

Critical Factors Influencing Bid Mark-up Decision in Public Street Project – A Review

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ABSTRACT

Deciding a bid price with an appropriate mark-up added to the estimated project cost is essential for the contractors' business survival. However, the competitive environment had influenced contractors to offer the lowest bid price, leading to the submission of unrealistically low prices to win bids. This practice can impact disputes and adversarial relationships between parties during construction and provide an additional risk to the project delay, cost overrun, quality compromise and failure to complete the project. Therefore, this paper aims to provide an overview of the literature on critical factors influencing bid mark-up decisions in public street projects. The objectives are to identify methods and tools, including the critical factors in determining the contractors' bid mark-up decision. The approach is based on analysing pertinent publications on the theme. The top five (5) ranked factors influencing contractors' decision on bid mark-up size can be found in the literature: the number of bidders, the competitiveness of other bidders, relationship and experience with clients, experience on similar projects and project size. Besides that, the determination of mark-up size is based on experience, intuition, past bidding results, past bidding patterns of competitors, the client's tender estimate, the client's record, and financial ability.

INTRODUCTION

The government is the main contributor to infrastructure projects in Malaysia, like any other developing country. According to Tayeh et al. (2019a), bid pricing for infrastructure projects is complex because of the competitiveness and fragmented nature of the construction industry. Zakaria et al. (2017) mentioned that the project site for an infrastructure project needs to cover a long boundary distance, whereas the building project is confined to a bounded area. Unlike building, construction projects have many different elements

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and trades, with lots of subcontractors engaged with the main contractor (Dulaimi & Shan, 2002). The conventional method, known as Design-Bid-Build (DBB), is the most extensive procurement method to be used in the Malaysian construction industry rather than non-conventional methods such as Design-Build and Construction Management (Yap et al., 2019; Suratkon et al., 2020). Likewise, government projects usually use repetitive standard designs imposed by the authority to follow cost and standard guidelines for cost accuracy (Azman et al., 2013).

Globally, the procurement system is mainly facilitated via competitive bidding (Khosro et al., 2021). Contractors' lowest-cost bidding globally drives the construction business's competitive nature (Dulaimi & Shan, 2002; Mohamed et al., 2017). Contractors have the most challenging job of winning a tender through intense competition in the construction industry (Alkhateeb et al., 2020). For overestimated bids, the contractors most likely will not win any bids. However, with an underestimated bid, the contractor is likelier to win a tender but suffers a profit loss (Zainon et al., 2016). In a competitive tender, many contractors submit bids without securing the construction projects. The contractors must profit and win tenders as the only way to survive in the competitive construction business (Oyeyipo et al., 2016).

After a decision to bid, the next step requires the contractor to evaluate the bid price (Oo et al., 2022b). After completing the cost estimate, the contractor must assess the project's price. It involved the decision to have a bid price with an appropriate mark-up add up to the estimated cost of a project (Zainon et al., 2016). Typically, the bid mark-up contains the sum of profit, overhead and risk contingency, calculated as a percentage of project costs. The mark-up size may vary from five (5) to more than twenty (20) per cent of the project cost. The effectiveness of making bid decisions in different bidding situations plays a vital role in contractors working out the estimate into a tender bid (Oyeyipo et al., 2016). The correct choice in bidding decision-making strategies based on the given factors may cause contractors' businesses to succeed in any construction project (Oo et al., 2022b).

Problem Statement

Government agencies are imposed to follow the public bidding circular, mainly to use the method of the low bid price in selecting contractors (Awwad & Ammourey, 2019). The competitive environment influenced contractors to offer the lowest bid price to be selected for the award (Dulaimi & Shan, 2002; Mohamed et al., 2017). In Malaysia, the problem of low bid price submission in government projects has always been the main issue in procuring authority (Azman et al., 2013). The public street projects in Selangor are mainly awarded based on the lowest bid price submitted by the qualified contractor (Perbendaharaan Negeri Selangor, 2014). This basis has led the contractors to submit unrealistically low prices to win bids (Awwad, 2010). It means that a bid price is submitted below or at the level of the assessed costs (Hanák et al., 2021). Inevitably, it also caused concern to the procuring authority at the Government agency of the District Level of the possible risk of selecting a bidder who deliberately submits an abnormally low bid price (Selected Committee of Local Authorities, 2019).

