

MODELING INTEGRATED MANAGEMENT OF CONSTRUCTION  
TENDER PRICE INFLATION

By

Moffat Tembo  
2100008

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the requirements for the degree of Doctor of Philosophy in Construction  
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LUSAKA

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**DECLARATION**

I, Moffat Tembo, do hereby declare that the work presented in this Thesis is the result of my research work except to the extent indicated in the Acknowledgements and references, and comments included in the report and that it has not previously been submitted for any degree at this or another University.

CANDIDATE

Name: Moffat Tembo

Signed: .....

Date: .....

SUPERVISOR

Name: Prof. Erastus Misheng'u Mwanaumo

Signed: .....

Date: .....

CO-SUPERVISOR

Name: Dr. Charles Kahanji

Signed: .....

Date: .....

**CERTIFICATE OF APPROVAL**

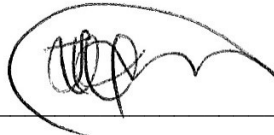
This Thesis of **Moffat Tembo** is approved to fulfill the requirements for the Doctor of Philosophy Degree in Construction Management award by the University of Zambia.

**NAME**

**SIGNATURES**

---

First Examiner – Prof. Ephraim Kabunda Munshifwa



---

Second Examiner – Dr. Chabota Kaliba, PhD

---

Third Examiner – Prof. Clinton O. Aigbavboa

---

Chairperson: Board of Examiners - Dr. Micheal N. Mulenga

## ABSTRACT

The worldwide problems associated with the construction industry include low productivity, poor safety, inferior working conditions, lack of adequate financing, and insufficient quality. Widespread problems in the construction industry in most developing countries correspondingly include project cost overruns and schedule delays. These then affect the general economy, ranging from poor allocative efficiency to total project abandonment. Several solutions, industrialization, prefabrication, and modularization, relieve these construction problems. In the Zambian case, varying construction tender prices have been one of the general challenges in the industry, which require devising methods by clients to control project cost from the onset of the project at the bidding stage. This study provided an integrated model that proposes a collective practical solution to eminent critical Zambian construction-sector challenges regarding construction tender price inflation on public projects. The study investigated strategies contractors adopt during project pricing and explores capabilities that clients use to make informed decisions on individual construction tender prices. To that effect, the research explored decisive factors and contributory processes involved in pricing decisions by contractors in the public construction sector. This phenomenological study is driven within qualitative and quantitative paradigms through case study and causal research designs. Thus, a mixed-method approach to address specific public infrastructure tender price challenges was adopted. The findings show construction tender prices increased by 31.4% annually for upgrading roads to bituminous standards between 2008 and 2018. Whereas, between 2012 and 2021, tender prices for periodic maintenance of feeder roads increased by an average of 49.7% per annum. The research utilized the Kaizer stopping criterion and Rotation Sums of Squared Loadings which determined that benchmarking price performance accounts for 40.457% of the inflation, and eliminating errors in tender documents accounts for 33.693%. The Pseudo R<sup>2</sup> indicated that the multinomial model explains 62.5% only of the variability between the independent variables and construction tender price inflation. The findings of the statistical analysis of the quantitative data provided a strong correlation between the dimension-independent variables and construction tender price. Regression functions correctly classify 86.4% of the inflation effect of tested predictor variables on construction tender price. The study established six key construction-related dimensions, including government, project, procurement, legal, industry, and project-specifics, with 65 indicators. It argues construction tender price inflation as a function of macroeconomic (quantitative) indicators and process management (qualitative) related variables. Further, the study notes significant positive and negative correlations between construction tender prices and foreign exchange rates, commercial interest rates, inflation rates, foreign direct investments, and government debt stock. The study developed an integrated model which acknowledges all 65 key dimension performance indicators as significant for producing a desirable construction tender price performance level. The developed model combines analytical and descriptive aspects of tender price factors.

**Keywords:** Construction tender price, public construction sector, public infrastructure, construction industry

**DEDICATION**

To Chaisa

With the compliments of Gertrude and Friday

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## **LIST OF ABBREVIATIONS**

ACEZ	Association of Consulting Engineers of Zambia
FDI	Foreign Direct Investment
Forex	Foreign Exchange Rate
GRZ	Government of the Republic of Zambia
MLGRD	Ministry of Local Government and Rural Development
MIHUD	Ministry of Infrastructure, Housing, and Urban Development
NCC	National Council for Construction
NRFA	National Road Fund Agency
RDA	Road Development Agency
US\$	United States Dollar
ZDA	Zambia Development Agency
ZMW	Zambian Kwacha (Rebased)
ZPPA	Zambia Public Procurement Authority
ZIA	Zambia Institute of Architects

## **CHAPTER 1: Introduction**

### **1.1 Contextual background**

Historically, the construction industry has experienced continuous higher prices, a continued productivity decline, and extreme waste levels. Worldwide chronic problems associated with the construction industry are well-known and include but are not limited to low productivity, poor safety, inferior working conditions, lack of adequate financing, and insufficient quality (Ramachandra & BamideleRotimi, 2015; Proverbs & Cheek, 2000). In developing countries, widespread problems in the construction industry also include project-cost overruns and schedule delays, which affect the broader economy leading to issues from poor allocative efficiency to total project abandonment (Gbahabo and Ajuwon, 2017). Unusual to developed countries, Wambui, Ombui, and Kagiri (2015) found the unavailability of project funds to significantly affect public sector construction projects in developing countries. Certainly, variable and higher construction tender prices constitute overall challenges in the Zambian industry, which require devising methods by the government to control project costs from the onset of the project at the bidding stage (Zhang, Luo & He, 2015). For developing countries, a classic problem at this point is attempting to manage a process holistically impacted by various factors.

Then again, the construction industry's contribution to economic growth and long-term national development is widely acknowledged (Isa, Jimoh & Achuenu, 2013; Lopes, Oliveira & Abreu, 2011; Berk & Biçen, 2018; Oladinrin, Ogunsemi, & Aje, 2012; and Khan, 2008). Particularly in developing countries, the nature of the construction industry and its importance in development is a critical area of primary concern (Oladinrin et al., 2012; Osei, 2013). Elements of the process of construction industry development that include ways and means of improving the performance of local construction firms are of primary concern. Particular focus on contractors, technology development, and other industry performance parameters, such as productivity and environmental performance, are focal points in modern times. Conspicuously, it needs to deliver a project with higher quality at a lower cost and, in a short period, challenge traditional ways of managing construction projects (Soares,

2013). Besides, these areas of concern influence the formulation of policies and legislation for establishing construction industry management and process reengineering development models. For the benefit of developing countries, it is vital to investigate the nature, essential characteristics, and particular requirements of their construction industry and use them to develop programs for its improvement.

Tender price inflation in the construction industry brings about two different indices of measure in tracking project costs: Construction Tender Price Index (CTPI) and Construction Input Cost Index (CICI) (Kissi, et al., 2016; Elfahham, 2019). These tender indices measure actual prices submitted by contractors and sub-contractors during tendering, reflecting the prices contractors charge to perform works. Thus, this index is crucial to a government when undertaking public works. On the other hand, construction cost indices measure the cost of construction inputs such as materials. All being equal, the two indices track each other closely through increases and decreases in the market or sector conditions. However, this may not be true for a construction sector that experiences unremitting rise and fall in public construction output. Contractors adopt artificially low tendering strategies during low-construction output periods to maintain workload aggressively (Okereke, 2019). This strategy is not sustainable in the long term as it puts pressure on firms' existence. Contractors later endeavor to recover their lost margins during high construction outputs by submitting tenders, which reflect an accurate picture of the input costs. Investigating construction tender price formulation contrivances is a continuing concern in developing countries and is a significant area of interest within construction management.

Tender price variations are even higher concerning public construction projects, with specific risks and challenges to execute (Adjei, et al., 2018). This scenario ultimately leads to a situation whereby construction tender prices begin to outstrip construction cost indices annually, thereby generating substantial imbalances concerning cost-benefit analysis on a government. The depiction worsens socially and politically, especially when construction tender price variability is inflationary. When construction inflation is considerably higher than inflation in the broader economic impacts, it gets highly noticeable in implementing public construction projects. The

cumulative effect of tender price inflation is significant on the capital cost of public projects by drastically raising the capital expenditure of a government (Montes, et al., 2016). At this point, successful implementation of construction projects requires making the right price decisions during the tendering process by tightly managing tender procedures (Mohamad, Hamdan, Othman & Noor, 2010). Some tendering procedures require judgmental projections into the future broader market and specific industry conditions. Since the construction industry is massive and highly competitive, the issues of contract pricing have become exceptionally complex matters to address (Akintoye and Skitmore, 1990). Broader economic conditions contribute to fluctuating construction tender prices, which increase expenditure uncertainties for clients who attempt to forecast construction prices in the sector (Kissi, Adjei-Kumi, Amoah, & Gyimah, 2018). Recent developments in construction management heightened the need to review the procurement function, as changes in tender prices over the past decade remain unprecedented.

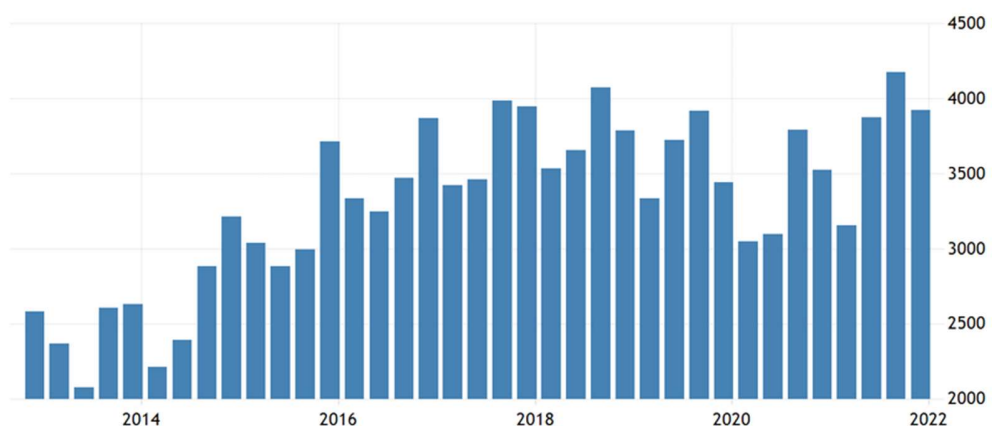
The past decades have seen a rapid development of solutions to construction-related challenges globally. As a result, previous studies offer several solutions that relieve similar problems. For example, recent evidence suggests that fragmentation in the construction sector is a significant cause of existing issues (Nawi, Baluch & Bahauddin, 2014; Riazi et al., 2020). Computer-integrated construction is a critical way to reduce fragmentation in construction (Nawi, Baluch & Bahauddin, 2014). Other closely related solutions have included robotized and automated construction (Kamaruddin, Mohammad & Mahbuba, 2016). Most solutions are readily adoptable and applicable. However, a significant problem with this approach is that undomesticated solutions always fail to address industry-specific challenges. Thus, despite several varying solutions to adopt from, long-standing solutions require developing tailor-made methodologies. Industry-specific methodologies must constitute problem identification, redesigning, implementation, and continual process change (Shakun & Deepa, 2018).

The construction industry requires a balance whereby as contractors develop strategies in pricing for projects, clients are equally equipping themselves with capabilities to

make informed decisions on individual prices (Stramarcos & Cattell, 2013). To that effect, this research explores decisive factors and contributory processes involved in tender price inflation. Further, this research provides an integrated model that proposes a collective practical solution to eminent critical Zambian construction-sector challenges regarding construction tender price inflation on public projects. In addition, the study investigates strategies contractors adopt during pricing for projects and explores capabilities that clients equip themselves with to make informed decisions on individual construction tender prices.

### 1.2 Overview of Zambia’s construction sector: Tender price perception

In Zambia, infrastructure development is a labor-intensive industry, crucial for the socioeconomic development of the country (Phiri & Matipa, 2004; Muya, et al., 2003). The construction sector in Zambia has seen increased activity in infrastructure development. In 2014 alone, the construction sector contributed about 9.9 percent of the National Gross Domestic Product (CSO, 2014). According to Zambia Development Agency (ZDA), Zambia recorded US \$3.3 billion in foreign direct investment, mainly in the construction sector in 2014, such that the sector grew 9.1% in 2013 and 2014. Zambia’s construction sector is the most important industrial sector comprising 27.5% of the GDP (Zambia Invest). According to Trading-Economics (2022), the construction sector's contribution to Zambia’s gross domestic product has steadily risen since 2014, as shown in Figure 1.1.



**Fig. 1.1:** GDP contributions from construction in Zambia  
(Source: Trading Economics, 2020)

The Zambian government is the primary client of most National Council of Construction (NCC) registered contractors. However, Zambia struggles with construction price inflation, hallmarked by a general increase in prices of works over time (Olabisi, 2022). Historic perceived increases in construction prices and project spending contribute to unsustainable infrastructure development costs in the country. While drivers of variable construction tender prices need further documentation and studying, impacts are already noticeable. Trapped in the government's push for development are citizens of whom too many questions the benefits of, or who benefits from, undertaking these public projects. In addition, society is concerned about how a government affords such spending considering the complexity and diverse nature of the sector, making it challenging to address variable tender prices while encouraging infrastructure development programs.

Zambia has a substantial residential construction sector, typically one-off residential constructions. Herein, most private clients obtain services from informal or non-NCC registered contractors. Like the government, private commercial developers use well-established NCC-registered contractors to contract complete services, including labor, supply of construction materials, and installations (Zambia Construction Analysis Report, 2014). In 2022, the Zambian government launched the Eighth National Development Plan (NDP), running until 2026. Through this plan, Zambia aims to become a thriving middle-income nation by 2030, building on previous NDPs. The construction sector is one of the program's top priority development areas. The country's National Vision 2030 upholds the critical nature of the construction sector. For instance, from 2017 to 2021, Zambia's construction sector received an investment of at least \$8.75 billion per the seventh NDP. Zambia is facing many problems in the construction industry despite being an area of government focus and drawing positive political and financial attention. Zambia's construction stats have been vital recently, with construction spending rising since 2011. The sector is projected to grow at 2.7% annually between 2023 and 2026, with a total market size of \$8.5 billion in 2021 alone (Wood, 2022; Globaldata, 2022). Then again, the industry has experienced relentless project costs that slow construction appetite and cause infrastructure development to lag.

For years, local contractors have been at the helm of the blame for their continued failure to implement projects awarded to them. Generally, this failure has been attributable to inadequate skills, capacity, overpricing, finance or capital, and lack of machinery to perform satisfactorily (Aigbavboa, et al., 2018; Muya, et al., 2003; Muya, et al., 2014). As a result, the industry has recorded considerable losses in infrastructure investments owing to shoddy work or run-away contractors. The country has sometimes experienced severe infrastructure decay due to poor design, construction, materials and maintenance regimes (Zulu, et al., 2022). Furthermore, Zambia's construction industry does not have responsive financial instruments that fund start-up works or the acquisition of large-scale machinery and, at times, finance the project. Therefore, although construction is one of Zambia's fastest-growing sectors, it ranks near the bottom of all employment sectors regarding wages, the proportion of permanent employees, social protection awareness, and sector predictability.

### **1.3 The rationale of the study**

In developing countries like Zambia, governments emphasize the cost of construction projects and the price of construction contracts. One of the principal achievements in that regard has been implementing the lowest bid selection or procurement approach. However, the client's attitude towards cost-benefit analysis remains an essential influence on whether a project comes with an acceptable price tag. In this regard, construction price is critical in delivering public-sector construction projects. Construction contract overpricing is commonplace during the procurement phase of public sector projects. Construction tender price inflation causes price uncertainties that reduce the effectiveness of public investments and require governments to raise additional finance to execute a similar quantum of private construction works. Tender price inflation negatively affects the broader economy because developing nations such as Zambia fund different construction pricing from reserves or borrowed funds to meet planned developmental obligations. It ultimately leads to enormous domestic and foreign debt contraction and stakeholder disagreements that frustrate project intentions and strain public confidence. Therefore, preventing construction tender price inflation is crucial during contracting construction projects.

A dilemma often exists among public-sector-project stakeholders regarding what to do to manage the price inflation of construction projects. This study constructs a better understanding of the complexity of pricing in the construction industry and leads to new insights into the substantiation of contract prices. Fathomably, impacts resulting from rising costs in the construction industry establish matters of principle that apply to sustainable development and the general economics of the country. Accordingly, the government requires developing practical policies to curtail construction-price inflation while significantly incentivizing the public construction sector. The solution is achievable by establishing a more rational tender pricing model that can meet the needs of all stakeholders. The research draws significance on several aspects regarding the calculation of prices on construction projects between contractors and the government. It further concedes that effective management of construction prices is vital in achieving required quality standards on time and within the client's budget. The study's principal predicate is that while governments employ numerous methods to manage financial aspects of construction, they neglect to manage or control construction tender price inflation.

Tender price upward variability in construction-sector financially outstretches governments to a point where public projects outweigh economic benefits. Focusing the government on preventing this from happening through awareness of the sources of rising construction prices is essential. Influencing construction tender prices are complex factors, not clearly understood how they interact with each other and individually. Moreover, there is an unembellished understanding of how these factors influence pricing in the construction sector. This knowledge gap has led to inaccuracies in construction sector expectations, incorrect stakeholder management and control, and poor or nonexistent construction sector pricing policies. This study bridges the knowledge gap by integrating and validating a multilevel model of Zambia's critical drivers of tender pricing.

The research investigates and measures critical factors to identify the most significant predictors of construction prices in Zambia while validating their impact. The study achieves this by identifying potential problem areas, advising on how to avoid them,

and mitigating adverse effects. Further, this study investigates the collective causes of price inflation on public sector projects by concentrating on contractors' priorities and decisions regarding project pricing. Tender price inflation is a crucial study area, for it can undermine construction sector certainty. The research study likewise identifies critical factors for preventing tender price inflation, particularly concerning ground conditions.

#### **1.4 Statement of the problem**

Construction tender price inflation threatens desirable infrastructure push in the public sector. The damaging effects of escalating tender prices outweigh the socioeconomic benefits of such infrastructure. If not addressed, this harmful effect destroys construction sector productivity, causing it to lag behind other economic sectors, thereby decreasing its value in the national economy.

#### **1.5 Research objectives**

1. To determine the impact of tender price inflation on the economic sustainability of the construction sector
2. To investigate circumstances surrounding the failure to mitigate construction tender price inflation through current interventions
3. To propose strategies for addressing public construction tender price inflation
4. To construct a model that facilitates Zambia's public construction sector productivity at beneficially predictable construction tender prices

#### **1.6 Research questions**

1. How does high tender price inflation affect the economic sustainability of the construction sector?
2. Why are current internal controls and measures failing to mitigate Zambia's construction tender price inflation?
3. What strategies can government use to address construction tender price inflation?
4. How can we address construction tender price inflation in Zambia's context?

## **1.7 Benefits to the government of Zambia**

There is little to no research on construction tender price inflation as an important area of construction economics in Zambia. Tracking statistical changes in tender price level and other related indices per annum is challenging. This significant disparity in research far underscores the importance of tender price formations and engineering estimate validations on public construction expenditure. Conceivable suggestions indicate that the government is yet to play a significant role in addressing, among other factors. This tender price inflation may be responsible for escalating price trends generally. The thesis explores and reviews how government can contribute significantly to tender pricing mechanisms and strategies for contractors executing public works. This research thus attempts to identify and analyze potential indicators of tender price trends and variables of importance.

The research also develops “Zambia’s Construction Tender Price Inflation Management Model,” which addresses Zambia’s challenges. More specifically, this research explores sector tender-pricing problems worthy of widespread public and political attention to influence sector-based policy. Therefore, this study focuses on identifying specific parameters for constructing a model for addressing the current and imminent critical tender-pricing issues in the Zambian public construction industry. Additionally, the research provides comprehensive possible future direction with pragmatic perspectives toward resolving interminable sector challenges. Tender price inflation is a pervasive problem, especially in public construction projects, since several internal and external factors are responsible for the trend. The research further models a process that assists a government in predicting tender price patterns in advance. The model helps the public sector plan for the construction workload, improving the construction market's stability.

## **1.8 Aim**

To develop a model that proposes a collective practical solution to eminent critical tender price inflation challenges regarding construction tender price inflation of public projects.

## **1.9 Research delimitations**

This research addresses specific causes of persistent construction tender price inflation in Zambia. The study relates to government construction-expenditure growth resulting from rising public construction sector output. This research, thus, identifies its respondents by narrowing down on local contractors and other construction project experts by exploring critical assumptions and their personal and professional experiences. The distinction of this research is within conditions and context that supposedly may be affected by construction tender price inflation. Therefore, this research covers all categories of local contractors to establish the government's role in addressing construction tender price inflation in the country. Second, the study involves identifying strategies and investigating challenges and assumptions contractors face during tender price formation. The assessment involves all the levels of flexibility implementation in the public construction pricing process and the provision of comprehensive future direction for the public-construction sector.

## **1.10 Research limitations**

First, the study limitations may include reliance on 'information' given by construction experts who may answer questions with some reservations for reasons of perception nature for seemingly politically insensitive questions. Such reservations may be misleading and a poor guide to determining the causes of construction tender price inflation. Second, the contractors may attempt to exaggerate or maximize their capacity to handle complex and technologically demanding public projects. Such a scenario may give a swing saw analysis on the problem matter such that the ideal condition may lead to unsettled findings. This combined scenario would affect the presentation of a detailed or highly accurate picture of the phenomena. However, conscious of this potential investigation bias, the research seeks to mitigate it by triangulating the ideas and opinions of respondents and comparing the survey data with existing documentary evidence whenever possible.

## **1.11 Bias**

The research uses documentary sources and recorded interviews to complement the survey questionnaire and minimize the problems of bias and poor recall. Documentary

data sources for the study come from various project implementation and evaluation reports, policy guidelines, minutes of meetings, and other organizational documents. This research follows proper scientific rules and procedures to reduce errors and biases and enhance the study results' reliability.

### **1.12 Operational definitions**

1. Tender price means the initial amount the client awards a construction contract to a bidder.
2. A Tender is a submission made by a bidder in response to an invitation to tender for a construction project.
3. Tender price inflation means the annual rate of increase in contract prices
4. Public Project is an infrastructure project financed, part-financed, and owned by the government.
5. Public Construction Sector means the portion of an infrastructure composed of levels of government and government-controlled institutions
6. Public Infrastructure means all state constructions for public use, developed by the government, owned and maintained by government or government-controlled institutions.

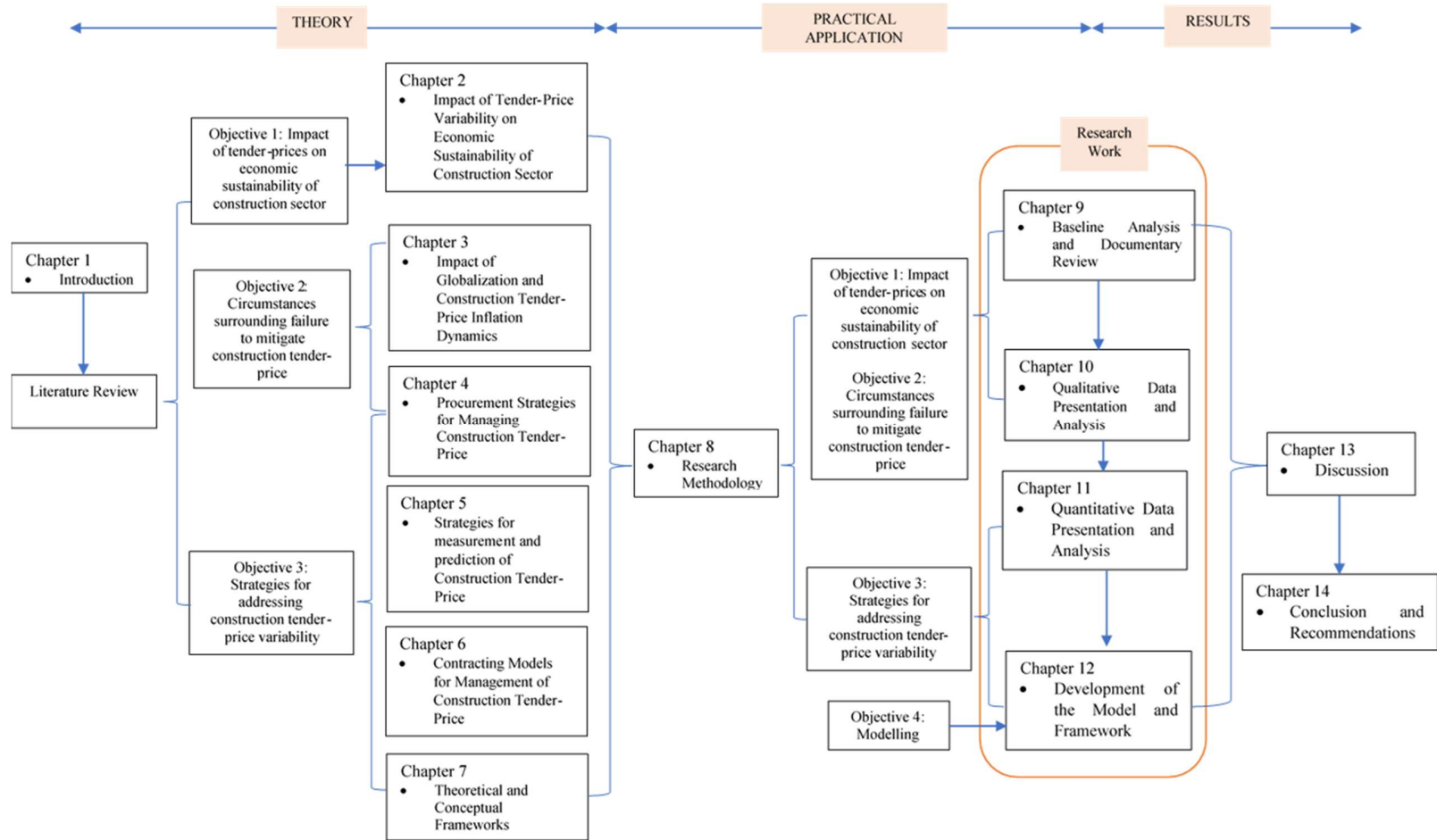
### **1.13 Ethical considerations**

Information obtained from respondents is solely for this research. Before data collection, the study seeks informed and consented permission from individual respondents. The examination ensures the protection of individual participants and any information collected against abuse of rights likely to be committed. The research is voluntary, and respondents willingly provide information collected. The study ensures that the respondents have complete knowledge concerning their information utilization. Data collection does not require providing personal details or any information that might jeopardize confidentiality considerations.

### **1.14 Structure of the thesis**

This thesis consists of fourteen chapters, and this CHAPTER is a general introduction describing the background, objectives, theories, and methodology. A summary (Figure 1.2 and Figure 1.3) of the contents of the remaining chapters includes:

1. CHAPTER 2 - CHAPTER 6 (Literature Review Chapters) includes a literature review of international construction price and cost models and strategies adopted to address price inflation globally. These Chapters reveal research gaps requiring in-depth investigation.
2. CHAPTER 7 - The chapter presents conceptual and theoretical frameworks for the study.
3. CHAPTER 8 - Details the research methodology for sampling techniques, defining the population in detail, and discussing measures for robustness and viability of the data to be collected.
4. CHAPTER 9 - Contains a baseline appraisal of construction tender price inflation in Zambia. The chapter collates the data from the documentary review and presents a case for further study.
5. CHAPTER 10 - Presents and analyzes the findings from qualitative data collection.
6. CHAPTER 11 - Presents and analyzes the findings from quantitative data collection.
7. CHAPTER 12 – Develop the public construction sector model to address construction tender price inflation and increase public infrastructure productivity conceptually.
8. CHAPTER 13 - Discusses the findings of the study
9. CHAPTER 14 - Concludes the thesis. It summarizes the significant findings, judges the critical assumptions in the developed model, discusses the limitations of the results, and suggests avenues for future research.



**Fig.1.2:** Thesis structure  
(Source: by the author)

Chapter 1	•Introduction
Chapter 2	•Impact of Tender Price Inflation on Economic Sustainability of Construction
Chapter 3	•Impact of Globalization and Construction Tender Price Inflation Dynamics
Chapter 4	•Procurement Strategies for Managing Construction Tender Price
Chapter 5	•Strategies for measurement and prediction of Construction Tender Price
Chapter 6	•Contracting Models for Management of Construction Tender Price
Chapter 7	•Theoretical and conceptual frameworks
Chapter 8	•Research Methodology
Chapter 9	•Baseline analysis and documentary review
Chapter 10	•Qualitative data presentation and analysis
Chapter 11	•Quantitative data presentation and analysis
Chapter 12	•Development of the model and framework
Chapter 13	•Discussion of results
Chapter 14	•Conclusions and recommendations

**Fig. 1.3:** Layout of Chapters  
(Source: by the author)

### 1.15 Chapter Summary

This research assumes a significant role in formulating policy for the construction industry and provides a basis for further study in the sector. This research is a reasonable basis for designing efficient financial instruments that support local contractors and ensure their timely and much-needed growth. The research elicits a pragmatic model, which promotes construction-process remodeling in the management of Zambia's construction sector. The study encourages sector linkages to economic growth and the development of reliable infrastructure.

## **CHAPTER 2: Impact of Tender Price Inflation on Economic Sustainability of the Construction Sector**

### **2.1 Introduction**

This chapter underscores the significance of adopting sustainable construction practices to sustainable development by focusing on strategies and sustainability challenges faced in the construction sector. The areas of interest for this research included exploring principles, investigating drivers, understanding implementation barriers, and examining sustainable strategies for sustainable construction. The chapter identifies critical factors for achieving economic sustainability in the construction sector of developing countries. According to Uttam (2014), implementation strategies for sustainability in construction include:

1. Strategic and project-level environmental impact assessments
2. Adoption of green public procurement
3. Improving stakeholder coordination

Most recently, Mjakuškina et al. (2019) found contributing factors of high significance to the provision of high-quality work as well as ensuring sustainable project supervision to include:

1. Enhancing collaboration between project stakeholders
2. Adoption of new technologies
3. Developing internal control systems
4. Developing industry-wide technology management capacities (Yilmaz & Bakis, 2015)

Construction-sector sustainability is increasingly important in developing countries, and threats of globalization amid construction tender price inflation require immediate action. In Zambia, construction plays a crucial role in development and has significant implications for resource utilization; hence specific measures alleviating challenges associated with sustainable construction become crucial-general arguments for good industry practice. In this study, construction tender price inflation accentuates sustainable construction practices: while global trends emphasize a sustainable

construction approach triggered by rapid economic growth and augmented environmental impact considerations (Plank, 2008; Hill & Bowen, 1997).

## **2.2 Economic principles of sustainable construction**

Among the principles of sustainable construction and particular interest to this study is Hill and Bowen's (1997) economic pillar. The listed elements influencing economic sustainability in construction include (p. 28):

1. Ensuring financial affordability of construction
2. Utilization of full-cost accounting and real-cost pricing during bidding

Hill & Bowen (1997) identify four pillars associated with sustainable construction: economic, technical, social, and biophysical sustainability (Table 2.1). They argue for the prominence of adopting real-cost pricing mechanisms to achieve equitable development and resource utilization. Lowe et al. (2003) present sustainable construction's economic, social, technical, and environmental dimensions. They further argue that most research fails to account for the economic extent and related concepts. Due to the business nature of the construction sector, they say that it is crucial to emphasize an economic view of construction sustainability and set underlying economic principles thereof, which include:

1. Long-term benefits
2. Value for money
3. Stakeholder partnerships

According to Lowe et al. (2003), challenges associated with economic sustainability construction and influencing sustainable business implementation in the sector include:

1. Higher capital costs
2. Lack of accurate cost information
3. Unreliable long-term profits
4. Invincible market value

Similarly, Akadiri et al. (2012, p. 131) highlight the significance of incorporating objectives and strategies addressing construction tender price, "initial cost or purchase cost," when implementing construction sustainability principles. They argue the

approach is critical to sustainable construction because it improves sector productivity, ensures stakeholder satisfaction, increases cost predictability, ensures lower project cost, provides the best value for clients, and focuses on developing the client's business. Akadiri et al. (2012) concentrate on dimensions of sustainable construction only economical, social, and environmental. At the same time, Hill and Bowen (1997) included technical and biophysical measurements. Similarly, Oke et al. (2019) defined sustainable construction through ecological principles. Ecological principles come about environmental sustainability.

On the other hand, Zhong & Chen (2011) presented a different principle of cultural sustainability and drew similarities between lean construction and sustainable construction principles. They argue that lean construction is pivotal in sustainable construction task management. Principles of sustainability in Table 2.1 form a framework for implementing sustainable practices in construction by guiding construction processes and decision-making. Sustainability principles are multi-disciplinary encompassing features that create a competitive advantage for the sector.

**Table 2.1 Principles of sustainability**

Author (yr)	Focus	Principles of sustainability
Hill & Bowen (1997); Sabeke (2008)	Environmental protection	Social, technical, economic, environmental, biophysical
Al-Yami & Price (2006)	Resources utilization	Tripple-bottom-line (Environmental, social, economic)
Zhong & Chen (2011)	Lean construction concepts	Social, ecological, cultural, and environmental
Akadiri, et al. (2012)	Resource conservation and cost efficiency	Tripple-bottom-line (Environmental, social, economic)
Esezobor (2016)	Policy reforms	Tripple-bottom-line (Environmental, social, economic)
Lim et al. (2019)	Quantity Surveying	Process-oriented approach, Social, technical, economic, biophysical
Grierson & Moultrie (2011)	Sustainable architectural design	Tripple-bottom-line (Environmental, social, economic)
Salama & Hana (2018)	Environmental protection	Tripple-bottom-line (Environmental, social, economic)
Isa et al. (2014)	Sustainable building	Environmental, social, economic, and design and innovation

(Source: by the author)

Successful construction project management is significantly affected by the detail in direction through a planning process (Alias, et al., 2014). All sustainability principles are integrated at the project's planning stage by including various stakeholder

perspectives. With the advent of climate change issues and fiscal-resource limitations in most third-world countries, there is a need to consider measures accounting for applying economic principles of sustainability.

### **2.3 Economic drivers of sustainable construction**

While applying sustainability principles and concepts, prioritizing discussion on benefits associated with cost reduction strategies at the early stages of construction project management is paramount. This process allows timely consideration of resource conservation while enhancing construction attributes to eliminate unnecessary costs and client satisfaction (Nasereddin & Price, 2021). Oke et al. (2019) noted that the construction industry's impact on the national economy is worrying despite its fundamental potency for development and growth. The concern arises from a failure to incorporate cost-reduction measures and financial incentives orchestrated by the government while adopting sustainable construction practices (Shi, et al., 2013). In addition, Dosumu & Aigbavboa (2021) consider construction cost the most significant variable in adopting sustainable construction practices. They further observe that sustainability discourse focuses more on environmental than economic benefits, thereby slowing the adoption of sustainable construction practices in weak economies.

Alattiyh et al. (2019) advance financial performance drivers for construction projects, which ascertain maximizing cost efficiency and achieving cost certainty significant to construction sustainability. The monetary savings through reduced procurement and implementation costs constitute and define economic sustainability in the construction sector (Dosumu & Aigbavboa, 2021). Ekung et al. (2021) affirm that cost-reduction strategies to facilitate the adoption of sustainable construction remain fundamentally unsound and ineffective. They developed a framework that proposes adopting procurement practices such as using collaborative contract forms, integrating supply chains, employing sustainability qualification recruitment, competitive process selection, fixed price contracting, and single-point responsibility for cost reduction. Zulu et al. (2022) approve focusing measures for improving sustainable construction on regulatory, economic, and cost-related interventions. Table 2.2 summarizes the

drivers of sustainable construction from the literature review. Implementation barriers to sustainable construction

Economic and cost-related barriers prevent the effective implementation and adoption of sustainable construction (Zulu et al., 2022; Durdyev et al., 2018; Munyasya & Chileshe, 2018; Ohiomah et al., 2019). These factors include a lack of government incentives, financial incentives (Serpell, et al., 2013), higher initial costs, etc. The higher initial cost is the main economic barrier to sustainable construction (Lim et al., 2019; Zulu et al., 2022). Toriola-Coker et al. (2021) affirm that barriers to sustainable construction include affordability issues synonymous with a general perception of higher cost or expensive buildings. Therefore, developing methods by generating local, lowering construction costs, and increasing mass production economies of scale is fundamental for enhancing sustainable construction (Moghayedi, et al., 2021). Furthermore, Serpell et al. (2013) argue that critical factors to sustainable construction include economic conditions specific to a country and traditional practices associated with its construction industry. Meaning each country should develop condition-specific measures and methods of addressing sustainability-construction challenges.

On the other hand, Häkkinen & Belloni (2011) underscores the need to set measurable targets during requirement setting, tendering, and procurement processes. They argue that procurement tools, methods, information, and techniques hinder sustainable construction. At the same time, Krechowicz (2022) finds a conservative approach with no action strategy to problem solving to be some of the main barriers to sustainable construction. Similarly, Brooks & Rich (2016) note that different perspectives of multiple states and stakeholder decision-making influence sustainable construction efforts. They further argue for the sustainable construction modification of existing country-specific procurement construction practices rather than introducing fundamental transformations. Long et al. (2021) affirm public infrastructure management systems exhibit certain complexities and dynamism due to external influences; therefore, integration and enhanced interaction of general internal elements are the fundamental driving force to promote sustainable construction behavior.

At present, Khalfan et al. (2015) found at least 60% positive perceptions among contractors regarding efforts addressing economic aspects of sustainable construction. They conclude that financial incentives to clients and contractors and overall government implementation policy are critical to sustainable construction. Table 2.3 discusses literature findings regarding barriers to implementing sustainable construction practices.

**Table 2.3 Barriers to the implementation of sustainable construction**

Author	Country	Barriers
Bahidrah & Korkmaz (2017)	Saudi Arabia	<ul style="list-style-type: none"> <li>• Lack of awareness</li> <li>• Lack of lean construction training</li> <li>• Lack of top management support</li> </ul>
Lim et al. (2019)	Australia	<ul style="list-style-type: none"> <li>• Inadequate understanding of sustainable construction</li> <li>• Insufficient awareness and practice of the five principles of sustainable construction</li> <li>• The culture of the construction industry</li> <li>• Attitudes of clients</li> <li>• High initial investment costs</li> <li>• Lack of sustainable measurement tools</li> <li>• Lack of building codes on sustainability</li> </ul>
Chang (2016)	China	<ul style="list-style-type: none"> <li>• Lack of adequate awareness of sustainable development</li> <li>• A lack of consideration of the social and economic dimensions of sustainable construction</li> <li>• Ineffectiveness of some policies</li> <li>• Weak practices toward environmental sustainability</li> <li>• Variability in strategic sustainability behaviors among contractors</li> </ul>
Said et al. (2011)	Malaysia	<ul style="list-style-type: none"> <li>• Lack of awareness</li> <li>• Lack of proper enforcement mechanisms</li> <li>• Inadequacies in legislature</li> </ul>
Marsh et al. (2020)	South Africa	<ul style="list-style-type: none"> <li>• Social-cultural barriers</li> <li>• Economic barriers</li> <li>• Technological barriers</li> <li>• Stakeholder barriers</li> <li>• Political barriers</li> </ul>
Ogunbiyi et al. (2011)	United Kingdom	<ul style="list-style-type: none"> <li>• Prevalent use of the theory of construction</li> <li>• Business strategies that lack lean construction implementation</li> </ul>
Willar et al. (2021)	Indonesia	Implementation constraints of sustainable principles
Samari (2012)	Iran	
Anzagira et al. (2021)	Ghana	Lack of awareness
Serpell et al. (2013)	Chile	<ul style="list-style-type: none"> <li>• Lack of financial incentives</li> <li>• Lack of integrated design</li> <li>• Affordability issues</li> </ul>
Elmualim & Alp (2016)	Cyprus	<ul style="list-style-type: none"> <li>• Lack of government policy</li> <li>• Lack of interlink with international construction</li> </ul>

Author	Country	Barriers
Oyewobi et al. (2017)	Nigeria	<ul style="list-style-type: none"> <li>• Lack of awareness</li> <li>• Lack of government commitment</li> <li>• Integrating and implementing sustainability issues</li> </ul>
On & Techapeeraparnich (2021)	Cambodia	<ul style="list-style-type: none"> <li>• Lack of support mechanisms for investors</li> <li>• Lack of government incentives</li> <li>• High investment cost</li> <li>• Lack of government commitment</li> <li>• Lack of responsible authority</li> <li>• Lack of government coordination and legislation</li> <li>• Negligent implementation</li> <li>• Lack of sustainability strategy</li> <li>• Lack of availability of sustainable materials</li> </ul>
Ametepey et al. (2015)	Ghana	<ul style="list-style-type: none"> <li>• Cultural resource resistance</li> <li>• Lack of government commitment</li> <li>• Higher investment cost</li> <li>• Lack of professional knowledge</li> <li>• Lack of legislation</li> </ul>
Zuofa & Ochieng (2017)	United Kingdom	Failure to embrace sustainability practices and initiatives
Enshassi & Mayer (2005)	Palestine	<ul style="list-style-type: none"> <li>• Lack of knowledge</li> <li>• Lack of training</li> <li>• Lack of legislation</li> <li>• Tendency to resist modern construction methods</li> <li>• Resistance to change legislation</li> <li>• Reluctance to try new ideas</li> <li>• Reluctance to adopt innovative technologies</li> </ul>
Zhou & Lowe (2003)	United Kingdom	<ul style="list-style-type: none"> <li>• Higher capital cost</li> <li>• Lack of accurate cost information</li> <li>• Unreliable long-term profits</li> <li>• Invisible market value</li> </ul>
Uttam (2014)	Sweden	<ul style="list-style-type: none"> <li>• Requirement of a high level of corporation among project stakeholders</li> <li>• Lack of coordination between project planning and implementation</li> </ul>
Pradhananga et al. (2021)	Venezuela	<ul style="list-style-type: none"> <li>• Corruption</li> <li>• Inflation</li> <li>• Lack of environmental awareness</li> </ul>

(Source: by the author)

## 2.4 Sustainable construction initiatives

Approaches and initiatives to enhancing sustainable construction vary according to prevailing circumstances and aspirations of a government. While others will take more hesitant practices to attain their objectives of the construction sustainability movement, others will elect more controversial ones. Conversely, employing various economic tools and incentives is the most supported policy initiative (Circo, 2007). Addressing affordability issues through incentives and advancing public policies and regulations

is paramount for boosting the profitability and competitiveness of the sustainable construction agenda (Pitt, et al., 2009). Díaz-López et al. (2021) confirm critical factors or drivers for supporting sustainable construction include those strategies related to financial and government interventions.

However, Myers' (2005) findings indicate that not all contractors positively embrace sustainable construction agenda, further complicating its implementation. Henceforward, few construction contractors are willing to change their business paradigm towards embracing sustainable construction. Arguably, Kibwami & Tutesigensi (2016) observe that it is much easier to adopt measures promoting environmental sustainability than economic sustainability since the traditional interpretation of sustainable construction is characteristic of environmental protection. Taylor & Norval (1994) contend that the main challenge in all African countries is modeling construction systems and activities based on norms and practices with little or nothing to do with local experience. Similarly, Adebayo (2014) urges the adoption of procurement systems focused on addressing macroeconomic issues and country-specific developmental needs.

Table 2.4 summarizes various initiatives adopted for implementing sustainable infrastructure construction activities as gathered from the literature review. Major economic sustainability initiatives include minimizing construction costs to support the local economy (Whang & Kim, 2015). Other approaches involve migrating traditional construction approaches to more modern ones, the involvement of contractors in procurement through competitive dialogue procedures, and creating incentives to address the high initial investment cost (Esezobor, 2016). The literature agrees on the need to generate more action and strategies for enhancing the adoption of sustainable construction through developing appropriate standards, regulations, and public policies.

**Table 2.4 Initiatives for implementing sustainable construction**

<b>Author</b>	<b>Country</b>	<b>Initiatives</b>
Willar & Pangemanan (2019)	Indonesia	<ul style="list-style-type: none"><li>• Establishing cooperation among parties</li><li>• Determining the method of project delivery system</li><li>• Equating vision of sustainability for all stakeholders</li><li>• Developing the criteria for sustainable infrastructure design</li><li>• Using technically, environmentally, socially, and economically competent contractors</li><li>• Identifying sustainable construction materials</li></ul>
Al-Yami & Price (2006)	Saudi Arabia	<ul style="list-style-type: none"><li>• Shifting stakeholder thinking from cost to value</li><li>• Implementing long-term thinking over short-term</li></ul>
Whang & Kim (2015)	South Korea	<ul style="list-style-type: none"><li>• Reducing life-cycle cost</li><li>• Minimizing construction cost</li><li>• Minimizing operation and maintenance issues</li><li>• Supporting local economy</li><li>• Ensuring commercial viability</li></ul>
Tafazzoli (2018)	United States of America	Creating incentives to address the high initial investment cost
Esezobor (2016)	Nigeria	<ul style="list-style-type: none"><li>• Reducing the traditional focus on economic values to more inclusive socio-environmental values</li><li>• Migrating traditional constructions practices to modern approaches</li><li>• Improving awareness</li><li>• Renewing thinking</li><li>• Developing the capacity to support sustainable construction</li></ul>
Khalil (2018)	Libya	<ul style="list-style-type: none"><li>• Increasing awareness and adoption of sustainable practices</li><li>• Changing understanding of the role of construction in national development</li><li>• Focusing education and training on the benefits of sustainable construction</li><li>• Ensuring functional application of legislation</li><li>• Ensuring leadership commitment</li><li>• Improving the ability to support sustainable construction</li></ul>
Zhou & Lowe (2003)	United Kingdom	<ul style="list-style-type: none"><li>• Developing a green market in the built environment</li><li>• Developing a clear sustainable strategy for construction</li></ul>
Uttam (2014)	Sweden	<ul style="list-style-type: none"><li>• Emphasizing the significant role of procurement</li><li>• Inter-linking impact assessment and green public procurement</li><li>• Involving contractors in procurement through a competitive dialogue procedure</li><li>• Incorporating sustainable values in public procurement decisions</li></ul>

(Source: by the author)

## **2.5 Macroeconomic and procurement bottlenecks in the construction industry**

According to Cheelo & Liebenthal (2020), critical bottlenecks in construction include macroeconomic, firm, and industry-wide ones. They observe that macroeconomic bottlenecks directly impact the cost of construction. Macroeconomic barriers include heightened inflation, exchange rate issues leading to the collapse of local currency, high-interest rates (cost of borrowing), a high price in the construction sector, and unsustainable high levels of public debt (Kirchberger, 2020). These macroeconomic bottlenecks integrate and participate in slowing demand for large public infrastructure projects. Cheelo & Liebenthal (2020) affirm that macroeconomic bottlenecks can significantly slow down the construction sector stimulated by public expenditure.

Similarly, Kikwasi & Escalante (2018) identify construction-sector performance hindrance constraints, including inefficient procurement systems, public-sector financial mismanagement, unfavorable donor conditions, and inappropriate project delivery practices. In addition, countries with higher corruption levels exhibit a 15% higher construction cost (Collier, et al., 2015). Table 2.5 summarizes a literature review regarding recommendations for addressing key construction industry bottlenecks. Mafini & Pillay (2017) states that significant bottlenecks in the construction industry are procurement-related challenges such as ineffective procurement practices and systems, supply chain management issues, and construction industry structure. They emphasize challenges including pandemic-induced supply disruptions (Rees & Rungcharoenkitkul, 2021), lackluster procurement approaches, continued tactical procurement mentality, inadequate information sharing, inefficient decision-making, rising costs, fixation on traditional practices, lack of new ideas and strategic thinking, etcetera. Further, they propose interventions to these constraints, which include enhancing strategic sourcing in procurement, initiating a paradigm shift in procurement processes, and embracing supply chain integration. Other interventions include governance and policy reform approaches that introduce incentives, create international price benchmarking, simplify procurement systems to support information and participation symmetries, implement cost-deescalation measures,

contract to unbundle, and update local content strategy (Cheelo & Liebenthal, 2020; Thwala & Mvubu, 2009; Aigbavboa, et al., 2018; Zidane, et al., 2015; Dlungwana & Rwelamila, 2014).

Kirchberger (2020) determines characteristics of poorly managed construction sectors as high prices and low-level output for a given level of expenditure. The study first notes that low capacity among local contractors, limits local content, stifles local employment generation, and enhances foreign-firm contracting for construction services. Secondly, that dependence on external financing for infrastructure development increases external influence on procurement and construction processes, resource-availability infrastructure demand, and reliance on political factors. The study affirms that higher construction costs negatively affect the construction sector by reducing the amount and affordability of infrastructure, affecting project selection criteria, reducing expenditure, and lowering the expansion ability of the construction sector. Procuring contractors through national and international competitive bidding harms local suppliers and contractors who fail to comply with terms, conditions, and other specifications (requiring experience in similar works). Lack of access to finance (Cheelo & Liebenthal, 2020) disadvantage local contractors, primarily on price-based contract awards.

Recommended interventions for construction bottlenecks are wide-ranging. Some notable ones include Kirchberger's (2020) proposal to implement smaller-sized time-related contracts, which guarantee the growth of and steady workflow to local mid-size contractors. Others include ensuring economic control of the project at the conception stage and enhancing and motivating positive stakeholder involvement early. Possible interventions from the literature include boosting committed leadership, supporting a cost-reduction-driven agenda (Kirchberger, 2020), improving procurement and project processes (Kikwasi & Escalante, 2018), and improving risk management systems, etcetera.

## **2.6 Chapter discussion**

The government must understand factors for sustainable-construction success and manage sustainable construction by integrating stability, resilience, and adaptability

dimensions (Schilling, et al., 2018). The success of sustainability approaches in construction depends on individuals' and groups' actions as they define dynamic structures, processes, and system functions. Sustainable construction is dependent on three specific aspects:

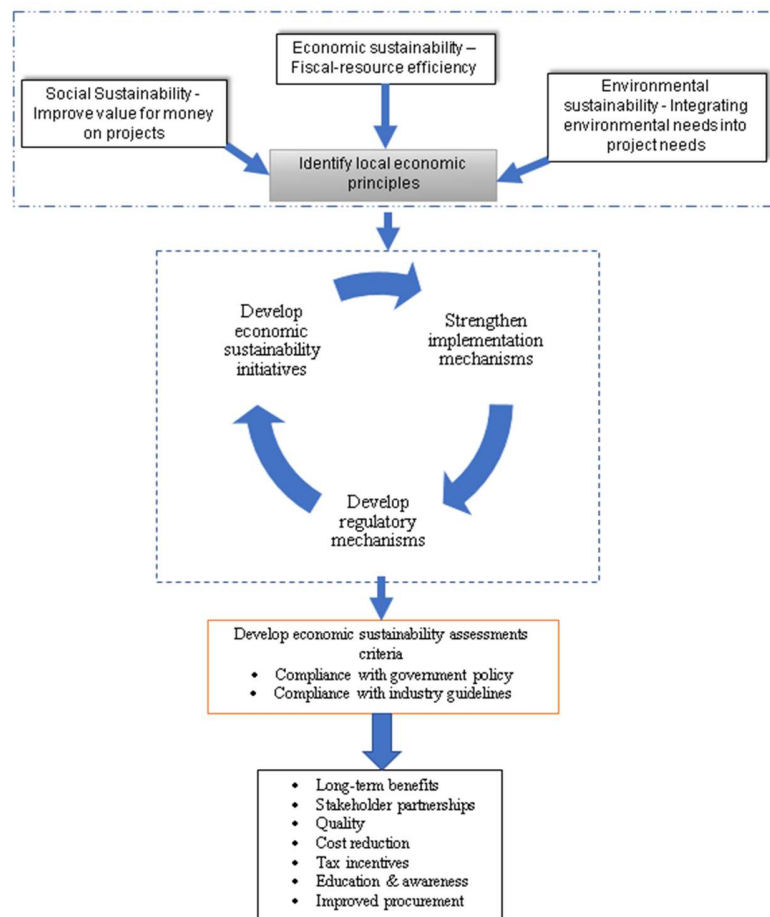
1. drivers for sustainable construction
2. resistance or barriers to sustainable construction
3. initiatives for achieving sustainable construction

These two aspects are critical in defining how much the system must change over a given period and the process requirement of change toward sustainability practices. In some cases, the change process could be radical and disruptive, while in others be subtly incremental and smooth (Plummer & Van Poeck, 2021). Sustainable construction assists in generating improvements in procurement ways consistent with advancing development by integrating social and environmental well-being. One significant component, however, of sustainable construction lies in developing local strategies informed by regional scenarios. The process requires understanding country-specific sustainability challenges followed by appropriate policy and regulatory changes. Hence, the state's role in designing and developing appropriate policy mixes in the construction-sector context must be emphasized (Söderholm, 2020).

Literature shows that most sustainability approaches are not sector-driven or country specific and instead concentrate on attempting to respond to extraordinary grand challenges such as climate change, poverty, degradation, etcetera. Markard et al. (2020) confirm that sustainability challenges are often associated with broader governance issues requiring vertical and horizontal alignments between multiple sectoral policies. These alignments may require a more interventionist approach considering various interventions such as regulating business, developing novel systems, reorienting public-economic activities, reorienting cultural and political power, and establishing a more decisive role of government in shaping market sectors. Through a literature review, the study developed an inference flowchart appropriate for enhancing economic sustainability considerations in the construction sector (Figure 2.1).

This interventionist approach requires an understanding of context-specific sustainable construction principles. The flowchart summarizes three practices required to domesticate investigation and navigate challenges associated with sustainable construction. These approaches allow the possibility to generalize solutions to facilitate and accelerate the implementation of context-specific sustainability practices:

1. identify local economic principles that drive sustainable construction
2. utilize an understanding of context-specific barriers to developing practical strategies, and
3. develop sustainability assessments to ensure compliance with sector policy and regulation



**Fig. 2.1:** Inference flowchart for developing economic sustainability in construction  
 Source: (Hill & Bowen, 1997) (Lowe, et al., 2003; Akadiri, et al., 2012; Al-Yami & Price, 2006; Oke, et al., 2019; Zulu, et al., 2022; Díaz-López, et al., 2021). By Author based on literature review.

## 2.7 Chapter Summary

Literature confirms sustainable construction is fundamental to national development. The chapter has reviewed the literature to highlight drivers and barriers to sustainable construction, including cost reduction necessities. However, the literature reviewed in this affirms that to achieve benefits from sustainable construction, policymakers and government need to:

1. improve upfront planning and less bureaucracy
2. better competencies among project members
3. ensure more effective use of resources
4. ensure better project control and
5. enhance project delivery structures

This study identifies knowledge and application gaps following this literature review, summarized as follows:

1. While most literature systematically examines drivers and barriers to sustainable construction, they neglect to underscore initial cost or contract costs (tender price) as a fundamental economic barrier or driver to sustainable implementation of public projects. Therefore, they have not entirely delved into leveraging firms' meaningful influence on the final price of construction contracts and corresponding impacts on the sustainability push.
2. Despite numerous literature on sustainable construction, sustainability principles have little application within the construction sector. This trend arises because solutions offered are often broad and not context specific. Therefore, present missing or insufficient country or sector-specific information limits the ability for practical adoption. This scenario limits the decision-maker's ability (policy-makers, contractors, consultants, etcetera) to make intelligent and efficient decisions in diagnosing causes of procurement-dependent construction project failure.

## **CHAPTER 3: Impact of Globalization and Construction Tender Price Inflation Dynamics**

### **3.1 Introduction**

The purpose of this chapter is threefold. The first is to investigate, through a literature review, the indicators of globalization in the construction sector (Table 3.1). The second intention is to evaluate the empirical impacts of globalization on construction with a focus on the derivation of bid price and overhead costs (Table 3.3). Thirdly, the study intends to separate the contributions of foreign direct investment (FDI) to global integration in construction. The chapter also aims to investigate the role of FDI in construction. Literature in the construction sector shows that FDI is responsible for making the construction industry more (Valence, 2002);

1. Global
2. De-regulated
3. Open
4. Competitive

Correspondingly, literature findings show that key drivers of globalization include (Naz & Ahmad, 2018, p.147):

1. Human capital
2. Labor
3. Capital
4. Transportation and communication, and
5. Financial index

### **3.2 Infrastructure: The missing link in the globalization**

Government must establish reliable estimates and schedules for justifying a construction project on economic grounds and means of financing. Infrastructure project that is considered too expensive loses their economic justification (Stasiak-Betlejewska & Potkány, 2015). The construction industry is critical in the economy by providing demand for products and services from other economic sectors and assisting in achieving national socio-economic development. Optimally, construction

influences every sector of the economy; hence, the industry is likewise one of the many driving factors of economic growth (Oladinrin, et al., 2012). The construction sector can create employment and enhance economic efficiency, meaningfully contributing to a country's gross domestic product (GDP). Wobowo (2009) argued that governments often manage their economies through construction to display funding availability and back up their decisions. Stasiak-Betlejewska & Potkány (2015) agree that infrastructure development is always affected by funding availability associated with technological, social, and economic aspects being indices of globalization and sustainability (Table 3.1).

**Table 3.1 Globalization indicators in construction**

Indicator(s)	Author
<ul style="list-style-type: none"> <li>• Foreign Direct Investment (FDI)</li> <li>• Foreign workers</li> <li>• Economic openness</li> <li>• Capital intensity</li> </ul>	Rahmah, et al. (2012)
<ul style="list-style-type: none"> <li>• Material development</li> <li>• Project documentation and procedures</li> <li>• Technology</li> <li>• International companies</li> </ul>	Ofori (2000)
High-rise or tall buildings (Increased construction activity)	Gültekin (2017)
<ul style="list-style-type: none"> <li>• Economic reforms</li> <li>• Economic adjustment policies</li> <li>• Structural adjustment programs</li> <li>• Economic stabilization programs</li> </ul>	Onyeonoru (2003)
<ul style="list-style-type: none"> <li>• The dominance of market forces</li> <li>• Free market economy</li> <li>• Trade liberalization</li> <li>• Currency devaluation</li> <li>• Public sector structural reforms</li> <li>• Privatization</li> <li>• Democratization</li> </ul>	Anugwom (2007)
<ul style="list-style-type: none"> <li>• Economic dimension</li> <li>• Social dimension</li> <li>• Political dimension</li> </ul>	Gygli, et al. (2019)
<ul style="list-style-type: none"> <li>• GDP</li> <li>• GDP per capita</li> <li>• International Organizations</li> <li>• Peacekeeping missions</li> <li>• Embassies</li> </ul>	Kudrle (2004)
International migration	Kahanec & Zimmermann (2008)

(Source: by the author)

### **3.3 Impact of globalization on the construction sector**

Literature shows that the impacts of globalization are numerous (Table 3.3 and Figure 3.3) yet measurable and monitored using dynamic linear models. However, to improve the forecast performance, there is a requirement to include information about the external environment since globalization tends to diminish or deteriorate the accuracy of traditional domestic macroeconomic models (Reklaite, 2016). Despite the positives of globalization, Pettinger (2019) notes the ever-present argument that globalization gives more power to foreign firms to monopolize the local industry and charge high prices. In addition, higher levels of globalization do not automatically translate into higher quality, which relates to business tax revenues (Potrafke, 2015). He further argues that economic globalization positively correlates to government spending, while social and political globalization negatively correlates to government spending in sub-Saharan Africa.

According to Gygli et al. (2019) KOF globalization index, the least globalized regions include Africa and Asia (Figure 3.4). According to this index and literature findings by Potrafke (2015), globalization has promoted:

1. Economic growth
2. Gender equality
3. Improved human rights

However, Gygli et al. (2019) argue the urgent need to investigate and re-examine other significant consequences of globalization. They aim to understand why globalization proceeded more rapidly in countries such as Zambia than others (Fig. 3.4). In 2018, the then-president of the United States, Mr. Donald Trump, initiated tariff wars to push back on some “negative” effects of globalization. The same year, the United Kingdom and the European Union successfully negotiated a withdrawal agreement, “Brexit.” All these constitute the need to measure and investigate the effects of globalization in more detail (Gygli, et al., 2019). However, the most important is to be specific when believing that globalization is dis-equalizing. By undertaking and observing its negative impacts, while it may be a bad idea for one sector, it certainly may be an

excellent idea for another. Adjusting and optimizing globalization in every industry toward sustainability is fundamental (Martens, et al., 2010).

### **3.4 Problems of globalization for developing countries**

Importantly, it is crucial to note that globalization affects different countries differently. Therefore, to quantify and qualify the impacts of globalization (Table 3.3) on a specific country, there is a need to describe other issues related to globalization, which Martens et al. (2014) highlight include:

1. The dimension of globalization
2. The measurement of globalization (the focus and unit of measure)
3. Country specific variables

Gygli et al. (2019) agree that globalization indices begin to differ and take a more country-specific shape when you focus on its measurement and a country's policies, resources, institutions, and conditions. Since the main globalization feature is its supra-territoriality, measuring it nationally suggests that it erodes national borders and reduces the importance of “economically small states” (Scholte, 2008). Martens et al. (2014) argue the importance of measuring globalization at a national level because national governments shape and affect the globalization process, and the data available is highest at the national level. Therefore, Gygli et al. (2019) categorize globalization (Table 3.2) to try to resolve some conflicting issues and areas of confusion. KoF Globalization Index (KOFGI) differentiates between de facto and de jure globalization, such as:

1. De facto globalization measures actual international flows and activities and
2. De jure globalization measures national policies and conditions

Bataka (2019) researched globalization and economic growth in sub-Saharan Africa and found that de jure globalization fostered economic growth while de facto globalization undermined it. The research notes some problems with globalization, which include:

1. Failure to compete as they face higher costs in developing their manufacturing industries

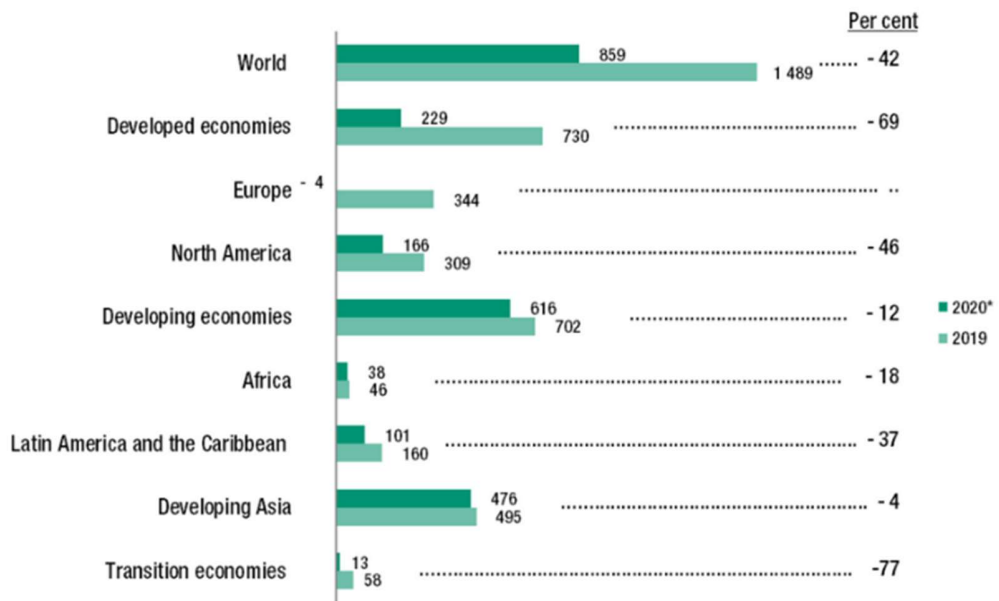
2. Loss of economies of scale due to cheap imports
3. Little scope for economic growth
4. De-industrialization as multinationals force out local competition
5. Highest skilled labor leaving for developed countries

While Yates (2007) and Thomas (2020) found that obstacles to globalization in the construction environment included;

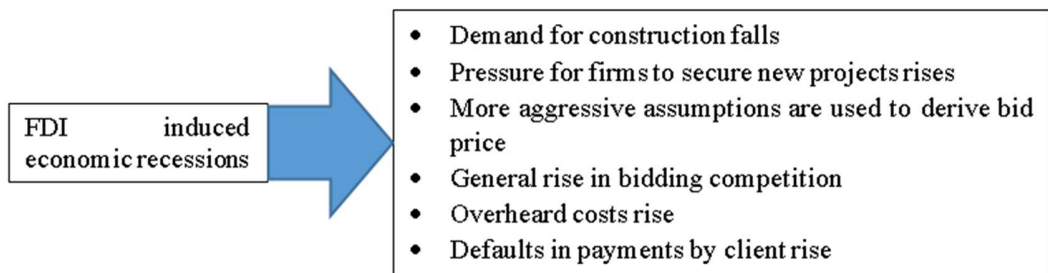
1. Language barriers
2. Cultural misunderstandings and
3. Variations in technical education

### **3.5 Globalization and economic recession**

Globalization caused the 2008 global economic recession, driving sharp economic contraction in international capital flows in 2009 (Kose, et al., 2020). Like in construction, multinational corporations (MNCs) are the primary carriers of economic globalization, thereby organizing their operations and activities according to the principle of profit maximization and reshaping national macroeconomic mechanisms (Shangquan, 2000). Shangquan (2000) agrees that developed countries are more dominant in globalization. Despite a developed-country-concentrated global foreign direct investment collapse of 20% (falling from \$1.5 trillion in 2019 to an estimated \$859 billion), Africa's FDI (Figure 5.1) in the world largely remained insignificant (UNCTAD, 2021). However, Kolodko (2001) argues that emerging market economies could catch up with the more advanced industrial economies in several generations in the broader globalization setting. De Marchi et al. (2013) found that global competition threatened local industries disrupting local economic growth if local firms did not integrate internal factors such as structural characteristics and specific business strategies. At the same time, Kahler (2013) found that despite the severity of the 2008 economic crisis, existing institutions of the global corporation became even more vital as they rebalanced their internal formulas for global influence aimed at increased policy coordination, surveillance, and financial regulation. As for the emerging economies or developing countries, the impact of the globalization-induced-economic-crisis where too significant (Figure 3.2).



**Fig. 3.1:** FDI inflows by region, 2019 and 2020 (billions of US dollars)  
(Source: UNCTAD, 2021)



**Fig. 3.2:** Impact of economic recession on the construction sector  
(Adapted from Pheng & Hou, 2019, p. 46)

**Table 3.2** Dimensions of globalization

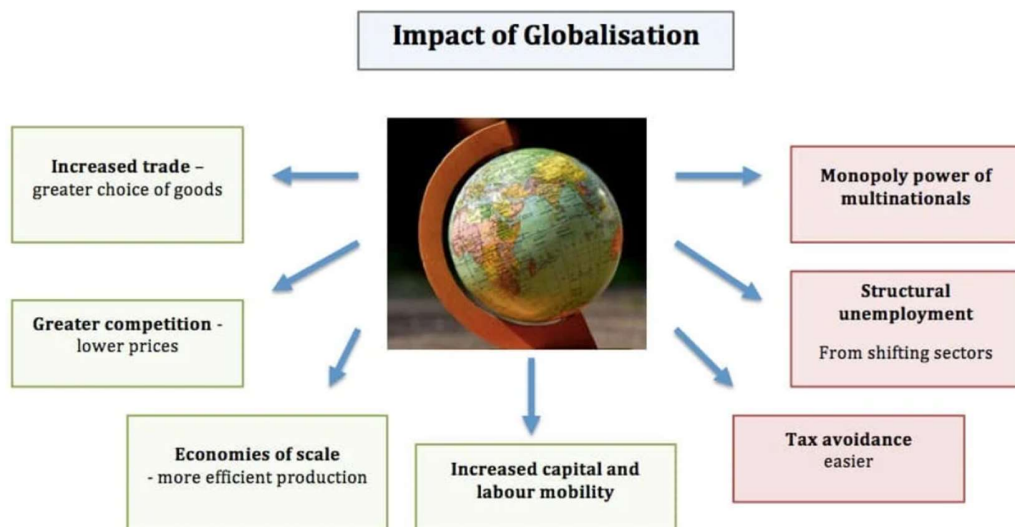
<b>Dimension</b>	<b>Type of globalization</b>	<b>Description</b>	<b>Author</b>
Social globalization	Interpersonal globalization	Global influence on social changes and interpersonal relations	Pawiak (2011)
	Informational globalization	Intensification of global links and modes of interaction	Lawlor (2007)
	Cultural globalization	Spread of values and standards of rationalism around the world	Raab et al. (2008)
	Technological globalization	Increase in technology exchange and increased skill level of IT workforce	Mayer (2000)
	Ecological globalization	the global level of environmental awareness and rationalized consumption	Ilić & Hafner (2015)
Economic globalization	Trade globalization	Openness to trade often reflected as a percentage of GDP	Gygli, et al. (2019)
	Financial globalization	Worldwide interconnectedness of capital markets	Castells (1999)
Political globalization	Military globalization	Globalized international systems into defense policy and military activity and operations	Tangredi (2003)
	Democratization	The global spread of democratic politics across countries	Nayyar (2015)

(Created by the author based on Gygli et al., 2019, p. 550)

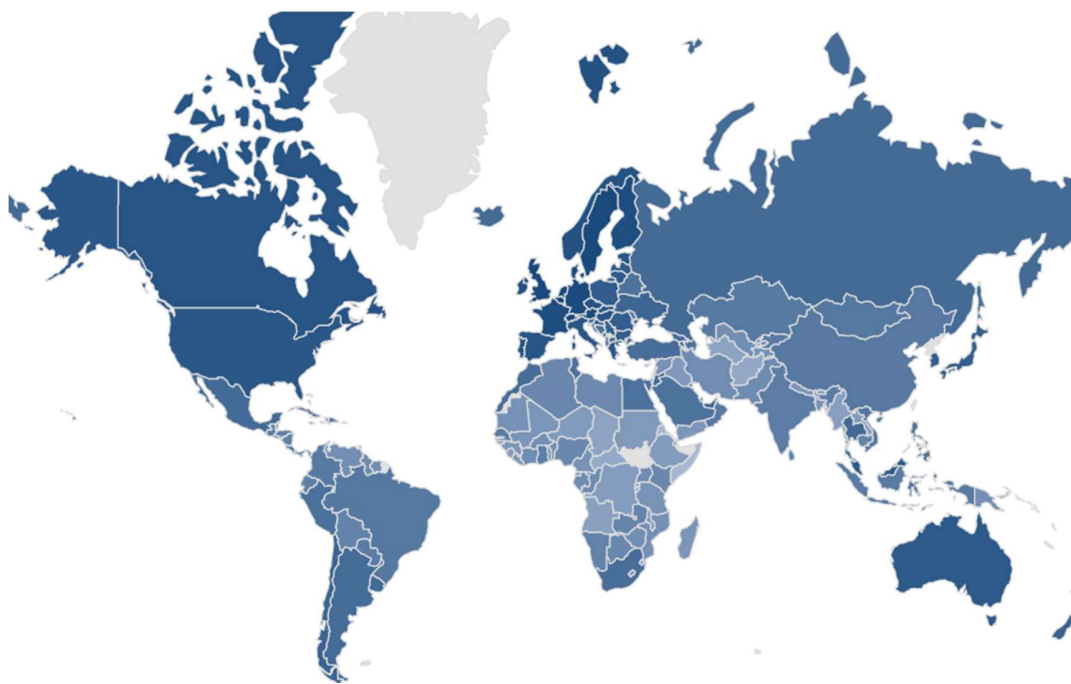
**Table 3.3 Impact of globalization on the construction sector**

Impact(s)	Author	Observation	Response
<ul style="list-style-type: none"> <li>• Reduction of barriers</li> <li>• Development of technologies</li> <li>• Adaptation of competitive strategies by local companies</li> </ul>	Katerina & Aneta (2014)	Possibility of premature intrusion into the domestic market to destabilize or suppress local competitors	Local companies can strategize to improve their competitive position
<ul style="list-style-type: none"> <li>• Political changes</li> <li>• Social and environmental changes</li> <li>• Increased economic activities</li> </ul>	Akiner & E. Akiner (2009)	Awareness is needed to embrace globalization	Set up an effective organization to monitor and evaluate the impact of globalization on local industry
<ul style="list-style-type: none"> <li>• Workers' exploitation</li> <li>• Rising income inequality among workers</li> <li>• Increased involvement of foreign construction firms in local construction</li> <li>• Government's loss of control of economic and development sectors</li> <li>• Tendency towards de-industrialization</li> </ul>	Anugwom (2007), Onyeonoru (2003)	Globalization marginalizes and impoverishes the recipient market	Need to regulate the activities of multinational companies significantly
<ul style="list-style-type: none"> <li>• Economic crisis</li> <li>• Unemployment</li> <li>• Poverty</li> <li>• Pollution</li> <li>• Disruption of social cohesion &amp; communities</li> </ul>	Orzeață (2013)	Globalization has both winners and losers	The Government must prepare well for Globalization if everybody is to benefit from it
<ul style="list-style-type: none"> <li>• Increased competition</li> <li>• Technological advancements</li> </ul>	Ocloo et al. (2014)	Globalization has brought increased competition from more prominent multinational firms with plentiful resources to the detriment of local SMEs' growth	need to formulate effective competitive strategies

(Source: by the author)



**Fig. 3.3:** Impact of globalization in the United Kingdom  
(Source: Pettinger, 2019)

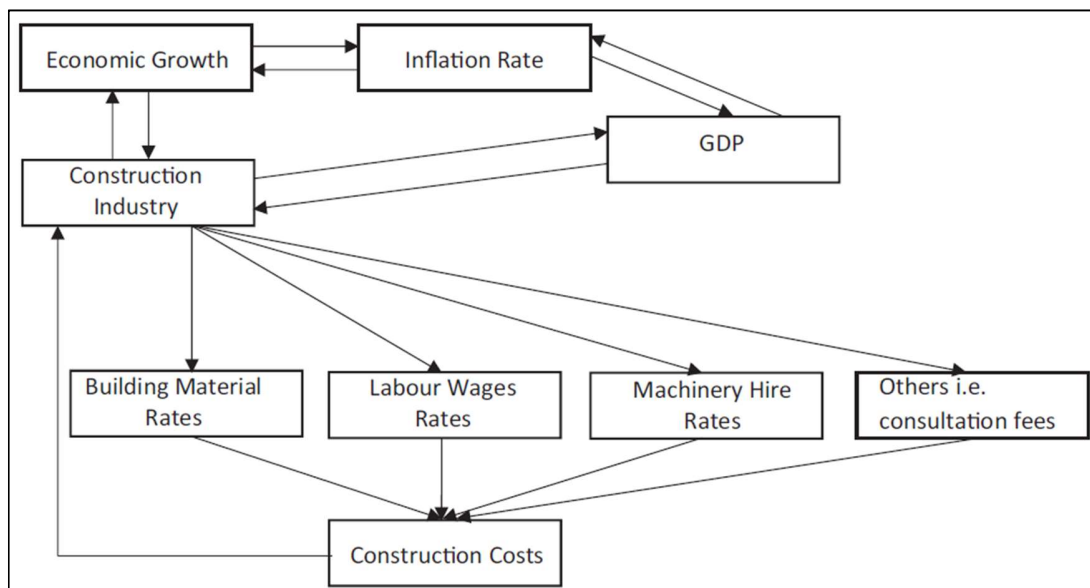


**Fig. 3.4:** Worldwide level of globalization in 2018  
(Gygli, et al., 2019).

Note: Dark-blue shaded areas indicate higher levels of globalization (According to this index, Zambia is at 57.79% globalization) (Source: <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>)

### 3.6 Impact of price inflation on construction

Musarat et al. (2021) state that inflation significantly impacts the nation's economy. Notably, in a particular market economy, for example, one industry sector could be positively affected by inflation. Musarat et al. (2021) found evidence of the devastating impact of inflation on the construction industry by highlighting the role of inflation in construction cost overrun (Figure 3.5). They recommend addressing the implications of inflation by factoring it into the construction budget estimates at the project onset rather than at the later stages. Their research proved that the inflation rate influenced the construction industry by manipulating its growth rate through the performance of GDP and economic growth. As the inflation rate rises, it lowers the GDP and raises construction costs, raising construction prices. Further, Yu (2014) found a positive correlation between the inflation indices and construction output price indices such that as output prices of construction rose, the construction industry generally dropped.



