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Improving Procurement Selection Criteria for Managing Construction Tender-Price Volatility on Public Projects

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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

INTRODUCTION

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 the study by Oladapo and Odeyinka (2006), the multi-attribute evaluation of tenders submitted indicated that the most suitable contractor among those that tendered was not the lowest bidder. However, "using the 'lowest bidder' criterion would have resulted in a different contractor for the project. 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 when using the lowest bid method, while even the lowest bidder is concerned about securing 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). It is because inefficient firms bid 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 predicates that (government) procurement methods are inefficient and inhibit efficient project delivery. The research aims to identify procurement-related factors contributing to the failure to mitigate construction-tender price inflation and variability in Zambia. The study evolves around procurement selection criteria to manage construction tender-price variability and

inflation among construction firms. This research addresses specific causes of persistent construction tender price inflation and variability in Zambia. 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 study 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 study involves identifying strategies and listing challenges and assumptions contractors make in tender price formation. The assessment involves all levels of flexibility implementation in public construction pricing process and the provision of comprehensive future direction for the public construction sector.

LITERATURE REVIEW

The literature has been collated and consolidated to understand critical issues regarding the construction sector's procurement function. Firstly, the study identifies procurement-related factors that affect the construction sector from the research literature. Secondly, the study conceives procurement modeling approaches for managing construction that is in practice.

Procurement bottlenecks in the construction

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 firstly 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 (Tembo, et al., 2020). Procuring contractors through national and international competitive bidding is detrimental to 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 when contract awards are price based. Table 1 summarizes critical bottlenecks related to the procurement function in the construction industry.

Table 1 Key procurement bottlenecks in the construction

Construction Bottlenecks	Country	Author	Comments
• Procurement practices and systems • Supply chain integration and relationships • Structure of the construction industry • Lack of technology	South Africa	Mafini & Pillay (2017); Agenbag & Amoah (2021)	Research recommends; • creation of awareness and application of supply chain management in construction • local contractors to procure equipment
• Low investments in modern construction methods and technology • Access to information • Firm collusions • Firm-specific characteristics • Systematic inertia (red tape) • Weak institutional support and commitment • Weaknesses in transparency, accountability, and good governance • Corruption • Unfair advantages among foreign-owned firms	Zambia	Cheelo & Liebenthal (2020)	• The bottlenecks mainly affect construction prices and the quality of infrastructure • Firm-specific characteristics such as firm grade and category prevent competitive prices from emerging in the industry • It underscores the need to streamline, strengthen, and simplify the procurement processes The research recommends; • establishment of a contract unbundling policy or law • establishing a better local content policy and strategy with viable options to increase access to financing
• Waiting • Administration and bureaucracy • Decision issues • Communication issues • Lacking capacity	Norway	Eik-Andresen, et al. (2016); Zidane, et al. (2015)	The research recommends; • improved upfront planning and less bureaucracy • better competence among project members • more effective use of human resources • better project control and enhanced structures

Construction Bottlenecks	Country	Author	Comments
• Delays in information exchange • Poor project relationship and information management • 2D documentation • Overreliance on traditional procurement methods	Zambia	Chiponde, et al. (2017)	The research recommends adopting building information modeling (BIM) in the Zambian construction industry.
Ethical issues • Corruption • Political and societal influences	Zambia	Zulu & Muleya (2018)	The research explores the ethical dimension of the Zambian construction industry with a particular focus on students' perceptions.
• Political-bureaucratic constraints • Regulatory constraints	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
• Policy deficiencies • Late subcontractor involvement in the procurement process • Foreign contractors do not have an interest in developing local contractors' capacity • Lack of incentives	Zambia	Mambwe, et al. (2020)	The research proposes a framework to enhance the implementation of the subcontracting policy by the government
• Lack of experience in preparing tender documents • Poor time management	Zambia	Aigbavboa, et al. (2018)	The research proposes using government incentives to promote the growth of SMMEs in the Zambian construction industry.
• Globalization	South Africa	Dlungwana & Rwelamila (2014)	The research recommends the development of a procurement environment that promotes exceptional performance by local contractors
• Intensified competition from large firms • Lack of enabling environment	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
• Inadequate capacity of contractors • Complexities and risks in contracting • Ineffective management • Lack of business management • Poor record keeping	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
• Inadequately skilled labor • Poor quality • Low productivity	Brazil	Barbosa & Vilnītis (2017)	The research recommends construction firms increase competitiveness to flourish in the advent of globalization