The practice can impact disputes and adversarial relationships between parties during construction. It also provides additional risk to the project delay, cost overrun (Awwad & Ammourey, 2019), quality compromise and failure to complete the project (Kissi et al., 2017). Empirical findings from an earlier study by Hanák & Muchová (2015) emphasised that infrastructure projects have greater competition than building projects, thus greater competition leading to a higher risk of the projects having abnormally low bids. Many problems happen, especially in infrastructure projects rather than other construction projects, which result in poor project performance and low client satisfaction (Tayeh et al., 2019a). Moreover, the small project is chosen as the focal point of concern in this study because small contractors are prone to have inaccurate cost estimates. Aibinu & Pasco (2008) revealed that contractors' estimates are more biased in smaller and larger projects.

Numerous bidding models have been developed to review the dynamics behind bid pricing in various conditions and surroundings to facilitate decision-making (Awwad & Ammouy, 2019). However, the contractors mainly make the considerations based on intuition and experience (Adnan et al., 2018). The prejudices of decision-making and the conventional use of competitive bidding in the construction industry have been the motivational drive for researchers worldwide to acknowledge the importance of factors influencing bid decision-making by contractors (Oo et al., 2022b). Furthermore, these models are convoluted, time-consuming and overburdened with data processing for contractors to make bidding decisions (Ghodoosi et al., 2021).

Scope of Study

This study focused on civil engineering works with limitations to public street projects as it is crucial to facilitate the movement between society. This type of infrastructure is an essential part of public assets in Malaysia, especially for developed states. The state of Selangor is chosen to be an area of study because it has the largest population and economy and is the most developed state in Malaysia (Ab Hamid et al., 2023). It has the best infrastructure network, including road and transportation systems, communication networks, sewage, water supply, and electricity systems (Selangor, 2021). In 2020, it was the second highest population district in Selangor, comprising 1,400,461 people covering an area of 829.4 km², including seven sub-districts inclusive of four (4) parliamentary seats and nine (9) state legislative assembly seats (Department of Statistics Malaysia Official Portal 2020). The State Government has appointed the Public Work Department (PWD) and Municipal Council at the district level as the contracting authorities to procure most of the public street projects. The public street projects involve the maintenance of state road pavement, road furniture, drainage, slope protection and various facilities (Selected Committee of Local Authorities, 2019).

Specifically, for this study, the scope of the research focused on public street projects in Hulu Langat District, Selangor. This research was carried out because of the immense issue of abnormally low bid prices faced by contracting authorities at the district level carrying out the procurement process for projects funded by the state government and Malaysia Road Record Information System (MARRIS) when most of the successful bidders were selected had shown the reduction in the bid price was significantly high, up to 30% compared to the client's estimated price (Selected Committee of Local Authorities, 2019). Public street projects are major infrastructure projects that require significant funding, planning, and execution. In the bidding process, contractors must submit a proposal detailing their approach to the project, along with a price mark-up that will determine the project's final cost. The bid mark-up decision is a critical factor in determining whether a contractor wins or loses the project. This paper will explore the critical factors influencing the bid mark-up decision in public street projects.

Methods

This paper extensively reviews the normative literature to comprehensively understand methods and tools, including the critical factors in determining the contractors' bid mark-up decision in public street projects. First, to conduct a systematic review of the literature, a web-based search was carried out, and thirty research reports and papers (refer to References) were selected for conducting further research. Second, the following search query in Scopus within the articles titles, abstract, and keywords of papers in the above journals: "critical factors", "construction", "bid mark-up", and "public street projects". This research generated forty-eight (48) papers. After detailed reading, thirty-two (32) were deemed relevant to the review and included. Third, the studies were analysed in detail to identify the input and output side of productivity measurement, i.e., the level of analysis, the indicators, and the sources of data used.

