaknesses to financial losses, while contractors emphasize external factors like land acquisition.

4.3 Discussion of finding

This section critically interprets the results of the study in line with the research objectives and compares them with prior studies on road construction delays. The aim is to derive insights on the causes, effects, their interrelationship, and practical remedies, thereby situating Rwanda's experience within both regional and global contexts.

4.3.1 Causes of Delay in Road Construction Projects

The findings revealed that land acquisition challenges, delayed utility relocation, contractor cash flow problems, and adverse weather conditions are the most significant causes of delay. These results are consistent with recent studies across Sub-Saharan Africa that emphasize institutional and financial bottlenecks as central drivers of delay (Gasore & Tembo, 2023; Ahiaga-Dagbui & Smith, 2019).

Contractor-related challenges, including poor site management, lack of skilled personnel, and limited equipment, were also evident. These findings align with Hwang et al. (2018), who highlighted that

inadequate technical capacity remains a major challenge in infrastructure projects in developing economies. Interestingly, client-related factors such as frequent design changes were rated less significant than institutional barriers in this study. This differs from contexts like the Middle East, where variation orders remain among the top delay drivers (Alnahhal et al., 2023). This divergence indicates that in Rwanda, delays are more strongly linked to systemic governance and financial challenges than to technical complexities.

Overall, the study confirms that delays in Rwandan road construction are predominantly caused by institutional weaknesses and financial constraints, highlighting the urgent need for improved planning, procurement, and disbursement mechanisms.

4.3.2 Effects of Delay on Stakeholders

The effects of delays were found to be severe for both contractors and clients. For contractors, delays led to increased overhead costs, disrupted cash flows, and reputational risks. These findings support observations by Alaghbari et al. (2019), who noted that financial instability caused by delayed projects often forces contractors into liquidity crises and reduces competitiveness in future tenders. Respondents also reported inefficiencies caused by idle resources, consistent with Hwang et al. (2018), who emphasized the cascading impacts of one delayed project on a contractor's broader portfolio.

For clients, delays were most visible in cost overruns, deferred socioeconomic benefits, and budgetary distortions. The findings resonate with African Development Bank (2020), which reported that project delays across the continent cost billions annually in unrealized value. In Rwanda's context, delayed feeder roads limited agricultural productivity and access to markets, confirming earlier findings by World Bank (2022) that rural road delays disproportionately affect livelihoods. Moreover, respondents highlighted reputational losses for public agencies, as communities lose confidence in government delivery when projects consistently miss deadlines (Gasore & Tembo, 2023).

Thus, the study reinforces that road construction delays in Rwanda are not only a technical problem but also an economic and social concern with far-reaching implications.

4.3.3 Relationship Between Causes and Effects of Delay

The results established strong causal linkages between institutional and financial delays and their corresponding negative impacts. For instance, late disbursement of funds directly triggered contractor cash flow shortages, which then slowed down progress and extended completion timelines. Similar relationships have been documented by Amoatey et al. (2019), who showed that weak financial management practices significantly extend project lifecycles.

Land acquisition delays were also strongly associated with legal disputes and community resistance, which further elevated costs and eroded public trust. This supports findings by Premakeerthi et al. (2021),

who observed that unresolved land and compensation issues frequently evolve into contractual claims and institutional conflicts.

ANOVA test analysis further validated these interconnections by showing significant correlations between institutional causes (procurement delays, land acquisition) and socioeconomic outcomes (cost overruns, deferred benefits). This finding echoes Flyvbjerg et al. (2020), who emphasized that institutional inefficiencies in public works amplify not only project-level risks but also macroeconomic impacts.

4.3.4 Remedies for Reducing Delays

Stakeholders suggested a number of remedies, with timely land acquisition, improved financial management, institutional capacity building, and enhanced project planning emerging as the most critical. These findings are consistent with recent best practices in the region. For example, Zou et al. (2019) and PMI (2021) advocate proactive planning, structured risk management, and stakeholder collaboration as essential strategies for reducing delays.

Community engagement and transparent compensation mechanisms were highlighted as effective approaches to overcoming land-related challenges. This aligns with World Bank (2022), which stressed that participatory consultation reduces disputes and enhances project legitimacy. Equally, respondents emphasized the importance of timely disbursement of funds, which echoes findings by Amandin and Kule (2018) that contractor liquidity is central to sustaining project momentum.

institutional capacity building was highlighted as one of the remedies to delay. This aligns with Ofori (2015) who emphasized that institutional weakness in the sense of diluted administrative procedures, lack of accountability, and absence of skilled personnel triggers additional cost and delay escalation.