**Fig. 3.5:** Conceptual framework of the impact of inflation rate on the construction industry

(Adapted from Musarat et al., 2021, p. 412)

### **3.7 Interventions to construction price Inflation**

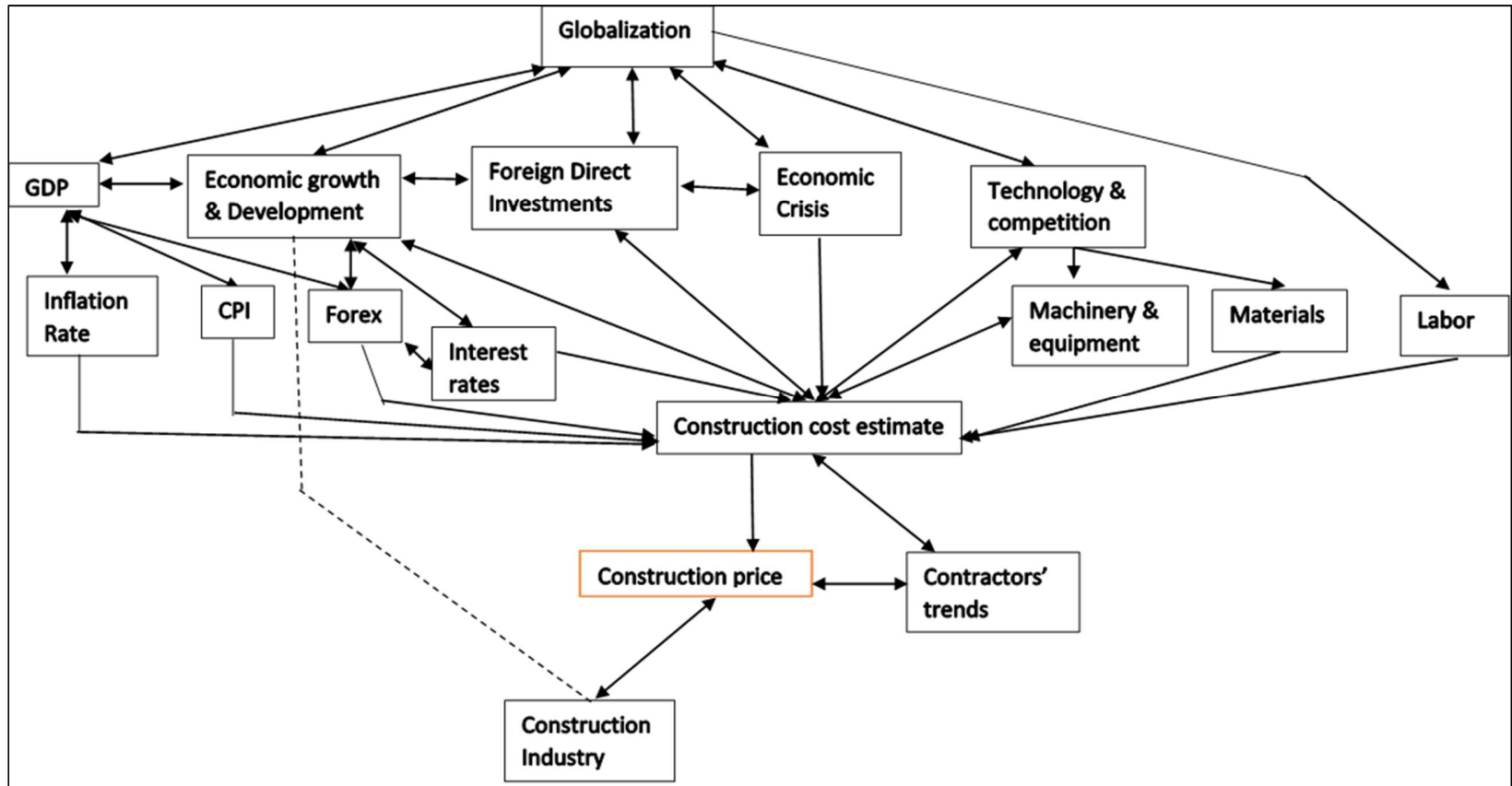
Globalization inspires open economies with dynamic markets and multifaceted but increasingly aggressive competition. Nguyen & Q. Nguyen (2020) carried out research that showed five critical factors that affected construction price inflation:

1. Consumer price index
2. Gross domestic product
3. Basic interest rates
4. Foreign exchange rate and
5. Total imports and exports

They argue that construction price level is very informative on changes in the construction industry as it arises from a combination of results regarding labor, materials, and equipment cost variables. The price level informs contractors about the orientation of the sector and the trends to follow. Nguyen & Q. Nguyen (2020) concluded that of the factors, the consumer price index exhibited the highest impact on the construction price level. Labor wages and price inflation show a dynamic interaction dependent primarily on the state of the economy and that, in practice, labor costs get passed on to price inflation with demand shocks to an industry eventually (Vansteenkiste, et al., 2019).

### **3.8 Chapter discussion**

There is a relationship between globalization and the performance of the construction sector. Based on the literature reviewed in this chapter, this study developed a basic framework to display a better understanding of this relationship. Figure 3.6 shows the framework. Many factors affect the construction price index at tendering, including machinery, construction materials, and the skill-set level of the labor force and its wages. In the conceptual framework, globalization directly influences the nation's GDP, economic growth, FDI, economic crises, the advancement of technology, and the degree of international competition. This begins to impact the inflation rate, consumer price index, foreign exchange rate, interest rates, and imports and exports that contractors must consider when building their bid rates to determine bid pricing.



**Fig. 3.6:** Basic framework of the impact of globalization on construction price  
 (By the author based on the literature review)

### 3.9 Chapter Summary

Literature has shown that globalization through foreign direct investment (FDI) is crucial in progressing global construction development. However, no qualitative or quantitative assessments explore how globalization and global economic integration relate to the construction sector or the interaction between their combined synergetic impacts on economic growth. The chapter has reviewed the literature to highlight numerous problems of globalization for developing countries like Zambia. The review highlights some distressing ones, which include loss of economies of scale, a tendency to de-industrialize as local competition gets ejected, and little space for economic growth for developing countries in a fully globalized state. The literature reviewed in this chapter showed a direct link between globalization and financial crisis or recessions. Economic recessions lead to price inflation, which in turn begins to affect the construction industry negatively. This study identifies knowledge gaps following this literature review, summarized as follows:

1. There is no holistic examination of globalization through foreign direct investments to investigate its impacts on the Zambian construction industry's performance. Based on preliminary literature, FDI in the oil and gas industry did not lead to any productivity spillover; instead caused the Dutch disease in the economy: an increase in the price of non-tradable goods (Nejati & Bahman, 2020). In addition, De Marchi et al. (2013) find that global competition threatens local industries disrupting local economic growth if local firms do not integrate internal factors such as structural characteristics and specific business strategies.
2. Factors or variables affecting the cost of construction and price inflation show a dynamic interaction that is dependent mainly on the state of the economy and that, in practice, labor costs are passed on to price inflation with demand shocks to the construction industry eventually. However, there is no investigation or examination into enhancing government policy and strategies to mitigate critical factors causing construction price inflation.

## **CHAPTER 4: Procurement Strategies for Managing Construction Tender Price Inflation**

### **4.1 Introduction**

All procurement methods aim to obtain value for money and promote private sector participation through the maximum possible competition (Public Procurement Act, no. 8 of 2020). According to the Public Procurement Regulations (2011), public procurement governance abides by fundamental principles, such as transparency; competition; economy; efficiency; fairness; value for money; and accountability. However, the prevailing procurement practices face criticism due to the “resulting adversarial relationships between the involved parties” and the construction processes' increased complexity and involvedness (Lahdenperä, 2014, p.2). Hence, there has been a comprehensive overall development of alternative, unconventional procurement methods “categorized by management of the interaction between the design and construction of the project” (Turina et al., 2008, p.2). Selection and utilization of inappropriate procurement approaches can heavily impact construction prices by introducing unanticipated cost uncertainties. Consequently, providing clear prospects for cost reduction strategy and time value for money should be the basis for selecting public-construction project procurement systems.

Procurement provisions for acquiring public construction works hinder accelerated public service provision (Manyathi, et al., 2021). Procurement legislation is inefficient and ineffective and fails to govern how to procure public infrastructure works adequately. To mitigate shortcomings of procurement legislation, governments need to remove unnecessary red tape that discourages innovation while establishing benchmarks for detecting inexperienced and fraudulent contractors. Procurement legislation encourages tendering, a troublesome practice that impedes learning and obtaining total value (Arlbjørn & Freytag, 2012). Public-sector procurement is inherently different from private-sector procurement because that is mainly profit-driven. Public procurement addresses numerous social issues and requires thoughtfulness of its varied nature for specific demand environments. For example, public procurement for works requires completely different practices, approaches, and

skill sets than public procurement for goods and other services. In that regard, generic procurement legislation is unlikely to work in the public infrastructure context (Uyarra & Flanagan, 2009). Procurement legislation is essential to establishing policies for increased innovation regarding procurement models for contracting for public works.

Procurement has proven benefits to public service delivery; however, when not adequately structured can become a “hot spot for corruption and inefficiencies” (Bilali and Bwisa, 2015, p.664). Governments strive to improve efficiency and transparency when developing their procurement policies. Agufa and Getuno (2019) found that key performance indicators such as monitoring and evaluation, balanced scorecards, and administration structures positively correlate with procurement optimization in public institutions. This method addresses the challenges and inadequacies of the lowest bid method by determining the appropriate weighting factor and rank ordering identifiable critical attributes. In Oladapo and Odeyinka's (2006) study, the multi-attribute evaluation of tenders submitted indicated that the most suitable contractor among those that tendered was not the lowest bidder. However, “if they used the ‘lowest bidder’ criterion, the project would have gone to a different contractor. Their evaluations showed that the multi-attribute analysis suggested the selection of contractors other than what the ‘lowest bidder’ criterion suggested” Oladapo & Odeyinka, 2006, p. 127).

The government's primary concern during tendering is controlling production costs and quality using the lowest bid method. At the same time, even the lowest bidder is concerned about how to secure their profit. Eger and Guo (2008, p.290) argued that this process leads to tensions between the parties during execution due to asymmetric information, which involves “the problems of moral hazard and adverse selection.” “Moral hazard occurs when the contractor has information about the cost of production, and the government cannot acquire that cost information. Adverse selection arises when the government cannot observe the expected production level of the individual contractor. As a result, the government cannot differentiate inefficient contractors from efficient ones” (Eger & Guo, 2008, p.290). When a project suffers from both adverse selection and dynamic moral hazard, the likelihood of its success depends on

the amount of work completed by the contractor. As a result, “firms can siphon a portion of the funds intended for the project and use the rest to create an illusion of productivity” (Johnson, 2013, p.1). This result in inefficient firms bidding to siphon and create unnecessary-unproductive competition for efficient firms. “The lowest bid method does not enable public construction administrators to select the most qualified contractor. And they have realized that selecting a contractor based on the lowest bid alone is inadequate and may lead to the project's failure in terms of time delay and poor-quality standards” (Alptekin, O. and Alptekin, N., 2017, p.1).

This research chapter predicates that (government) procurement methods are inefficient and inhibit efficient project delivery. The research chapter aims to identify procurement-related factors contributing to the failure to mitigate construction tender price inflation in Zambia. The chapter evolves around procurement selection criteria to manage construction tender price inflation and inflation among construction firms. This chapter addresses specific causes of persistent construction tender price inflation in Zambia. The study chapter relates to government construction-expenditure growth resulting from rising public construction sector output. The distinction of this research is within conditions and context that supposedly may be affected by construction tender price inflation. Therefore, the chapter identifies strategies and lists clients' challenges and assumptions while adopting a procurement strategy.

#### **4.2 Procurement strategies for public sector projects**

Procurement for public construction projects is challenging for procuring entities due to the fragmentation of the construction industry, which is “apparent most especially in the traditional separation of design and construction processes” (Jimoh et al., 2016, p.1096). According to the Zambia Public Procurement Act (2008), a procuring entity means a government agency, parastatal body, or any other body or unit established and mandated by the Government to procure public funds. Procuring entities and their procurement units require expertise correlating the government’s project objectives with appropriate procurement approaches for attaining value for money and cost control during project implementation. Table 4.1 lists the effects of current procurement strategies and practices gathered from the literature review.

**Table 4.1 Impact of current procurement selection strategies**

No.	Impact	Observations based on literature	References
1.	Project costs increase	The lowest price selection strategy creates imperfect competition by artificially lowering prices	Bochenek (2014), Ajayi, et al. (2010) and Lavelle, et al. (2007)
2.	Profit repatriation	Current construction strategies allow multinational construction companies to dominate the construction industry	John et al. (2019)
3.	Complicates Bidding Decision	The over-usage of price-based evaluation of the competitive bidding model in public projects	Alzober & Yaakub (2014)
4.	Imperfect competition	Open tendering encourages competition among contractors in terms of price	Thiruchelvam & Tookey (2011)
5.	Uncertainties about project performance	Procurement strategy has an impact on project performance	Ogunsanmi (2013), Demirkesen & Bayhan (2019), Rajeh, et al. (2014) and Ghadamsi (2016)
6.	Derisory selection criteria	The adopted procurement strategy must consider many factors other than the bid price	Lavelle, et al. (2007), Ajayi, et al. (2010), Rajeh, et al. (2014) and Ajayi (2017)
7.	Selection of incompetent contractor	Fail to emphasize the requirements of the client and project	Dwarika & Tiwari (2014)

(Source: by the author)

The notable impact of current procurement strategies and practices include increasing project costs, enabling profit repatriation by foreign firms, and complicated bidding decisions due to derisory and limited scope of selection criteria. In addition, current procurement practices encourage imperfect competition, emphasizing the focus on price, thereby transferring uncertainties onto project performance. Failure to highlight the client's and project's specific requirements often leads to a selection of incompetent contractors.

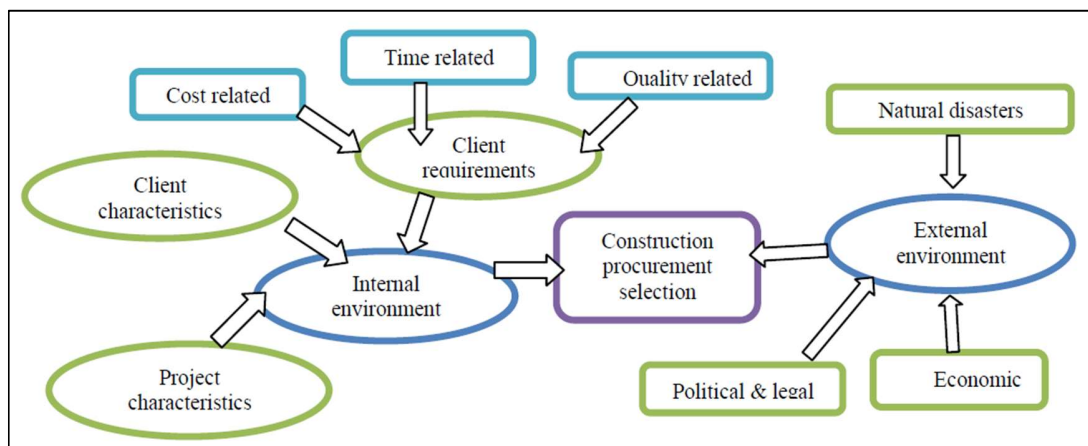
Clients need to improve by making informed decisions at the contractor selection stage. Procurement entities and units ensure the completion of public projects within acceptable costs, without delay and abandonment (Ajayi et al., 2010). The main contributor to public project failures was a lack of control and appreciation of procurement selection procedures and regulations by procurement units (CRC, 2009). Procurement selection criteria for public projects is thus a very critical subject that requires rigorous cost-benefit and price sensitivity analysis for successful implementation. Kelman (n.d., p1) acceptably argues, “It is tempting to believe that when a government decides that private organizations should provide something for which it is paying, it has removed one item from its agenda of worries. A moment’s reflection will suffice to remind any who might hold such fond hopes that the decision to contract changes the nature of government’s worries, adversatively doesn’t eliminate them”.

#### **4.2.1 Factors affecting the adoption of procurement strategy**

Ogunsanmi (2013) researched the effects of procurement-related factors on construction project performance in Nigeria and found that cost-related factors had the highest impact on project performance of all procurement selection criteria. His findings further show that other factors, particularly time and quality, also strongly influence public construction projects' implementation. Due to the complex nature of public construction projects, there is no single approach to selecting an appropriate procurement strategy for an individual project. For the project to be implemented successfully (See Fig. 4.1), there is a need to consider a decision-support model that encompasses all the factors that might be significant (Ratnasabapathy & Rameezdeen, 2007). Rajeh et al. (2014, p.56) argue that the selection of an appropriate procurement strategy is an essential element of project success and should consider factors such as “cost, quality, time, project complexity, certainty, risk, responsibility, and degree of control by the client.” Love et al. (2008) found an entrenched culture of uncertainty avoidance guiding selection while researching procurement methods in Australia.

Dahiru and Bashir (2015) found risk-related factors that restricted the success of construction procurement performance by causing a substantial increase in the overall

project cost leading to an increase in the tender price. Their results are essential to developing a supportive mechanism for risk management in public construction procurement management. Their results recognize that “corruption-related risk, conflict of interest, ineffective project technical feasibility, and lack of commitment to transparency are the most significant factors limiting construction procurement performance” (Dahiru & Bashir, 2015, p.77). They recommend selecting a construction-procurement system by focusing on curbing corruption, conflict of interest risks, and practical technical feasibility to improve the whole project's performance. El Agha and El Sawalhi (2013) found six significant factors that influenced the selection of Construction procurement methods in the Gaza Strip. These factors include price competition; degree of project complexity; time constraints, project size; client's financial capability, and client's experience in procurement methods.



**Fig. 4.1:** Factors affecting the selection of a procurement method

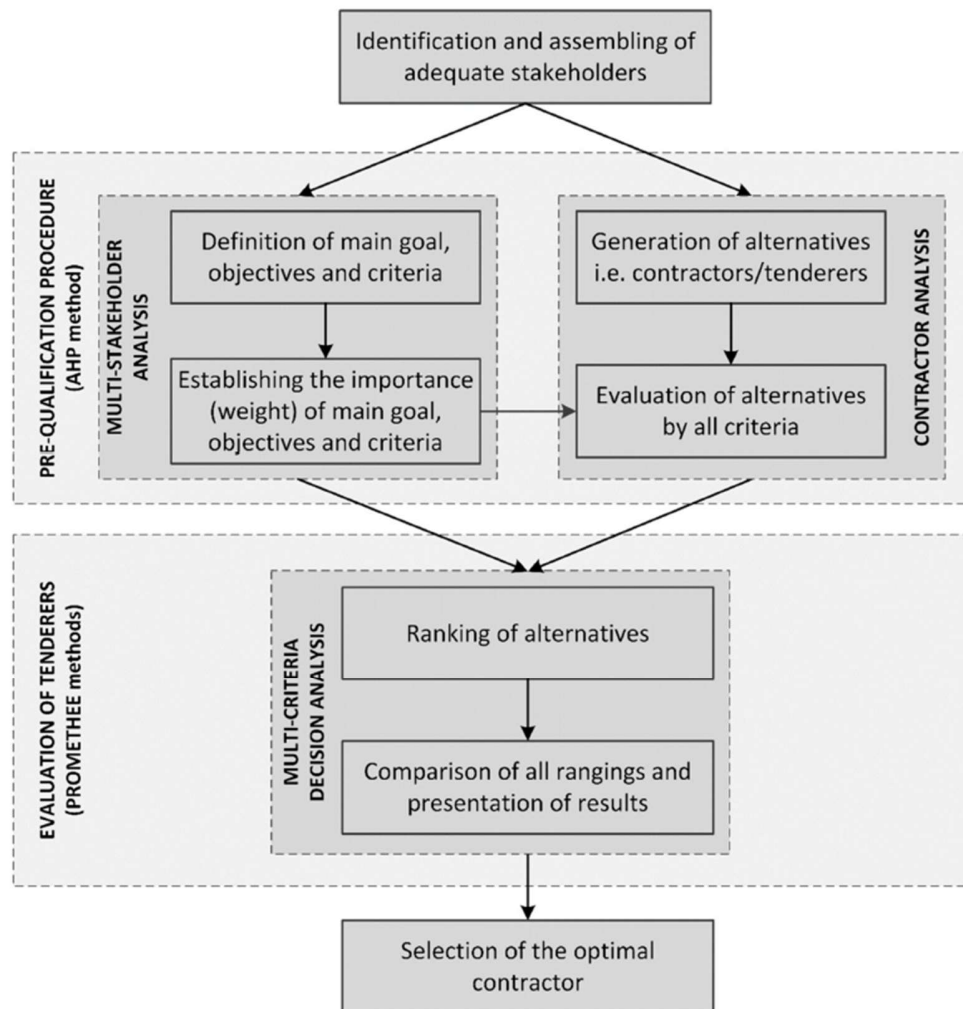
(Adapted from Ratnasabapathy, 2006)

Bakar et al. (2009) carried out research involving five (5) non-governmental organizations (NGOs) worldwide to help out rebuilt affected areas following the devastation caused by a 9.2 earthquake in Aceh, Indonesia. Their findings show factors influencing the procurement method's choice for the reconstruction efforts included timing, responsibility, and the quality of work. In comparison, Ajayi et al. (2016) found, in their research on procurement selection criteria for projects in the public sector in Nigeria, that quality, cost, and duration of the project determined the type of

procurement method to implement. In Tanzania, procurement processes are directly affected by a lack of knowledge in ICT when using E-procurement, poor record keeping, and a lack of personnel training on procurement matters (Ivambi, 2016). The principal factors influencing the selection of procurement systems include (El Sawalhi and El Agha, 2016); the client's willingness to be actively involved; the flexibility to change design during both the design and construction period; risk allocation/avoidance; project size; client's experience; the certainty of cost and time; experienced contractor availability; client's trust in other parties; client's requirement for value for money; and project type.

#### **4.2.2 Procurement Selection Criteria for Public Projects**

An informed approach to selecting the most appropriate procurement system is central to the success of any public infrastructure project, as shown in Figure 4.2. Choosing a proper procurement system, crucial in implementing public projects, is even more difficult with the increasing fragmentation and complexity of the construction industry. The failure to decide on an appropriate procurement system could result in time delays, cost overruns, and quality problems (Al-Jawhar and Rezouki, 2012). However, a “procurement method cannot be the reason for project success or failure alone because every procurement method has a defined procedure for project delivery and specific conditions” (Silwimba & Mwiya, 2017, p.10).



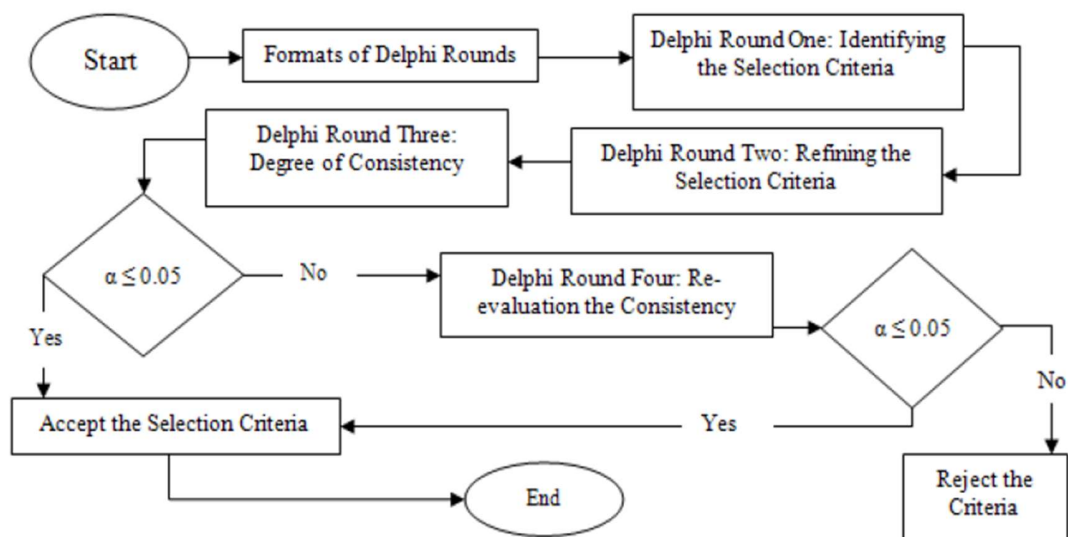
**Fig. 4.2:** Decision support concept for selecting the optimal contractor  
(Adapted from Marovi'c et al. 2021)

### i. The Delphi Method

Al-Jawhar and Rezouki (2012) adopted the Delphi method (Figure 4.3) to develop and identify the selection criteria of the construction procurement system in Iraq to provide an appropriate and effective tool. Their study conducted three Delphi rounds, identifying exclusion criteria for selecting the procurement system following the first two rounds. The last round of the Delphi derives a statistical significance of the utility factors, allowing them to reject the criteria that do not achieve the level of effectiveness required. Their method developed fifteen criteria, which were of statistical significance. The practical measures included; quality level, speed, flexibility for

changes, technology, complexity, time predictability, the certainty of cost, familiarity, responsibility, risk avoidance, accountability, client involvement, price competition, availability of procurement system in the local market, and legal issues.

The Delphi method is an appropriate technique for developing objective opinions. However, the process requires time to apply fully and the whole panel of experts to respond to each round of Delphi since the dropout of panel experts would distort the outcome. Nonetheless, “the goal of the Delphi method is not to produce a single answer as output, but instead to produce a relatively narrow spread of opinions within which the majority of experts concur” (Al-Jawhar and Rezouki, 2012, p.147).

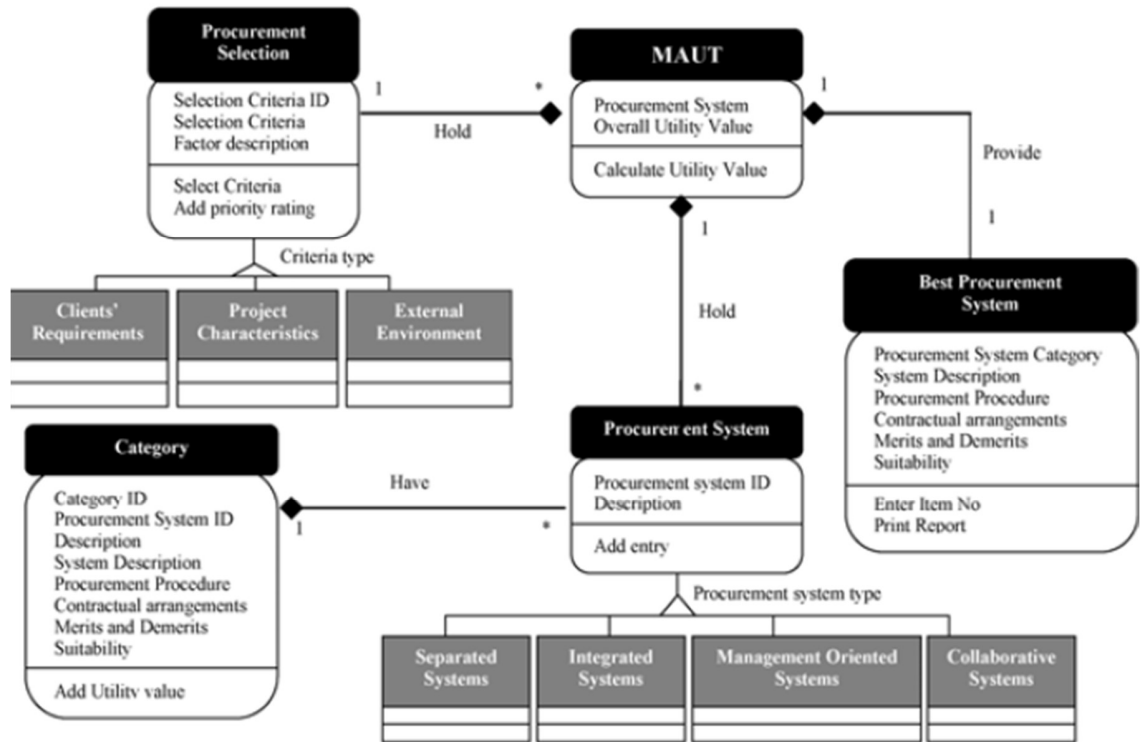


**Fig. 4.3:** Application of the Delphi rounds  
(Adapted from Al-Jawhar and Rezouki, 2012, p.144)

## ii. Object Oriented Model

Ratnasabapathy and Rameezdeen (2007) developed a model (Figure 4.4) that has the potential to assist governments in overcoming any inconsistency in the procurement decision-making process. They adopted the Multi-Attribute Utility Technique (MAUT) and the Delphi technique to develop a more systematic and consistent approach to create a multiple decisive factor model for selecting the best procurement system in public construction by improving objectivity in decision-making. The Delphi technique derives utility values for each factor, while the final selection process

considers clients' requirements, project characteristics, and external environment in the broader classification of procurement methods. The model considers multiple factors and procurement options using a selection criterion to overcome subjectivity due to individuals and other external influences (Ratnasabapathy and Rameezdeen, 2007).



**Fig. 4.4:** Object-oriented model for procurement selection (Adapted from Ratnasabapathy & Rameezdeen, 2007, p.47)

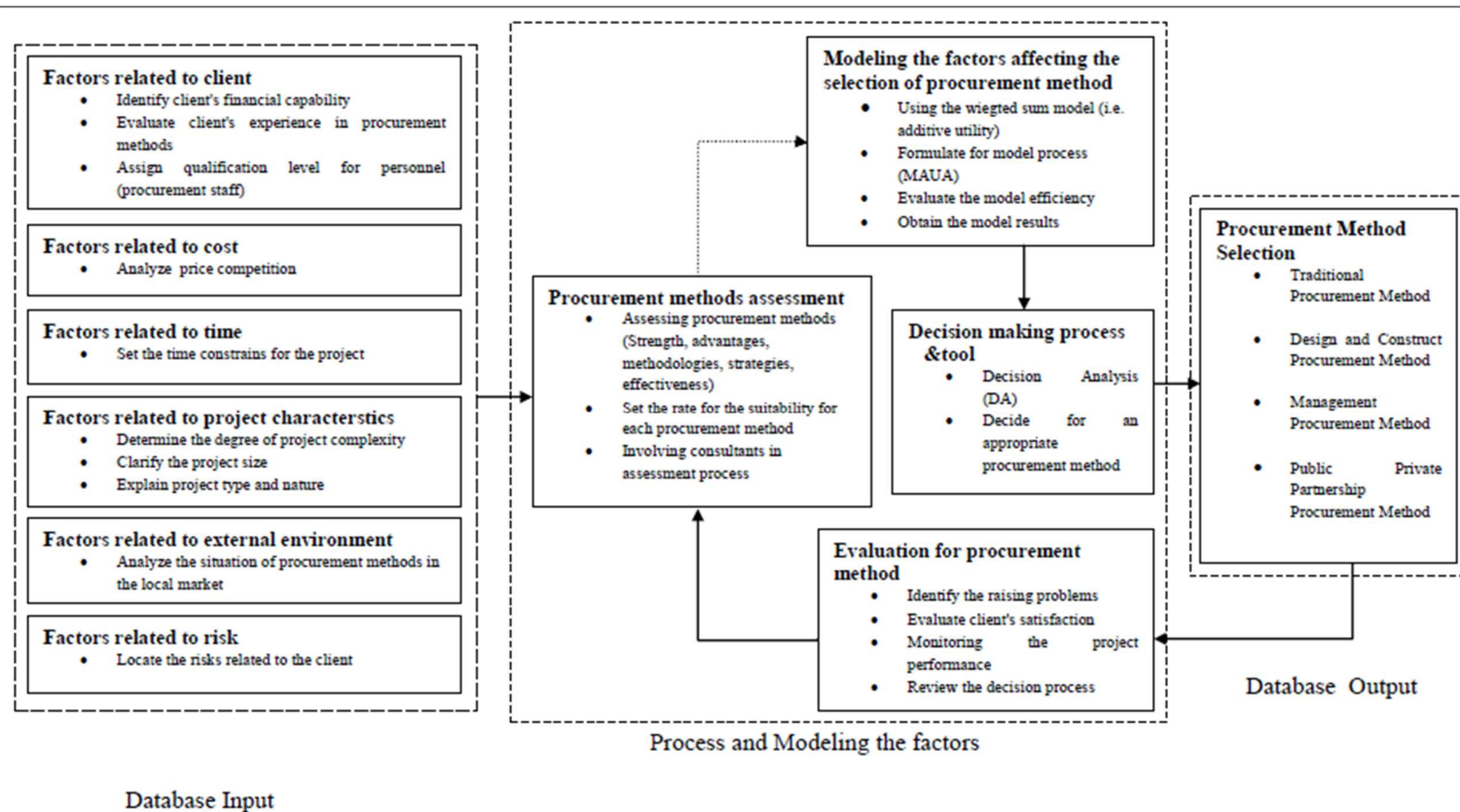
### iii. Multi-Attribute Utility Model

El Agha (2013), in the study on project procurement in the Gaza Strip, recommended the use of a conceptual framework that utilizes the multi-attribute utility approach (MAUA) as a decision support system for the selection of appropriate construction procurement methods (Figure 4.5). The EL Agha Model improves procurement systems and guides the selection of proper procurement systems for public construction projects by considering the government's requirements, the project's

profile, and the impact of the external environment on procurement selection. This model consists of three main phases: the database input phase, the process and modeling of the factors phase, and the database output phase (Figure 4.5). Furthermore, the Model facilitates the following (El Agha, 2013, p.102):

- a. Assists clients and their representatives in the initial decision on making an appropriate procurement selection for any construction project;
- b. Ensures systematic and consistent approach for procurement selection through the application of relevant research methods;
- c. Provides a better understanding of selection criteria that affect the procurement selection and various types of alternative construction procurement systems in practice;

Utilization of the multi-attribute-utility-theory (MAUT) is when decision-makers mainly require an assessment of the value of possible outcomes based on utility functions. It has become a technique for measuring objectivity and appropriately examining clients' requirements against the preferences of procurement experts and consultants.



**Fig. 4.5:** Framework for the selection of an appropriate procurement method  
(Adapted from El Agha, 2013, p.104)

**iv. The Equivalent Tender Price Model (ETPM)**

Selection criteria are essential to the success or failure of a construction project. Meland et al. (2011) argue that tender competition with a high focus on price in construction projects is a detriment to collaboration in terms of cost and quality, thereby making the lowest bid selection criteria result in the most expensive project. Instead, they developed the Equivalent Tender Price Model (ETPM) as an alternative method for evaluating tenders. The model increases the “probability of avoiding project failure related to cost overrun, poor quality and lack of functionality, in addition to ensuring more transparency in the tender evaluation process” (Meland et al., 2011, p1). Their general formula for the ETP model as developed by Meland et al. (2011):

$$ETP = P \frac{M^2 + k}{(\sum_i v_i m_i)^2 + k} \dots\dots\dots(\text{Equation 4.1})$$

Where:

- ETP = Equivalent tender price
- P = Estimated price inclusive of the supplier’s profit
- M = Maximum score on a selected scale (e.g., 5)
- k = A selected constant as a number [0, ∞)
- vi = Weight of the quality factor i (∑ vi = 1)
- mi = Score of the quality factor i (e.g. [1,5])

The quadratic ETP model has the potential to discriminate between different contractors k when reduced towards zero and steadily increase the weight on quality. The model incorporates price and qualitative elements to give high scores to “tenders offering factors that increase the probability of avoiding project failure related to cost overrun. It also gives a high score for pure quality and lack of functionality, thereby allowing a turn of focus from lowest cost to value enhancement in complex construction projects” (Meland et al., 2011, p12). Meland et al. (2011) further indicate that the ETP model demonstrates transparency, more robustness for adding more qualitative elements into the model, and: building country-specific conditions into scores and weightings offers a lower risk of manipulation. For example, to establish

an operational balance between price factors and qualitative elements in the ETP model, the model operates so that “the value of k influences the client’s choice of focus; from pure price, competition to hardly any weight on price. A substantial value of k represents pure price competition, whereas reducing k towards zero emphasizes qualitative elements” (Meland et al., 2011, p8).

### **4.3 Analytic hierarchy process decision-making framework**

Lin et al. (2014) presented a decision-making framework selection of procurement methods for building maintenance works in public institutions (focusing on university infrastructure). Their research found that selecting a procurement method in public organizations lacked strategy and systems. Figure 4.6 shows the framework developed to enhance and systemize decision-making for the selection of a procurement method adopted. Their proposed framework remains untested to realistic implementation and meeting perceived benefits.

### **4.4 Procurement methods in practice and their challenges**

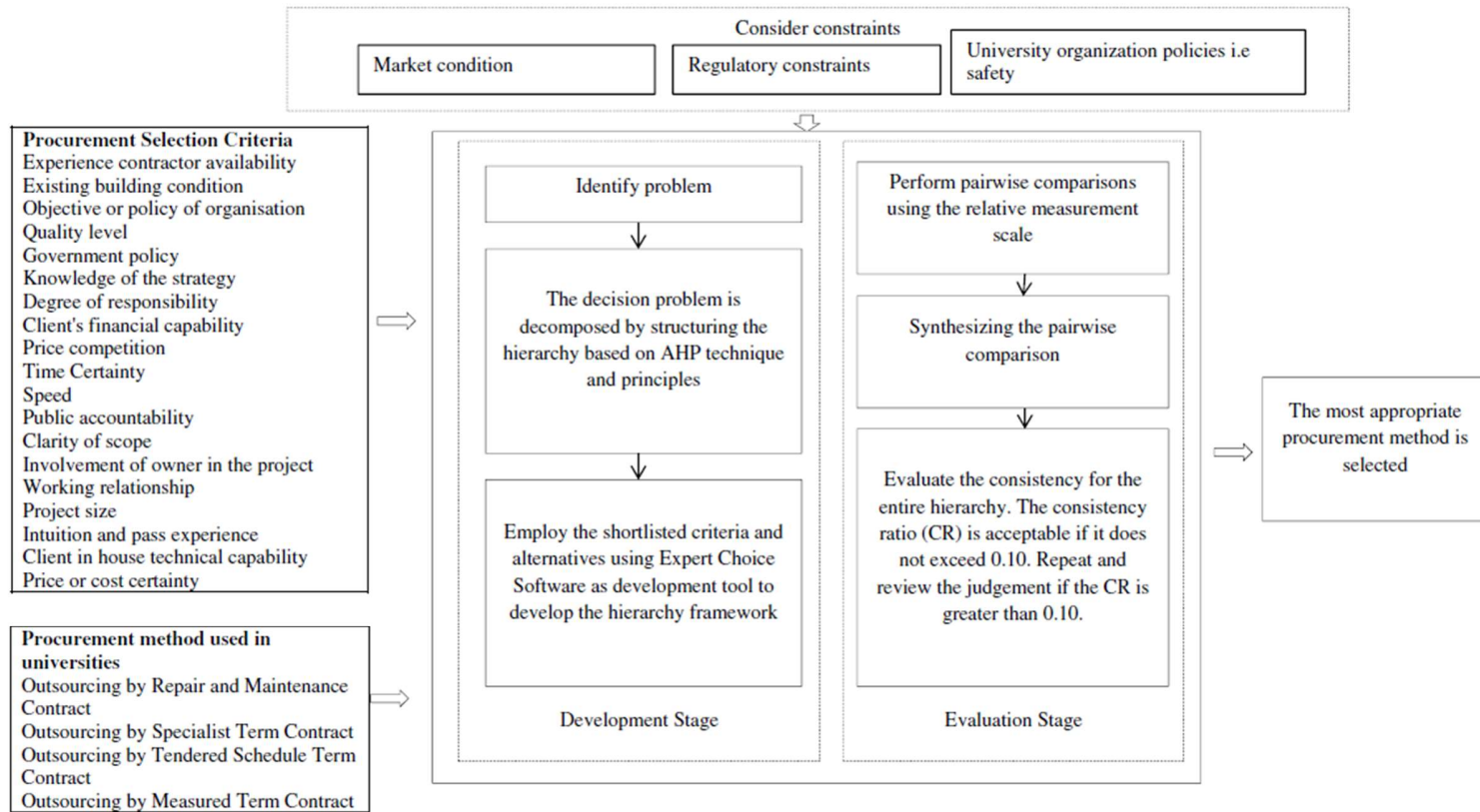
Ogunsanmi’s (2013) findings further show that cost, time, and quality determine the selection of procurement methods. Additionally, the study summarizes its findings in Table 4.2. Criteria for the appointment of a procurement method include (El Sawalhi & El Agha, 2016, p.3):

1. “Time (Speed); Quality level;
2. Risk allocation/avoidance;
3. Flexibility to change design during both the procedure and construction periods;
4. Responsibility;
5. Complexity;
6. Price competition;
7. Certainty of cost and time;
8. Disputes and arbitration;
9. Project type;
10. Client's experience;
11. Experienced contractor availability;
12. Client’s willingness to be actively involved;
13. Project site location;
14. Client’s trust in other parties;

15. Political constraints;
16. Project size;
17. Regulatory impact;
18. Market competitiveness;
19. Client's requirement for value for money;
20. Material availability;
21. Client's financial capability"

#### **4.4.1 Zambia's procurement practice - Lowest bid method**

The government's primary concern during tendering is controlling production costs and quality using the lowest bid method. At the same time, even the lowest bidder is concerned about how to secure their profit. Alptekin, O. and Alptekin, N. (2017, p.1) argue that "the lowest bid method does not enable public construction administrators to select the most qualified contractor." Eger and Guo (2008, p.290) argue that this process leads to tensions between the parties during execution due to asymmetric information, which involves "the problems of moral hazard and adverse selection occurs when the contractor has information about the cost of production, and the government cannot acquire that cost information." As a result, the government cannot differentiate inefficient contractors from efficient ones. Adverse selection arises when the government cannot observe the expected production level of the individual contractor under an illusion of productivity. Selecting a contractor based on the lowest bid is inadequate and may lead to failure. The likelihood of a project procured through the lowest bid method becoming successful depends on how much work the contractor completes (Johnson, 2013). However, from an investment and project cost perspective, arguments support that tender competitions with a high focus on price by using the lowest bid criterion ironically result in the most expensive projects (Meland, Robertsen & Hannas, 2011). This method allows inefficient firms to bid to siphon and create unnecessary-unproductive competition for efficient firms.



**Fig. 4.6:** Proposed decision-making framework for the selection of appropriate procurement method for public organizations

(Adapted from Lin et al., 2014, p. 9)

## **4.5 Improving construction procurement systems**

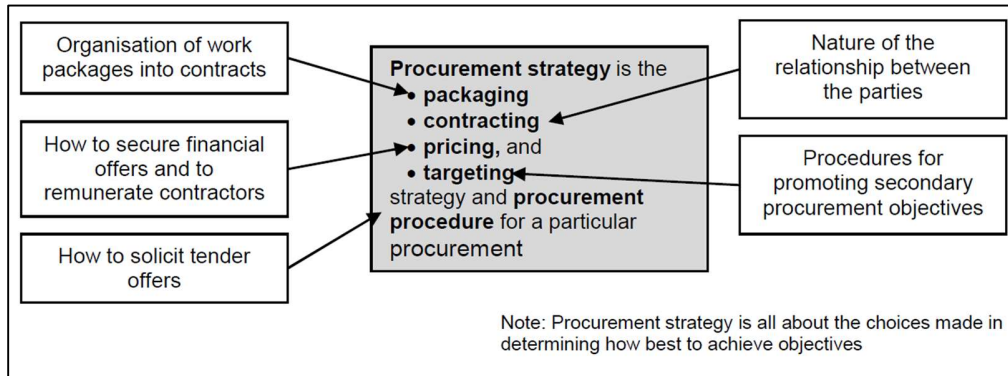
Procurement has proven benefits to public service delivery; however, when not adequately structured can become a “hot spot for corruption and inefficiencies” (Bilali and Bwisa, 2015, p.664). This system is why governments strive to improve efficiency and transparency when developing procurement policies. Agufa and Getuno (2019) found that key performance indicators such as monitoring and evaluation, balanced scorecards, and administration structures positively correlate with procurement optimization in public institutions.

### **4.5.1 Applying the multi-attribute model to tender evaluation**

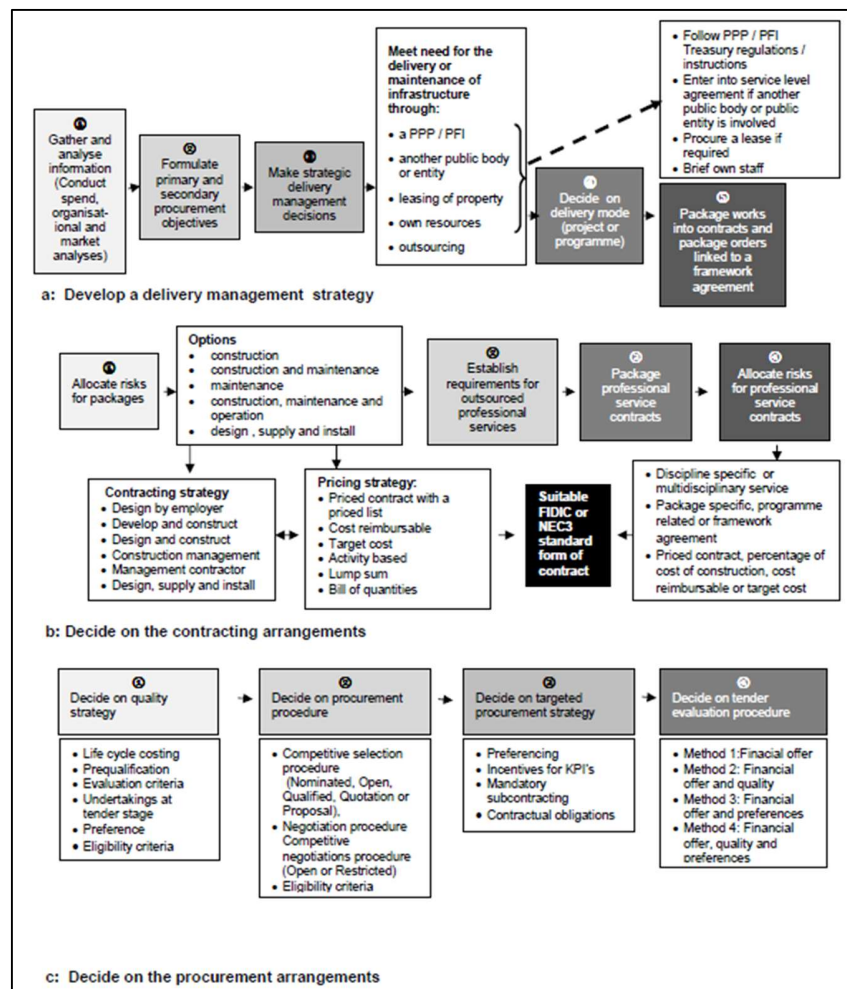
This method addresses the challenges and inadequacies of the lowest bid method by determining the appropriate weighting factor and rank ordering identifiable critical attributes. In Oladapo and Odeyinka's (2006) study, the multi-attribute evaluation of tenders submitted indicated that the most suitable contractor among those that tendered was not the lowest bidder. However, “the ‘lowest bidder’ criterion would have skewed the award. Their evaluations showed that the multi-attribute analysis suggested the selection of contractors other than what the ‘lowest bidder’ criterion suggested” (Oladapo & Odeyinka, 2006, p. 127).

## **4.6 Developing a construction procurement strategy**

Watermeyer (2012) argues that procurement strategy is about developing an approach that allows you to meet and promote your procurement objectives. In his study, he outlined the components of a procurement strategy (Figure 4.7) and factors considered when selecting or constructing a procurement method. He further argues that there is an inherent need to match the resources and objectives with choices. On the other hand, he developed a framework for developing a procurement strategy based on the four components (Figure 4.8), including pricing and contracting systems.



**Fig. 4.7:** Components of a procurement strategy  
(Adapted from Watermeyer, 2012, p. 224)



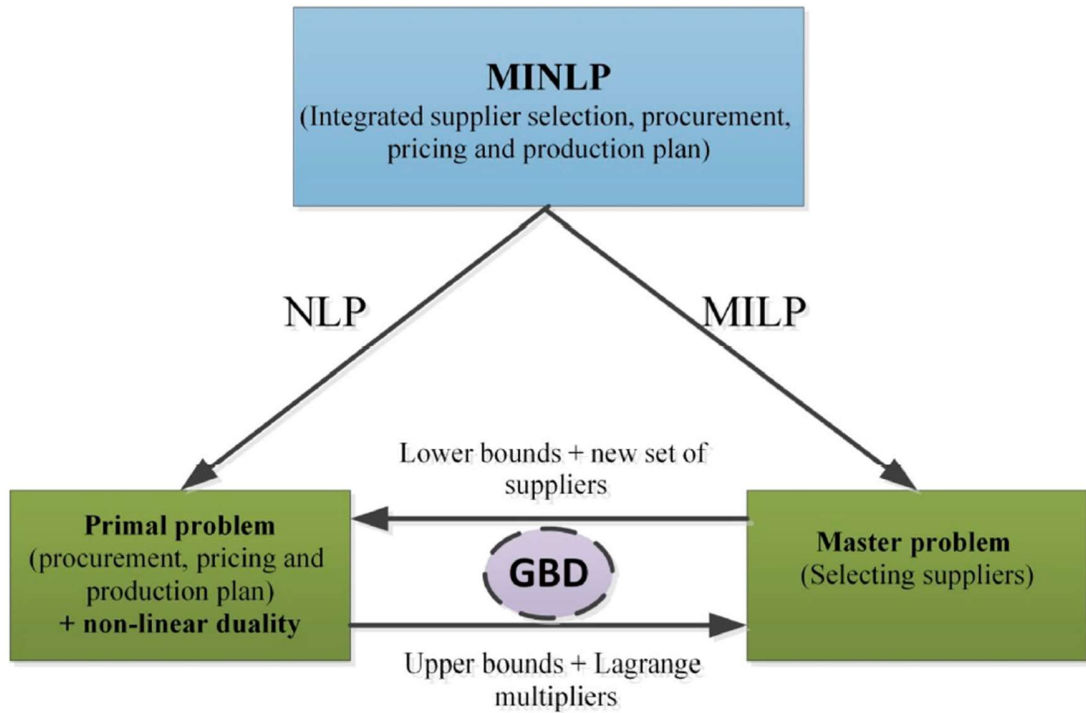
**Fig. 4.8:** A framework for developing a construction procurement strategy  
(Adapted from Watermeyer, 2012, p. 14)

## **4.7 Chapter discussion**

Literature reveals that pricing is one of the most complicated and involving aspects of procurement. Investigations into this aspect have led to the discovery of the term “procurement price,” which means the price of the government or a client to procure works, goods, or services. Literature has also shown that procurement covers a wide range of tasks, activities, and responsibilities, including functions relating to selecting contractors, negotiating contracts, and completing construction works. Hence, procurement has a strategic impact on the project goals. Asker & Cantillon (2010) argue that a client always seeks to procure a good or project characterized by a reasonable price and good quality through a contractor with private information about the project cost structure.

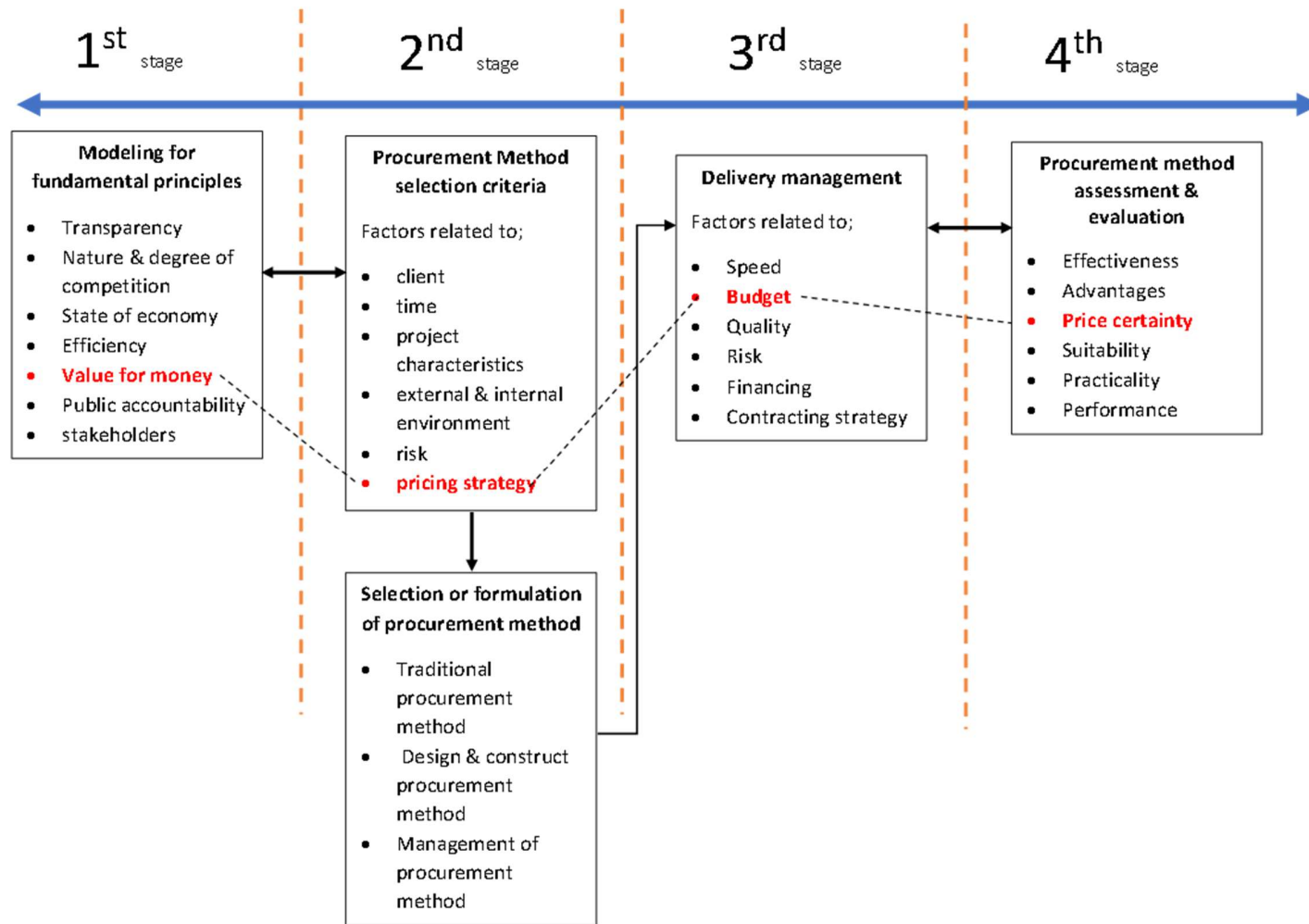
Literature findings show that procurement rarely involves decisions solely based on price; however, literature agrees that improving the procurement function can significantly contribute to an organization's price/cost performance. Schiele (2007) pointed out the direct correlation between procurement performance and the financial performance of an organization. The literature emphasizes the need to assess whether the public sector is being cost-effective in its procurement of construction contracts and develop price review mechanisms for procuring projects in the public sector. Tan & Goh (2017) found a general lack of attention on public expenditure concerning construction projects. Research by Yaghin & Goh (2020) identified three related supply chain decisions in handling supply risks: procurement, price, and production. They carried out research that attempted to integrate procurement, pricing, and production plan by formulating the problem of a supply chain network involving suppliers, manufacturers, and retailers and tailoring a generalized Benders decomposition for solution (Figure 4.9). Through literature review, this research developed a conceptual decision-making framework for selecting a procurement method or formulating a procurement strategy that integrates factors such as value for money, price or pricing strategy, budget, and price certainty. The four (4) stage

decision-making framework (Figure 4.10) would assist the government in carrying out timely reviews of procurement strategies that are currently in use.



**Fig. 4.9:** Schematic of proposed generalized benders decomposition  
(Adapted from Yaghin & Goh, 2020, p. 9)

However, the conceptual framework (developed through literature review) sheds light on the tactical level of procurement- decision-making in the public sector. It emphasizes a new focus on developing programming approaches in developing optimal case-sensitive procurement approaches. Through literature review, this research has likewise identified and amplified the correlation between the procurement method in use and its influence on pricing strategy and price certainty of the construction project remains ignored in practice (Tan & Goh, 2017).



**Fig. 4.10:** Decision-making framework for procurement method selection (Watermeyer, 2012; Yaghin & Goh, 2020; Lin et al., 2014; El Agha, 2013; Ratnasabapathy & Rameezdeen, 2007; Marović et al., 2021; Ratnasabapathy, 2006). By the author based on the literature review.

#### **4.8 Chapter Summary**

This chapter investigates current knowledge concerning adopted procurement strategies for managing construction-price in the public sector. The literature reveals that studies address mostly four main areas: procurement decision support systems, transparency, and ethical considerations in procurement, identification of procurement criteria, and overcoming inconsistencies in the procurement process. The review provides a new perspective on the selection of procurement strategy. Therefore, selecting a suitable procurement strategy is essential for managing project pricing. The study has revealed that the lowest bid is the main criterion of contractor selection in the public sector. There is a need to combine some, if not all, procurement strategies within a significantly flexible system that can have multiple potential advantages in the construction field by serving as a robust decision-making tool. Specific knowledge gaps found in the literature include the following:

1. The literature agrees that improving the procurement function can significantly contribute to the price/cost performance due to apparent direct correlations between procurement performance and the financial performance of an organization. Therefore, exploring and assessing whether the public sector is cost-effective in procuring construction contracts is essential.
2. Literature findings show that procurement rarely involves decisions solely based on price; however, price is a crucial decision factor and contractor evaluation criterion. Moreover, soaring construction tender prices threaten the infrastructure push in the public sector as the effects of escalating tender prices begin to outweigh the socioeconomic benefits of such infrastructure. Price in the construction sector needs management and control, much like other project variables, by developing price review mechanisms for procuring construction projects in the public sector. There is a need to create a public procurement strategy for managing construction price inflation by modeling fundamental principles such as value for money, impacts of price inflation on client perception and infrastructure push, and public accountability.

## **CHAPTER 5: Strategies for Measurement and Prediction of Construction Tender Price Level**

### **5.1 Introduction**

The lowest price bidding does not ensure maximum value in construction. Therefore, evaluating bids solely based on the lowest-bid system creates challenges in achieving a value-based procurement system. Khan and A. Khan (2015, p. 9) found that the lowest-bid procurement approach is undesirable due to the;

1. inferior quality of constructed facilities,
2. high incidence of claims and litigation, and
3. frequent cost and schedule overruns

Contractors determine the bid price by maximizing expected profit while factoring in the probability of winning the bid, underlying conditions on bid items, client characteristics, and competition level. An optimal bid price is significant in winning a construction contract. However, Wang et al. (2012) affirm that making accurate pricing in a bid is enormously expensive and time-consuming.

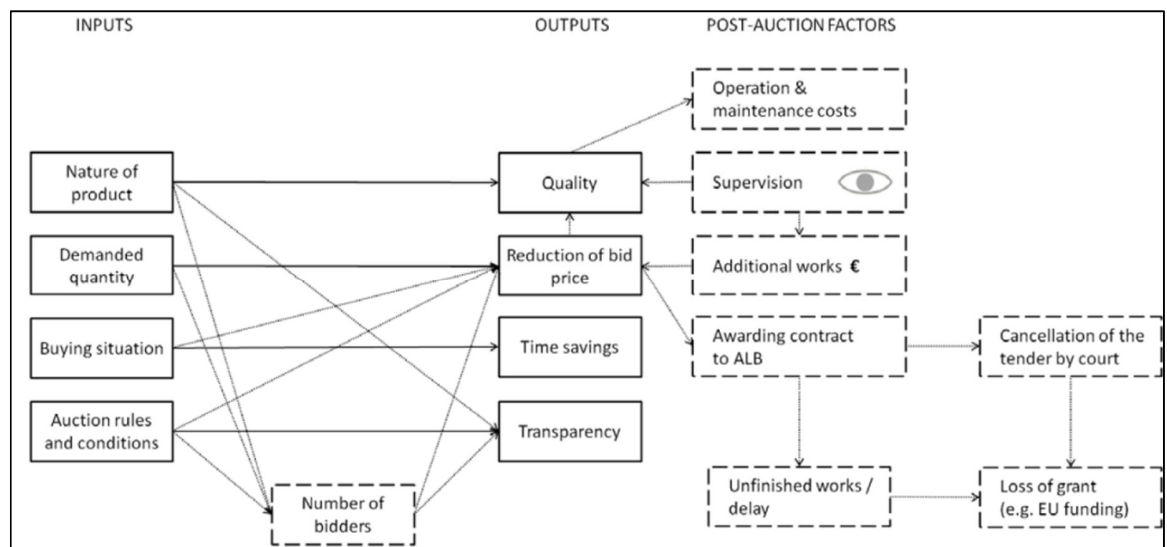
### **5.2 Approaches to optimal bid pricing**

A construction company's strategy is to establish its bid price and win in competitive tenders builds upon an analysis of the economic environment, the expected behavior of competitors, and the contractor's capabilities (Jaśkowski & Czarnigowska, 2019). Contractors must ensure that the bid price is high enough to cover various costs, including profits while being low enough to be considered successful among the competitors by the client.

#### **5.2.1 Electronic reverse auctions (e-RA) model**

Hanák (2018) examined the successful adoption of real-time electronic reverse auctions in public construction procurement. Electronic reverse auctions are considered an appropriate tool or mechanism for exploiting the power of the client (or buyer) while simultaneously enhancing relationships with contractors (Gelderman, et al., 2017). However, Bajari et al. (2003) found that auctions perform poorly when complex projects attract few bidders and contain poor designs. Hanák (2018)

developed an e-RA model for the construction sector (Fig. 5.1), highlighting post-auction factors' influence in the construction sector context. According to the model: a reduction in the bid price results in poor-quality delivery during construction, consequently affecting future operation costs. Hanák (2018) argues that this phenomenon may not be visible at first sight, resulting in hidden defects, especially where there is a lack of supervision and quality requirements.



**Fig. 5.1:** An e-RA model of relationships in the context of the construction sector  
(Adapted from Hanák, 2018, p. 47)

### 5.2.2 Modified Friedman's model

Jaśkowski and Czarnigowska (2019) presented a modified Friedman's model by adding correlations between competitor's bids to the initial assumptions. Accordingly, it recommends establishing a database of competitor's historic estimates markups to determine a functional or statistical correlation between the contractors' bid prices. In this model, Jaśkowski and Czarnigowska (2019, p.162) argued that the procedure for determining the optimum markup when bidding includes:

1. Establishing bidding patterns of competitors from an existing database
2. Setting correlation coefficients among estimated markups
3. Generate or simulate correlated random values to represent the bidding profiles of competitors

4. Determine the optimum value of the markup that corresponds to the maximum profit

The general formula for the model, as modified by Jaśkowski and Czarnigowska (2019, p.164), is as follows;

$$\begin{aligned} P(\text{win}|w_0^m, n) \\ = P(W_1^m > w_0^m \cap W_2^m > w_0^m \cap \dots \cap W_n^m > w_0^m) \end{aligned}$$

The probability of winning a tender with a markup close to the optimum price depends on the competitors' bid correlations. "A contractor using this model in bidding decisions may submit bids with high markups," which means a high bid price. This model is also affected by the type of competitor. If the contractor is weaker than the competitors are; the value of their markup is lower than when the contractor is stronger than the competitors (Dwijayant & Johny, 2020).

### 5.2.3 Machine-learning method

Contractors determine the optimal price by maximizing expected profit while considering the probability of winning the bid (Lawrence, 2003). Lawrence (2003) further argues that other features crucial to developing an optimal bid price include the nature of the completion and the type of client. He created the Bayes classification model using these features to determine the bid outcome by generating a win probability as a function of the bid price. This model shows that the win probability increases as a function of the bid price in which implicit strategies employ higher prices to make more profit. According to the model, the frequency of this scenario will eventually force the contractor to win at higher prices as they become even more willing to price aggressively. The main challenge with machine learning is developing a method that can effectively and efficiently predict human-approved bid prices for training new users and independently checking experienced users.

### 5.2.4 Probabilistic approach

To determine the bid price, contractors often factor in direct costs, overhead, and markup in the rates leading to high inaccuracies and more significant risks of losing a

competitive bid (Chao & Kuoa, 2016). Chao and Kuoa (2016) developed a probabilistic approach for determining the overheads and markups in the bid price by building into the regression model four factors: project duration, direct costs on the project, location, and type of project as inputs. They used the model to increase the probability of winning a competitive bid based on overall risk minimization and prevention of price over-cuts when bidding. They also argue that contractors face an increased risk of making losses during the project implementation stage. Losses may occur once the project costs exceed the winning bid due to cutting bids, mainly when the client uses the lowest bid method to make an award.

### **5.3 Addressing price inflation during construction**

Price volatility is a significant risk in construction projects (Abdulrazaq, 2017). Every construction industry is unique and thus requires the development of industry-specific strategies to address price volatility. Abdulrazaq (2017, p.161) argued that the method best suited for managing price volatility includes;

1. Inclusion of price adjustment clauses
2. Fast track and Lean project delivery method
3. Risk management method
4. Contingencies
5. Early procurement method
6. Use of price cap contract
7. Use of ICT

#### **5.3.1 Fast track and lean project delivery method**

These consist of a collaboration of people, systems, and practices aimed at harnessing participation to increase value to the owner throughout the construction phase. This method allows the team to focus on the full implication of the project rather than focusing exclusively on one's part. The approach enables collaborative and informed decision-making in the initial phases of the project. Since the project's final cost is unknown when construction commences, this method combines ideas to solve several contemporary construction problems to increase productivity and lower the final project cost.

### **5.3.2 Risk management method**

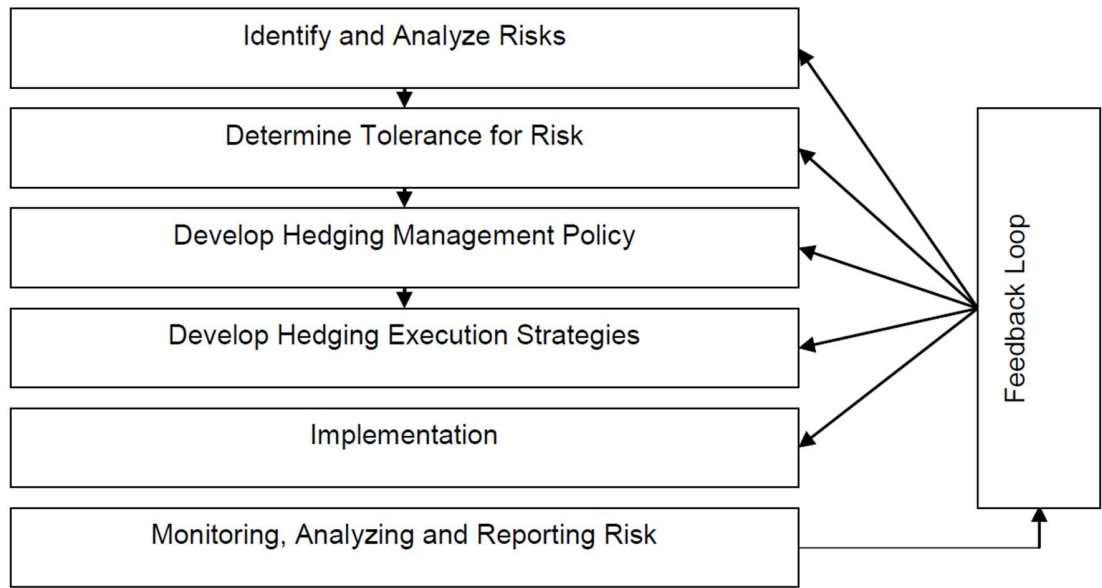
This method utilizes quantitative and qualitative techniques to measure the risks in the material price fluctuation on construction projects (Alireza, et al., 2016). Research deploys quantitative techniques to model and forecast future trends of cost indexes, while qualitative approaches remain subjected to expert opinion and the construction sector's confidence indexes (Abdulrazaq, 2017).

### **5.3.3 Early procurement method**

This method involves making an advance purchase of materials prone to price fluctuations. However, when adopting this method to address price inflation, the contractor must accept additional risks, such as material storage and theft (Abdulrazaq, 2017).

### **5.3.4 Hedging method**

Hedging is a risk management tool proposed as a construction material price-risk mitigation measure. The proposal follows its successful implementation in the airline industry. From its applications in airline fuel hedging, research recommends its performance in material hedging in the construction industry that can help contractors submit competitive bids (Al-Zarrad, et al., 2015). Al-Zarrad et al. (2015) suggest a systematic guide (Figure 5.2) for hedging to mitigate material risk uncertainties and reflect price inflation. In their research, Al-Zarrad et al. (2015) recommended further investigations into material hedging cost or the cost of implementing hedging to establish the feasibility of its applications in the construction sector.



**Fig. 5.2:** The seven-step guideline for construction material hedging application  
(Adapted from Al-Zarrad et al., 2015, p.142-5)

### 5.3.5 A classification model

Jang et al. (2021) developed a classification model for determining bid price inflation. The model showed that uncertainty within the bid documents caused price inflation. They further revealed factors that affected the bid price, including omissions in the bid document, insufficient information, discrepancies, and errors. They claim to reach a more acceptable price through a rigorous pre-clarification process. They insist that addressing uncertainty in bid documents could change the price inflation level. Crucially, uncertainty in bidding documents is immeasurable quantitatively. Hence, methods must be developed to measure it first comprehensively. The detail requirement renders the classification model highly inaccurate and localized. This model does not offer control for market risk factors.

### 5.4 Strategies for predicting construction tender price

Historical data must be readily available to predict the bid price, coupled with necessary documentation and processes for adjusting unit costs. Underutilization of historical project cost data exacerbates cost control challenges during tendering

(Zhang, et al., 2015). Moreover, using pricing models is challenging for contractors because they are unnecessarily complicated (See Table 5.2). Even the best-simplified and streamlined models involve the imposition of constants and price limits that are arbitrary and subjective (Cattell, et al., 2007). Using such arbitrarily chosen values fails to provide a scientific basis by which to construct the optimum price. Kissi et al. (2019) hypothesized the existence of a relationship between the different pricing strategies and the factors that influence the pricing of a tender (Figure 5.3 and Table 5.1).

**Table 5.1 Price impact on bid-or-no-bid decision**

No.	Price impact on Bid-or-No-Bid Decision	Reference
1.	Bid price directly affects the economic efficiency of the contractor	Biruk et al. (2017)
2.	Price is one of the dominant factors when considering any contractor	Thiruchelvam & Tookey (2011), Hartmann, et al. (2009) and Storteboom, et al. (2017)
3.	Price is an essential and universal criterion of the client's assessment of bids	Biruk, et al. (2017), Basua, et al. (2017), Afolayan, et al. (2018), Thiruchelvam & Tookey (2011), Mbachu (2008) and Dwarika & Tiwari (2014)
4.	It is possible to predict the price before bidding reasonably	Thomas, et al. (2002)
5.	The inflation rate helps predict the bid price	Oghenekevwe, et al. (2014)
6.	Price inflation is dependent on macroeconomic factors	Alireza, et al. (2016)
7.	Construction prices are a function of many factors other than material costs	Gransberg & Kelly (2008)
8.	Price inflation has a significant impact on construction cost	Baek & Ashuri (2017)
9.	Material prices realistically fluctuate up and down	Al-Zarrad, et al. (2015)
10.	Price is the decisive parameter in evaluating the competition in the construction	Nový et al. (2016)
11.	Price is a significant factor in attaining market share and is a flexible element of marketing strategy	Pokharel & B. Pokharel (2018)
12.	Price fixing capacity is an effective way of improving organizational performance	Liozu & Hinterhuber (2013)
13.	Adopting high prices has a direct and positive impact on profit margin	Toni et al. (2017)
14.	Larger companies have a greater capacity to influence prices in the industry	Toni et al. (2017)
15.	Escalation of material prices is a pertinent risk factor in construction	Tembo-Silungwe & Khatleli (2017)
16.	Price assurance assessment should be a core criterion in contractor selection	Jimoh et al. (2016)

No.	Price impact on Bid-or-No-Bid Decision	Reference
17.	Contractors inflate tender prices if the reputation of the client is that of delayed payments	Ye & Abdul-Rahman (2010)
18.	Construction materials are a significant factor in price escalation	Ramanathan, et al. (2012)
20	A boom in construction activity is significantly associated with a general increase in construction prices	Cruywagen (2014)

(Source: by the author)

#### 5.4.1 Unbalanced pricing methods

**Front-end Loading:** This strategy involves skewing the distribution of markup among the component items by overpricing work items that occur early in the project to enhance contractors' cash flow (Skitmore & Cattell, 2013). Skitmore and Cattell (2013) revealed that the front loader's profit increases with the number of front-loading bidders during bidding. They argue that the practice of front loading presents a high cost to the client because it increases cash for the bidder at the expense of the client's cash flow. Furthermore, it increases the client's risk of the contractor defaulting mid-way through the project, leaving them in a situation whereby they would have overpaid for the interim work (Skitmore & Cattell, 2013). Hence, the contractor uses these strategies to manipulate prices to their benefit (Table 5.2).

**Back-end loading:** This is essentially a practice of overpricing items at the end of the project or "inflating the prices of late schedule" (Nikpour, et al., 2017, p. 410). Like all unbalanced pricing methods, back-end loading provides unjustified advantages to the contractor at the project owner's cash flow expense. Contractors achieve Back-end loading by deflating the markup of a project's early activities while inflating the late activities while maintaining the bid price. This loading method leads to inefficient personnel use as, towards the end, more personnel become engaged in the few remaining works. The strategy may consequently quickly overrun the budget.

**Individual rate loading or quantity error exploitation** involves inflating a few item markups and deflating others while keeping the bid price unchanged. The practice causes an "uneven markup fluctuation over the project timeline" (Nikpour, et al., 2017, p. 412). Research by Nikpour et al. (2017) and Azizi & Aboelmagd (2019) reveal that

the bidder can effortlessly increase their profit by manipulating the markup distribution.

**Collusive bid unbalancing:** This practice involves an employee of the client colluding with the contractor by providing them with confidential bid information concerning items subject to changes after an award (Prajapati & Bhavsar, 2017). This information, in turn, allows the bidder to gain a peculiar advantage by manipulating the price of those items and appearing lowest at evaluation to win the tender.

#### **5.4.2 Balanced pricing Methods**

A method that leads to balanced pricing involves allocating the markup proportionally to the cost of each activity, thereby ensuring a constant markup across the project timeline. This method rarely leads to improved cash flow for the contractor (Nikpour, et al., 2017). Table 5.2 summarizes the construction tender pricing models.

#### **5.5 Mitigation of unbalanced bid pricing strategies**

Research regarding unbalanced bidding dates back to 1959 when Martin Gates proposed an alternative model to the then-balanced model by Friedman (1956). These unbalanced pricing strategies usually result in client overpayment on the project as contractors aim to increase profit and cash flow (Nikpour, et al., 2017). Unbalance pricing strategies are illegal methods that reduce the client's position and contractors' incentive to complete the project as they lose their financial motivation. Nikpour et al. (2017) found that unbalanced pricing methods are challenging to detect, posing significant consequences on the clients' cost liability of implementing a project. Unbalanced bidding harms competition by getting rid of genuine bidders by placing extremely low bids.