The paper consolidates the current debate on the meaning and relevant issues regarding factors influencing contractors' bid mark-up decisions. Other research findings regarding the factors influencing contractors' bid mark-up decisions were compared. The articles then purified different viewpoints

concerning the relative importance of bid mark-up decisions in public street projects. Lastly, due to such complexity, providing critical factors to enhance contractors' bid mark-up decisions is essential.

LITERATURE REVIEW

Challenges in Construction Bidding

The construction industry faces the problem of tendering in an environment of intense competition. Currently, every country's public sector procurement of the construction industry is mainly based on awarding contracts to the lowest bidder (Cheaitou et al., 2019). Low-ball bidding was found to be excessively used in the Hong Kong construction market as a competitive strategy for bidding (Tan et al., 2010). This medium happens because construction projects are awarded based on the lowest tender price that meets specifications (Dulaimi & Shan, 2002; Mohamed et al., 2017). Contractors must submit their lowest offer through the competitive bidding system, often leading to unrealistically low bid prices and inferior project quality (Lo et al., 2007). The effect of awarding projects to the lowest bidder permits the unrealistic submission of a low bid price, which raises the risks of delay in completion, cost overruns (Awwad & Ammouy, 2019), lack of quality, failure to complete the project (Kissi et al., 2017), claims for variations, and disputes between construction parties that may lead to a court of law for adjudication (Awwad, 2010).

Incorrect Cost Estimate Done by the Contracting Authority

The reason for the abnormally low bid price was an incorrect cost estimate done by the contracting authority about the contractors' highly efficient delivery of construction processes (Heralová, 2015; Hanák et al., 2021). Correspondingly, in the Malaysian construction industry, the Public Works Department prepared estimates that were usually overestimated rather than underestimated (Azman et al., 2013). Smaller contracting authorities typically do not have enough expertise to accurately estimate the costs of projects (Hanák et al., 2021). Notwithstanding, Heralová (2015) discovered a significant difference between the in-house database price and the minimum price estimated from the submitted bids for road infrastructure projects in the Czech Republic. Bid prices only consider 60% to 70% of the expected price calculated by the contracting authority. The huge dissimilarity is mainly because of lower indirect costs and profit rates. Significant differences in direct costs of up to 30% can be obtained by obtaining lower material costs from rebates when buying materials, using plants with high performance, and using lower-cost plants and equipment that have previously been written off.

Intense Competitive Environment

Hanák et al. (2021) surveyed that contractors in the Czech Republic deliberately submitted unrealistically low bid prices in a highly competitive environment that forced them to lower their bid prices significantly because of the need to survive during economic decline, marketing references for future job prospects, preventing unemployment of staff, and the difficulties of reappointing new employees. Likewise, Yang & Wang (2003) mentioned that contractors intended to bid below a reasonable price to ensure their company's survival.

Need for More Understanding in the Field of Estimation

Awwad & Ammouy (2019) also agree that contractors often submit unrealistically low bids because of inaccurate estimates or intentionally practise low bid pricing. Hanák et al. (2021) concluded that the smaller a company is, the less it can deal with a bid price estimation. Nevertheless, the contractors practise intentionally submitting a low bid in anticipation of making a profit through change orders and claims during the project's construction (Bista & Dahal, 2018). According to Bhatta (2014), predatory bidding happens when a contractor practices submitting an abnormally low bid by carefully studying the bid

documents and searching for mistakes to cover loss through change orders and claims during the construction project. The contractor intentionally submits a lower bid, making a small sacrifice to recoup the profit later. Likewise, Alexandersson & Hulten (2006) discover that a lack of education can motivate the submission of an abnormally low bid. The firm may submit the lowest bid to drive out or worn-out competitors under the assumption that groups of competitors can be expelled from the competition. Besides that, the contractor intentionally presumed profit could be gained by creating new work variations. The estimators may have made mistakes in calculation unintentionally or simply because of uneducated practices.

