Project Attributes Influencing Contractors' Bid Decision

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Response to Reviewers' comments

No		Reviewer 1	Reviewer 2	Authors' Response
1	Recommendation	Minor revision	Minor revision	We thank the reviewers for their kind but true judgment.
	Additional Questions			
2	Originality: Does the paper contain new and significant information adequate to justify publication?	YES – To some extent, the originality is now explained around unbundling the long list of decision factors, over a hundred of them, reported in literature.	With the revised title, the originality is better evident.	We are pleased and grateful to the reviewers. We have taken these comments to mean the article has deepened its originality; no further changes are required in this area.
3	Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?	YES – As indicated in the first round of reviewing, the paper still demonstrates an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources.	The authors justification on the lack of recent references is technically acceptable. However, the question now is "where in the timeline your contribution can be genarised to" should be answered. Options I see include (i)justifying the timeliness of your contributions referring to empirical findings in the light of recent world development (ii) if the findings are biased pre-COVID era, let that specificity be mentioned without harming the accuracy of your contribution. If you see ant (an?) additional option, that should be justified, and such justification should be included in the paper appropriately.	We agree with Reviewer 1. Our review of literature is appropriate both in depth and in time range. We have framed the remit of the study using studies from 1982 to 2024. In particular, we used Preferred reporting items for systematic and meta-analyses (PRISMA) review technique to identify all the variables assessed in the study, using studies from 2000 up to 2024. We don't think we need (and have chosen not) to segregate by timelines in relation to COVID. Project attributes have not such delimiters. The variables we measured are as valid before and after COVID. Further, our goal whilst reviewing literature is to problemize knowledge gaps around the variables. The

				additionality of our findings is not discussed in the literature review on theoretical frameworks (where Reviewer 2 have made their kind comments), rather under 'implications of findings'.
4	Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?	NO – To some extent, some earlier concerns around the research methodology are addressed. However, the entire research methods section is devoid of any supporting references for the approach as undertaken. This appears to be included in the standalone 'Data analysis' section whilst the rationale and justification for the correlation analyses is not reported. Please revise this and include the 'Data analysis' as a sub section of the 'Research methods'.	Yes	We thank Reviewer 2 and agree with their position. To accommodate Reviewer 1's suggestion, we have changed the heading of that section from Research Method (RM) to Research Design (RD). These are two different – we refer the Reviewer to a brief note by Bowron (2025) and textbooks by Salkind (2010) and Marczyk et al. (2010). RD is about research strategy, which must be justified; RM is about the research technique, which in our case is an established protocol. As this is a portion of an ongoing work/a serial – Reviewer 1 has made reference to the clarity we provided about 'unbundling the research theme' – it is incumbent therefore to consider following an established protocol, rather than re-justifying this research technique. Our initial intention was to explain the research technique basically – this

				requires no justification. We did this to save space. But now that we have seen the grace to do more, we have argued our strategy choices between hard and soft methodologies. All our variables are identified with clear boundaries from literature: they are hard and should studied quantitatively through prescriptive assessments. **Cited works** Bowron, R. (2025, Feb. 21, 2025). *Research Design and Methods: Setting up the Research Design*. Austin Peay State University. Retrieved Accessed May 19, 2025 from https://libguides.apsu.edu/c.php?g=923794&p=7115026 Marczyk, G. R., DeMatteo, D., & Festinger, D. (2010). *Essentials of research design and methodology* (Vol. 2). John Wiley & Sons. Salkind, N. J. (2010). *Encyclopedia of research design* (Vol. 1). sage.

	Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?:	YES – The revised results are now presented clearly.	Original comment is not addressed and the justification is brief. Hence I assume either the authors are struggling with the paper length limits or a research inherited difficultly in distinguishing factual implications from discussion due to standalone implications lose meaning when separated from reason. Hence an attempt or a reasonable justification is expected. I still hold the view that the current write-up under the heading implications resembles more of a discussion. Implications can even be presented tabulated.	Please see response above regarding Reviewers' comments about the literature review. Reviewer 1 thinks our review is considerable. We agree with their judgment. Reviewer 2 thinks the findings have not been justified, and that the current draft looks like a discussion. We have decided to add 'discussion' to the section heading. A Table -Table 6- has been added as well, showing how the variables fit into their respective clusters and whether they are correlated, orthogonal, included or excluded ex-post.
	Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice	YES – The authors have now addressed this shortcoming adequately.	Please refer to the comments in the above section. However, the research and social implications are still not clear.	The socio-economic implications of the findings are the focus of the discussion section e.g. projects as the main stay of construction businesses, the place of projects in the construction world, how various sub-sectors of the construction industry respond to safety and environmental concerns, and the complexity of understanding the role of project