**Table 5.2** A summary of construction bid pricing models (Cattell, et al., 2007)

Category	Strategy/Bidding Model	Modeling approach	Basis	Author
Unbalanced Pricing	Gate's Strategy	<ul style="list-style-type: none"> <li>• Use of mathematics to determine the probability of winning a tender</li> <li>• Determination of optimum project markup</li> </ul>	<ul style="list-style-type: none"> <li>• Obvious errors in the project's initial quantities</li> <li>• Contractor's expectation of variations</li> </ul>	Martin Gates (1959, 1967)
	Stark's Deterministic Model	<ul style="list-style-type: none"> <li>• linear programming solution</li> <li>• Bid constraints</li> <li>• Unit bid constraints</li> <li>• Rate constraints</li> </ul>	<ul style="list-style-type: none"> <li>• Contractors' knowledge</li> <li>• Contractor's risk management process</li> <li>• Benefits of contractor's cash flow</li> <li>• Availability of quantity estimation errors</li> </ul>	Stark R. M. (1968, 1972, 1974)
	Ashely & Teicholz Model	<ul style="list-style-type: none"> <li>• Simple linear unbalancing</li> <li>• Item price loading</li> </ul>	<ul style="list-style-type: none"> <li>• Increased contractor's cash flow</li> <li>• Quantity error exploitation</li> <li>• Contractor's expectation of variations</li> <li>• Discount rate</li> </ul>	Ashely, D. B. and Teicholz, P. M. (1977, 1978)
	Diekmann Probabilistic Model	<ul style="list-style-type: none"> <li>• Probabilistic formulation</li> <li>• Changes in final item quantities</li> </ul>	<ul style="list-style-type: none"> <li>• Benefits of cash flow to the contractor</li> <li>• Quantity error exploitation</li> </ul>	Diekmann, J. E., Mayer, R. J. Jr. and Stark, R. M. (1982)
	Cattell's Model	<ul style="list-style-type: none"> <li>• Item's contribution to contractor's profit</li> <li>• Maximization of project profit</li> </ul>	<ul style="list-style-type: none"> <li>• Risk and return factors</li> <li>• Risk-return trade-off</li> </ul>	Cattell, D. W. (1984)
	Tong-Lu's Model	<ul style="list-style-type: none"> <li>• Individual rate loading</li> <li>• Linear programming</li> <li>• Maximum/minimum rule</li> </ul>	<ul style="list-style-type: none"> <li>• Anticipated quantity variation of orders</li> </ul>	Tong, Y. and Lu, Y. (1992)
Balanced Pricing	Friedman's Model	<ul style="list-style-type: none"> <li>• Use of mathematics to determine the probability of winning a closed tender bid</li> </ul>	<ul style="list-style-type: none"> <li>• Contractor's knowledge of the competition</li> <li>• A known number of competitors</li> </ul>	Friedman, L. (1956)

(Source: by the author)

Low-priced bids may earn the contractor huge profits. On the other hand, if they turn negative, it puts the client under a significant financial burden by challenging the economic stability of the project through poor quality work and heightened corruption (Prajapati & Bhavsar, 2017). There are models capable of identifying a combination of item prices that can generate high profit for the contractor at the client's and the project's expense, as shown in Table 5.3. Nikpour, Senouci and Eldin Technique

Nikpour et al. (2017) developed an innovative detection tool for identifying-unbalanced bidding in unit price contracts during the evaluation stage. The technique uses the Bid Markup Distribution Index (BMDI) graphs to visualize markup distribution in the project lifecycle and the Monte Carlo simulation to evaluate the impact of cost uncertainties and other related pricing risks. The method enhances the detection of unbalanced bids over and above mainly applied qualitative methods that can be unreliable and time-consuming.

#### **5.5.1 Prajapati and Bhavsar Technique**

Prajapati and Bhavsar (2017) propose the adoption of a Unit Quantity Contract to mitigate against unbalanced bidding. They suggest a technique of providing the bidders with only a unit quantity for all line items whereby the bidders only have to quote only the rates for the items and submit a bid. The client will then calculate the price by multiplying the estimated quantities with the rates to establish the lowest evaluated bidder. However, this technique does not eliminate the opportunity for collusion between a bidder and the estimator.

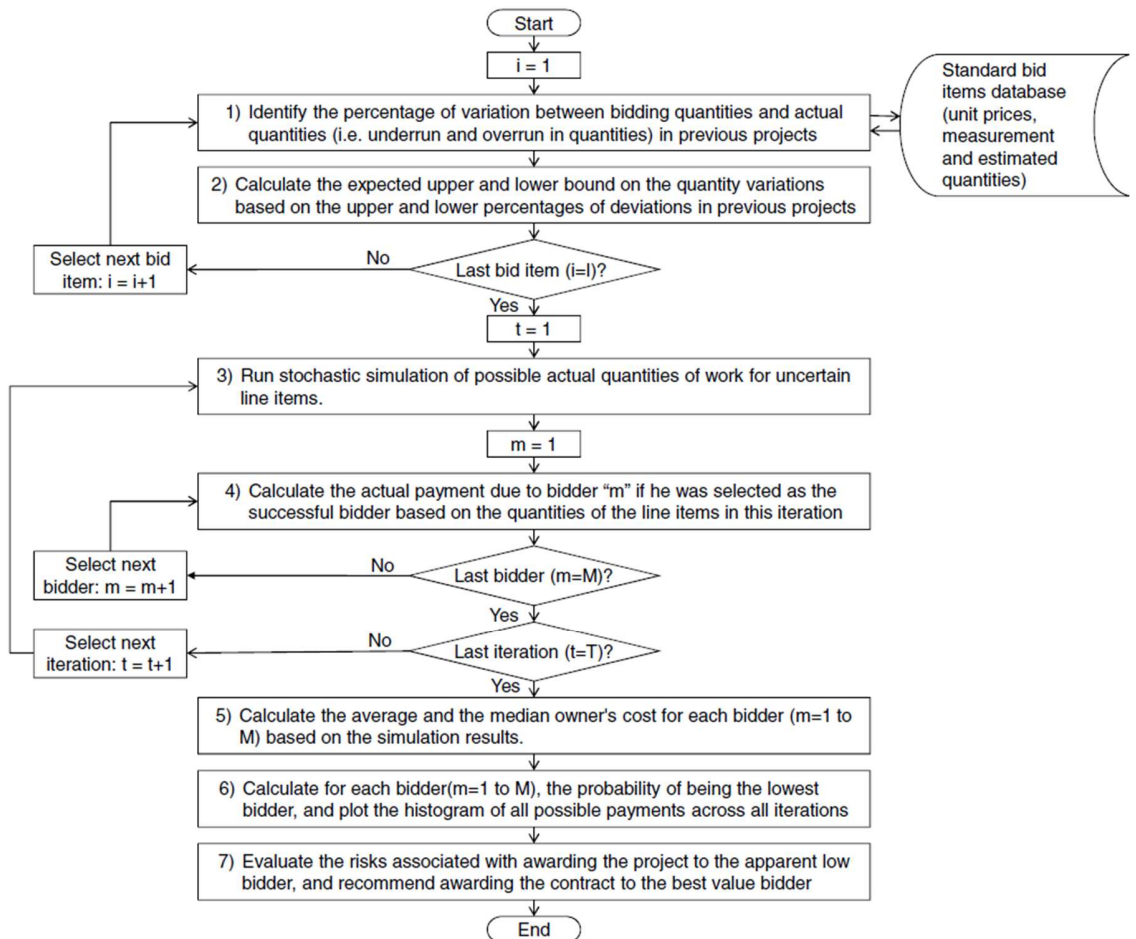
**Table 5.3 Price calculation methods for construction works**

Author	Price determination method/tool	Attributes considered	Comments
Nový et al. (2016)	Retrograde calculation pricing method	<ul style="list-style-type: none"> <li>• Overall costs</li> <li>• Cost of living</li> <li>• Profit</li> </ul>	<ul style="list-style-type: none"> <li>• Limited application</li> <li>• Difficulties in authenticating sub-items</li> </ul>
Pokharel & B. Pokharel (2018)	Markup pricing method	<ul style="list-style-type: none"> <li>• Profit margin</li> <li>• Breakeven analysis</li> <li>• Overall Cost</li> <li>• Competition</li> <li>• Customers' value</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainties in the competition distort markup percentages</li> <li>• Difficulties in establishing accurate prices for sub-items</li> <li>• The basis for higher pricing</li> </ul>
Kamerschen (1975)	Target return pricing model	<ul style="list-style-type: none"> <li>• Profit</li> <li>• Target rate of return on investment</li> <li>• Overall cost</li> </ul>	<ul style="list-style-type: none"> <li>• Not ideal for open market situations</li> <li>• Dependent on assumptions and expectations</li> </ul>
Hinterhuber (2008)	Value-based pricing strategy	<ul style="list-style-type: none"> <li>• The perceived value of works</li> </ul>	<ul style="list-style-type: none"> <li>• Not ideal when a client is motivated by the price</li> <li>• Numerous implementation obstacles</li> <li>• Accounts for clients' perspective</li> <li>• Client value-driven approach leads to higher prices</li> </ul>
Toni et al. (2017)	Competition-based pricing strategy	<ul style="list-style-type: none"> <li>• Competitor's price</li> <li>• The competitive advantage of competitors</li> <li>• Degree of competition in the industry</li> <li>• Pricing strategy of competitors</li> </ul>	<ul style="list-style-type: none"> <li>• Does not significantly influence the company's profitability</li> <li>• Companies become forced to work with shallow margins</li> </ul>
Yu et al. (2013)	Price elasticity of quality (PEQ) model	<ul style="list-style-type: none"> <li>• Profitability of the contractor</li> <li>• Contractor's competitiveness</li> <li>• Project quality level</li> <li>• Overall cost</li> <li>• Contractor's capabilities</li> </ul>	<ul style="list-style-type: none"> <li>• It does not consider external factors such as the number of competitors</li> <li>• It does not account for opportunistic bidding behaviors</li> <li>• Dependent on assumptions</li> </ul>

(Source: by the author)

### 5.5.2 Hyari, Tarawneh and Katkhuda Model

Hyari et al. (2016) proposed a model for detecting unbalanced bids that quantified the risk arising from deviations of actual quantities from the estimated ones (Figure 5.4). Furthermore, the model considers the impact of multiple uncertainties on line items. The model utilizes historical project quantity deviations to estimate and forecast future variations. The model authenticates the lowest bidder by incorporating uncertainties in quantities in the evaluation to identify objectionable unbalanced bidding. The model can quantify the impact of deviation in actual amounts in unit price contracts by deploying the Monte Carlo simulation.

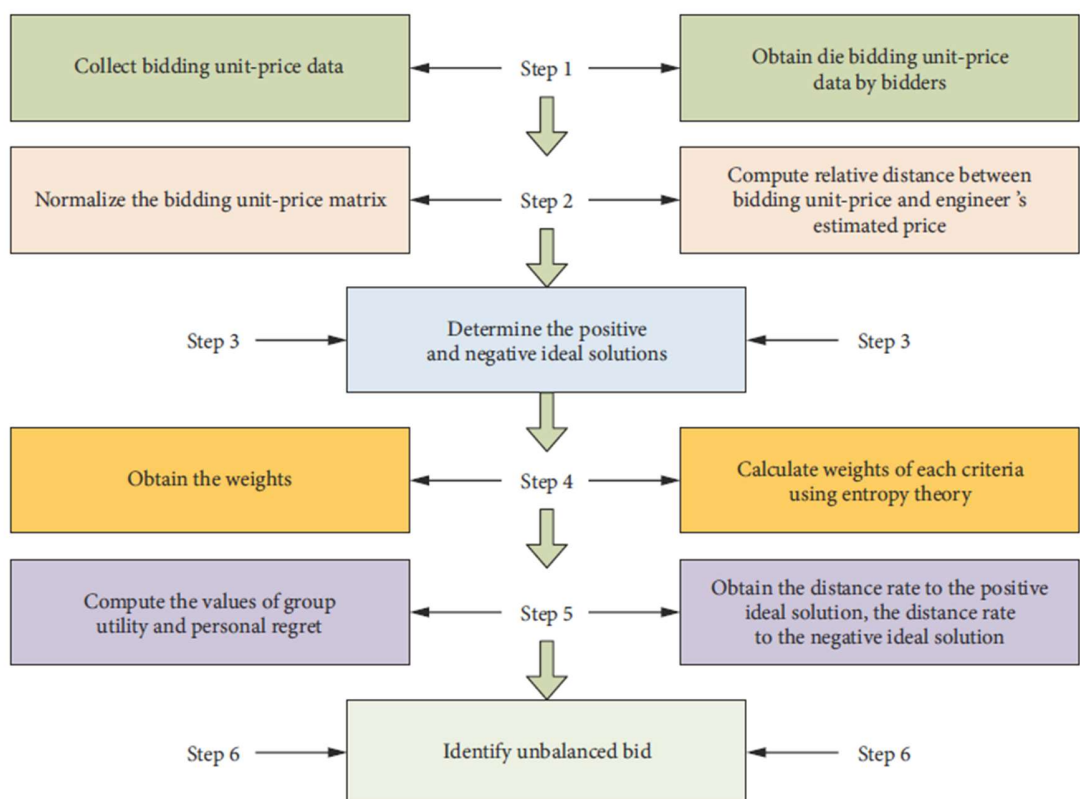


**Fig. 5.4:** Unbalanced bid detection model

(Adapted from Hyari et al., 2016, p. 4)

### 5.5.3 VIKOR Model

The VIKOR model is a multi-criteria decision-making method for developing rankings and alternatives following the closeness to the ideal values. After defining the positive and negative perfect points, the model adopts information entropy weightings to normalize the evaluation information matrix (Su, et al., 2020). According to Su et al. (2020), the VIKOR model utilizes the engineer's estimates as a benchmark for the analysis in which line items and bidders are alternatives and criteria. Figure 5.5 shows their steps for the unbalanced bid identification process.



**Fig. 5.5:** The framework of the VIKOR model for the detection of the unbalanced bid

(Adapted from Su et al., 2020, p. 47)

## 5.6 Chapter Summary

The Chapter reviews the literature on construction pricing methods, techniques, frameworks, and strategies adopted in construction. The review shows that current literature broadly addresses pricing in the construction industry through a cost-based perspective of the contractor. This knowledge gap entails that literature restricts itself to managing construction prices after tendering. The review has also highlighted several complex pricing and price calculation processes that may be either too complicated or time-consuming for a bidder at the time of bidding. The literature also shows that inherently numerous attributes, most of them, are difficult to measure quantitatively and, in practice, unpredictable affect price. These attributes, unfortunately, have a profound impact and influence on the bid price. Other observed knowledge gaps are as follows:

1. The actual pricing complexity for a contract makes models based on a handful of inputs unreliable and inaccurate. Existing models focus significantly on markup rates or percentages whose determination is subject to uncertainties and individual assumptions. Therefore, there is a need to develop methods and frameworks that enable parties in construction to establish prices by considering various qualitative and quantitative factors.
2. No existing research proves, with certainty, that a particular pricing method reduces bid or tender price. Instead, they demonstrate a substantial breakthrough in assisting contractors in increasing their profitability and cash flow. There is a need to develop a model that encompasses the perceptions of the project owners or financiers and will assist the client in increasing their appetite for construction projects while achieving affordability.

## **CHAPTER 6: Contracting Models for Management of Construction Tender Price Inflation**

### **6.1 Introduction**

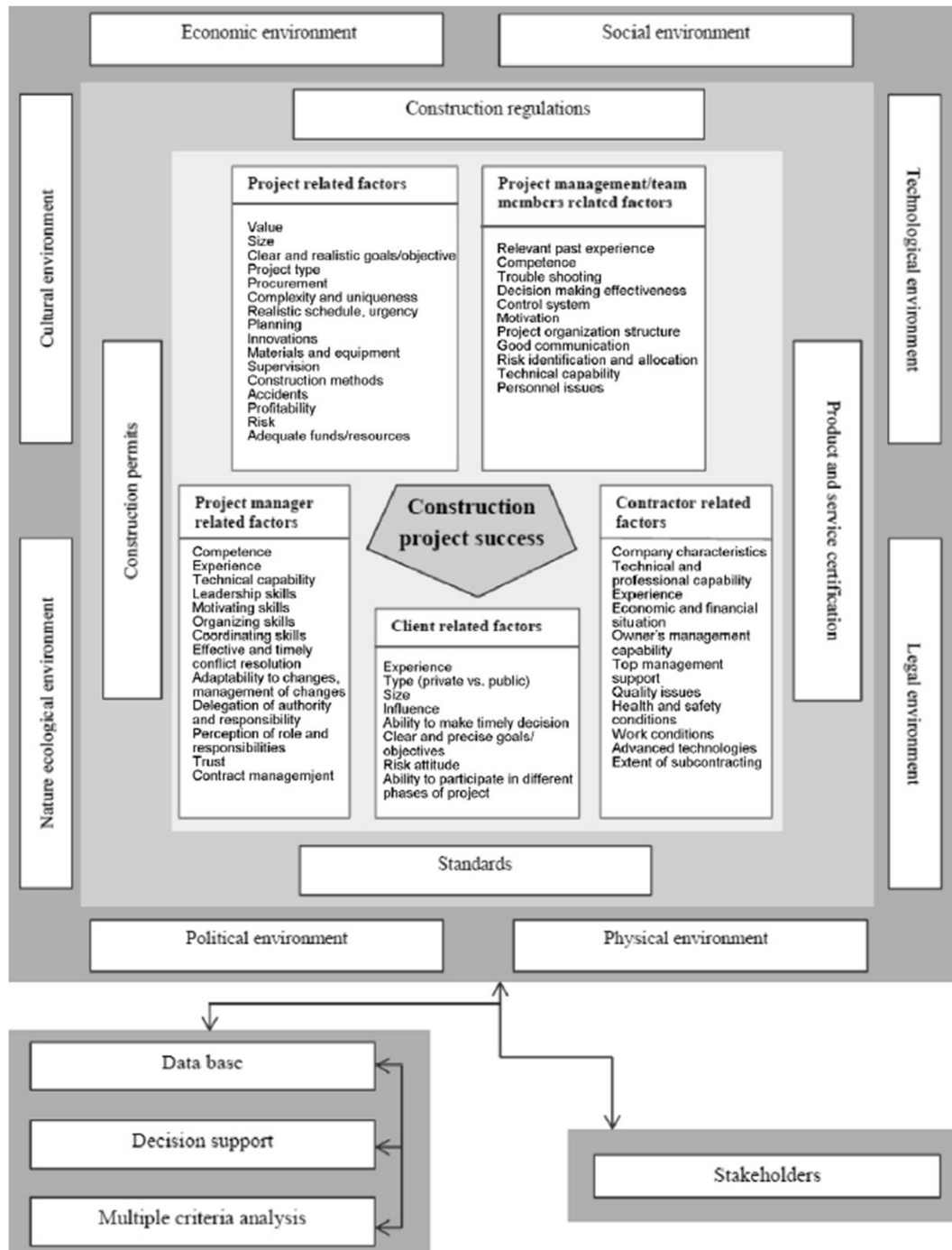
Construction-sector uses construction-cost indices or tender price indices for monitoring price movements. This monitoring measures relative change over time in construction materials prices. Cruywagen (2014, p. 25) argues that several factors influence the establishment and composition of the relevant tender price index. Such factors include the availability of data, selection of items to consider from the bills of quantities, selection of base year or period, choices of weights, and construction method. All these factors begin to affect the accuracy of the index. Once established, the index works as a deflator for construction prices. In a free market, the bidder presents an item price uniquely dependent on the construction technique (Cattell, et al., 2010). Through a literature review, this chapter aims to identify better, more effective, and more informed scientific fundamentals for price management by contractors and clients. The chapter also aims to gain better discretion regarding bidding risks and pricing management techniques in construction.

Construction projects face numerous unpredictable factors. Gudienė et al. (2013, p. 397) identified and classified these factors into seven influential groups, namely (Figure 6.1):

1. External factors
2. Institutional factors
3. Project related factors
4. Project team management-related factors
5. Project manager-related factors
6. Client-related factors and
7. Contractor related factors

To investigate how these factors influenced the success of a construction project, they developed a conceptual model (Figure 6.1) which grouped the project success factors. However, they did not perform a factor analysis to investigate the underlying

relationships among the elements. Project price is not among the factors identified for a possible multi-criteria analysis of alternatives for selecting a successful project.



**Fig. 6.1:** Critical success factors for a construction project  
(Adapted from Gudienė, et al., 2013, p. 395)

Despite the spate of studies aimed at improving construction management practices in Zambia, difficulties still plague the construction industry (Zulu & Muleya, 2018; Zulu et al., 2022; Tembo et al., 2023; Aigbavboa et al., 2018; Silwimba & Mwiya, 2017; Cheelo & Liebenthal, 2018; Chilongo & Mbetwa, 2017; Chiponde et al., 2017). Notable studies (particularly those by Zulu et al., 2022, Sibanyama et al., 2012 and Tembo et al., 2023) have identified challenges associated with implementing public projects. The public construction sector in Zambia formally exhibits relationships governed by contracts. However, accompanying these relationships between the government and the contractors are informal practices that progress to characterize unforeseen project implementation difficulties.

Joukar (2016) and Tembo et al. (2023) put forward challenges associated with tender price inflation in construction. Tender price inflation profoundly influences the financial sustainability of the construction sector. Tembo et al. (2023) demonstrate that the effects of the management of tender price inflation are across multiple fundamental dimensions, including the government, the contractors, the industry, the procurement, and the legal framework. This research, therefore, adds to the scientific knowledge, eventually informing management practice in the public construction sector and consequently providing strong empirical and theoretical support to tender price-oriented research. The study investigates factors affecting tender price determination in construction and current tender price controls in practice. The paper carries with it a particular focus on how contractors' prices for construction at tendering and highlights influential risk-related factors.

The study predicates that contractors use price to mitigate procurement-related risks at the tendering stage. Further, this research focuses on implementing procurement strategies considering price reduction implications at the project tendering phase. Ignoring this construction attribute leads to the development of contract delivery models that inadequately address the impact and potential value of pricing in construction projects. Therefore, they fail to establish possible strategies to overcome tender pricing inflation.

## **6.2 Factors affecting bid price in construction**

Evaluating bids is through a variety of criteria, but the key shared among the criteria is the total bid price; usually, considerations are that choosing a bidder with the lowest price is most beneficial to the client (Jaśkowski & Czarnigowska, 2019). Jaśkowski and Czarnigowska (2019, p. 159) argued that the public sector is inclined to use the approach of lowest price bidding or low bid model to make contract awards due to perceived monetary benefits of transparency while overlooking facts that the practice results in;

1. low quality of works
2. claims
3. disputes
4. time overruns
5. bid-rigging
6. increased costs
7. unrealistically low price
8. collusion

There are related factors in the pricing of each item in construction (Azizi & Aboelmagd, 2019). The main challenges to contractors come with identification methods by measuring the risk rate within an item price loading and achieving the highest profitability while accepting the most negligible risks (Azizi & Aboelmagd, 2019). Another concern when pricing for a bid is that the awarding of a construction contract depends on the total bid price. Mostly without considering the variations in the item's unit price: a scenario that leads to contractors' deliberate manipulation of unit prices (Nikpour, et al., 2017). Olawale and Sun (2010) found that price inflation was one of the significant factors that affected cost control on a project. Furthermore, they argued that price fluctuation and inaccurate estimates were the top variables causing cost overruns on a project.

The ability to deploy strategies productively and effectively has a cost-decreasing impact. In the public-construction sector, developing and setting appropriate tender conditions following an in-depth investigation of how the factors affecting pricing

mechanisms correlate enhance this ability. Table 6.1 show factors obtained through the literature review that affect bid pricing decision in the construction sector.

### **6.3 Risk pricing in public-construction**

When risk factors are uncertain on a project, contractors face the challenge or problem of deciding the bidding price for construction. The existing theoretical principles of project risk management lack more realistic considerations. This situation leads to unclearly allocated and unreasonably priced risks at the project onset (Zhang, et al., 2006). At the tendering stage, one of the main risks for consideration is the financial position of the client in such a manner as being unable to pay the contractor on time: A scenario often leading to project delays and wrong cost estimations (Naji & Ali, 2017). The failure of a construction firm to fully consider or estimate the risk event on a construction project could have a disastrous impact. Construction enterprises are conscious of this scenario, and due to a lack of appropriate knowledge on risk pricing and mitigation measures, they often subsequently overestimate their markups. This practice causes construction prices to escalate over time.

Laryea & Hughes (2008) found no evidence suggesting that construction project pricing was systematic. Therefore, they doubted the justification of pricing models for contractors as their final price depends on a varying range of complex microeconomic indicators and risk factors. The argument is on efficient pricing for risk while encountering and estimating various contingencies. Contractors remain aware of the nature of the construction industry in which all competitors are “hungry for a job” such that if they were to consider and price for all realistic contingencies, they would remain uncompetitive. Table 6.2 shows some risk factors contractors must contend with during bidding pricing.

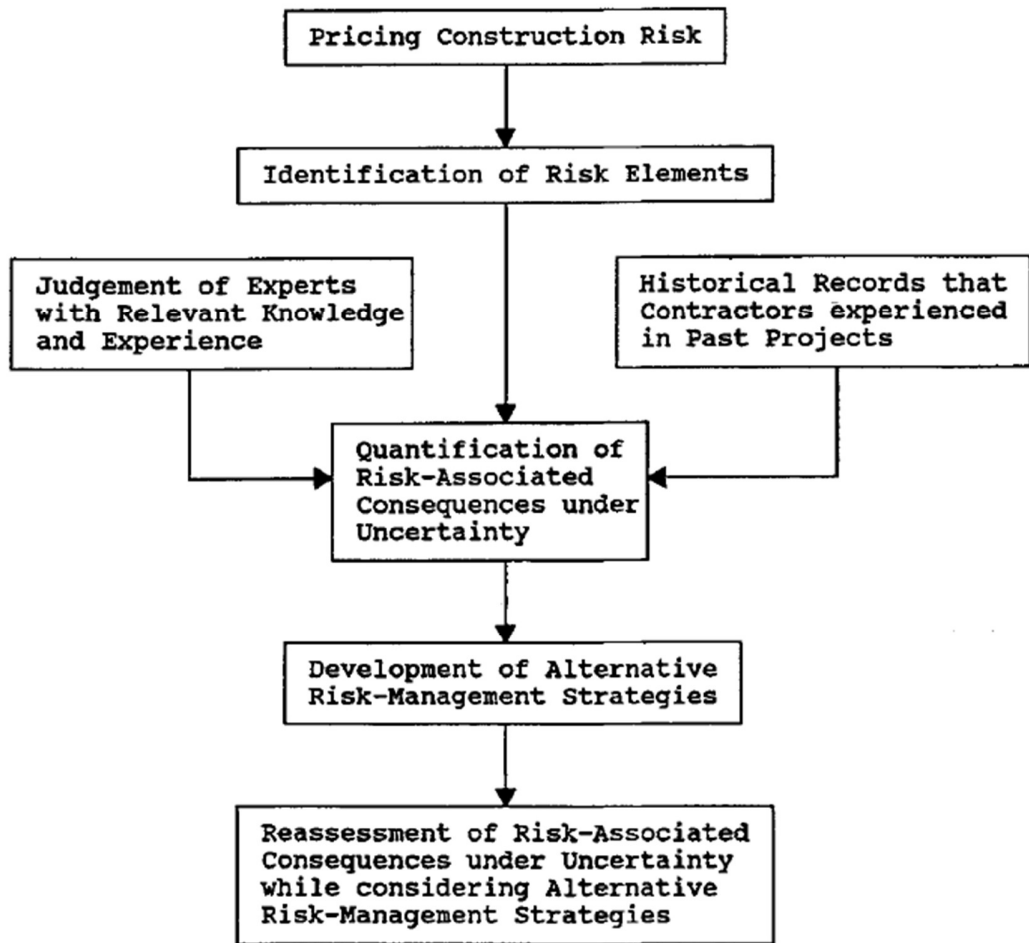
Paek & Lee (1993) proposed a risk pricing method for analyzing and pricing construction projects, which consisted of identifying risk factors and pricing for their consequences. They suggested using a fuzzy set approach to quantify the implications and directly incorporate them into the bid price. Their research developed a framework (Figure 6.2) for assisting contractors in making valid estimations in the presence of uncertainty through their risk-pricing method. They adopted a fuzzy set theory to

present a risk-based pricing algorithm and computer-based software. However, since the selection of risk factors is project specific, the algorithm could not formulate generalizations. Therefore, it is advisable to ensure that all risk elements whose consequences might fatally flaw the project identification are priced for during the tendering phase accordingly (Paek & Lee, 1993). However, Laryea & Hughes (2008) argued that most models and pricing methods are desk-based and lack knowledge of what contractors do during the bid pricing stage.

**Table 6.2 Risk-related factors during pricing in construction**

Risk factor(s)	Author
Value of liquidated damages	Towner & Baccarini (2012)
Clients' financial state	Naji & Ali (2017)
Project cost risk (range between 2.7% and 8.7% of project cost)	Xu (2014), Brokbals, et al. (2019)
Technical information or detailed specifications	Nketekete, et al. (2016)
Practical knowledge of the construction process	Akintoye & Fitzgerald (2000)
Contractor size	Dulaimi & Shan (2002)
Market competition	Laryea & Hughes (2008)
Contingency additions	Dada & Jagboro (2007)
Apportionment of contractual responsibilities	Al-Ajmi & Makinde (2018)
<ul style="list-style-type: none"> <li>• Material availability</li> <li>• Labor productivity</li> </ul>	Aje et al. (2016)
Project scope	Dziadosz, et al. (2015)

(Source: by the author)



**Fig. 6.2:** Framework for pricing construction risk

(Adapted from Paek & Lee, 1993, p. 747)

#### **6.4 Construction tender price control**

Tender price management is an essential consideration for bid success; however, complex pricing interrelationships make it much easier to generally express construction project success in terms of cost and budget variance (Yismalet & Patel, 2018). This trend, over time, has shifted the long-term focus to project cost management processes. In addition, research shows that project success depends on mitigating factors affecting tender pricing at the procurement stage. Aje et al. (2016) determined fifteen (15) factors that influenced the success rate of contractors in competitive bidding concerning tender price, which included material availability,

labor productivity, and profit as the most significant. These factors highly influence construction tender price (at tendering stage) and later significantly affect contractors' performance.

The dilemma with competitive bidding is that the bid price must be low enough to win the bid yet high enough to ensure the contractor's profitability and reasonably sufficient to guarantee the quality of work. That is when the cost estimation function becomes essential, as it is the basis for most contractors to build their tender price (Akintoye & Fitzgerald, 2000). It is equally imperative to note that the availability of funds influences the client's decision to award a contract, the contractor's price, as well as prices of other contractors. Excessively, the parties in construction view construction price through the understanding of and emphasis on project cost. Hence, related approaches to price control are cost control measures through contracting delivery models (Table 6.3). Clients resort to employing delivery models such as EPC to manage construction prices and are slightly more regular (Zhong, 2011).

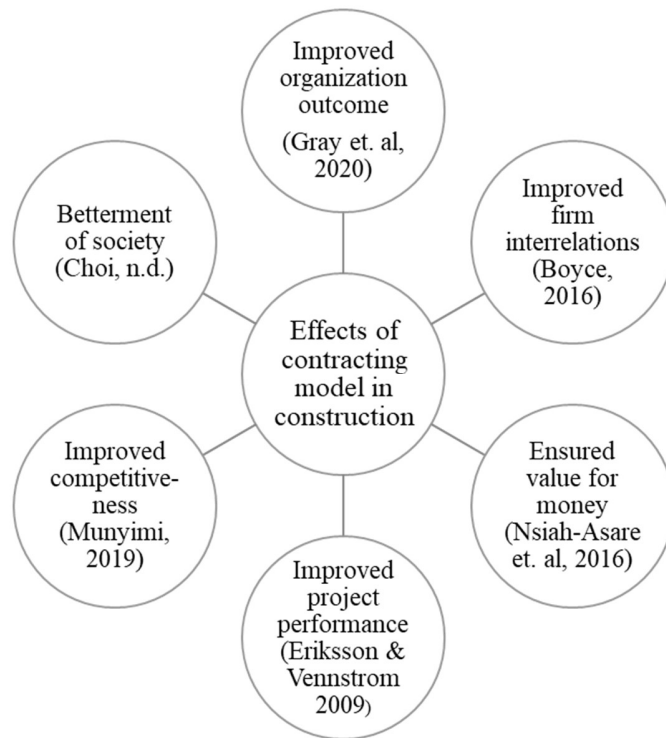
### **6.5 Effects of a contracting model on cost level**

Initiating procurement quality controls generate improved competitiveness from a price viewpoint through the value-added competencies of the procurement function. In construction, procurement quality controls allow for significantly high procurement performance leading to the best possible price to meet the client's needs (Munyimi, 2019). However, procurement functions in the public face numerous challenges (Table 6.4). Unique challenges include a significant lack of empirical research on the impact of public procurement systems on price or cost levels in the construction sector. Gray et al. (2020) argue that current procurement decisions are too focused on cost minimization at the expense of stakeholder value. They propose a new approach known as "total value contribution" (TVC) as an extension of "total cost of ownership" (TCO) methods that broaden the factors during a procurement exercise. They argued that putting value first through procurement would increase organizational outcomes. Figure 6.3 shows the effects of procurement as obtained from the literature review.

**Table 6.4 Challenges faced by public procurement**

<b>Challenge(s)</b>	<b>Author</b>
Failure to implement a procurement system	Fourie & Malan (2020)
Inadequate policy and lack of innovation	Uyarra & Flanagan (2009)
Inability to implement change management	Ateto et al. (2013), Mohamed (2016)
Poor organizational structures and processes	Tsuma & Kanda (2017)
<ul style="list-style-type: none"> <li>• Poor procurement planning</li> <li>• Lack of procurement competence</li> </ul>	Onyango (2014), Musa, et al. (2014), Ambe & Badenhorst-Weiss (2012)
Inadequate specifications	Munyimi (2019)
Corruption	Eyo (2017), Ambe & Badenhorst-Weiss (2012)
<ul style="list-style-type: none"> <li>• Excessive Bureaucracy</li> <li>• Political interference</li> </ul>	Boatema-Yeboah (2019), Sukasuka & Manase (2016), Musa, et al. (2014)
Inadequate or lack of ICT infrastructure	Riziki (2018), Modisakeng, et al. (2020), Maleki, et al. (2020)
Failure to ascertain value for money	Sukasuka & Manase (2016)
Poor organizational culture	Musa, et al. (2014), Kiama (2014)
Lack of project management skill	Kabanda, et al. (2019)
Poor resource allocation	Hamza et al. (2016)
Lack of transparency	Anane & Kwarteng (2019), Pooe, et al. (2015)
<ul style="list-style-type: none"> <li>• Lack of training</li> <li>• Lack of capacity</li> <li>• Failure to comply with procurement policies</li> </ul>	Pooe et al. (2015)
Procurement malpractices	Kedir & Ganfure (2020)
<ul style="list-style-type: none"> <li>• Lack of knowledge</li> <li>• Knowledge gap</li> </ul>	Rais et al. (2018), Ngunjiri (2019), Ambe & Badenhorst-Weiss (2012)
<ul style="list-style-type: none"> <li>• Inadequate monitoring and evaluation</li> <li>• Noncompliance with regulations</li> <li>• Over-decentralization of a procurement system</li> <li>• Lack of accountability</li> </ul>	Ambe & Badenhorst-Weiss (2012)
<ul style="list-style-type: none"> <li>• Instability generated by electoral cycles</li> <li>• Lack of prioritization</li> </ul>	Delmonico et al. (2018)
<ul style="list-style-type: none"> <li>• Tendency to maintain current practices</li> <li>• Lack of long-term planning</li> </ul>	Durdyev et al. (2018), Blanco-Portela et al. (2018)

(Source: by the author)



**Fig. 6.3:** Effects of a contracting model in construction (*By Author*)

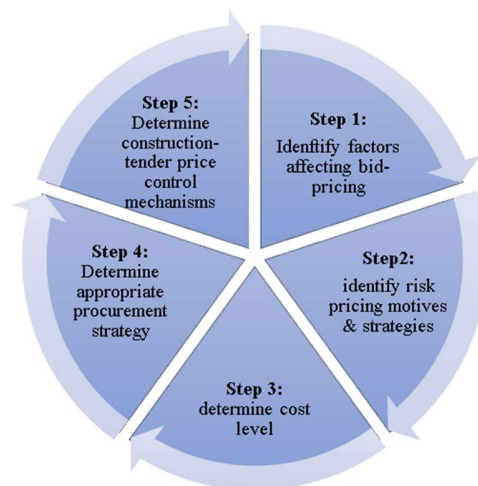
## 6.6 Chapter discussion

An evaluation of the literature findings shows the complexities of establishing adequate controls for managing construction tender pricing. Nový et al. (2016) argue that a precise determination of construction tender price is essential for project success. However, the process is tedious and insists on developing correct tools for pricing based on a specific situation. Figure 6.4 presents a continuously improving construction tender price management process following a relevant literature review on the subject matter. The method includes at least five separate steps:

1. Step 1: involves identifying all factors affecting construction-bidding price. This step allows an institution to develop an understanding of both internal and external factors. This step starts from identifying predetermined objectives of bidders to existing economic conditions at a particular time.
2. Step 2: This step draws down the most significant project-specific risk-pricing factors, which according to Baccarini (2012), may include the type of contract,

type of procurement method used, value of liquidated damages, completeness of documentation, current workload, etc.

3. Step 3: involves deriving cost-per-unit information to set prices to generate profits adequately. This step allows the bidder or client to derive variable and fixed costs. Consideration of direct material costs, greater-volume discounts, additional capacity, etc., constitute prudent choices. During this step, Oberholzer & Ziemerink (2004) perfectly underscores the significance of the “high-low method” in determining cost levels.
4. Step 4: Literature findings by Laryea (2018) and Ekung et al. (2013) best prescribe essential issues of concern regarding this step to include flexibility, quality requirements, payment certainty, price-competition, problems of autonomy and responsibility, dispute resolution procedures, and project duration.
5. Step 5: This step requires a government economic policy of imposing floors (minimums) and ceilings (maximums) to public construction prices at both materials and services level to make them affordable and reflective. A study by Majumdar (2003) discusses this step in detail and proposes using and adopting price controls as incentive mechanisms to achieve social-economic benefits.



**Fig. 6.4:** Construction-price management process

(Paek & Lee, 1993; Gudienė, et al., 2013) (By author: based on a literature review)

## 6.7 Chapter Summary

This chapter reviews the literature on investigating factors affecting tender price determination in construction and current tender price controls in practice and explores some effects of public procurement. The review carries with it a particular focus on how contractors' prices for construction at tendering and highlights influential risk-related factors. Specific knowledge gaps found in the literature include the following:

1. The review indicates that contractors use price to mitigate procurement-related risks at the tendering stage. Further, much research explores project risk-related issues from the project implementation perspective. This research gap hugely ignores the implementation of procurement strategies that consider price reduction implications at the project tendering stage leading to the development of contract delivery models that inadequately address the impact and potential value of pricing in construction projects. Therefore, they run short of establishing possible strategies to overcome overpricing.
2. Correspondingly, these models present corrective, preventive, and organizational measures to cost control while lacking a predictive approach that can effectively begin to ensure advanced bid-price control.
3. The study also observes an application gap for construction regarding using price-control incentive mechanisms. Zhang & Jian-li (2016) highlights the fundamental benefits of price-control incentives by developing an incentive-regulation model that governments can use to maximize social gains from an infrastructure project by deriving accurate technical parameters, optimal investments, and effort.

## **CHAPTER 7: Theoretical and Conceptual Frameworks**

### **7.1 Introduction**

Key definitions arising from the statement of the problem and research questions informed the development of the theoretical framework. The problem for this study state, “The soaring construction tender prices are threatening the infrastructure push in the public sector as the effects of escalating tender prices begin to outweigh the socioeconomic benefits derived from such infrastructure. If not addressed, the construction sector productivity will lag behind other economic sectors, thereby decreasing the sector’s value in the national economy”. Key definitions in the statement included:

1. Escalating construction tender prices
2. Outweighed socioeconomic benefits
3. Slowed construction sector productivity

The concepts of “construction-price inflation,” deriving “socioeconomic benefits” from infrastructure development, and “increased construction push” for sustained economic growth were categorically central to this study. Figure 7.1 develops relationships summary between concepts and relevant ideas, including:

1. Escalating construction tender prices – the agency cost theory
2. Outweighed socioeconomic benefits – resource-based theory
3. Slowed construction sector productivity – volume-based theory

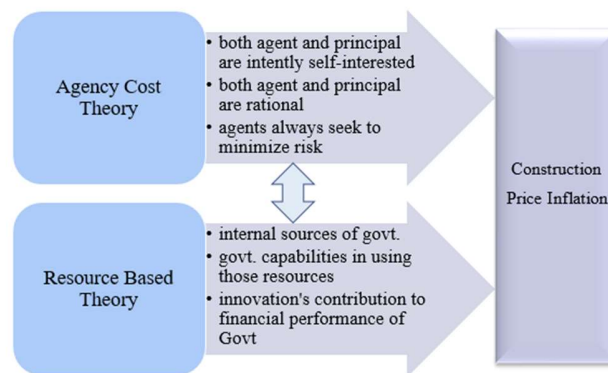
The study focused on the following:

1. testing whether these theories applied to Zambia’s construction sector context, and
2. using these theories as a basis for the interpretation of study findings

### **7.2 Theoretical framework**

The study organizes its theoretical framework in two sections (Fig. 7.1). The first section involves the agency cost theory that attempts to reveal numerous factors that influence construction price inflation from the aspect of the contractor. The second

section highlights the importance of the resource-based approach enhancing the roles and involvement of government and highlighting the institutional perspective. This study examines and develops relationships between construction industry actors in addressing construction price inflation. The agency cost is crucial in the study because it allows the research to investigate concepts such as interaction, environment, and behavior, thereby assisting the research in examining the thought processes of public construction agents. The resource-based theory allows the study to determine the government functioning model and reveal the strategies and role of government through public-infrastructure delivery aspects.



**Fig. 7.1:** Theoretical Framework (Source: Author)

### 7.2.1 The agency cost theory

The Agency Theory assumes that (1) both agent and principal are intently self-interested, (2) both agent and principal are rational, and (3) agents always seek to minimize risk (Bosse & Phillips, 2016). The theory explains how the principal (government) engages an agent (contractor) to execute construction works. In addition, it attempts to reconcile the goals and objectives of the agent to those of the principal. The idea is essential in managing contractors on construction sites as it tries to address principal-agent risk tolerances (Markowitz, 2005). The Agency Theory presents the client with a rational contractor who, instead of “furthering their interests, is aiming to maximize their usefulness” (Glinkowska & Kaczmarek, 2015, p. 88). This Theory explains the specific behaviors of construction contractors that collectively create financial problems in public infrastructure delivery. “Essential features of the agency problem are that the interests of the principal and agent diverge, resulting in

unmeasurable and significant costs and inefficiencies ultimately borne by society” (Bosse & Phillips, 2016, p. 276).

Today’s agency theory assumes the pursuit of self-interests at any cost due to “simplistic and unrealistic premises which constitute the basis of the theory” (Kultys, 2016, p. 632). To be of benefit to the public, Kultys (2016) suggests numerous additional requirements for reshaping relationships between the principal and the agent. The theory structure does not sustain nor necessarily protect the public from competing self-interests. Kathleen M. Eisenhardt (1989) concluded that agency theory is an empirically valid perspective that offers an exceptional perception of sector uncertainty and risks only when coupled with complementary perspectives. Governments (clients) must realize that the lack of balancing views in applying the theory makes it narrow and dangerous. Hence, there is a profound need to utilize the theory in examining and realigning the relationship between clients and contractors by focusing on the theory’s strengths, weaknesses, opportunities, and threats.

Today’s challenges in public sector construction projects subsequently exposed severe dysfunctions in government-contractor relations that are inspiring to scrutinize the theoretical and practical components of the agency theory applicability. The theory remains an undisputedly popular approach to implementing public infrastructure projects. Yet “normatively and theoretically, the theory is more problematic than is usually recognized” (Widmalm, 2016, p. 127). Problems in the public construction sector have arisen within the ‘nexus of contractor’s bids’ that characterize the modern tender pricing procedures where contractors act to control costs by maximizing firm profits. This gap leads to a central area where contractors’ interests have likely diverged from the employer’s. Accordingly, Sanfelix and Puig (2015) argued that applying Agency Theory is merely successful in traditional sectors with easily standardized processes and procedures.

### **7.2.2 Resource-based theory**

The competitiveness in the modern construction sector depends on one’s ability to utilize the knowledge and sufficiently exploit knowledge flows within the organization

(Villasalero, 2016). This theory posits that organizations should look internally to build that competitive advantage through their resources. The resource-based theory states that the possession of resources is valuably inimitable, rare, and challenging to substitute (Chuang & Lin, 2017). Therefore, governments need to develop and utilize their knowledge flows to benefit from their existing inimitable resource base within the public construction sector instead of relying on contracting out all public works. This relational view places governments in some global competition to deliver public infrastructure through linkages or networking (Wong, 2011). The idea encourages governments to tap into other firms (contractors) to meet their obligations by mobilizing external resources in construction.

The resource-based theory of competitive advantage, if used as a framework for innovative implementation of public construction projects, should work in favor of the government, for it possesses many valuable resources. The theory argues that support and sustainability of internally executed public infrastructure are attainable through (1) utilizing internal resources of government, (2) enhancing the government's capabilities in using those resources, and (3) ensuring innovation's contribution to the financial performance of government (Holdford, 2018). Governments are in a good position to implement accessible composite frameworks or models that elaborate the natural relationship between resource-based and knowledge-based views in developing specific assets and ensuring that society benefits fully from that unique competitive advantage (Theriou, et al., 2009).

The resource base makes valuable contributions, particularly when formulating strategic alliances with contractors based on rationale and performance (Das & Teng, 2000): in line with support to transactional price economics in public construction projects by utilizing the government's internal resources. Governments can harness both their tangible and intangible resources, leading to unprecedented competitive advantage and creating certain societal benefits by regularly interrogating perspectives of their resource-based views. Under the Resource Based Theory, governments can perform better if they internally implant public construction projects because they hold valuable assets and unique characteristics.

## **Other relevant theories**

### **7.2.3 Volume-based theory**

In volume-based allocation, costs allocation to cost items is under the volume of direct labor costs or contract amount. A company's pricing policies constitute critical aspects influencing profitability at a given cost level. Toni et al. (2017) argue that most have ignored the importance prices take in organizations. Construction-sector selection criteria emphasize contract tender prices inevitably increasing price competition. Hence, price discrepancies have become apparent in public construction projects due to a lack of "contractor relationship management that can help protect against direct price competition" (Passyn, et al., 2013, p. 413).

However, the nature of the construction industry in Zambia does not seem to follow the fundamentals of the volume-based theory. Even contractors with vast volumes of work do not seem to bid at lower prices; in short, there is no significant correlation between volume change and price change (Podobnik, et al., 2009). Instead, it is the opposite, such that new sector contractors with almost zero volumes of work are tender with low prices for market entry strategies. The theory's applications in the public construction sector are almost mainly nonexistent because it is a theory of accumulation and distribution.

### **7.2.4 Post-Keynesian pricing theory**

Post-Keynesians posit that inflation originates in the markets for labor and raw materials. For output between capital and work to be acceptable, "industries with below-average productivity growth should be allowed to raise their prices: and industries, where productivity was growing faster, should be required to reduce prices so that the overall price level remains roughly constant" (King, 2013, p. 497). Herr (2009) found that costs through "mark-up pricing and a direct price-price effect or in the case of wages determine price level in equilibrium—creating a direct wage-price effect" (Herr, 2013, p. 13) such that all firms in a particular sector increase prices when confronted with higher costs. In a closed economy, they will do so. Public construction projects focus on production costs as the primary determinant of price and emphasize that exchange value is more relevant to price formation than use value. In that vein, a

public construction project contains both the valuable purposes in society and the effort by the government needed to produce.

Since construction firms consider the utilization of productive capacity in setting their prices, price stability should be associated with a standard capacity utilization rate. In the construction sector, firms with low-capacity utilization develop high-pricing strategies to offset the abnormal capacity utilization rate (Dutt & Scot, 2005). In most sectors, price is a function of disequilibria between supply and demand. In the public construction sector, the post-Keynesians consider price as constant or at least as a function of market power. Prices in the construction sector are not necessarily sensitive to demand hence the support for central fixing prices. Because in construction, prices are set according to markup procedures and are a direct function of costs as opposed to demand.

The danger of unpredictable and ever-escalating prices in the public construction sector could lead to governments slowing down their implementation of infrastructure projects to save money for other sectors. In an uncertain and unknown world, the Post Keynesians demonstrate that governments (political and economic agents) and other economic agents prefer to retain money rather than make investment decisions. The preference results in the possibility of unemployment because of the insufficiency of adequate investment. Through the concept of uncertainty and “Considering the idea above, the Post Keynesian and institutionalist theories try to answer the when do they retain (or decide not to retain) money while making rational decisions?” (Ferrari-Filho & Conceição, 2005, p579).

### **7.2.5 The labor theory of value**

This dissenting theory argues that the economic value of a good or service is determined by the total amount of labor socially required to produce it by assuming that prices have an orderly relationship to the value of goods and services (Foley, 2000). This theory still does not explain how labor value transforms into market prices and how to reduce from one abstract value of labor that consists of all different forms of labor (Rössel, 2017). Generally implied, the validity of the labor theory of value is in a state where there is no exploitation. It arises from perfect competition in which

relative prices equate to the ratio of marginal labor values (Hagendorf, 2014). Governments and most political philosophers, thus, assume a state of perfect competition when they implement public construction projects intending to create employment. As argued by Rössel (2017), it may not be necessarily true due to linearity problems of value conversion or transformation into market prices that render value irrelevant since one does not need to know the value to explain price and profit. Thus, it is difficult to agree on the significance of this relationship between labor and value in the construction industry because there is a considerable variety of ambiguous interpretations on the subject of the labor theory of value. This is more so since, in the case of construction, the “value of work is determined by the socially necessary labor time required for its execution” (Henninger, 2007, p158). In Zambia’s public-construction sector, the device of measurement used by contractors allows prices to repeatedly exceed the labor value perpetuating a consequence in which the labor theory of value ceases to make much analytical sense. Construction clients must adopt the labor theory of value to create renewed focus or concertation on tender price by adopting approaches that ascertain contractors’ cheating on prices. Comparative statistics can become helpful in reading the respective price against what it was at a given time in the past.

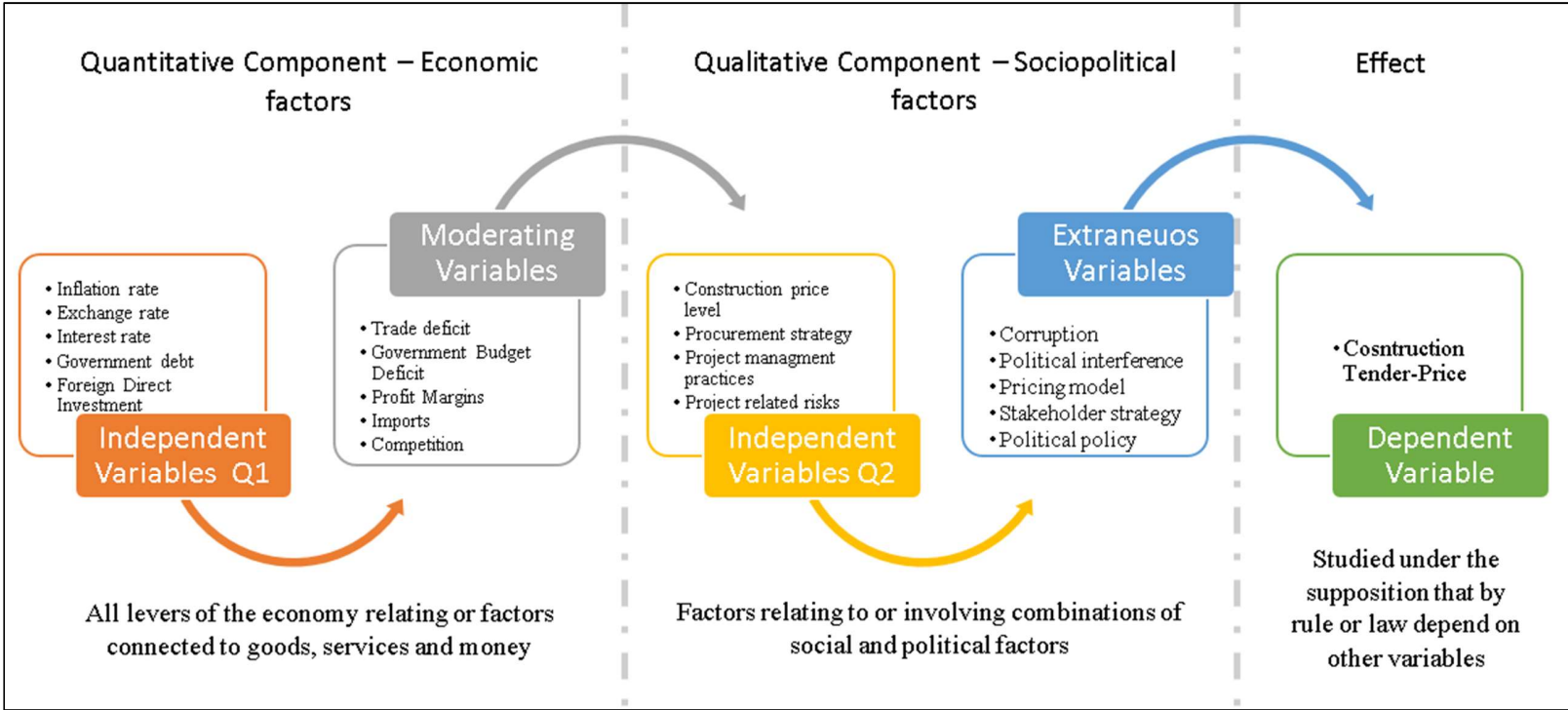
#### **7.2.6 Ricardo’s surplus-based theory of profits**

It is futile for governments to implement more public infrastructure projects to create more employment and economic value because “only those industries which directly or indirectly contribute to the production of wage goods matter” (Kurz, 2009, p1). After human labor has created economic value in society, surplus labor remains, producing surplus value. To make a profit, the capitalists exploit laborers to appropriate this surplus value, made even more possible by inventing machine power that takes over more significant amounts, requiring an increasingly complex-labor power process (Kurz, 2018). The theory defeats the aim of creating employment by implementing more and more public construction projects since the surplus labor, if any, only ends up being financially exploited by the contractors for surplus profits.

The equalization of contractors' profits through competitive tendering and the labor theory of values thus create problems for advancement in the political economy by infrastructure delivery. The two issues defeat governments' perspectives on the concept of income distributions in society because of exploitation and tender prices that are perceptibly greater than the product's value (Piva & Vivarelli, 2017). The exciting part about public service delivery in Zambia is that it does not seem to agree with the more comprehensive economic rationale whereby innovations involve workers' displacement. Yet, these innovations cannot lead to a decrease in the unit costs of production to effect decreasing prices. Decreasing prices stimulate new demand for public infrastructure projects and create additional production and employment (Piva & Vivarelli, 2017). No amount of public infrastructure projects supplied in the construction sector can depress work prices. Ultimately, the governments would collapse or purposively decrease the number of projects they embark on simply because it is challenging to distribute value already created through a system of competitive-tender prices (Ormazabal, 2011).

### **7.3 Development of the conceptual framework**

The study is developing a conceptual framework to describe critical concepts involved in grounding it firmly in theoretical constructs. The conceptual framework will make research finding more acceptable, meaningful, and generalizable by providing direction to the study. The research will use the frameworks (both abstract and theoretical) to ascertain its academic position and make the findings more appreciable as contributing to the body of knowledge. Figure 7.2 presents the conceptual framework guiding this research. Preliminary literature indicates that pricing in construction is influenced by macroeconomic indicators such as inflation quantitatively, exchange rate, interest rate, government debt, foreign direct investments, imports, trade deficits, budget deficits, etc. Other qualitative factors include but are not limited to the construction price level, procurement strategy, project management practices, project-related risks, corruption, political interferences, adopted pricing models, stakeholder management strategies, political policy, and extant legislative framework.



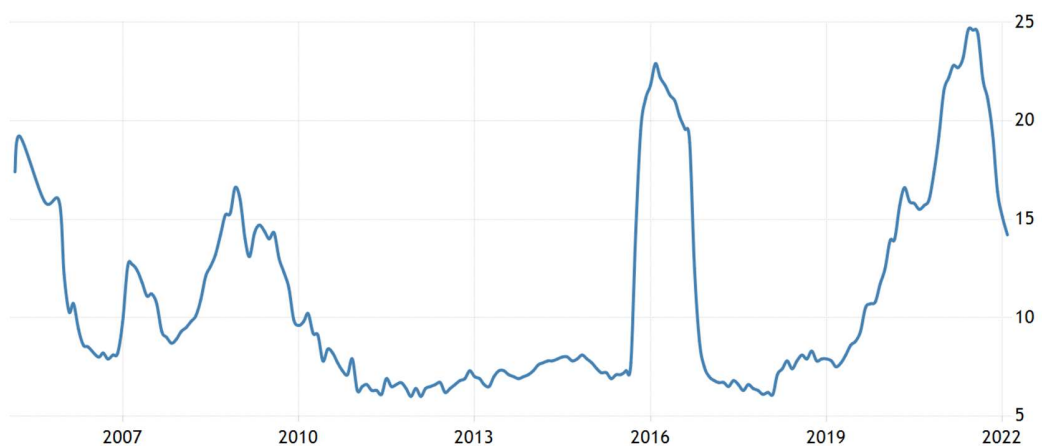
**Fig. 7.2:** Conceptual Framework (Source: Author)

## 7.4 Relations within the conceptual framework

Overpricing is a severe problem in Zambia's public construction sector. It is propagated further by a situation in which contractors have become more informed than the client (government). Contractors have an exaggerated understanding of cost impacts that create information disproportionateness with clients. Contractors skew unit prices and enhance profits by increasing the unit price of a quantity expected to go up and lowering the unit price of a portion expected to decrease. This predicament requires government as a client to optimize trend detection using already developed models. However, this requires empirical studies that capture the magnitude of the problem in Zambia's context. Unbalanced bidding is one potential pitfall of unit price contracting (Nyström, 2015). Unit price contracting is widely used in Zambia's public construction sector. It manifests by the client/government paying too much for the final construction product.

### 7.4.1 Inflation rate and price level

The annual inflation rate in Zambia went up to 10.5 percent in September 2019 (Figure 7.3) from 9.3 percent in the prior month. It is the highest inflation rate in almost three years amid rising prices. Monthly, consumer prices rose 1.2 percent. The inflation rate in Zambia averaged 9.68 percent from 2005 until 2019, reaching an all-time high of 22.90 percent in February 2016 and a record low of 6 percent in December 2011 (Trading-Economics, 2022).



**Fig. 7.3:** Inflation rate in Zambia (Source: Trading Economics)

The construction tender price is subject to the effects of inflation (Bai, 2014). To promote economic growth, the government should keep inflation low (Kasidi & Mwakanemela, 2013). The government must address all factors appropriately, increasing general price levels to foster the public construction sector. Zambia experienced stable inflation and inconsistent exchange rates during the past decade. “An increase in foreign exchange rates also raises inflation” (Monfared & Akin, 2017, p329), increasing general prices in the broader economy, including construction tender prices.

#### 7.4.2 Interest rate, money, and price level

The Interest Rate in Zambia averaged 10.25 percent from 2012 until 2019 (Figure 7.4), reaching an all-time high of 15.50 percent in November 2015 and a record low of 9 percent in May 2012 (Trading-Economics, 2022). In this case, the direct price level affects the interest rate through what is known as the “Keynes effect,” in which a rise in price level caused by an increase in the nominal money stock causes the actual money stock to decline, increasing interest rates. Thus, if financial market participants anticipate a price rise, effects on market interest rates are often immediate (Thornton, 2012).



**Fig. 7.4:** Interest rates in Zambia (Source: Trading Economics)

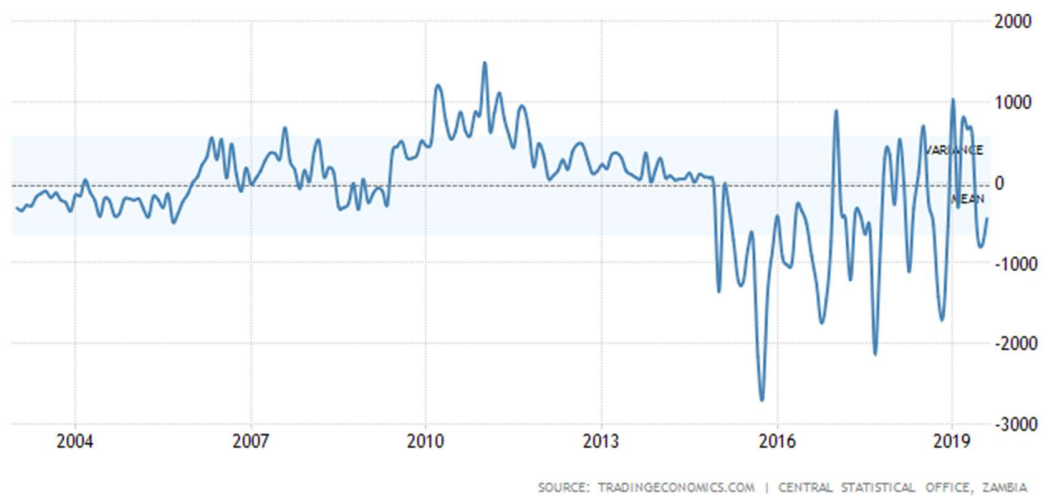
Instead of paying attention to the relationship between interest rate and price level, Thornton (2012) argues that money is even more essential for economic activity in the

construction sector and determining the price level, not interest rates. Thornton (2012, p31) argues that a lack of a strong static relationship between money and economic activity, as well as an “exaggerated belief in the ability of the Governments to control interest rates,” reduces the significant role of money. Money is essential for controlling the price level in the public construction sector because the lack of it poses severe and crucial implications for government infrastructure. For purposes of price stability, policymakers would do well to look at the role of money critically.

### **7.4.3 Trade deficit**

Zambia recorded a trade deficit of ZMK451.90 million in August 2019. Balance of Trade in Zambia averaged ZMK-56.49 million from 2003 until 2019 (Figure 7.5), reaching an all-time high of ZMK1484 Million in January 2011 and a record low of ZMK-2678 million in October 2015 (Trading-Economics, 2022). Depreciation of the Kwacha against the world’s significant currencies causes the price of foreign goods to be relatively higher than that of domestic goods. Trade deficit influences domestic and foreign demand for goods, increasing exports and reducing imports (Purwono, et al., 2018). On the supply side, the depreciation of the Kwacha increases the cost of imported raw materials, which can lead to a decrease in production output and will trigger a rise in construction prices (inflation). The interaction between the demand and supply sides directly affects international trade flows reflected in Zambia’s balance of trade (Krugman, 2010). Consequently, contractors raise their prices to create the ability to acquire foreign construction materials made expensive in the proportion of business because they do not have the luxury to abandon such products unless they also choose not to perform the works.

Zambia recorded a capital and financial account deficit of USD 229.90 million in the second quarter of 2019. Capital Flows in Zambia averaged USD111.24 million from 1998 until 2019, reaching an all-time high of USD2111.20 million in the second quarter of 2006 and a record low of USD-902.70 million in the third quarter of 2015 (Trading-Economics, 2022).



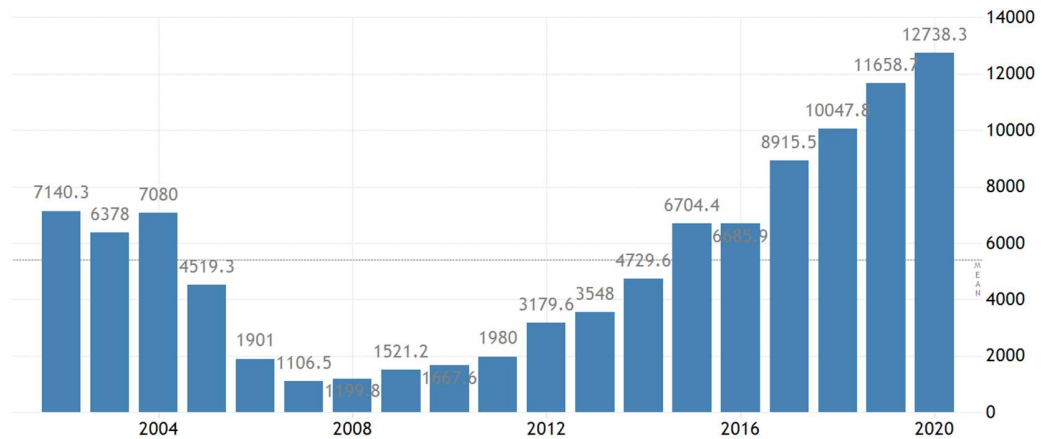
**Fig. 7.5:** Trade Deficit in Zambia (*Source: Trading Economics*)

Zambia’s balance of trade deficit affects inflation in the short and long run because the economy is not flexible enough to produce substitutes for imported raw materials required for the construction sector. In Zambia, “the dynamics of local inflation in the short and long term is proportionally and largely affected by imported inflation, national exports, workers' remittances, external shocks, and credit facilities” (Alawin & Oqaily, 2017, p46). Zambia’s trade deficit is due to low exports per head compared to global averages. Because the country is not industrialized enough to export adequately, thereby being mainly an importing nation that imports inflations as well which in turn increases domestic prices of construction works.

#### **7.4.4 Government debt**

Government Debt in Zambia increased to USD10047.80 million in 2018 from USD8915.50 million in 2017. The debt in Zambia averaged USD4606.15 million from 2002 until 2018, reaching an all-time high of USD10047.80 million in 2018 (Figure 7.6) and a record low of USD1106.50 million in 2007 (Trading-Economics, 2022). Zambia recorded a government debt equivalent to 59 percent of the country's Gross Domestic Product in 2018. The debt to GDP in Zambia averaged 122.65 percent from 1990 until 2018, reaching an all-time high of 277.53 percent in 1991 and a record low of 28.80 percent in 2013. Zambia’s External Debt increased to USD9144.60 million

in 2018 from USD8261.10 million in 2017, averaging USD4484.88 million from 2008 until 2018, reaching an all-time high of USD 9208.80 Million in 2016 and a record low of USD909.60 million in 2008 (Trading-Economics, 2022).



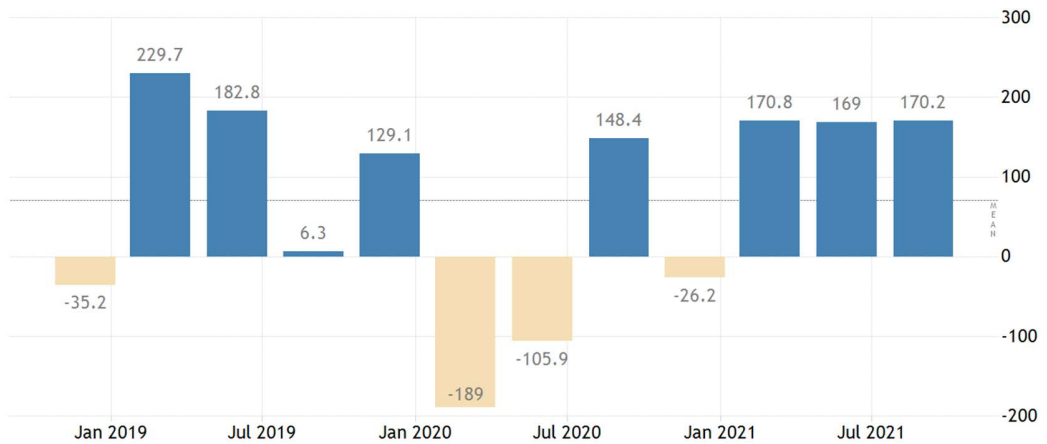
**Fig. 7.6:** Government Debt in Zambia (Source: Trading Economics)

Public debt has a significant positive effect on inflation and vice versa because the high level of government debt in a country with a weak fiscal position like Zambia depresses income and stimulates the direct price level (Biswajit, 2019). External debt shocks have long-term negative impacts on economic growth and public investment.

#### 7.4.5 Foreign direct investment (FDI)

Foreign Direct Investment in Zambia increased by USD 426.30 million in the second quarter of 2019. It averaged USD210.07 million from 1998 until 2019, reaching an all-time high of USD 1335.70 million in the third quarter of 2012 and a record low of USD 281.90 million in the first quarter of 2012 (Figure 7.8) (Trading-Economics, 2022). In Zambia, FDI has a crowding-out effect, mainly wiping out local construction firms in high-earning public projects. Foreign contractors have better access to financial resources, creating a welfare loss and forcing the government to intervene through local firms' 20% subcontracting policy. Maura and Forte (2010) found that the effects of Foreign Direct Investment on economic growth depend on the current level of development of the host country's internal socioeconomic, political, and cultural conditions. Since Zambia has weak conditions, it experiences the adverse effects of

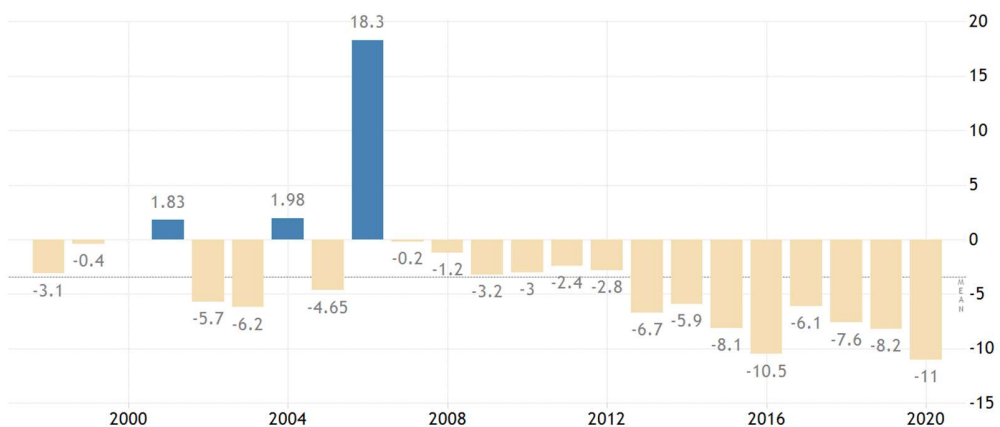
FDI, but the insistence on the positives of FDI makes political and economic philosophers blind to their impacts.



**Fig. 7.8:** Foreign Direct Investment in Zambia (Source: Trading Economics)

#### 7.4.6 Government budget deficit

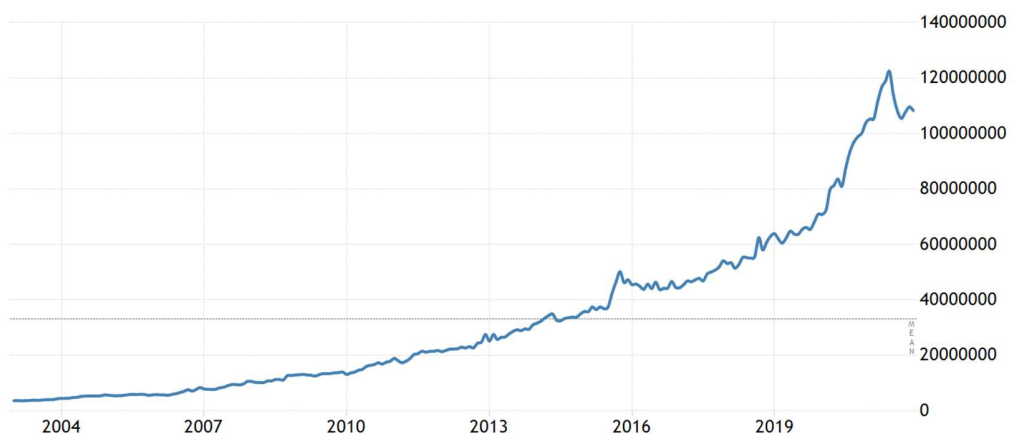
Zambia's Government Budget deficit equaled 7.50 percent of the country's Gross Domestic Product in 2018. The government Budget in Zambia averaged -2.78 percent of GDP from 1998 until 2018 (Figure 7.9), reaching an all-time high of 18.30 percent of GDP in 2006 and a record low of -10.50 percent in 2016 (Trading-Economics, 2022).



**Fig. 7.9:** Government Budget Deficit (Source: Trading Economics)

Budget deficits propagated by government overspending fuel inflation and, in Zambia. The country can print more money to add to the money supply to resolve a budget

deficit, but this option increases inflation (Figure 7.10). On the other hand, it can go into recession by refusing to print money. This scenario brings the government to a third and more acceptable option of borrowing more money for operating expenses, resulting in continued debt accumulation. Continuation in this path forces the country to raise the debt ceiling or eventually default on the nation's current debt repayments. Zambia has continued budget deficits have slowed economic growth and implementation of public construction sector projects. “Budget deficits also bring various political problems that arise as the nation moves closer to an election year (Figure 7.9). Those responsible for the deficit face blame only when the deficit has a negative economic impact. At the same time, those in office that fail to do something about the economic crises also fall prey to the electorate that decides to remove them from office for that failure” (Lewis, 2019, Par.5).



**Fig. 7.10:** Zambia’s Money Supply Deficit (*Source: Trading Economics*)

Money Supply in Zambia decreased to ZMK 63,668,561.19 million in July from ZMK 63,736,175 million in June of 2019, averaging ZMK 24,286,589.27 million from 2003 until 2019 (Figure 7.10), reaching an all-time high of ZMK 64,801,114.95 million in May of 2019 and a record low of ZMK 3,661,075 million in March of 2003 (Trading-Economics, 2022).

## **7.5 Chapter Summary**

The most relevant theories that support this study include agency-cost theory, resource-based theory, and post-Keynesian pricing theory. Pertinent other ideas include the volume-based theory, labor theory of value, and Ricardo's surplus-based theory. These theories formed assumptions that informed the study approach and development of the study rationale. The conceptual and theoretical frameworks presented have analyzed literal circumstances surrounding general price inflation and draw critical implications indicating Zambia lacks strategic sustainability behavior to guarantee:

2. Attainment of sustainable levels of economic growth
3. Reducing debt burden requires aggressive measures
4. Encourage domestic savings and investments
5. Manage to channel borrowed funds without inflating the economy
6. Financing profitable projects that generate reasonable revenues
7. Preventing debt overhang

**8.1 Introduction**

The study is phenomenological-driven within a qualitative and quantitative paradigm. Phenomenology was appropriate in this study because it aimed not at measuring but understanding a matter's circumstances in a setting. In this study, phenomenology was essential to understanding circumstances surrounding the construction sector in Zambia; and drawing from experiences and factors that perpetuate price inflation. Further, the adoption of phenomenology is to know from the point of view of construction sector actors the preferred model to propel the sector into curtailing the construction price inflation. Applying phenomenology within qualitative research describes and interprets a phenomenon of interest. The research design matrix in Figure 8.4 shows the framework for this study. The research objectives include the following:

1. To determine the impact of tender price inflation on the economic sustainability of the construction sector
2. To investigate circumstances surrounding the failure to mitigate construction tender price inflation through current interventions
3. To propose strategies for addressing public construction tender price inflation
4. To construct a model that facilitates Zambia's public construction sector productivity at beneficially predictable construction tender prices

While the research questions include the following:

1. How does high tender price inflation affect the economic sustainability of the construction sector?
2. Why are current internal controls and measures failing to mitigate Zambia's construction tender price inflation?
3. What strategies can government use to address construction tender price inflation?
4. How can we address construction tender price inflation in Zambia's context?

## **8.2 Research Philosophy**

This study adopted the following philosophies:

### **8.2.1 Positivism**

The study assumed a stable, observable, and describable reality from an objective viewpoint of the existence of measurable characteristics independent of the researcher. This positivist approach supported the research to achieve its objectives without the need to interfere with the study phenomena. In addition, it allowed the researchers to isolate the phenomena and ensured the repeatability of observations by manipulating variations within independent variables. The positivism philosophy was suitable for the study to allow for the generation of consistent and empirically established findings. The study further adopted the positivist philosophy to pursue an understanding and observation of a reality that consists of discrete occurrences by accepting that knowledge is derived from experience. Through logical positivism, the research denied any non-experienced theoretical notions, excluding value judgments for purposes of validity. The study considered anything unverifiable by expertise irrelevant. Consequently, through this philosophy, the study made the following assumptions (Kivunja & Kuyini, 2017):

1. Experience alone informed scientific knowledge
2. Direct application of methods of natural sciences to explain the social world
3. The subject matter of the study consisted of studying a reality external to itself
4. Expert normative statements had the status of knowledge
5. Pursuance of technically practical knowledge

The study sought to derive formal propositions and draw inferences about a specified study population from the sample through an induction strategy. Hence, the study attempted to discern through a distinctive approach to the scientific method. This study is empirical with a fundamental idea that scientific methods include observations and measurements with characteristics that include (Bhattacharya, 2021):

6. generalizations
7. discovery of truth or knowledge

8. distinguishing and analyzing cause and effect
9. quantification of inquiry results
10. application of scientific methods
11. application of empirical or analytical approaches
12. discovery of facts
13. observable knowledge
14. accounting for human and social behavior

Therefore, a positivist research philosophy adopted a survey methodology for quantitatively studying applied research questions.