Insufficient Bidding Period

Previous research has reported that cost estimates by contractors can be inaccurate due to insufficient time during the bidding period (Ye et al., 2014; Bista & Dahal, 2018; Tayeh et al., 2019). For example, in the Gaza Strip, due to the limited period provided to the contractor in the pricing of the tender, most of the contractors in infrastructure projects did not examine the tender documents thoroughly. Hence, many errors occurred in the pricing (Tayeh et al., 2019a). Likewise, according to Bista & Dahal (2018), unrealistic norms, for instance, insufficient time to prepare the bid, may cause a significant calculation error. This challenge has a greater impact on small-sized contractors than on medium- and large-sized contractors since enough time has improved contractors' assessments of the project intended to be bid on according to the procurement method to prevent companies' losses (Muhammed et al., 2022). Since a limited time is given, contractors rely prominently on intuition and experience in making bid pricing decisions (Lesniak & Plebankiewicz, 2015; Ye et al., 2014). An empirical study has shown that contractors' estimates are more biased for more minor projects than larger ones (Aibinu & Pasco, 2008).

Lack of Cost Information

Many problems also arise when conducting cost estimating due to a lack of preliminary information, a lack of a cost database, and a lack of suitable cost estimation methods (Mahamid, 2011). According to Bhatta (2014), a lack of cost information due to unreliable historical data and unsuitable cost estimation norms results in an underpriced bid. Research by Suratkon et al. (2020) revealed that in Malaysia, lack of price certainty is a primary concern, resulting in a low probability of a project being completed at the predetermined cost for the procurement method of Design-Bid-Build.

Unethical Behaviours

Some contractors also make it easy to submit bids by using unethical and unscrupulous approaches. According to Awwad (2010), unethical collusion among bidders usually happens in competitive bidding, whereby groups of bidders arrange their bid prices before submission to control competition and share profits after winning the project. An empirical finding from an earlier study by Hanák & Muchová (2015) detected an extreme decrement between the expected price and award price in a tender, which showed potential signs of a cartel. Besides that, pricing manipulation may occur in the item in the bid by unbalanced bidding. Nystrom (2015) mentioned that unbalanced bidding includes 'front-loading, in which contractors submit high bids at the beginning of the construction process to cover the project cost quickly. The price reduction will be noticeable later, at the end of the construction process. The main purpose of 'front loading' is to improve the contractor's cash flow, but eventually, it will lead to further complications during construction management.

CRITICAL FACTORS INFLUENCING THE CONTRACTORS' BID PRICING DECISION IN PUBLIC STREET PROJECTS

There are many factors influencing the bid mark-up decision of the contractors. Several recent studies have been made on different countries from year 2016 until year 2022. For instance, Zhang et al. (2022) examined essential factors influencing the bid mark-up decisions of large and medium-sized contractors in the Jilin Province of China. Perera et al. (2021) discovered several factors affecting the contractors' bid mark-up decisions for infrastructure projects in Sri Lanka. Tayeh et al. (2019a) assessed several factors that affect the bid mark-up by contractors in the Gaza Strip. Adnan et al. (2018) surveyed several essential factors influencing large-sized contractors' decision to bid mark-up in Malaysia. In 2016, these researchers came across different important factors chosen by construction contractors in Nigeria (Aje et al., 2016). As referred to the approach from a previous research study by Chileshe et al. (2020) on a related study on bid decisions, the differences in the ranking of factors only included the top five (5) ranked factors and the lower quartile, as shown in Table 1.