Procurement approaches to managing construction

An informed approach to the selection of the most appropriate procurement system is central to the success of any public infrastructure project. Marovi´c, et al. (2021) developed a decision support system for selecting an optimal contractor, as depicted in Figure 1. The selection of an appropriate procurement system, which is 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 to be met" (Silwimba & Mwiya, 2017, p.10).

Al-Jawhar and Rezouki (2012) adopted the Delphi method 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, placing a set of 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 responds 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).

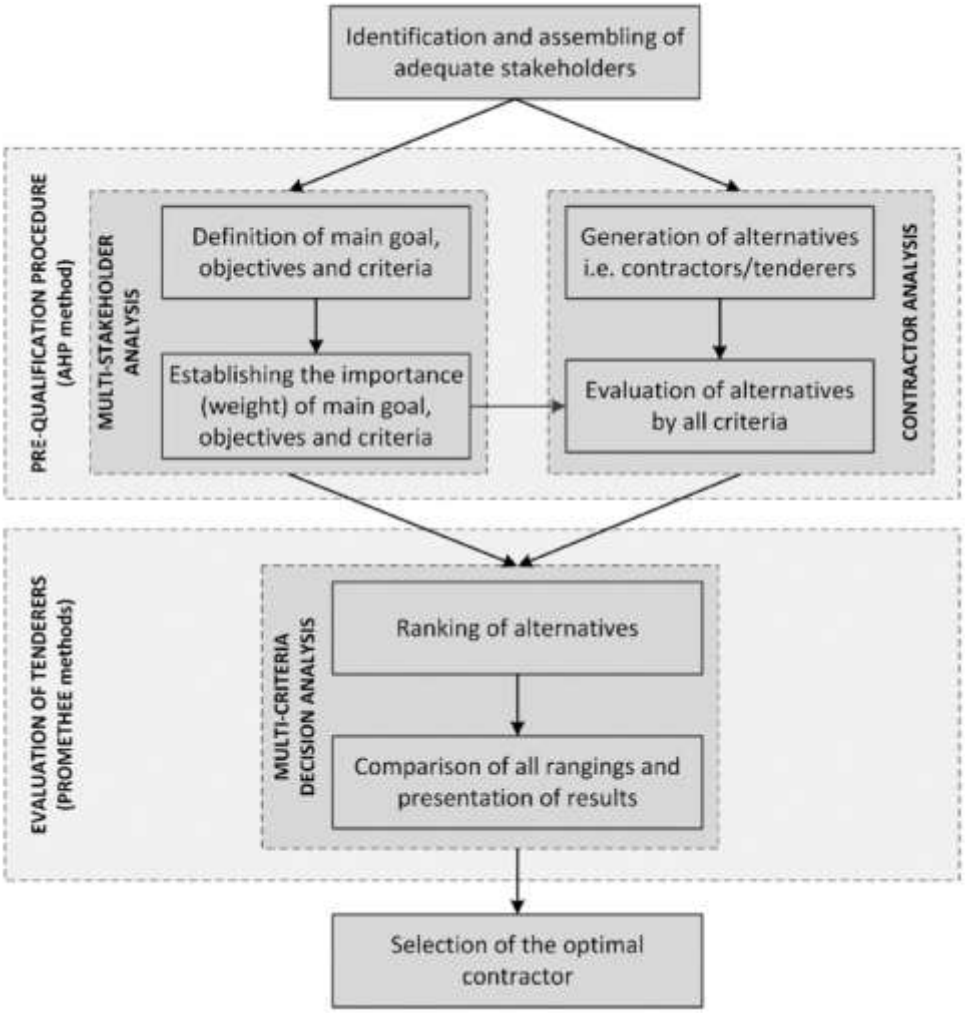

Fig. 1: Decision support concept for selecting optimal contractor (Adapted from Marovi´c, et al. 2021)