### **8.2.2 Phenomenology**

The study adopted a phenomenology strategy to explore people's experiences of the phenomena under investigation. This strategy helped explore challenging problems in the construction sector by understanding the nature of price inflation and preparing appropriate alignment to solutions. Phenomenology constituted the fundamental premise of this research by fostering learning drawn from lived experiences. Learning from experiences was essential to maximize the effectiveness of feedback and reasoning resulting from the phenomena. This qualitative-research approach was critical and uniquely positioned to answer and draw insights of foundational significance to the study. The strategy supported the study to explore and describe the essence of construction tender price inflation through the perspectives and experiences of construction experts. By examining lived experiences, the study developed new meanings and appreciations to further inform a shared understanding of an experience. Additionally, the study adopted hermeneutic (interpretive) phenomenology (Neubauer, et al., 2019).

### **Interpretivism (Hermeneutics)**

The study was interested in people as actors and focused on how the realities of construction tender price inflation invariably influenced the world as lived by the participants. The study could derive the meaning of personal experiences by understanding individual narratives. The study achieved this by rooting itself in interpreting participants' experiences and construction tender price inflation via the

participant's lifeworld. The research sought to understand underpinning thoughts, beliefs, assumptions, and values to explore the social world of the construction sector (George, 2021). This study achieved this by capturing in-depth perspectives, establishing close contact and interaction with participants, phenomena under investigation, and the researcher's interpretations.

Interpretivist approach allowed for the generalization of results to include settings other than the study context while recognizing different orientations of interpretation as influenced by different researcher biases. Through hermeneutics, the study obtained in-depth data to better comprehend the participants' subject world by focusing less on subjective interpretations. The research thus derived personal meanings by exploring the social world of participants (Fuster-Guillen, 2019):

1. acknowledging their existence
2. understanding subjective meanings
3. reconstructing subjective meanings
4. avoiding distortions
5. accepting intentionality of actors

### **8.2.3 Pragmatism**

This study adopted pragmatism because it considers experience an active and ongoing affair in which construction-industry experts and construction tender price inflation establish a fundamental relational and interactive unity. Pragmatism was vital in exploring experience deprived of inner deceptions between the knowing consciousness and known content by negating dichotomies involving experience and plural flow (Firmanto, et al., 2019). This philosophy allowed the study to construct reality rather than discover it. It inspired the researcher to conceive processes of becoming with ongoing change as a rule in continuous flux. This intertwined theory of truth and experience was integral to theorizing and academically speculating on past experiences and conceptions.

The study relied on pragmatism to systematically draw experience from theory; without abandoning rigor but emphasizing formulated conjectures for testing and falsification. This approach provided objectivity in science and ensured the quality of

the critical process rather than absolute certainty in interpretation (Campbell, 2007). Through pragmatism, the study reflected on the nature of becoming and what is worth doing through a systematic process of informed awareness. Sense-making and enactment formed the processual view of the reality of this study in creating a perspective of becoming through movement, emergency, and process. The primary assumption of the study was constitutive of existing-social structures wholly dependent on acts by focusing on strategy, organization, knowledge, and collective actions. Therefore, pragmatic notions formed a fundamental conceptual basis for this study.

#### **8.2.4 Significance of combining research paradigms**

This study ignored purists' arguments supporting that paradigms remain unmixed, kept apart, and treated as distinct approaches. While ideas for discerning differences hold even for this study, it explored space and possibilities for blending philosophies with pragmatic awareness to reduce data uncertainty and clarify findings. In addition, the study utilizes elaborate-ideal perspectives without hybridizing to investigate-clarify phenomena and practices. This approach presented empirically derived results, which comprised interpretive and pragmatist elements. The study adopted a combination of paradigms to explore reality fully and establish a clear picture of the real world. The study assumed a philosophical viewpoint in which various philosophies provided different perspectives of the real world. Significant benefits of combining philosophies for the study included (Malboeuf-Hurtubise et al., 2020; Johnson & Onwuegbuzie, 2004; Žukauskas et al., 2018):

1. considering a variety of views
2. bridging compromises existing between pure positions
3. viewing research approaches a set of tools
4. encouraging and contributing to philosophical and methodological pluralism
5. highlighting the objectivist nature of the study

#### **8.3 Research strategy**

The research undertook to select the best possible strategy to answer each research question as enumerated below:

### **8.3.1 Inductive reasoning**

This strategy creates generalizations concerning observed data patterns and measured characteristics of the studied phenomena (Heit & Rotello, 2010). The investigation began with individual-specific statements to develop universal propositions. The study explored the world's functioning based on facts derivable from dispassionate-neutral observations rather than preconceived ideas. The strategy critically assisted the analysis in extracting knowledge from comments in a passively receptive manner. Hence, the study derived inductive arguments, exploring beyond premises to develop a comprehensive understanding of experience.

Question one of the study was, "Why are current internal controls and measures failing to mitigate construction tender price inflation in Zambia?" The study utilized inductive logic of reasoning from particular to generalizations. They answered this question by defining regularity in a social setting and generalizing regularity patterns in the acquired data. As specified by Majeed (2019), the inductive strategy in this research was helpful for:

1. inductively representing relationships between facts
2. recording facts presented by respondents without hypothesizing
3. testing generalizations further

This study question aimed to investigate and be familiar with basic facts about the causes of construction tender price inflation and any practical interventions in the social-industrial setting. For this question, the research utilized inductive strategies with an inner-world focus (Realist Ontologies). This research question followed modified realist epistemology with human nature assumptions of determinism to outline principles of causality as a central concept in the construction tender price inflation.

### **8.3.2 Deductive reasoning**

The study adopted deductive reasoning to draw inferences from established premises by combining several viewpoints (statements) to make conclusions based on logic and evidence (Lassiter & Goodman, 2017). The study utilized sentential deductive

reasoning by syllogism to draw assumptions into logical and factual findings. Conversely, for a deductive reason to draw valid conclusions, the study undertook to ensure true premises. By utilizing deduction, the study derived logical conclusions from observed-true multiple assumptions based on factual knowledge and formal rules while accounting for errors. The property of logical validity was essential to the study in that valid was derived from being accurate if and only if all premises were true in every possibility.

### **8.3.3 Abductive and retroductive reasoning**

The research adopted abduction to discern relationships and connections to formulate new ideas beyond initial premises. This reasoning allowed the research to discover structures and circumstances initially obscured in empirical data. The study adopted abduction in conjunction with retroduction to develop a conceptual framework or model for addressing construction tender price inflation by analyzing beyond the confines of the theoretical framework and ensuring transparency. This reasoning enabled the study to investigate initially novel findings and reveal an understanding of empirical outputs (Kovács & Spens, 2005; Mirza, et al., 2014).

Retroduction leads to developing new concepts fundamental and essential for progress in the sector by allowing the researcher to bring assumptions to the study. This approach allowed the study to question necessary prerequisites and conditions for a priori assumptions. Central to the research analysis for considering dialogue and bridging the gap between ideas and evidence through a comprehensive understanding of conditions or circumstances requiring interventions. This strategy was fundamental in answering question three “How can we address construction tender price inflation in Zambia’s context?”

### **8.4 Research design**

The study utilizes case studies and causal research designs. The strategy selected for this study aimed to integrate several components logically, as shown in the detailed design matrix summary in Figure 8.4. The study adopted quantitative, qualitative, and mixed-method approaches.

#### **8.4.1 Qualitative research design (Exploratory)**

The study utilized qualitative research design to answer to research-question one, two, and three:

1. How does high tender price inflation affect the economic sustainability of the construction sector?
2. What strategies can government use to address construction tender price inflation?
3. How can we address construction tender price inflation in Zambia?

The study adopted qualitative research that followed an exploratory design to understand decisions and opportunities regarding construction tender price inflation. The technique allowed the study to focus the collection of data on a small number of respondents by asking questions through open-ended person-to-person interviews and observing the behavior of respondents. This approach was essential in ensuring timely data collection and accuracy and gaining rich-preliminary insights.

The exploratory research design was significant for the study to understand the phenomenon and define the problem precisely (Sreejesh, et al., 2014). The study deployed unstructured procedures for primary data collection, including in-depth interviews and project procurement techniques. The discussions used direct techniques to obtain data on respondents' beliefs, feelings, and attitudes. The design assisted the study in probing for attitudinal and behavioral data encompassing all past, present, and future periods by turning respondents' answers into related detailed questions. The interviewing techniques utilized in this study included:

1. laddering – which allowed the study to discover meanings and psychological and emotional motives that affected the respondents' decision-making behaviors (Veludo-de-Oliveira, et al., 2006)
2. hidden-test questioning – which focused on finding share-social values and personal beliefs, and attitudinal concerns (Buschle, et al., 2021)
3. symbolic analysis – which utilized deductive reasoning to unravel symbolic meanings associated with construction tender prices (Lune & Berg, 2017; Bengtsson, 2016)

#### **8.4.2 Quantitative research design (Conclusive: Descriptive and Causal)**

The study utilized a quantitative causal research design to answer to research-question one:

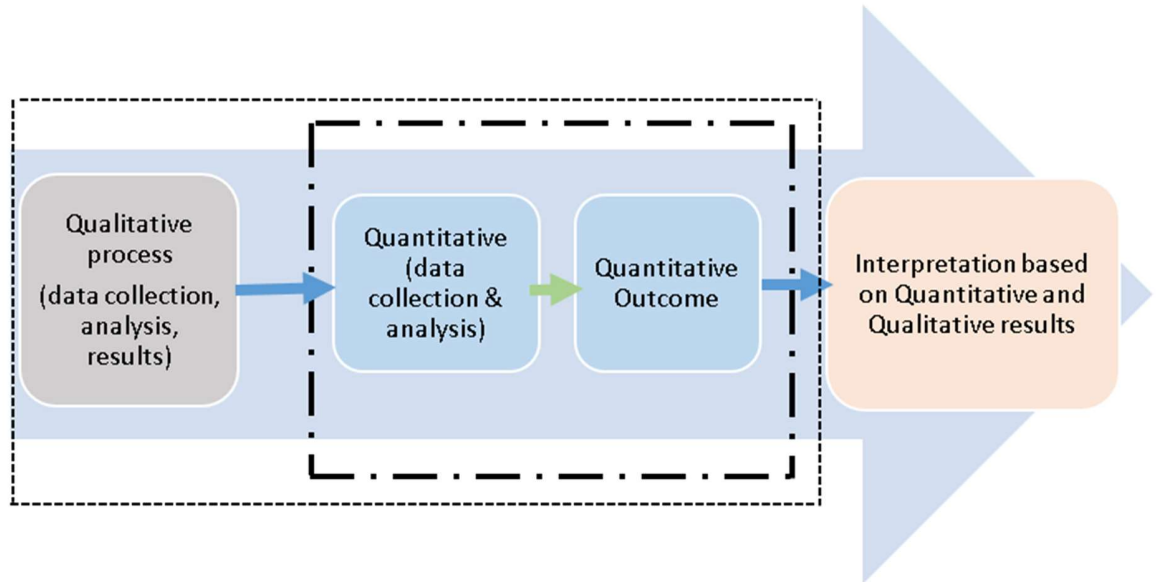
1. Why are current internal controls and measures failing to mitigate Zambia's construction tender price inflation?

This design allowed the collection of primary data that was quantitative. The study achieved this by emphasizing structured-standardized questions with predetermined response options. The study packaged queries in a self-administered questionnaire to many respondents. This selected design is heavily related to explaining the descriptive and casual nature of the study by providing specific facts for informed decision-making. This design assisted the investigation in establishing other statistical relationships regarding construction tender price inflation. The design provided generalizability advantages to the study to characteristic statistical rigor and a large sample of respondents (Eyisi, 2016).

#### **8.4.3 Mixed-methods research design**

The study utilized a triangulation design of mixed methods to obtain different yet supplementary data on construction tender price inflation. This method was essential to encompass different strengths and weaknesses in qualitative and quantitative methods (Johnson & Onwuegbuzie, 2004). The design assisted the study during analysis to expand quantitative findings and contrast them with statistical results. The study simultaneously implemented qualitative and quantitative methods in the same time- period (Yu & Khazanchi, 2017) by following a triangulation-embedded model (Figure 8.1). Triangulation-correlational-embedded model variant required embedding qualitative data within a quantitative inquiry. This process required collecting qualitative data to correlate circumstances surrounding construction tender price inflation to help explain how strategies or interventions work. Embedding beliefs and experiences assisted in predicting and explaining relational interventions. Thus, the primary purpose for collecting qualitative data was to inform quantitative mechanisms while allowing for separate reporting of the two sets of results. This stage

was critical in deciding which qualitative results to utilize in the quantitative phase and informing aspects for further exploration.



**Fig. 8.1:** Embedded triangulation model  
(Source: by the author)

## 8.5 Research paradigm

The components of this research paradigm include “ontology, epistemology, methodology, and methods” (Rehman & Alharthi, 2016, p. 51).

### 8.5.1 Research ontology

The study utilizes an ontology of a social world populated by human beings with thoughts, meanings, and interpretations. Thus, the study used interviews as an interpretive design to obtain respondents' experiences, inner thoughts, and feelings. The study assumed a realist ontological (inner-world focus) assumption of a physical world influenced by cause and effect (Berryman, 2019). The research believed in the existence of realities that affect construction tender price inflation and hence emphasized exploring circumstances related to what happened or what was happening to seek explanations. The study intends to predict what might happen in the future of construction following certain-specific interventions.

The study adopted a nominalist ontology (outer-world focus) with the pragmatic strategy to influence mitigation and policy-making by identifying social and cultural consequences of the program (Al-Ababneh, 2020), project, and policy actions on traditional industry structures, processes, and stakeholders. The research used the nominalist ontology to explain the systems involved in the model and the ways they connect and explained connections and relationships that would occur. The study constructed the existence and demonstrated the operation of these structures and mechanisms. The research built a hypothetical model to uncover fundamental structures and mechanisms assumed to produce pragmatic phenomena.

### **8.5.2 Research epistemology**

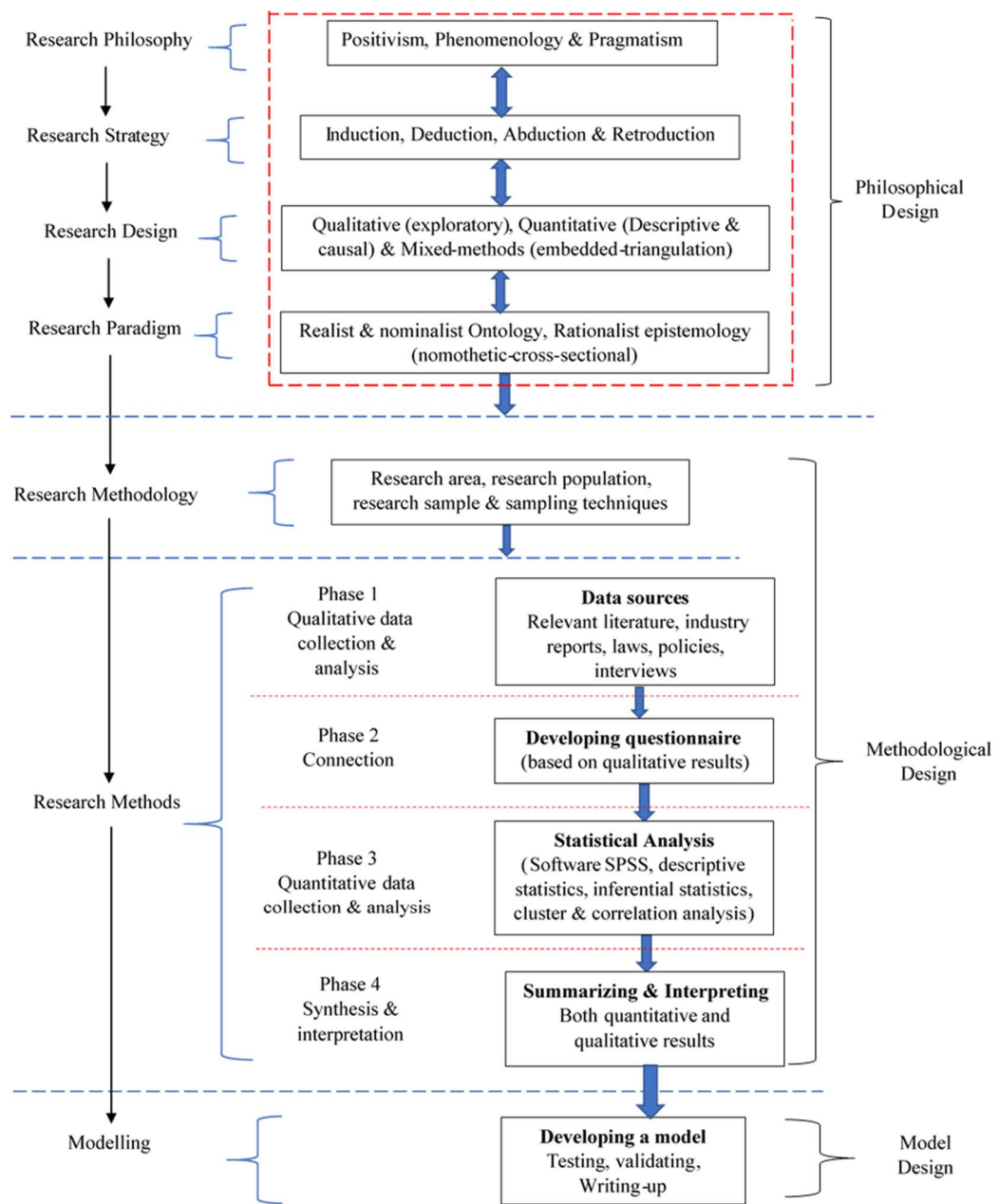
The epistemological assumption for this study is rationalism. The epistemology follows a nomothetic dimension of the cross-sectional cohort (Dieronitou, 2014). Thus, the study attempted to gain knowledge through reason and asserting that truth exists. The study utilized rationalism to lay hold of truth beyond certainty and generality perceptions of sense.

### **8.5.3 Research Methodology**

This section concerned the general research strategy, outlining the study's process by identifying the population, study sample, and sampling techniques employed. Figure 8.2 shows a summary of the methodological design for this study.

#### **Study area**

The study focused on public infrastructure projects by targeting the experiences and understanding of several experts in the construction sector.



**Fig: 8.2:** Causal and exploratory mixed-methods design (By author)

### Study population

In this study, the population will refer to experts in the construction sector, particularly those with experience and understanding of public infrastructure projects. The study targets experts in general infrastructure delivery because they constitute a set of individuals from whom desired information to provide essential data will assist in

concluding an innovative sound model. Consequently, the study adopts expert purposive sampling to select respondents with specialist knowledge about the sector and the subject under inquiry.

### **Study sample**

The study drew sample elements from heads of departments, academic staff, project management experts, procurement experts, contractors, and consultants.

### **Sampling techniques**

The research attempted to produce a logical sample assumed to represent the population logically.

#### **i. Interview participants (Purposive and snowball sampling)**

According to the phenomenon under study and the type of participants, the study adopted purposive sampling in identifying participants for interviews (Martínez-Mesa, et al., 2016). This sample was selected non-probabilistically using judgment to locate participants with experiences relating to construction-price inflation. The researcher made internet searches and telephone inquiries to experts in the construction sector to identify suitable participants for the research study. These interviewees formed a primary unit of data collection and analysis.

The research utilized a snowball-sampling technique in which participants recommended others for interviewing. The study solicited expert knowledge of the research population. In a nonrandom manner, the study selected a sample of respondents representing a cross-section of the research population. Since this is a nonprobability sample, the study used subjective methods to decide which element to include. The research obtained dissimilar participants without compromising the sampling frame by establishing inclusion criteria during snowballing. All participants generated through snowballing met the inclusion criteria for data collection.

#### **ii. Questionnaire participants (simple random sampling)**

The study utilized simple random selection for the administration of the questionnaire. The technique assisted the survey in selecting a genuinely random sample

representative of the participant population (Table 8.1). The sampling allowed each participant an equal probability of selection to the study, free from any selection bias.

### **iii. Key informants (nested sampling)**

The researcher adopted nested sampling to select a second set of critical participants required for testing and model validation. The study targeted a sub-sample of participants to achieve a credible nested sample that best represented the whole sample. Sub-samples presented theoretical-sampling cases of additional people through whom the study extracted further data for the development of the model. The technique was essential to develop emergent themes, refine ideas and identify conceptual inadequacies without changing or increasing the initial sample size. The critical informants sampled from the overall research participants assisted the research in attaining data saturation and statistical and analytical generalizations (Onwuegbuzie & Leech, 2007).

### **Data collection**

Data was collected through a literature review, person-to-person interviews, key-informant interviews, and questionnaire surveys.

#### **i. Interviews (Primary Data)**

The study adopted person-to-person interviews to collect primary data (McGrath, et al., 2019). The interviews consisted of unstructured, open-ended questions appropriate in a phenomenological survey for respondents to speak while allowing the researcher to probe aspects further. In addition, the open-ended questions were relevant because the research required a higher cognitive load that supported respondents to think analytically before giving responses. These questions produced rich insights that provided the necessary depth to the investigation. For best results, the study provided an interview guide to all respondents before the interview; however, probing during interviews did not strictly restrict the guide. This process also allowed the researchers to keep unstructured, open-ended questions to a minimum, allowing a higher response rate and higher-quality data.

### **ii. Questionnaire (Primary Data)**

The research deployed a self-administered questionnaire. Structured questions required respondents to select a high or low score for a question. The study, informed by qualitative results, created a good and reliable list of questions addressing research objectives during questionnaire design. The study administered the questionnaire online (kobo toolbox) to guarantee respondents' self-pace, cost-effectiveness, and anonymity. The questionnaire utilized restricted-choice or closed-ended questions offering respondents a fixed-set categorically classified Likert-type variables. The Likert-type questions provided quantitative composite data on an interval scale for statistical hypothesis testing and determining the statistical significance of predictor variables.

### **iii. Literature (Secondary Data)**

The study accessed existing information from journal publications, articles, book sections, reports, and conference proceedings presented in detail in chapters; 2, 3, 4, 5, 6, and 8. The utilization of secondary data was noteworthy for understanding and describing the phenomena and identifying existing research gaps.

## **Data analysis, instruments, and procedures**

The descriptive data analysis utilized abductive, deductive, and inductive reasoning through systematic, iterative searching and integrating data, as shown in the detailed research design matrix in Figure 8.4. The research attempted to describe the meaning of findings from the respondents' perspective and develop significant generalizations from a limited number of experts and specific experiences.

### **i. Qualitative data analysis**

The study attempted to explain specific factors, away from those in the broader economy, contributing to construction tender price inflation and underscore how such connections or relations occurred. This analysis entailed conducting person-to-person interviews to seek clarity about the documentary and literature review. To propose strategies for addressing construction tender price inflation demanded providing a factually accurate viewpoint of participants concerning the characteristics and nature

of their relationships in the construction market. The study presented the findings as verbal accounts and narratives of lived experiences gathered through interviews. The study utilized thematic analysis of key informant interviews to extract impact mitigations and envisaged policy measures.

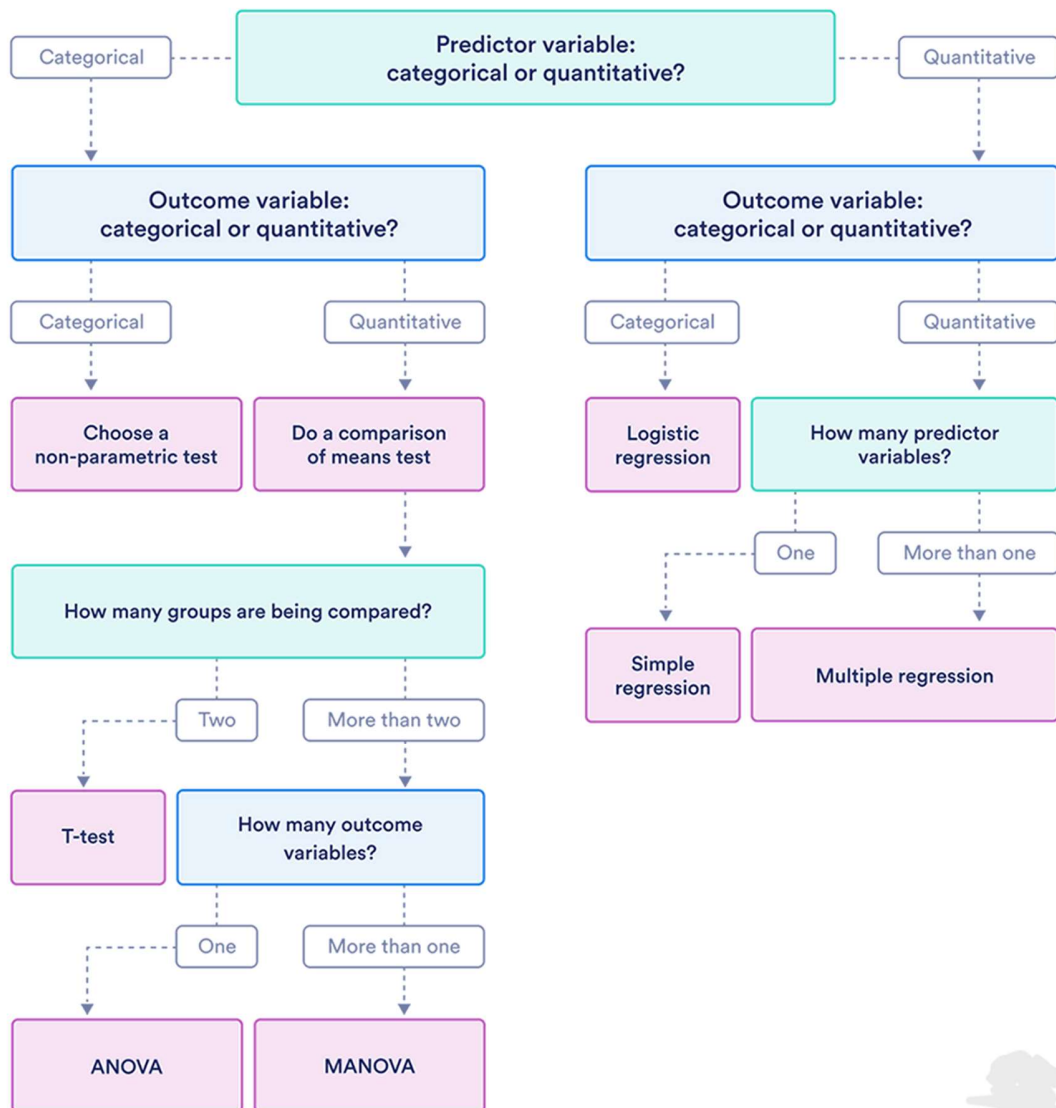
## **ii. Quantitative data analysis**

The study utilized a self-administered questionnaire to establish generalization. The study further adopted statistical parametric analysis exploiting an analytical process by Bevans (2021), as shown in Figure 8.3.

## **8.6 Research ethics**

The research developed and utilized specific-informed consent agreements to ensure ethics when conducting unstructured in-depth phenomenological interviews. This process assisted the research in avoiding deception that would have been counter-productive. The study reduced suspicion and harnessed insights by developing simple and confidential procedures. The consent agreement highlighted specific issues, including indicating:

1. procedures adopted by the study
2. benefits of the study
3. purpose of participating in the study
4. voluntary nature of participation in the study
5. strategies for protecting the confidentiality
6. ethical clearance obtained from the ethics committee



**Fig. 8.3:** Flow chart for choosing statistical parametric test (Adopted from Bevans, 2021)

### 8.7 Chapter discussion

This discussion borders on the justification of sample sizes for qualitative and quantitative data collection. The study adopted sample sizes contingent on epistemological, pragmatic, and phenomenological considerations. The survey ensured large enough samples for data saturation yet small enough to permit in-depth case-oriented analysis.

### **8.7.1 Qualitative sample size**

Practical research shows that a qualitative sample of twelve (12) interview participants was adequate to reach theoretical data saturation (Braun & Clarke, 2016; Boddy, 2016; Guest et al., 2006). Therefore, a purposive sample of 14 interview participants was sufficient for qualitative analysis considering the homogeneousness of the research population and the scale of this cross-sectional study (Hennink & Kaiser, 2022).

#### **Participant inclusion criteria**

The study employed a purposive sampling method to identify possible interview participants (Martínez-Mesa, et al., 2016). The selection method for the inclusion of participants for research interviews defined the characteristics of potential participants in the study. The criteria ensured the participants were relevant enough to provide the necessary information to address research objectives. The requirements were as follows:

1. Age of the participant – all participants were required to be old enough to provide legal consent, typically above 18 years old
2. Professional past of the participant – the study considered relevant construction-sector details about participants' professional and personal lives. Ensured that participants were essentially actively practicing professional aspects related to the construction sector
3. Academic qualifications – the study verified participants' academic qualifications or educational background to ensure they had at least a bachelor's degree related to aspects of the construction sector
4. Active years of practice – The study included participants with at least ten years of practice within the construction sector. Therefore, the study evaluated people in the construction sector-related fields for more than ten years.
5. Management position of the participant - The participant owns a construction-sector-related company or has been in senior management for a period longer than five years

### 8.7.2 Quantitative sample size

The study utilized a proportionate stratification approach for determining the sample size in each category due to the distinctive categorical nature of the population under consideration (Bless, et al., 2020; Sibanyama, et al., 2012). The sample size determination considered a margin of error of 5% and a confidence level of 95%. The study randomly selected actual participants. Table 8.1 show the derivations of the quantitative sample size for the self-administered questionnaire to be 170 respondents.

**Table 8.1 Determination of quantitative sample size**

Category	Category population ( $N_c$ )	Proportion $f = \frac{N_c}{N}$	Category sample $n_s = f \cdot N_c$	Final category sample (Cochran's)
Contractors NCC grade 2 (Zambian Construction Firms)	124	0.27	34	46
Client (Public Infrastructure-Based Institutions): Ministries, utility organizations, local authorities	135	0.30	40	51
Consultants-Civil/Structural (ACEZ registered firms)	88	0.19	17	33
Architectural Firms (ZIA registered firms)	74	0.16	12	28
Quantity Surveying Firms (QS Registration Board)	33	0.07	2	12
<b>Totals</b>	<b><math>\sum N_c = 454</math></b>	<b><math>\sum f = 1</math></b>	<b><math>\sum n_s = 106</math></b>	<b>170</b>

(Source: by the author)

Following an anticipated return or response rate of 90%, the study adjusted the sample size for the response rate:

Where minimum sample size =  $\sum n_s = 106$

Where the anticipated rate of return for oversampling procedure = 90%

Therefore,  $n_f = \frac{106}{0.9} = 118$  respondents

The study adopted Cochran's method or formula for calculating the categorical quantitative data sample size (Cochran, 1977; Bartlett, et al., 2001).

$$n_s = \frac{pq^2}{d^2} = \frac{0.5 \times 0.5 \times 1.65^2}{0.05^2} = 272$$

Where pq is the estimate variance = 0.25

Where t is the value of selected alpha level = 1.65 for a level of 0.025 in each tail

Where d is the acceptable margin of error = 5%

Therefore, for a population of 454, the required sample size is 272. However, since the sample size is 26% (exceeds 5%;  $(454 \times 0.05 = 22.7)$ ) of the population, the study utilized Cochran's (1977) formula to recalculate the final sample size. The calculations were rounded-down as follows:

$$n_f = \frac{n_s}{\left(1 + \frac{n_s}{\text{population}}\right)} = \frac{272}{\left(1 + \frac{272}{454}\right)} = 170$$

### 8.7.3 Reliability of results

Since the study utilized Likert-type questions in the questionnaire, the study adopted Cronbach's alpha ( $\alpha$ ) to assess reliability for homogeneity or internal consistency assessments. A Cronbach's alpha score above 0.7 indicated a robust internal consistency of results (Heale & Twycross, 2015).

### 8.7.4 Validity of the research

A validity assessment measured the extent to which the study estimates the phenomenon of construction-price inflation. The study measured content and construct validity. Including items from qualitative results in the questionnaire followed the content validity index (CVI) (Mashaalah & Negin, 2014; Polit, et al., 2007). The study only included items with CVI scores greater than 0.54 as per the Lawshe table (Lawshe, 1975). The study discarded items with low mean scores through simple statistical tests for construct validity.

## 8.8 Chapter Summary

The study adopted a mixed-method research design encompassing a mixture of exploratory quantitative design approaches and descriptive-causal quantitative design. The research employed content and thematic analysis for primary qualitative data analysis while utilizing statistical techniques to analyze quantitative questionnaire data. Therefore, for qualitative analysis, a homogeneous research population, and the scale of this cross-sectional study, a purposive sample size of 14 interview participants was sufficient. In contrast, a quantitative sample size for the self-administered questionnaire was 170 respondents.

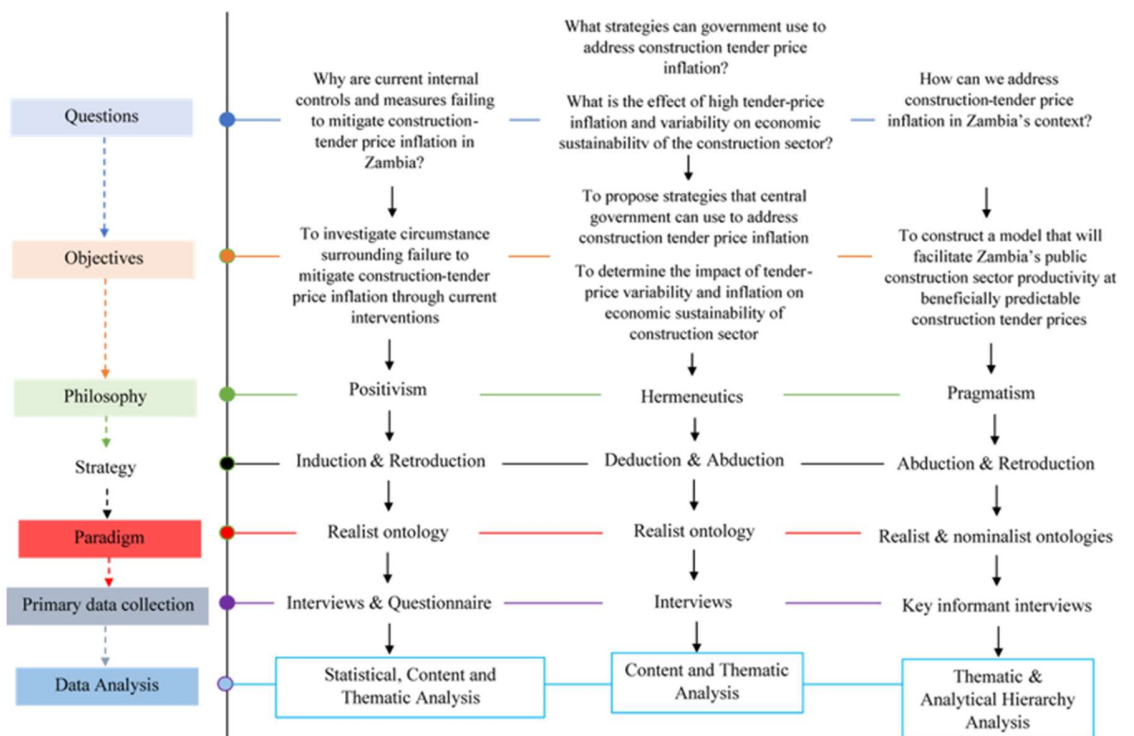


Fig. 8.4: Detailed research design matrix (By Author)

## **CHAPTER 9: Baseline Analysis and Documentary Review**

### **9.1 Introduction and background information**

The essentiality of public infrastructure delivery cannot be over-stressed. However, to attain sustainable improvement in the public construction sector, there is a need to challenge existing practices and poor performance and focus on the value that public infrastructure can deliver. This research opines the situation warrants the development of a model that promotes ambitious performance targets in the delivery of public infrastructure by making radical changes to the process of public project delivery. Like many developing countries, Zambia's public construction sector experiences numerous challenges that create a vicious cycle. The soaring construction tender prices threaten the infrastructure push in the public sector as the effects of escalating tender prices begin to outweigh the socioeconomic benefits of such infrastructure. If not addressed, the construction sector's productivity will lag behind other economic sectors, thereby decreasing the sector's value in the national economy.

Historical increases in construction prices and project spending contribute to unsustainable infrastructure development costs in the country. While drivers of these rising construction prices need further documentation and studying, the impacts are already noticeable. Trapped in the middle of this government's push for development are citizens. Of which too many begin to question the benefits of, or who benefits from, undertaking these public projects. In addition, society is concerned about how the government will afford such spending considering the complexity and diverse nature of the sector, making it challenging to address rising prices while encouraging infrastructure development programs.

The purpose of this chapter is to provide a base against which to carry out an investigation on construction tender price inflation and highlight the urgent need to manage the phenomenon. The data generated by this baseline study is critical to measuring the degree and extent of change in construction tender prices within a period covering between 2008 and 2021. In this case, the chapter collates the data from the documentary review and presents a case for further study. However, considering

insufficient or incomplete existing data, the baseline study sets a target on information that is already available, easy to access, and contrasting. Thus, the study places collected data into two major categories relevant to the study to develop its case. These categories of projects include:

1. Upgrading of roads to bituminous standards and
2. Periodic maintenance of feeder roads

The comparisons include drawing out averages of tender price per kilometer of specific road categories per year, then contrasting to the preceding years to develop a trend line analysis. This analysis forms the basis for observing rises and falls in tender prices to assess price inflation. The baseline study adopts the “before-and-after” activity method of measuring the change in tender prices across the study period. The study achieves this by measuring the shift in tender prices for similar construction works or projects over time in the exact activity location (Zambia). The study focuses on a documentary review for replicability of the collected data, if necessary, for subsequent evaluations. This approach was critical in providing the minimum information required to assess and ascertain the reality or representativeness of construction tender price inflation.

The baseline result allows the study to apprehend the research problem and provide information realistically centric to the quo. Information contained in this chapter is thus crucial in defining the behavior of construction tender prices. It assists in determining the study's focus and outlining study priorities. Therefore, this baseline undertakes to respond to a set of questions regarding the status of construction tender prices; these include the qualified behavior of construction tender prices. In addition, what is the extent of the observable behavior? However, the baseline does not undertake to list questions; instead, the strategy is to align the findings with the study's overall goals by offering literature from documentary review and heterogeneity of government infrastructure-based institutions. The institutions reviewed include the Ministry of local government and rural development (MLGRD) and the Ministry of Infrastructure, Housing, and urban development (MIHUD). Within the Ministry of Infrastructure, Housing and Urban Development (MIHUD), the study focused on road

infrastructure works under the Road Development Agency (RDA). The documentary review included the Improve Road Connectivity Project (IRCP) under World-Bank funding (Table 9.1).

**Table 9.1 Details of the case firms and case project**

<b>Case Firm</b>	<b>Main project types</b>	<b>Scope</b>	<b>Intervention</b>
MIHUD/RDA	Paved Roads – Main, Trunk, Urban, and District roads	Infrastructure design and construction	Upgrading to bituminous standards
	IRCP – World Bank Funded	Improve rural road accessibility	Output and performance-based capacity building
MLGRD	Unpaved-feeder roads	Infrastructure design and construction	periodic maintenance of feeder roads

The reasons for choosing these firms were:

1. They have the responsibility of road infrastructure provision in Zambia
2. A preliminary examination showed that the institutions produced more detailed annual reports
3. There are readily available audit reports on these institutions
4. The relative ease associated with the comparisons of road projects based on easily obtainable road lengths
5. The already classified system regarding interventions on roads (unpaved, paved, gravel, upgrading, maintenance, rehabilitation)
6. The roads are already classified in the gazette (Urban, Feeder, Main, and Trunk Roads)

The chapter utilized a documentary review (Table 9.2) of the circumstances surrounding the implementation of projects in case firms. The chapter holistically investigates project management behaviors and practices adopted by case firms between 2006 and 2021 using multiple case-study approaches.

**Table 9.2 List of documents reviewed**

<b>Institution</b>	<b>List of documents reviewed</b>	<b>Number of contracts reviewed</b>
MIHUD/RDA	• Annual reports (2013-2019)	7
	• Final audit report (2006-2009)	3
	• Final audit report (2012-2015)	4
	• 2009 RDA-PAC report	1
	• Contracts	92
MLGRD	• Auditor General main reports (2010-2019)	10
	• AWP (2015-2022)	8
	• Annual departmental reports (2013-2021)	9
	• Contracts	97
NRFA	• Annual reports (2012-2019)	IRCP (9 contracts)

(Source: by the author)

### **9.2 Selection of independent variables**

This study section identifies independent variables considered decently correlated with tender price. Table 9.3 summarizes the literature review on macroeconomic variables correlating with construction tender prices. The Table shows that exchange rate, inflation, interest rates, labor force, and unemployment rate are crucial to the price level in construction. The chapter identifies and evaluates the performance of tender prices on construction projects about unstable economic occurrences. A literature review of macroeconomic variables identifies variables with a significant impact on tender price. In addition, the chapter adds other local macroeconomic factors as experts recommend in implementing construction projects. The addition of variables is to improve understanding of their impacts in Zambia's sector-specific setup. Classification of all factors identified is into two groups. The groups include macroeconomic (or quantitative) elements, as shown in Table 9.3, and socio-political (or qualitative) factors, as shown in Table 9.4. From the literature, the study identifies inflation and interest rate for further evaluation. Data regarding the unemployment rate and labor force is not readily available for the study. Further, the study adds the Exchange rate, globalization (foreign direct investments), and government debt. According to industry experts, these added macroeconomic factors, and those from the literature review, significantly impact the tender price level of Zambia's construction sector.

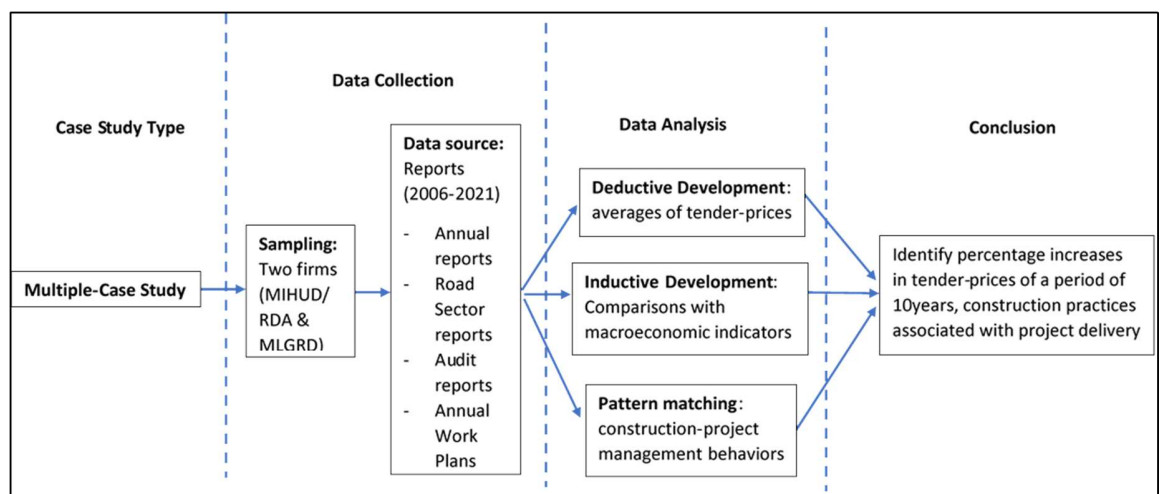
**Table 9.3 Macroeconomic variables affecting construction price**

Variables	(Arditi, et al., 2000)	(Ngowi, et al., 2005)	(Enshassi, et al., 2009)	(Oladipo & Oni, 2012)	(Choi, et al., 2013)	(Jiang & Liu, 2015)	(Chilongo & Mbetwa, 2017)	(Cheelo & Liebenthal, 2018)	(Asamoah, et al., 2019)	(Kirchberger, 2020)	(Musara, et al., 2021)	(Makoye, et al., 2022)
Exchange rate				✓					✓			
Inflation		✓		✓					✓		✓	✓
Interest rate	✓			✓		✓	✓	✓	✓			✓
Imports				✓								
Money supply				✓								
Export				✓		✓						
Gross Domestic Product				✓					✓			
External debt				✓								
Money supply				✓								
Labor force			✓		✓	✓	✓	✓		✓		✓
External reserve				✓								
Balance of payment				✓								
Industry weakness	✓											
Poor growth prospect	✓											
Consumer price index									✓			
Black market									✓			
Cost of raw materials										✓		
Unemployment rate				✓	✓	✓					✓	
Construction price level					✓	✓						
Globalization		✓										

(Source: by the author)

### 9.3 Method

The chapter utilizes a directed content analysis of documents from multiple case studies to offer more compelling evidence and a robust data set. The multiple-case design adopted (Fig. 9.1) allowed the study to perform a cross-case analysis regarding the tender price phenomena. The study aimed at the practices and behaviors surrounding project implementation in case firms without depending on the interviewee’s personal experiences and bias. Therefore, detailed historical records were the best alternative to obtaining accurate behaviors and practices.



**Fig. 9.1:** Chapter research procedure and methods  
(Source: by the author)

Annual publications of various reports allowed the study to track changes in chronological order and investigate utilizing analyzing these reports. These reports pass through rigorous checks for accuracy before publication, ensuring the information's authenticity. Sampling cases was purposeful, aiming to choose information-rich cases that would illuminate the phenomena under investigation. The cases sampled intensely manifested the phenomena under investigation as leading public infrastructure-based institutions with adequate experience in construction project practice.

#### 9.4 Circumstances surrounding construction practice: a pattern-matching analysis

The study adopted a pattern-matching analysis to identify behaviors and practices of case firms regarding construction project implementation by comparing construction-project-management methods of case firms; the study described in Table 9.4 an overall understanding concerning the implementation of project management and inherent contributing causes to tender price inflation.

**Table 9.4 Circumstances surrounding construction-management practices (2006-2020)**

(By author from Auditor-General, 2015; NRFA, 2022; PAC, 2009)

Observed Challenges	Frequency	Percentage (%)	Rank
Late engagement of supervising consultant	42	13.5	1
Delayed payments	40	12.9	2
Poor contract or project management	37	11.9	3
Poor quality of work	32	10.3	4
Lack of detailed engineering design	25	8.0	5
Excessive and questionable variations	22	7.1	6
Delayed project implementation	21	6.8	7
Questionable award of contract	17	5.5	8
Non-adherence to procurement procedures	16	5.1	9
Overpayment on claims	10	3.2	10
Failure to provide/renew contract bonds/guarantees	10	3.2	11
Interest claims	9	2.9	12
Unjustified single-sourcing	8	2.6	13
Poor quality materials	6	1.9	14
Lack of equipment	5	1.6	15
Questionable and uncompetitive rates	4	1.3	16
Inadequate budget provision	4	1.3	17
Irregular contract documents	1	0.3	18
Over procurement	1	0.3	19
Inconsistent application of evaluation criteria	1	0.3	20

(Source: by the author)

The table indicates issues requiring prioritization, including late engagement of supervising consultant at 13.5%, ranked one, and delayed payments at 12.9%, ranked 2. Others are poor contract or project management practices at 11.9%, ranked 3, poor quality of works at 10.3%, ranked 4, lack of detailed engineering designs at 8%, ranked 5, questionable award of contract at 7.1%, ranked 6, and, delayed project

implementation at 6.8%. The study graphed information gathered in Table 9.4 into a Pareto chart in Figure 9.2 to indicate the frequency of a challenge and its cumulative impact. This analysis helped find areas to prioritize interventions for the most significant overall effect. The chart suggests areas requiring prioritization include:

1. Late engagement of supervising consultant
2. Delayed payments
3. Poor contract or project management practices
4. Poor quality of work
5. Lack of detailed engineering designs
6. Delayed project implementation
7. Questionable award of contract

#### **9.5 Averages of construction tender prices: A deductive development**

The study identified the general feature of construction projects in case firms by analyzing tender-pricing behaviors. Consequently, the study employed a deductive development approach to develop specific annual tender-pricing averages (Table 9.5; Figure 9.3; Table 9.6; Figure 9.4). The study reviewed 92 contracts (N=92) for upgrading to bituminous standards between 2008 and 2018 (Table 9.5). Figure 9.3 indicates the average construction tender prices for the same period. Similarly, the study reviewed 97 contracts (N=97) for periodic maintenance of feeder roads between 2012 and 2021 (Table 9.6). Figure 9.4 shows the average construction tender prices for routine maintenance of feeder roads. The analysis shows that there has been a steady increase in construction tender prices between 2006 and 2021. For upgrading roads to bituminous standards, construction tender prices increased from K1,438,825.8/km in 2008 to an average of K14,395,749.5/km in 2018. At the same time, periodic maintenance of feeder roads increased from an average construction tender price of K162,880.3/km in 2012 to an average of K1,623,899.1/km in 2021.

#### **9.6 Macroeconomic indicators and construction tender prices: An inductive development**

The study utilized a qualitative data analysis approach of construction projects within case firms to develop averages of construction firms by examining various annual and

audit reports. The analysis consisted of directed content analysis, summative content analysis, and conventional content analysis. Based on existing information, the study identified 192 road construction projects from case firms in directed content analysis. The study developed two coding categories of length and the tender price at this research stage. Afterward, the investigation examined contracts based on these coding categories. The inquiry utilized a conventional content analysis to identify project categories that comprised upgrading roads to bituminous standards and periodic maintenance of feeder roads. Due to limited literature, the design was appropriate in determining works of similar nature, type of intervention, and scope. The study adopted a summative analytical method to calculate averages and draw comparisons with macroeconomic trend lines.

The analysis indicated that the percentage increase in construction tender prices for upgrading roads to bituminous standards between 2008 and 2018 was 31.4% (see Table 9.7). While the percentage increase in construction tender prices for periodic maintenance of feeder roads between 2012 and 2021 was 49.7% (see Table 9.11). Figure 9.5 shows how annual average construction tender prices for paved (bituminous) increased. The charts confirm a positive trend line or a steady rise in construction tender prices between 2008 and 2021. Moreover, Tables 9.7 and 9.9 show a positive correlation between construction tender prices to the foreign exchange rate, commercial interest rate, and external debt stock (*Figure 7.2: Conceptual framework*). Figure 9.7 shows how annual average construction tender prices for unpaved (feeder) roads increased. However, there was a negative correlation between construction tender prices and foreign direct investment. Further, Figures 9.6 and 9.8 show the correlation between macroeconomic indicators (moderating and independent variables of the conceptual framework) and construction tender price.

### **9.7 Chapter Discussion**

The findings indicate that all five factors (interest rate, exchange rate, FDI, government debt, and inflation) correlate with a tender price level in construction. Four elements show a positive correlation with tender prices, while FDI shows a negative correlation. Meaning increases in interest rates, exchange rates, government debt, and

inflation correspond with increases in construction tender prices. In contrast, increases in foreign direct investments are associated with decreases in construction tender prices. The findings regarding interest rates agree with those of Jiang & Liu (2015) that interest rate is a crucial determinant of construction demand. The study further concurs with the findings of Cheelo & Liebenthal (2018) and Nhabinde et al. (2012), suggesting that legal and regulatory reforms governing construction contracting rules require more focus on the economic circumstances of a country. In addition, the study agrees with Musarat et al. (2021), who argue that there is a strong relationship between the inflation rate and the construction industry. They say that the inflation rate is a significant cause of project cost overruns.

### **9.8 Improved rural connectivity project (IRCP) – Case project**

The improved rural connectivity project was a World Bank-funded project for improving Zambia's rural road accessibility and strengthening institutional capacity. The project aimed to improve selected feeder roads through upgrading, habitation, and maintenance interventions. The project enhanced feeder roads to gravel and low-cost-seal standards. However, the project has several components, and the study concentrated on the construction component of feeder roads. The project had meager average construction tender prices of K578,906.68/km (Table 9.11). The averages for IRCP were as low as 57.8% of the average tender prices of feeder road projects (see Table 9.12) despite the period between 2019 and 2021 recording average forex rates of 12.91, 18.28, and 20.05, respectively. External debt averaged 15.05bn, US\$16.45bn, and US\$17.7bn in 2019, 2020, and 2021 respectively. IRCP tender prices did not show any solid correlation for macroeconomic indicators (Table 9.13) compared to paved and unpaved road projects (see Tables 9.7 and 9.8). IRCP tender prices had a strong negative correlation to interest rates. In contrast, tender prices for upgrading to bituminous and periodic maintenance of feeder roads positively correlated with interest rates. Other projects (see Tables 9.7 and 9.8) show a strong positive correlation with foreign exchange rates, while IRCP tender prices (see Table 9.13) only had a weak positive correlation.

**Table 9.11 Construction tender prices for improved rural connectivity project IRCP**

Province	Package No. (Districts)	Project detail	Tender price(ZMW/Km)
Central	Package 1 in Mkushi District (254km)	The contract was signed with Sinohydro Zambia Ltd in May 2019 at a sum of K143,245,597.98 VAT Exclusive	584,675.91
	Package 2 in Chibombo & Mumbwa Districts (247.9km)	The contract was signed with China CAMC Engineering Co. Limited in May 2019 at a sum of K158,222,480.56 VAT Exclusive	640,576.84
Eastern	Package 3 in Petauke & Nyimba District (324.84km)	The contract was signed with China Geo-Engineering Corporation on May 8, 2020, at a sum of K178,467,322.32 VAT Exclusive	549,400.70
	Package 4 in Petauke, Sinda, and Katete Districts (180.95km)	Contract awarded to Zhongmei Engineering Group Limited on May 5, 2022, at a sum of K120,843,552.47 VAT Exclusive;	667,828.42
Northern	Package 7 in Mungwi, Mbala, and Senga Districts (204.36km)	The contract was signed with Sinohydro Corporation Limited on May 7, 2020, at a sum of K101,226,481.85 VAT Exclusive;	495,334.13
	Package 8 in Luwingu and Kasama Distrcets (198.85km)	The contract was signed with China Jiangxi International Economic and Technical Corporation Company Limited on June 3, 2020, at a sum of K91,666,713.42 VAT Exclusive;	460,984.23
	Package 10 in Samfya and Chifunabuli Districts (186.93km)	The contract was signed with Longjian Road and Bridge Company on May 11, 2020, at a sum of K81,585,918.62 VAT Exclusive;	436,451.71
Southern	Package 12 in Zimba, Kazungula, and Kalomo Districts (155km)	Contract awarded to M and N Industrial Merchants Limited on January 28, 2022, at a sum of K115,494,706.94 VAT Exclusive;	745,127.14
Muchinga	Package 14 in Chinsali and Shiwang'andu Districts (186.753km)	Contract awarded to M and N Industrial Merchants Limited on January 28, 2022, at a sum of K143,824,214.14 VAT Exclusive;	770,130.68
<b>Average tender price per kilometer</b>			<b>578,906.68</b>

(Source: by the author)

Improved rural connectivity projects – World Bank funded (IRCP) had an average construction tender price of K578,906.68/km, about 42.7% lower than that for (similar projects) unpaved roads under government funding, despite the period between 2019 and 2021 recording average forex rates of 12.91, 18.28, and 20.05, respectively. External debt averaged 15.05bn, US\$16.45bn, and US\$17.7bn in 2019, 2020, and 2021 respectively.

**Table 9.12 Cross-case analysis**

Case Firm	Main project types	Scope	Intervention	Average construction tender price (ZMW/Km)	Average percentage increment per annum
MIHUD/RDA	Paved Roads – Main, Trunk, Urban and District roads	Infrastructure design and construction	Upgrading to bituminous standards	5,262,736.9	+31.4%
	IRCP – World Bank Funded	Improve rural road accessibility	Output and performance based, capacity building	578,906.68	-
MLGRD	Unpaved-feeder roads	Infrastructure design and construction	periodic maintenance of feeder roads	1,000,912.87	+49.7%

(Source: by the author)

The averages for IRCP construction tender prices are as low as 57.8% of the average tender prices of feeder road projects (similar projects)

**Table 9.13 IRCP tender prices/macroeconomic correlation coefficients**

Year	2019	2020	2021	Averages	Coefficient ( r ) Pearson's	Comment
	584,675.91	549,400.70	667,828.4			
	640,576.84	495,334.13	745,127.1			
		460,984.23	770,130.7			
		436,451.71				
<b>Average (ZMK/Km)</b>	612,626.38	485,542.69	727,695.41	608,621.49	-	-
<b>Forex rates</b>	12.91	18.28	20.05	17.08	<b>0.21</b>	Weakly positive
<b>Inflation rates</b>	9.1	15.7	22.1	15.63	<b>0.47</b>	Weakly positive
<b>Interest rates</b>	25.6	26.8	25.7	26.03	<b>-0.84</b>	Strongly negative
<b>FDI (US \$'Bn)</b>	0.55	-0.17	0.19	0.19	<b>0.52</b>	Moderately positive

(Source: by the author)

IRCP tender prices do not correlate strongly to macroeconomic indicators compared to paved and unpaved road projects (see Tables 9.7 and 9.8). IRCP tender prices had a strong negative correlation with interest rates (-0.84). In contrast, tender prices for upgrading to bituminous and periodic maintenance of feeder roads positively correlated with interest rates. In addition, IRCP tender prices show only weak positive correlations to forex and inflation.

## 9.9 IRCP Characteristics

Table 9.13 indicates a weak positive correlation with forex rates, inflation, and FDI. However, there is a strong negative correlation between IRCP tender prices and interest rates; enough evidence of other factors' significant influence on construction tender prices. What are these various factors? This section explicitly studies the rationale and factors that affect IRCP tender pricing to develop critical mechanisms toward coherent conceptualization of factors influencing tender pricing.

### 9.9.1 Method

The study adopted a purposive sample of experts and personnel involved in the execution or implementation of IRCP. The study identified and interviewed seven (7) respondents directly managing IRCP, and the factors affecting tender pricing in IRCP grouped according to emergent themes (see Table 9.14). The study derived IRCP-specific characteristics from the content and thematic analysis of the interview data set. The final list of drivers to IRCP tender pricing includes seven (7) emergent themes (see Table 9.14).

**Table 9.14 IRCP Characteristics**

S/N	Respondent ID	Emergent theme	Characteristics of improved rural connectivity projects (IRCP)	Theme code
1	WBR1 WBR3	Cash flow assurance	Funds are readily available; assured cash flow; contractors need cash flow	IRCP1
2	WBR2 WBR3 WBR4	Guaranteed payments	Timely payments; there is payment certainty; payments guaranteed	IRCP2
3	WBR2 WBR7	Completeness of designs	Designs completed before procurement processes commence	IRCP3
4	WBR1 WBR4 WBR5	Competitiveness	There is high competition, Competitive prices due to increased demand, and fewer jobs; international competition improves pricing modeling	IRCP4
5	WBR3 WBR6	Breakeven strategy	Foreign firms want to stay in construction as long as they can; the industry has slowed down, so the IRCP offers the only viable projects on	IRCP5

S/N	Respondent ID	Emergent theme	Characteristics of improved rural connectivity projects (IRCP)	Theme code
			the market, and contractors are strategizing to bid as low as possible so that they can at least have some works to guarantee some income	
6	WBR4 WBR5	Procurement strategy	The procurement process of breaking work into packages create demand which gives potency for competitive pricing; a stringent procurement process that requires an understanding of bid rates	IRCP6
7	WBR4 WBR7	Government support	Foreign firms win all IRCP projects because they receive (their) government support such that they can outbid local contractors with low prices	IRCP7
8	WBR6	Life cycle strategy	Foreign firms have created a competitive advantage in the construction market, and they know that government projects have gone down; so instead of leaving for other needs due to reduced government spending on projects, they stay longer by lowering prices just to be able to sustain their operations without having to pack up	IRCP8

(Source: by the author)

## 9.10 Chapter Summary

On average, construction tender prices increased by 31.4% annually for upgrading roads to bituminous standards between 2008 and 2018. Whereas, between 2012 and 2021, tender prices for periodic maintenance of feeder roads increased by an average of 49.7% per annum. Upgrading of roads to bituminous standards (paved) averaged about K5,262,736.92/km (2008-2018), while periodic maintenance of feeder roads (unpaved) averaged about K1,000,906.28/km for the period 2012 and 2021. For paved roads, construction tender prices increased by K12,956,923.7/km from K1,438,825.8/km in 2008 to K14,395,749.5 /km in 2018. For unpaved roads (periodic maintenance), construction tender prices increased by K1,461,018.8/km from K1,438,825.8/km in 2012 to K1,623,899.1/km in 2021. On the other hand, improved rural connectivity projects – World Bank funded (IRCP) had an average construction tender price of K578,906.68/km, about 42.7% lower than that for (similar projects) unpaved roads under government funding.

**10.1 Introduction**

Integrating construction tender price management principles and practices into the public construction sector is a transition process, compounded by the fact that tender pricing is a complex concept. It is imperative to facilitate the transition by identifying and understanding the most critical and worst-performing tender price management aspects. In this chapter, the study attempts to identify the most crucial attributes of construction tender price management. The study investigates circumstances surrounding construction tender price inflation by highlighting the following:

1. the significance of a tender price in a construction project
2. factors for developing tender prices in construction
3. high construction tender prices' effect on the construction sector
4. effects of global competition or the emergence of foreign construction firms in the construction
5. significance of the procurement function and its contribution to the price performance of public infrastructure projects
6. current controls and their success or failures in mitigating escalating construction tender prices
7. government potential to overcome overpricing and maintain or increase its appetite for construction projects

**10.2 Method**

The chapter utilized person-to-person interviews to collect data from 14 interviewees (Table 9.1 and Table 9.2) identified through purposive sampling for better insights and a more thorough investigation of the construction tender price phenomena. It collected information from the best-fit participants to attain relevant research context results (Table 9.2). The adopted method presented the study with information-rich participants and cases regarding issues of central significance to the phenomena of inquiry. The study transcribed recorded interviews for coding and eventual analysis. In addition, the chapter utilized snowball sampling in which existing respondents

recruited or referred other respondents from among their professional acquaintances. The study ensured that the nominated subjects and the generated pool of participants exhibited traits similar to the purposively sampled ones.

### 10.3 Respondents' profile

Respondents included vital industry stakeholders (Table 10.1) whose age group ranged between 35 and 65 years. The respondents' experience was crucial in determining the evolution and true nature of the construction industry regarding tender price management. Table 10.1 shows the respondents' classification into six general practice areas. The target for each category is to represent a specific industry and project professional contribution. Of the fourteen (14) respondents, three were civil engineering consultants, three contractors, two architects, three quantity surveyors, two civil engineers (client representatives), and one procurement specialist.

Four respondents had over 30 years of experience; seven had experience ranging between 20 and 30 years, while three had practical experience between 15 and 20 years (Table 10.2). The sample group profile indicated that respondents comprised 22% civil engineering consultants, 22% contractors, 21% quantity surveyors, 14% architects, 14% client representatives, and 7% procurement experts. All respondents were construction-project managers with holistic understanding and experience regarding the construction sector and its various aspects. The selection of respondents reduced the selection bias while improving the representativeness of the sample categories. Among the respondents, one had a Ph.D.; two had bachelor's degrees, and eleven had master's degrees (Table 10.2).

**Table 10.1 Professions sampled**

Qualification/Area of practice	No. of Participants (n=14)	Percentage (%)
Civil engineering consultants	3	22
Contractors	3	22
Architects	2	14
Quantity Surveyors	3	21
Civil engineers/client representative	2	14
Procurement expert	1	7
Total	14	100

(Source: by the author)

#### **10.4 Significance of construction tender price**

The significance of construction tender price related to economic, business, project, and procurement dimensions. Tables 10.3 and 10.4 show tender prices to consist of five facets:

1. a measure of project value (S1)
2. a determinant of project success (S5)
3. the basis for contract award (S4)
4. an indicator of nature and level of competition (S3), and
5. an indicator of demand (S2)

The findings show that the significance of construction tender price relates to economic, business, project, and procurement dimensions. Tables 10.3 show a list of claims from 14 expert respondents regarding the significance of tender prices concerning the financial sustainability of the construction sector. The measurement indicators for tender price consisted of five measurement facets: a measure of project value, a determinant of project success, a basis for contract award, an indicator of nature and level of competition, and an indicator of demand. Respondents evaluated their understanding of tender price about five-set-out measurement indicators. Participant choices regarding the significance of construction tender price show an excellent long-term appreciation and understanding, among sector players, of its impact on the sector. Table 10.4 highlights factors affecting the development of construction tender prices from collected interview data.

##### **10.4.1 Economic Dimension - Measure of project value (S1)**

A measure of project value (S1) is the most significant aspect of the tender price. Suggesting that choosing benefits realizable from a project and its processes is essential to the stakeholders. The tender price directly influences short- and long-term benefits that accrue to stakeholders.

#### **10.4.2 Project Dimension - Determinant of project success (S5)**

Tender price as a significant determinant of construction project success was highly ranked. Tender price was an essential contextual independent factor influencing project success.

#### **10.4.3 Procurement Dimension - Basis for contract award (S4)**

Construction tender price ranked highly as the basis for an award of a construction contract. Entailing the need to address challenges of price factor and its weighting in contract award with express provisions regarding its treatment (de Gouveia, 2002).

#### **10.4.4 Business Dimension - Indicator of nature and level of competition (S3)**

From the interviews, high prices were a good measure of the quality and type of competition due to the grading system of contractors.

#### **10.4.5 Business Dimension - Indicator of demand (S2)**

The respondents considered high prices a sign of low construction jobs because contractors priced all risks patterning their existence in fewer projects on the market.

#### **10.5 Factors affecting the development of construction tender price**

Tables 10.4, 10.5, and Figure 10.1 highlight factors influencing construction tender price growth from collected interview data. The frequency and percentages in Table 10.4 show that five out of 25 elements have a ratio above seven. These factors include interest rate, equipment cost, material cost, labor cost, and delayed payments.

**Table 10.4 Summary of factors for developing construction tender price**

<b>S/N</b>	<b>Identified Factor</b>	<b>Code</b>	<b>Frequency</b>	<b>Percentage (%)</b>
1	Nature and level of competition	F10	4	4.7
2	Capabilities of the contractor	F15	2	2.3
3	Interest rate	F2	8	9.3
4	Equipment cost	F3	6	7.0
5	Material cost	F1	9	10.5
6	Inflation rate	F12	4	4.7
7	Labor cost	F4	6	7.0
8	Profit markup	F8	4	4.7
9	Allowance for price adjustment	F21	1	1.2
10	Risk of delayed payments	F5	6	7.0

11	Exchange rate	F6	5	5.8
12	Political risks	F9	4	4.7
13	Nature and type of project	F7	5	5.8
14	Availability of materials related to the project	F22	1	1.2
15	Contractor's workload	F23	1	1.2
16	Nature & type of procurement	F13	3	3.5
17	Project scope	F25	2	2.3
18	Poor project management practices	F14	3	3.5
19	Project location & site conditions	F16	2	2.3
20	Transportation	F17	2	2.3
21	Nature & type of client	F11	4	4.7
22	Nature & type of stakeholders involvement	F18	2	2.3
23	Regulatory environment (taxes etc.)	F24	1	1.2
24	Nature & type of contract	F19	2	2.3
25	Project duration	F20	2	2.3

(Source: by the author)

Construction tender prices determination includes a mix of different factors; While Table 10.5 show a broad range of factors influencing pricing in construction; Figure 10.1 shows the top 13 characteristics requiring immediate consideration to address construction tender price inflation, and these include:

1. Material cost
2. Interest rates
3. Equipment cost
4. Labor cost
5. Delayed payments
6. Exchange rate
7. Nature and type of project
8. Nature and level of competition
9. Inflation rate
10. Profit markup
11. Political risks
12. Nature and type of client
13. Project management practices

Accordingly, results in Figure 10.1, project-related costs (materials, equipment, and labor) and delayed payments to contractors are the most crucial factors contributing to construction tender price inflation. Therefore, better cost control and financial planning are essential for addressing tender price inflation. The client's macroeconomic indicators and project management practices constitute the reason for construction tender price inflation. As shown in Table 10.4, experienced contractors respond to issues of poor project management practices and the nature and type of client by making corresponding adjustments to profit markup when developing tender prices. Results show that contractors believe that increasing tender price is the way to address an erratic client and reduce or mitigate project-related risks. Factors of least concern when developing tender prices include:

1. Contractor's workload
2. Regulatory environment
3. Allowance for price adjustment and
4. Availability of materials related to the project

### **10.6 Impact of high construction tender price inflation**

The results in Table 10.6 categorize four specific areas, shown in Figure 10.2, significantly affected by high construction tender prices. The interview results indicate that the government is severely impacted, followed by the industry itself, when there is high construction tender price inflation. Project impacts are equally overwhelming; however, contractors appear to experience more positive-impact though in the short term. The long-term effects of high construction tender price inflation were detrimental to all stakeholders by observation. The negative impacts were immediate and more severe to stakeholders like the government (client).

### **10.7 Strategic construction tender pricing behavior**

The study identifies four categories of pricing behaviors demonstrated by contractors during tendering. These behaviors provide insights into construction tender price inflation arising from industry and client-specific features. The pricing behaviors include resistance (PB1), reactive (PB2), anticipatory (PB3), and Consultant-based

(PB4). Consultant-based (PB4) pricing was the least practiced behavior, whereas reactive (PB2) was the most established among all behaviors.

**Table 10.6 Tender pricing behaviors**

<b>Bid pricing behavior</b>	<b>Code</b>	<b>Features</b>	<b>Conditions for behavior</b>
Resistant	PB1	<ol style="list-style-type: none"> <li>1. Ignoring nature and type of competition</li> <li>2. Overlooking challenges</li> <li>3. Contractor overconfidence</li> </ol>	<ol style="list-style-type: none"> <li>1. Single sourcing or direct bidding of contractors</li> <li>2. Pre-bidding qualifications</li> <li>3. Lack of competition</li> <li>4. Lack of experience</li> <li>5. Subcontracting</li> </ol>
Reactive	PB2	<ol style="list-style-type: none"> <li>1. Strategies regarding inflationary problems</li> <li>2. Sensitivity strategies to stakeholder interference</li> <li>3. Prediction strategies against exchange rate fluctuation</li> <li>4. Reaction strategies to external stimuli</li> <li>5. Time strategies against delayed or non-payments</li> <li>6. Strategies against client instability</li> <li>7. Expectation strategies for profit erosion</li> <li>8. Strategies for front-loading</li> </ol>	<ol style="list-style-type: none"> <li>1. The incompleteness of designs and tender documents</li> <li>2. Poor or lack of information</li> <li>3. Corruption</li> <li>4. Project variations</li> <li>5. Poor project management</li> <li>6. Government financed projects</li> <li>7. Profit maximization</li> </ol>
Anticipatory	PB3	<ol style="list-style-type: none"> <li>1. Prediction strategies against exchange rate fluctuation</li> <li>2. Client stability strategies</li> <li>3. Strategies to gain competitive advantage</li> <li>4. Innovation strategies</li> </ol>	<ol style="list-style-type: none"> <li>1. Donor funded projects</li> <li>2. Incentives</li> </ol>
Consultant-based	PB4	<ol style="list-style-type: none"> <li>1. Stakeholder engagement strategies of competent pricing consultants</li> <li>2. Policy strategies</li> <li>3. Deliberate information-seeking systems</li> <li>4. Strategies for reflecting market rates</li> </ol>	<ol style="list-style-type: none"> <li>1. Capacity building</li> <li>2. Standardized specifications</li> <li>3. Availability of historical data</li> <li>4. Availability &amp; uniformity of information</li> </ol>

(Source: by the author)

### **10.8 Critical construction tender price management aspects**

The study identifies critical management aspects to help mitigate construction tender price inflation. Further, categorizations of tender price management aspects are into six dimensions. Table 10.7 and Figure 10.3 show these aspects to include:

1. Government dimension
2. Contractor dimension
3. Industry dimension
4. Project dimension
5. Procurement dimension
6. Legal dimension

These aspects indicate areas requiring improvement and development to mitigate high construction tender price inflation. Table 10.7 provide detailed explanations concerning the nature of the necessary intervention.

### **10.9 The pricing structure of Zambia's construction industry**

Table 10.8 describes the characteristics of Zambia's construction tender-pricing structure. Observation indicates that the pricing structure consists of five factors: client characteristics, aspects of local firms, foreign firms, the procurement process, and the project itself. The highest frequency or percentage designates the most significant description for each factor. For example, describing client characteristics of utmost consideration in the pricing structure is failing to make timely payments (CC1) and poor project management practices (CC2). Whereas other characteristic descriptions most relevant to pricing structure include:

1. Characteristics of local firms - Difficulties in accessing local financing (LF1)
2. Characteristics of foreign firms - Receive foreign government assistance (FF1)
3. Characteristics of the procurement process - Lack detection mechanism for the most economical price (PP1) and,
4. Characteristics of construction projects - Heavily affected by macroeconomic factors (CP1)

### **10.10 FDI – Emergence of foreign construction firms**

The emergence of foreign firms means enhanced access to money, skills, technology, and knowledge for the construction sector. Table 10.9 discusses the advantages and disadvantages regarding the emergence of foreign firms through foreign direct investments in the construction sector specifically. The discussion develops in line with FDIs' influence on construction tender price inflation. The study develops five thematic constructs to analyze the impact of the emergence of foreign firms on the construction market. Table 10.9 categorizes emergent themes, including:

1. Skills and technology transfer
2. Global competition
3. Project management and delivery practices
4. Access to resources and
5. Reputational damage

The research argues some of the notable disadvantages (Table 10.9) of foreign direct investments, which include:

1. Cause unfair competition. They can undercut prices and absorb losses to make it uncompetitive for local firms
2. Foreign firms have an unfair advantage because they are state-owned enterprises with immense and unlimited resources and have access to cheap loans or money that they can borrow from their countries
3. Foreign firms are heavily subsidized by their governments, making them strong enough to have a negative knock-out effect on local firms
4. They are an active component of unhealthy competition because they have a lot of financial influence to tip the scales and erode intended benefits and encourage harmful vices such as corruption
5. The competition brought about globalization, and the emergence of foreign firms exterminated, especially emerging local firms. After that, they increase tender prices systematically to meet huge expenses associated with managing a foreign firm

6. They have a level of capacity to perform (much better than local firms) and compete (better than local firms), thereby perpetrating the perception that local contractors are non-performers

### **10.11 Price management through the procurement function**

Construction procurement delivers value for all project dimensions, including tender price and long-term cost reduction. Consequently, construction procurement devises strategies for mitigating tender price inflation appropriately and sufficiently. Construction procurement develops and implements appropriate price management systems to deliver value and reduce and control construction tender prices. Table 10.10 identifies strategies of significance for efficient price management and performance in the construction sector, including:

1. Developing informed engineers' estimates early during project planning stages
2. Benchmark prices of construction elements through price indices and developing procurement controls for tendering processes, which enhance market predictability
3. Improve stakeholder involvement and understanding of project requirements
4. Building capacity and resilience of local firms to ensure competitiveness by developing exclusion and inclusion criteria
5. Anticipating instability of macroeconomic indicators, eliminating tender errors, and streamlining and shortening procurement processes
6. Ensuring transparency and developing appropriate information dissemination criteria
7. Localizing the context of international bidding standards and promoting partnerships by making local firms lead participants
8. Ensuring clarity of tender documents from the onset and eliminating human error or influence in handling documents

9. Ensuring construction professionals manage construction project procurement by Developing construction-specific procurement laws and involving construction professionals in procurement policy-making

Table 10.10 categorizes strategies for managing construction tender prices through procurement function into three main approaches:

1. Procurement planning
2. Protectionism
3. Procurement policy

### **10.12 Emerging patterns (tender price turnaround strategies)**

This study section addresses the second objective, “to propose strategies that central government can use to address public construction tender price inflation.” The study section adopts a theoretical approach, which utilizes a hierarchical analytical process to create a total score reflecting relative significance and respondents’ feelings. Table 10.11 shows the turnaround strategies and their respective grouping and scoring developed through numerical trade-offs and synthesis criteria driven by importance considerations. The study scored one (1) every time a respondent mentioned a strategy as part of the turnaround framework. The study identifies nine key turnaround strategies for addressing construction tender price inflation, grouped into six categories to include:

1. Planning management practices
2. Stakeholder management practices
3. Capacity management practices
4. Capacity building practices
5. Legal-framework modernization
6. Procurement management practices
7. Project management practices
8. Management of macroeconomic indicators
9. Sustainable-construction management practices

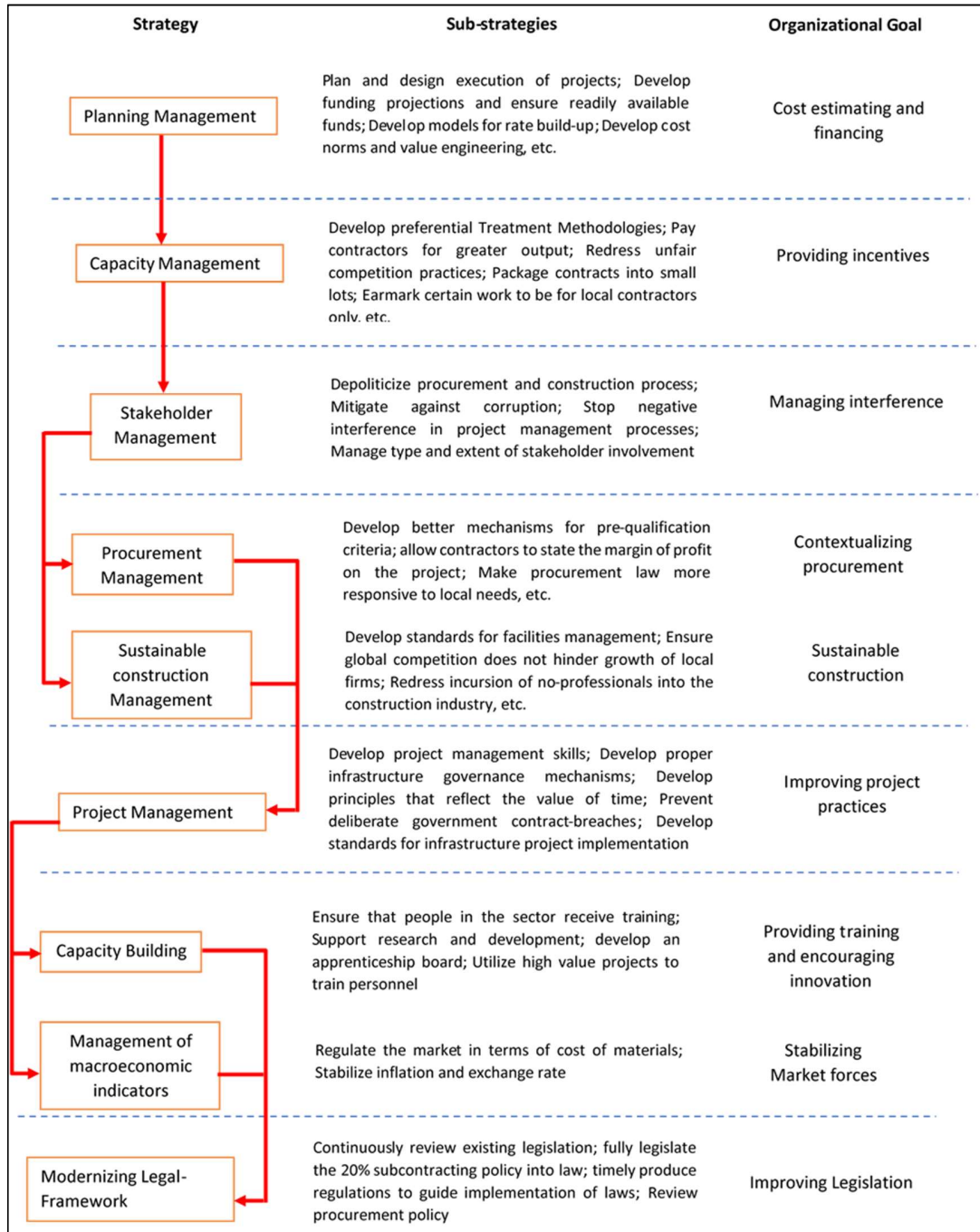
Emergent patterns for turnaround strategies include cost estimating and financing, mitigating external and internal interferences, providing incentives, providing training, and encouraging innovations. Others include revising legislation, contextualizing procurement functions, improving project management practices, predicting market forces, and guaranteeing sustainability. Figure 10.4 shows the weaving together of strategies following the scoring and grouping. The phasing of the vital system begins with the most critical:

1. Planning management – to be the first and most important strategy
2. Capacity management – to be the second most important strategy
3. Stakeholder management – to be the third most important strategy
4. Procurement management and sustainable construction management – to be grouped as the fourth most important strategies
5. Project management – to be the fifth most important strategy
6. Capacity building and management of macroeconomic indicators – to be grouped as the sixth most important strategies
7. Modernizing legal-framework – to be the seventh most crucial strategy

### **10.13 Chapter Summary**

The study finds that construction tender price depends upon numerous external and internal factors. There are 25 factors directly linked to construction tender price inflation (Table 10.4). Principal factors include material cost, interest rates, equipment cost, labor cost, delayed payments, exchange rate, nature and type of project, nature and level of competition, inflation rate, profit markup, political risks, character, and variety of client and project management practices. Given these factors (Table 10.11), the study identifies a possible range of nine both existent and non-existent strategies for mitigating construction tender price inflation, including planning management practices, stakeholder management practices, capacity management practices, capacity building practices, legal-framework modernization, procurement management practices, project management practices, management of macroeconomic indicators and sustainable-construction management practices.