Most recently, a research study by Oo et al. (2022b) compiled twelve (12) relevant studies over the past twenty (20) years published between the years 2002 and 2021 to examine the factors influencing contractors' bid mark-up decisions, as shown in Table 2. The study aims to acknowledge a global perspective of critical factors influencing contractors' bid mark-up decisions by statistical meta-analysis. The findings showed the generalisation of the result to a global context of twenty-three (23) critical factors and the ranking shown in Table 3.

Bidding Characteristics

The bidding features examined in the meta-analysis conducted by Oo et al. (2022b) encompassed several factors, namely the competitiveness of other bidders, number of bidders, tendering procedure, completeness of tender documents and time allowed for submitting bids. According to Oo et al. (2022b), the bidding factors that received the highest consideration were the competitiveness of other bidders and the number of bidders. The interrelation between the first two (2) factors can be observed as Carr (2005) suggests that increased bidders lead to heightened market competitiveness. Consequently, contractors are compelled to maintain a lower mark-up to enhance their prospects of securing a successful bid.

Furthermore, the tendering procedure is prominent among the twenty-three (23) variables, as indicated by its inclusion in the top ten (10). This medium underscores its importance, emphasising the necessity of implementing pre-qualification measures within the tendering process (Oo et al., 2022b). Selective competitive bidding has been utilised in procurement, evaluating contractors' competencies. This approach is seen as crucial as it enables the assessment of their ability to perform by specifications and contractual obligations (Kementerian Kewangan Malaysia, 2020). Nevertheless, because of the limited number of participants, there is an escalation in the cost of the undertaking (Abdullah, 2020).

The assessment of the mark-up's magnitude should also consider the completeness of tender documents (Oo et al., 2022b). The accuracy of cost estimates relies heavily on the comprehensiveness of design papers (Heralová, 2015) and the abundance of project information (Awwad, 2010). According to Perera et al. (2021), seasoned bidders tend to incorporate a more significant margin for risk in their proposal mark-ups when the available information is inadequate and the bid documents are deficient. Furthermore, assessing the mark-up size necessitates considering the allotted time duration for bid submission (Oo et al., 2022b). Owing to the limited time allocated to contractors within the tender's pricing framework, a significant portion of infrastructure contractors in Gaza fail to examine all the tender documents thoroughly. The occurrence of errors in pricing can have significant implications, leading to cost deviations that exceed initial predictions (Tayeh et al., 2019a). According to Perera et al. (2021), seasoned bidders frequently adjust their proposals by increasing the prices to account for heightened uncertainty.

Client Characteristics

In the meta-analysis conducted by Oo et al. (2022b), the client characteristics encompassed a single factor which is the relationship and historical experience with the client. In construction contracting, skilled and adept contractors facilitate a company's ability to present a more competitive proposal with a reduced mark-up. This medium is particularly evident when there exists a favourable rapport between the contractor and the client and a history of previous collaborations.

Contractor Characteristics

According to Oo et al. (2022b), the meta-analysis incorporated contractor variables such as current workload, availability of cash to carry out the work, experience on similar projects, past profit in similar jobs, and availability of qualified site management staff. The variables that received the most significant consideration among the contractor characteristics were experience on similar projects and current workload, as identified in the top ten (10) out of the twenty-three (23) (Oo et al., 2022b). Perera et al. (2021) observed a notable correlation between experienced bidders and their tendency to decrease bid prices by implementing a smaller mark-up. This phenomenon can be elucidated by the fact that contractors can evaluate their past performance in similar projects, which enables them to make informed decisions on their pricing strategies for future projects (Tayeh et al., 2019a). The pricing dynamics of a contractor's bid may also be influenced by the contractor's existing workload (Oo et al., 2022b). According to Oo et al. (2022a), an increase in bid submissions is observed during economic recessions, as contractors exhibit a heightened eagerness to secure projects despite the decreased available workload. According to Perera et al. (2021), a seasoned bidder eager to secure a project may opt to reduce the bid mark-up, notwithstanding their desperation, to decrease the overall bid price.