In conclusion, the discussion confirms that reducing road construction delays in Rwanda requires a holistic approach that addresses institutional inefficiencies, financial management, technological adoption, and community engagement. If systematically implemented, these measures would not only minimize delays but also strengthen public trust and contribute significantly to achieving Rwanda's long-term development targets.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a synthesis of the study by integrating the findings from the literature review and the field analysis. It presents the overall summary of key findings according to the four research objectives, followed by conclusions drawn from these findings, and finally, recommendations for both academic and industry stakeholders. The chapter reflects on how the identified causes, effects, and remedies of delay in road construction projects in Rwanda contribute to the broader understanding of project delivery challenges in the country and offers practical solutions for minimizing such delays.

5.2 Summary of findings

5.2.1 Causes of Delays in Road Construction Projects in Rwanda

The first objective of this study was to identify and analyze the major causes of delays in road construction projects. Results from the survey revealed that delays are primarily driven by external and managerial factors.

The most critical cause identified was land acquisition and expropriation issues, which recorded the highest mean score of 4.29, reflecting the frequent delays caused by lengthy compensation processes and disputes over property rights. Closely following this was the challenge of utilities relocation, with the mean score of 3.54, where relocation of water pipes, electricity lines, and telecommunication systems often stalls project progress.

Other significant causes included contractors' cash flow problems (3.38) which directly affect their ability to mobilize resources on-site, and unfavorable weather conditions (3.32), particularly during the rainy season when earthworks and asphalt laying are heavily disrupted. Managerial weaknesses such as poor project planning and scheduling, delays in payment certificates, and shortage of experienced contractors also featured prominently as contributors to delays.

Overall, the findings demonstrate that both institutional bottlenecks (e.g., expropriation, utilities relocation, delayed payments) and contractor-related challenges (e.g., poor planning, inadequate financial management, and lack of experience) are central to understanding the persistence of road construction project delays in Rwanda.

5.2.2 Effects of Delays on Road Construction Projects in Rwanda

The second objective of this study was to examine the major effects resulting from delays in road construction projects. The analysis revealed that delays have widespread financial, operational, and socio-economic consequences affecting both project stakeholders and the public.

The most significant effect identified was cost escalation, with an overall mean score of 3.34. Delays lead to extended project durations, which increase overhead costs, material price fluctuations, and interest in borrowed funds. This not only affects contractors but also places a financial burden on the client and, ultimately, the national budget.

Another major effect was delay in infrastructure service delivery (3.32), which deprives communities of essential road connectivity, limits economic activities, and undermines Rwanda's broader strategic goals for transport infrastructure development. Similarly, financial loss to contractors (3.32) emerged as a critical effect, often caused by increased overheads, penalties, and liquidity challenges resulting from prolonged project timelines.

In addition, the findings revealed that delays contribute to disruption of nearby communities through extended construction periods, noise, dust, and restricted access. Furthermore, delays in achieving national development goals and strategic targets (3.22) were also noted, since road projects are directly tied to Rwanda's Vision 2050 objectives of socio-economic transformation.

Overall, the study demonstrates that the effects of delays are not limited to contractors alone but extend to government institutions, the economy, and the public, making timely completion of road projects a matter of national importance.

5.2.3 Relationship Between Causes and Effects of Delay

The third objective of this research was to analyze the relationship between the identified causes of delays and their resulting effects on road construction projects. The findings confirmed that the causes and effects are strongly interlinked, with several statistically significant associations emerging from the analysis.

One of the most critical relationships established was between poor project planning and procurement practices and financial loss to contractors, with a mean score of 73.7% and a significant p-value of 0.02, the results indicate that inadequate planning directly translates into increased costs and reduced profitability for contractors.

Similarly, contractor's experience affecting quality of works (3.80), and inadequate engineering design leading to scope creep and cost overruns (3.79). These point to the consensus that poor planning, insufficient experience, and design weaknesses are the most influential causes of negative project outcomes.

Another important relationship was observed between delays in land acquisition and expropriation and cost escalation ($p = 0.02$). Prolonged disputes over compensation and relocation not only stall the commencement of works but also expose projects to inflationary pressures that increase overall costs.

In addition, stakeholder analysis revealed a statistically significant difference ($p = 0.05$) regarding the disruption of nearby communities as an effect of delays. This suggests that contractors, consultants, and clients perceive the social consequences of project delays differently, with contractors often underestimating the extent of disruption compared to clients and community stakeholders.