Ratnasabapathy and Rameezdeen (2007) developed a model that could 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 the selection of 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 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). 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. It aimed "to increase the probability of avoiding project failure related to cost overrun, poor quality and lack of functionality, in addition, to ensure more transparency in the tender evaluation process" (Meland et al, 2011, p1). 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 low prices. Other factors that increase the probability of avoiding project failure are cost overrun, 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 indicates that the ETP model demonstrates transparency, more robustness for adding more qualitative elements into the model, and: a lower risk of manipulation when country-specific conditions are built into scores and weightings.

El Agha (2013), in the study on project procurement in the Gaza strip, recommended the use of a conceptual framework that utilizes a multi-attribute utility approach (MAUA) as a decision support system for the selection of appropriate construction procurement methods (Figure 2). 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 3). Furthermore, the model facilitates (El Agha, 2013, p.102) assists clients and their representatives in the initial decision on making an appropriate procurement selection for any construction project. The models ensure a systematic and consistent approach to procurement selection by applying appropriate research methods that provide a better understanding of selection criteria that affect procurement selection and various types of alternative construction procurement systems and report on a ranked list of procurement systems. The multi-attribute-utility-theory (MAUT) is applicable primarily when decision-makers require an assessment of the value of possible outcomes. The approach is based on utility functions and has become a technique for measuring objectivity and appropriately examining client requirements against the preferences of procurement experts and consultants.