	(economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?			stakeholders in contractors' project selection.
	Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.	The quality of communication is fine.	Improved.	Thank you. We appreciate all the suggestions provided by the reviewers.

No	Associate Editor	
1	As seen from the review comments, the revised paper has improved in many aspects. However, the paper still needs some more improvements, e.g. in terms of literature review, data analysis, justification and implications of results, especially as mentioned by the reviewers.	Dear Associate Editor, we believe these comments have now been addressed. As pointed in our response, both reviewers agree on the originality of the study. However, while Reviewer 1 agrees that the literature review is adequate, Reviewer 2 thinks we need to justify the timeline of the additionality of our work – whether it is pre- or post-COVID. We have answered accordingly. Reviewer 2 asks for scholarly deepening of the methodology. Although our initial approach is to describe the study method, we have taken the suggestions of reviewer on board and have explained our initial position in the response.
	In addition:	
2	1) refer page 10, line 39: maximum skewness >> is 546 correct? Extant literature suggest maximum permissible limit is + (plus) or - (minus) 2.00.	Thank you for pointing this out. The situation is an unintended typographical error. The correct figure was 0.546. The error has now been corrected.
3	2) Page 10, Line 51: Likert scale wordings: "1 being highly insignificant and 5 being critically significant". The terms 'significant' and 'insignificant' have special meaning in statistical analysis, as also have been used in reporting results in this paper. So, it is confusing which 'significant' or insignificant' means what. Authors should give a reasonable explanation to clarify this.	We have modified this as 1 being extremely unimportant and 5 being critically or extremely important to decision making. 'Significant' has been replaced with 'important', limiting our reference only to the measurement scale rather than the stats.
4	3) The Likert scale for data collection: was it continuous or ordinal scale? If ordinal, was there any interval: equal or unequal? And, if parametric analysis allows such scale.	We used data from our Likert scale process as ordinal data. We know the magnitude of the difference within each interval may be seen as unequal e.g. 1-2 is not necessarily equal to 3-4. But when a relatively large scale is used (e.g. 5

		points or more), the "distances" between points can be *approximated* as equal enough for practical purposes. Using parametric tests for these is often more robust and powerful than their non-parametric counterparts, especially when the data distribution is not severely skewed – see Carifio & Perla (2007) and Sullivan & Artino Jr. (2013). As evident in the response to comment No 2 above, Skewness and Kurtosis were tested, and they confirm the pattern of data distribution before further tests were undertaken. **Cited works** Carifio, J., & Perla, R. J. (2007). Ten common misunderstandings, misconceptions, persistent myths and urban legends about Likert scales and Likert response formats and their antidotes. *Journal of Social Sciences*, 3(3), 106-116. Sullivan, G. M., & Artino, A. R., Jr. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education*, 5(4), 541-542.
	4) Analysing Likert scale data: collected data are 2, 3, 4, 5, etc. Then how can a mean value of (say) 3.24, or 3.94 (etc.) be interpreted, especially if data collected are not in bands, but integers. Is it not then necessary to develop multiple categories within a scale for the interpretation of results, e.g. from 0.5 to 1.5, 1.50 to 2.50, etc.?	We agree with the Associate Editor that this is one of the ways to go. However, our work did not stop at the descriptive stats. Using data bands would not have changed the outcome of the study – the structural model and analysis of variance.
	5) page 10, line 20; is the sentence complete?	We have double-checked the entire section, and the whole manuscript. We can confirm all our sentences are complete, placed correctly as intended
	The above questions/ points need to be responded to, even if briefly, in the 'Responses to Review comments' document, so we know how our concerns have been	We thank the Associate Editor for their kindness. We can confirm all the comments have been responded to.

	addressed. Also of course, please include the corresponding clarifications and adjustments at appropriate places in the manuscript.	Changes have been made on the manuscript everywhere necessary.