Additionally, the availability of cash to carry out the work significantly influences contractors' decisions about bid mark-up (Oo et al., 2022b). Oyeyipo et al. (2016) stated that businesses may encounter difficulties due to inadequate financial resources. Accordingly, Mahamid (2011) underscored the significance of several elements influencing a company's present financial condition when making mark-up decisions, particularly about the crucial role of cash flow within the construction industry.

According to Oo et al. (2022b), historical profitability in comparable job contexts has predominantly served as a significant determinant for contractors in determining the magnitude of bid mark-ups. When calculating the mark-up percentage for a project, the contractors would have considered the permissible cost and potential hazards. According to Abdullah (2020), the contractor has the potential to achieve an optimal equilibrium between profit maximisation and sustaining a competitive advantage by examining past profit margins. The significance of competent site management personnel is considered a crucial aspect of contractor attributes (Oo et al., 2022b). According to Abdullah (2020), smaller contractors may encounter challenges in effectively competing with larger rivals to attract and retain highly skilled personnel. Consequently, smaller contractors may hire individuals with inferior qualifications and reduce the prices they charge.

Project Characteristics

The meta-analysis incorporates project characteristics published by Oo et al. (2022b). These characteristics encompass project size, duration, location, kind of project, type of contractual structure, amount of work to be subcontracted, degree of hazard (safety), and quantum of liquidated damages. The project size indicates the inherent risks associated with its execution (Hillebrandt, 2000). Alkhateeb et al. (2020) conducted a study to investigate the influence of project size on contractors' mark-up. Their research findings revealed that contractors exhibited either increased competitiveness or overall success within a specific range of project values. Experienced bidders commonly incorporate higher pricing in their proposals to accommodate the heightened level of risk involved.

According to Perera et al. (2021), there is an inverse relationship between bid mark-up and the duration of infrastructure projects. An inverse relationship exists between the mark-up and the project duration, whereby an increase in the mark-up leads to a decrease in the project duration. As the passage of time continues, the rate of increase in overhead percentage may decelerate, enabling a reduction in the mark-up for bidding. Furthermore, the size of the mark-up may also be influenced by the project's geographical location. Usually, the mark-up will decrease if the project's site can be easily accessed and the procurement of materials is manageable.

Nevertheless, many bidders tend to decrease their profit margins for geographically novel projects. This action aims to develop the bidder's visibility within the region, a crucial factor in enhancing the bidder's prospects of securing more projects in the area through the provision of lower mobilisation expenses. In addition, it is essential to note that the magnitude of mark-up differs significantly across various types of infrastructure projects. For example, the irrigation and water supply projects have higher mark-up margins than road projects. Projects that entail greater risk necessitate allocating specialist resources and involving professionals with the knowledge to achieve practical completion.

A study by Abdullah (2020) presented a comprehensive compilation of elements to be incorporated into project documentation. These factors encompassed various aspects, including the type of contractual arrangement, the extent of subcontracted work, the level of hazard in terms of safety, and the magnitude of liquidated damages. A thorough examination of these elements is necessary to mitigate the risk of inadvertent financial losses for the contractual agreement. When determining the appropriate mark-up size, contractors are afforded extra consideration in situations characterised by a high risk or degree of hazard, particularly about safety. Typically, an increased allocation for risk contingency buffers can be anticipated when there is a greater level of risk and uncertainty associated with the task at hand. According to Laryea (2022), contractors mitigate project risks by delegating significant work to subcontractors and compensating them accordingly.

Economic Characteristics

In the study conducted by Oo et al. (2022b), the authors examined the generalisability of the meta-analysis findings about economic characteristics. These characteristics encompassed overall economy (availability of work), availability of equipment, availability of labour, and availability of other projects for tendering. Contractors considered the aspect of the overall economy, specifically the availability of work, given the prevailing economic conditions (Oo et al., 2022b). Economic expansion generates many investment prospects that contribute to the development of the infrastructure sector, subsequently resulting in a surge in the demand for building endeavours (Perera et al., 2021). However, considering the economic downturn, contractors operating in the Czech Republic were compelled to substantially decrease the prices of their bids to ensure their enterprises' survival (Hanák et al., 2021).