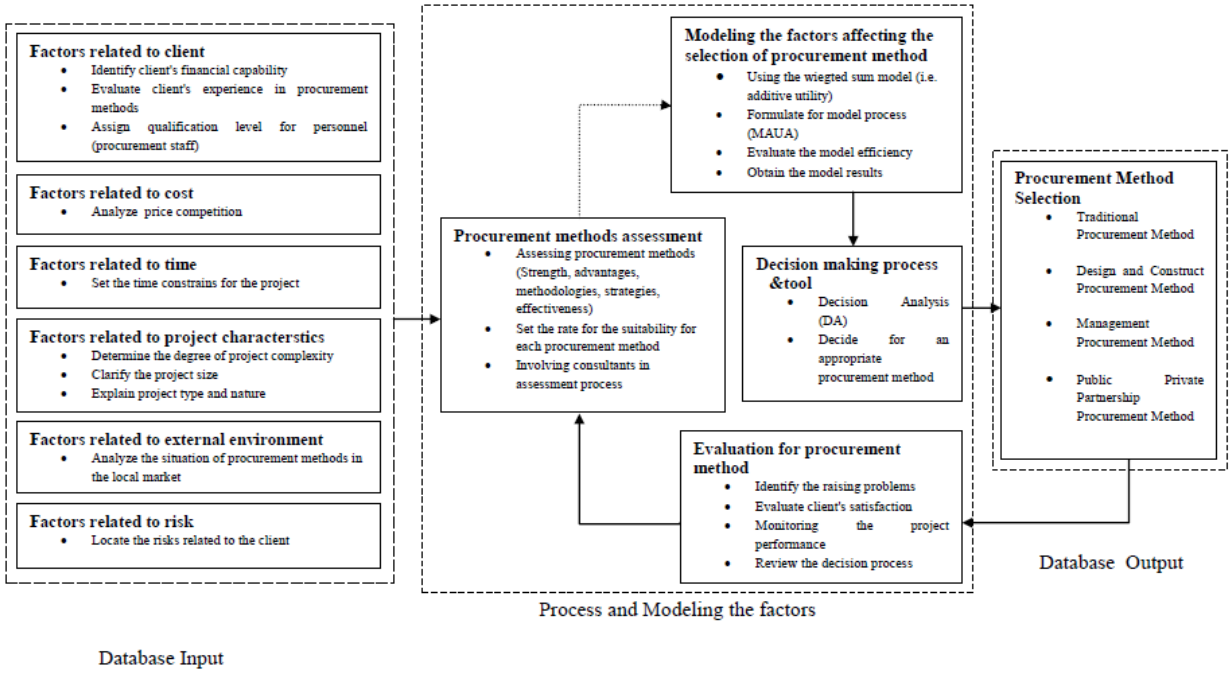

Fig. 3: Framework for the selection of an appropriate procurement method (Adapted from El Agha, 2013, p.104)

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. Their proposed framework remains untested regarding realistic implementation and meeting perceived benefits. Ogunsanmi's (2013) findings further show that cost, time, and quality determine procurement method selection. Additionally, the study summarizes its findings in Table 2. Criteria for selecting a procurement method include (El Sawalhi & El Agha, 2016, p.3) "quality level, risk allocation/avoidance, flexibility to change design during both design and construction period. Others include responsibility, complexity; price competition, the certainty of cost and time, disputes and arbitration; project type, client's experience, experienced contractor availability, client's willingness to be actively involved, project site location, client's trust in other parties, political constraints, project size, regulatory impact, market competitiveness, client's requirement for value for money, material availability and client's financial capability".

Table 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	• Fails to detect malicious low price – tender offer below the cost • Fails to identify project cost • Dependent on the expert's grasp of project content
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	• Fails to mitigate susceptibility to unethical and corrupt practices • Fails to detect and minimize Single-point-responsibility abuse • Lacks framework for assessing & mitigating frontloading risks
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 (CBA) Model	• Lacks framework for a cost comparison • Overly dependent on assumptions and expert judgment • Fails to model subjective views of decision-makers • Fails to embed consistency checks in decision making

Author	Attributes	Approach	Observed gaps in the approach/strategy
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	• Lacks the framework for low technology use • Fails to perform price sensitivity analyses
Afolayan, et al. (2018)	Contractors' financial stability, contractor's technical capability, contractor's past performance, management capability, experience, reputation, and safety	Analytic Hierarchy Process	• Lacks generic model • Lacks comprehensive discrimination among alternatives • Can give different solutions to the same problem
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)	• Fails to produce ideal results when combined with traditional elements • Fails to mitigate its high cost of implementation • Implantation of its four phases effortlessly consumes time • No framework for bid price reduction • Restrains competitive innovation
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	• Fails to mitigate against unethical and corrupt practices • Difficult to justify

Author	Attributes	Approach	Observed gaps in the approach/strategy
			• Fails to establish the extent of permissible consultations or restrictive dialogue
Hastie, et al. (2017)	Knowledge interconnectivity, integration of disciplines, collaborative environment, inter-organizational integration,	Early Contractor Involvement (ECI) procurement	• Lacks the methodology for implementing complex knowledge integration • Restrain competitive innovation • Difficulties in establishing the collaborative framework
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	• Complications when data attributes and information are imprecise and non-deterministic • The methodology still requires enhancements

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) and factors considered when selecting or constructing a procurement method. He further argues there is an inherent need to match the resources and objectives with choices to achieve an optimal project performance or outcome. On the other hand, he developed a framework for developing a procurement strategy based on the four components (Figure 2.8), including pricing and contracting processes.