Project Attributes Influencing Contractors' Bid Decision

Version 2, June 2025

ABSTRACT

Purpose: This study investigates attributes of projects that attract and retain bidders' interest towards achieving optimal participation in bidding processes. When such participation is inadequate, outcomes are vulnerable to commercial improprieties as though winner's and loser's curse syndrome.

Research design: 19 factors decision factors underlying project selection were extracted from literature. They were formed into a structured questionnaire, administered to project selection stakeholders. 49 samples were analysed, 92% of whom were based in Western Australia. Means between participants' subgroups were tested using t-test. Relationships between variables were measured, culminating into a structural model where decision factors were clustered into themes.

Findings: Project selection decisions are motivated by project resource requirements, design quality and clarity, project's local ecology, construction methodology and impact as well as bidder's mobility and project outlook. Post-hoc analysis shows varying considerations by stakeholders across industry sub-sectors (private vs public), functional lines (contractors vs consultants) and firm sizes.

Implications: Projects have default attributes to attract bidders' participation. These attributes only need to be made obvious and convincing, rather than being prohibitive and complex. Further, value sharing is important in this: it is impossible to unify the transactional interests of every project stakeholder. Being open to the expectations and requirements of other parties is a key milestone in successful project delivery.

Originality: This study unbundles project selection research. Whilst extant studies that report a global view of decision factors are inconclusive and indexical, this current study narrows 19 critical decision factors relating to project attributes into six themes that are easier to uptake and disseminate.

Keywords: bidding, loser's curse, price, ex-post analysis, procurement, project success, reductionism, structural model and winner's curse.

INTRODUCTION

Contractor must participate adequately and appropriately in bidding processes for procurement to be truly successful. However, normative literature has overlooked the setting of appropriate conditions for an *optimal* bid participation to occur. For example, literature is not definitively clear on project attributes that attract and retain the interest of serious bidders. In addition, there is no consistent relationship between project types and sizes, and optimal number of bidders (Dyer & Kagel, 1996). Whilst large projects may attract more restrictive bidding conditionalities than smaller projects, there is no science behind the number of bidders that is appropriate for a project or how construction projects can be primed to attract an appropriate number of bidders' interests. Without a clear understanding of these conditions, *optimal* bid participation is impossible. Further, common regrets of *optimal* bid participation have been reported in normative literature to include winner's curse and loser's curse (Priemus, 2004; Signor et al., 2016). Winner's curse is an eventuality where a bid winner under- or overestimates the true cost of a project whilst attempting to survive intense competition or choose to lower their motivation and expectation in a quasi-desperate attempt to acquire new project so they can keep their business running (Ahmed et al., 2016). Holt and Sherman (1994) also argue winner's regret can arise from 'utility of winning', a situation where a perpetual winner becomes overly confident; thus, overprice their tender. Loser's curse, on the hand, is a situation where a bidder underprices their tender, perhaps due to repeated previous losses, inadequate or misaligned information during tender action, intense competition or an irrational intention to mislead project owners (Holt & Sherman, 1994). Harris et al. (2021) explain the cost of a failed bid also goes into every new bid, thereby raising the new bid and making them less competitive than they should.

The objective of this study to investigate project attributes that help facilitate optimal participation of contractors in bidding. This study unbundles bid decisioning with a focus on the roles of project attributes, with a view to understanding key elements and the associativity amongst them to trigger optimal bid participation. Rationales for this unbundling have been canvassed by several studies: previous analysis on the subject have been superficial, replicative, inconclusive, and cumbersome when integrated (Olatunji & Ramanayaka, 2023; Stephen & Andrew, 2017). Review of literature and development of new evidence are reported below.