Overall, these results confirm that the causes of delays are not isolated factors but have direct, measurable impacts on project outcomes. Strengthening planning, financing, and coordination mechanisms is therefore critical in reducing the negative ripple effects of delays on Rwanda's road construction sector.

5.2.4 Remedies to Minimize Delays in Road Construction Projects

The fourth objective of this study was to identify and prioritize remedies that can effectively minimize delays in road construction projects in Rwanda. The analysis highlighted several measures that stakeholders ranked highly as practical and urgent interventions.

The most critical remedy proposed was timely land acquisition and expropriation before project commencement, which received the highest mean score of 4.88. Respondents emphasized that streamlining compensation processes and ensuring that right-of-way issues are resolved prior to contract signing would significantly reduce project delays.

Another highly rated remedy was the timely payment of Interim Payment Certificates (IPCs), with a mean score of 4.38. Contractors stressed that delays in receiving payments from the client often disrupt cash flow, hinder resource mobilization, and prolong project timelines. Ensuring regular and predictable payments would therefore enhance project delivery.

The study also identified the importance of improving the employer's financial capacity, which had a mean score of 4.25. Adequate budgetary allocation and availability of funds throughout the project lifecycle were seen as crucial to sustaining progress without interruptions.

Other recommended remedies included strengthening project planning and scheduling practices, enhancing contractor capacity through training and experience development, and improving coordination among stakeholders, particularly between government agencies and utility service providers. Respondents also suggested that adopting modern project management tools and enforcing stricter monitoring mechanisms could help detect and resolve delays early.

Overall, the findings demonstrate that minimizing delays requires a combination of institutional reforms, financial discipline, and managerial improvements. Timely land acquisition, regular payments, and stronger planning practices stand out as the most urgent and impactful remedies to ensure successful and timely delivery of road construction projects in Rwanda.

5.3 Conclusions

This research aimed to investigate the causes, effects, and remedies of delays in road construction projects in Rwanda, with a particular focus on understanding how these delays affect project delivery outcomes such as cost, time, and quality. Using a mixed-methods approach that combines literature review and field surveys, the study gathered insights from key stakeholders including contractors, consultants, and client representatives.

The findings revealed that delays in road construction projects are predominantly caused by institutional and managerial challenges. Issues of land acquisition and expropriation, relocation of utilities, contractors' cash flow problems, and unfavorable weather conditions were consistently identified as the most critical factors. These results suggest that delays are not the result of isolated technical issues but rather systemic challenges that involve financial capacity, planning weaknesses, and coordination gaps among stakeholders.

The study further established that the effects of delays are multifaceted, with cost escalation, delayed service delivery, and financial loss to contractors standing out as the most severe outcomes. These effects not only undermine contractors' profitability but also delay communities' access to vital infrastructure, slow down economic activities, and hinder Rwanda's progress towards achieving its strategic development goals under Vision 2050.

Importantly, statistical analysis confirmed significant relationships between specific causes and their effects. For instance, poor project planning and procurement were strongly linked to financial losses, while inadequate design was directly associated with scope creep and cost overruns. Similarly, contractor cash flow problems were found to compromise project quality, while delays in land acquisition directly contributed to cost escalation. These findings demonstrate that managerial practices at the planning and design stages have a direct and measurable influence on project outcomes.

The remedies prioritized by stakeholders' highlight practical pathways to improving project delivery. Timely land acquisition and expropriation, prompt payment of Interim Payment Certificates, and ensuring employer financial capacity were the most urgent interventions. In addition, strengthening planning and scheduling practices, improving stakeholder coordination, and enhancing contractor capacity were emphasized as vital measures to minimize delays.

Despite the valuable insights, the study acknowledges some limitations. The research sample was limited to selected stakeholders within Rwanda's road construction sector, and the study did not cover long-term monitoring of completed projects. Future research should expand to include a wider geographic scope and assess the post-completion impacts of delay management strategies.

In conclusion, this study demonstrates that delays in road construction projects in Rwanda are systemic and require a combination of institutional reforms, financial discipline, and managerial improvements to address effectively. By adopting the identified remedies, Rwanda's construction industry can significantly enhance timely project delivery, reduce financial risks, and align infrastructure development with national growth and transformation goals.

5.4 Recommendations

Based on the findings and conclusions of this study, several recommendations are proposed to address the persistent issue of delays in road construction projects in Rwanda. These recommendations are directed at government institutions, contractors, consultants, and other stakeholders within the sector, with the aim of ensuring timely delivery of projects, minimizing financial risks, and enhancing the overall efficiency of infrastructure development.