The study weaves turnaround strategies to mitigate construction tender price inflation, as shown in Figure 10.4. The figure presents the phases of interventions beginning with the most critical approach that helps attain the highest impact. The objective of mitigating construction tender price inflation is achievable through achieving institutional goals, as shown in Figure 10.4. Nine target goals in this implementation schedule include improving cost estimating and project financing, managing stakeholder interference, developing local-firm incentives, developing training programs and encouraging innovation, reviewing legislation, contextualizing procurement function, improving project practices, stabilizing market forces, and adopting sustainable construction practices.



**Fig. 10.4: Weaving turnaround strategies**  
(Source: by the author)

## **CHAPTER 11: Quantitative Data Presentation and Analysis**

### **11.1 Introduction**

This chapter presents empirical results following the summary of qualitative data findings and interpretations of the responses (see Table 10.7). In this regard, the study developed a questionnaire to ascertain the level of acceptability of a construction management practice that lowers tender pricing. The second objective highlighted in Chapter 1 is the guiding principle for this chapter.

### **11.2 Questionnaire Design**

The study designed the questionnaire with six parts (see Figure 10.3 and Table 10.7). These parts indicate strategies requiring improvement and development to mitigate high construction tender price inflation. Table 10.7 provide detailed explanations concerning the nature of the necessary intervention. Table 10.7 and Figure 10.3 show these parts to include:

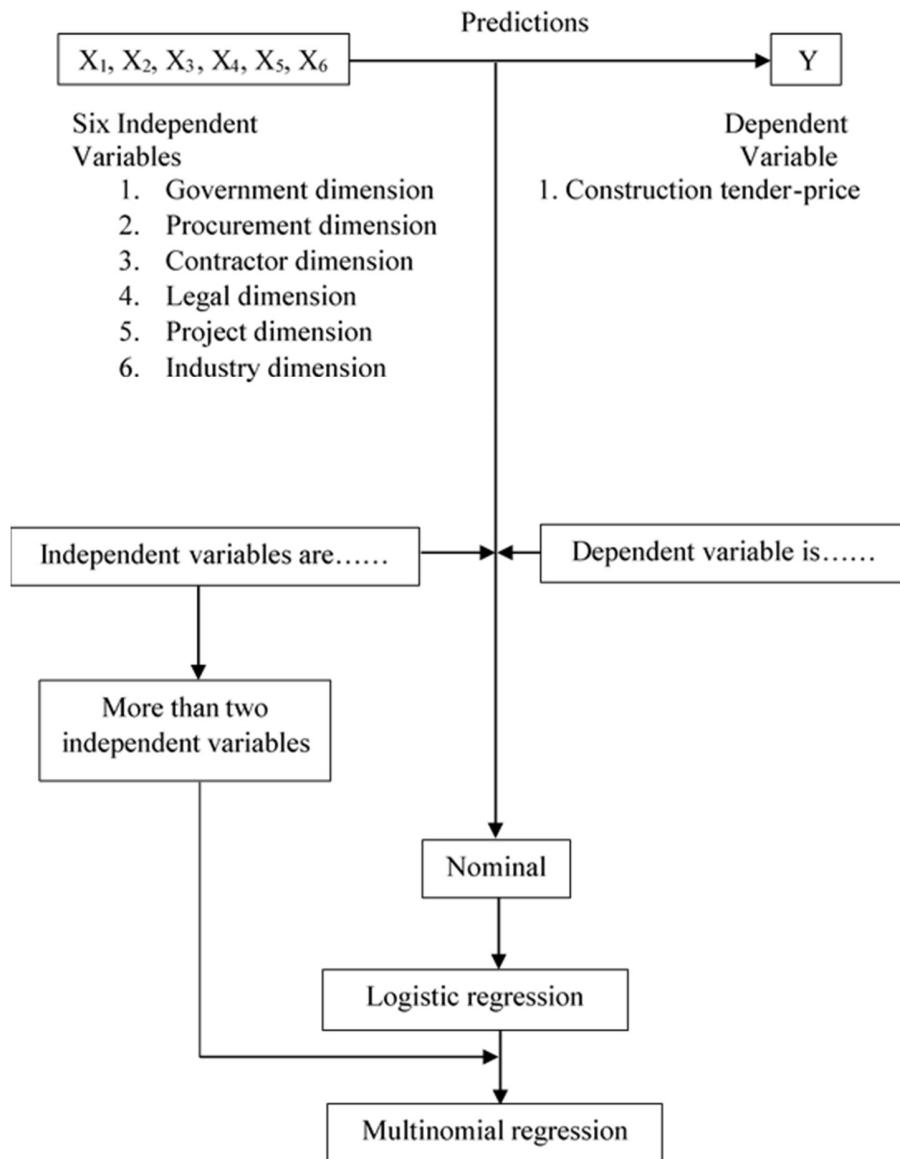
1. Government dimension
2. Contractor dimension
3. Industry dimension
4. Project dimension
5. Procurement dimension
6. Legal dimension

The study developed the questionnaire with statements regarding strategies for lowering construction tender prices by collecting ordinal data through numerical values. The ordinal scale with numerical values using a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”), whether they agreed that the strategy impacts lower tender prices. The study further tested statements with a mean score greater than 3.5 using a standard one-sample t-test.

### **11.3 Decision tree for predictive analysis**

The statistical research questions for this study fall in the prediction category. The research thus is interested in predicting the outcome variable (construction tender price)

by investigating how construction tender prices change (Y: increase or decrease) for one more or less unit of the independent variable (X). Figure 11.1 show the statistical analysis decision process adopted for this study.



**Figure 11.1** Statistical analysis decision tree

(Source: by the author)

#### 11.4 Response rate

The study adopted a sample of 170 construction industry practitioners for the questionnaire survey (see Table 8.1). Out of 170, the study collected and accepted 147 questionnaires. Table 11.1 show the distribution and response rate of questionnaires. Therefore, the study achieved a total response rate of 86.5%. All questionnaires received were useable as no questionnaire submitted was without data.

**Table 11.1 Distribution and response rate of questionnaires**

Questionnaires	Contractors	Clients	Consultants	Architects	Quantity Surveyors	Grand Total
Distributed	46	51	33	28	12	170
Received	37	50	26	24	10	147
Useable						
Frequency	25.17	34.01	17.69	16.33	6.80	100
Response rate (%)	80.43%	98.04%	78.79%	85.71%	83.33%	86.47%

(Source: by the author)

#### 11.5 Profile of respondents

The respondents represented critical stakeholders in the construction industry. As indicated in Table 11.1, contractors represented 80% of respondents. The study-distributed questionnaires to 46 contractors registered with NCC in Category 2 (see Table 8.1). This category was critical to the study because it consisted of almost equal numbers of local and foreign firms registered with NCC while conducting this research. The target was to obtain good representation from the category most impacted by foreign-firm competition. Clients' respondents represented 98%, while engineering-based consultants constituted 78.8%.

#### 11.6 Questionnaire administration and survey period

The study administered the questionnaire online over seven weeks, from 23 June to 10 August 2022. The researcher created and administered the online questionnaire through a free online platform, "kobo toolbox." The questionnaire conveyed a covering ethical statement, identified the type of research to the respondent, and explained the study's purpose.

### 11.7 Tender price controls for economic sustainability in construction

Respondents answered questions regarding identified tender price practices and controls for achieving economic sustainability in the construction sector. As a result, respondents agreed with the proposition of the study, as shown in Table 11.2. The results suggest that improving payment flows, providing contract clauses for price adjustments, and mitigating direct project-related costs are critical tender price controls for successfully implementing an economically sustainable construction sector. Other essential tender price controls include establishing technical rules, mitigating interest rate impacts, utilizing engineer's estimates, and mitigating inflation rate impacts. The study underscores thirteen tender price practices and controls for economic sustainability in the construction sector.

**Table 11.2 Tender price practices and controls for economic sustainability in construction**

Variable	Mean Rank	Mean	Std.	Variance	Skewness	Kurtosis		
		Deviation		Statistic	Statistic	Std. Error	Statistic	Std. Error
		Statistic	Statistic					
Improving payment flows	1	4.49	0.975	0.950	-2.377	0.200	5.372	0.397
Providing clauses for project variations/price adjustments	2	4.33	0.938	0.879	-1.760	0.200	3.450	0.397
Mitigating project-related costs	3	4.31	0.920	0.847	-1.627	0.200	2.717	0.397
Establishing technical & financial controls	4	4.29	0.944	0.890	-1.891	0.200	4.093	0.397
Mitigating interest rate impacts	5	4.29	0.972	0.945	-1.781	0.200	3.382	0.397
Utilizing engineer's estimates	6	4.27	1.055	1.114	-1.720	0.200	2.553	0.397
Mitigating inflation rate impacts	7	4.24	0.989	0.977	-1.617	0.200	2.529	0.397
Mitigating personnel/labor cost escalations	8	4.20	0.904	0.817	-1.643	0.200	3.554	0.397
Mitigating the impact of material-price escalations	9	4.20	0.934	0.872	-1.582	0.200	2.998	0.397

Reducing imports	10	4.14	1.070	1.146	-1.464	0.200	1.722	0.397
Benchmarking price performance	11	4.09	1.020	1.040	-1.515	0.200	2.398	0.397
Managing profit margin estimations	12	4.05	1.012	1.024	-1.195	0.200	1.223	0.397
Legislating regulations for Price reasonableness analysis	13	4.05	1.052	1.107	-1.434	0.200	1.876	0.397
Legislating rate analysis	14	4.00	1.020	1.041	-1.216	0.200	1.336	0.397

(Source: by the author)

### 11.8 Procurement selection criterion-key-indicators for managing tender price

A literature study and documentary review examined factors as indicators for managing tender price inflation and established which strategy would be appropriate for use. The study identified eight (8) critical indicators for an improved procurement selection criterion relevant to managing construction tender price inflation. Key indicators from documentary reviews and confirmed through key informant interviews are collated into eight categories and presented in Table 11.3. Table 11.3 further show the relationships between procurement-selection-criterion vital indicators and the adopted pricing structure derived from interviews.

**Table 11.3 Relationship between procurement indicators and pricing structure in construction**

No.	Indicator	Interview quote describing the nature of the industry	Frequency	Percentage	Contractor pricing approach	Turnaround Strategy
1	Availability of preferential systems for targeting local firms	Lack of preferential systems for targeting local firms	7	16	artificially lower price	Ensuring the protection of local firms
2	Ability to use engineer's estimates, detect collusion and fraudulent bidding practices	Cannot detect collusion	3	7	increase markup and frontload	Benchmarking price performance
3	Ability to achieve value for money	Lack of detection mechanism for a most	8	18	increase markup	Establishing technical & financial controls

		economical price				
4	Availability of procurement principles that are specific to construction	Not specialized in following construction principles	5	11	increase markup	Legislating regulations for Price reasonableness analysis
5	Domestication of procurement processes and provisions	Procurement provisions do not suit the local market	7	16	increase markup and frontload	Legislating procurement controls
6	Completeness of tender documents and designs	Documents lack clarity & incomplete designs	5	11	increase markup	Eliminating errors in tender documents
7	Procurement timeframe	Lengthy procurement processes	4	9	increase markup	Standardizing Procurement timeframe
8	Adequacy of procurement provisions for construction projects	Not adequate for construction projects of complex technical nature	5	11	increase markup	Legislating subcontracting policy & joint venture agreements
Total			44	100%		

(Source: by the author)

The respondents rated eight (8) identified indicators of improved procurement selection criterion on a Likert scale of 1 to 5. The study presents the resultant descriptive statistics and means scores in Table 11.4. With a cutoff point set at a mean score of 3.5, the Table shows that all identified indicators are fundamental in improving procurement selection criteria for managing construction tender prices in public projects.

**Table 11.4 Respondents' mean scores for critical indicators and commonalities for principal factor analysis**

Indicator	Turnaround Strategy	Mean	Rank	Initial	Component No.
Ability to use engineers' estimates, detect collusion and fraudulent bidding practices	Benchmarking price performance	4.09	6	1.000	1
Completeness of tender documents and designs	Eliminating errors in tender documents	4.02	8	1.000	2
Ability to achieve value for money	Establishing technical & financial controls	4.29	1	1.000	3
Standardizing and reducing procurement timeframe	Standardizing Procurement timeframe	4.25	2	1.000	4
Availability of procurement principles that are specific to construction	Legislating regulations for Price reasonableness analysis	4.05	7	1.000	5

Adequacy of procurement provisions for construction projects	Legislating subcontracting policy & joint venture agreements	4.20	3	1.000	6
Domestication of procurement processes and provisions	Legislating procurement controls	4.14	5	1.000	7
Availability of preferential systems for targeting local firms	Ensuring the protection of local firms	4.19	4	1.000	8

(Source: by the author)

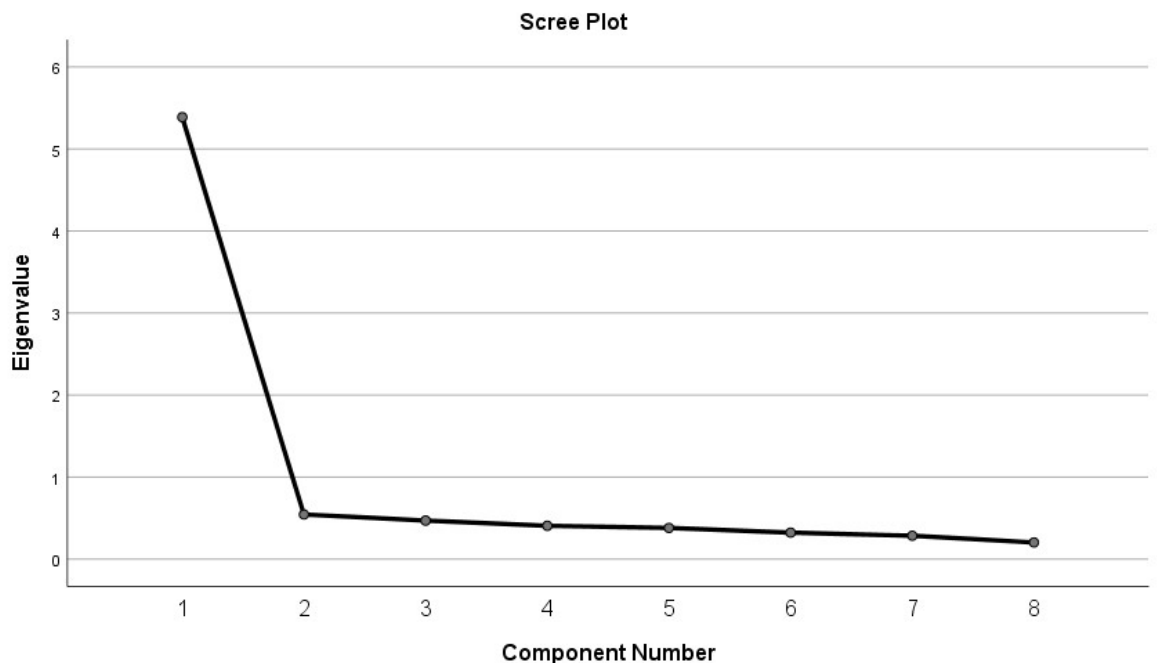
The data for factor analysis gives the key indicators and their corresponding strategy for improving procurement selection criteria to manage construction tender price inflation. The question is whether the key indicators can enhance procurement function to manage construction tender prices on public infrastructure projects, with the appropriate strategies, using factor analysis. Table 11.5 show the percentage variance using principle-component-extraction analysis. The research utilizes the Kaizer stopping criterion to determine the number of indicators to extract. The Table indicates that only one indicator is removed since only one has an Eigenvalue (5.388) greater than 1.

**Table 11.5 Percentage variance of strategies as derivative of principle-component-analysis method**

Strategy/Indicator	Component No.	Initial Eigenvalues		
		Total	% of Variance	Cumulative %
Benchmarking price performance	1	5.388	67.346	67.346
Eliminating errors in tender documents	2	0.544	6.805	74.151
Establishing technical & financial controls	3	0.470	5.872	80.023
Standardizing Procurement timeframe	4	0.407	5.085	85.108
Legislating regulations for Price reasonableness analysis	5	0.380	4.752	89.860
Legislating subcontracting policy & joint venture agreements	6	0.323	4.036	93.897
Legislating procurement controls	7	0.285	3.563	97.459
Ensuring the protection of local firms	8	0.203	2.541	100.000

(Source: by the author)

The study adopts the rotational method to obtain indicators that are as different as possible from each other and interpret them by putting them all primarily on one of the indicators. An orthogonal solution (Varimax Rotation) is opted for in which all indicators are not highly correlated. This method is utilized despite Table 11.5 showing that only one factor is extracted after meeting the cutoff point (indicators with Eigen values greater than 1). The “% of variance” shows that 67.3% of total inflation is attributable to benchmarking price performance. While eliminating errors in tender documents accounts for only 6.8% of the inflation in all eight variables, and so on. However, the scree plot (Figure 11.1) leads to a different finding as the slope of the curve levels out after two indicators, rather than one.



**Fig. 11.1:** Scree plot of eight key indicators  
(Source: by the author)

Table 11.6 shows actual indicators, which meet the cut-off point criterion based on the Scree plot. Meaning that benchmarking price performance accounts for 40.457% of the inflation, and eliminating errors in tender documents accounts for 33.693%. It

gives a cumulative 74.151% inflation from rotational sums of square loading (extraction method).

**Table 11.6 Actual extracted key indicators**

Strategy/Indicator	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Benchmarking price performance	5.388	67.346	67.346	3.237	40.457	40.457
Eliminating errors in tender documents	0.544	6.805	74.151	2.695	33.693	74.151
Establishing technical & financial controls	0.470	5.872	80.023	-	-	-
Standardizing Procurement timeframe	0.407	5.085	85.108	-	-	-
Legislating regulations for Price reasonableness analysis	0.380	4.752	89.860	-	-	-
Legislating subcontracting policy & joint venture agreements	0.323	4.036	93.897	-	-	-
Legislating procurement controls	0.285	3.563	97.459	-	-	-
Ensuring the protection of local firms	0.203	2.541	100.000	-	-	-

(Source: by the author)

The rotated component matrix in Table 11.7; show factor loadings for each indicator. The figures are all positive, which indicates strong loadings of factors upon one another. Based on these factor loadings, findings show that all indicators except legal-related strategies (legislating regulations for Price reasonableness analysis and Legislating subcontracting policy & joint venture agreements) load strongly on

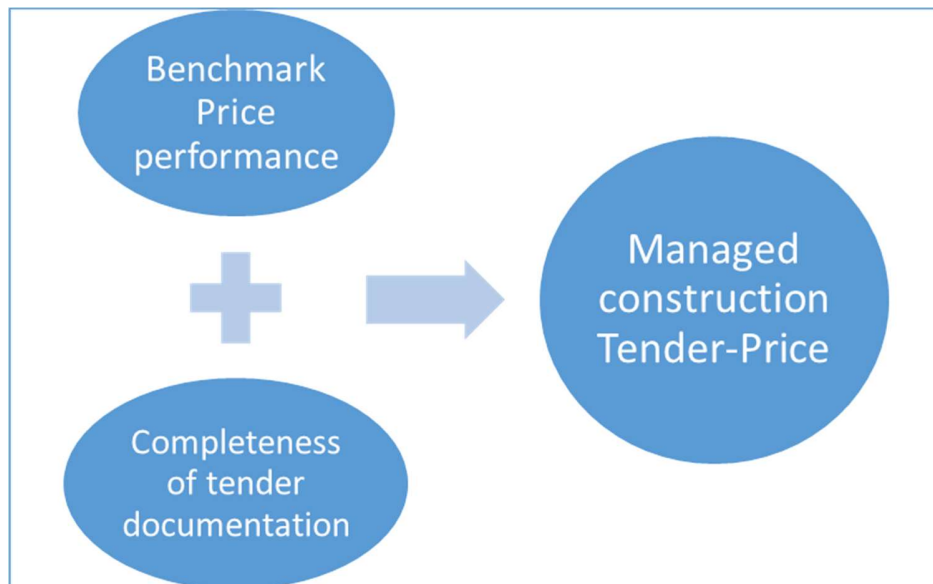
benchmarking price performance. However, legal-related strategies load firmly on eliminating errors in tender documents.

**Table 11.7 Rotated component Varimax matrix with Kaiser Normalization**

Strategy/Indicator	Component	
	1	2
Benchmarking price performance	0.661	0.484
Eliminating errors in tender documents	0.863	0.228
Establishing technical & financial controls	0.757	0.412
Standardizing Procurement timeframe	0.699	0.495
Legislating regulations for Price reasonableness analysis	0.318	0.794
Legislating subcontracting policy & joint venture agreements	0.340	0.831
Legislating procurement controls	0.557	0.671
Ensuring the protection of local firms	0.682	0.472

(Source: by the author)

The study, thus, deduces two principal factors that serve as critical indicators of a procurement selection criterion focused on managing construction tender price inflation, as depicted in Figure 11.2.



**Fig. 11.2:** Procurement selection criterion key indicators for managing tender price

(Source: by the author)

### **11.9 Statistical analysis on variables (Dimension strategies)**

The means for all twelve statements were greater than 3.5, as shown in Table 11.8. The study uses the mean to describe and represent the center of the data sets. The analysis indicates that the data sets have mean values ranging from 3.96 (lowest mean of the data set) to 4.49 (highest mean of the data set) for a Likert range of one (“strongly disagree”) to five (“strongly agree”). These typical values indicate that the data’s center points fall within the ranges of agreeing and strongly agreeing that specific dimension strategies stated could yield lower construction tender prices. For this nominal distribution, 67% of the standard deviation values (0.975, 0.926, 0.958, 0.958, 0.958, 0.988, 0.983, 0.964) fall within one standard deviation of the mean, while 100% of the standard deviation values (include: 1.02, 1.095, 1.017, 1.042) fall within two standard deviations of the mean as shown in Table 11.8. These lower standard deviation values indicate a lesser spread in the data. The coefficient of variation (CV=standard deviation/mean) of less than one shows relatively low variation; therefore, the distribution of the dataset is of low variance. The data set has much less variability than its mean.

Table 11.8 establishes positive kurtosis values ranging from 1.708 to 5.372. These kurtosis values significantly deviate from zero, indicating that the data is not normally distributed. The kurtosis values between -2 and +2 are acceptable in proving univariate normal distribution. The positive kurtosis values indicate leptokurtic distribution in which data follows a t-distribution. In addition, the Kolmogorov-Smirnov and Shapiro-Wilk test results suggest that data sets do not follow a normal distribution in the entire population (Table 11.9). The variables Kolmogorov-Smirnov test and Shapiro-Wilk test results “Sig.” are less than 0.05. Importantly, since the p-values in the Sig. Column is less than 0.05, and the study adopts non-parametric tests in further analysis. Table 11.8 indicate skewness values for the variables that range from -1.172 to -2.377. It indicates a highly left-skewed distribution since the values are all less than -1.00. Therefore, the distributions are not normal because they exhibit skewness and kurtosis values that exceed guidelines for normal distribution. In Table 11.8, the study

ranks the variables according to their means. Finch (2022) agrees that the mean ranking of variables reflects how popular the research sample found the item.

Since the study had more than two variables in a single group, it adopted general linear model procedures for one sample t-test to compare means, as shown in Table 11.9. In Table 11.9, the hypothesis is that government dimension strategies do not mitigate construction tender price inflation. The statistics performed assuming equal variances have associated significance levels of 0.000. The significance levels evidence that there is no impact of government strategies on construction tender prices is very small or highly insignificant. Specifically, less than once in a thousand, we obtain a mean difference of between 3.959 and 4.490 or larger where government strategies have no impact. In addition, the t-test associated significance levels tests the hypothesis that government strategies do not affect construction tender price inflation (Table 11.10). The high *t*-statistics and their associated significance levels ( $p < 0.001$ ) indicate this is not the case. The observed associated mean differences would occur fewer than once in a thousand times if there were no impact between government dimension strategies and construction tender price inflation. The finding means more extraordinary evidence of a significant effect of government strategies. The greater the magnitude of *t*-statistics (Table 11.10), the greater the evidence against the null hypothesis.

Table 11.9 indicate Kolmogorov-Smirnov sig. values of 0.000 ( $p < 0.001$ ), therefore, we have significant evidence to reject the null hypothesis that the variables follow a normal distribution. The Kolmogorov-Smirnov test statistic values are high (above 0.05), indicating goodness of fit. The study utilizes bootstrapping resampling technique to estimate statistics by iteratively sampling the dataset with replacement. Summary statistics such as mean and standard deviations included desirable results of the bootstrapping method. With 1000 resamples, the bootstrap distribution shape is approximately normal as it provides a distribution of means of each sample. In Table 11.9, for example, the estimate for the sample mean for *improving stakeholder management* under government dimension strategies is approximately 4.395. We, therefore, can be 95% confident that the population mean lies between 4.25 and 4.537. The bootstrap bias in this particular case is 0.000. The bootstrap estimate of bias is the

difference between the mean of the bootstrap estimate and the estimate computed using the original sample. Table 11.10 indicates the mean estimates calculated using the actual samples.

### **11.10 Reliability**

The study used Cronbach's alpha to measure how a set of items in a group are closely related. The test, developed by Lee Cronbach in 1951, measures the internal consistency of the variables. The alpha measures if the multiple-question Likert scale questionnaire is reliable. The alpha findings range between 0.000 and 1.000. However, negative values are also obtainable. In the study, Cronbach's alpha is 0.988. It implies that the instrument used to measure the effects on construction tender price inflation is highly reliable. The minimum acceptable value of Cronbach's alpha is 0.700, while the maximum expected value is 0.900. Alpha values below 0.700 mean the standard range has a low internal consistency. However, alpha values above 0.900 could imply duplication or be perceived as redundancy. For example, under the industry dimension, there could be duplication regarding variables: *Providing training* and *building local firms' capacity*. This solution combines duplicate variables.

### **11.11 Multinomial logistic regression analysis**

The study adopts regression analysis to predict future happenings between independent predictor variables identified in the six dimensions: government, procurement, contractor, project, legal, and industry, and the dependent target variable: construction tender price inflation. The analysis predicts the effects of dimension-related variable interventions on construction tender price inflation. This study's primary uses of regression include forecasting and establishing cause-and-effect relationships between independent and dependent variables. Table 11.11 describes the model design of the multinomial regression analysis. In the table, strongly agree/influencing (5) represents 62.3% of the model design, agree/influencing (4) represents 31.3%, and neutral (3) represents only 6.1%.

**Table 11.11 Case-processing summary**

		N	Marginal Percentage
Construction tender price inflation	3	9	6.1%
	4	46	31.3%
	5	92	62.6%
Valid		147	100.0%
Missing		1	
Total		148	
Subpopulation		142 <sup>a</sup>	

a. The dependent variable has only one value observed in 141 (99.3%) subpopulations.

(Source: by the author)

Table 11.12 details the model fitting information in which entered variables. The table indicates the -2Log (likelihood) change between models utilized for significance testing and calculating the Pseudo R-squares. It is known as the zero (0) model in the study.

**Table 11.12 Model fitting information**

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	237.977			
Final	93.619	144.358	130	0.184

(Source: by the author)

Table 11.13 and Table 11.15 contain the goodness-of-fit criteria. The chi-Square test of the null hypothesis that the coefficients are different from zero is insignificant. Nagelkerke's  $R^2$  is close to 1.000. The Pseudo  $R^2$  indicates that the multinomial model explains 62.5% only of the variability between the independent variables and construction tender price inflation.

**Table 11.13 Goodness-of-fit and Pseudo R-Square**

	Goodness-of-Fit			Pseudo R-Square	
	Chi-Square	df	Sig.		
Pearson	131.539	152	0.883	Cox and Snell	0.625
Deviance	91.397	152	1.000	Nagelkerke	0.773
				McFadden	0.593

(Source: by the author)

Table 11.14 indicate that the estimated multinomial regression functions correctly classify 86.4% of the inflation events. However, this is a less powerful goodness-of-fit test than Pearson's or Deviance. Table 11.16 shows the multinomial regression analysis's parameter estimates, including the logistic regression function coefficients.

In addition, the table highlights the test of significance for each coefficient in the multinomial regression model.

**Table 11.14 Classification**

Observed	Predicted			Percent Correct
	3	4	5	
3	9	0	0	100.0%
4	0	31	15	67.4%
5	0	5	87	94.6%
Overall Percentage	6.1%	24.5%	69.4%	86.4%

(Source: by the author)

Parameter estimates tell us how much each variable contributes to addressing construction tender price inflation. The B-value in the table tells us that if the variable changes by the value indicated under B, then the construction tender price changes by one unit, provided that variable is significant. Table 11.16 suggest that all variables are significant ( $p > 0.05$ : higher  $p$ -value means greater influence). The table summarizes the effect of each predictor on the target variable. For this study, a factor level with a more significant coefficient (B) indicates a greater impact on construction tender price inflation. The sign (positive or negative) of a coefficient for a factor level depends upon that factor level's effect relative to the reference category (5.00 = strongly agree or strongly influencing).

Regarding *industry dimension*, the study makes the following interpretations based on parameter estimates:

1. *Providing training* has a statistically significantly ( $p$ -value of 0.318) more significant influence on the construction tender price inflation level (estimated coefficient of 1.123) than *alleviating effects of the existence of foreign firms* with statistically significantly ( $p$ -value of 0.733) lower influence on construction tender price inflation level (estimated coefficient of -0.403)

Regarding *project dimension*, the study makes the following interpretations based on parameter estimates:

1. *Ensuring a steady flow of payments* has a statistically significantly ( $p$ -value of 0.720) more significant influence on construction tender price

inflation level (estimated coefficient of 0.471) than *Mitigating the impact of material-price escalations* with a statistically significantly ( $p$ -value of 0.035) lower influence on construction tender price inflation level (estimated coefficient of -2.148)

### **11.12 Chapter Summary**

The findings of the statistical analysis of the quantitative data indicate a strong correlation between the dimension-independent variables and construction tender price. Regression functions correctly classify 86.4% of the inflation effect of tested predictor variables on construction tender price. The study evidences a more significant influence of independent variables on tender price.

## **CHAPTER 12: Model Development**

### **12.1 Introduction**

The chapter develops a hybrid model (Figure 12.1) that mathematically and categorically describes construction tender price inflation beliefs. The advantages of formulating a mathematical aspect of the model lie in the precision of mathematics in developing ideas and identifying fundamental assumptions. However, mathematical modeling for optimal construction tender price requires elements of compromise since the majority of interacting variables are far too complicated. The first level of compromise includes identifying the most important independent variables to tender price. The second level of compromise includes selecting the type and amount of meaningful mathematical manipulation. It is because the results largely depend on the form of equations adopted. The understanding is to create a much more robust model than one with elegant results. The mathematical model developed in this chapter is applicable in several scenarios depending on the state of knowledge about tender price inflation, including enhancing scientific understanding of the phenomenon through the quantitative expression of existing expertise and supporting strategic and tactical decisions made by managers and planners. The descriptive aspects of the model allow more informed-decision making that guides the management of public infrastructure projects. This aspect is critical for developing project management analytics for institutions to make better decisions and improve the performance of tender prices by identifying trends and patterns. This aspect helps the production of key performance indicators and metrics for public infrastructure projects regarding tender price. Thus, this aspect focuses on the prominence of patterns observable in historical and current information. However, the study combines descriptive and analytical elements to predict the future state and conditions of construction tender prices.

### **12.2 Previous studies on construction tender price**

Table 12.1 discusses strengths and weaknesses observed in relevant and contiguous previous studies that developed models regarding construction tender price.

**Table 12.1 Previous studies on models regarding construction tender price**

Continent	Country	Author	Model	Strength	Weakness
Asia	China	(Zhang, et al., 2015)	System for construction tender price evaluation based on big data	<ul style="list-style-type: none"> <li>• Use big data to give a reasonable project cost range</li> <li>• Establish price controls</li> </ul>	How to revise and refine algorithms to improve the degree of automation of bid data and result accuracy
	Malaysia	(Hassim, et al., 2018)	Estimating model for pre-tender estimation process using fuzzy logic combined with neural network method	<ul style="list-style-type: none"> <li>• Assist pre-tender estimation process enabling the client to make early funding arrangements</li> <li>• Assist contractors in coming up with more accurate tender price estimations</li> </ul>	The model estimated cost is subject to the accuracy of rating of factors
	Taiwan	(Wang, et al., 2007)	Simulation-based cost model	<ul style="list-style-type: none"> <li>• Assesses cost uncertainties</li> <li>• Improves bid price decision quality</li> </ul>	The model does not account for the effects of tendering method and project type
	Hong Kong	(Tan & Goh, 2017)	Grey model (GM) for forecasting price indices	Forecast the likely tender price of a given project	<ul style="list-style-type: none"> <li>• The model performs poorly in the face of dramatic fluctuation in the dependent variables, as is the case with developing countries</li> <li>• Statistically unstable for small sample sizes</li> <li>• It involves solving complex equations</li> <li>• Time-consuming</li> </ul>

Continent	Country	Author	Model	Strength	Weakness
					<ul style="list-style-type: none"> <li>The model does not incorporate new information</li> </ul>
		(Wong & Ng, 2010)	Vector error correction model	Provides medium-term forecasts in tender price movements	Limited to predictions of tender price index patterns
		(Yiu & Tam, 2006)	Real options model	Describes bidders underpricing phenomenon	The model does not account for correlations between the option value and macroeconomic volatilities
Europe	United Kingdom	(Akintoye & Skitmore, 1990)	Construction price causal model using simultaneous equations focusing on construction demand and supply models	Predict movements in the tender price index	The model does not incorporate changes in the composition of the construction market aggregate tender price
	Poland	(Jaśkowski & Czarnigowska, 2019)	Modified Friedman's Model with correlations	Simulates bidder's maximum profit margin and determination of profit ratio	Assumes positive correlations between competing bid prices
	Macedonia	(Petruševa, et al., 2016)	Support Vector Machine (DTREG Software Package)	Predicts bid price with high accuracy	The algorithm underperforms for large data sets and requires higher training time
Africa	Ghana	(Kissi, et al., 2018)	Autoregressive integrated moving average with exogenous (ARIMAX) model	Forecasting tender price index	Difficulties in forecasting accumulated time series
		(Kissi, et al., 2017)	Structural model for tender price determination	Provides causal relations regarding the degree of influence of	The model does not forecast accumulated time series and fails to account

<b>Continent</b>	<b>Country</b>	<b>Author</b>	<b>Model</b>	<b>Strength</b>	<b>Weakness</b>
	Nigeria	(Olatunji, 2008)	Model for predicting project final construction cost and period	Investigates the relationship between tender price and final construction costs	for the effects of extant price levels The model fails to account for sociopolitical issues relating to non-economic dimensions of the industry

(Source: by the author)

### 12.3 The analytical (quantitative) aspect of the model

The analytical aspect of the model presents a closed-form solution to equations describing changes to construction tender price expressed in a mathematical analytic function. The quantitative nature of the analytical characterization of the model is crucial for making specific decisions regarding the reliability of engineers' estimates and the performance of the adopted procurement method and other related strategies. The study expresses the analytical aspect of the model with sufficient precision to allow formal and reliably supported analysis. The dynamic analytical element represents the time-varying state of construction tender prices. For this paper, a model simulates the execution based on actual conditions. It allows the model to recreate simulations on instances related to the simulation environment. The model further applies actual initial conditions of the cases and later uses mathematical equations to determine changes as a function of specific independent variables.

#### 12.3.1 Model assumptions

In construction, the assumption is that, without other limiting and encouraging factors, tender pricing is positively proportional to interest rate, exchange rate, inflation rate, foreign direct investment, and national debt. A mechanistic or empirical model, which describes such a price in construction infrastructure projects, is an equation of the form:

$$Y : f(I + R + E + Fdi + D) \dots\dots\dots \text{[Equation 12.1]}$$

Where Y is the construction tender price, which is the dependent variable, the independent variables consist of I (inflation rate), R (interest rate), E (Exchange rate), D (Government debt), and Fdi (Foreign direct investment). The study utilizes statistical processes to estimate the relationship between construction tender price and the independent variables in this modeling. The study proposes a regression model of the form:

$$Y_i = f(X_i, \beta) + e_i \dots\dots\dots \text{[Equation 12.2]}$$

$Y_i$  is a function of  $X_i$  and  $\beta$  in which  $e_i$  represents an additive error representing unmodeled determinants of  $Y_i$ . The study proposes a simple multivariate regression to estimate the function  $f(X_i, \beta)$  of the form:

$$Y_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + e_i \dots \dots \dots \text{[Equation 12.3]}$$

The form represents a reasonable approximation of the statistical process and a convenient form for the function  $f(X_i, \beta)$ . The study utilizes the proportion of variance (R-Squared) values describing the relationship of each independent variable with construction tender price. Polynomial regression with the highest R-Squared values represents the optimum effect on the tender price, as shown in Table 13.1 and Table 3.2. The standard form of the adopted polynomial function is:

$$f(x) = \beta_n x^n + \beta_{n-1} x^{n-1} + \dots + \beta_2 x_i^2 + \beta_1 x_i + \beta_0 \dots \dots \dots \text{[Equation 12.4]}$$

Where  $\beta_n$  and  $\beta_{n-1}$  are real number constants,  $\beta_n$  cannot equal zero, and  $n$  is a non-negative integer. In this function, all exponents of the variable are whole numbers. However, this is still linear regression despite quadratic expression in the independent variable. The function is linear in the parameters  $\beta_0$ ,  $\beta_1$ , and  $\beta_n$ . The straight-line case thus suffices, given a random sample from the population, in estimating the population parameters through a linear regression model:

$$y_i = f(\text{Inflation} + \text{Interest} + \text{forex} + \text{Fdi} + \text{Debt}) + \varepsilon_i \dots \dots \dots \text{[Equation 12.5]}$$

Table 12.1 summarizes the variables used in multinomial regression analysis. The variable values are annual averages, which may affect the significance and prediction level of the model. However, the analysis is in accordance and appropriate with regression model development. Table 12.1 presents averaged values for the stated variables. The second row, ‘tender price,’ represents averages per annum of total tender prices divided by the entire length of contracts reviewed in each particular year. Other rows represent annual variable values as obtained from documentary reviews as well. The analysis further presents respective means and standard deviations for valid observations of all 11 and 10 case studies.

**Table 12.2 Summary of variables**

Case	Year	Tender price (ZMW'million/k m)	Forex rates	Inflatio n rates	Interes t rates	FDI (US \$'Bn)	Externa l Debt (US \$'Bn)	
Upgrading of roads to bituminous standards	2008	1.438825829	4.2	12.5	19.1	0.94	0.91	
	2009	1.811932233	4.9	13.4	22.1	0.69	2.25	
	2010	1.373748439	4.8	8.5	20.9	1.73	1.72	
	2011	2.684805086	7.3	8.7	18.8	1.11	1.68	
	Valid N	2012	4.599107964	5.14	6.6	19.1	1.73	0.92
	(listwise) =	2013	4.690770679	5.39	7	16.3	2.1	2.13
	11	2014	4.260340586	6.15	7.8	18.7	1.51	5.02
	2015	6.874454978	8.63	10	21.1	1.58	8.08	
	2016	7.053690932	10.31	18.2	28.1	0.66	9.21	
	2017	8.706679835	9.54	6.6	26.9	1.11	12.45	
	2018	14.39574954	10.45	7.5	24	0.41	12.1	
Mean		5.263	6.9827	9.709	21.373	1.2336	5.1336	
Std.		3.888	2.3647 0	3.6231	3.6519	0.5347 4	4.51533	
Periodic maintenance of feeder roads	2012	0.162880317	5.14	6.6	19.1	1.73	0.92	
	2013	0.690114967	5.39	7	16.3	2.1	2.13	
	2014	0.466011329	6.15	7.8	18.7	1.51	5.02	
	2015	0.58755172	8.63	10	21.1	1.58	8.08	
	Valid N	2016	0.878497449	10.31	18.2	28.1	0.66	9.21
	(listwise) =	2017	1.43244782	9.54	6.6	26.9	1.11	12.45
	10	2018	1.405497777	10.45	7.5	24	0.41	12.1
	2019	1.20648096	12.91	9.1	25.6	0.55	15.05	
	2020	1.555681335	18.28	15.7	26.8	-0.17	16.45	
	2021	1.623899147	20.05	22.1	25.7	0.19	17.7	
	Mean		1.001	10.685 0	11.060	23.230	9.9110	0.9670
Std.		0.51196	5.1144 5	5.5670	4.1148	5.8710 4	0.74772	

(Source: by the author)

Where  $\varepsilon_i$  are an error term and subscript  $i$  indexes a specific observation. The observed R-Squared values in Table 13.3 for a linear relationship support this assumption, as they are approximately equal to those for quadratic polynomials. The  $\ell_i = y_0 - y_i$  is the residual or the difference between the predicted value of the construction tender price and its actual value.

**Table 12.3 Model function and regression for upgrading of roads to bituminous standards**

Independent Variable	Model	Regression type	The proportion of variance R-squared (R <sup>2</sup> )	Optimum effect on tender price
Forex rates	$y = 2.7471e^{0.1041x}$	Exponential	R <sup>2</sup> = 0.5371	• polynomial
	$y = 0.8295x + 1.1566$	Linear	R <sup>2</sup> = 0.6864	
	$y = 9.4795\ln(x) - 11.489$	Logarithmic	R <sup>2</sup> = 0.7576	
	$y = -0.0642x^2 + 2.4333x - 7.1354$	Polynomial	R <sup>2</sup> = 0.7671	
	$y = 0.4939x^{1.2466}$	Power	R <sup>2</sup> = 0.6508	
Inflation rates	$y = 4.4337e^{0.0573x}$	Exponential	R <sup>2</sup> = 0.1928	• polynomial
	$y = 0.429x + 5.2757$	Linear	R <sup>2</sup> = 0.2175	
	$y = 5.2137\ln(x) - 1.9979$	Logarithmic	R <sup>2</sup> = 0.2092	
	$y = 0.0116x^2 + 0.1117x + 7.0459$	Polynomial	R <sup>2</sup> = 0.2195	
	$y = 1.5518x^{0.7304}$	Power	R <sup>2</sup> = 0.204	
Interest rates	$y = 0.4707e^{0.1238x}$	Exponential	R <sup>2</sup> = 0.4918	• polynomial
	$y = 0.9338x - 11.672$	Linear	R <sup>2</sup> = 0.563	
	$y = 20.387\ln(x) - 53.797$	Logarithmic	R <sup>2</sup> = 0.5577	
	$y = -0.0169x^2 + 1.6895x - 19.849$	Polynomial	R <sup>2</sup> = 0.5645	
	$y = 0.0019x^{2.6761}$	Power	R <sup>2</sup> = 0.4774	
External Debt (US \$'Bn)	$y = 2.8732e^{0.1077x}$	Exponential	R <sup>2</sup> = 0.7576	• polynomial
	$y = 0.8043x + 2.0486$	Linear	R <sup>2</sup> = 0.8503	
	$y = 4.5114\ln(x) + 0.999$	Logarithmic	R <sup>2</sup> = 0.7346	
	$y = 0.0046x^2 + 0.7199x + 2.2958$	Polynomial	R <sup>2</sup> = 0.8509	
	$y = 2.1598x^{0.6767}$	Power	R <sup>2</sup> = 0.8209	

(Source: by the author)

### 12.3.2 Model variables

The independent variables considered for this study include external government debt, inflation rate, interest rate, foreign exchange rate, and foreign direct investment, as shown in Table 12.4.

**Table 12.4 Model variables**

Model	Case	Variables Entered	Variables Removed	Method
1	Upgrading of roads to bituminous standards	External Debt (US \$'Bn), Inflation rates, FDI (US \$'Bn), Interest rates, Forex rates <sup>b</sup>	.	Enter
	Periodic maintenance of feeder roads	FDI (US \$'Bn), Inflation rates, Interest rates, External Debt (US \$'Bn), Forex rates <sup>b</sup>	.	Enter

- 
- a. Dependent Variable: Tender price (ZMW'million/km)
  - b. All requested variables were entered.
- 

(Source: by the author)

Table 12.4 shows that out of all variables entered. The analysis considered all variables and removed no during the regression analysis.

### 12.3.3 Correlations between variables

The correlation between construction tender prices and macroeconomic indicators such as external debt and the foreign exchange rate is +0.876 and +0.844, respectively, indicating both strong and positive (Table 12.5). Therefore, higher foreign exchange rates and government debt levels are strongly associated with higher construction tender prices. The  $p$ -value results from a 2-tailed test significance is zero, thus  $p < 0.005$ , which means the two variables are significantly positive.

### 12.3.4 Regression coefficients of the model

Table 12.6 indicates an R-Squared value of 0.742. Macroeconomic indicators under study explain at least 74.2% of the variance of the construction tender price.

**Table 12.6 Model Summary**

Model	Case study	R	R Square	Adjusted Square	R	Std. Error of the Estimate
1	Upgrading of roads to bituminous standards	.933 <sup>a</sup>	.871	.742		1.9739
	Periodic maintenance of feeder roads	.927 <sup>a</sup>	.859	.683		.2882

a. Predictors: (Constant), External Debt (US \$'Bn), Inflation rates, FDI (US \$'Bn), Interest rates, Forex rates

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(Source: by the author)

The analysis of variance (ANOVA) summarizes information regarding multiple correlations to test the significance of the model regarding the extent to which asset of macroeconomic indicators (independent variables) predict construction tender prices (Table 12.7). The Sig. column represents the  $p$ -value for the test of significance of the model and, in the case,  $p < 0.05$  for a  $p$ -value of 0.028, so we conclude that the set of indicator variables is significantly related to construction tender prices.

**Table 12.7 Analysis of variance**

Model <sup>a</sup>		Sum of Squares	df	Mean Square	F	Sig.
Upgrading of roads to bituminous standards	Regression	131.670	5	26.334	6.759	.028 <sup>b</sup>
	Residual	19.480	5	3.896		
	Total	151.150	10			
Periodic maintenance of feeder roads	Regression	2.027	5	.405	4.879	.075 <sup>b</sup>
	Residual	.332	4	.083		
	Total	2.359	9			

a. Dependent Variable: Tender price (ZMW'million/km)  
b. Predictors: (Constant), External Debt (US '\$Bn), Inflation rates, FDI (US '\$Bn), Interest rates, Forex rates

(Source: by the author)

The other columns provide the detail from which the  $p$ -value is determined. The sum of squares for regression (26.334) is the mean of the square for regression. The sum of squares labeled residual (19.480) is the sum of differences between the predicted values and the actual values of  $y$ , which is the sum of squared deviations of the data around the regression line. The square root of the variance of residuals, 3.896, is 1.974, which is the standard error of the estimate.

To estimate the regression equation, the coefficients table, Table 12.8, presents the least squares estimates of the intercept and slope of the regression line. Five values of regression weights (b, 0.638, -0.241, -0.334, -1.561, 0.577) are listed in the column headed B, while the regression intercept is (a, 9.255). Respectively, the equation of the least squares is therefore:  $y = 9.255 + 0.638x_1 - 0.241x_2 - 0.334x_3 - 1.561x_4 + 0.577x_5$ . In which  $x_1$  = forex rates,  $x_2$  = inflation rate,  $x_3$  = interest rates,  $x_4$  = FDI and  $x_5$  = government debt. The negative sign of the regression coefficients (on inflation rates, interest rates, and FDI) indicates negative correlations between each indicator variable and construction tender price. Positive coefficients regarding forex rates and government debt indicate that as their values increase, the mean of the construction tender price also tends to increase. On the other hand, the  $p$ -values in the Sig. column of Table 12.8 is much greater than the significance level of 0.05.

**Table 12.8 Regression coefficients**

Model <sup>a</sup>		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
Upgrading of roads to bituminous standards	(Constant)	9.255	8.105		1.142	.305	-	30.091
	Forex rates	.638	.699	.388	.913	.403	-1.158	2.435
	Inflation rates	-.241	.262	-.225	-.920	.400	-.915	.433
	Interest rates	-.334	.385	-.314	-.868	.425	-1.325	.656
	FDI (US \$'Bn)	-1.561	1.661	-.215	-.940	.390	-5.831	2.709
	External Debt (US \$'Bn)	.577	.447	.670	1.290	.253	-.573	1.727
Periodic maintenance of feeder roads	(Constant)	.145	1.785		.081	.939	-4.812	5.101
	Forex rates	.022	.105	.222	.210	.844	-.270	.315
	Inflation rates	-.018	.043	-.201	-.430	.689	-.138	.101
	Interest rates	.007	.063	.057	.111	.917	-.168	.182
	External Debt (US \$'Bn)	.068	.079	.775	.854	.441	-.152	.287
	FDI (US \$'Bn)	-.010	.389	-.015	-.027	.980	-1.089	1.069

a. Dependent Variable: Tender price (ZMW'million/km)

(Source: by the author)

It indicates insufficient evidence in the data set sample to conclude that a non-zero correlation exists between independent and dependent variables. Keeping variables that are not statistically significant possibly reduces the precision of the model. Considering all other model-fit criteria, this finding may create a possibility of either type I or type II statistical error that could lead to a false rejection or acceptance of the null hypothesis. Increasing the sample size would address the risk of encountering type I and type II statistical errors. Larger sample sizes, as opposed to averaged ones (used in this case), allow the student to increase the significance level of the findings as higher sample sizes have a higher possibility of accurately mirroring the population's behavior. The research suggests using more samples to draw out the model since the regression line appears not flat and many points fall within. The correlations of some variables are not small ( $r = 0.876$ ,  $r = 0.538$ , and  $r = 8.44$ ) and significant ( $p = 0.000$  and  $p = 0.001$ ), and more than 70% inflation is attributed to macroeconomic indicators.

Therefore, the study argues that there is significance in predicting construction tender prices from macroeconomic indicators.

### **12.3.5 Validation of analytical aspect**

This aspect of the model utilized practical validation. The study corrected tender prices for 12 selected projects that case firms procured in 2015. Table 12.9 lists the selected contracts. Table 12.10 shows the utilization of the ordinary least square method to establish the annual optimum tender price for the year 2015, considering the yearly average values for the independent variables for the year and OLS-generated coefficients. The independent variables include considered inflation rate (10), foreign exchange rate (8.63), foreign direct investment (US \$1.58 billion), External government debt (US \$8.08 billion), and interest rate (21.1). To illustrate, the computer-generated OLS equation ( $Y = 9.255 + 0.638x_1 - 0.241x_2 - 0.334x_3 - 1.561x_4 + 0.577x_5$ ) determines the optimum tender price for the year 2015 to be ZMW7,499,320.00/km. By illustration, three factors, road length, price per kilometer, and annual optimum tender price, are later used to generate the tender price error (error =  $L(P - Y)$ ) as shown in Table 12.10. As a case in point, a negative error indicates a low tender price, while a positive error indicates a high tender price. Notably, the bid for upgrading Selected urban roads (20.02km) to the Bituminous standard of Mkushi in the Central Province by Wah-Kong Enterprises Ltd in a joint venture with Stalwart Investments Ltd indicated a tender price of ZMW123,142,060.36. The analysis in Table 12.10 shows that the negative tender price error of ZMW28,344,203.64 is generated.

Consequently, this is adjudged as a low-priced bid such that the corrected tender price show an upward adjustment to ZMW151,486,264.00. At the same time, the bid for upgrading selected urban roads (9.6km) to the bituminous standard of Zambezi in the Northwestern Province by Roads and Paving Ltd at a tender price of ZMW129,403,184.05 gave a positive tender price-error of ZMW57,409,712.05. The corrected tender price arising from this high-priced bid is ZMW71,993,472.00.

**Table 12.9 List of contracts reviewed**

S/N	Contract name	Contractor	Length (Km)	Contract sum (Zmk)	Award date
1	Upgrading of Isoka – Muyombe- Chama- Lundazi Road to Bituminous Standard in Eastern Province of Zambia Lot 4 (Muyombe Road Junction) to Lundazi (Km40+000 on D103) to (84 km)	China Civil Engineering Construction Corporation (Z) Limited	84	585,556,978	December 2015
2	Upgrading of Isoka – Muyombe – Chama - Lundazi Road to Bituminous Standard in Eastern Province of Zambia Lot 5 (Muyombe Road Junction) to Lundazi (Km40+000 on D103) to (84Km)	Sable Transport Limited	84	417,108,471	December 2015
3	Construction of Mazabuka bypass road	-	5	57,014,787.00	2015
4	Upgrading of Isoka – Muyombe – Chama - Lundazi Road to Bituminous Standard in Eastern Province of Zambia Lot 5 (Muyombe Road Junction) to Lundazi (Km40+000 on D103) and 15Km of Lusuntha	-	56	417,108,471.29	2015
5	Upgrading and realignment of Nakonde-Kanyala-Sansamwenje Road (M14/RD69)	-	83.9	367,218,609.29	2015
6	Upgrading of Nsemuka via Kayambi to Chozi to D001, including 18km from Chimba to Chitimukulu and 35km of selected urban roads in Mungwi District Lot 2	-	82	631,194,336.31	2015
7	Upgrading of Selected urban roads (15km) to Bituminous standard of Sinda in the Eastern Province	BuildTrust Construction	15	123,936,213.56	March 2015
8	Upgrading of Selected urban roads (20.02km) to the Bituminous standard of Mkushi in the Central Province	Wah-Kong Enterprises Ltd In Jv With Stalwart Investments Ltd	20.02	123,142,060.36	2015
9	Upgrading of Selected urban roads (11.4km) to the Bituminous standard of KapiriMposhi in the Central Province	Asphalt Roads Zambia Ltd	11.4	109,660,183.91	2015
10	Upgrading of Selected urban roads (9.27km) to the Bituminous standard of Kasempa in the Northwestern Province	Asphalt Roads Zambia Ltd	9.27	115,405,395.11	March 2015
11	Upgrading of Selected urban roads (20.5km) to the Bituminous standard of Solwezi in the Northwestern Province	China Geo Engineering Corporation Southern Africa Ltd	20.5	220,867,715.90	March 2015
12	Upgrading of Selected urban roads (9.6km) to the Bituminous standard of Zambezi in the Northwestern Province	Roads and Paving Ltd	9.6	129,403,184.05	March 2015

**Table 12.10 OLS corrected tender price for each reviewed contract**

S/N	Variable	Value = X	Regression coefficient (Rc)	Weighting = RcX (ZMW/Km)		
-	intercept	-	9.255	9.255		
1	Forex rates	8.63	0.638	5.50594		
2	Inflation rates	10	-0.241	-2.41		
3	Interest rates	21.1	-0.334	-7.0474		
4	FDI (US \$'Bn)	1.58	-1.561	-2.46638		
5	External Debt (US \$'Bn)	8.08	0.577	4.66216		
2015 Annual optimum tender price (Y)		$Y = 9.255 + 0.638x_1 - 0.241x_2 - 0.334x_3 - 1.561x_4 + 0.577x_5$			7,499,320.00	
Length (Km) = L	Tendered Price (TP) ZMW	Price = (P) ZMW/Km	P-Y	error ( e ) =L(P-Y)	Comment	Corrected TP = TP-e ZMW
84	585,556,978.00	6,970,916.40	(528,403.60)	(44,385,902.00)	low tender price	629,942,880.00
84	417,108,471.00	4,965,577.04	(2,533,742.96)	(212,834,409.00)	low tender price	629,942,880.00
5	57,014,787.00	11,402,957.40	3,903,637.40	19,518,187.00	high tender price	37,496,600.00
56	417,108,471.29	7,448,365.56	(50,954.44)	(2,853,448.71)	low tender price	419,961,920.00
83.9	367,218,609.29	4,376,860.66	(3,122,459.34)	(261,974,338.71)	low tender price	629,192,948.00
82	631,194,336.31	7,697,491.91	198,171.91	16,250,096.31	high tender price	614,944,240.00
15	123,936,213.56	8,262,414.24	763,094.24	11,446,413.56	high tender price	112,489,800.00
20.2	123,142,060.36	6,096,141.60	(1,403,178.40)	(28,344,203.64)	low tender price	151,486,264.00
11.4	109,660,183.91	9,619,314.38	2,119,994.38	24,167,935.91	high tender price	85,492,248.00
9.27	115,405,395.11	12,449,341.44	4,950,021.44	45,886,698.71	high tender price	69,518,696.40
20.5	220,867,715.90	10,774,034.92	3,274,714.92	67,131,655.90	high tender price	153,736,060.00
9.6	129,403,184.05	13,479,498.34	5,980,178.34	57,409,712.05	high tender price	71,993,472.00

(Source: by the author)

#### **12.4 Descriptive (Qualitative) aspect of the model**

Descriptive analytics is fundamental to public infrastructure management to keep track of operational performance. The descriptive aspect of the model allows public institutions to monitor trends and track tender-pricing goals. This aspect provides dynamic information about construction tender price performance over time. The descriptive aspect offers valuable insights regarding historical trends for monitoring progress by comparing interventions for different periods. Public institutions can utilize the descriptive aspect performance of different strategies (strengths and weaknesses). The aspect is a tender price management system for identifying typical barriers to effective tender price management and implementing control measures. It assists public institutions or governments in developing tender price values and goals for effective infrastructure project implementation through effective tender price management practices or specific player-based sector strategies. Correspondingly, the aspect allows for aggregating results and obtaining long term-benefits through an effective continuous improvement process.

#### **12.5 Model's conceptual framework**

The basis of the structure of the proposed model in this study is the conceptual framework presented in Figure 7.2. The study finds a lack of formal tender price management systems at all sector levels, yet awareness of tender price inflation implications remains high. The proposed model is a creation emergent from tender price practices and experiences in the Zambian construction sector. Based on the conceptual framework, the proposed model consists of two integrated components, as shown in Figure 12.1. Further, the research highlights difficulties in managing and developing tender prices and implementing other closely related models (Table 12.1). It led to the study's recommendation for creating a new model that is robust, less rigorous, and easier to implement to improve construction tender price management of construction projects in Zambia. Subsequently, Figure 12.1 presents the Tembo tender price management model concepts for public sector construction players in Zambia grounded on research findings. The model is helpful to all construction players, such as clients (mainly public institutions), contractors, and consultants, in bridging

contemporary gaps regarding tender price inflation. Figure 12.2 show model components that weave together to create the right culture for effective construction tender price management.

## **12.6 Description of model components**

Brief descriptions of each component of the model are as follows:

### **12.6.1 Tender price level**

The tender price level is the annual average of the previous year's tender prices per kilometer (in the case of a road project, as is the case with this study). Therefore, the tender price level is a suppositious measure of inclusive prices for an exact set of construction goods or services.

### **12.6.2 Tender price improvement barriers**

These include barriers to implementing adequate tender price management controls, such as unrealistically low prices, corruption, poor documentation, and resistance to change.

### **12.6.3 Economic indicators or quantitative variable**

These include measures of a country's macroeconomic performance such as GDP, government debt, inflation, exchange rate, government budget, international trade, investment, prices, and balance of payments.

### **12.6.4 Ordinary Least Squares regression (OLS) method**

OLS method is a mathematical technique of estimating coefficients of economic indicators utilizing linear regression equations for describing their relationship with tender price.

### **12.6.5 Technical assistance**

Technical assistance is obtaining targeted support from organizations or consultants with developmental knowledge regarding tender price indices or identifying statistically applicable quantitative-independent variables.

### **12.6.6 Tender price-level objectives**

These are goals established by a public institution to meet the construction tender price needs and the central government's and other stakeholders' expectations. This stage involves the process explained in Figure 13.1.

### **12.6.7 Tender price negotiations**

Tender price negotiations include requesting a better price, more additional value formation, and establishing more favorable terms between the client and potential contractor. This stage involves the process explained in Figure 13.3.

### **12.6.8 Tender price management practices**

These are formal processes, working methods, innovations, work systems, and activities developed by public institutions to guide effective tender price management direction and actions to influence and improve the behavior of tenderers. This study indicates that these shall be within the dominions of strategies related to the central government, procurement, existing legal framework, contractors, industry, and projects.

### **12.6.9 Tender price management outcomes**

These expected outcomes motivate price management practices and continual improvement processes.

### **12.6.10 Tender price monitoring**

Tender price monitoring involves gathering intelligence through analyzing and determining tender price internal and external variables to optimize management strategies and practices.

### **12.6.11 Tender price evaluation**

It evaluates the effectiveness and performance of tender price management strategies and practices by identifying key performance indicators critical for optimizing tender prices.

### **12.6.12 Tender price improvement**

Tender price improvement involves developing corrective and preventive actions through identifying causes to ensure the execution of public projects with even better prices than the best-quoted sector prices.

### **12.6.13 Tender price controls**

Control involves developing a set of actions that serve as a guideline for tender price strategy implementation. These may include such things as formal tender price documentation.

### **12.6.14 Tender price rationalization**

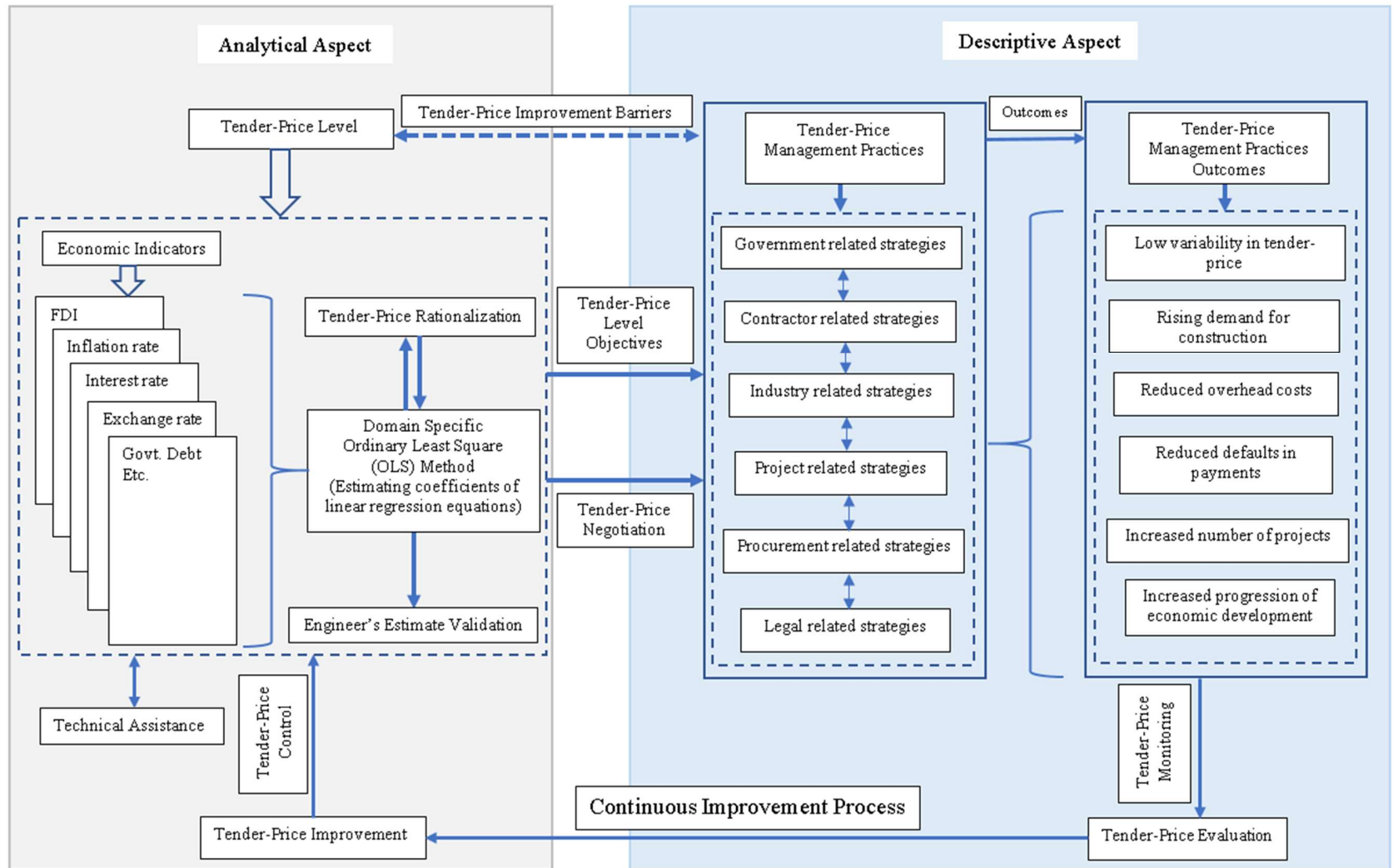
A process of justifying the price level changes and ensuring a more goal-oriented pricing system centered on specific rules.

### **12.6.15 Validation of engineer's estimates**

Process of certifying the accuracy of project cost estimates by verifying information and methods utilized during estimation.

### **12.6.16 Continual improvement**

Involves continuously improving tender prices by seeking incremental, breakthrough improvements and other opportunities focusing on directing and concentrating effort.



**Fig. 12.1:** Proposed Hybrid Tembo Model (HTM) for Tender Price Management  
(Source: by the author)

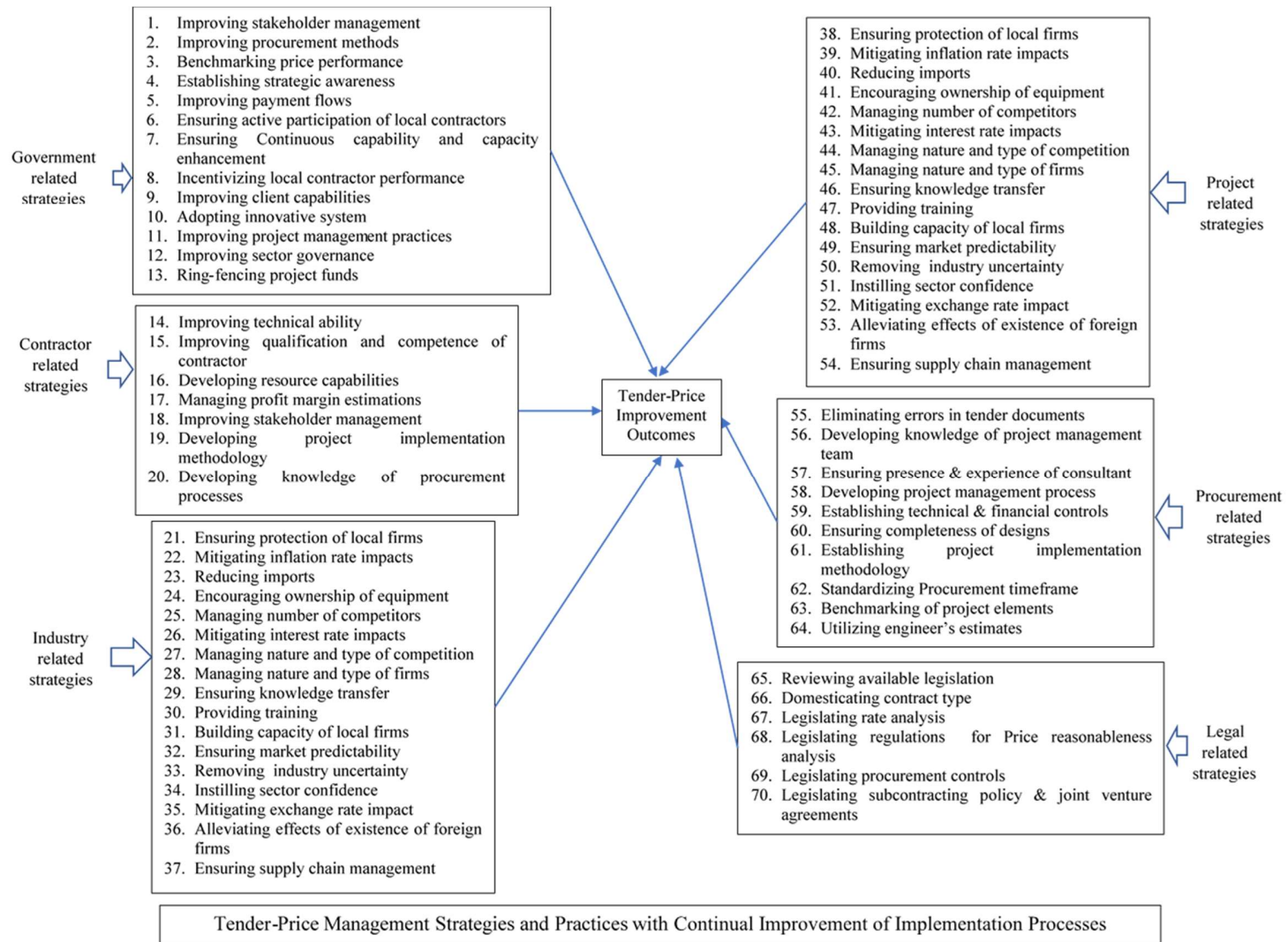
### **12.7 The distinctiveness of the model**

The model shows similarities to other developed models and their components, such as Olatunji (2008). However, unique aspects of the model lie in the primary data collected to establish optimum annual tender prices and the inclusion of qualitative elements that enable the model to highlight sociopolitical issues surrounding tender pricing. The study focuses on the conceptual development of the model that underscores how to revise and refine algorithms to improve the degree of automation of bid data and result in accuracy. Unlike other models, the model accounts for the effects of tendering method and project type while showing stable performance in the face of dramatic fluctuation in the dependent variables, as is the case with developing countries. Although the model shows statistical unsoundness for small sample sizes (due to the use of averages in this example), it does not involve solving complex equations and is less time-consuming.

Moreover, the model allows for continuous improvement due to its easy incorporation of new information. It gives the model unlimited prediction capabilities while accounting for various correlations between volatilities. Moreover, the model quickly forecasts accumulated time series and accounts for the effects of extant price levels while accounting for sociopolitical dimensions of public project implementation.

### **12.8 Model Validation**

The study utilized nested sampling to determine a sample size of 20 key informants to validate the model. Of the 20 key informants, only 19 returned the online questionnaire bringing the response rate to 95%. Accordingly, a high nested response rate for this study is essential as representativeness affects the validity of findings (Goodwin, et al., 2020). All respondents for the nested sample hold professional qualifications and practice experience within the Zambian construction industry. As a case in point, Table 12.11 shows that 47.4% of critical informants characterize clients in the public sector, withal consultants (31.58%) and contractors (21.05%).



**Fig. 12.2:** Components of the model for the establishment of a tender price management culture  
(Source: by the author)

**Table 12.11 Background information of respondents**

<b>Category of Practice</b>	<b>Frequency</b>	<b>Percentage</b>
Client (Public Sector)	9	47.37
Consultant	6	31.58
Contractor	4	21.05
Total	19	100

(Source: by the author)

Table 12.12 shows that the results of the validation exercise are probably reliable due to low standard deviations (between 0.496 and 0.653) obtained across key validation elements. Based on normal distribution, 70% of these observations lie within one standard deviation of their mean. Overall, the results show a mean of 3.35 and a standard deviation of 0.57 across all price-management elements of the model. This shows that 68% of experts in the industry agree that the model is client-focused, inspires stakeholder engagement, facilitates the process and information-based decision-making, and improves tender price management. Regarding the focus of the tender price management model, results show a mean of 2.95 and a standard deviation of 0.62. It indicates that only 30% of industry experts disagree that the model is client focused. However, the model shows effective stakeholder engagement with a mean of 3.26 and a standard deviation of 0.65. It reflects 70% of an effective stakeholder-engagement structure within the Zambian public construction sector. On the improvement of tender price management, a higher mean of 3.32 and a standard deviation of 0.58 means that 68% of experts agree that the model offers some intrinsic improvements to tender price management in public infrastructure delivery. The study uses the 2-tailed t-test to test for the significance of the findings. It establishes that all responses are statistically significant at  $p < 0.05$ . It echoes a high standard of validity, acceptability, and usefulness.