REVIEW OF LITERATURE

Research problemization

The centrality of this study is that bidders' participation is critically important to project delivery processes. Such participation could be measured for adequacy and quality of outcomes. None of these has been addressed adequately in extant studies. However, both can be measured from the perspective of project attributes e.g. by examining project attributes that attract and retain bidders' motivation and how these shape their outcomes. For example, Mishra et al. (2020) analyse 315 road projects in India's Butwa and Shivpur Divisions, completed between 1972 and 1976. They found an average of 4–12 bidders per project was able to trigger a competition that achieved winning bids – of about 13–28% below owners' pre-construction estimates. Al-Arjani (2002) also investigates 200 maintenance projects in Saudi Arabia. They found owners awarded contracts for small projects (below SR3 million) when at least one bidder had participated, and large projects (exceeding SR100 million) when up to 15 bidders have competed. In addition, Hyari (2017) examines 1,396 construction projects undertaken in Jordan between 2004 and 2015. They report an average of 5-11 bidders participated in bidding. Apparently, it is impossible to determine a perfect number of bidders required for a bidding process to be effective across all jurisdictions and project sizes and types. However, evidence is clear on procurement outcome when contractors are unwilling to participate in bidding. These include extended delays, high costs, renegotiations and outright cancellations (Albalate & Bel, 2012; Dewulf et al., 2012; Menezes, 2023). Further, a World Bank study by Harris et al. (2003) reports an investigation of 2,500 infrastructure projects between 1990 and 2001, worth $750 billion in private investment commitments in developing countries. They found participation had fallen and investments had plummeted to less than half of their peak by 2001. Whilst it is arguable that there are many explanations to botched procurement processes, it is equally necessary to conclude that bidding participation issues stall development aspirations and investments, and more efforts are needed to ensure key players' interests are attracted and retained throughout project development processes.

Bid decisions and project attributes

Snee and Rodenbaugh (2002) describe a project as a problem that is scheduled for solution. Flanagan (2002) outlines how project phenomena are sufficiently complex

and are laden with multidimensional risks. The risks start with analysing stakeholder's own capacity against project attributes and ecosystems and determining the potential additionality of participation. The decision of whether to bid or refrain from bidding is complex. It revolves around personal, project, and economic factors. These factors range from the commercial attractions in project economics to climate factors around the project. For example, contractors seek potential for profitable commercial activities when considering their project selection commitments (Harris et al., 2021). In doing this, they seek and absorb significant risks (Bowman, 1982). As Bageis and Fortune (2009) report, contractors deploy varying risk assessment systems depending on their tolerance. These include the various factors identified and analysed adaptively in reaching a decision to bid or not to bid. At a personal level, these factors include contractors' interest and willingness to participate. At the project level, they include the selection of a suitable project with considerable commercial motivation. At economic level, participation is justified based on company's financial position and market forces. Contractors' organizational size and project owner's capacity, their appetite for success and reputation are critical decision factors also (Bageis & Fortune, 2009).

Oo et al. (2022) report five key financial attributes of projects that inform a contractor's decision to participate in bidding. These include project size, payment mechanism, project owners' reputation in the market and financial authority, as well as their financial performance in past projects. The centrality of Oo's work is that owners' financial capacity and contractor's ability and motivation for profit remain the main drivers of project selection and bid participation. This can be summed up to mean contractors are reluctant to participate in projects if they cannot see a reasonable propensity to make appropriate profit or impact when they participate in a project. Zaqout et al. (2022) support the notion that contractors prioritize profit margins and markups in most of their bid decisions. The authors reported 48 factors that shape contractors' acceptable markup decisions. Their conclusion is that contractors focus on the project's context, risks, and uncertainties to decide on an optimal markup.

Dodanwala and Santoso (2024) report the significant role of organizational size in the decision to participate or refrain from bidding. They found small-sized contractors allocate higher decision weight to project size, current workload, project finance, business overhead, and client's proactiveness in the payment process. On the other hand, medium-sized contractors decide based on the project type, project size,

current workload, availability of skilled staff, and project duration. Li et al. (2020) report on similar statistics for the role of the contractor's size in bid decisions. They found contractors' size has a significant positive impact on making bid decisions.

Contractor's risk tolerance is another important factor. Shokri-Ghasabeh and Chileshe (2016) report 26 factors and project attributes that inform bid decisions. Their top bid decision factors include project risk, client financial capability, future benefits and profitability, and intensity of competition. Their findings highlight how contractors' risk tolerance generally decreases with the size of their organization, with medium and small-sized contractors assigning a higher weight to project risks. However, Oyeyipo et al. (2016) found the number of bidders and the intensity of competition between them seldom have significant impact on bid decision. The variation in the two findings is significant. One, it is convenient to associate them with the contextual variability of the studies. Shokri-Ghasabeh and Chileshe (2016) report on Australia, a structured market, whereas Oyeyipo et al. (2016) report on Nigeria, a developing ecosystem where solutions to extant seemingly chaotic challenges remain soft and incipient. Nevertheless, there was a consensus in the two studies on the importance of the owners' financial capability and availability of capital and resources.