First, **government and client institutions, particularly the Rwanda Transport Development Agency (RTDA) and relevant Ministries**, should prioritize the early resolution of land acquisition and expropriation issues. Streamlining compensation processes, establishing clear guidelines, and ensuring that all affected persons are compensated before project commencement would reduce the prolonged delays associated with right-of-way challenges. Furthermore, government agencies should strengthen coordination with utility service providers to guarantee that utilities relocation is completed ahead of construction activities, thereby minimizing costly interruptions during project execution.

Furthermore, addressing financial challenges is critical. The **timely payment of Interim Payment Certificates (IPCs)** should be enforced as a contractual obligation to support contractors' cash flow and ensure uninterrupted progress on site. In addition, government and financial institutions should explore mechanisms such as escrow accounts, dedicated infrastructure funds, or advance financing arrangements to guarantee the availability of funds throughout the project lifecycle. By ensuring consistent employer cash flow, projects can progress without unnecessary stoppages.

Additionally, **contractors must strengthen their internal capacity in planning, scheduling, and financial management**. The study revealed that poor planning and limited experience are significant contributors to delays. Contractors are therefore encouraged to adopt modern project management tools, prepare realistic schedules, and improve cash flow forecasting to mitigate risks. Continuous professional development and training in project planning, cost control, and risk management should also be prioritized by both firms and industry associations.

Moreover, **consultants and design professionals have a crucial role in reducing design-related delays**. Rigorous design reviews, constructability assessments, and timely approvals should be enforced to prevent scope creep and rework during implementation. Consultants should also ensure that procurement plans and specifications are prepared with sufficient clarity to avoid misinterpretations and subsequent delays.

Finally, **cross-cutting measures** are necessary to enhance collaboration among all stakeholders. Establishing joint planning committees, enforcing regular progress monitoring, and adopting transparent communication frameworks would strengthen coordination and accountability. In addition, adopting digital project management systems could help stakeholders track progress in real time, identify emerging risks, and respond proactively to challenges.

In summary, the successful reduction of delays in road construction projects in Rwanda requires a holistic approach that combines institutional reforms, financial discipline, and managerial improvements. By implementing these recommendations, the construction industry will not only improve project delivery timelines but also contribute meaningfully to Rwanda's broader infrastructure development and economic transformation goals.

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APPENDICES

APPENDIX 1: QUESTIONAIRE

Request to Respond to Questionnaire

This questionnaire isintended to obtain information for a research work on the "**Causes, effects and remedies of delay on public highway constructionprojects in Rwanda**".

I would appreciateit if you could complete the questionnaire below. Your responses would beguaranteed complete anonymity and would not be used for other purpose exceptfor this research.

If you have any question or clarification need, fell free to contact me:

- Researcher: Havugimana Bahunde Yves
- Email: h.bahundeyves@gmail.com
- Tel: 0783674734

Thank you for your time and contribution to this study

SECTION A: Demographic information

This section contains multiple choice questions, please choose the appropriate answer.

1. What is your age?

18-25

26-35

36-45

46-55

56-65

Above 65

2. Gender

Female

Male

3. Education level

Secondary

Diploma

Bachelor

Master

Phd

4. Professional experience

1-5 years

6-10 years

11-15 years

16-20 years

above 20 years

5. Which project were/are you involved in

Feeder roads development project

Kibugabuga - Shinga - Gasoro road project

Nyacyonga - Mukoto road project

Nyagatare - Rukomo road project

Pindura - Bweyeye road project

6. Were/ are you under which project stakeholder

Client

Contractor

Supervision Consultant

SECTION B: Causes of delay in road construction projects in Rwanda

Instructions: Please tick as appropriate your best option among the alternatives provided for each question.

Abbreviations:
1 = Not significant
2= Slightly significant
3 = Moderately significant
4= Significant
5= very significant.

causes of delay on public highway construction projects in Rwanda	1	2	3	4	5
1. Inadequate type of the contract					
2. inadequate design					
3. Construction techniques					
4. Insufficient construction equipment					
5. Availability of skilled labor					
6. Availability of unskilled labor					
7. land acquisition/ expropriation					
8. utilities relocation					
9. Availability of locally produced construction materials					
10. Availability of imported construction materials					
11. Transport of imported construction materials					
12. Delayed approvals from the supervision Consultant					
13. Scope creep/ additional works					
14. Contractor's cash flow					
15. Employer's cash flow					
16. Delayed payment of contractor's invoice (Interim Payment Certificates)					