Abdullah (2020) highlights that contractors place significant emphasis on equipment and labour availability while making decisions regarding mark-up size within the economic situation category. According to Tayeh et al. (2019b), one of the primary difficulties encountered by small contractors in the Gaza Strip is the preservation of personnel stability and the guarantee of a consistent provision of materials and equipment. These challenges arise as a result of security and political concerns. However, the effective utilisation of resources by contractors is a crucial aspect of the project execution process that leads to achieving targeted outcomes (Wang et al., 2020).

The contractors have emphasised the availability of alternative projects for tendering as the ultimate criterion for economic aspects (Oo et al., 2022b). Oo et al. (2012) acknowledged that the observed variations in bidding behaviour over time, in response to fluctuations in firm capacity levels, can be detected before and after the placement of a successful bid. Following the revelation of the winning bids, companies subsequently filed less competitive bids, reflecting a diminished eagerness to secure the job. Conversely,

prior to the announcement of the winning bids, companies exhibited greater enthusiasm, resulting in more competitive bids.

Table 1. Selected recent studies from year 2016 until year 2022 on factors influencing contractors' bid mark-up decision

Authors	Country	Number of factors	5 most highly ranked factors	Lower quartile ranked factors	Target group of respondents
Zhang et al. (2022)	China	40	<ol style="list-style-type: none"> 1. Client's financial capability 2. Government legislations 3. Clients' payment history 4. Company's current financial situation 5. Ability to fulfil tender conditions 	<ol style="list-style-type: none"> 1. Company's idle resources of the 2. Project location 3. Project start time 	Large and medium sized contractors
Perera et al. (2021)	Sri Lanka	20	<ol style="list-style-type: none"> 1. Estimated direct cost 2. Competitiveness of other bids 3. Type of work 4. Project duration 5. Ability to predict pre-tender estimate 	<ol style="list-style-type: none"> 1. Quality of labour 2. Availability of equipment 3. Relationship with the consultant 	Contractors in the field of infrastructure project
Tayeh et al. (2019a)	Gaza Strip	68	<ol style="list-style-type: none"> 1. Project site visit 2. Study tender documents accurately 3. Accuracy of quantities in bill of quantities 4. Status of crossing 5. Coordination between owner and donor 	<ol style="list-style-type: none"> 1. Maintenance costs of machinery and equipment 2. Size of required site equipment and tools 3. Weather conditions (season) 	Contractors, consultants and clients of infrastructure construction
Adnan et al. (2018)	Malaysia	62	<ol style="list-style-type: none"> 1. Availability of work (overall economy) 2. Project size 3. Experience in similar project 4. Availability of required cash 5. Difficulty degree 	<ol style="list-style-type: none"> 1. Time of bidding 2. Cost savings' policy 3. Duration of tender 	Large contractors
Mohamed et al. (2017)	Egypt	32	<ol style="list-style-type: none"> 1. Project cash flow 2. Inflation in material prices 3. Experience in similar old projects 4. Availability of required cash 5. Availability of qualified staff 	<ol style="list-style-type: none"> 1. Duration of tender 2. Bidding document price 3. Tendering method 	Construction contractors
Aje et al. (2016)	Nigeria	15	<ol style="list-style-type: none"> 1. Availability of material 2. Labour productivity 3. Level of profit 4. Project financing 5. Cost of manpower 	<ol style="list-style-type: none"> 1. Project size 2. Type of development 3. Construction plant 	Contractors and consultants

Source: Oo et al., 2022b

Table 2. Research studies meet the requirements of meta-analysis to provide a global perspective of critical factors influencing contractors' bid mark-up decisions