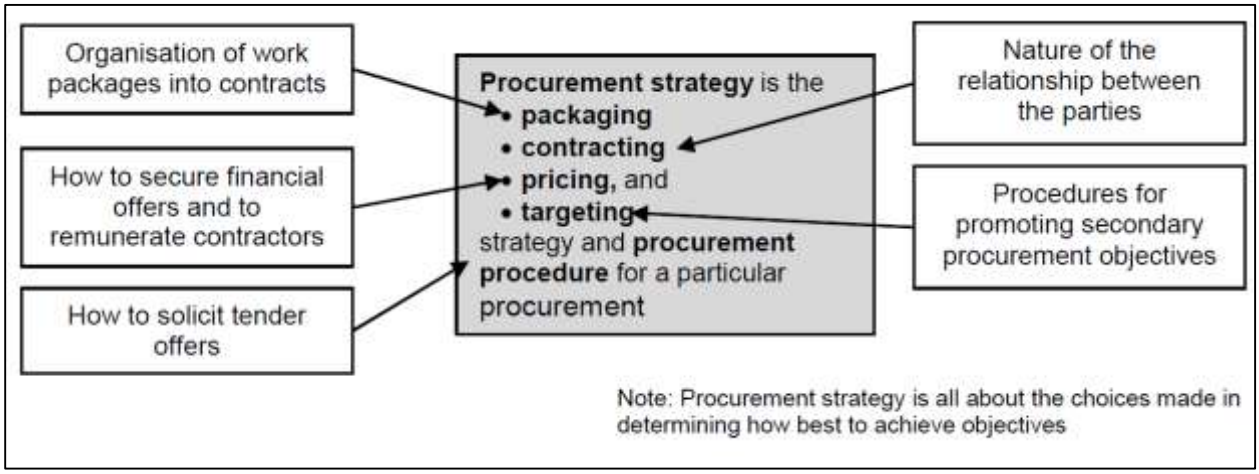

Fig. 4: Components of a procurement strategy (Adapted from Watermeyer, 2012, p. 224)

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 is the price the government or a client pays to procure works, goods, or services. Literature has also shown that procurement covers various tasks, activities, and responsibilities, including 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 reasonable price and 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) points out a 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 expenditure in the public sector whenever it concerned 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 5). 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 2.10) would assist the government in carrying out timely reviews of procurement strategies that are currently in use.

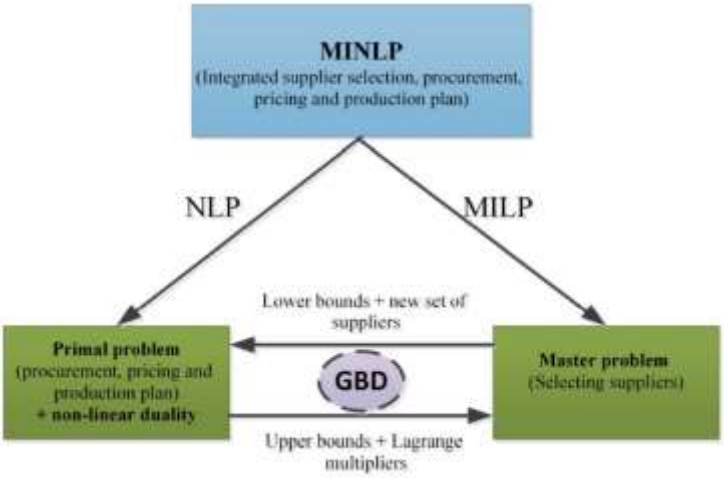

Fig. 5: Schematic of proposed generalized benders decomposition (Adapted from Yaghin & Goh, 2020, p. 9)

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).

RESEARCH METHODOLOGY

Eriksson & Westerberg (2009) adopted a literature review to comprehend the relationship between procurement and construction project performance. At the same time, Jeptepkeny (2015) employed a structured questionnaire and descriptive statistics to investigate relationships between procurement procedures and project performance. Correspondingly, this research adopted interviews to collect qualitative-primary data and utilized a literature review for secondary data collection. The interviews targeted 14 professionals working in the construction industry in Zambia. The professionals were purposively sampled based on their experience and prominence in the sector. Quantitative data collection utilized a questionnaire survey. The survey sample was drawn from consulting engineers, architects, quantity surveyors, and contractors. The

questionnaire-survey design established common indicators (and their importance) of improved procurement selection criteria for managing construction tender price variability and inflation. The study utilized ordinal level measurements: strongly disagree, disagree, neutral, agree, and strongly agree. The study obtained 147 valid responses from the questionnaire survey.