**Table 12.12 Implementation of the tender price management system**

SN	Key elements of the validation exercise	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
1	Implementation of the model is client focused	15.79	63.16	21.05	0	2.95	0.621	0.143	20.679	0.000
2	Implementation of the model enables the engagement of industry players	36.84	52.63	10.53	0	3.26	0.653	0.150	21.770	0.000
3	The model enables a process-based approach	63.16	36.84	0	0	3.63	0.496	0.114	31.941	0.000
4	The model is an improvement on tender price management systems	36.84	52.63	5.26	0	3.32	0.582	0.134	24.817	0.000
5	The model enables evidence-based decision making	57.89	42.11	0	0	3.58	0.507	0.116	30.754	0.000
*from 1 for strongly disagree to 4 for strongly agree *Valid N (listwise) = 17 *Significant at $p < 0.05$										

(Source: by the author)

In identifying factors affecting the implementation of the model, key informants reveal the following:

1. Lack of mechanisms for working out costs from basic prices
2. Failure by state institutions to make adequate budget provisions
3. Procurement-related problems and
4. Failure to ring-fence project funds.

The key experts recognized the following considerations for the functionality of the model:

1. Need to increase both knowledge and equipment ownership transfer by foreign contractors as they participate with local firms that may not have technical and equipment capacity
2. Government to encourage or form construction sector banks with lower borrowing rates to support the local construction companies
3. Need to develop solicitation documents that respond to the needs of clients/owners
4. The procurement staff of the client/owner must be fully knowledgeable of construction projects management
5. Project monitoring should be encouraged through clients' M&E teams. The government should develop award and penalty regimes for those who comply and exceed the requirements and those who fail to comply.

### **12.9 Chapter Summary**

The model overview in this Chapter specifies components of the model required to provide a systematic tender price management system for public infrastructure delivery. The developed model combines analytical and descriptive aspects of tender price factors. The Zambian public construction sector practitioners have rendered the model functional and valid.

## **CHAPTER 13: Discussion of Results**

### **13.1 Introduction**

The discussion focuses on literature findings, interviews, and questionnaire results relating to construction tender price management and the integrated model developed in this study. Additionally, the argument underscores particular emphasis on the following:

1. Tender price management factors;
2. Tender price management strategies; and
3. Predictive potential of the integrated model

### **13.2 Effect of high tender price inflation on the economic sustainability of the construction sector**

The study finds that tender price ranked highly as the basis for an award of a construction contract. Hence, De Gouveia (2002) argues the need to address the challenges of price factor and its weighting in contract awards with express provisions regarding its treatment. The study finds further that public institutions in developing countries face severe challenges from tender price inflation. This study finds that tender price inflation severely impacts infrastructure projects' financial sustainability. Tender price inflation critically cripples project finances, reduces government morale in undertaking projects, and contributes to the loss of community goodwill due to the perception that contractors rip off the government of value for money. The leading causes of tender price inflation include material costs; interest rates; equipment costs; labor costs; delayed payments; exchange rates; and the nature and type of project. Other causes include the nature and level of competition, inflation rate, profit markup, political risks, the character of the client, and project management practices. The findings agree with Kissi et al. (2017) regarding factors affecting Ghana's tender price. In addition, Beck & Walter (2013) concluded that construction tender prices are influenced by varying regional determinants.

This study also established that tender price inflation leads to stalled projects, negative social perceptions by impacting the delivery of development, and incomplete and

expensive projects. Other severe impacts include reduced projects leading to fewer players in the industry and creating a negative ripple effect on the nation's employment and wealth creation. Tender price inflation emboldens poor project practices that outstrip government budgets and limit expenditure and output. It makes it difficult for the client to manage cash flows increasing the risk of delayed and non-payments. Zhang et al. (2015) state that tender price management is essential to clients for controlling project costs at the bidding stage. Kissi et al. (2021) echoed these sentiments, writing that construction tender price remains a critical challenge to project stakeholders. The study findings show that these unaffordable bid prices increase the national debt burden and poor governance in the construction sector. The client is the most negatively affected because they are paying for projects, and it is difficult for them to budget due to projection challenges caused by expensive projects. The study finds that tender price inflation is the leading cause of budget overruns and the ultimate loss of business to contractors in developing countries as the government loses its appetite for expensive infrastructure development. The increased prices in the construction sector are unfortunate in developing countries as the rising tender prices affect the industry. It is challenging to see actual infrastructure development despite considerable expenses.

The study shows public infrastructure productivity plummets directly from tender price inflation. If there is tender price inflation, the government starts to feel that they are not getting the best out of the sector, and it loses the morale to keep financing infrastructure projects. Even the communities do not appreciate the contractors because they think they are ripping off the government of taxpayers' money. Therefore, high contracting prices are uncomfortable for the government, communities, or citizens. The study finds that the inflation rate of the developing country has a significant role in tender prices. Developing countries import most of the materials they use in construction, so they import many inflationary problems. Inflationary problems reduce the client's buying power and constrain their fiscal space, resulting in expensive and incomplete construction projects. It is a double-sided sword for contractors; on one side, initially, it will look like it is a good thing because the prices are going up, giving room to contractors to generate more revenue. As prices rise on

the other end, they become unsustainable and negatively affect the country's overall economic growth forcing the government to slow its expenditure by abandoning perceived expensive construction projects. Ultimately tender price inflation erodes value for money and creates an unsustainable business environment.

### **13.3 Circumstances surrounding tender price inflation**

The findings of the documentary review (Chapter 9 Section 9.3) and interviews (Chapter 10 Section 10.5) show that various factors affect construction tender price development and management. The study finds 15 sociopolitical factors: late engagement of supervising consultant; delayed payments by the client; poor contract or project management; poor quality of works; lack of detailed engineering design; excessive and questionable variations; delayed project implementation; and dubious award of contract. Over and above, other factors include non-adherence to procurement procedures; unjustified single-sourcing; inconsistent application of evaluation criteria; and inadequate budget provision. More elements, including irregular contract documents, questionable and uncompetitive rates, and lack of equipment, are identified to be the most impacting tender price management factors. Further, the study identifies Ten (10) economic factors in agreement with the findings of Nguyen & Q. Nguyen (2020) and Vansteenkiste et al. (2019). These factors include foreign direct investment; level of government debt; interest rate; inflation rate; construction imports; exchange rate, and trade deficit. Other economic factors include government budget, profit margin, and level and type of competition. Literature shows high differences in factors that affect tender price management primarily dependent on a country's specific social, political, economic, and technological status.

The study's findings agree with Akintoye and Skitmore (1990) assertion that the construction industry's nature makes contract pricing exceptionally complex. In like manner, the study agrees with the argument advanced by Al-Jawhar and Rezouki (2012) that failure to decide on an appropriate procurement system results in time delays, cost overruns, and quality problems on a construction project. Other notable authors who agree with the assertion include Kikwasi & Escalante (2018); Mafini & Pillay (2017); Cheelo & Liebenthal (2020); Thwala & Mvubu (2009); Aigbavboa et

al. (2018); Zidane et al. (2015); and Dlungwana & Rwelamila, (2014). The study findings note numerous procurement-related irregularities in the Zambian public construction sector, including late procurement of consultants, irregular award of contracts, failure to follow procurement regulations, and failure to use or no adherence to engineer's estimates. Deductively, it shows that public institutions in developing countries like Zambia have failed to manage many factors affecting their construction infrastructure delivery.

The study shows that the client needs to develop abilities to understand and anticipate all technical and management outcomes of a construction project. This process entails encouraging the utilization of good estimating models and giving special attention to price reasonableness and engineers' estimates. These are aspects critical to addressing the vagueness of procurement selection criteria and reducing complications during evaluations. Further, the findings agree with the assertions of Zhao et al. (2022) that, due to a lack of consensus in construction regarding the identification and classification of a selection criterion, there was an inherent need to develop domesticated-industry-specific procurement selection systematic mechanisms. It appears that procurement selection criteria are more oriented to the overall objectives of a particular specific industry. Zhao et al. (2022) classified procurement criteria into generic and unique. Note from the results that, for the Zambian construction industry, the factor of concern when utilizing procurement function to manage tender price inflation includes two indicators that relate to a government function. The study deduced the critical indicators include benchmarking price performance and eliminating errors in tender documents.

The study's findings agree with those of Laryea (2011) that errors in the tender documentation and designs significantly contribute to inaccurate estimations by bidders. As in this paper, Laryea (2011) recommended that public institutions describe the project as accurately as possible to reduce the probability of errors in documentation. Further, their study suggested reasonableness in developing tender periods and adopting fair risk-sharing approaches. In addition, Mikulík et al. (2022) identified that errors in tender documentation significantly affect a project negatively.

They further argued that the most occurring errors related to specifications involve bills of quantities. This study discusses the need for consultants to provide technical assistance, price assessments, and project evaluation services. Likewise, clients must employ qualified teams responsible for project execution and providing outlined deliverables.

Dosumu et al. (2017) agreed that one major cause of tender documentation errors is the inexperience of design management teams. Similarly, Akal (2022) attributed at least 73% of documentation challenges to readability issues. This study agrees with Akal (2022) that listing irrelevant issues or unclear project scope is a significant readability issue compelling assumptions and is misleading to bidders during tendering. Using the legal methodology, Kamil et al. (2018) found contractors had feeble abilities to rectify tender documentation mistakes; most bidders continued tendering despite apparent noticing errors. The study approves the need to develop a detection and correction mechanism for dealing with contractors' errors in tender documents. The study further argues the need to assimilate both quantitative and qualitative pricing information regarding project performance to help measure targets and improve processes and decision-making is paramount.

Consequently, the need to benchmark price performance on public projects is a crucial indicator of this study. Since construction tender price ranks highly as the basis for an award of construction contracts, the need to address challenges of the benchmarking price factor and its weighting in contract award is worthwhile. Assertions in the agreement include those of Markin (1992) that price benchmarking is a critical factor in decision-making and pulling together crucial information for project planning purposes.

#### **13.4 Strategies for addressing public construction tender price inflation**

In Chapter 10 (Section 10.8) and Chapter 11 (Section 11.7), the study identifies Nine (9) key turnaround strategies for addressing construction tender price inflation, grouped into six categories, including planning management practices; and stakeholder management practices. Other key strategies include capacity management practices; capacity building practices; legal-framework modernization; procurement

management practices; project management practices; management of macroeconomic indicators, and sustainable construction management practices. These strategies indicate emergent patterns consisting of Nine (9) sub-strategies, including cost estimating and financing, mitigating external and internal interferences, and providing incentives. Other sub-strategies include training and encouraging innovations, revising legislation, contextualizing procurement functions, improving project management practices, predicting market forces, and guaranteeing sustainability. Though this study reduces the categorization of strategies into six groups, the findings still agree with Gudienė et al. (2013), who identified and classified these as factors affecting the successful implementation of a construction project into seven major groups.

Findings show current modeling approaches and procurement strategies for managing construction (Zhang, 2019; Ghadamsi, 2016; Marzuki & Tamin, 2017; Demirkesen & Bayhan, 2019; Alzober & Yaakub, 2014; Afolayan, et al., 2018; Storteboom, et al., 2017; Burnett, 2009; Bovis, 2006; Hastie, et al., 2017; Zavadskas, et al., 2016; and Alptekin & N. Alptekin, 2017). They all present numerous associated gaps that fail to mitigate inflationary variability and rising construction tender prices. The study further argues that attaining institutional goals is achievable by mitigating construction tender price inflation. Nine target goals in this implementation schedule include improving cost estimating and project financing, managing stakeholder interference, developing local-firm incentives, developing training programs and encouraging innovation, reviewing legislation, contextualizing procurement function, improving project practices, stabilizing market forces, and adopting sustainable construction practices. On the other hand, it shows that public institutions in developing countries like Zambia have failed to weave together pragmatic strategies for addressing public construction tender price inflation.

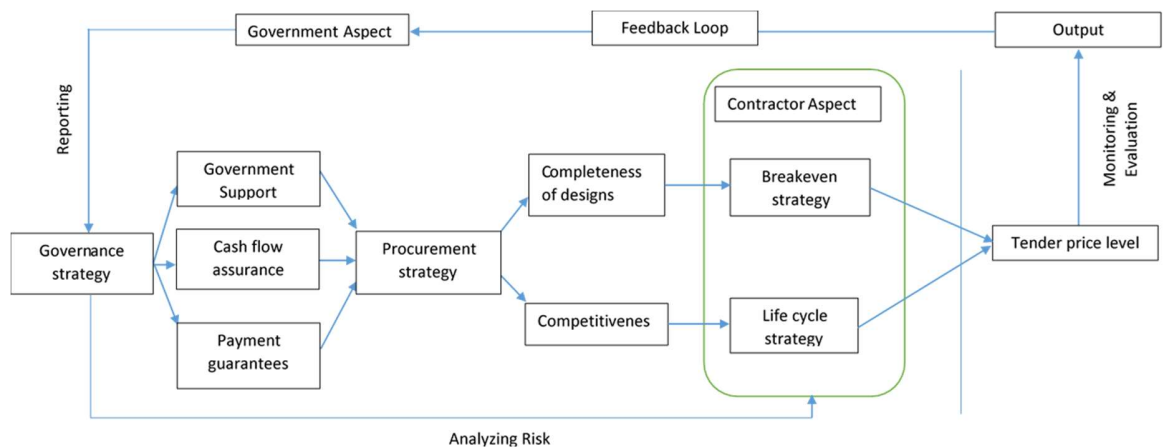
Joukar (2016) reasons that tender price inflation is a critical risk factor in the construction sector. Correspondingly, the findings of this study show that addressing construction tender price inflation requires deploying systematic changes. Governments must streamline the project implementation environment. It aligns with

the motives of Damnjanovic et al. (2009) regarding the need to actively identify methods and strategies for addressing factors that lead to bidding price escalations. The findings demonstrate 22 strategies correlating significantly with attempts to measure and predict construction tender prices accurately. The strategies include managing the nature and type of firms, ensuring supply chain management, ensuring active participation of local contractors, improving payment flows, developing project implementation methodology, ensuring completeness of designs, managing the nature and type of competition, and building the capacity of local firms. Other strategies include legislating regulations for price reasonableness analysis, improving the qualification and competence of the contractor, and eliminating errors in tender documents. The findings agree with Tembo et al. (2023), who argue that failing to establish an acceptable construction tender price level is detrimental to the construction industry. Likewise, Ellis et al. (2021) underscore the need to understand the project scope and ensure the designs' completeness to control project costs.

The government must develop innovative mechanisms to improve project delivery. It must work with local contractors to provide cash flow assurance and guarantee payments. The government is crucial in ensuring designs are completed accurately before procurement processes commence. Enshassi et al. (2010) rank client-related factors regarding project cost escalations arising from variation due to incomplete project designs. Public procurement processes must break work into packages that create demand and give potency for competitive pricing; it requires a stringent procurement process that understands bid rates. The study finds that international competitiveness in construction improves pricing modeling due to increase demand. The findings concur with Obodo et al. (2021) regarding the importance of competition in a bid-or-no-bid decision of the contractor. They argue that competition positively influences local contractors' ability to bid for projects. However, the strategy must be implemented together with "phasing project techniques" to give an impression of fewer jobs in the sector—the technique forces contractors to adopt breakeven strategies that optimize their profit margins. The study observes that construction firms respond to a slowed-down industry that offers the only viable projects on the market

by strategizing to bid as low as possible so that they can at least have some works to guarantee some income.

The study shows that when government provides fiscal support to contractors, contractors attempt to outbid each other using low prices. The trend is observed in the IRCP projects when foreign local-based firms that receive (their) government support developed capabilities to outbid local contractors with low prices. They adopted the life cycle strategy to create a competitive advantage in the construction market. As government project output slowed, they stayed longer by lowering tender prices to sustain their operations without packing up— due to reduced government spending on projects. The study weaves turnaround strategies to propose an enhanced prediction model of construction tender price level, as shown in Figure 13.1. The figure presents the phases of interventions beginning with the most critical approach that helps attain the highest impact.



**Fig. 13.1:** Weaving turnaround strategies for enhanced prediction model of construction tender price level

(Source: by the author)

The model proposes strategies and a guideline to assist the government in providing the needed support and contractors to develop consistent and logical tender prices. The model intends to prioritize tender price inflation management by enhancing strategies related to government and local contractor aspects.

The study agrees with Joukar et al. (2017) regarding integrating strategies to manage tender price inflation in the construction sector. They found that risk management and incorporating price adjustment clauses were essential to mitigating tender price inflation. The study further concurs with Weidman (2010) that price inflation harms the fundamental economic assumptions of a construction contract. The research by Tembo et al. (2023) highlights the harmful impacts of tender price inflation on the construction sector. They argue that tender price inflation causes an unpredictable business environment, reduces the number of public projects, reduces value for money, and compromises the quality of work. Like Joukar et al. (2017), the findings show the complexities of establishing adequate controls for managing construction tender pricing. Correspondingly, construction models present corrective, preventive, and organizational measures to cost control while lacking a predictive approach that can effectively begin to ensure advanced tender price control. The study agrees with Azizi & Aboelmagd (2019) that most research fails to establish a balance that improves profitability while reducing prices. Nový et al. (2016) argue that a precise determination of construction tender price is essential for project success. However, the process is tedious and insists on developing correct tools for pricing based on a specific situation. Figure 1 presents a continuously improving tender price negotiation process. The practice includes at least five separate steps and forms the basis of a negotiation process embedded in Figure 2:

Step 1: involves identifying all factors affecting tender price. This step allows an institution to develop an understanding of both internal and external factors. This step starts from identifying predetermined objectives of bidders to existing economic conditions at a particular time.

Step 2: In this step, the study draws down the most significant project-specific risk-pricing factors, which according to Baccarini (2012), may include the type of contract, type of procurement method used, value of liquidated damages, completeness of documentation, current workload, etc.

Step 3: involves deriving cost-per-unit information to set prices to generate profits adequately. This step allows the bidder or client to derive variable and fixed costs.

Consideration of direct material costs, greater-volume discounts, additional capacity, etc., constitute prudent choices. During this step, Oberholzer & Ziemerink (2004) perfectly underscores the significance of the “high-low method” in determining cost levels.

Step 4: Literature findings by Laryea (2018) and Ekung et al. (2013) best prescribe essential issues of concern regarding this step to include flexibility, quality requirements, payment certainty, price-competition, problems of autonomy and responsibility, dispute resolution procedures, and project duration.

Step 5: This step requires a government economic policy of imposing floors (minimums) and ceilings (maximums) to public construction prices at both materials and services level to make them affordable and reflective. A study by Majumdar (2003) discusses this step in detail and proposes using and adopting price controls as incentive mechanisms to achieve social-economic benefits.



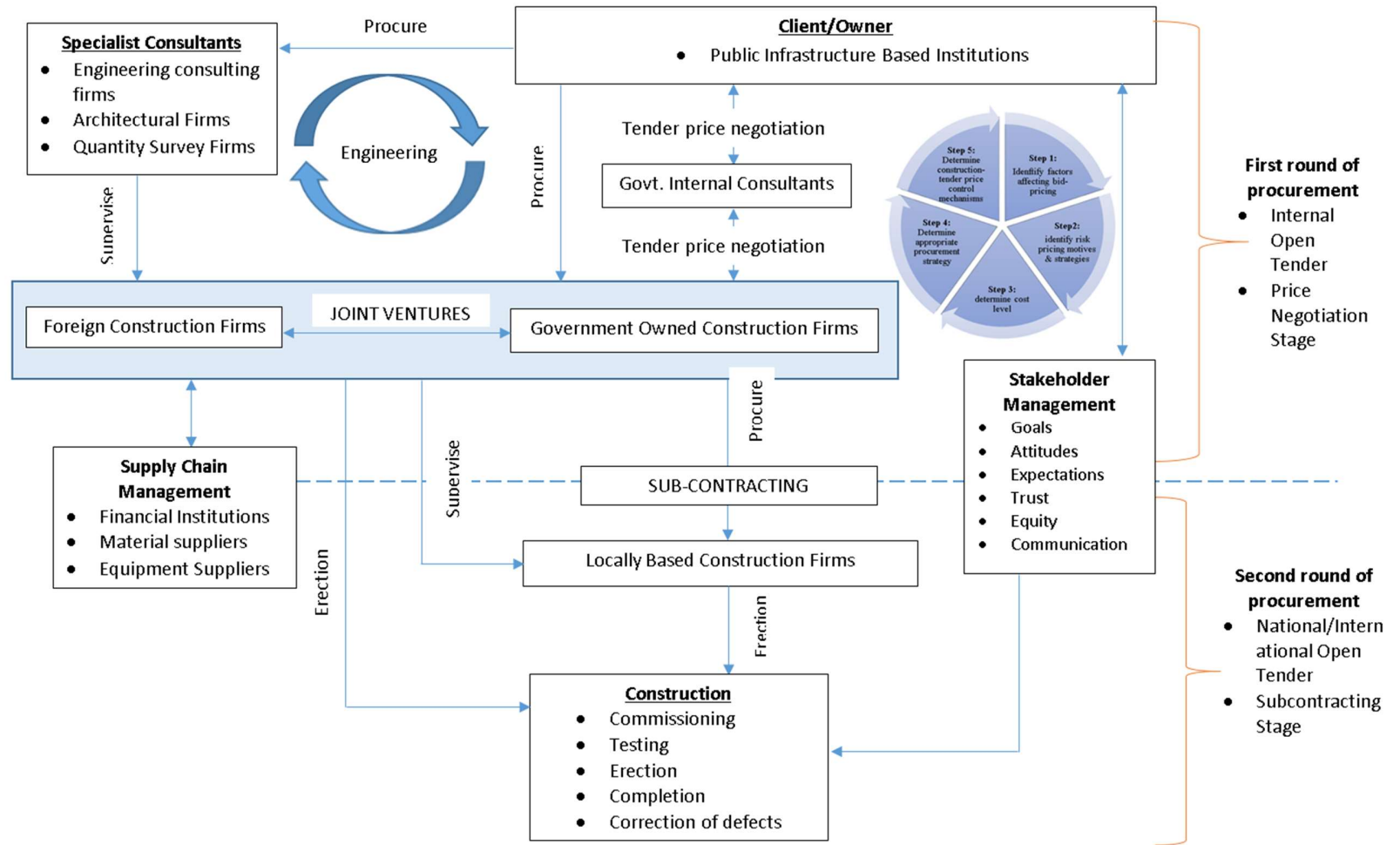
**Fig. 13.2:** Construction price negotiation process  
(By the author based on a literature review and research findings; Paek & Lee, 1993; Gudienè, et al., 2013)

The study also observes an application gap for construction regarding using price control incentive mechanisms. The findings further agree with Zhang & Jian-li (2016), who highlights the fundamental benefits of price-control incentives by developing an incentive-regulation model. The study findings show that governments can maximize

social gains from an infrastructure project by deriving accurate technical parameters and optimizing procurement. Figure 13.3 proposes the conceptual Negotiated Construction Approach (NCA) for public projects summarizing and weaving together identified strategies. The phasing of the vital system begins with the most critical:

1. Planning management (Engineering)– to be the first and most important strategy
2. Capacity management – to be the second most important strategy
3. Stakeholder management – to be the third most important strategy
4. Procurement management– to be grouped as the fourth most important strategy
5. Project management – to be the fifth most important strategy
6. Capacity building– to be grouped as the sixth most important strategy
7. Modernizing legal framework – to be the seventh most crucial strategy

A theoretical perspective of this study expands the current knowledge by providing valuable insights into the contractors' perception of the public construction sector, procurement methods, and client conditions. For instance, the study reveals that contractors increase price markups when there are difficulties in accessing local financing. It was also true when the client lacked a detection mechanism for the most economical price and was heavily affected by macroeconomic factors. Concerning the study area, the findings and corresponding conceptualized model are applicable to the wider developing world, especially Africa, whose infrastructure development is heavily public sector oriented. The conceptual negotiated construction approach focuses on developing life-cycle costings for best-value-for-money in the public sector. However, the model requires further validation to ascertain its applications in country-specific settings.



**Fig. 13.3:** Conceptual negotiated construction approach for public projects

(Wondimu, et al., 2016; Walker & B. Lloyd-Walker, 2012; Finnie et al., 2018; Penn et al., 2017; Opoku & Ibrahim-Adam, 2018; Botha et al., 2020; Lefebvre & McAuley, 2019; Sanchez et al., 2015; Botha & Scheepbouwer, 2015)

(By the author based on a literature review and research findings)

### **13.5 Development of an integrated construction tender price management model**

Throughout the study, Chapter 12 Section (12.2) observations indicate that closely related models focus on predicting movements in the tender price index. The aim is to stimulate the bidder's maximum profit margin, determine the profit ratio, and forecast the tender price index (Wong & Ng, 2010; Yiu & Tam, 2006; Akintoye, 1991; and Jaśkowski & Czarnigowska, 2019). Other notable studies with a similar focus include those of Kissi et al. (2018) and Kissi et al. (2017), and Olatunji (2008). However, identical to the focus of this research is that in Hong Kong Ho (2013). Ho (2013) developed a Grey model (GM) for forecasting price indices and the likely tender price of a given project. Yet the model performs poorly in the face of dramatic fluctuation in the dependent variables, as with developing countries. The model is also statistically unstable for small sample sizes, involves solving complex equations, is time-consuming to implement, and is rigid such that it does not incorporate new information. Another model that comes close is that developed by Olatunji (2008). The model explains using OLS in the Nigerian setup to predict tender prices. However, the model by Olatunji (2008) only focuses on the analytical aspect.

Unique aspects of the model developed by this study lie in the primary data collected to establish optimum annual tender prices and the inclusion of qualitative elements that enable the model to highlight sociopolitical issues surrounding tender pricing. The study focuses on the conceptual development of the model that underscores how to revise and refine algorithms to improve the degree of automation of bid data and result in accuracy. Unlike other models, the model accounts for the effects of tendering method and project type while showing stable performance in the face of dramatic fluctuation in the dependent variables, as is the case with developing countries. Although the model shows statistical unsoundness for small sample sizes (due to the use of averages in this example), it does not involve solving complex equations and is less time-consuming. Moreover, the model allows for continuous improvement due to its easy incorporation of new information. It gives the model unlimited prediction capabilities while accounting for various correlations between volatilities. Moreover,

the model quickly forecasts accumulated time series and accounts for the effects of extant price levels while accounting for sociopolitical dimensions of public project implementation.

### **13.6 Chapter Summary**

The chapter discusses the study's construction tender price management results and attempts to rationalize perceived rising construction tender prices in Zambia. The discussion considers other literal research findings, construction experts in the sector, and documentary reviews. The debate underscores three inherent findings:

1. The need to identify and manage country-specific factors affecting construction infrastructure management
2. The need to identify and weave together industry-specific strategies for addressing tender price inflation
3. The need for adopting the model developed by this study because of its unlimited prediction capabilities and implementation flexibility

**14.1 Introduction**

Construction tender price is an authoritative factor when capitalizing on a construction project. More than that, tender price is a critical factor clients use to control a construction project's cost (obtain value for money) at its evaluation stage. For contractors, tender price is essential in winning or losing a bid. It is critical to whether a construction firm generates profit and revenue and whether the government generates the best public value and accounts for all project benefits. The research set out to:

1. to determine the impact of tender price inflation on the economic sustainability of the construction sector
2. investigate circumstances surrounding the failure to mitigate construction tender price inflation through current interventions
3. propose strategies for addressing public construction tender price inflation
4. construct a model that will facilitate Zambia's public construction sector productivity at beneficially predictable construction tender prices

**14.2 Conclusions**

The conclusions relate to research findings and the achievement of objectives.

**14.2.1 Effect of high tender price inflation on the economic sustainability of the construction sector**

Tender price is a major contextual independent factor that influences project success. High tender prices are a significant measure of the quality and type of competition. While also a sign of the low number of construction jobs because contractors price all risks patterning their existence in fewer projects on the market. Hence, the study ranks tender price significance highly in determining economic construction sustainability success. However, better cost control and financial planning are essential for addressing tender price variableness and inflation. The client's macroeconomic indicators and project management practices are significant areas of concern for addressing construction tender price inflation. Contractors respond to poor project

management practices and the client's unpredictability by adjusting to profit markup when developing tender prices. Contractors believe that increasing tender price is the way to address an erratic client and reduce or mitigate project-related risks. The study suggests determining benefits realizable from tender price level regarding the economic sustainability of construction is essential to the stakeholders. Tender price inflation directly influences short- and long-term benefits to stakeholders and the construction sector.

#### **14.2.2 Circumstances surrounding the failure to mitigate construction tender price inflation through current interventions**

The study finds 15 sociopolitical factors: late engagement of supervising consultant; delayed payments by the client; poor contract or project management; poor quality of works; lack of detailed engineering design; excessive and questionable variations; delayed project implementation; and dubious award of contract. Over and above, other factors include non-adherence to procurement procedures; unjustified single-sourcing; inconsistent evaluation criteria; inadequate budget provision; irregular contract documents; questionable and uncompetitive rates; and lack of equipment as the most impacting tender price management factors.

The research upholds that improving procurement selection criteria can significantly contribute to tender price performance due to apparent direct correlations between procurement performance and the financial performance of a project. Therefore, it is essential to explore and assess whether the public sector is being priced effectively in its procurement of construction contracts. Price is a crucial decision factor in contractor evaluation criteria. Price in the construction sector needs management and control, much like other project variables, by developing price review mechanisms for procuring construction projects in the public sector. There is a need to establish a public procurement strategy for managing construction price inflation. It is achievable by modeling fundamental principles such as value for money, benchmarking price performance, and reducing tendering documentation errors that collude and conspire to affect price inflation, client perception and infrastructure push, and public accountability.

Further, the study identifies Ten (10) economic factors, including foreign direct investment; level of government debt; interest rate; inflation rate; construction imports; exchange rate, and trade deficit. Other economic factors include government budget, profit margin, and level and type of competition. Literature shows high differences in factors that affect tender price management primarily dependent on a country's specific social, political, economic, and technological status.

### **14.2.3 Strategies for addressing public construction tender price inflation**

The study identifies Nine (9) key turnaround strategies for addressing construction tender price inflation, grouped into six categories: planning management practices; stakeholder management practices; capacity management practices; and capacity building practices. Other key strategies include legal framework modernization; procurement management practices; project management practices; management of macroeconomic indicators, and sustainable construction management practices. These strategies indicate emergent patterns consisting of Nine (9) sub-strategies, including cost estimating and financing, mitigating external and internal interferences, providing incentives, providing training, and encouraging innovations. Other sub-strategies include revising legislation, contextualizing procurement functions, improving project management practices, predicting market forces, and guaranteeing sustainability. The top strategies for measuring and predicting public projects' construction tender price levels are related to the government. The government must develop innovative mechanisms to improve project delivery. It must work with local contractors to provide cash flow assurance, guarantee payments, and develop and implement a viable procurement strategy. The government is crucial in ensuring designs are completed accurately before procurement processes commence. The government plays an essential role in developing the construction sector by implementing alternative procurement models while supporting local firms through technical support, policy, and training. Considering the strategies, the most important is managing the quantum of public projects tendered at a given time. The study findings show that the government benefits from reduced tender prices when public projects are fewer. It is because construction firms respond to a slowed-down public construction sector that

offers the only viable projects on the market by strategizing to bid as low as possible so that they can at least have some works to guarantee some income.

#### **14.2.4 Development of a construction tender price management model**

The developed hybrid model integrates analytical (quantitative features based on economic factors) and descriptive (qualitative characteristics based on sociopolitical factors) aspects of tender price inflation. The combined quantitative factors and variables utilize the equations of ordinary least squares (OLS) to determine an optimum domain-specific tender price, while the qualitative base integrates sociopolitical strategies. Combining the two categories gives the model a low variability tender price output. The model is versatile and adaptable in that additions of variables, work descriptions, associated unit rates, and base prices are conceivable. The quantitative aspect of the model does not require any external content management systems (CMSs) and is programmable to support web-based solutions. The model requires comprehensive data collection regarding public construction projects to establish a database or an information management system. This information (such as nature, tender price, type of project, work or item description, and microeconomic indicators) requires uninterrupted updates as an essential component of the model's prediction accuracy.

The model validation utilizes a two-step process. Firstly, the model is validated using empirical project data from Twelve (12) road projects from the Zambian road sector. Involving Ordinary Least Square (OLS) equations, the model accomplishes predictions by correcting the tendered prices. The second step utilizes a selection of 20 industry experts as key informants. Results obtained indicate a consensus among experts regarding the validity and applicability of the model. The model functions correctly in both steps, as the corrected tender price obeys operational principles set out in the assumptions. It confirms that further investigations into the model behavior are not necessary. However, the model requires a high quantity of datasets to guarantee to improve its tender price prediction and statistical significance of input variables.

#### **14.2.5 Contribution to the body of knowledge**

This study contributes to the body of knowledge through the following:

1. **Specialization:** the research focused on developing an integrated construction tender price management model. This unique process considered the Zambian public construction sector focusing on two public road-infrastructure-based institutions as case firms.
2. **Methodology:** the study utilizes Ordinary Least Square Methods (OLS Method) to predict optimum construction tender prices definitively. It is the first time a study used OLS in the Zambian construction sector to make derivations of conclusive estimates for validating engineer's estimates and reducing tender price inflation.
3. **Pragmatism:** the hybrid model provides a standardized mechanism for querying construction tender prices, understanding trends in the construction market, and informing authorities on remedial measures.
4. **Uniqueness:** the models require revision of several construction management practices in the public sector, providing a radical breakthrough in developing public-project information management systems to come.

### 14.3 Recommendations

Based on conclusions, the main recommendations of this study include:

1. Compulsory use of engineer's estimates by the government
2. Adoption of the hybrid model for public sector construction management by the government
3. Establishment and updating of domain-specific databases or information management systems for variables by all public infrastructure-based institutions
4. Calibration of the model for use in specific type and nature of project or work description thereof by all public infrastructure-based institutions

### 14.4 Limitations

When interpreting the findings, consider the following limitations of the study:

1. The analytical aspect of the model (OLS equations) developed from case firms evaluates, in particular, two leading performance indicators on road infrastructure: length (Km) and tender price (ZMW).
2. The lack of detailed project data from case firms led to the use of limited factors such as length and tendered prices only. Specific information regarding road width; layer thickness; loading capacity; number and type of culverts; number and type of bridges; etc., would make the calculations more robust. It would have permitted better project categorization for analyzing more similar projects and improved model prediction significantly. However, the study took caution in using such available data to successfully demonstrate the model's operational principles.
3. The analytical aspect of the model, specifically the OLS equations, is limited to road sector information obtained from case firms. Thus, the study findings only apply to other projects after developing domain-specific OLS equations. It requires more refined categorization regarding the type of project, work description, and their respective tendered prices reflected. It implies that OLS findings of a category of tasks, such as a kilometer of a specified road section, are not generalizable for, e.g., bridges or buildings.

#### **14.5 Practical implications**

The findings in this study are consistent with the knowledge of project management practitioners in Zambia. However, these results have general applications in public-infrastructure sectors of most developing countries and can be used to mitigate the effects of tender price variableness and inflation. The study provides a quick overview of the tender price inflation problem and its implications for Zambia's implementation of economic sustainability principles in construction. Managing tender price levels offers a better chance to improve sustainable construction. This study implies adding a novel contracting model to the already more familiar ones, such as;

1. Engineering, procurement, and construction (EPC) model
2. Engineering, procurement, and construction management (EPCM) model
3. Project Management Contractor (PCM) model and

#### 4. Early Contractor Involvement (ECI) Model

The proposed contracting model specifies using a two-round procurement approach and establishing two classes of relationships between contractors and clients. The model also identifies the pre-conditions that contractors and clients must meet in the price negotiations and subcontracting stages. The model focuses on aligning the financial goals between the client and contractor through tender price negotiations. The model allows for the early elimination of adversarial relationships emanating from traditional contracting models. This contracting model is rooted in early price negotiation, thereby permitting exploring a “preventative diplomacy” concept that is rarely applicable in construction.

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## Appendices

## **Appendix A: Sample of research instruments**

## INTERVIEW GUIDE

### Consent Form

I voluntarily agree to participate in the collection of data of the PhD Thesis. I understand that this data collection and analysis thereafter is being conducted by **Moffat Tembo**, the PhD Candidate, and is the basis of his doctoral dissertation.

I understand that the collection methods which may involve me are:

1. The candidate's recorded observations of my circle and its process and/or
2. My participation in a 30-60 minute interview.

I grant permission for the interview to be tape recorded and transcribed, and to be used only by **Moffat Tembo** for analysis of interview data. I grant permission for the research data generated from the above methods to be published in a doctoral dissertation report to the University, the research journals, conference papers, book chapters, and in the dissertation and other future publication(s).

I understand that any identifiable information concerning my name and/or agency name may be listed *only* in the above-mentioned evaluation report to the University of Zambia, that is, this information will *not* be listed in the dissertation or any future publication(s).

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Research Participant

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Date

### **Interview Questions**

1. Please kindly enlighten the significance of tender price in a construction project
2. How do you feel about soaring construction tender prices?
3. Please describe how construction tender prices affect construction sector
4. Describe the factors being considered when developing prices in construction?
5. Please describe how procurement function can make significant contribution to price performance of public infrastructure projects
6. Please describe current controls and their success or failures in mitigating escalating construction tender prices
7. How could government potentially overcome overpricing and maintain or increase its appetite for construction projects?
8. How do you feel about global competition or emergency of foreign construction firms on the market threatening existence of local firms?
9. What additional information, if any, do you believe pertinent to the study not discussed in the interview questions?

### **Objective 1 - To investigate circumstance surrounding failure to mitigate construction tender price inflation through current interventions**

8. Please kindly enlighten the significance of tender price in a construction project
9. How do you feel about soaring construction tender prices?
10. Please describe how high construction tender prices affect construction sector
11. Describe the factors that are considered when developing prices in construction

### **Objective 2 - To propose strategies that central government can use to address public construction tender price inflation**

5. How do you feel about global competition or emergence of foreign construction firms on the market threatening existence of local firms?
6. Please describe how procurement function can make significant contribution to price performance of public infrastructure projects
7. Please describe current controls and their success or failures in mitigating escalating construction tender prices
8. How could government potentially overcome overpricing and maintain or increase its appetite for construction projects?

### **Other emerging issues**

1. What additional information, if any, do you believe pertinent to the study not discussed in the interview questions?

## QUESTIONNAIRE

Dear Participant,

### REQUEST FOR YOUR PARTICIPATION

I am Moffat Tembo, Computer No. ENG2100008, a Doctor of Philosophy (PhD) candidate at the University of Zambia, in the School of Engineering, Department of Civil and Environmental Engineering.

I am currently researching on “Developing an Integrated Construction Price Management Model for Public Sector Projects in Zambia”. It is for this reason that I write to request assistance with information and data from you through your participation in the questionnaire survey to enable me successfully carryout and complete this research.

By filling the questionnaire, you give consent to the study to conduct scientific research based on your responses. The data collected through this questionnaire is coded-recorded anonymously. The study does not require you to give your name or any other confidentiality related details.

The questionnaire is solely for research purposes.

Please do not hesitate to contact the undersigned in case of any further clarifications.

Yours faithfully,

Moffat Tembo – PhD Candidate  
The University of Zambia  
School of Engineering  
Department of Civil and Environmental Engineering  
+260966648863  
[tembomoffat@yahoo.com](mailto:tembomoffat@yahoo.com)

### Part 1: Background Information

What is your occupation and nature of work?

What is your profession?	Please Tick
Quantity Surveyor - Quantity Surveying Firms (QS Registration Board)	
Architect (ZIA Registered)	
Contractors (Zambian Construction Firms)	
Client (Public Infrastructure-Based Institutions): Ministries, utility organizations, local authorities	
Consultants-Civil/Structural, etc. (ACEZ registered)	

### Status of construction tender price level

Please indicate the extent of your agreement with these statements according to the following scale.

1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

There is tender price variation in Zambia's construction sector	Acceptance				
	1	2	3	4	5

### Part 2: Government dimension of construction tender price management

Please indicate the extent of your agreement with these statements according to the following scale.

1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

- 1. Please evaluate the following statements associated with the government dimension of construction tender price management**

Government dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5

Project management practices	Establish project purpose, ensure timely project planning, and establish project control mechanism, management principles, roles and tasks before commencing procurement process. Establish consistent behavior towards contractors. Advocate on behalf of project implementation teams. Ensure understanding of project whole-life-costs and development of cost reduction principles. Implement appropriate project management processes.					
Strategic awareness	Establish understanding of market appetite, capability and capacity to make informed use of competition. Improve nature, behavior and type of approaches to guarantee sustainable construction practice.					
Continuous capability and capacity enhancement	Consider capacity provision through training programs for local contractors and, adoption of lean concepts and principles.					
Benchmarking price & performance	Invest in information management. Implement appropriate estimation models and processes. Apply appropriate industry comparators.					
Client capabilities	Invest in development of client organization capabilities. Understand the needs and prioritize accordingly. Translate requirements into clear, achievable and functional technical requirements. Provide arrangements for clear project responsibility and accountability.					
Payment flows	Objectively develop requirements and cost estimates for price reasonableness. Ensure availability of funds through adequate and informed budgeting. Ensure timely financing of projects and conformance to cash flow projections.					
Procurement methods	Employ competitive processes that result in desired outcomes.					
Stakeholder management	Effectively bridge interface between stakeholders and organizations. Ensure project needs supersede individual stakeholder demands. Improve contractor engagement criteria and remove unnecessary political or management interference.					
Incentives program	Apply appropriate measurements and targets for success. Incentivize performance within the construction supply chain.					
Innovation system	Adapt and change behavior in accordance to prevailing circumstances.					
Active participation framework	Ensure active participation of local firms and provide clear competence requirements. Implement appropriate participation processes for guaranteeing local-firm bespoke suit.					
Sector governance	Make timely decisions, and consider long-term benefits and efficiency over short-term political gains. Ensure acceptance of risk and rewards that deliver optimum outputs. Avoid application of unnecessary standards. Improve risk and contingency management.					

**Part 3: Contractor dimension of construction tender price management**

Please indicate the extent of your agreement with these statements according to the following scale.

1– Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

**2. Please evaluate the following statements associated with the contractor dimension of construction tender price management**

Contractor dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5
Technical ability	Develop expertise to perform construction project related tasks efficiently and costlly.					
Qualification and competence of contractor	Ensure to deliver complex projects on time by developing desired capacity and ability to perform. Endeavor to employ competent and qualified personnel.					
Profit margin	Endeavor to keep expenses low to generate efficient profit margin without worsening the clients’ financial or economic result.					
Stakeholder management	Maintain good relations with people and institutions that with most influence on the project while ensuring that project needs supersede individual stakeholder interests.					
Resource capabilities	Develop competitive advantage through a collection of resources possessions. Utilize existing internal resources of the company to create strategies and develop potential for creating competitive advantage.					
Project implementation methodology	Outline precise course of action in a step-by step process to implement construction initiatives that synchronize project execution. Develop methodology that addresses specific needs of particular project.					
Knowledge of procurement processes	Develop understanding of series of steps and activities involved in procurement.					

**Part 4: Industry dimension of construction tender price management**

Please indicate the extent of your agreement with these statements according to the following scale.

1– Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

**3. Please evaluate the following statements associated with the industry dimension of construction tender price management**

Industry dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5
Protection of local firms	Understand the justifications for protecting local participation in the industry and developing protectionism policies.					
Inflation rate	Understand the nature and type of inflation in construction sector and address its driver early.					
Interest rate	Reduce the cost of borrowing. Reconcile interest rates with project cost prior to tendering.					
Exchange rate	Endeavor to minimize project duration. Develop forex-fluctuation prediction mechanisms.					
Imports	Maintain value of local currency to guarantee economic performance of a project and its stakeholders. Maximize utilization of local building materials.					
Nature and type of competition	Encourage competitiveness of local firms.					
Nature and type of firms	Develop strategies to improve performance of local firms. Address local-firm-specific challenges and bottlenecks while encouraging joint ventures.					
Ownership of equipment	Develop deliberate equipment ownership policy and equipment ownership systems.					
Industry uncertainty	Develop strategies for positive stakeholder participation and ensure timely availability of resources					
Number of competitors	Improve quality of specification and design.					
Capacity of local firms	Address local-firm-specific challenges and bottlenecks while encouraging joint ventures and subcontracting strategies.					

Market predictability	Disseminate information regarding market fundamentals to guarantee results and reduce need to recreate the wheel at each tender.					
Knowledge transfer	Harmonize knowledge from different participants and construction projects. Encourage sharing and reuse of acquired knowledge. Develop deliberate mechanism of efficient knowledge transfer that discourages loss during a project lifecycle. Identify bottlenecks to knowledge transfer.					
Sector confidence	Develop frameworks that sustain high economic growth levels. Identify and address factors leading to the sector's prolonged state of decline. Improve supply chain management, which build long-term supplier alliances.					
Existence of foreign firms	Develop mechanism that encourage knowledge transfer and technical-know-how. Develop strategies to prevent out-performance and out-competing of foreign firms.					
Supply chain management	Develop informed decision-making. Develop models for detecting supply chain risks. Implement effective supply-chain management practices.					
Training	Develop structured assessment tools to gauge the efficacy of contractors and workforce. Encourage contractor-management training programs to increase competency and capacity among local contractors.					

#### Part 5: Project dimension of construction tender price management

Please indicate the extent of your agreement with these statements according to the following scale.

1– Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

#### 4. Please evaluate the following statements associated with the project dimension of construction tender price management

Project dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5
Project duration	Prepare practical and realistic project schedules with limited timeframe and minimum cost implication.					
Project quality	Reconcile design and purpose. Develop strategies against wastage of time and materials.					

Location of project	Use project location and site characteristics to plan and budget adequately.					
Scope of project	Develop effective project scope managed models. Ensure informed decision-making through project scope.					
Price of materials	Encourage good communication regarding progress of different projects and construction material management. Give special attention to material's estimates and handling.					
Nature and type of equipment	Pursue efficient utilization of equipment. Ensure utilization of advanced and contractor-owned equipment.					
Personnel/labor	Identify and document project roles and responsibilities. Develop plans that describe end-to-end processes for scheduling of personnel.					
Flow of payments	Ensure appropriate funding levels and develop drawdown facilities for predictable cash flows.					
Project variations/price adjustments	Provide possibilities for price adjustment and clearly define necessitating circumstances.					
Project costs	Ensure to implement effective cost controls and management practices.					
Complexity of the works	Develop an efficient overall approach to the project that specifies the tools, equipment, resources, and expertise and implementation techniques.					
Risk factors	Anticipate constraints prior to tendering the project.					
Project environment	Anticipate and mitigate the risk of negative stakeholder involvement.					

### Part 6: Procurement dimension of construction tender price management

Please indicate the extent of your agreement with these statements according to the following scale.

1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

#### 5. Please evaluate the following statements associated with the procurement dimension of construction tender price management

Procurement dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5

Project management process	Integrate principles and practices of sustainable construction. Understand and anticipate all technical and management outcomes.					
Engineer's estimates	Encourage utilization of good estimating models. Give special attention to price reasonableness and engineers' estimates					
Presence & experience of consultant	Engage consultants to provide technical assistance services, price assessments and project evaluation services.					
Technical & financial controls	Develop client's project management assessments and project control tools.					
Benchmarking of project elements	Measure data and compare results to other successful projects.					
Knowledge of project management team	Engage qualified teams to be responsible for project execution and providing outlined deliverables.					
Project implementation methodology	Develop a project management plan outlining exact courses of action and implementation initiatives.					
Procurement timeframe	Identify and consolidate requirements, and determine cost effective timeframe					
Errors in tender documents	Develop detection and correction mechanism for dealing with contractors' mistakes in tender documents.					
Completeness of designs	Develop a standardized system of scoring the entire behavior of a design.					

### Part 7: Legal dimension of construction tender price management

Please indicate the extent of your agreement with these statements according to the following scale.

1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree

#### 6. Please evaluate the following statements associated with the legal dimension of construction tender price management

Legal dimension	Critical tender price management aspect	Acceptance				
		1	2	3	4	5
Legislation for Price reasonableness analysis	Provide regulations for determination of fairness of price considering quality and all associated project delivery risks.					
Legislation for rate analysis	Provide mathematical descriptions of how changes in the project-item related factors result in a particular rate.					

Procurement controls	Provide regulation for establishing streamlined procurement structure, responsibility and clear lines of authority.					
Review available legislation	Continuously identify potential gaps, workarounds and obstacles.					
Subcontracting legislation	Provide legal framework for subcontracting					
Contract type	Provide domesticated contract forms that respond to prevailing circumstances.					

## **Appendix B: Ethical Clearance Approval**



**THE UNIVERSITY OF ZAMBIA**  
**DIRECTORATE OF RESEARCH AND GRADUATE STUDIES**

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777  
Fax: (+260)-211-290 258/253 952 | E-mail: [director.dirgs@unza.zm](mailto:director.dirgs@unza.zm) | Website: [www.unza.zm](http://www.unza.zm)

**APPROVAL OF STUDY**

**IORG No. 0005376**  
**HSSREC IRB No. 00006465**

25<sup>th</sup> July, 2022

**REF NO. NASREC-2022-JUL-009**

Moffat Tembo  
The University of Zambia  
School of Engineering  
Department of Civil Engineering  
P.O. Box 32379  
**LUSAKA**

Dear Mr. Tembo,

**RE: "DEVELOPING AN INTEGRATED CONSTRUCTION TENDER-PRICE  
MANAGEMENT MODEL FOR PUBLIC SECTOR INFRASTRUCTURE  
PROJECTS"**

Reference is made to your protocol dated as captioned above. NASREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

REVIEW TYPE	ORDINARY REVIEW	APPROVAL NO. NASREC-2022-JUL-009
Approval and Expiry Date	Approval Date: 25 <sup>th</sup> July, 2022	Expiry Date: 24 <sup>th</sup> July, 2023
Protocol Version and Date	Version - Nil	24 <sup>th</sup> July, 2023
Information Sheet, Consent Forms and Dates	<ul style="list-style-type: none"><li>English.</li></ul>	To be provided
Consent form ID and Date	<ul style="list-style-type: none"><li>Version - Nil</li></ul>	To be provided
Recruitment Materials	<ul style="list-style-type: none"><li>Nil</li></ul>	Nil
Other Study Documents	<ul style="list-style-type: none"><li>Questionnaire.</li></ul>	

## Appendix C: Peer-reviewed journal articles and conferences

### □ Peer-reviewed Journals

1. **Citation:** Tembo, M., Mwanaumo, E. M. and Kahanji, C. (2023). Improving Procurement Selection Criteria for Managing Construction Tender price Volatility on Public Projects. *European Journal of Logistics, Purchasing, and Supply Chain Management*, 11 (1). pp. 1-25. ISSN 2054-0930 (Print), 2054-0949 (Online). DOI: <https://doi.org/10.37745/ejlpbcm.2013/vol11n1125>

European Journal of Logistics, Purchasing and Supply Chain Management

Vol.11 No.1, pp.1-25, 2023

Print ISSN: 2054-0930 (Print)

Online ISSN: 2054-0949 (Online)

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### Improving Procurement Selection Criteria for Managing Construction Tender-Price Volatility on Public Projects

**Moffat Tembo, Dr. Erastus Misheng'u Mwanaumo, Dr. Charles Kahanji**  
Department of Civil and Environmental Engineering, School of Engineering, P.O. Box 32379,  
University of Zambia

DOI: <https://doi.org/10.37745/ejlpbcm.2013/vol11n1125>

Published 1<sup>st</sup> January 2023

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Citation: Tembo M., Mwanaumo E.M., and Kahanji C. (2023) Improving Procurement Selection Criteria for Managing Construction Tender-Price Volatility on Public Projects, *European Journal of Logistics, Purchasing and Supply Chain Management*, Vol.11 No.1, pp.1-25

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**ABSTRACT:** This paper investigates current knowledge concerning adopted procurement strategies for managing construction-price in the public sector. The article reveals that studies mainly address four main areas: procurement decision support systems, transparency, ethical considerations in procurement, identification of procurement criteria, and overcoming inconsistencies in the procurement process. The paper provides a new perspective on the selection of procurement strategy. Therefore, selecting a suitable procurement strategy is essential for managing project pricing. The review has revealed that the lowest bid is the main criterion of contractor selection in the public sector. There is a need to combine some, if not all, procurement strategies within a significantly flexible approach that can have multiple potential advantages in the construction field by serving as a robust decision-making tool. There is a need to develop a public procurement strategy for managing construction price variability and inflation by modeling for fundamental principles such as value for money, benchmarking price performance, and reducing tendering documentation errors, that collude and conspire to impact price inflation, client perception and infrastructure push, and public accountability. The study, thus, deduces two principal factors that serve as critical indicators of a procurement selection criterion focused on managing construction tender-price variability and inflation. These include benchmarking price performance and eliminating errors in the tender documentation.

**KEYWORDS:** procurement selection criteria, tender price, construction, public sector, infrastructure

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1

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Publication of the European Centre for Research Training and Development-UK

2. **Citation:** Tembo M., Mwanaumo E.M.,Kahanji C.(2023) Impact of Tender Price Variability on Economic Sustainability of Construction Sector in Developing Countries, *International Journal of Development and Economic Sustainability*, Vol.11, No.1, pp.50-80. Print ISSN: 2053-2199 (Print), Online ISSN: 2053-2202(Online). Doi: <https://doi.org/10.37745/ijdes.13/vol11n15080>

International Journal of Development and Economic Sustainability

Vol.11, No.1, pp.50-80, 2023

Print ISSN: 2053-2199 (Print),

Online ISSN: 2053-2202(Online)

Website: <https://www.eajournals.org/>

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Publication of the European Centre for Research Training and Development -UK

### **Impact of Tender Price Variability on Economic Sustainability of Construction Sector in Developing Countries**

**Moffat Tembo, Dr. Erastus Misheng'u Mwanaumo, Dr. Charles Kahanji**

Department of Civil and Environmental Engineering, School of Engineering, P.O. Box 32379, University of Zambia

Doi: <https://doi.org/10.37745/ijdes.13/vol11n15080>

Published February 14, 2023

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**Citation:** Tembo M., Mwanaumo E.M.,Kahanji C.(2023) Impact of Tender Price Variability on Economic Sustainability of Construction Sector in Developing Countries, *International Journal of Development and Economic Sustainability*, Vol.11, No.1, pp.50-80

**ABSTRACT:** *Economic sustainability in the construction sector is increasingly important in developing countries, and threats from construction tender price variability and inflation require immediate action. While global trends emphasize sustainable construction practices triggered by rapid economic growth and augmented environmental impact considerations, this paper underscores the significance of adopting tender-price practices that focus on attaining economic sustainability for enhancing sustainable development in developing countries. The study predicated how construction tender price variability accentuates sustainable construction practices. The study identified respondents through purposive sampling for better insights and a more thorough investigation of the construction tender-price phenomena. The adopted method presented the study with information-rich participants and cases regarding issues of central significance to the inquiry. In addition, the study utilized snowball sampling in which existing respondents recruited or referred other respondents from among their professional acquaintances. The study findings 13 factors requiring immediate consideration to address construction tender price variability and inflation. These include material costs; interest rates; equipment costs; labor costs; delayed payments; exchange rates; and the nature and type of project. The results categorize four specific areas significantly affected by high construction tender prices. The harmful impacts were immediate and more severe to stakeholders like the government (client). The effect on projects is equally devastating; however, contractors appear to experience more positive-impact though in the short term. The long-term effects of high construction tender-price variability inflation were detrimental to all stakeholders by observation. Thus, the article recommends strategies that address tender price sustainability challenges faced in the construction sector.*

**KEYWORDS:** Economic sustainability, tender price, developing countries, the construction sector

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3. **Citation:** Tembo M., Mwanaumo E.M., Kahanji C. (2023) Impact of Globalization on Sustainable Implementation in the Construction Industry: Dynamics of Construction Tender price Volatility, *International Journal of Developing and Emerging Economies*, Vol.11, No.1, pp.19-53. Print ISSN: 2055-608X (Print), ISSN: 2055-6098(Online). DOI: <https://doi.org/10.37745/ijdee.13/vol11n11953>

International Journal of Developing and Emerging Economies

Vol.11, No.1, pp.19-53, 2023

Print ISSN: 2055-608X (Print),

Online ISSN: 2055-6098(Online)

Website: <https://www.eajournals.org/>

Publication of the European Centre for Research Training and Development -UK

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### **Impact of Globalization on Sustainable Implementation in the Construction Industry: Dynamics of Construction Tender-Price Volatility**

**Moffat Tembo, Dr. Erastus Misheng'u Mwanaumo, Dr. Charles Kahanji**  
Department of Civil and Environmental Engineering, School of Engineering, P.O. Box 32379,  
University of Zambia

DOI: <https://doi.org/10.37745/ijdee.13/vol11n11953>

Published: February 14, 2023

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Citation: Tembo M., Mwanaumo E.M., Kahanji C. (2023) Impact of Globalization on Sustainable Implementation in the Construction Industry: Dynamics of Construction Tender-Price Volatility, *International Journal of Developing and Emerging Economies*, Vol.11, No.1, pp.19-53

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**ABSTRACT:** *Construction infrastructure plays a crucial role in development, bringing significant implications for resource utilization. Henceforward, specific measures for alleviating challenges associated with sustainable construction become crucial-general arguments of good industry practice. Construction-sector sustainability is increasingly important in developing countries, and threats of globalization amid construction-tender price volatility require immediate action. The purpose of this paper is threefold. The first is to investigate, through a literature review, the indicators of globalization concerning the construction sector. The second intention is to evaluate the empirical impacts of globalization on the construction sector with a focus on the derivation of construction tender-price. Thirdly, the study intends to separate the contributions of foreign direct investment (FDI) to global integration for construction sustainability. The study adopts qualitative and quantitative approaches that follow a case study and causal research design to explore and understand decisions and opportunities regarding construction-tender price inflation. The study utilizes content, thematic, and statistical methods for data analysis. The study finds that construction tender prices increased by an average of 49.7% per annum for periodic maintenance of feeder roads between 2012 and 2021, with varying correlations to globalization indicators. The research highlights notable disadvantages of foreign direct investments in the construction sector through the emergence of foreign firms in developing countries. The drawbacks include instigating unfair competition, initiating adverse knockout effects on local firms, exterminating local firms, and perpetuating corruption. In addition, the study identifies areas requiring attention to address the impacts of globalization in the construction sector. Critical areas include legislating procurement controls that protect local firms and improving the qualifications and competencies of local firms. The study further underscores mitigation measures against the adverse effects of foreign firms in the construction sector. These measures include providing training to local firms, managing the nature and type of competition, managing the nature and type of competing firms, and building the capacity of local firms.*

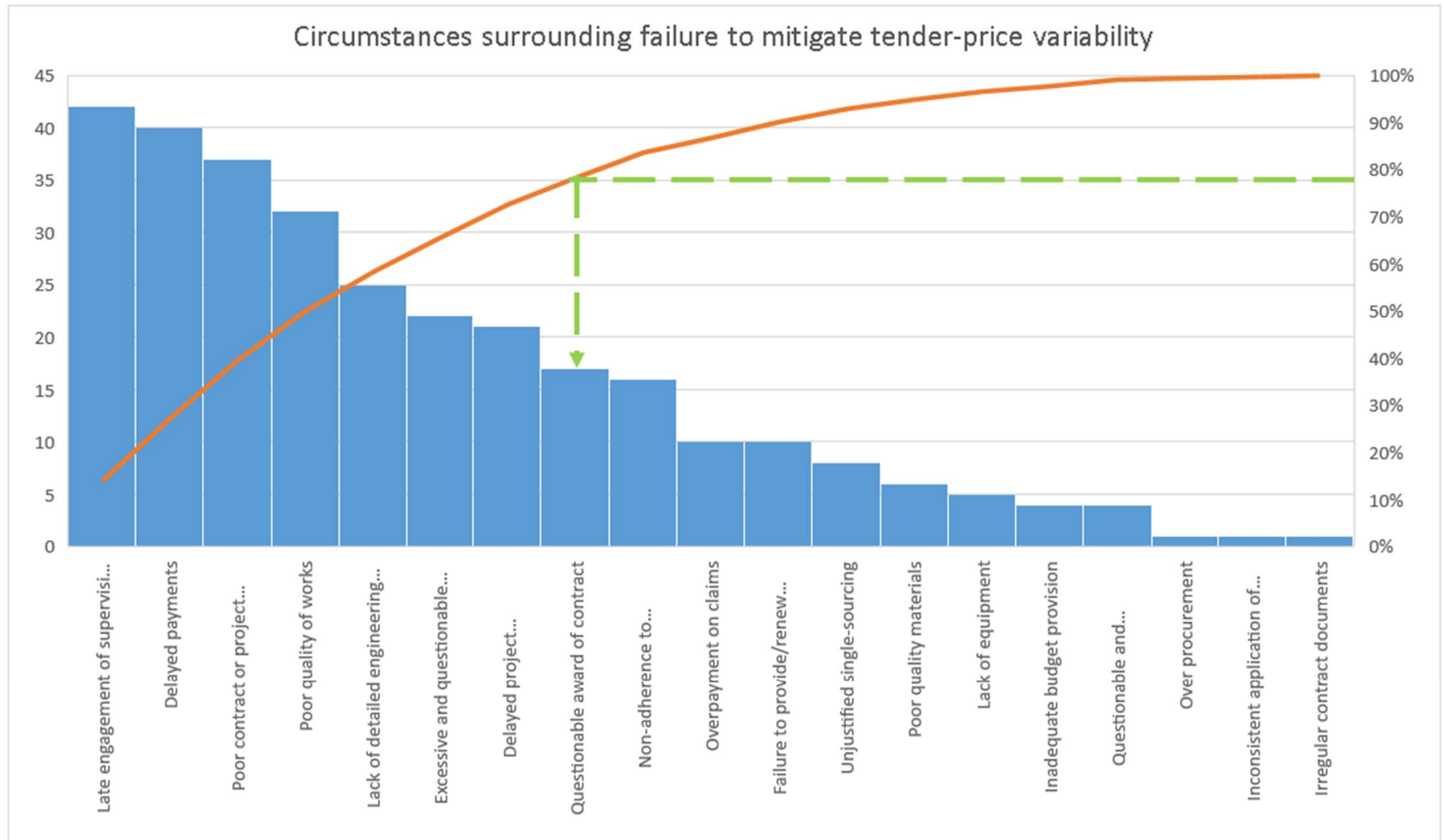
**KEYWORDS:** globalization, construction sustainability, tender price variableness, foreign direct investment, the construction sector

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□ **Papers under consideration in peer-reviewed journals**

1. Tembo, M., Mwanaumo, E. M. and Kahanji, C. (TBA). “Developing an Integrated Construction Tender Price Management Model for Public Sector Infrastructure Projects,” *Journal of Construction Project Management and Innovation*.
2. Tembo, M., Mwanaumo, E. M. and Kahanji, C. (TBA). “An Investigation into Tender Price Inflation in Construction: A Documentary Review,” *Journal of Construction Business and Management*.
3. Tembo, M., Mwanaumo, E. M. and Kahanji, C. (TBA). “Procurement Strategies for Managing Construction Tender Price,” *Journal of Construction in Developing Countries*.
4. Tembo, M., Kahanji, C. and Mwanaumo, E. M. (TBA). “Public Sector Contracting Model for Management of Construction Tender Price Volatility,” *Journal of Construction Project Management and Innovation*.
5. Tembo, M., Kahanji, C. and Mwanaumo, E. M. (TBA). “Developing strategies for measurement and prediction of tender price level on public construction projects,” *Journal of Construction Economics and Building*.

## **Appendix D: Tables and Figures**



**Fig. 9.2:** Pareto chart highlighting main challenges regarding construction tender price inflation. The chart indicates areas requiring prioritization, including Late engagement of supervising consultant, Delayed payments, Poor contract or project management practices, Poor quality of works, Lack of detailed engineering designs, Delayed project implementation, and Questionable award of contract.

**Table 2.2 Drivers of sustainable construction practices**

Author	Country	Drivers	Annotation	Summary	Synthesis
Oke et al. (2019)	Zambia	<ul style="list-style-type: none"><li>• Cost reduction</li><li>• Resource efficiency</li><li>• Strengthening implementation mechanisms</li><li>• Co-operation and partnerships</li><li>• Developing regulatory mechanisms</li><li>• Competitive advantage</li><li>• Financial incentives</li></ul>	The research identified 23 drivers of sustainable construction in the Zambian construction industry. The study further emphasizes the need to enhance the adoption of sustainable construction practices by implementing research findings and enforcing legislation that supports construction.	Research identifies cost reduction and resource efficiency as some of the essential drivers of sustainable construction	The research fails to develop a model or framework for the adoption of construction practices in the Zambian construction sector (only recommends it); Findings rate resource efficiency and cost reduction drivers, with mean scores of 4.00 and 3.75, respectively; However, it fails to underscore the drivers' strategic influence on the slowing down of the sector by escalating tender prices. Therefore, the research fails to fully reveal the underlying mechanism for transforming the Zambian construction industry towards sustainability.
Zhang et al. (2020)	German	<ul style="list-style-type: none"><li>• Quality</li></ul>	The research describes a building project's social, technical, and environmental quality aspects. The study develops a holistic quality model (HQM) that enhances control and decision points.	The research considered all three quality aspects in setting up a holistic quality model explicitly focusing on their interrelations.	The research fails to highlight an understanding of how quality through its model would affect the bottom line by not integrating the role of institutional quality. The study would have considered the sum of bureaucracy, corruption,

Author	Country	Drivers	Annotation	Summary	Synthesis
					government stability, investment profile, standards and regulations, and legislation by combining institutional quality. The model is not applicable because a change in quality characteristics and their interrelation means that control; and redefined decision points for different processes and construction phases.
Bohari, et al. (2016)	Malaysia	<ul style="list-style-type: none"> <li>• Compliance with government policy and</li> <li>• Compliance with industry guidelines</li> </ul>	The research found that formulating government policy and industry-specific guidelines triggered the push for sustainable construction.	The research acknowledges the lack of experts and practitioners in sustainable construction, making findings difficult to generalize since they had to work with limited sample size.	This research's findings prove that the influential power of critical stakeholder groups is a significant factor in the push and awareness generation of sustainable construction practices.  There is no academic theory to underpin identified drivers to sustainability, which points further to a lack of a coherent approach in the field, leading to many scholars finding different drivers.
Dahiru (2019)	Nigeria	<ul style="list-style-type: none"> <li>• Improve maintenance and</li> </ul>	The research found 13 drivers pushing for	The research provides insight into an emergent	The findings of this research underscore the

Author	Country	Drivers	Annotation	Summary	Synthesis
		operating cost savings <ul style="list-style-type: none"> <li>Integrating environmental needs into project needs</li> <li>Improve environmental compliance</li> <li>Improve value for money on projects</li> </ul>	sustainable construction procurement practices.	strand of construction sustainability that allows a new focus on incorporating environmental considerations into procurement stages to promote the adoption and implantation of sustainable construction practices.	fact that sustainable construction balances on sustainable procurement practices that must reflect all functional requirements spearheaded by a national institutional and legal framework that supports and enables construction prices that reflect value for money better.
Omopariola, et al. (2019)	Nigeria	<ul style="list-style-type: none"> <li>Education and Awareness</li> <li>Environmental and economic integration</li> <li>Cooperation, partnerships, and participation</li> <li>Guidelines and sustainability assessments</li> </ul>	The research found using and adopting conventional construction processes and practices to be a significant barrier to sustainable construction practices. The study further identified poverty to be a barrier to sustainable construction.	The research emphasizes the essence of maximizing resource use through savings and applying sustainable assessment systems.	The research identifies a large number of both barriers and drivers to sustainable construction. Still, it fails to highlight the core mechanisms and their impact on transitioning to sustainable construction within the industry.
Bidin et al. (2020)	Malaysia	<ul style="list-style-type: none"> <li>Tax incentives toward sustainable practices</li> <li>Sustainability guidelines and policies</li> <li>Sustainability assessments</li> <li>Top-level commitment and</li> </ul>	The research finds that knowledge about green building and sustainable construction among stakeholders in Malaysia is still deficient.	The research provides six strategies (integration of green practices; guidelines and policies; constant assessment; management commitment; stakeholder values; and incentives) for adoption to accelerate sustainable construction practices,	The research only focuses on the niche level and fails to underscore the drivers that motivate construction stakeholders to adopt sustainable practices. The study concentrates its efforts at the management level and largely ignores establishing and highlighting current

Author	Country	Drivers	Annotation	Summary	Synthesis
		stakeholder values		derived from prior literature and validated using focus group interviews.	dynamics contributing to the growth of sustainability innovation.