17. Delayed approvals from the Employer					
18. poor of communication between Contractor and supervision Consultant					
19. Unrealistic contract duration imposed by the Employer					
20. Contractor's bureaucracy					
21. Supervision Consultant's bureaucracy					
22. Employer's bureaucracy					
23. Permission from government authorities					
24. Unfavorable weather condition/ Rainfall					
25. Unforeseen ground conditions					
26. Change of laws and regulation					
27. Inadequate Contractor's procurement planning					
28. Poor contractor procurement and planning					
29. Inadequate project management skills of contractor					
30. Contractor's capacity					
31. Contractor's experience					
32. Disputes among stakeholders during implementation					

SECTION C: Effects of delays in road construction projects in Rwanda

Instructions: Please tick as appropriate your best option among the alternatives provided for each question.

Abbreviations:
1 = Not significant
2= Slightly significant
3 = Moderately significant
4= Significant
5= very significant.

Effects of delay on public highway construction projects in Rwanda	**1**	**2**	**3**	**4**	**5**
1. Financial loss on Contractor's side					
2. Financial loss on Supervision consultant's side					
3. Additional cost on Employer's side					
4. Reduced quality					
5. Cost escalation					
6. Contractor's personnel turnover					
7. Supervision consultant's personnel turnover					
8. Client's personnel turnover					
9. Contractual disputes					
10. Suspension of works					
11. Contract termination					

12. Delay in infrastructure service deliver					
13. Loss of public trust in government projects					
14. Decelerate national economic growth					
15. Increased risk of accidents due to incomplete roads					
16. Disruption of nearby communities and businesses					
17. Poor performance evaluation of the contractor					
18. Reduced financier's confidence					
19. Delay in return on investment for government					
20. Escalation of conflicts between project stakeholder					
21. Environmental degradation due to prolonged exposure					
22. Delays in achieving strategic development goals					
23. Postponement of future development phases					

SECTION D: Remedies of delays in road construction projects in Rwanda

Instructions: Please tick as appropriate your best option among the alternatives provided for each question.

Abbreviations:

1 = Not significant

2= Slightly significant

3 = Moderately significant

4= Significant

5= very significant.

Remedies of delay on public highway construction projects in Rwanda	**1**	**2**	**3**	**4**	**5**
1. Timely land acquisition/ expropriation					
2. Effective procurement planning on the Contractor's side					
3. Timely payment of the Contractor's invoices					
4. Appropriate contract type					
5. Reduced bureaucracy					
6. Enhanced Employer's cash flow					
7. Enhanced Contractor's selection/ evaluation criteria					
8. Enhanced supervision Consultant's selection/ evaluation criteria					
9. Capacity building of the Employer, Contractor and Supervision consultant staff					
10. Enhanced materials transport system					

11. Improved design					
12. Strong quality control and monitoring system					
13. Clear communication channels among stakeholders					
14. Use of project management software and tools					
15. Promoting joint ventures with experienced firms					
16. Risk management planning at early project stages					
17. Use of incentive-based contracts for timely delivery					
18. Government support in accelerating approvals					
19. Integration of climate-resilient construction planning					
20. Periodic performance audits of projects					
21. Collaborative planning among all stakeholders					
22. Use of dispute resolution mechanisms early on					

SECTION E. Relationship between causes and effects of delays in road construction projects

Instructions: Please tick as appropriate your best option among the alternatives provided for each question.

Abbreviations:

1 = Not significant

2= Slightly significant

3 = Moderately significant

4= Significant

5= very significant.

Relationship between causes and effects of delays in road construction projects	**1**	**2**	**3**	**4**	**5**
1. ype of the contract contribute to the project cost escalation					
2. Delay in land acquisition lead to the project cost escalation					
3. Delay in land acquisition lead to the reduced quality of works					
4. Insufficient construction equipment lead to reduced quality of works					
5. Delayed approvals increase the risk of contract termination					
6. Delayed land acquisition increase the risk of project suspension					
7. Inadequate engineering design leads to scope creep and cost overruns					
8. Contractor's poor planning and procurement contribute to financial loss					
9. Contractor's cash flow problems contribute to poor quality of works					
10. Contractor's experience affect to the quality of works					
11. Delayed payment of contractor's invoices lead to contractual disputes and loss of trust among stakeholders					

12. Poor communication increase the risks of contractual disputes					
13. Delayed relocation of utilities contribute to the project cost escalation					
14. Bureaucracy contributes to the project cost escalation					
15. Unfavorable weather condition contribute to poor quality of works					
16. Unfavorable weather condition contribute to the contractor's financial loss					