According to Li et al. (2020), project's location, and the cultural customs of the people in project proximity are important decision factors. They found contractors' capability to work in diverse cultures, with the ability to deal with risks associated with host localities. Their findings show the foremost factor considered in international bid decisions is the host's cultural risks. Macro-economic issues such as rates of inflation, foreign currency exchange and security are key issues also. Contractors also consider the strength of the local justice system, political stability, and security of the banking and financial market of the host country. Further, Chileshe et al. (2021) report 11 contextual project attributes for indigenous contractors in relation to bidding. They include contractor's current workload, project size, profitability, type, and need for work. However, contrary to Li et al. (2020), Chileshe et al. (2021) found the statistical significance of weather in project selection considerations is low.

Project attributes reported in literature are relative to availability of project resources, bidder's mobility, local ecology, project outlook, design quality and clarity, construction methodology, and impact. This study also follows a systematic literature review (SLR) approach to further investigate these factors thematically. Preferred

reporting items for systematic and meta-analyses (PRISMA) review technique proposed by Moher et al. (2009) was followed. PRISMA has been used by multiple studies in construction and project management for similar purposes (Oo et al., 2022; Sajid et al., 2024). Table 1 lists the search strings used for this study, which comprised a combination of the pre-decided keywords. These were "project attributes," "project factors," "contractor," and "bid decision". Scopus and Web of Science (WoS) repositories were used to retrieve relevant articles. They represent a significant repository of scholarly publications in the subject area being investigated. The search period was kept between the year 2000 and onwards to keep a recent focus on the factors. Article types were limited to original research and review papers. All other types of articles and those not published in the English language were discarded. A total of 13 papers were retrieved from Scopus, and 43 were retrieved from WoS repositories. After removing duplicates, a total of 44 articles were used for the final review. This procedure helped systemically retrieve relevant articles and identify the key decision factors for project bid participation used by the contractors.

Insert Table 1

Figure 1 shows a network visualization of the most occurring keywords in the retrieved articles in the retrieved articles. Four research themes or clusters emerged based on the network mapping: performance, business, project, and management. As shown in Figure 1, performance cluster houses keywords such as options, governance, uncertainty, and success. Management cluster houses keywords such as complexity, delivery methods, risks, and management models. Project cluster include administrative decisions, costs, bidding considerations, and the severity of market competition. Business cluster include factors of culture, project identification, and location. Overall, top keywords include project management (n=16), construction (n=10), performance (n=8), decision uncertainty (n=7), framework/model (n=7), and complexity (n=5) – where ***n*** is the number of papers reviewed.