(Source: by the author)

**Table 2.5 Key bottlenecks in the construction industry**

Construction Bottlenecks	Country	Author	Comments
<ul style="list-style-type: none"> <li>• Skills and qualifications</li> <li>• Procurement practices and systems</li> <li>• Supply chain integration and relationships</li> <li>• Structure of the construction industry</li> <li>• Lack of technology</li> </ul>	South Africa	Mafini & Pillay (2017); Agenbag & Amoah (2021)	<ul style="list-style-type: none"> <li>• Research recommends;</li> <li>• creation of awareness and application of supply chain management in construction</li> <li>• local contractors to procure equipment</li> </ul>
<ul style="list-style-type: none"> <li>• Low investments in modern construction methods and technology</li> <li>• Access to finance</li> <li>• High labor turn-over</li> <li>• Access to information</li> <li>• Firm collusions</li> <li>• Firm-specific characteristics</li> <li>• Structural challenges</li> <li>• Systematic inertia (red tape)</li> <li>• Weak institutional support and commitment</li> <li>• Weaknesses in transparency, accountability, and good governance</li> <li>• Corruption</li> </ul>	Zambia	Cheelo & Liebenthal (2020)	<ul style="list-style-type: none"> <li>• The bottlenecks mainly affect construction prices and the quality of infrastructure</li> <li>• Firm-specific characteristics such as firm grade and category prevent competitive prices from emerging in the industry</li> <li>• Observations underscore the need to streamline, strengthen, and simplify the procurement processes</li> </ul> <p>The research recommends;</p> <ul style="list-style-type: none"> <li>• establishment of a contract unbundling policy or law</li> <li>• establishing a better local content policy and strategy with viable options to increase access to financing</li> </ul>

<b>Construction Bottlenecks</b>	<b>Country</b>	<b>Author</b>	<b>Comments</b>
<ul style="list-style-type: none"> <li>• Cadreism</li> <li>• Unfair advantages among foreign-owned firms</li> <li>• Currency collapse</li> <li>• Heightened inflation</li> <li>• High-interest rates</li> <li>• High level of public debt</li> </ul>			
<ul style="list-style-type: none"> <li>• Waiting</li> <li>• Administration and bureaucracy</li> <li>• Safety issues</li> <li>• Decision issues</li> <li>• Communication issues</li> <li>• Poor engineering process</li> <li>• Lacking capacity</li> </ul>	Norway	Eik-Andresen, et al. (2016); Zidane, et al. (2015)	<p>The research recommends;</p> <ul style="list-style-type: none"> <li>• improved upfront planning and less bureaucracy</li> <li>• better competence among project members</li> <li>• more effective use of human resources</li> <li>• better project control and enhanced structures</li> </ul>
<ul style="list-style-type: none"> <li>• Delays in information exchange</li> <li>• Poor project relationship and information management</li> <li>• 2D documentation</li> <li>• Overreliance on traditional procurement methods</li> </ul>	Zambia	Chiponde, et al. (2017)	The research recommends adopting building information modeling (BIM) in the Zambian construction industry.
<p>Ethical issues</p> <ul style="list-style-type: none"> <li>• Corruption</li> <li>• Political and societal influences</li> </ul>	Zambia	Zulu & Muleya (2018)	The research explores the ethical dimension of the Zambian construction industry with a particular focus on students' perceptions.
<ul style="list-style-type: none"> <li>• Political-bureaucratic constraints</li> <li>• Regulatory constraints</li> <li>• Financial constraints</li> <li>• Methodological constraints</li> </ul>	Zambia	Ngoma et al. (2014)	The research proposes the use of the PPP approach in executing public sector projects that would otherwise be too costly to procure
<ul style="list-style-type: none"> <li>• Policy deficiencies</li> <li>• Late subcontractor involvement in the procurement process</li> </ul>	Zambia	Mambwe et al. (2020)	The research proposes a framework to enhance the implementation of the subcontracting policy by the government

<b>Construction Bottlenecks</b>	<b>Country</b>	<b>Author</b>	<b>Comments</b>
<ul style="list-style-type: none"> <li>• Lack of guidelines on the implementation of policies</li> <li>• Foreign contractors do not have an interest in developing local contractors' capacity</li> <li>• Lack of incentives</li> </ul>			
<ul style="list-style-type: none"> <li>• Poor financial control</li> <li>• Poor project management</li> <li>• Lack of experience in preparing tender documents</li> <li>• Poor time management</li> <li>• Lack of capital</li> </ul>	Zambia	Aigbavboa et al. (2018)	The research proposes using government incentives to promote the growth of SMMEs in the Zambian construction industry.
<ul style="list-style-type: none"> <li>• Globalization</li> </ul>	South Africa	Dlungwana & Rwelamila (2014)	The research recommends the development of a procurement environment that promotes exceptional performance by local contractors
<ul style="list-style-type: none"> <li>• Lack of finance</li> <li>• Inadequate skills</li> <li>• Intensified competition from large firms</li> <li>• Lack of enabling environment</li> </ul>	South Africa	Hove (2016)	The research proposes that government must prepare clear and comprehensive contracting policies that will enhance the growth and profitability of small local contractors
<ul style="list-style-type: none"> <li>• Inadequate capacity of contractors</li> <li>• Complexities and risks in contracting</li> <li>• Ineffective management</li> <li>• Lack of business management</li> <li>• Poor record keeping</li> <li>• Inadequate technical, financial, and managerial skills</li> <li>• Late payment by the government</li> </ul>	Eswatini	Thwala & Mvubu (2009)	The research recommends the government improve its payment system and break down big contracts into small contracts that small contractors with lower grading can qualify to perform
<ul style="list-style-type: none"> <li>• Inadequately skilled labor</li> <li>• Poor quality</li> <li>• Low productivity</li> </ul>	Brazil	Barbosa & Vilnītis (2017)	The research recommends construction firms increase competitiveness to flourish in the advent of globalization

Construction Bottlenecks	Country	Author	Comments
<ul style="list-style-type: none"> <li>High tax burden</li> </ul>			

(Source: by the author)

**Table 4.2 Modeling approaches and procurement strategies for managing construction**

Author	Attributes	Approach	Observed gaps in the approach/strategy
Zhang (2019)	Construction type, construction ability, technical level, management ability, procurement channels of equipment, price competition	Evaluated lowest bid method	<ul style="list-style-type: none"> <li>• Fails to detect malicious low price – tender offer below the cost</li> <li>• Fails to identify project cost</li> <li>• Dependent on the expert’s grasp of project content</li> </ul>
Ghadamsi (2016) Marzuki & Tamin (2017)	The technical complexity of the project, quick start of the project, low technical capacity of the client, integration of construction processes, prompt delivery of construction process, flexibility in design, reduced project cost, Innovation, creation of single-point of responsibility, saving on time	Design & Build Method	<ul style="list-style-type: none"> <li>• Fails to mitigate susceptibility to unethical and corrupt practices</li> <li>• Fails to detect and minimize Single-point-responsibility abuse</li> <li>• Lacks framework for assessing &amp; mitigating front-loading risks</li> </ul>
Demirkesen & Bayhan (2019)	Transparency of decisions, tracking performance, participatory environment, context-based analysis, safety, the reputation of the contractor, the importance of the contractor, risk certifications, contractor workload	Choosing-by-Advantage Model (CBA)	<ul style="list-style-type: none"> <li>• Lacks framework for a cost comparison</li> <li>• Overly dependent on assumptions and expert judgment</li> <li>• Fails to model subjective views of decision-makers</li> <li>• Fails to embed consistency checks in decision making</li> </ul>

<b>Author</b>	<b>Attributes</b>	<b>Approach</b>	<b>Observed gaps in the approach/strategy</b>
Alzober & Yaakub (2014)	Time and cost, statistical modeling, neural network prequalification, contractor performance, multiple criteria decisions making, analytic hierarchy process, automated decision-making	Integrated Model	<ul style="list-style-type: none"> <li>• Lacks the framework for low technology use</li> <li>• Fails to perform price sensitivity analyses</li> </ul>
Afolayan, et al. (2018)	Contractors' financial stability, contractor technical capability, past Contractor performance, management capability, experience, reputation, and safety	Analytic Hierarchy Process	<ul style="list-style-type: none"> <li>• Lacks generic model</li> <li>• Lacks comprehensive discrimination among alternatives</li> <li>• Can give different solutions to the same problem</li> </ul>
Storteboom, et al. (2017)	Need for collaboration, overall complexity, early involvement of construction parties, quality and efficiency, mutual benefit, risk management, accountability, and transparency	Best Value Procurement (BVP)	<ul style="list-style-type: none"> <li>• Fails to produce ideal results when combined with traditional elements</li> <li>• Fails to mitigate its high cost of implementation</li> <li>• Implantation of its four phases effortlessly consumes time</li> <li>• No framework for bid price reduction</li> <li>• Restrains competitive innovation</li> </ul>
Burnett (2009), Bovis (2006)	Affordability and timely implementation, dialogue phases in the tender process, complex and high-value infrastructure, practical application of PPP	Competitive Dialogue Procedure	<ul style="list-style-type: none"> <li>• Fails to mitigate against unethical and corrupt practices</li> <li>• Difficult to justify</li> <li>• Fails to establish the extent of permissible consultations or restrictive dialogue</li> </ul>
Hastie, et al. (2017)	Knowledge interconnectivity, integration of disciplines, collaborative environment, inter-organizational integration,	Early Contractor Involvement (ECI) procurement	<ul style="list-style-type: none"> <li>• Lacks the methodology for implementing complex knowledge integration</li> <li>• Restrain competitive innovation</li> </ul>

Author	Attributes	Approach	Observed gaps in the approach/strategy
Zavadskas, et al. (2016), Alptekin & N. Alptekin (2017)	Tender cost, technical competence, past performance, managerial, financial strength and credibility, health and safety aspects, lowest price offer	Technique for order preference by similarity to the ideal solution (TOPSIS) method	<ul style="list-style-type: none"> <li>Difficulties in establishing the collaborative framework</li> <li>Complications when data attributes and information are imprecise and non-deterministic</li> <li>The methodology still requires enhancements</li> </ul>

(Source: by the author)

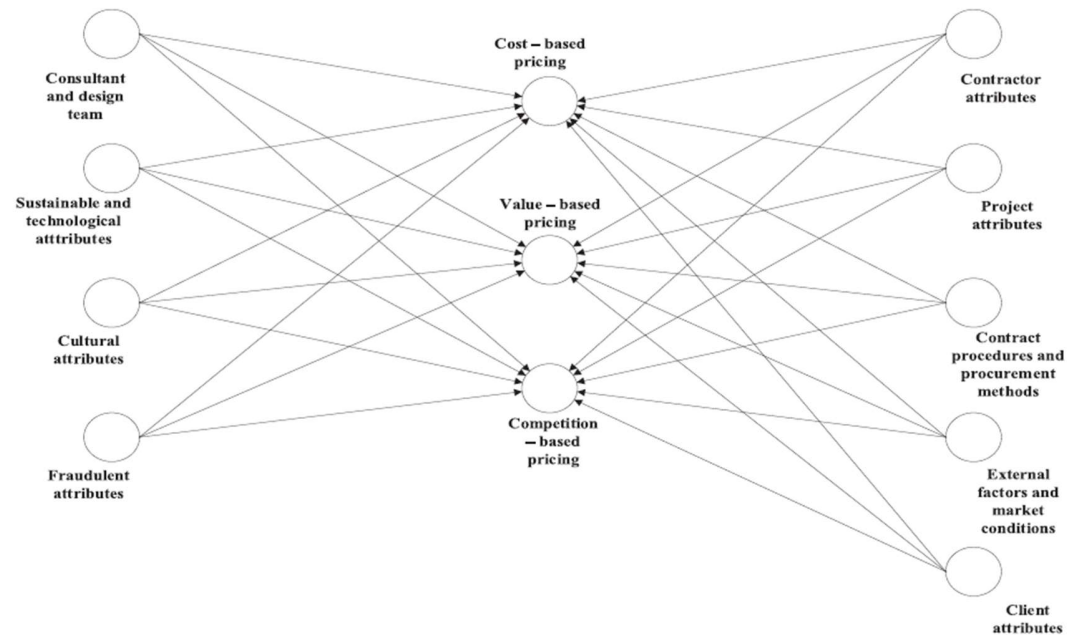


Fig. 5.3: Hypothetical conceptual framework of relationships between pricing strategies

(Adapted from Kissi et al., 2019, p. 6)

**Table 6.1 Factors affecting tender price in construction**

<b>Factor(s)</b>	<b>Postulation</b>	<b>Author</b>
Nature of competition	Firms raise prices in competitive markets	Chalkidou et al. (2020)
Inflation rate	The inflation rate helps predict the bid price	Oghenekevwe et al. (2014)
Macroeconomic factors	Price inflation is dependent on macroeconomic factors	Alireza, et al. (2016)
Material cost	Construction prices are a function of many factors, including material costs	Gransberg & Kelly (2008), Al-Zarrad et al. (2015), Tembo-Silungwe & Khatleli (2017), Ramanathan et al. (2012)
Profit margin	Adopting high prices has a direct and positive impact on profit margin	Toni et al. (2017)
Size of a construction company	Larger companies have a greater capacity to influence prices in the industry	Toni et al. (2017)
Reputation of client	Contractors inflate tender prices for clients reputed for delayed payments	Ye & Abdul-Rahman (2010)
Level of construction activity	A boom in construction activity is significantly associated with a general increase in construction prices	Cruywagen (2014)
Unbalanced bidding	The practice of unbalanced bidding comes as a possible added cost to the project	Skitmore & Cattell (2013)
	Unbalanced bidding contaminates the database of previous tenders that clients often use to establish and estimate the cost of a project	Molenaar et al. (2011)
	Unbalanced bidding is a common practice by contractors in determining prices in construction	Cattell, et al. (2007)
Degree and level of competition	The level of competition has an impact on the bid price	Lawrence (2003)
Nature of construction work	The nature of construction is critical in the development of bid price	Lawrence (2003)
Number of competitors	The number of participants has a direct impact on the bidders' final price	Raventós & Zolezzi (2015)
Pricing policies	Pricing policy can influence the profitability of an organization	Toni et al. (2017)
Experience in a construction company	Emerging contractors exhibit inadequacies in tender price estimation	Seeletse & Ladzani (2012)
Engineer's estimate	Benchmarking engineer's estimate during the evaluation of bids	Su et al. (2020)

<b>Factor(s)</b>	<b>Postulation</b>	<b>Author</b>
Project quality level	The increase in price offered by the client encourages contractors to provide a better-quality product	Yu et al. (2013)
Direct cost drivers (Labor, equipment, plant, etc.)	Cost drivers are crucial in the compilation of tender price	Seeletse & Ladzani (2012)
<ul style="list-style-type: none"> <li>• Reduced bureaucracy,</li> <li>• higher corruption rate,</li> <li>• poor business environment</li> </ul>	It is hardly possible to construct lower prices with a higher corruption rate, high bureaucracy, and poor business environment	Grega & Nemeč (2015)
Procurement method	The procurement method is a significant qualitative factor affecting project cost	Ali (2018)
Exchange rate volatility	The exchange rate is the leading indicator that influences the price of goods and services	Morina et al. (2020)
Regulation and control	Price floor regulations have long-term effects on the structure of the market by creating endogenous barriers that can even lower prices	Carranza et al. (2015)
Dependency on imported materials	Import tariffs have an almost immediate effect on prices	Amiti et al. (2019)
Interest rate	Changes in the interest rates affect macroeconomic variables such as price level	Li Suyuan & Khurshid (2015)
Globalization	The integration of world markets has general equilibrium implications on product's relative prices	Farahane & Heshmati (2020)
Location and control of the site	<ul style="list-style-type: none"> <li>• Cost estimating is used more for project control than planning and evaluation</li> <li>• The project location is one of the significant factors affecting the accuracy of cost estimation</li> </ul>	Akintoye & Fitzgerald (2000)
Tender duration	<ul style="list-style-type: none"> <li>• If the timeframe is inadequate, contractors will lack time to carry out a proper analysis of the project, thereby leading to contractors overpricing their tender to make up for unforeseen risks</li> </ul>	Knowles (1997)

(Source: by the author)

**Table 6.3 Contracting delivery models in construction**

<b>Contracting model</b>	<b>Practice</b>	<b>Success factors</b>	<b>Cost control measure</b>	<b>Author(s)</b>	<b>Constraints</b>
Engineering, procurement, and construction (EPC) model	The contractor takes control of engineering, procurement, and construction and takes full responsibility for the quality, safety, construction cost, and construction period	<ul style="list-style-type: none"> <li>• Address time constraints in project delivery</li> <li>• Utilization of contractors' design capabilities and technical experience</li> <li>• Single point responsibility</li> </ul>	Preventive	Zhong (2011)	<ul style="list-style-type: none"> <li>• Enhanced difficulties in client's control of project price due to reduced participation</li> </ul>
Engineering, procurement, and construction management (EPCM) model	The contractor takes control of the designing and management of the project for the client on a reimbursable basis	<ul style="list-style-type: none"> <li>• Pays on actual costs basis at pre-agreed rates</li> <li>• Multiple point responsibility</li> </ul>	Organizational	Fentona, et al. (2016), Altemirova & Burenina (2021), Chattopadhyay & Mo (2010)	<ul style="list-style-type: none"> <li>• The client bears responsibility for cost overruns and outturns</li> <li>• Not ideal if social and technical issues characterize the client</li> </ul>
Project Management Contractor (PCM) model	The client engages a contractor or a project manager to assist with management aspects of the project delivery process	<ul style="list-style-type: none"> <li>• Efficient project management</li> <li>• Efficient cost estimation strategies</li> <li>• Efficient knowledge-</li> </ul>	Organizational	Tatum (1979), Golini, et al. (2017)	<ul style="list-style-type: none"> <li>• It does not guarantee the overall price or quality of the project</li> </ul>

<b>Contracting model</b>	<b>Practice</b>	<b>Success factors</b>	<b>Cost control measure</b>	<b>Author(s)</b>	<b>Constraints</b>
		<ul style="list-style-type: none"> <li>sharing management</li> <li>Realistic correlation between cost and quality</li> </ul>			
Early Contractor Involvement (ECI) Model	Involves procuring a contractor in the preliminary design stage of the project	<ul style="list-style-type: none"> <li>Allows for contractors' contribution and influence on a major decision</li> <li>Transfer of manageable risks to the contractor</li> <li>Enhanced understanding between client and owner</li> </ul>	Organizational	Wondimu, et al. (2016), Walker & B. Lloyd-Walker, (2012), Finnie, et al. (2018), Penn, et al. (2017), Opoku & Ibrahim-Adam (2018), Botha, et al. (2020), Lefebvre & McAuley (2019), Sanchez, et al. (2015), Botha & Scheepbouwer (2015)	<ul style="list-style-type: none"> <li>Late consideration of price elements creates an opportunity for price manipulation in the second stage</li> <li>The approach focuses on establishing better relationships and increased understanding among parties</li> <li>The contractor's interest in participating is dependent on compensation amounts</li> </ul>

(Source: by the author)

**Table 9.5 Construction Tender prices for upgrading roads to bituminous standard (2008-2018)**

Year	2008		2009		2010		2011		2012		2013	
	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price
	14.4	14,143,540	52.4	47,562,388	23.5	33,397,491	90	213,805,420	402	1,797,195,724.20	54	221,212,397
	45	77,741,065	104	290,063,867	65	80,002,657	14.6	59,004,963	43.8	242,296,469.00	48.5	205,807,776
	73.19	90,097,344	96	192,695,237	50	101,286,041	171.9	180,000,000	14.6	59,004,963.00	16	208,241,515
	17.78	34,379,087	225	319,160,884	52.4	47,562,388	131.5	707,400,000	64	290,287,688.00	91	314,958,672
			82	164,112,515			171	421,706,455	34.47	165,827,800.00	45.5	561,813,606
							7	11,491,186.95	86	371,478,276.00	27.32	139,270,689
							131.5	332,939,624	115	466,731,196.00	65	175,787,988
									40	118,441,534.00	100	295,906,766
									70	278,824,387.00	158	385,583,452
									175	1,067,928,906.52	114	361,187,528
									15	72,236,835.00	105	529,047,639
									14.1	61,562,946.64	90	856,110,428
									22.6	51,427,095.02	18	118,370,863.31
Average	37.5925	54,090,259	111.88	202,718,978	47.725	65,562,144	102.5	275,192,521	84.35154	387,941,832	71.71692	336,407,640
ZMW/Km	1,438,857.72		1,811,932.23		1,373,748.44		2,684,805.09		4,599,107.96		4,690,770.68	
Year	2014		2015		2016		2017		2018			
	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price		
	98	690,958,848	84	585,556,978.00	270	2,061,451,626.00	85	959,189,051.33	220	4,205,527,260.00		
	8	41,999,823	84	417,108,471.00	109	546,877,969.00	257	1,839,580,493.66	179	3,994,919,827.00		
	111.2	285,886,120	5	57,014,787.00	69.9	282,394,736.00	25.63	294,310,644.73	258	3,994,919,827.00		
	94	264,798,761	56	417,108,471.29	78.2	291,105,602.00			103	784,279,480.62		
	118	429,962,249	84	585,556,977.51	58.2	529,938,197.00			107	713,664,926.91		
	93	396,624,924	83.9	367,218,609.29	194	1,695,918,648.00			88.3	1,162,942,884.00		
	90	332,824,438	82	631,194,336.31	112	607,349,167.00			4	32,078,862.69		
	71	229,969,700	15	123,936,213.56	10.65	160,270,962.37			95	289,105,667.00		
	107.5	592,500,000	20.2	123,142,060.36	9.37	108,575,278.37						
	115.7	500,040,614	11.4	109,660,183.91	15.04	250,374,945.86						
	113	439,062,227	9.27	115,405,395.11								
	117	540,831,955	20.5	220,867,715.90								
	17	168417173	9.6	129,403,184.05								
Average	88.72308	377,990,526	43.45154	298,705,644.87	92.636	653,425,713.16	122.5433	1066945569	131.7875	1,897,179,841.90		
ZMW/Km	4,260,340.59		6,874,454.98		7,053,690.93		8,706,679.83		14,395,749.54			

(Source: by the author)

The Table shows average construction tender prices for upgrading roads to bituminous standards. The analysis shows a steady increase in construction tender prices between 2008 and 2021. For upgrading roads to bituminous standards, construction tender prices increased from an average of K1,438,825.83/km in 2008 to an average of K14,395,749.54/km in 2018 (N=92)



**Fig. 9.3:** Construction Tender prices for upgrading roads to bituminous standard (2008-2018)  
(Source: by the author)

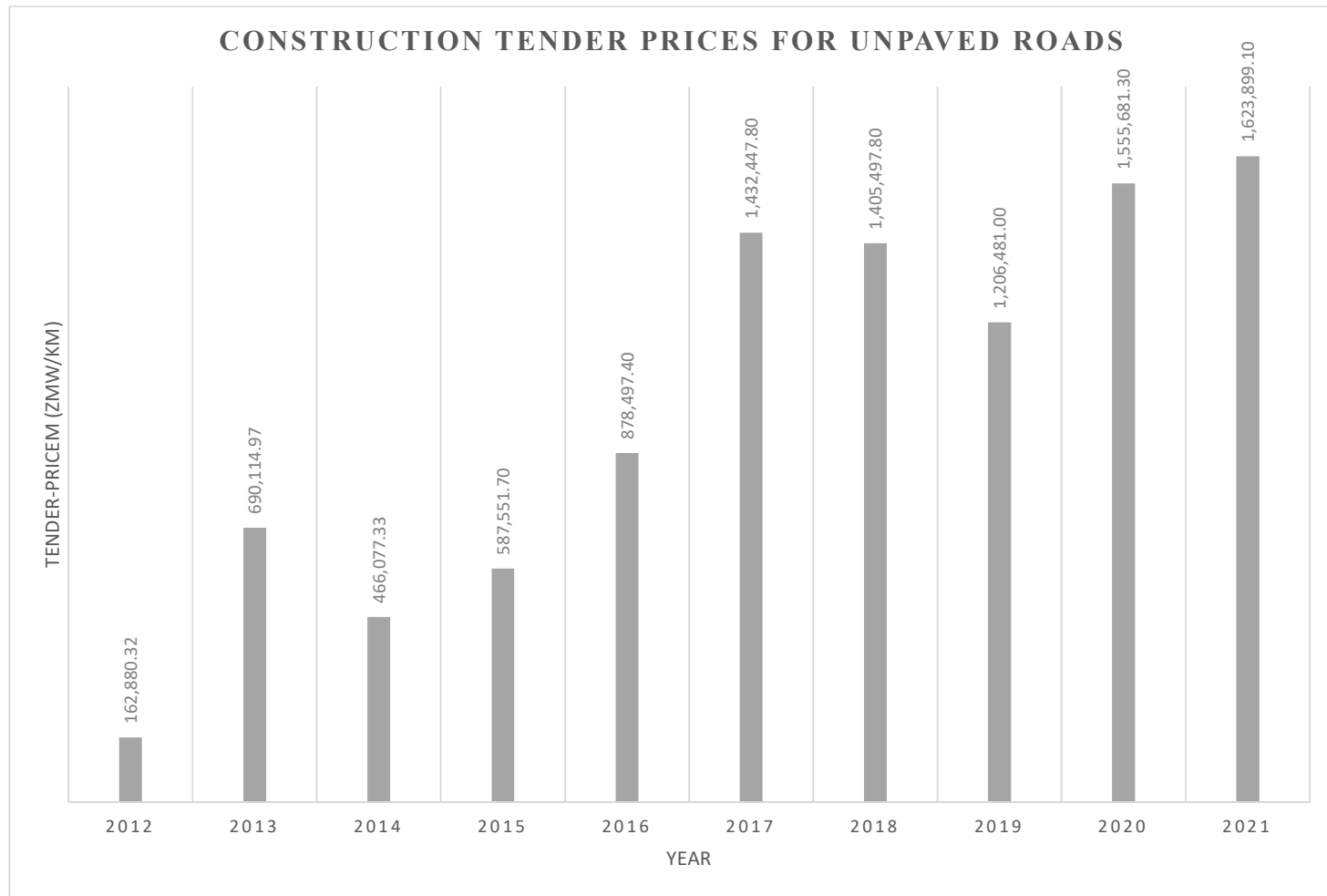
The figure shows average construction tender prices for upgrading roads to bituminous standards. The analysis shows a steady increase in construction tender prices between 2008 and 2021. For upgrading roads to bituminous standards, construction tender prices increased from K1,438,825.8/km in 2008 to an average of K14,395,749.5/km in 2018. (Source: by the author)

**Table 9.6 Construction Tender prices for periodic maintenance of feeder roads (2012-2021)**

Year	2012		2013		2014		2015		2016	
	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price
	31.1	3,602,336.00	52	90,654,684.40	38	38,484,042.65	50	29,377,586.00	12.3	6,500,774.68
	67.7	3,687,002.00	8	1,986,040.71	15	5,228,837.46			58	34,899,588.23
	57.2	6,534,268.00	7.7	4,104,000.00	14	5,422,655.97			40	44,655,304.32
	41.1	2,470,591.00	20.5	11,296,647.24	47.8	13,879,176.12			95	63,615,299.00
	28	3,602,335.57	12.7	5,303,000.00	8	3,190,957.00			54	46,833,110.94
	55	3,236,650.56	12.3	4,911,000.00	4	1,203,035.13			91.5	69,927,528.90
	32	2,831,444.00	9.4	5,809,000.00	14	6,248,041.67			36	26,918,990.00
	175.8	49,115,527.72	6.4	3,322,228.40	23	6,006,621.67			38	47,484,042.65
	18	1,479,358.44	82	26,108,525.12	17	4,591,480.56			58	34,899,588.23
	55	12,311,865.61	12.5	5,116,849.32					24.5	69,927,528.90
	15	4,931,395.48	18	7,320,348.20						
			3.8	2,453,505.56						
			2.3	2,486,636.90						
Average	52.35455	8,527,524.94	19.04615	13,144,035.83	20.08889	9,361,649.80	50	29377586	50.73	44,566,175.59
ZMK/Km		162,880.32		690,114.97		466,011.33		587,551.72		878,497.45
Year	2017		2018		2019		2020		2021	
	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price	Km	Tender Price
	70.9	108,415,598.13	30	74,061,380.18	83	91,295,870.00	53	100,856,437.86	21	35,880,675.40
	55	57,737,462.42	29.3	69,950,583.11	17	19,693,457.81	42	66,885,061.25	16	24,294,384.56
	12.3	11,761,113.13	83	88,267,870.42	42	48,756,183.30	60	70,108,544.00	21.6	35,787,669.46
	45	76,925,272.28	40	42,372,750.00	80	93,998,709.02	37.5	46,501,969.80	24.6	35,465,358.24
	57	78,561,606.97	33	36,738,694.08	110	124,819,468.40	45	58,605,602.00	24	95,902,918.23
	10	24,997,391.58	83	88,267,870.42	50	74,335,140.24	29.9	46,753,597.00	61.8	95,902,918.23
			33	55,130,702.88	45	58,702,533.24	33	40,162,355.20	22	31,469,143.70
			37.6	42,372,504.34	44	56,651,170.16	46	57,108,663.10	21.6	35,787,669.46
			43.6	56,774,458.20			60	70,420,192.50	44.5	53,424,968.51
			27	44,461,293.70			58	118,291,479.20	24	55,825,258.52
			32	53,822,751.20			60	128,298,370.88	20	30,644,894.50
			64.1	75,999,351.12			50	97,395,937.26	50.8	62,329,581.22
			70.9	124,214,192.00			50	69,979,215.60	50	59,929,627.17
Average	41.7	59,733,074.09	46.65385	65,571,877.05	58.875	71,031,566.52	48.03077	74,720,571.20	30.91538	50,203,466.71
ZMK/Km		1,432,447.82		1,405,497.78		1,206,480.96		1,555,681.34		1,623,899.15

(Source: by the author)

The figure shows a steady increase in construction tender prices between 2012 and 2021. For periodic maintenance of feeder roads, tender prices increased from an average construction tender price of K 162,880.32/km in 2012 to an average of K 1,623,899.15/km in 2021 (N=97).



**Fig. 9.4:** Construction Tender prices for periodic maintenance of feeder roads (2012-2021)  
(Source: by the author)

The figure shows a steady increase in construction tender prices between 2012 and 2021. For periodic maintenance of feeder roads, tender prices increased from an average construction tender price of K 162,880.3/km in 2012 to an average of K1,623,899.1/km in 2021.

**Table 9.7** Macroeconomic indicators and tender prices for upgrading of roads to bituminous standards

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Aver ages	Coefficient ( r ) Pearson's	Comment
<b>Tender price (ZMW'million/km)</b>	1.438	1.8119	1.3737	2.6848	4.599	4.6907	4.2603	6.874	7.0536	8.7066	14.39	5.262	-	-
<b>Forex rates</b>	826	322	484	051	108	707	406	455	909	798	575	737	<b>0.84</b>	strongly positive
<b>Inflation rates</b>	4.2	4.9	4.8	7.3	5.14	5.39	6.15	8.63	10.31	9.54	10.45	6.98	<b>-0.18</b>	no correlation
<b>Interest rates</b>	12.5	13.4	8.5	8.7	6.6	7	7.8	10	18.2	6.6	7.5	9.71	<b>0.54</b>	moderately positive
<b>FDI (US \$'Bn)</b>	19.1	22.1	20.9	18.8	19.1	16.3	18.7	21.1	28.1	26.9	24	21.37	<b>-0.39</b>	weakly negative
<b>External Debt (US \$'Bn)</b>	0.94	0.69	1.73	1.11	1.73	2.1	1.51	1.58	0.66	1.11	0.41	1.23	<b>0.88</b>	strongly positive
<b>% change (forex)</b>	0.91	2.25	1.72	1.68	0.92	2.13	5.02	8.08	9.21	12.45	12.1	5.13	-	-
<b>% change (Inflation)</b>	0	16.7	-2.0	52.1	-29.6	4.9	14.1	40.3	19.5	-7.5	9.5	<b>+11.8</b>	-	-
<b>% change (Interest)</b>	0	7.2	-36.6	2.4	-24.1	6.1	11.4	28.2	82.0	-63.7	13.6	<b>+2.6</b>	-	-
<b>% change (FDI)</b>	0	15.7	-5.4	-10.0	1.6	-14.7	14.7	12.8	33.2	-4.3	-10.8	<b>+3.3</b>	-	-
<b>% change (Debt)</b>	0	-26.6	150.7	-35.8	55.9	21.4	-28.1	4.6	-58.2	68.2	-63.1	<b>+8.9</b>	-	-
<b>% change (Tender price)</b>	0	147.3	-23.6	-2.3	-45.2	131.5	135.7	61.0	14.0	35.2	-2.8	<b>+45.1</b>	-	-
	0	25.9	-24.2	95.4	71.3	2.0	-9.2	61.4	2.6	23.4	65.3	<b>+31.4</b>	-	-

(Source: by the author)

The analysis in the Table indicates an average percentage increment per annum of 31.4% of construction tender prices for upgrading roads to bituminous standards between 2008 and 2018. This Table shows a tender price increment of 900.52% over the ten years under review. The data confirms a positive trend line or a steady increase in construction tender prices in the period (2008-2021). Moreover, the analysis shows a positive correlation between construction tender prices to foreign exchange rates (0.84), commercial interest rates (0.54), and external debt stock (0.88). Also, refer to Figure 7.2: Conceptual framework - moderating and independent variables of the conceptual framework. However, there is a negative correlation between construction tender prices and foreign direct investment of -0.39. At the same time, the analysis shows a lack of correlation between construction tender prices and an inflation rate of -0.18.

**Table 9.8** Correlations between macroeconomic indicators and tender prices for upgrading of roads to bituminous standards

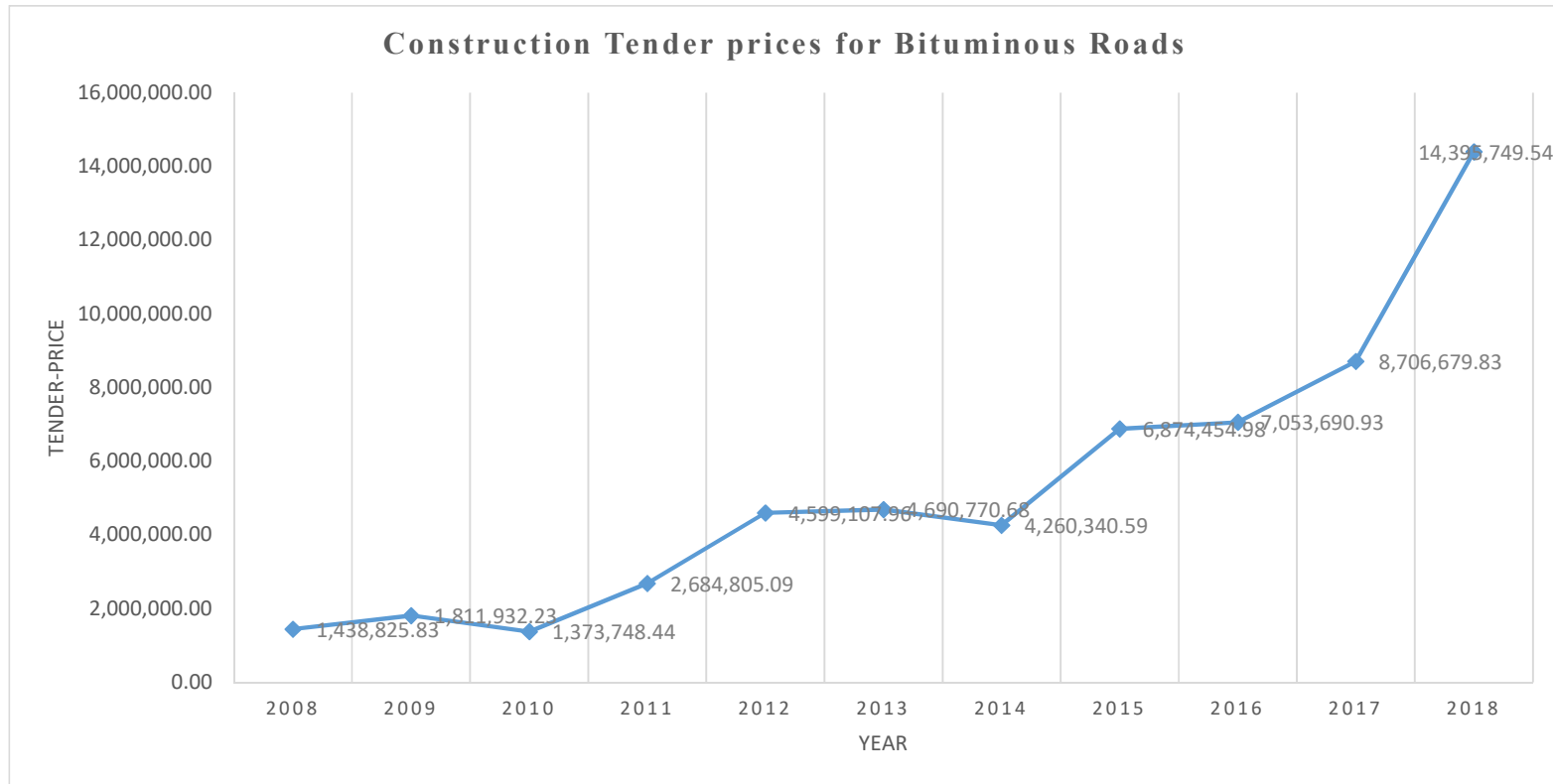
Correlations		Tender price (K'million/km)	Forex rates	Inflation rates	Interest rates	FDI (US \$'Bn)	External Debt (US \$'Bn)
Tender price (K'million/km)	Pearson Correlation	1	0.844**	-0.183	0.538	-0.391	0.876**
	Sig. (2-tailed)		0.001	0.590	0.088	0.234	0.000
	N	11	11	11	11	11	11
Forex rates	Pearson Correlation	0.844**	1	0.136	0.749**	-0.491	0.918**
	Sig. (2-tailed)	0.001		0.691	0.008	0.125	0.000
	N	11	11	11	11	11	11
Inflation rates	Pearson Correlation	-0.183	0.136	1	0.449	-0.531	0.024
	Sig. (2-tailed)	0.590	0.691		0.165	0.093	0.944
	N	11	11	11	11	11	11
Interest rates	Pearson Correlation	0.538	0.749**	0.449	1	-0.651*	0.779**
	Sig. (2-tailed)	0.088	0.008	0.165		0.030	0.005
	N	11	11	11	11	11	11
FDI (US \$'Bn)	Pearson Correlation	-0.391	-0.491	-0.531	-0.651*	1	-0.462
	Sig. (2-tailed)	0.234	0.125	0.093	0.030		0.153
	N	11	11	11	11	11	11
External Debt (US \$'Bn)	Pearson Correlation	0.876**	0.918**	0.024	0.779**	-0.462	1
	Sig. (2-tailed)	0.000	0.000	0.944	0.005	0.153	
	N	11	11	11	11	11	11

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

(Source: by the author)

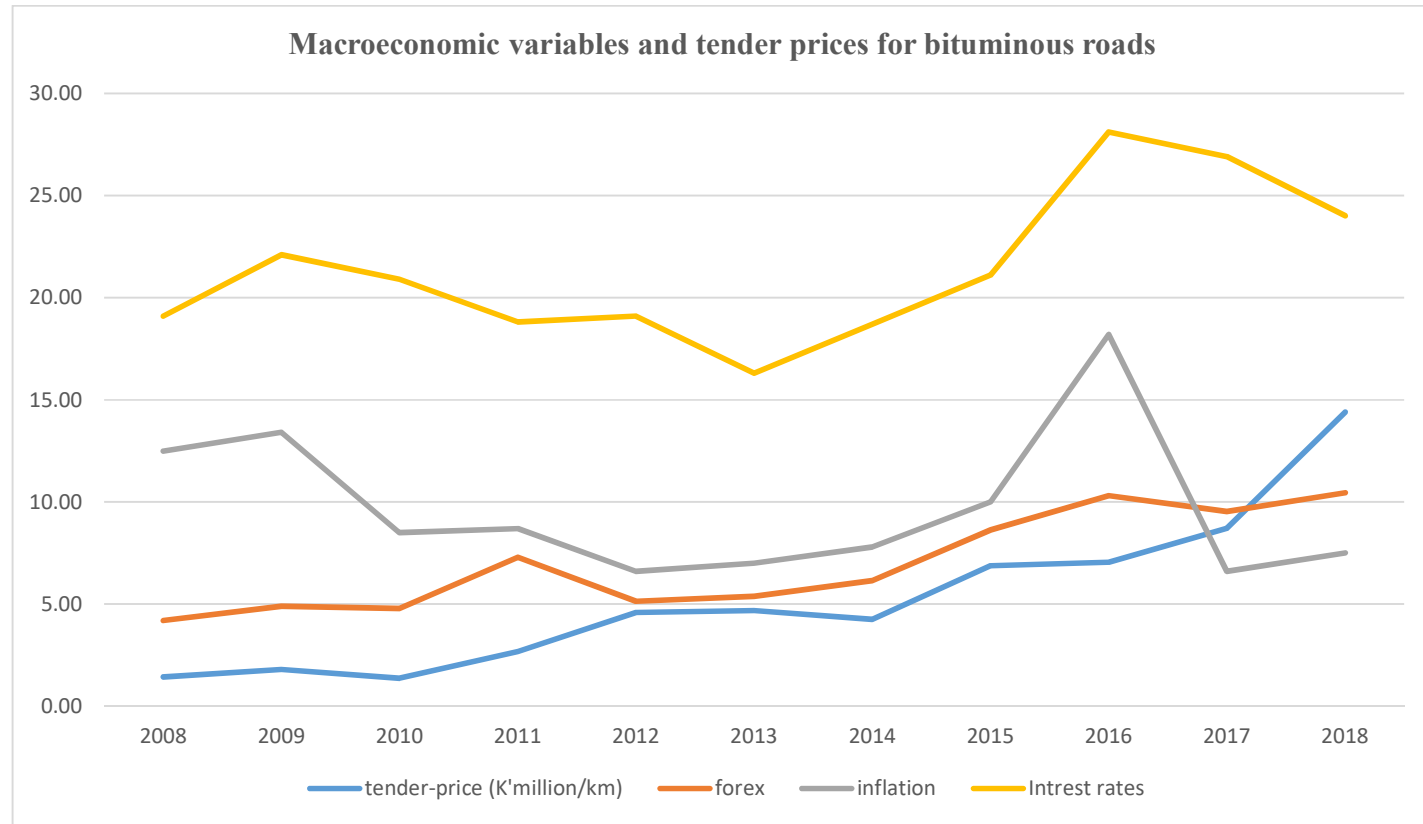
In Table 9.8, the diagonal consists of correlations of each variable with itself that always result in a value of 1.00. Values on each side replicate those on the opposite side of the diagonal. Table 9.8 show a positive correlation between construction tender prices and forex, interest rates, and external debt. For example, the positive correlation coefficient between construction tender price and forex (0.844) indicates a statistically significant ( $p \leq 0.001$ ) linear relationship between these two variables, such that the higher the forex rate, the higher the construction tender prices become. The other correlation coefficients (inflation rate = -0.183 and FDI = -0.391) indicate negative associations with construction tender prices, although these correlations are weak.



**Fig. 9.5:** Average construction tender prices for upgrading roads to bituminous standards

(Source: by the author)

The figure shows that, for upgrading roads to bituminous standards, construction tender prices increased from an average of K1,438,825.83/km in 2008 to an average of K14,395,749.54/km in 2018



**Fig. 9.6:** Correlation between macroeconomic indicators and tender prices for upgrading of roads to bituminous standards  
(Source: by the author)

**Table 9.9** Macroeconomic indicators and tender prices for periodic maintenance of feeder roads

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Averages	Coefficient ( r ) Pearson's	Comments
<b>Tender price (ZMW'million/km)</b>	0.1628	0.6901	0.4660	0.5875	0.8784	1.4324	1.4054	1.2064	1.5556	1.6238	1.00	-	-
<b>Forex rates</b>	80	15	11	52	97	48	98	81	81	99	10.69	<b>0.80</b>	strongly positive
<b>Inflation rates</b>	5.14	5.39	6.15	8.63	10.31	9.54	10.45	12.91	18.28	20.05	10.69	<b>0.26</b>	weakly positive
<b>Interest rates</b>	6.6	7	7.8	10	18.2	6.6	7.5	9.1	15.7	22.1	11.06	<b>0.75</b>	moderately positive
<b>FDI (US \$'Bn)</b>	19.1	16.3	18.7	21.1	28.1	26.9	24	25.6	26.8	25.7	23.2	<b>-0.80</b>	strongly negative
<b>External Debt (US \$'Bn)</b>	1.73	2.1	1.51	1.58	0.66	1.11	0.41	0.55	-0.17	0.19	1.0	<b>0.90</b>	strongly positive
<b>%Change in Interest rates</b>	0.92	2.13	5.02	8.08	9.21	12	12.1	15.05	16.45	17.7	9.9	-	-
<b>%Change in Forex</b>	0	-14.7	14.7	12.8	33.2	-4.3	-10.8	6.7	4.7	-4.1	<b>+4.3%</b>	-	-
<b>%Change in inflation</b>	0	4.9	14.1	40.3	19.5	-7.5	9.5	23.5	41.6	9.7	<b>+17.3%</b>	-	-
<b>%Change FDI</b>	0	6.1	11.4	28.2	82.0	-63.7	13.6	21.3	72.5	40.8	<b>+23.6%</b>	-	-
<b>%Change in Debt</b>	0	21.4	-28.1	4.6	-58.2	68.2	-63.1	34.1	-130.9	-211.8	<b>-40.4%</b>	-	-
<b>%Change in TP</b>	0	131.5	135.7	61.0	14.0	35.2	-2.8	24.4	9.3	7.6	<b>+46.2%</b>	-	-
	0	323.69	-32.47	26.08	49.52	63.06	-1.88	-14.16	28.94	4.39	<b>+49.7%</b>	-	-

(Source: by the author)

The analysis in the Table indicates an average percentage increment per annum of 49.7% of construction tender prices for periodic maintenance of roads between 2012 and 2021. This Table shows a tender price increment of 899% over the ten years under review. The data confirms a positive trend line or a steady increase in construction tender prices in the period (2012-2021). Moreover, analysis shows a positive correlation of construction tender prices to foreign exchange rates (0.80), inflation rates (0.26), commercial interest rates (0.75), and external debt stock (0.90). Also, refer to Figure 7.2: Conceptual framework - moderating and independent variables of the conceptual framework. However, there is a negative correlation between construction tender prices and foreign direct investment of -0.80.

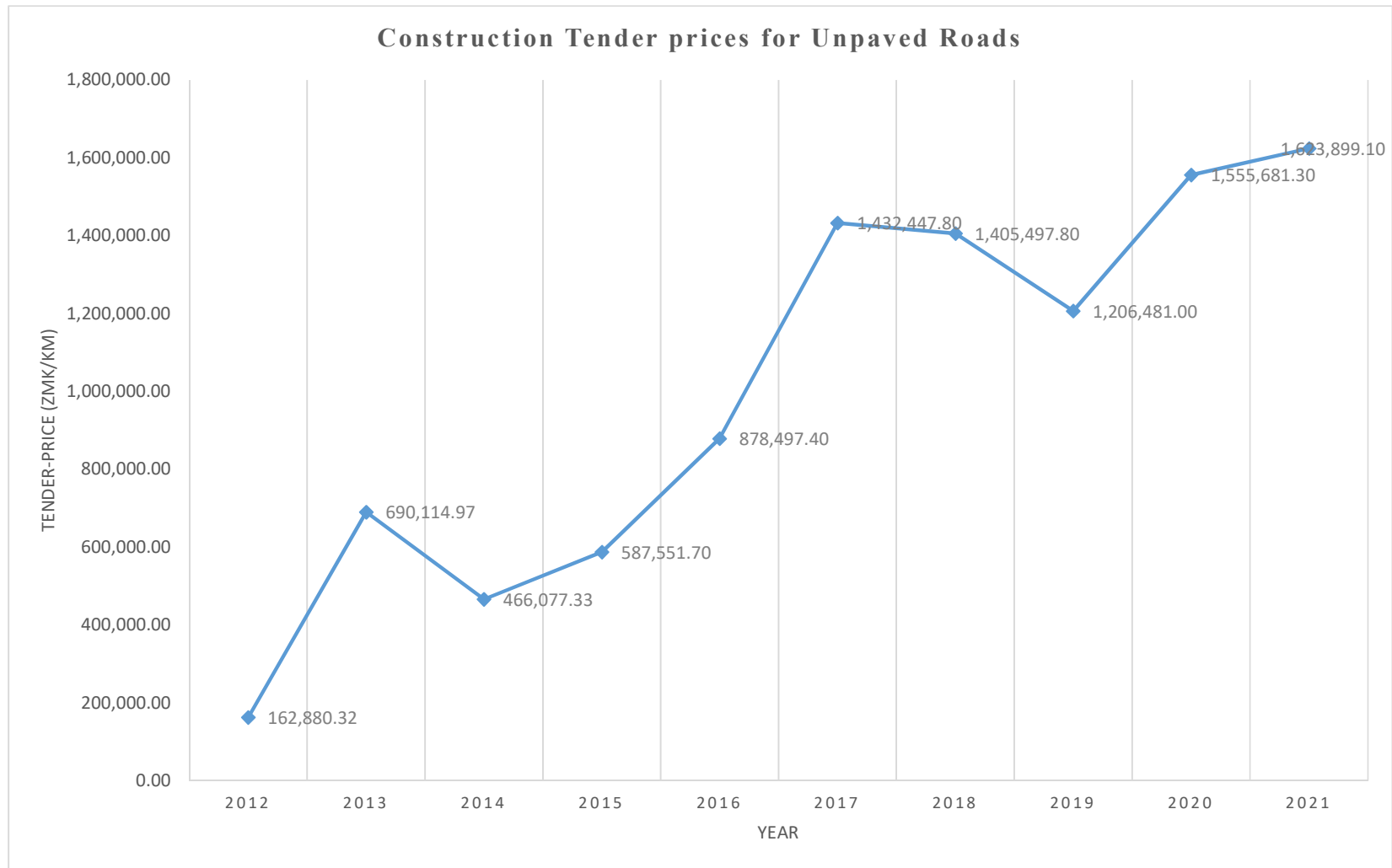
**Table 9.10** Correlation between macroeconomic indicators and tender prices for periodic maintenance of feeder roads

Correlations		Tender price (K'million/km)	Forex rates	Inflation rates	Interest rates	External Debt (US \$'Bn)	FDI (US \$'Bn)
Tender price (K'million/km)	Pearson Correlation	1	0.829**	0.467	0.750*	0.922**	-0.831**
	Sig. (2-tailed)		0.003	0.173	0.012	0.000	0.003
	N	10	10	10	10	10	10
Forex rates	Pearson Correlation	0.829**	1	0.783**	0.707*	0.917**	-0.892**
	Sig. (2-tailed)	0.003		0.007	0.022	0.000	0.001
	N	10	10	10	10	10	10
Inflation rates	Pearson Correlation	0.467	0.783**	1	0.574	0.584	-0.649*
	Sig. (2-tailed)	0.173	0.007		0.082	0.076	0.042
	N	10	10	10	10	10	10
Interest rates	Pearson Correlation	0.750*	0.707*	0.574	1	0.825**	-0.835**
	Sig. (2-tailed)	0.012	0.022	0.082		0.003	0.003
	N	10	10	10	10	10	10
External Debt (US \$'Bn)	Pearson Correlation	0.922**	0.917**	0.584	0.825**	1	-0.904**
	Sig. (2-tailed)	0.000	0.000	0.076	0.003		0.000
	N	10	10	10	10	10	10
FDI (US \$'Bn)	Pearson Correlation	-0.831**	-0.892**	-0.649*	-0.835**	-0.904**	1
	Sig. (2-tailed)	0.003	0.001	0.042	0.003	0.000	
	N	10	10	10	10	10	10

\*\* . Correlation is significant at the 0.01 level (2-tailed).

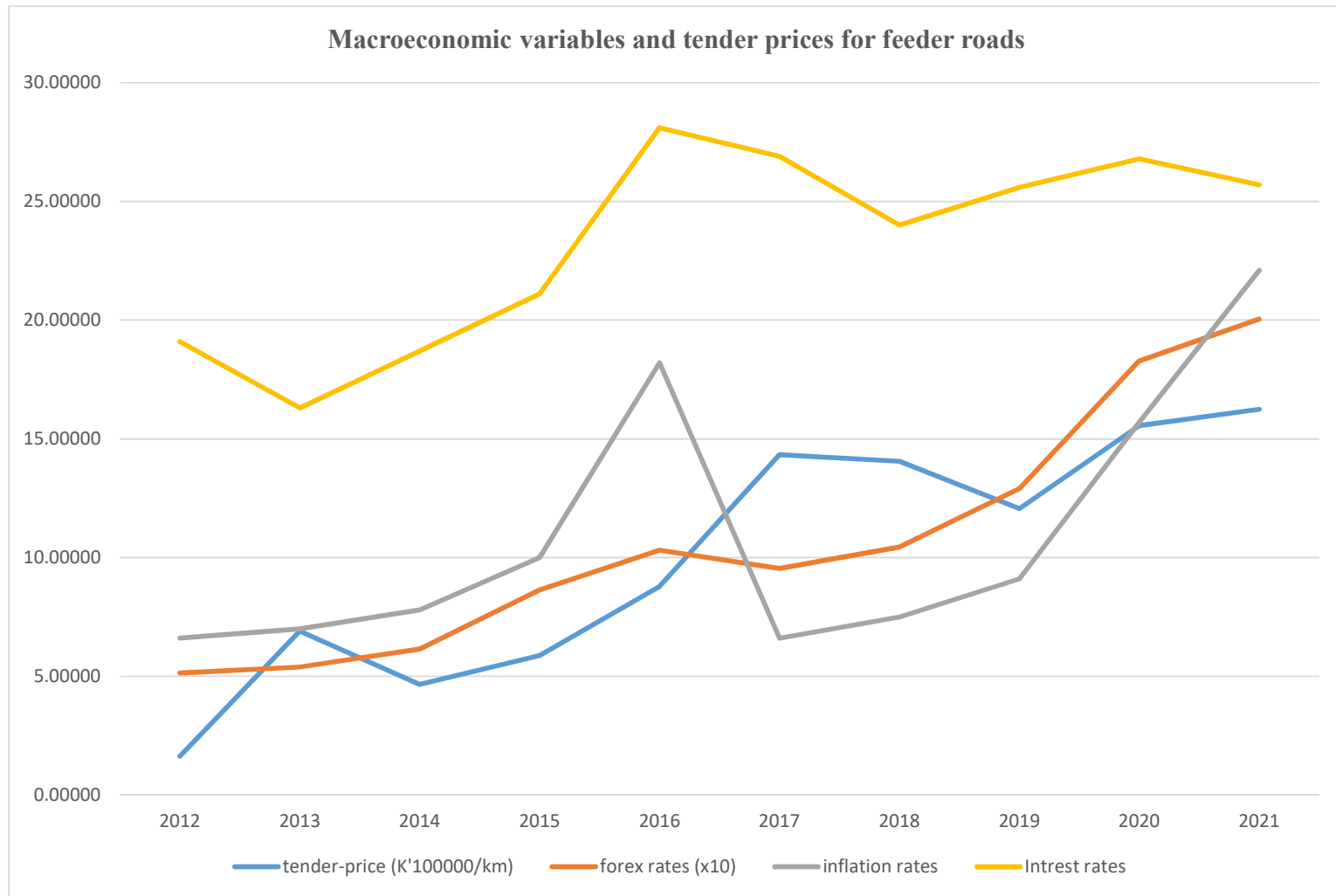
\* . Correlation is significant at the 0.05 level (2-tailed).

In Table 9.10, the diagonal consists of correlations of each variable with itself that always result in a value of 1.00. Values on each side replicate those on the opposite side of the diagonal. Table 9.10 show a positive correlation between construction tender prices and forex, interest rates, and external debt—for example, the positive correlation coefficient between construction tender price and Govt. Debt (0.922) indicates a statistically significant ( $p < 0.001$ ) linear relationship between these two variables such that the higher the Govt. Debt is the more elevated the construction tender prices become. The other correlation coefficients (FDI = -0.831) indicate negative associations with construction tender prices, although these correlations are weak.



**Fig. 9.7:** Average construction tender prices for periodic maintenance of feeder roads  
(Source: by the author)

The Figures show that, for periodic maintenance of feeder roads, tender prices increased from an average construction tender price of K162,880.3/km in 2012 to an average of K1,623,899.1/km in 2021.



**Fig. 9.8:** Correlation between macroeconomic indicators and tender prices for periodic maintenance of feeder roads  
(Source: by the author)

**Table 10.2 Participants for research interviews**

S/N	Description	Participant ID	Age	Academic qualification/Highest level of education	Experience (years of practice)	Position in company/firm	Area of Practice/Expertise	Recommended by
<b>Purposive sample participants</b>								
1	Purposive Participant 1	PS1	47	Bachelor of Engineering (Civil & Environmental Engineering)	22	Owner/Managing Director	Civil engineering consultant	Researcher
2	Purposive Participant 2	PS2	40	MSc Project Management	18	Owner/Managing Director	Contractor	Researcher
3	Purposive Participant 3	PS3	65	MSc (Construction Management & Economics)	40	Owner/Managing Director	Quantity surveying & Construction management	Researcher
4	Purposive Participant 4	PS4	52	Bachelor of Engineering (Civil & Environmental Engineering)	27	Principal Engineer/Public sector projects implementation	Civil Servant/Public Infrastructure-Based Institution	Researcher
5	Purposive Participant 5	PS5	42	<ul style="list-style-type: none"> <li>• MSc Business Management</li> <li>• Bachelor of Engineering (Civil Engineering)</li> </ul>	17	Owner/Managing Director	Contractor	Researcher
6	Purposive Participant 6	PS6	39	<ul style="list-style-type: none"> <li>• MEng Construction Management</li> <li>• BSc Architecture</li> </ul>	15	Owner/Managing Director	Architectural consultant	Researcher
7	Purposive Participant 7	PS7	51	<ul style="list-style-type: none"> <li>• MSc Project Management</li> <li>• BSc Building Science</li> </ul>	25	Owner/Managing Director	Quantity surveying consultant	Researcher
8	Purposive Participant 8	PS8	63	<ul style="list-style-type: none"> <li>• MSc Architecture</li> <li>• PGDip. Project management and Building Law</li> <li>• BSc Architecture</li> </ul>	30	Owner/Managing Director	Architectural consultant	Researcher

S/N	Description	Participant ID	Age	Academic qualification/Highest level of education	Experience (years of practice)	Position in company/firm	Area of Practice/Expertise	Recommended by
9	Purposive Participant 9	PS9	49	<ul style="list-style-type: none"> <li>• MSc Logistics &amp; supply chain management</li> <li>• BSc Procurement management</li> <li>• Dip. Chartered Institute of Purchasing &amp; Supply</li> </ul>	22	Head of procurement	Civil Servant/Public Infrastructure-Based Institution	Researcher
<b>Snowball sample participants</b>								
10	Snowballing Participant 1	SS1	50	<ul style="list-style-type: none"> <li>• Ph.D. (Transportation Economics)</li> <li>• MEng Civil (Pavement &amp; Transportation)</li> <li>• BEng Civil &amp; Environmental Engineering</li> </ul>	24	Director/Public sector projects financing	Public project financing	Purposive Participant 1
11	Snowballing Participant 2	SS2	56	<ul style="list-style-type: none"> <li>• MEng Civil (Pavement Design)</li> <li>• BEng Civil &amp; Environmental Engineering</li> </ul>	30	Consultant/Public sector projects implementation	Civil engineering consultant	Snowballing Participant 1
12	Snowballing Participant 3	SS3	49	<ul style="list-style-type: none"> <li>• MEng Construction Management</li> <li>• BEng Civil &amp; Environmental Engineering</li> </ul>	25	Consultant/Public sector projects implementation	Civil engineering consultant	Snowballing Participant 2
13	Snowballing Participant 4	SS4	49	<ul style="list-style-type: none"> <li>• MEng Project Management</li> <li>• BEng Civil &amp; Environmental Engineering</li> </ul>	22	Owner/Managing Director	Contractor	Snowballing Participant 3

S/N	Description	Participant ID	Age	Academic qualification/Highest level of education	Experience (years of practice)	Position in company/firm	Area of Practice/Expertise	Recommended by
14	Snowballing Participant 5	SS5	60	<ul style="list-style-type: none"> <li>MSc Construction Management</li> <li>BSc Quantity Surveying</li> </ul>	35	Owner/Managing Director	Quantity surveying consultant	Purposive Participant 7

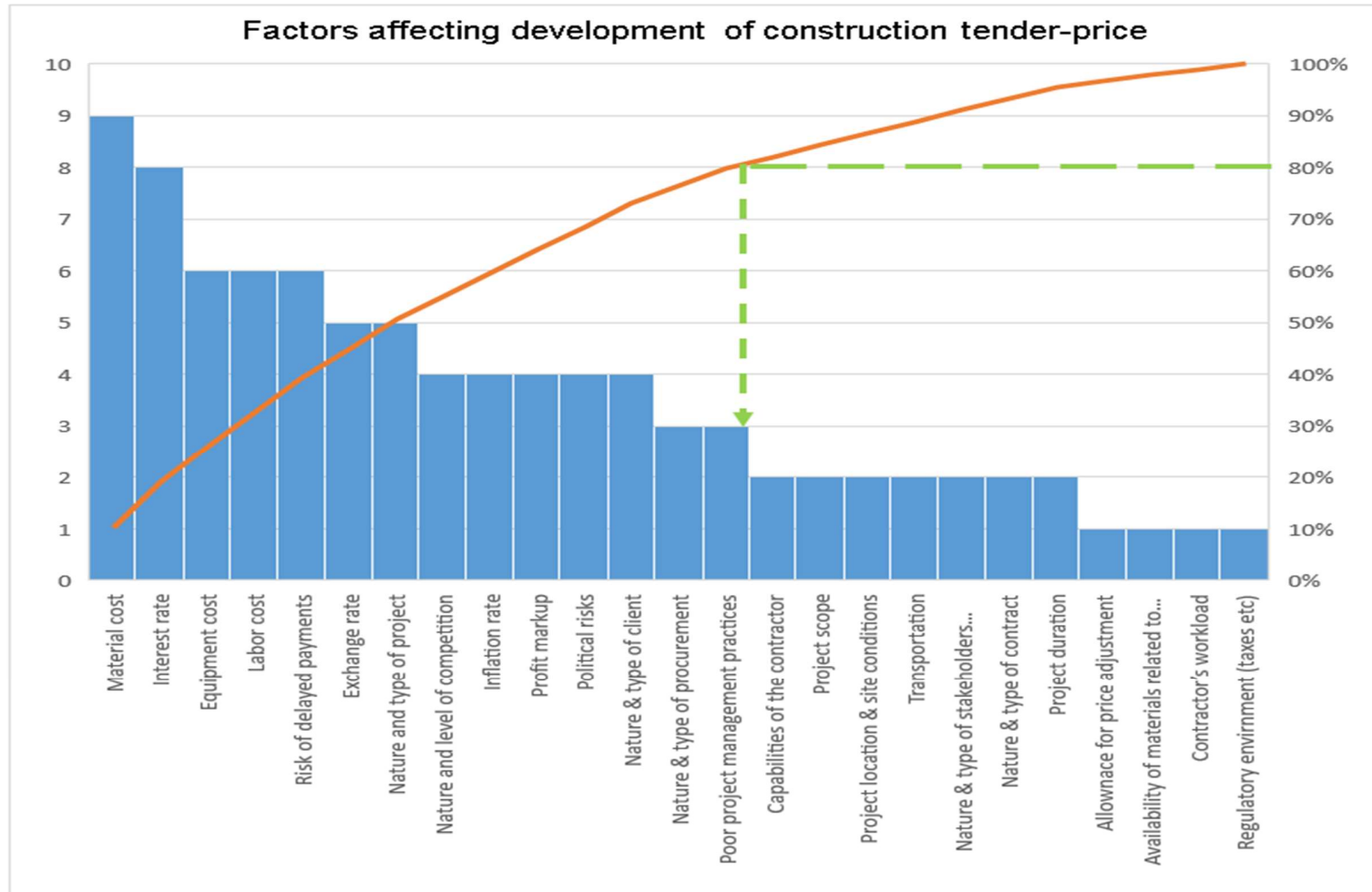
**Table 10.3 Measurement indicator variables for construction tender price**

Participant ID	Construct: significance of construction tender price	Measurement variables: Themes				
		A measure of project value	Strength of demand	Indicator of competition	Basis for award	Determinant of project success
PS1	The significance of tender price is in control. First, it is a basis for the comparison of tenders.				✓	
SS1	Tender price is paramount in projects because it gives a fair estimate of what governs the budget for your project to be successful. It forms a basis of cash flow approach projections that ensure the healthy delivery of a project.	✓				✓
PS2	The tender price is critical to business operations because these undertakings aim to generate revenue and profit. So logically, the tender prices highly affect a contractor's existence and financial wealth. It also sometimes involves the methodologies of implementing projects.	✓	✓	✓		✓
PS3	The tender price reflects the understanding and assumptions of the bidder.	✓				✓
PS4	The tender price guides the project in terms of managing the finances. Moreover, before contracting, it indicates how pricing affects the budget provided. In addition, it gives the estimated cost of the works to guide more or so in the	✓				✓

Participant ID	Construct: significance of construction tender price	Measurement variables: Themes				
		A measure of project value	Strength of demand	Indicator of competition	Basis for award	Determinant of project success
	project's budgeting framework and financial management.					
SS2	Tender prices are significant on a project as they determine the quality and what sort of intervention you will get. The price is essential because it will decide in the end whether you get a good quality job, and it will, to some extent, signify what sort of quality a contractor you get.	✓	✓		✓	✓
PS5	Tender price in construction projects determines many factors like quality, the scope of works, etc., which constitutes the price at which the tender is given.	✓		✓	✓	
PS6	Tender pricing is critical to construction projects because it brings about value for money for a client and is a strategic way that construction companies use to grow by a build up their costs and profits from there, which ultimately helps in the growth of the construction sector at large.	✓	✓	✓		
SS3	The tender price of a construction project is what determines the success or failure of the project. The price reflects the proposal on how the contractor intends to undertake the work. Therefore, the price has to be reasonable enough for the contractor to undertake the project to fruition. In addition, they meet all their costs and even have a bit of markup. However, at the same time, it should be economical enough for the client to get value for money. The price must be sufficient for the client to get value for money.	✓	✓	✓	✓	✓

Participant ID	Construct: significance of construction tender price	Measurement variables: Themes				
		A measure of project value	Strength of demand	Indicator of competition	Basis for award	Determinant of project success
PS7	The tender price is crucial because you can appreciate a cross-sectional representation of value for money.	✓				
SS4	The tender price is for contractors to maximize their profit based on the available opportunities and competition. In summary, the significance of the tender price is just for the profit of the contractors or the people doing the business.	✓	✓	✓		
PS8	The tender price is essential because it forms a basis for negotiating the contract sum.				✓	
SS5	It is a basis for measuring value for money and the financial evaluation of a bidder.	✓			✓	
PS9	The tender price is a benchmark used to arrive at a responsive bidder.	✓		✓	✓	✓

(Source: by the author)



**Fig. 10.1:** Factors affecting the development of construction tender price  
(Source: by the author)

**Table 10.5 Significance of construction tender price and factors affecting the development of a construction tender price**

<b>Participant ID</b>	<b>Significance of construction tender price</b>	<b>Factors affecting the development of a construction tender price</b>
PS1	<ul style="list-style-type: none"> <li>• Basis of comparison between tenderers</li> <li>• Presents a reasonable estimate of project cost for the client</li> </ul>	<ol style="list-style-type: none"> <li>1. Nature and level of competition</li> <li>2. The capability of the contractor</li> <li>3. Market rates</li> <li>4. Equipment cost</li> <li>5. Materials cost</li> <li>6. Labor costs</li> <li>7. Profit markup</li> <li>8. Possibility for price adjustment</li> <li>9. Delays in payments</li> </ol>
SS1	<ul style="list-style-type: none"> <li>• Guides cash flow projections</li> <li>• Gives a fair estimate of the project budget</li> </ul>	<ol style="list-style-type: none"> <li>1. Market forces</li> <li>2. Macroeconomic fundamentals (interest rates, exchange rates, etc.)</li> <li>3. Market prices for commodities</li> <li>4. Baseline consumer price index</li> <li>5. Cost of materials</li> <li>6. Nature and type of client</li> <li>7. Nature of project risks</li> <li>8. Nature and type of competition</li> <li>9. Government interventions (political pronouncements)</li> </ol>
PS2	<ul style="list-style-type: none"> <li>• Critical to contractors' business operations</li> <li>• Impact existence and financial wealth of contractors</li> </ul>	<ol style="list-style-type: none"> <li>1. Project costs</li> <li>2. Complexity of works</li> <li>3. Nature and type of project</li> </ol>
PS3	<ul style="list-style-type: none"> <li>• Demonstrates understanding of the project by a bidder</li> <li>• Reveals competition level</li> </ul>	<ol style="list-style-type: none"> <li>1. Availability of materials related to the project</li> <li>2. Contractor's workload</li> <li>3. Level and nature of competition</li> <li>4. Allowance for price fluctuations</li> <li>5. The anticipated rise in prices of project-related commodities</li> <li>6. Inflation</li> <li>7. Exchange rates</li> <li>8. Price inflation of materials</li> </ol>
PS4	<ul style="list-style-type: none"> <li>• Guides management of project finances</li> <li>• Basis of determination of budget performance</li> </ul>	<ol style="list-style-type: none"> <li>1. Lengthy procurement processes</li> <li>2. Unstable macroeconomic indicators</li> <li>3. prices of materials</li> <li>4. delayed or nonpayment</li> </ol>
SS2	<ul style="list-style-type: none"> <li>• Determines quality and intervention of the project</li> </ul>	<ol style="list-style-type: none"> <li>1. Project risks</li> </ol>

<b>Participant ID</b>	<b>Significance of construction tender price</b>	<b>Factors affecting the development of a construction tender price</b>
	<ul style="list-style-type: none"> <li>Signifies the quality of the contractor</li> </ul>	<ol style="list-style-type: none"> <li>Project scope</li> <li>Flow of payments</li> <li>Cost and sourcing of material</li> <li>Cost of equipment</li> <li>Cost of labor</li> <li>Interest rates</li> <li>Political environment</li> <li>Acceptability of corporate and infrastructure governance</li> </ol>
PS5	<ul style="list-style-type: none"> <li>Determines the quality of works</li> <li>Determines scope of works</li> <li>Determines macroeconomic-factors consideration</li> </ul>	<ol style="list-style-type: none"> <li>Quality</li> <li>Scope of works</li> <li>Inflation rate</li> <li>Exchange rate</li> <li>imports</li> <li>Project duration</li> <li>The complexity of the project</li> <li>Distance from major supply cities</li> <li>Infrastructure leading to the project site</li> <li>Location of the project</li> </ol>
PS6	<ul style="list-style-type: none"> <li>Basis of measurement of value for money</li> <li>Strategy for contractor's growth</li> <li>Determines growth of the construction sector</li> </ul>	<ol style="list-style-type: none"> <li>Competition</li> <li>Cost of materials</li> <li>Transportation</li> <li>Profit markup</li> <li>Inflation rate</li> <li>Exchange rate</li> <li>Management costs</li> <li>Equipment type</li> <li>Specialties in terms of personnel</li> <li>Site conditions</li> <li>Nature and type of client</li> <li>Political risks</li> <li>Stakeholder requirements</li> <li>Nature of project risks</li> </ol>
SS3	<ul style="list-style-type: none"> <li>Determines the success or failure of a project</li> <li>Reflects the work methodology</li> <li>Chooses to understand the contractor</li> <li>Basis of measurement of value for money</li> </ul>	<ol style="list-style-type: none"> <li>Cost of material inputs</li> <li>Regulatory environment (taxes)</li> <li>Statutory obligations</li> <li>Cost of financing and borrowing</li> <li>Risk of delayed payments</li> <li>Poor project management practices</li> </ol>

<b>Participant ID</b>	<b>Significance of construction tender price</b>	<b>Factors affecting the development of a construction tender price</b>
PS7	<ul style="list-style-type: none"> <li>• Illustrates orientation of market forces</li> </ul>	<ol style="list-style-type: none"> <li>12. Nature and type of procurement</li> <li>13. Competition</li> <li>14. Availability of information</li> <li>15. Materials</li> <li>16. Transportation</li> <li>17. Labor cost</li> <li>18. Equipment</li> <li>19. Nature of client</li> <li>20. Flow of payments</li> <li>21. Interest rates</li> <li>22. Corruption</li> </ol>
SS4	<ul style="list-style-type: none"> <li>• Suggests the amount of profit for the contractor</li> </ul>	<ol style="list-style-type: none"> <li>1. Profit margin</li> <li>2. Cost of inputs</li> <li>3. Cost of borrowing</li> <li>4. Delayed payments</li> </ol>
PS8	<ul style="list-style-type: none"> <li>• The basis for contract negotiations</li> </ul>	<ol style="list-style-type: none"> <li>1. Availability of opportunities</li> <li>2. Materials costs</li> <li>3. Wages</li> <li>4. Site conditions</li> <li>5. Project location</li> <li>6. Transport cost</li> <li>7. Supply chain management</li> <li>8. Equipment cost</li> </ol>
SS5	<ul style="list-style-type: none"> <li>• The basis for the award of the contract</li> </ul>	<ol style="list-style-type: none"> <li>1. Nature &amp; type of contract</li> <li>2. Profit distribution (front-loading)</li> <li>3. Profit margin</li> <li>4. Project duration</li> <li>5. Nature &amp; type of procurement</li> </ol>
PS9	<ul style="list-style-type: none"> <li>• The basis for the award of the contract</li> </ul>	<ol style="list-style-type: none"> <li>6. Anticipation of delayed payments</li> </ol>

(Source: by the author)

<b>Impact on government</b>	<b>Impact on contractors</b>	<b>Impact on projects</b>	<b>Impact on industry</b>
<ul style="list-style-type: none"> <li>• Reduced number of projects</li> <li>• Reduced value for money</li> <li>• Compromise on quality</li> <li>• Slow delivery of infrastructure development</li> <li>• Increased cost of construction</li> <li>• Failure to meet contractual obligations regarding payments</li> <li>• Unaffordable tenders</li> <li>• Poor infrastructure governance</li> <li>• Reduced purchasing power</li> <li>• Expensive projects</li> <li>• Negatively affects government spending and budgeting</li> </ul>	<ul style="list-style-type: none"> <li>• High profits</li> <li>• Less work</li> <li>• Adoption of project implementation methodology</li> <li>• Non-payments or delayed payments</li> <li>• High motivation</li> <li>• High productivity level</li> </ul>	<ul style="list-style-type: none"> <li>• Incomplete projects</li> <li>• Poor quality of works</li> <li>• Delayed completion</li> <li>• Political interference</li> <li>• Stalled projects</li> <li>• Unsustainable</li> <li>• Stiff competition</li> <li>• Reduced scope of works</li> </ul>	<ul style="list-style-type: none"> <li>• Shrinking of industry</li> <li>• Proliferation of foreign firms</li> <li>• Reduced progression of economic development</li> <li>• Higher bids</li> <li>• Reduced number of public projects</li> <li>• Artificial prices</li> <li>• Corruption</li> <li>• Manipulation of procurement processes</li> <li>• Reduced capacity of the industry</li> <li>• Loss of community goodwill</li> </ul>

**Fig. 10.2:** Impact of high construction tender price inflation  
(Source: by the author)

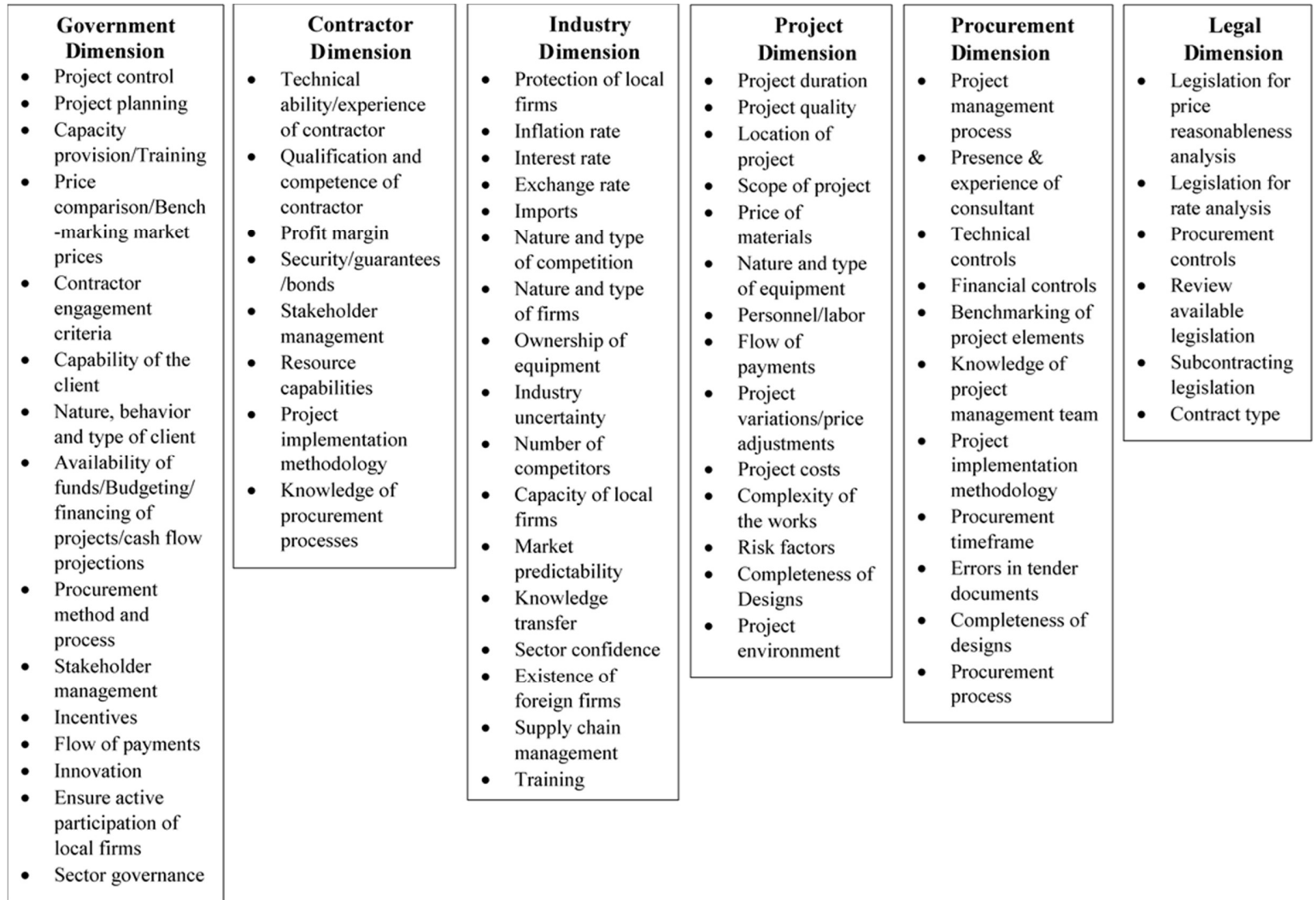
**Table 10.6 Impact of high construction tender price inflation**

<b>Participant ID</b>	<b>Interview quotes</b>	<b>Respondent's summary regarding impacts of high construction tender prices</b>
PS1	It is worrying, of course, being in the industry, you see this is going on. Nevertheless, something is very worrying, so we could do something about it to try to stop it somehow.	<ol style="list-style-type: none"><li>1. Unpredictable business environment</li><li>2. Reduced number of projects</li><li>3. Expensive projects</li><li>4. Reduced value for money</li><li>5. Compromise on quality of works</li></ol>
SS1	It is painful if you are a client because you can do fewer projects than you intended when developing your plans. It is unfortunate when you sit as a client because we are in a hurry to deliver infrastructure development.	<ol style="list-style-type: none"><li>1. Fewer projects than intended</li><li>2. Negatively affects the progression of economic development</li><li>3. Slow delivery of infrastructure development</li></ol>
PS2	It is double-sided; on one side, initially, it will look like it is a good thing because the prices are going up, giving room to generate more revenue. As prices rise on the other end, they become unsustainable and negatively affect the country's overall economic growth.	<ol style="list-style-type: none"><li>1. Adoption of project implementation methodology</li><li>2. It affects the duration of the project</li></ol>
PS3	They are simply a response to rampant inflation.	<ol style="list-style-type: none"><li>1. Negatives effects on the national economy</li><li>2. Higher bids prices</li><li>3. The increased cost of construction</li></ol>
PS4	The soaring prices make the government fail to achieve most of its infrastructure programs because the inadequate budget provisions. Therefore, I think it is working against the government's will to provide infrastructure for the country	<ol style="list-style-type: none"><li>1. Negatively affects the management of contracts</li><li>2. Negatively affects the quality of works</li><li>3. Affects completion period</li><li>4. Causing government failure to achieve their infrastructure programs</li><li>5. Outstripping budget provisions</li></ol>
SS2	The increased prices in the construction sector are unfortunate. Nevertheless, I think many factors contribute to that.	<ol style="list-style-type: none"><li>1. Difficulty in managing cash flows</li><li>2. Increases risk of delayed and non-payments</li><li>3. Unaffordable bids</li><li>4. Increases national debt burden</li></ol>

<b>Participant ID</b>	<b>Interview quotes</b>	<b>Respondent's summary regarding impacts of high construction tender prices</b>
		5. It leads to general poor governance in the infrastructure sector
PS5	Inflation in the country has a significant role in prices in Zambia. We are importing most of the materials we use in the construction sector, so importing has many inflationary problems.	<ol style="list-style-type: none"> <li>1. Reduces the buying power of the client</li> <li>2. Reduced number of projects</li> <li>3. Reduced fiscal space for the client</li> <li>4. Incomplete projects</li> <li>5. Expensive projects</li> </ol>
PS6	The rising prices affect the sector because it is challenging to see real growth despite huge expenses.	<ol style="list-style-type: none"> <li>1. The leading cause of unsustainable construction practices</li> <li>2. Stiff competition</li> <li>3. Increased number of players</li> <li>4. Artificial level of prices</li> <li>5. Corruption</li> <li>6. Pilferage of information between bidders and the client</li> <li>7. Stage-managed procurement practices</li> <li>8. Encourages imbalanced pricing models</li> </ol>
SS3	Zambia is probably in the higher 25% tier regarding high prices in the construction sector.	<ol style="list-style-type: none"> <li>1. Emboldens poor project management practices</li> <li>2. Outstripping government budget</li> <li>3. Limits government expenditure and output</li> <li>4. It affects the delivery of development</li> <li>5. Translates into a lack of development</li> </ol>
PS7	The high prices are due to the failure to utilize professionals when pricing most public projects.	<ol style="list-style-type: none"> <li>1. Breeds grounds for disputes</li> <li>2. Reduced number of projects leading to fewer players in the industry</li> <li>3. Creates a negative ripple effect on employment creation and wealth creation for the nation</li> </ol>

<b>Participant ID</b>	<b>Interview quotes</b>	<b>Respondent's summary regarding impacts of high construction tender prices</b>
SS4	It affects everyone because what happens is that even competitive prices have to be capped to a level where the financiers, and the government, are comfortable for the business to continue. Therefore, if everyone overprices and the government starts to feel that they are not getting the best out of the sector, it loses the morale to keep financing the project. Even the communities do not appreciate the contractors because they think they are ripping off the government of taxpayers' money. High contracting prices are uncomfortable for the government and communities or the citizens.	<ol style="list-style-type: none"> <li>1. High motivation for contractors</li> <li>2. High productivity level</li> <li>3. The government reduced the morale to undertaking projects</li> <li>4. Loss of community goodwill due to the perception that contractors rip off the government of value for money</li> </ol>
PS8	Some professionals check those that can point out at the beginning that the prices are above the market prices.	<ol style="list-style-type: none"> <li>1. It affects the scope of works</li> <li>2. Budget overruns</li> <li>3. Failure to complete other works</li> <li>4. Poor quality of work</li> <li>5. Failure to commence other works</li> </ol>
SS5	The client is the most negatively affected because they are paying for projects, and it is difficult for them to budget due to projection challenges.	<ol style="list-style-type: none"> <li>1. Expensive projects</li> <li>2. Budget overruns</li> <li>3. Loss of business by contractors</li> </ol>
PS9	The construction sector is costly due to poor time management, resources, and projects. The price must be equal to the product and not influenced by non-project-related factors.	<ol style="list-style-type: none"> <li>1. Stalled projects</li> <li>2. Negative social perceptions</li> <li>3. Incomplete projects</li> <li>4. Expensive projects</li> </ol>

(Source: by the author)



**Fig. 10.3:** Dimensions of construction tender price management  
(Source: by the author)

**Table 10.7 Construction tender price management dimensions**

<b>The critical price management aspect</b>	<b>Code</b>	<b>Explanation</b>
<b>1. Government Dimension</b>		
Project management practices	GD1	Establish project purpose, ensure timely project planning, and establish project control mechanism, management principles, roles, and tasks before commencing the procurement process. Establish consistent behavior towards contractors. Advocate on behalf of project implementation teams. Ensure understanding of project whole-life costs and development of cost reduction principles. Implement appropriate project management processes.
Strategic awareness	GD2	Establish an understanding of market appetite, capability, and capacity to make informed use of competition. Improve nature, behavior, and type of approaches to guarantee sustainable construction practice.
Continuous capability and capacity enhancement	GD3	Consider capacity provision through training programs for local contractors and adopting lean concepts and principles.
Benchmarking price & performance	GD4	Invest in information management to support and implement appropriate estimation models and processes. Apply appropriate industry comparators.
Client capabilities	GD5	Invest in the development of client organization capabilities. Understand the needs and prioritize accordingly. Translate requirements into clear, achievable, and functional technical requirements. Provide arrangements for clear project responsibility and accountability.
Payment flows	GD6	Objectively develop requirements and cost estimates for price reasonableness. Ensure availability of funds through adequate and informed budgeting. Ensure timely financing of projects and conformance to cash flow projections.
Procurement methods & Process	GD7	Employ competitive processes that result in desired outcomes.
Stakeholder management	GD8	Effectively bridge interface between stakeholders and organizations. Ensure project needs supersede individual stakeholder demands. Improve contractor engagement criteria and remove unnecessary political or management interference.
Incentives program	GD9	Apply appropriate measurements and targets for success—Incentivize performance within the construction supply chain.
Innovation system	GD10	Adapt and change behavior following prevailing circumstances.