Further, the study adopted a mean score rating to characterize critical indicators. The study distributed 170 questionnaires to construction industry practitioners. Out of 170, the study collected and accepted 147 questionnaires. Table 3 shows 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 3 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%

RESEARCH FINDINGS

A literature study and documentary review examined factors as indicators for managing tender-price volatility and established which strategy would be appropriate for use. Therefore, audit and annual reports were analyzed to identify critical indicators. The study identified eight (8) essential indicators for an improved procurement selection criterion appropriate for managing construction tender-price variability and inflation. Key indicators identified through documentary reviews and confirmed through key informant interviews are collated into eight categories and presented in Table 4. Table 4 further shows the relationships between procurement-selection-criterion vital indicators and the adopted pricing structure derived from interviews.

Table 4 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 economical price	8	18	increase markup	Establishing technical & financial controls
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%		

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 mean scores in Table 5. 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-price in public projects.

Table 5 Respondents' mean scores for critical indicators and commonalities for principal factor analysis

No.	Indicator	Turnaround Strategy	Mean	Rank	Initial	Component No.
1	Availability of preferential systems for targeting local firms	Ensuring the protection of local firms	4.19	4	1.000	8
2	Ability to use engineers' estimates, detect collusion and fraudulent bidding practices	Benchmarking price performance	4.09	6	1.000	1
3	Ability to achieve value for money	Establishing technical & financial controls	4.29	1	1.000	3
4	Availability of procurement principles that are specific to construction	Legislating regulations for Price reasonableness analysis	4.05	7	1.000	5
5	Domestication of procurement processes and provisions	Legislating procurement controls	4.14	5	1.000	7
6	Completeness of tender documents and designs	Eliminating errors in tender documents	4.02	8	1.000	2
7	Standardizing and reducing procurement timeframe	Standardizing Procurement timeframe	4.25	2	1.000	4
8	Adequacy of procurement provisions for construction projects	Legislating subcontracting policy & joint venture agreements	4.20	3	1.000	6

The data for factor analysis gives the key indicators and their corresponding strategy for improving procurement selection criteria to manage construction tender-price variability and inflation. The question is whether the key indicators can enhance procurement function to manage construction tender-price on public infrastructure projects, with the appropriate strategies, using factor analysis. Table 6 shows the percentage variance using principle-component-extraction analysis. The study utilizes the Kaizer stopping criterion to determine the number of indicators to extract. The Table indicates that only one indicator has an Eigenvalue (5.388) greater than 1.

Table 6 Percentage variance of strategies as a 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

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 6 showing that only one factor is extracted after meeting the cutoff point (indicators with Eigen values greater than 1). The "% of variance" in the Table shows that 67.3% of total variability is attributable to benchmarking price performance. While eliminating errors in tender documents accounts for only 6.8% of the variability in all eight variables, and so on. However, the scree plot (Figure 6) leads to a different finding as the slope of the curve levels out after two indicators rather than one.