Authors	Country	Number of Factors	Income level classification	Type of project	Target group of respondents
Zhang et al. (2022)	China	40	Upper middle	General building	Medium and large contractors
Perera et al. (2021)	Sri Lanka	20	Lower middle	Infrastructure projects	Contractors
Tayeh et al. (2019a)	Gaza Strip	68	Lower middle	Infrastructure projects	Clients, contractors and consultants

Adnan et al. (2018)	Malaysia	62	Upper middle	General building	Large contractors
Aje et al. (2016)	Nigeria	15	Lower middle	General bulding	Contractors and consultants
Ye et al. (2014)	China	33	Upper middle	General bulding	Contractors
Jarkas (2013)	Kuwait	40	High	General bulding	Small, medium and large contractors
Oyediran & Asuquo (2011)	Nigeria	24	Lower middle	General bulding	Small, medium and large contractors
Enshassi et al. (2010)	Gaza Strip	94	Lower middle	General bulding	First, second and third grades of contractors
Egemen & Mohamed (2007)	Northern Cyprus and Turkey	83	High income (Cyprus) Upper middle income (Turkey)	General bulding	Small and medium contractors
Ling (2005)	Singapore	52	High	General bulding	Large contractors
Dulaimi & Shan (2002)	Singapore	40	High	General bulding	Medium and large contractors

Source: Oo et al., 2022b

Table 3. Global perspective of critical factors influencing contractors' bid mark-up decision

No.	Critical factors	Rank
1	Bidding characteristics	
F1.1	Number of bidders	2
F1.2	Competitiveness of other bidders	1
F1.3	Time allowed for submitting bids	19
F1.4	Tendering procedure	10
F1.5	Completeness of tender documents	13
2	Client characteristics	
F2.1	Relationship and experience with client	3
3	Contractor characteristics	
F3.1	Current workload	6
F3.2	Availability of cash to carry out the work	16
F3.3	Experience on similar projects	4
F3.4	Past profit in similar jobs	18
F3.5	Availability of qualified site management staff	23
4	Project characteristics	
F4.1	Project size	5
F4.2	Project duration	14
F4.3	Project location	20
F4.4	Type of project	11
F4.5	Type of contractual arrangement	9
F4.6	Amount of work to be subcontracted	15
F4.7	Degree of hazard (safety)	17
F4.8	Quantum of liquidated damages	8
5	Economic characteristics	
F5.1	Overall economy (availability of work)	12
F5.2	Availability of equipment	22
F5.3	Availability of labour	21
F5.4	Availability of other projects for tendering	7

Source: Oo et al., 2022b

CONCLUSION

The top five (5) factors influencing contractors' decision on bid mark-up size were competitiveness of other bidders, number of bidders, relationship and experience with client, experience on similar projects and project size. Besides that, based on the perception of the small contractors, the determination of mark-up

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size is based on experience, intuition, past bidding results, past bidding patterns of competitors, client's tender estimate, client's record, and financial ability.

This paper highlighted significant findings for bid mark-up decisions in determining the most appropriate bid price to win tenders and complete the project successfully with acceptable profit. It is recommended that contractors have proper record keeping and always keep the updated current market situation for contractors able to become more competitive by understanding the bid price patterns that occurred from several different scenarios in the market and bidder characteristics. Besides that, contractors should have used suitable bidding models to assist contractors in determining the most appropriate bid price to win tenders. For example, the average-bid method bidding model can be suitable for contractors when the public procuring agency has used the average bid method for selecting tender prices.

In conclusion, the bid mark-up decision in public street projects is a critical factor that can impact the project's success. Contractors must carefully analyse the project's complexity, level of competition, availability of resources, risk level, and experience level when determining the bid mark-up. By considering these critical factors, contractors can ensure that their bid is competitive while covering the costs associated with the project.

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All authors involved in carried out the research, wrote and revised the article, conceptualised the central research idea and provided the theoretical framework, review and approved the article submission.

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