<b>The critical price management aspect</b>	<b>Code</b>	<b>Explanation</b>
Active participation framework	GD11	Ensure active participation of local firms and provide precise competence requirements. Implement appropriate participation processes for guaranteeing local-firm bespoke suit.
Sector governance	GD12	Make timely decisions. Prioritize long-term benefits and efficiency over short-term political gains. Ensure acceptance of risk and rewards that deliver optimum outputs. Avoid the application of unnecessary standards. Improve risk and contingency management.
<b>2. Contractor Dimension</b>		
Technical ability	CD1	Develop expertise to perform construction project-related tasks efficiently and costly.
Qualification and competence of the contractor	CD2	Ensure delivery of complex projects on time by developing desired capacity and ability to perform—endeavor to employ competent and qualified personnel.
Profit margin	CD3	Endeavor to keep expenses low to generate efficient profit margins without worsening the clients' financial or economic results.
Stakeholder management	CD4	Maintain good relations with people and institutions with the most influence on the project while ensuring that project needs supersede individual stakeholder interests.
Resource capabilities	CD5	Develop a competitive advantage through a collection of resources and possessions. Utilize existing internal resources of the company to create strategies and develop the potential for creating a competitive advantage.
Project implementation methodology	CD6	Outline specific courses of action in a step-by-step process to implement construction initiatives that synchronize project execution. Develop a methodology that addresses the specific needs of a particular project.
Knowledge of procurement processes	CD7	Develop an understanding of the series of steps and activities involved in procurement.
<b>3. Industry Dimension</b>		
Protection of local firms	ID1	Understand the justifications for protecting local participation in the industry and developing protectionism policies.
Inflation rate	ID2	Understand the construction sector's nature and type of inflation and address its driver early.
Interest rate	ID3	Reduce the cost of borrowing. Reconcile interest rates with project cost before tendering.

<b>The critical price management aspect</b>	<b>Code</b>	<b>Explanation</b>
Exchange rate	ID4	Endeavor to minimize project duration. Develop forex-fluctuation prediction mechanisms.
Imports	ID5	Maintain the value of the local currency to guarantee the economic performance of a project and its stakeholders. Maximize utilization of local building materials.
Nature and type of competition	ID6	Encourage competitiveness of local firms.
Nature and type of firms	ID7	Develop strategies to improve the performance of local firms. Address local-firm-specific challenges and bottlenecks while encouraging joint ventures.
Ownership of equipment	ID8	Develop deliberate equipment ownership policy and equipment ownership systems.
Industry uncertainty	ID9	Develop strategies for positive stakeholder participation and ensure the timely availability of resources
Number of competitors	ID10	Improve the quality of specification and design.
The capacity of local firms	ID11	Address local-firm-specific challenges and bottlenecks while encouraging joint ventures and subcontracting strategies.
Market predictability	ID12	Disseminate information regarding market fundamentals to guarantee results and reduce the need to recreate the wheel at each tender.
Knowledge transfer	ID13	Harmonize knowledge from different participants and construction projects. Encourage sharing and reuse of acquired knowledge. Develop a deliberate mechanism of efficient knowledge transfer that discourages loss during a project lifecycle. Identify bottlenecks to knowledge transfer.
Sector confidence	ID14	Develop frameworks that sustain high economic growth levels. Identify and address factors leading to the sector's prolonged state of decline. Improve supply chain management, which builds long-term supplier alliances.
Existence of foreign firms	ID15	Develop a mechanism that encourages knowledge transfer and technical know-how. Develop strategies to prevent out-performance and out-competing of foreign firms.
Supply chain management	ID16	Develop informed decision-making. Develop models for detecting supply chain risks. Implement effective supply-chain management practices.
Training	ID17	Develop structured assessment tools to gauge the efficacy of contractors and the workforce. Encourage contractor-management training programs to increase competency and capacity among local contractors.

<b>The critical price management aspect</b>	<b>Code</b>	<b>Explanation</b>
<b>4. Project Dimension</b>		
Project duration	PD1	Prepare practical and realistic project schedules with a limited timeframe and minimum cost implication.
Project Quality	PD2	Reconcile design and purpose. Develop strategies against wastage of time and materials.
Location of project	PD3	Use project location and site characteristics to plan and budget adequately.
Scope of project	PD4	Develop practical project, scope-managed models. Ensure informed decision-making through project scope.
Price of materials	PD5	Encourage good communication regarding the progress of different projects and construction material management. Give special attention to material estimates and handling.
Nature and type of equipment	PD6	Pursue efficient utilization of equipment. Ensure utilization of advanced and contractor-owned equipment.
Personnel/Labor	PD7	Identify and document project roles and responsibilities. Develop plans that describe end-to-end processes for scheduling personnel.
Flow of payments	PD8	Ensure appropriate funding levels and develop drawdown facilities for predictable cash flows.
Project variations/price adjustments	PD9	Provide possibilities for price adjustment and clearly define necessitating circumstances.
Project costs	PD10	Ensure implementation of adequate cost controls and management practices.
The complexity of the works	PD11	Develop an efficient overall approach to the project that specifies the tools, equipment, resources, expertise, and implementation techniques.
Risk factors	PD12	Anticipate constraints before tendering the project.
Completeness of Designs	PD13	Develop a standardized system of scoring the entire behavior of a design.
Project environment	PD14	Anticipate and mitigate the risk of negative stakeholder involvement.
<b>5. Procurement Dimension</b>		
Project management process	MD1	Integrate principles and practices of sustainable construction. Understand and anticipate all technical and management outcomes.
Engineer's estimates	MD2	Encourage the utilization of good estimating models. Give special attention to price reasonableness and engineers' estimates

<b>The critical price management aspect</b>	<b>Code</b>	<b>Explanation</b>
Presence & experience of the consultant	MD3	Engage consultants to provide technical assistance, price assessments, and project evaluation services.
Technical & financial controls	MD4	Develop client project management assessments and project control tools.
Benchmarking of project elements	MD5	Measure data and compare results to other successful projects.
Knowledge of project management team	MD6	Engage qualified teams to be responsible for project execution and providing outlined deliverables.
Project implementation methodology	MD7	Develop a project management plan outlining exact courses of action and implementation initiatives.
Procurement timeframe	MD8	Identify and consolidate requirements, and determine the cost-effective timeframe
Errors in tender documents	MD9	Develop detection and correction mechanisms for dealing with contractors' mistakes in tender documents.
Completeness of designs	MD10	Develop a standardized system of scoring the entire behavior of a design.
<b>6. Legal Dimension</b>		
Legislation for Price reasonableness analysis	LD1	Provide regulations for determining the fairness of price considering the quality and all associated project delivery risks.
Legislation for rate analysis	LD2	Provide mathematical descriptions of how changes in the project-item-related factors result in a particular rate.
Procurement controls	LD3	Provide regulation for establishing a streamlined procurement structure, responsibility, and clear lines of authority.
Review available legislation	LD4	Continuously identify potential gaps, workarounds, and obstacles.
Subcontracting legislation	LD5	Provide a legal framework for subcontracting
Contract type	LD6	Provide domesticated contract forms that respond to prevailing circumstances.

(Source: by the author)

**Table 10.8 Description of the pricing structure of Zambia’s construction industry**

<b>Industry characteristic</b>	<b>Interview quote describing the nature of the industry</b>	<b>Code</b>	<b>Frequency</b>	<b>Percentage</b>	<b>The local contractor pricing approach</b>
1. Client characteristics	Fails to make timely payments	CC1	12	18	increase markup and frontload
	Embroided with political interference	CC3	7	11	increase markup
	Poor project management practices	CC2	12	18	increase markup
	General preference for foreign firms	CC8	4	6	artificially lower price
	Low appetite for infrastructure projects	CC4	7	11	increase markup
	Prone to contract breaches	CC7	5	8	increase markup
	No incentives for local contractors	CC6	6	9	increase markup
	Corruption prone	CC5	7	11	increase markup
	Lack of sector regulation mechanism	CC9	4	6	increase markup
	Public projects lack economic benefits	CC10	2	3	increase markup and frontload
<b>Total</b>			<b>66</b>	<b>100%</b>	
2. Characteristics of local firms	Lack government support	LF5	5	11	increase markup
	Heavily taxed	LF2	6	13	increase markup
	Ill-equipped to compete effectively	LF6	5	11	artificially lower price
	Poor development of cost estimates	LF4	4	9	increase markup or artificially lower price
	Lack appropriate capacity	LF3	6	13	artificially lower price
	Swamped by financial pressure	LF4	6	13	increase markup and frontload
	The proliferation of unqualified and non-technical players	LF7	4	9	increase markup

Industry characteristic	Interview quote describing the nature of the industry	Code	Frequency	Percentage	The local contractor pricing approach
3. Characteristics of foreign firms	Firms not growing to become competitive	LF8	4	9	increase markup and frontload
	Difficulties in accessing local financing	LF1	7	15	increase markup and frontload
	<b>Total</b>		<b>47</b>	<b>100%</b>	
	Foreign government owned	FF3	7	19	artificially lower price
	Receive foreign government assistance	FF1	10	28	artificially lower price
	Have huge capital outlays	FF2	9	25	artificially lower price
	Have tax and material rebates from their home country	FF5	4	11	artificially lower price
	Higher efficiency than local contractors	FF6	6	17	artificially lower price
	<b>Total</b>		<b>36</b>	<b>100%</b>	
	4. Characteristics of procurement processes	Lack of preferential systems for targeting local firms	PP2	7	16
Cannot detect collusion		PP8	3	7	increase markup and frontload
Lack of detection mechanism for a most economical price		PP1	8	18	increase markup
Not specialized in following construction principles		PP4	5	11	increase markup
Procurement provisions do not suit the local market		PP3	7	16	increase markup and frontload
Documents lack clarity & incomplete designs		PP5	5	11	increase markup
Lengthy procurement processes		PP7	4	9	increase markup
Not adequate for construction projects of complex technical nature		PP6	5	11	increase markup
<b>Total</b>		<b>44</b>	<b>100%</b>		

<b>Industry characteristic</b>	<b>Interview quote describing the nature of the industry</b>	<b>Code</b>	<b>Frequency</b>	<b>Percentage</b>	<b>The local contractor pricing approach</b>
5. Characteristics of construction projects	Heavily dependent on imports	CP8	4	7	increase markup
	Heavily affected by macroeconomic factors	CP1	11	19	increase markup
	Embroided with external pricing pressure	CP7	5	9	increase markup
	High cost of inputs	CP2	8	14	increase markup
	High-risk allocation	CP3	7	12	increase markup and frontload
	Lack of adequate and practical price control mechanisms	CP5	6	11	increase markup
	No basis for pricing	CP9	3	5	Increase markup
	Reducing/reduced the number of projects	CP6	6	11	increase markup
	Stalled projects	CP4	7	12	increase markup
<b>Total</b>			<b>57</b>	<b>100%</b>	

(Source: by the author)

**Table 10.9 Advantages and disadvantages of the emergence of foreign construction firms**

<b>1. Theme: Skills &amp; technology transfer</b>			
<b>Participant ID</b>	<b>Thematic construct</b>	<b>Advantage</b>	<b>Disadvantage</b>
PS1	Reserve specific jobs for local firms and ensure that foreign firms go into joint ventures every time they tender	<ul style="list-style-type: none"> <li>• Help build the capacity of local firms when competition is regulated</li> </ul>	<ul style="list-style-type: none"> <li>• Cause of unfair competition</li> </ul>
SS2	I think that global firms are supposed to complement local firms if competition is level	<ul style="list-style-type: none"> <li>• It would help complement the local firms and help transfer technology when well regulated</li> </ul>	<ul style="list-style-type: none"> <li>• They are state-owned enterprises with immense and unlimited resources</li> <li>• They can undercut prices and can absorb losses to make it uncompetitive to local firms</li> <li>• They have an unfair advantage because they can access cheap loans or money they can borrow from their countries.</li> </ul>
SS3	It is dependent on how the recipient harnesses that situation. The ability to tap into foreign-firm expertise can help build local capacity through knowledge and technology transfer	<ul style="list-style-type: none"> <li>• Fundamental for skills transfer if well harnessed</li> </ul>	<ul style="list-style-type: none"> <li>• They have a lot of financial influence to tip the scales and erode intended benefits.</li> </ul>
<b>2. Theme: Global competition</b>			
<b>Participant ID</b>	<b>Thematic construct</b>	<b>Advantage</b>	<b>Disadvantage</b>
SS1	We buy services from them (foreign construction firms) because of their competence, pre-exposure to works of similar nature, and massive capital outlays that enable them to deliver projects on time and to the required quality.	<ul style="list-style-type: none"> <li>• Deliver projects on time and to the required quality</li> </ul>	<ul style="list-style-type: none"> <li>• Component of unhealthy competition</li> </ul>
PS2	High prices in the sector make it attractive for foreign firms to come and undertake projects	<ul style="list-style-type: none"> <li>• An increase in foreign competitiveness may help stabilize prices over time</li> </ul>	<ul style="list-style-type: none"> <li>• Their strength has a negative knockout effect on local firms</li> </ul>
PS9	Global competition is beneficial, but the construction industry in Zambia is facing unfair competition		<ul style="list-style-type: none"> <li>• Foreign firms get assistance from their governments</li> </ul>

PS8	We should not be afraid of foreign competition if the competition is fair.	<ul style="list-style-type: none"> <li>• Push local firms to adapt quickly to international norms</li> </ul>	<ul style="list-style-type: none"> <li>• Foreign firms get subsidies from their governments</li> <li>• Agents of unfair competition</li> </ul>
<b>3. Theme: Project management and delivery practices</b>			
<b>Participant ID</b>	<b>Thematic construct</b>	<b>Advantage</b>	<b>Disadvantage</b>
PS3	If you are competing from an even playing field, then it is evident that the local contractors will lose out		3. They encourage vices such as corruption
PS7	We see a lot of infrastructure in the country without participating in any of them. They come as investors, yet we do not realize any investment	<ul style="list-style-type: none"> <li>• They have ready access to external financing</li> </ul>	4. They have support from their governments which guarantees them an unfair advantage 5. Only use local firms to rubber stamp what they are doing without tangible skills transfer
PS6	Globalization poses a real threat as it threatens local firms due to their lack of exposure and understanding of the dynamics of survival	<ul style="list-style-type: none"> <li>• Can meet stringent international-level pre-tender requirements</li> </ul>	6. The competition brought about globalization and the emergence of foreign firms exterminates, especially emerging local firms
SS5	It is expensive to bring in expertise from a foreign country		7. They increase prices to meet huge expenses associated with managing a foreign firm
<b>4. Theme: Access to resources</b>			
<b>Participant ID</b>	<b>Thematic construct</b>	<b>Advantage</b>	<b>Disadvantage</b>
PS4	<ul style="list-style-type: none"> <li>• There is a pattern suggesting that foreign construction firms have better access to finances</li> </ul>		<ul style="list-style-type: none"> <li>• Have better advantages over local firms</li> </ul>

PS5	<ul style="list-style-type: none"> <li>Any industry needs a healthy dose of competition for it to be competitive. However, in Zambia, we have overlooked the challenges of local contractors in preference for foreign contractors</li> <li>They have had good grooming and incubation protected by their governments at some point for them to grow.</li> </ul>	<ul style="list-style-type: none"> <li>They can use their finances to execute the project.</li> </ul>	<ul style="list-style-type: none"> <li>Local firms lack the level of capacity to perform and compete with foreign firms</li> </ul>
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**5. Theme: Reputational damage**

Participant ID	Thematic construct	Advantage	Disadvantage
SS4	Local financial institutions shy away from financing local contractors, so if you introduce foreign firms with more foreign financial capabilities to take on jobs	<ul style="list-style-type: none"> <li>They have a better capacity to outperform and outcompete local firms</li> </ul>	<ul style="list-style-type: none"> <li>They perpetuate the perception that local contractors are non-performers</li> </ul>

**Table 10.10 Procurement considerations and strategies for efficient tender price management**

Participant ID	Procurement considerations	Interview quote	Relevance	Methodology	Procurement Strategy
PS1 SS4 SS5 PS9	<ul style="list-style-type: none"> <li>Ensure adequate project budgeting</li> <li>Ensure timely procurement planning</li> </ul>	<ul style="list-style-type: none"> <li>The procurement function must know how much money is allocated to a project. You do not just go into procuring a project; at the end of the day, there is no money.</li> <li>Plan procurement activities and allocate enough time to each process-it should not take forever.</li> </ul>	Develop informed engineers' estimates early during project planning stages	<ul style="list-style-type: none"> <li>Utilize experienced professionals (quantity surveying consultants)</li> <li>Include estimated budgets of the project in the tender</li> </ul>	Planning
SS1 PS9	Enhance the construction price index	<ul style="list-style-type: none"> <li>The price index is not perfect yet because it is still hungry for data-but; as more data is inputted</li> </ul>	Benchmark prices of construction elements	<ul style="list-style-type: none"> <li>develop procurement controls for</li> </ul>	Planning/Policy

Participant ID	Procurement considerations	Interview quote	Relevance	Methodology	Procurement Strategy
		<p>into the system, averages and means will normalize toward marginal variations from actual market prices</p> <ul style="list-style-type: none"> <li>• The market must become more predictable. Once the players know a price index to follow, the market will adjust its behavior and reach a new equilibrium.</li> <li>• Following the ZPPA price index could help stabilize prices</li> </ul>		<p>tendering processes</p> <ul style="list-style-type: none"> <li>• enhance market predictability</li> </ul>	
PS2	Early involvement of contractors	<p>There is a need for procurement to take deeper engagement with subcontractors and contractors to be more involved with the technicalities of the project</p>	Improve stakeholder involvement	<ul style="list-style-type: none"> <li>• clearly define project technicalities</li> <li>• enhance stakeholder understanding of project requirements</li> </ul>	Planning/Policy
PS3 PS7 SS1 PS8	Legislate preferential procurement for local contractors	<ul style="list-style-type: none"> <li>• It is within reasonable bounds not to allow foreign companies to bid for some works. Until you reach a level where you think even local firms need some global competition</li> <li>• Legislate a 20% subcontracting policy</li> </ul>	<ul style="list-style-type: none"> <li>• Build capacity and resilience of local firms</li> <li>• Ensure fair competition</li> </ul>	<ul style="list-style-type: none"> <li>• Utilize joint ventures</li> <li>• Develop exclusion and inclusion criteria</li> </ul>	Protectionism

<b>Participant ID</b>	<b>Procurement considerations</b>	<b>Interview quote</b>	<b>Relevance</b>	<b>Methodology</b>	<b>Procurement Strategy</b>
PS4	Rationalize competition and procurement processes	How our local contractors understand tender documents and procurement processes leaves much to desire. The timeframe it takes to conclude a procurement process affects the construction industry. A prolonged procurement process in our environment works against pricing structures	<ul style="list-style-type: none"> <li>• Build capacity for local firms</li> <li>• Anticipate instability of macroeconomic indicators</li> </ul>	<ul style="list-style-type: none"> <li>• Eliminate tender errors</li> <li>• Streamline and shorten procurement processes</li> <li>• Shorten procurement process</li> <li>• Streamline competition</li> </ul>	Protectionism
SS2 PS9	Information and communication management	The procurement function significantly contributes because it drives the process of procuring works and subsequently determines the quality of the works. Ensures transparency, good governance, and lack of corruption in the system	<ul style="list-style-type: none"> <li>• Ensure transparency and appropriate information dissemination criteria</li> </ul>	<ul style="list-style-type: none"> <li>• Utilize corporate governance principles</li> <li>• Depoliticize the project procurement process</li> </ul>	Policy
PS5	Contextualize international bidding standards	<ul style="list-style-type: none"> <li>• We need to be very careful with the use of international bidding standards. We need to separate the conditions under which a local firm and a global firm can qualify to win a tender</li> <li>• Ensure that local can be the only firms who can win tenders but with the backing or in partnership</li> </ul>	<ul style="list-style-type: none"> <li>• Localize the context of international bidding standards</li> </ul>	<ul style="list-style-type: none"> <li>• Make local firms more competitive</li> <li>• Promote partnerships by making local firms lead participants</li> </ul>	Policy

Participant ID	Procurement considerations	Interview quote	Relevance	Methodology	Procurement Strategy
		with an international firm			
PS6 PS8	Model procurement documents	<ul style="list-style-type: none"> <li>• Procurement entities need to ensure that documents are clear enough. Because shifting through clarifications and issuing addendums affects the pricing structure</li> <li>• A procurement system is essential to assist project delivery</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure clarity of tender documents from the onset</li> </ul>	<ul style="list-style-type: none"> <li>• Develop clear bidding procedures</li> <li>• Ensure fairness during procurement</li> <li>• Eliminate human error or elements in handling documents</li> </ul>	Policy
SS3 PS7 PS8	Differentiate construction procurement laws from general procurement laws	<ul style="list-style-type: none"> <li>• Reform procurement laws to ensure they are more responsive to the actual situation in the market. In construction, the lowest bidder may not necessarily be the best price</li> <li>• The contracting authority has to undertake a price reasonableness analysis and a rate analysis on a bid. Somebody higher in price could be awarded than someone lower because the reasonable price is higher. The low price does not always mean that it is the best.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust some of the provisions in international contracting and procurement forms to suit the local market</li> <li>• Ensure construction professionals manage construction project procurement</li> </ul>	<ul style="list-style-type: none"> <li>• Develop construction-specific procurement laws</li> <li>• Involve professionals in policy-making</li> </ul>	Policy

Participant ID	Procurement considerations	Interview quote	Relevance	Methodology	Procurement Strategy
		Sometimes, it could be that it is not workable			

**Table 10.11 Turnaround tender price management strategies**

S/N	Participant ID	Pattern	Key Strategy	Sub-Strategy	Score	Category	Rank
1	PS1 PS2 PS3 PS4 SS2 PS6 SS3 PS7 SS4 PS8 SS5 PS9	Cost estimate and financing	Planning Management	14. Government to plan and design execution of projects. 15. Develop funding projections and ensure readily available funds 16. Guarantee availability of project funding 17. Control interest, value-related, and time-related costs 18. Hire experienced consultants early enough in the project stages 19. Develop well-informed cost estimates 20. Avoid the “text-book” approach when developing price indices 21. Ensure timely payment to contractors 22. Prepare project plans with robust designs and costings 23. Ensure that control systems like the e-GP and materials price index are realistic 24. Develop models for rate build-up 25. Utilize various professionals to develop cost norms and value engineering 26. Produce indices timely	12	1	1
2	PS1 PS4	Interference	Stakeholder Management	1. Government to depoliticize procurement and construction process	6	2	3

S/N	Participant ID	Pattern	Key Strategy	Sub-Strategy	Score	Category	Rank
	SS2 PS5 PS8 PS9			2. Mitigate against corruption 3. Stabilize the cost of materials, exchange rate, and inflation on the market 4. Stop negative interference in project management processes 5. Manage the type and extent of stakeholder involvement			
3	PS1 SS1 SS2 SS3 PS8 SS5	Incentives	Capacity management	1. Develop preferential Treatment Methodologies 2. Pay contractors for greater output 3. Redress unfair competition practices 4. Package contracts into small lots 5. Earmark-specific work is to be for local contractors only 6. Review single-sourcing or direct-bidding rules 7. Introduce incentives in terms of taxes and statutory obligations 8. Redress entry barriers into the industry 9. Ensure that the shareholding of construction firms contains qualified allied professionals	6	2	2
4	SS1 SS2 PS6 SS3 PS8	Training and innovation	Capacity Building	1. Ensure that people in the sector receive training 2. Support research and development 3. Develop an apprenticeship board 4. Utilize high-value projects to train personnel	5	3	6
5	SS1 PS7 PS9	Legislation	Legal-Framework Modernization	1. Continuously review existing legislation	3	5	7

S/N	Participant ID	Pattern	Key Strategy	Sub-Strategy	Score	Category	Rank
				<ul style="list-style-type: none"> <li>2. Fully legislate the 20% subcontracting policy into law</li> <li>3. Timely produce regulations to guide the implementation of laws</li> <li>4. Review procurement policy</li> </ul>			
6	PS2 PS3 SS3 PS7 PS8 PS9	Procurement function	Procurement Management	<ul style="list-style-type: none"> <li>1. Develop better mechanisms for pre-qualification criteria</li> <li>2. Allow contractors to state the margin of profit on the project</li> <li>3. Make procurement law more responsive to local needs</li> <li>4. Subscribe procurement function to best and better practices</li> <li>5. Cancel projects whose contractors manage without referencing their bidding documents</li> <li>6. Ensure to award to the correct contractor</li> <li>7. Establish a department or supreme organ to address all government procurement-related functions, including complaints, final-reporting, professional well-being of procurement officers, and appointment of officers</li> </ul>	6	2	4
7	PS3 SS2 PS6 SS3 PS7 PS8	Project practices	Project Management	<ul style="list-style-type: none"> <li>1. Develop project management skills</li> <li>2. Develop proper infrastructure governance mechanisms</li> <li>3. Develop principles that reflect the value of time</li> <li>4. Prevent deliberate government contract-breaches</li> <li>5. Develop standards for infrastructure project implementation</li> </ul>	6	2	5

S/N	Participant ID	Pattern	Key Strategy	Sub-Strategy	Score	Category	Rank
				6. Handle projects professionally 7. Ensure that project key personnel are professionals 8. Refer to the contents of the bidding document rather than concentrating on the general conditions of the contract alone			
8	PS6 PS7	Market forces	Management of macroeconomic indicators	1. Regulate the market in terms of the cost of materials 2. Stabilize inflation and exchange rate	2	6	6
9	PS5 PS7 SS4 PS8	Sustainability	Sustainable construction Management	1. Develop standards for facilities management 2. Ensure global competition does not hinder the growth of local firms 3. Optimize bulk procurement of imported materials 4. Setup adequate and cost regulated material's producing plants 5. Redress incursion of no-professionals into the construction industry	4	4	4

(Source: by the author)

**Table 11.8 Descriptive analysis of dimension-related strategies**

Variable	Code	Rank	Mean	Std. Deviation		Variance	Skewness	Kurtosis			
				Statistic	Statistic			Statistic	Statistic	Std. Error	Std. Error
<b>Government Dimension*</b>											
Improving stakeholder management	GD8	2	4.39	0.926	0.857	-2.128	0.200	5.132	0.397		
Improving procurement methods	GD7	3	4.32	0.958	0.918	-1.914	0.200	3.982	0.397		
Benchmarking price performance	GD4	9	4.09	1.020	1.040	-1.515	0.200	2.398	0.397		
Establishing strategic awareness	GD2	10	4.08	0.983	0.966	-1.394	0.200	2.128	0.397		
Improving payment flows	GD6	1	4.49	0.975	0.950	-2.377	0.200	5.372	0.397		
Ensuring active participation of local contractors	GD11	6	4.24	1.095	1.200	-1.611	0.200	2.048	0.397		
Ensuring Continuous capability and capacity enhancement	GD3	7	4.22	1.017	1.034	-1.677	0.200	2.779	0.397		
Incentivizing local contractor performance	GD9	11	4.05	1.042	1.087	-1.273	0.200	1.460	0.397		
Improving client capabilities	GD5	8	4.21	0.988	0.976	-1.689	0.200	3.117	0.397		
Adopting innovative system	GD10	12	3.96	0.964	0.930	-1.172	0.200	1.708	0.397		
Improving project management practices	GD1	5	4.32	0.958	0.918	-2.104	0.200	4.852	0.397		
Improving sector governance	GD12	4	4.32	0.958	0.918	-1.630	0.200	2.575	0.397		
<b>Procurement Dimension*</b>											
Eliminating errors in tender documents	MD9	10	4.02	1.088	1.185	-1.301	0.200	1.273	0.397		
Developing knowledge of the project management team	MD6	1	4.43	0.944	0.890	-2.246	0.200	5.314	0.397		
Ensuring the presence & experience of the consultant	MD3	6	4.22	1.017	1.034	-1.638	0.200	2.665	0.397		
Developing project management process	MD1	9	4.20	0.941	0.885	-1.555	0.200	2.834	0.397		
Establishing technical & financial controls	MD4	2	4.29	0.944	0.890	-1.891	0.200	4.093	0.397		
Ensuring completeness of designs	MD10	8	4.20	1.006	1.013	-1.565	0.200	2.394	0.397		
Establishing project implementation methodology	MD7	4	4.26	0.907	0.823	-1.597	0.200	3.075	0.397		
Standardizing Procurement timeframe	MD8	5	4.25	0.920	0.847	-1.912	0.200	4.471	0.397		

Variable	Code	Rank	Mean	Std.	Variance	Skewness	Kurtosis		
							Deviation		
							Statistic	Statistic	Std. Error
Benchmarking of project elements	MD5	7	4.22	0.910	0.829	-1.551	0.200	2.919	0.397
Utilizing engineer's estimates	MD2	3	4.27	1.055	1.114	-1.720	0.200	2.553	0.397
<b>Legal Dimension*</b>									
Reviewing available legislation	LD4	1	4.24	0.924	0.854	-1.655	0.200	3.331	0.397
Domesticating contract type	LD6	3	4.14	1.108	1.228	-1.376	0.200	1.238	0.397
Legislating rate analysis	LD2	6	4.00	1.020	1.041	-1.216	0.200	1.336	0.397
Legislating regulations for Price reasonableness analysis	LD1	5	4.05	1.052	1.107	-1.434	0.200	1.876	0.397
Legislating procurement controls	LD3	4	4.14	0.963	0.927	-1.538	0.200	2.743	0.397
Legislating subcontracting policy & joint venture agreements	LD5	2	4.20	0.970	0.940	-1.503	0.200	2.382	0.397
<b>Contractor Dimension*</b>									
Improving technical ability	CD1	4	4.17	0.909	0.827	-1.508	0.200	2.812	0.397
Improving the qualification and competence of the contractor	CD2	5	4.12	0.827	0.684	-1.928	0.200	5.581	0.397
Developing resource capabilities	CD5	6	4.08	0.983	0.966	-1.087	0.200	1.014	0.397
Managing profit margin estimations	CD3	7	4.05	1.012	1.024	-1.195	0.200	1.223	0.397
Improving stakeholder management	CD4	3	4.22	0.856	0.733	-1.299	0.200	2.109	0.397
Developing project implementation methodology	CD6	2	4.28	0.858	0.737	-1.561	0.200	3.229	0.397
Developing knowledge of procurement processes	CD7	1	4.28	0.809	0.655	-1.733	0.200	4.615	0.397
<b>Project Dimension*</b>									
Making clear project quality requirements	PD2	3	4.35	0.942	0.888	-1.860	0.200	3.724	0.397
Ensuring a steady flow of payments	PD8	1	4.41	0.920	0.847	-2.150	0.200	5.028	0.397
Mitigating risk factors at inception	PD12	4	4.34	0.940	0.884	-1.835	0.200	3.456	0.397

Variable	Code	Rank	Mean	Std.	Variance	Skewness	Kurtosis		
							Deviation		
							Statistic	Statistic	Std. Error
Providing clauses for project variations/price adjustments	PD9	6	4.33	0.938	0.879	-1.760	0.200	3.450	0.397
Clarify the scope of the project from inception	PD4	9	4.23	0.907	0.823	-1.704	0.200	3.709	0.397
Accounting for project-location parameters	PD3	2	4.37	0.944	0.892	-1.837	0.200	3.377	0.397
Accounting for the project environment	PD14	12	4.17	0.968	0.937	-1.452	0.200	2.258	0.397
Mitigating personnel/labor cost escalations	PD7	11	4.20	0.904	0.817	-1.643	0.200	3.554	0.397
Accounting for the complexity of the works	PD11	8	4.24	0.911	0.830	-1.609	0.200	3.085	0.397
Accounting for nature and type of equipment	PD6	13	4.06	0.995	0.989	-1.140	0.200	1.059	0.397
Mitigating project costs	PD10	7	4.31	0.920	0.847	-1.627	0.200	2.717	0.397
Upholding project duration specifications	PD1	5	4.33	0.923	0.852	-1.811	0.200	3.575	0.397
Mitigating the impact of material-price escalations	PD5	10	4.20	0.934	0.872	-1.582	0.200	2.998	0.397
<b>Industry Dimension*</b>									
Ensuring the protection of local firms	ID1	12	4.19	1.009	1.018	-1.487	0.200	1.983	0.397
Mitigating inflation rate impacts	ID2	9	4.24	0.989	0.977	-1.617	0.200	2.529	0.397
Reducing imports	ID5	14	4.14	1.070	1.146	-1.464	0.200	1.722	0.397
Encouraging ownership of equipment	ID8	16	4.09	1.091	1.191	-1.268	0.200	.978	0.397
Managing the number of competitors	ID10	7	4.27	0.953	0.909	-1.662	0.200	2.801	0.397
Mitigating interest rate impacts	ID3	4	4.29	0.972	0.945	-1.781	0.200	3.382	0.397
Managing nature and type of competition	ID6	2	4.35	0.948	0.899	-1.920	0.200	3.884	0.397
Managing nature and type of firms	ID7	3	4.33	0.982	0.963	-1.903	0.200	3.664	0.397
Ensuring knowledge transfer	ID13	6	4.28	0.890	0.792	-1.823	0.200	4.346	0.397
Providing training	ID17	1	4.35	0.941	0.886	-2.147	0.200	5.245	0.397
Building capacity of local firms	ID11	5	4.29	0.922	0.849	-1.825	0.200	3.916	0.397
Ensuring market predictability	ID12	13	4.16	0.907	0.822	-1.503	0.200	2.826	0.397

Variable	Code	Rank	Mean	Std.	Variance	Skewness	Kurtosis		
			Deviation						
			Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Removing industry uncertainty	ID9	11	4.20	0.914	0.835	-1.729	0.200	3.699	0.397
Instilling sector confidence	ID14	15	4.13	0.953	0.908	-1.563	0.200	2.915	0.397
Mitigating exchange rate impact	ID4	17	3.99	1.030	1.062	-1.129	0.200	1.080	0.397
Alleviating effects of the existence of foreign firms	ID15	10	4.23	0.987	0.974	-1.565	0.200	2.391	0.397
Ensuring supply chain management	ID16	8	4.26	0.951	0.905	-1.846	0.200	3.844	0.397

\*Valid N (listwise) = 147

(Source: by the author)

**Table 11.9 Tests of normality and bootstrap one sample t-test analysis of dimension-related strategies**

Variable	Code	Bootstrap for One-Sample Test							Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval		Kolmogorov-Smirnova		Shapiro-Wilk		
						Lower	Upper	Statistic	Sig.	Statistic	Sig.	
<b>Government Dimension</b>												
Improving stakeholder management	GD8	4.395	.000	.075	0.001	4.245	4.537	.322	0.000	.652	0.000	
Improving procurement methods	GD7	4.320	.000	.075	0.001	4.163	4.469	.292	0.000	.686	0.000	
Benchmarking price performance	GD4	4.088	.002	.081	0.001	3.925	4.252	.289	0.000	.757	0.000	
Establishing strategic awareness	GD2	4.082	.001	.079	0.001	3.919	4.231	.283	0.000	.778	0.000	
Improving payment flows	GD6	4.490	.000	.079	0.001	4.333	4.639	.387	0.000	.570	0.000	
Ensuring active participation of local contractors	GD11	4.245	.003	.086	0.001	4.082	4.415	.319	0.000	.706	0.000	
Ensuring Continuous capability and capacity enhancement	GD3	4.218	.000	.079	0.001	4.055	4.367	.266	0.000	.723	0.000	
Incentivizing local contractor performance	GD9	4.048	.003	.082	0.001	3.891	4.211	.257	0.000	.793	0.000	
Improving client capabilities	GD5	4.211	-.002	.078	0.001	4.048	4.354	.266	0.000	.727	0.000	
Adopting innovative system	GD10	3.959	.000	.075	0.001	3.803	4.109	.279	0.000	.811	0.000	
Improving project management practices	GD1	4.320	-.001	.076	0.001	4.163	4.469	.288	0.000	.651	0.000	
Improving sector governance	GD12	4.320	.000	.078	0.001	4.156	4.469	.319	0.000	.716	0.000	
<b>Procurement Dimension</b>												

Variable	Code	Bootstrap for One-Sample Test						Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	Bootstrap <sup>b</sup> 95% Confidence Interval		Kolmogorov-Smirnov		Shapiro-Wilk	
						Lower	Upper	Statistic	Sig.	Statistic	Sig.
Eliminating errors in tender documents	MD9	4.020	-.001	.090	0.001	3.837	4.190	.282	0.000	.784	0.000
Developing knowledge of the project management team	MD6	4.429	-.001	.075	0.001	4.279	4.565	.340	0.000	.622	0.000
Ensuring the presence & experience of the consultant	MD3	4.218	.000	.082	0.001	4.054	4.374	.269	0.000	.729	0.000
Developing project management process	MD1	4.197	-.001	.075	0.001	4.048	4.333	.267	0.000	.751	0.000
Establishing technical & financial controls	MD4	4.286	.002	.073	0.001	4.129	4.429	.272	0.000	.694	0.000
Ensuring completeness of designs	MD10	4.204	.002	.080	0.001	4.048	4.367	.262	0.000	.742	0.000
Establishing project implementation methodology	MD7	4.259	.001	.074	0.001	4.109	4.395	.263	0.000	.741	0.000
Standardizing Procurement timeframe	MD8	4.252	-.002	.072	0.001	4.102	4.388	.297	0.000	.690	0.000
Benchmarking of project elements	MD5	4.218	.000	.073	0.001	4.075	4.360	.269	0.000	.749	0.000
Utilizing engineer's estimates	MD2	4.265	.001	.083	0.001	4.095	4.422	.301	0.000	.699	0.000
<b>Legal Dimension</b>											
Reviewing available legislation	LD4	4.238	.001	.076	0.001	4.088	4.381	.262	0.000	.735	0.000
Domesticating contract type	LD6	4.136	.003	.088	0.001	3.959	4.306	.272	0.000	.755	0.000

Variable	Code	Bootstrap for One-Sample Test						Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	Bootstrap <sup>b</sup> 95% Confidence Interval		Kolmogorov-Smirnov		Shapiro-Wilk	
						Lower	Upper	Statistic	Sig.	Statistic	Sig.
Legislating rate analysis	LD2	4.000	-.003	.086	0.001	3.830	4.156	.282	0.000	.803	0.000
Legislating regulations for Price reasonableness analysis	LD1	4.054	.001	.085	0.001	3.878	4.211	.296	0.000	.766	0.000
Legislating procurement controls	LD3	4.136	.000	.076	0.001	3.986	4.286	.287	0.000	.755	0.000
Legislating subcontracting policy & joint venture agreements	LD5	4.197	-.001	.076	0.001	4.034	4.340	.256	0.000	.755	0.000
<b>Contractor Dimension</b>											
Improving technical ability	CD1	4.170	.001	.070	0.001	4.027	4.306	.290	0.000	.754	0.000
Improving the qualification and competence of the contractor	CD2	4.122	-.001	.064	0.001	3.987	4.238	.366	0.000	.656	0.000
Developing resource capabilities	CD5	4.082	.002	.080	0.001	3.932	4.245	.233	0.000	.810	0.000
Managing profit margin estimations	CD3	4.054	.004	.082	0.001	3.898	4.218	.261	0.000	.803	0.000
Improving stakeholder management	CD4	4.218	-.001	.071	0.001	4.068	4.347	.257	0.000	.775	0.000
Developing project implementation methodology	CD6	4.279	.000	.072	0.001	4.129	4.415	.262	0.000	.743	0.000
Developing knowledge of procurement processes	CD7	4.279	.002	.067	0.001	4.150	4.415	.284	0.000	.710	0.000

Variable	Code	Bootstrap for One-Sample Test						Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval		Kolmogorov-Smirnov		Shapiro-Wilk	
Lower	Upper					Statistic	Sig.	Statistic	Sig.		
<b>Project Dimension</b>											
Making clear project quality requirements	PD2	4.354	.001	.076	0.001	4.211	4.510	.318	0.000	.689	0.000
Ensuring a steady flow of payments	PD8	4.415	.001	.074	0.001	4.265	4.565	.329	0.000	.641	0.000
Mitigating risk factors at inception	PD12	4.340	.001	.079	0.001	4.184	4.490	.303	0.000	.689	0.000
Providing clauses for project variations/price adjustments	PD9	4.327	.001	.077	0.001	4.170	4.476	.308	0.000	.707	0.000
Clarify the scope of the project from inception	PD4	4.231	.000	.074	0.001	4.088	4.374	.277	0.000	.728	0.000
Accounting for project-location parameters	PD3	4.367	-.002	.079	0.001	4.204	4.510	.327	0.000	.684	0.000
Accounting for the project environment	PD14	4.170	.000	.080	0.001	4.020	4.320	.260	0.000	.765	0.000
Mitigating personnel/labor cost escalations	PD7	4.197	.000	.074	0.001	4.054	4.347	.284	0.000	.738	0.000
Accounting for the complexity of the works	PD11	4.245	.002	.076	0.001	4.102	4.395	.265	0.000	.739	0.000
Accounting for nature and type of equipment	PD6	4.061	.001	.082	0.001	3.898	4.224	.258	0.000	.808	0.000
Mitigating project costs	PD10	4.313	.000	.075	0.001	4.163	4.463	.296	0.000	.723	0.000

Variable	Code	Bootstrap for One-Sample Test							Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval		Kolmogorov-Smirnov Statistic	Sig.	Shapiro-Wilk Statistic	Sig.	
						Lower	Upper					
Upholding project duration specifications	PD1	4.327	.000	.075	0.001	4.170	4.476	.291	0.000	.699	0.000	
Mitigating the impact of material-price escalations	PD5	4.197	.000	.074	0.001	4.048	4.340	.273	0.000	.747	0.000	
<b>Industry Dimension</b>												
Ensuring the protection of local firms	ID1	4.190	.000	.080	0.001	4.027	4.340	.262	0.000	.750	0.000	
Mitigating inflation rate impacts	ID2	4.238	.000	.080	0.001	4.088	4.401	.269	0.000	.729	0.000	
Reducing imports	ID5	4.136	-.001	.086	0.001	3.959	4.299	.273	0.000	.751	0.000	
Encouraging ownership of equipment	ID8	4.088	.003	.087	0.001	3.918	4.258	.257	0.000	.777	0.000	
Managing the number of competitors	ID10	4.265	-.001	.077	0.001	4.109	4.408	.269	0.000	.720	0.000	
Mitigating interest rate impacts	ID3	4.286	-.001	.077	0.001	4.129	4.435	.286	0.000	.707	0.000	
Managing nature and type of competition	ID6	4.347	-.002	.078	0.001	4.177	4.490	.305	0.000	.679	0.000	
Managing nature and type of firms	ID7	4.333	-.002	.078	0.001	4.170	4.483	.309	0.000	.680	0.000	
Ensuring knowledge transfer	ID13	4.279	-.001	.071	0.001	4.143	4.415	.268	0.000	.710	0.000	
Providing training	ID17	4.347	-.003	.076	0.001	4.190	4.496	.287	0.000	.651	0.000	
Building capacity of local firms	ID11	4.286	.001	.072	0.001	4.136	4.422	.269	0.000	.705	0.000	

Variable	Code	Bootstrap for One-Sample Test						Tests of Normality			
		Mean Difference	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval		Kolmogorov-Smirnov		Shapiro-Wilk	
						Lower	Upper	Statistic	Sig.	Statistic	Sig.
Ensuring market predictability	ID12	4.163	.001	.073	0.001	4.021	4.313	.293	0.000	.755	0.000
Removing industry uncertainty	ID9	4.204	-.002	.073	0.001	4.054	4.347	.303	0.000	.718	0.000
Instilling sector confidence	ID14	4.129	-.002	.075	0.001	3.980	4.279	.296	0.000	.750	0.000
Mitigating exchange rate impact	ID4	3.993	-.001	.085	0.001	3.823	4.156	.258	0.000	.815	0.000
Alleviating effects of the existence of foreign firms	ID15	4.231	.000	.078	0.001	4.061	4.374	.272	0.000	.739	0.000
Ensuring supply chain management	ID16	4.259	.000	.074	0.001	4.116	4.395	.284	0.000	.700	0.000

a. Lilliefors Significance Correction

b. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

c. df =147 d. N=147 e. Statistically significant at p<0.05

(Source: by the author)

**Table 11.10 Standard one sample t-test analysis of dimension-related strategies**

Variables	Codes	Test Value = 0					
		t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
<b>Government Dimension</b>							
Improving stakeholder management	GD8	57.557	146	0.000	4.395	4.24	4.55
Improving procurement methods	GD7	54.674	146	0.000	4.320	4.16	4.48
Benchmarking price performance	GD4	48.605	146	0.000	4.088	3.92	4.25
Establishing strategic awareness	GD2	50.353	146	0.000	4.082	3.92	4.24
Improving payment flows	GD6	55.843	146	0.000	4.490	4.33	4.65
Ensuring active participation of local contractors	GD11	46.985	146	0.000	4.245	4.07	4.42
Ensuring Continuous capability and capacity enhancement	GD3	50.277	146	0.000	4.218	4.05	4.38
Incentivizing local contractor performance	GD9	47.075	146	0.000	4.048	3.88	4.22
Improving client capabilities	GD5	51.684	146	0.000	4.211	4.05	4.37
Adopting innovative system	GD10	49.781	146	0.000	3.959	3.80	4.12
Improving project management practices	GD1	54.674	146	0.000	4.320	4.16	4.48
Improving sector governance	GD12	54.674	146	0.000	4.320	4.16	4.48
<b>Procurement Dimension</b>							
Eliminating errors in tender documents	MD9	44.788	146	0.000	4.020	3.84	4.20
Developing knowledge of the project management team	MD6	56.902	146	0.000	4.429	4.27	4.58
Ensuring the presence & experience of the consultant	MD3	50.277	146	0.000	4.218	4.05	4.38
Developing project management process	MD1	54.080	146	0.000	4.197	4.04	4.35
Establishing technical & financial controls	MD4	55.066	146	0.000	4.286	4.13	4.44
Ensuring completeness of designs	MD10	50.647	146	0.000	4.204	4.04	4.37
Establishing project implementation methodology	MD7	56.909	146	0.000	4.259	4.11	4.41
Standardizing Procurement timeframe	MD8	56.006	146	0.000	4.252	4.10	4.40
Benchmarking of project elements	MD5	56.164	146	0.000	4.218	4.07	4.37

Variables	Codes	Test Value = 0					
		t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Utilizing engineer's estimates	MD2	48.995	146	0.000	4.265	4.09	4.44
<b>Legal Dimension</b>							
Reviewing available legislation	LD4	55.607	146	0.000	4.238	4.09	4.39
Domesticating contract type	LD6	45.254	146	0.000	4.136	3.96	4.32
Legislating rate analysis	LD2	47.531	146	0.000	4.000	3.83	4.17
Legislating regulations for Price reasonableness analysis	LD1	46.729	146	0.000	4.054	3.88	4.23
Legislating procurement controls	LD3	52.096	146	0.000	4.136	3.98	4.29
Legislating subcontracting policy & joint venture agreements	LD5	52.481	146	0.000	4.197	4.04	4.36
<b>Contractor Dimension</b>							
Improving technical ability	CD1	55.595	146	0.000	4.170	4.02	4.32
Improving the qualification and competence of the contractor	CD2	60.455	146	0.000	4.122	3.99	4.26
Developing resource capabilities	CD5	50.353	146	0.000	4.082	3.92	4.24
Managing profit margin estimations	CD3	48.568	146	0.000	4.054	3.89	4.22
Improving stakeholder management	CD4	59.724	146	0.000	4.218	4.08	4.36
Developing project implementation methodology	CD6	60.441	146	0.000	4.279	4.14	4.42
Developing knowledge of procurement processes	CD7	64.124	146	0.000	4.279	4.15	4.41
<b>Project Dimension</b>							
Making clear project quality requirements	PD2	56.026	146	0.000	4.354	4.20	4.51
Ensuring a steady flow of payments	PD8	58.157	146	0.000	4.415	4.26	4.57
Mitigating risk factors at inception	PD12	55.983	146	0.000	4.340	4.19	4.49
Providing clauses for project variations/price adjustments	PD9	55.952	146	0.000	4.327	4.17	4.48
Clarify the scope of the project from inception	PD4	56.555	146	0.000	4.231	4.08	4.38
Accounting for project-location parameters	PD3	56.080	146	0.000	4.367	4.21	4.52
Accounting for the project environment	PD14	52.242	146	0.000	4.170	4.01	4.33

Variables	Codes	Test Value = 0					
		t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Mitigating personnel/labor cost escalations	PD7	56.302	146	0.000	4.197	4.05	4.34
Accounting for the complexity of the works	PD11	56.491	146	0.000	4.245	4.10	4.39
Accounting for nature and type of equipment	PD6	49.503	146	0.000	4.061	3.90	4.22
Mitigating project costs	PD10	56.831	146	0.000	4.313	4.16	4.46
Upholding project duration specifications	PD1	56.845	146	0.000	4.327	4.18	4.48
Mitigating the impact of material-price escalations	PD5	54.504	146	0.000	4.197	4.05	4.35
<b>Industry Dimension</b>							
Ensuring the protection of local firms	ID1	50.349	146	0.000	4.190	4.03	4.35
Mitigating inflation rate impacts	ID2	51.981	146	0.000	4.238	4.08	4.40
Reducing imports	ID5	46.849	146	0.000	4.136	3.96	4.31
Encouraging ownership of equipment	ID8	45.426	146	0.000	4.088	3.91	4.27
Managing the number of competitors	ID10	54.253	146	0.000	4.265	4.11	4.42
Mitigating interest rate impacts	ID3	53.446	146	0.000	4.286	4.13	4.44
Managing nature and type of competition	ID6	55.575	146	0.000	4.347	4.19	4.50
Managing nature and type of firms	ID7	53.526	146	0.000	4.333	4.17	4.49
Ensuring knowledge transfer	ID13	58.312	146	0.000	4.279	4.13	4.42
Providing training	ID17	56.003	146	0.000	4.347	4.19	4.50
Building capacity of local firms	ID11	56.383	146	0.000	4.286	4.14	4.44
Ensuring market predictability	ID12	55.658	146	0.000	4.163	4.02	4.31
Removing industry uncertainty	ID9	55.788	146	0.000	4.204	4.06	4.35
Instilling sector confidence	ID14	52.544	146	0.000	4.129	3.97	4.28
Mitigating exchange rate impact	ID4	46.989	146	0.000	3.993	3.83	4.16
Alleviating effects of the existence of foreign firms	ID15	51.994	146	0.000	4.231	4.07	4.39
Ensuring supply chain management	ID16	54.264	146	0.000	4.259	4.10	4.41

**Table 11.15 Likelihood ratio tests**

Effect	Code	Model Fitting Criteria	Likelihood Ratio Tests		
		-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept		96.943 <sup>a</sup>	3.323	2	.190
<b>Government Dimension</b>					
Improving stakeholder management	GD8	93.757	.138	2	.933
Improving procurement methods	GD7	96.252	2.633	2	.268
Benchmarking price performance	GD4	98.926	5.306	2	.070
Establishing strategic awareness	GD2	94.182	.563	2	.755
Improving payment flows	GD6	93.709	.089	2	.956
Ensuring active participation of local contractors	GD11	93.668	.048	2	.976
Ensuring Continuous capability and capacity enhancement	GD3	94.809	1.190	2	.552
Incentivizing local contractor performance	GD9	93.825	.205	2	.902
Improving client capabilities	GD5	93.885	.265	2	.876
Adopting innovative system	GD10	99.466	5.847	2	.054
Improving project management practices	GD1	93.620	.001	2	1.000
Improving sector governance	GD12	94.124	.504	2	.777
<b>Procurement Dimension</b>					
Eliminating errors in tender documents	MD9	94.509	.889	2	.641
Developing knowledge of the project management team	MD6	93.734	.115	2	.944
Ensuring the presence & experience of the consultant	MD3	102.067	8.448	2	.015
Developing project management process	MD1	94.191	.571	2	.752
Establishing technical & financial controls	MD4	94.720	1.101	2	.577
Ensuring completeness of designs	MD10	93.789	.169	2	.919
Establishing project implementation methodology	MD7	94.823	1.203	2	.548
Standardizing Procurement timeframe	MD8	97.249	3.629	2	.163
Benchmarking of project elements	MD5	94.578	.958	2	.619
Utilizing engineer's estimates	MD2	93.779	.159	2	.923
<b>Legal Dimension</b>					
Reviewing available legislation	LD4	94.030	.410	2	.815
Domesticating contract type	LD6	94.801	1.181	2	.554
Legislating rate analysis	LD2	99.755	6.136	2	.047
Legislating regulations for Price reasonableness analysis	LD1	94.523	.903	2	.637
Legislating procurement controls	LD3	97.169	3.550	2	.169
Legislating subcontracting policy & joint venture agreements	LD5	94.117	.497	2	.780
<b>Contractor Dimension</b>					
Improving technical ability	CD1	107.294	13.675	2	.001
Improving the qualification and competence of the contractor	CD2	95.639	2.020	2	.364
Developing resource capabilities	CD5	104.591	10.972	2	.004
Managing profit margin estimations	CD3	97.523	3.903	2	.142

Effect	Code	Model Fitting Criteria	Likelihood Ratio Tests		
		-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Improving stakeholder management	CD4	93.624	.005	2	.997
Developing project implementation methodology	CD6	93.770	.151	2	.927
Developing knowledge of procurement processes	CD7	98.147	4.528	2	.104
<b>Project Dimension</b>					
Making precise project quality requirements	PD2	94.182	.562	2	.755
Ensuring a steady flow of payments	PD8	93.749	.130	2	.937
Mitigating risk factors at inception	PD12	102.229	8.610	2	.014
Providing clauses for project variations/price adjustments	PD9	94.846	1.227	2	.541
Clarify the scope of the project from inception	PD4	98.405	4.786	2	.091
Accounting for project-location parameters	PD3	93.868	.249	2	.883
Accounting for the project environment	PD14	95.355	1.735	2	.420
Mitigating personnel/labor cost escalations	PD7	94.098	.479	2	.787
Accounting for the complexity of the works	PD11	95.212	1.593	2	.451
Accounting for nature and type of equipment	PD6	95.586	1.967	2	.374
Mitigating project costs	PD10	100.415	6.795	2	.033
Upholding project duration specifications	PD1	99.923	6.304	2	.043
Mitigating the impact of material-price escalations	PD5	99.536	5.916	2	.052
<b>Industry Dimension</b>					
Ensuring the protection of local firms	ID1	95.183	1.564	2	.458
Mitigating inflation rate impacts	ID2	93.646	.027	2	.987
Reducing imports	ID5	95.439	1.820	2	.403
Encouraging ownership of equipment	ID8	99.930	6.311	2	.043
Managing the number of competitors	ID10	97.886	4.267	2	.118
Mitigating interest rate impacts	ID3	95.799	2.179	2	.336
Managing nature and type of competition	ID6	93.874	.254	2	.881
Managing nature and type of firms	ID7	93.627	.008	2	.996
Ensuring knowledge transfer	ID13	94.084	.464	2	.793
Providing training	ID17	94.668	1.048	2	.592
Building capacity of local firms	ID11	93.875	.255	2	.880
Ensuring market predictability	ID12	94.978	1.359	2	.507
Removing industry uncertainty	ID9	101.034	7.415	2	.025
Instilling sector confidence	ID14	100.154	6.535	2	.038
Mitigating exchange rate impact	ID4	94.476	.857	2	.652
Alleviating effects of the existence of foreign firms	ID15	93.737	.117	2	.943
Ensuring supply chain management	ID16	93.628	.009	2	.996

The chi-square statistic is the difference in -2 log-likelihoods between the final and reduced models. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

**Table 11.16 Parameter estimates**

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)		
								Lower Bound	Upper Bound	
3	Intercept	45.188	.000	.	1	.				
<b>Government Dimension</b>										
	Improving stakeholder management	GD8	-26.045	124124.698	.000	1	1.000	4.885E-12	.000	. <sup>b</sup>
	Improving procurement methods	GD7	5.548	153478.146	.000	1	1.000	256.708	.000	. <sup>b</sup>
	Benchmarking price performance	GD4	6.310	149645.302	.000	1	1.000	550.208	.000	. <sup>b</sup>
	Establishing strategic awareness	GD2	-18.893	144983.393	.000	1	1.000	6.235E-9	.000	. <sup>b</sup>
	Improving payment flows	GD6	36.380	172320.304	.000	1	1.000	6303982191538866.000	.000	. <sup>b</sup>
	Ensuring active participation of local contractors	GD11	-9.931	190509.148	.000	1	1.000	4.866E-5	.000	. <sup>b</sup>
	Ensuring Continuous capability and capacity enhancement	GD3	-16.867	198462.831	.000	1	1.000	4.729E-8	.000	. <sup>b</sup>
	Incentivizing local contractor performance	GD9	5.226	127684.050	.000	1	1.000	185.986	.000	. <sup>b</sup>
	Improving client capabilities	GD5	8.101	130672.543	.000	1	1.000	3297.427	.000	. <sup>b</sup>
	Adopting innovative system	GD10	-42.439	38643.116	.000	1	.999	3.707E-19	.000	. <sup>b</sup>
	Improving project management practices	GD1	1.562	177854.237	.000	1	1.000	4.770	.000	. <sup>b</sup>
	Improving sector governance	GD12	20.522	181525.577	.000	1	1.000	817524199.322	.000	. <sup>b</sup>
<b>Procurement Dimension</b>										
	Eliminating errors in tender documents	MD9	3.100	140847.551	.000	1	1.000	22.188	.000	. <sup>b</sup>
	Developing knowledge of the project management team	MD6	-6.104	118546.577	.000	1	1.000	.002	.000	. <sup>b</sup>

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Ensuring the presence & experience of the consultant	MD3	5.952	101255.385	.000	1	1.000	384.612	.000	. <sup>b</sup>
Developing project management process	MD1	-19.606	187674.304	.000	1	1.000	3.057E-9	.000	. <sup>b</sup>
Establishing technical & financial controls	MD4	22.159	172601.825	.000	1	1.000	4203712184.314	.000	. <sup>b</sup>
Ensuring completeness of designs	MD10	-6.189	159439.007	.000	1	1.000	.002	.000	. <sup>b</sup>
Establishing project implementation methodology	MD7	-16.330	123898.206	.000	1	1.000	8.089E-8	.000	. <sup>b</sup>
Standardizing Procurement timeframe	MD8	14.890	271759.930	.000	1	1.000	2928733.484	.000	. <sup>b</sup>
Benchmarking of project elements	MD5	-1.129	205360.055	.000	1	1.000	.323	.000	. <sup>b</sup>
Utilizing engineer's estimates	MD2	9.252	104995.863	.000	1	1.000	10424.112	.000	. <sup>b</sup>
<b>Legal Dimension</b>									
Reviewing available legislation	LD4	-4.552	147468.558	.000	1	1.000	.011	.000	. <sup>b</sup>
Domesticating contract type	LD6	20.702	116278.899	.000	1	1.000	979127377.379	.000	. <sup>b</sup>
Legislating rate analysis	LD2	17.733	135293.806	.000	1	1.000	50283757.913	.000	. <sup>b</sup>
Legislating regulations for Price reasonableness analysis	LD1	3.279	84904.569	.000	1	1.000	26.538	.000	. <sup>b</sup>
Legislating procurement controls	LD3	4.067	204394.071	.000	1	1.000	58.387	.000	. <sup>b</sup>
Legislating subcontracting policy & joint venture agreements	LD5	.340	157254.786	.000	1	1.000	1.405	.000	. <sup>b</sup>
<b>Contractor Dimension</b>									

Construction tender price inflation <sup>a</sup>		Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Improving technical ability		CD1	4.649	187084.448	.000	1	1.000	104.452	.000	. <sup>b</sup>
Improving the qualification and competence of the contractor		CD2	-6.624	235320.995	.000	1	1.000	.001	.000	. <sup>b</sup>
Developing resource capabilities		CD5	16.670	91210.103	.000	1	1.000	17373846.146	.000	. <sup>b</sup>
Managing profit margin estimations		CD3	-.567	106392.987	.000	1	1.000	.567	.000	. <sup>b</sup>
Improving stakeholder management		CD4	-12.830	121586.696	.000	1	1.000	2.680E-6	.000	. <sup>b</sup>
Developing project implementation methodology		CD6	-12.544	182259.078	.000	1	1.000	3.568E-6	.000	. <sup>b</sup>
Developing knowledge of procurement processes		CD7	-10.051	123178.411	.000	1	1.000	4.313E-5	.000	. <sup>b</sup>
<b>Project Dimension</b>										
Making precise project quality requirements		PD2	9.044	132219.195	.000	1	1.000	8464.868	.000	. <sup>b</sup>
Ensuring a steady flow of payments		PD8	17.079	129668.965	.000	1	1.000	26130692.866	.000	. <sup>b</sup>
Mitigating risk factors at inception		PD12	-29.685	229450.086	.000	1	1.000	1.282E-13	.000	. <sup>b</sup>
Providing clauses for project variations/price adjustments		PD9	-18.204	217446.802	.000	1	1.000	1.242E-8	.000	. <sup>b</sup>
Clarify the scope of the project from inception		PD4	2.321	148729.754	.000	1	1.000	10.181	.000	. <sup>b</sup>
Accounting for project-location parameters		PD3	-1.917	214317.241	.000	1	1.000	.147	.000	. <sup>b</sup>
Accounting for the project environment		PD14	7.177	186338.357	.000	1	1.000	1308.514	.000	. <sup>b</sup>

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Mitigating personnel/labor cost escalations	PD7	9.390	367689.500	.000	1	1.000	11967.185	.000	. <sup>b</sup>
Accounting for the complexity of the works	PD11	-8.943	260358.141	.000	1	1.000	.000	.000	. <sup>b</sup>
Accounting for nature and type of equipment	PD6	18.490	153106.593	.000	1	1.000	107180565.608	.000	. <sup>b</sup>
Mitigating project costs	PD10	-1.942	165925.697	.000	1	1.000	.143	.000	. <sup>b</sup>
Upholding project duration specifications	PD1	-12.961	263946.019	.000	1	1.000	2.350E-6	.000	. <sup>b</sup>
Mitigating the impact of material-price escalations	PD5	-1.914	146251.507	.000	1	1.000	.147	.000	. <sup>b</sup>
<b>Industry Dimension</b>									
Ensuring the protection of local firms	ID1	-7.177	149059.897	.000	1	1.000	.001	.000	. <sup>b</sup>
Mitigating inflation rate impacts	ID2	-2.526	134620.124	.000	1	1.000	.080	.000	. <sup>b</sup>
Reducing imports	ID5	5.161	91598.319	.000	1	1.000	174.390	.000	. <sup>b</sup>
Encouraging ownership of equipment	ID8	-7.395	146915.470	.000	1	1.000	.001	.000	. <sup>b</sup>
Managing the number of competitors	ID10	14.494	135504.897	.000	1	1.000	1971798.617	.000	. <sup>b</sup>
Mitigating interest rate impacts	ID3	12.081	112275.229	.000	1	1.000	176404.336	.000	. <sup>b</sup>
Managing nature and type of competition	ID6	-29.990	199279.646	.000	1	1.000	9.454E-14	.000	. <sup>b</sup>
Managing nature and type of firms	ID7	13.734	174887.630	.000	1	1.000	921275.096	.000	. <sup>b</sup>
Ensuring knowledge transfer	ID13	-12.405	234916.894	.000	1	1.000	4.100E-6	.000	. <sup>b</sup>
Providing training	ID17	6.878	158128.362	.000	1	1.000	970.831	.000	. <sup>b</sup>
Building capacity of local firms	ID11	-2.106	210157.077	.000	1	1.000	.122	.000	. <sup>b</sup>

Construction tender price inflation <sup>a</sup>		Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
									Lower Bound	Upper Bound
Ensuring predictability	market	ID12	-3.388	105520.568	.000	1	1.000	.034	.000	. <sup>b</sup>
Removing uncertainty	industry	ID9	17.303	175840.192	.000	1	1.000	32693841.001	.000	. <sup>b</sup>
Instilling confidence	sector	ID14	-19.669	152946.287	.000	1	1.000	2.870E-9	.000	. <sup>b</sup>
Mitigating rate impact	exchange	ID4	-14.504	81211.558	.000	1	1.000	5.022E-7	.000	. <sup>b</sup>
Alleviating effects of the existence of foreign firms		ID15	18.324	115641.640	.000	1	1.000	90798070.678	.000	. <sup>b</sup>
Ensuring supply chain management		ID16	4.075	213366.658	.000	1	1.000	58.874	.000	. <sup>b</sup>
<b>4</b>		Intercept	1.046	3.046	.118	1	.731			
<b>Government Dimension</b>										
Improving stakeholder management		GD8	-.282	.761	.137	1	.711	.755	.170	3.355
Improving procurement methods		GD7	1.432	.968	2.185	1	.139	4.185	.627	27.924
Benchmarking price performance		GD4	-2.027	.983	4.253	1	.039	.132	.019	.904
Establishing awareness	strategic	GD2	.891	1.250	.508	1	.476	2.437	.210	28.213
Improving payment flows	payment	GD6	-.316	1.072	.087	1	.768	.729	.089	5.962
Ensuring active participation of local contractors	active	GD11	-.205	.940	.048	1	.827	.814	.129	5.143
Ensuring capability and capacity enhancement	Continuous	GD3	1.246	1.198	1.083	1	.298	3.478	.332	36.389
Incentivizing contractor performance	local	GD9	.368	.824	.200	1	.655	1.445	.288	7.262
Improving capabilities	client	GD5	-.500	.969	.266	1	.606	.606	.091	4.055
Adopting innovative system	innovative	GD10	-1.858	1.150	2.613	1	.106	.156	.016	1.484

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Improving project management practices	GD1	-.029	1.195	.001	1	.980	.971	.093	10.100
Improving sector governance	GD12	.611	.865	.499	1	.480	1.843	.338	10.039
<b>Procurement Dimension</b>									
Eliminating errors in tender documents	MD9	.690	.737	.876	1	.349	1.994	.470	8.464
Developing knowledge of the project management team	MD6	.311	.926	.113	1	.737	1.364	.222	8.373
Ensuring the presence & experience of the consultant	MD3	1.956	.812	5.801	1	.016	7.072	1.440	34.737
Developing project management process	MD1	.815	1.104	.545	1	.460	2.260	.259	19.680
Establishing technical & financial controls	MD4	-1.771	1.816	.951	1	.329	.170	.005	5.978
Ensuring completeness of designs	MD10	.398	.976	.166	1	.683	1.489	.220	10.073
Establishing project implementation methodology	MD7	-1.255	1.170	1.150	1	.284	.285	.029	2.825
Standardizing Procurement timeframe	MD8	-2.327	1.344	2.997	1	.083	.098	.007	1.360
Benchmarking of project elements	MD5	-.961	1.020	.888	1	.346	.383	.052	2.822
Utilizing engineer's estimates	MD2	-.326	.825	.156	1	.693	.722	.143	3.638
<b>Legal Dimension</b>									
Reviewing available legislation	LD4	-.557	.870	.411	1	.521	.573	.104	3.148
Domesticating contract type	LD6	1.151	1.118	1.060	1	.303	3.162	.353	28.302
Legislating rate analysis	LD2	-2.189	1.031	4.511	1	.034	.112	.015	.844

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Legislating regulations for Price reasonableness analysis	LD1	.818	.886	.852	1	.356	2.265	.399	12.867
Legislating procurement controls	LD3	1.738	1.002	3.009	1	.083	5.685	.798	40.500
Legislating subcontracting policy & joint venture agreements	LD5	-.633	.882	.514	1	.473	.531	.094	2.993
<b>Contractor Dimension</b>									
Improving technical ability	CD1	-3.333	1.190	7.843	1	.005	.036	.003	.368
Improving the qualification and competence of the contractor	CD2	1.609	1.226	1.723	1	.189	4.999	.452	55.281
Developing resource capabilities	CD5	-2.386	.940	6.447	1	.011	.092	.015	.580
Managing profit margin estimations	CD3	-1.348	.730	3.413	1	.065	.260	.062	1.085
Improving stakeholder management	CD4	-.066	.931	.005	1	.944	.937	.151	5.808
Developing project implementation methodology	CD6	.375	.963	.152	1	.697	1.455	.221	9.601
Developing knowledge of procurement processes	CD7	3.003	1.625	3.413	1	.065	20.138	.833	486.883
<b>Project Dimension</b>									
Making precise project quality requirements	PD2	.855	1.214	.496	1	.481	2.351	.218	25.370
Ensuring a steady flow of payments	PD8	.471	1.317	.128	1	.720	1.602	.121	21.184
Mitigating risk factors at inception	PD12	3.207	1.392	5.306	1	.021	24.708	1.613	378.469
Providing clauses for project	PD9	-1.280	1.246	1.056	1	.304	.278	.024	3.196

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
variations/price adjustments									
Clarify the scope of the project from inception	PD4	3.382	1.849	3.345	1	.067	29.428	.785	1103.118
Accounting for project-location parameters	PD3	-.840	1.698	.245	1	.621	.432	.015	12.032
Accounting for the project environment	PD14	1.501	1.214	1.527	1	.217	4.484	.415	48.448
Mitigating personnel/labor cost escalations	PD7	1.058	1.569	.454	1	.500	2.879	.133	62.383
Accounting for the complexity of the works	PD11	1.531	1.267	1.461	1	.227	4.621	.386	55.317
Accounting for nature and type of equipment	PD6	.972	.746	1.697	1	.193	2.644	.612	11.420
Mitigating project costs	PD10	-2.738	1.230	4.954	1	.026	.065	.006	.721
Upholding project duration specifications	PD1	-3.561	1.683	4.476	1	.034	.028	.001	.770
Mitigating the impact of material-price escalations	PD5	-2.148	1.016	4.468	1	.035	.117	.016	.855
<b>Industry Dimension</b>									
Ensuring the protection of local firms	ID1	1.145	.969	1.395	1	.238	3.141	.470	20.994
Mitigating inflation rate impacts	ID2	.206	1.256	.027	1	.870	1.229	.105	14.413
Reducing imports	ID5	.860	.708	1.476	1	.224	2.363	.590	9.460
Encouraging ownership of equipment	ID8	-1.713	.757	5.124	1	.024	.180	.041	.795
Managing the number of competitors	ID10	2.019	1.132	3.180	1	.075	7.529	.819	69.252
Mitigating interest rate impacts	ID3	-1.715	1.251	1.881	1	.170	.180	.015	2.088

Construction tender price inflation <sup>a</sup>	Code	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Managing nature and type of competition	ID6	-.597	1.193	.251	1	.617	.550	.053	5.703
Managing nature and type of firms	ID7	-.114	1.280	.008	1	.929	.892	.073	10.961
Ensuring knowledge transfer	ID13	-1.068	1.616	.437	1	.509	.344	.014	8.156
Providing training	ID17	1.123	1.124	.999	1	.318	3.075	.340	27.846
Building capacity of local firms	ID11	-.472	.939	.253	1	.615	.624	.099	3.927
Ensuring market predictability	ID12	1.688	1.532	1.213	1	.271	5.407	.268	108.930
Removing industry uncertainty	ID9	-3.635	1.688	4.636	1	.031	.026	.001	.722
Instilling sector confidence	ID14	3.861	1.965	3.861	1	.049	47.503	1.010	2234.172
Mitigating exchange rate impact	ID4	.762	.838	.826	1	.364	2.142	.414	11.079
Alleviating effects of the existence of foreign firms	ID15	-.403	1.179	.117	1	.733	.668	.066	6.737
Ensuring supply chain management	ID16	-.102	1.114	.008	1	.927	.903	.102	8.019

a. The reference category is 5.

b. The floating-point overflow occurred while computing this statistic. Its value is therefore set to system missing.

(Source: by the author)

**Table 12.5 Correlations of variables**

Case	Variables		Tender price (ZMW'million/km)	Forex rates	Inflation rates	Interest rates	FDI (US \$'Bn)	External Debt (US \$'Bn)
Upgrading of roads to bituminous standards	Tender price (ZMW'million/km)	Pearson Correlation	1	.844**	-.183	.538	-.391	.876**
		Sig. (2-tailed)		.001	.590	.088	.234	.000
		N	11	11	11	11	11	11
	Forex rates	Pearson Correlation	.844**	1	.136	.749**	-.491	.918**
		Sig. (2-tailed)	.001		.691	.008	.125	.000
		N	11	11	11	11	11	11
	Inflation rates	Pearson Correlation	-.183	.136	1	.449	-.531	.024
		Sig. (2-tailed)	.590	.691		.165	.093	.944
		N	11	11	11	11	11	11
	Interest rates	Pearson Correlation	.538	.749**	.449	1	-.651*	.779**
		Sig. (2-tailed)	.088	.008	.165		.030	.005
		N	11	11	11	11	11	11
	FDI (US \$'Bn)	Pearson Correlation	-.391	-.491	-.531	-.651*	1	-.462
		Sig. (2-tailed)	.234	.125	.093	.030		.153
		N	11	11	11	11	11	11
	External Debt (US \$'Bn)	Pearson Correlation	.876**	.918**	.024	.779**	-.462	1
		Sig. (2-tailed)	.000	.000	.944	.005	.153	
		N	11	11	11	11	11	11

Case	Variables		Tender price (ZMW'million/km)	Forex rates	Inflation rates	Interest rates	FDI (US \$'Bn)	External Debt (US \$'Bn)
Periodic maintenance of feeder roads	Tender price (ZMW'million/km)	Pearson Correlation	1	.829**	.467	.750*	.922**	-.831**
		Sig. (2- tailed)		.003	.173	.012	.000	.003
		N	10	10	10	10	10	10
	Forex rates	Pearson Correlation	.829**	1	.783**	.707*	.917**	-.892**
		Sig. (2- tailed)	.003		.007	.022	.000	.001
		N	10	10	10	10	10	10
	Inflation rates	Pearson Correlation	.467	.783**	1	.574	.584	-.649*
		Sig. (2- tailed)	.173	.007		.082	.076	.042
		N	10	10	10	10	10	10
	Interest rates	Pearson Correlation	.750*	.707*	.574	1	.825**	-.835**
		Sig. (2- tailed)	.012	.022	.082		.003	.003
		N	10	10	10	10	10	10
	FDI (US \$'Bn)	Pearson Correlation	.922**	.917**	.584	.825**	1	-.904**
		Sig. (2- tailed)	.000	.000	.076	.003		.000
		N	10	10	10	10	10	10
	External Debt (US \$'Bn)	Pearson Correlation	-.831**	-.892**	-.649*	-.835**	-.904**	1
		Sig. (2- tailed)	.003	.001	.042	.003	.000	
		N	10	10	10	10	10	10

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

(Source: by the author)