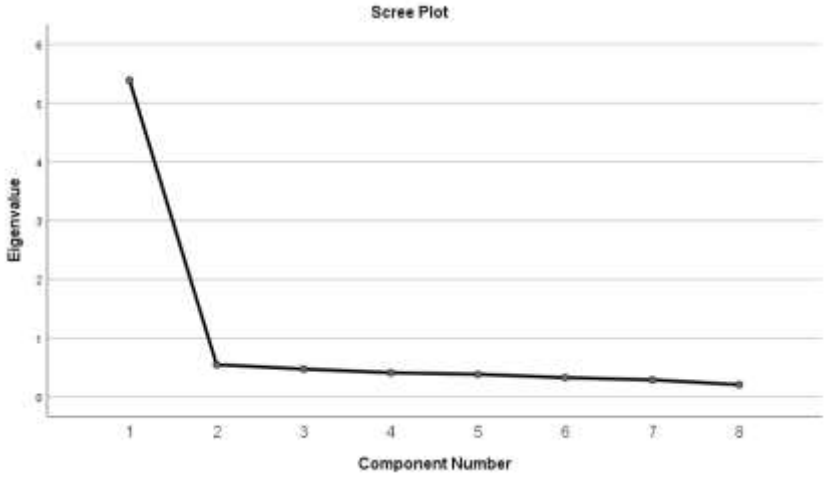

Fig. 6: Scree plot of eight key indicators

Table 7 shows indicators that meet the cutoff point criterion based on the Scree plot. Benchmarking price performance accounts for 40.457% of the variability, and eliminating errors in tender documents accounts for 33.693%. It gives a cumulative 74.151% variability from rotational sums of square loading (extraction method).

Table 7 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	-	-	-

The rotated component matrix in Table 8 shows 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 8 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

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, as depicted in Figure 7.

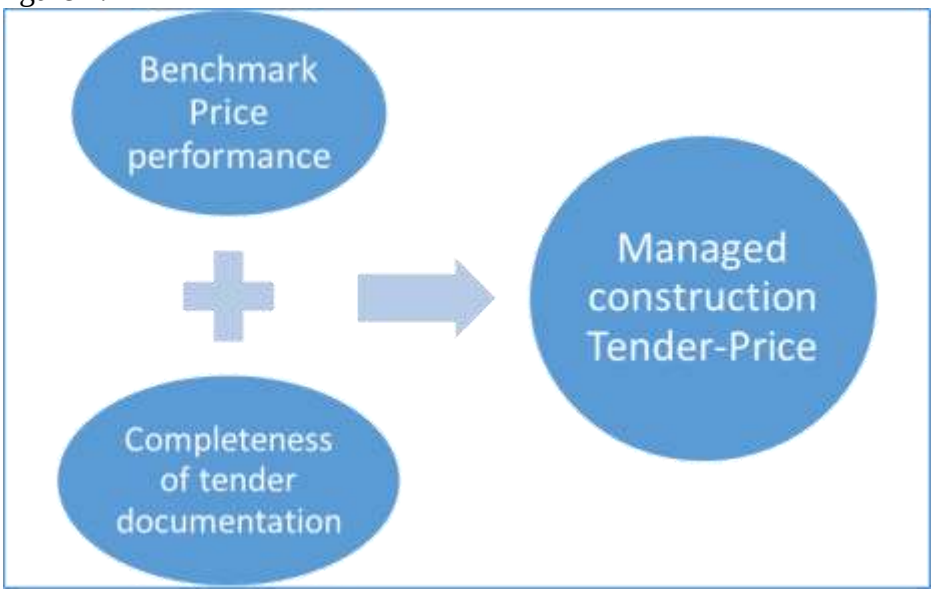

Fig. 7: Procurement selection criterion key indicators for managing tender-price

RESEARCH DISCUSSION

The study shows that the client must 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 variability and inflation includes two indicators related 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 misleading to bidders during tendering. Using the legal methodology, Kamil et al. (2018) found contractors had inferior abilities to rectify tender documentation mistakes, at most bidders continued tendering despite apparent noticing errors. The study approves the need to develop a detection and correction mechanism for dealing with contractors' mistakes 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 price benchmarking factor and its weighting in contract award is worthwhile. Assertions in the agreement include those of Markin (1992) that price benchmarking is the critical factor in decision-making and pulling together crucial information for project planning purposes.

CONCLUSION

The paper argues that improving the procurement selection criterion can significantly contribute to the 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. Tender 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 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.

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