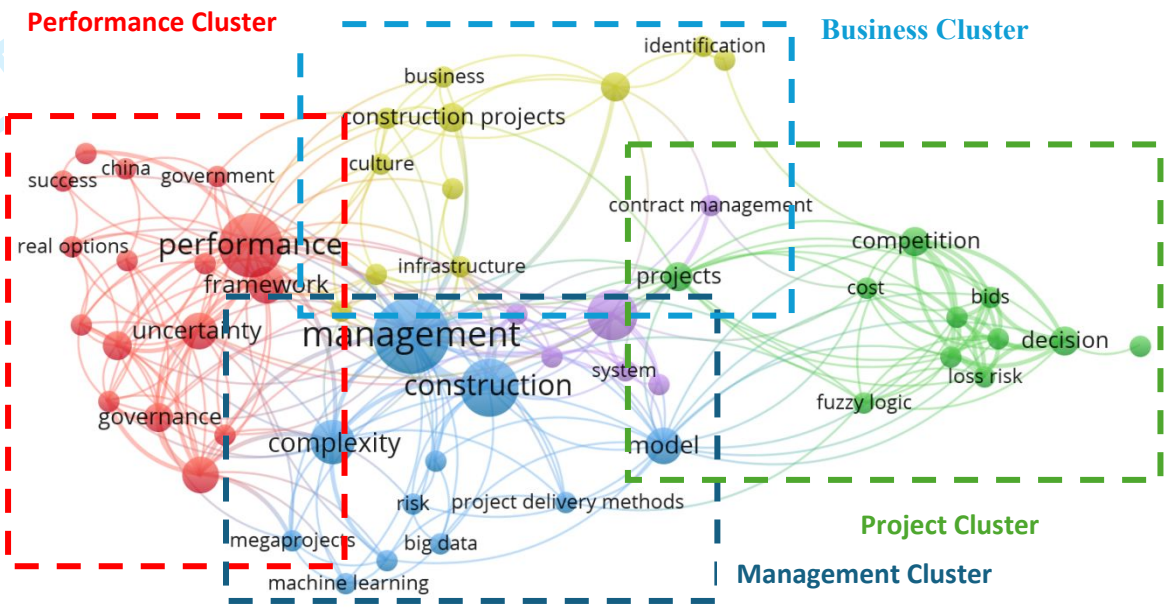

Figure 1: Network visualization of keywords

Source: Authors' work

RESEARCH DESIGN

The detailed review of literature identifies 19 factors, shown in Table 2, which lists the factors and how they apply in bid participation decision-making. In consonance with previous studies where these factors have been extracted, the strategy of the current research is to treat the factors as hard variables. Nicholls (2009) describes hard variables as though their remits and characters have been established definitively in extant studies and can be assessed by research participation without significant knowledge augmentation. This is different to soft variables that are intended to emerge from the various unique lenses of research participants. Research techniques that deliver the best results in hard and soft methodologies have been argued in normative literature. Hard variables are best assessed using quantitative methods, whilst qualitative methods are most suitable for soft variables (Bowron, 2025; Green, 1999; Marczyk et al., 2010; McLucas, 2003; Salkind, 2010).

Insert Table 2

Bacon-Shone (2013) explains quantitative research techniques to include the use of structured questionnaire, where variables are listed for relevant participants to input their opinions in ways that new evidence can be built. Bowron (2025) explains this could be in four forms: descriptive, correlational, experimental and quasi-experimental. Descriptive questionnaires are used often used to measure characteristics, behaviours or attitudes of a population, and are often aimed at explaining the current status of a phenomenon in reference to a norm or standard (Fallowfield, 1995). Correlational questionnaires are used to investigate the strength of association between multiple variables (Bhandari, 2021). In contrast, experimental questionnaires are used to measure cause-and-effect relationships between two variables (Amiel & Cowell, 1998). Quasi-experimental questionnaires are used to measure cause-and-effect relationships without relying on random assignment – e.g. see Plöger et al. (2018).

The current study uses experimental techniques to obtain data from participants such that the cause-and-effect relationships between decision factors and bidders' participation in bidding can be measured. All the factors extracted from literature were designed into a structured questionnaire survey, administered to industry practitioners. Human research ethics protocol of the research was approved as per standard procedure. A total of 49 participants returned fully completed questionnaires following purposive snowball sampling approach that lasted 6 months.

The following hypotheses were tested:

H_1: Project-related factors are significant decision attributes for bidding from bidder's perspectives.

H_2: There is significant association amongst project-related decision factors.

H_3: Bidder's demographic variables of aspect, firm size, clientele, success of winning, and bidding method moderate participants' perceptions regarding the significance of project-related decision factors in the bidding process.

Demographics

In addition to participants' basic information such as age, gender, educational attainment, and work experience, measurement also captured information about core business operations of participants, their predominant sector, number of submissions per annum and average contract value. However, they were not

considered under H_3 as the sample sizes of their sub-categories was inadequate. Further, geographic location is not included in the analysis because 92% of the participants were from Western Australia. 51% of participants are contractors. 43% are claims consultants. 6% are manufacturers and clients who possess considerable understanding who undertake significant tasks in relation to tender action. 51% work for large national and multinational firms. 49% are employees of small and medium-sized firms. 90% are involved in construction projects and construction related supplies. 10% provide consultancy services in relation to contract claims and research.

Further, participants were asked to indicate the sub-sector of construction where they submit the most bid. 20% are most prominent in residential projects; industrial projects, 6%; "others" (specified by participants as "commercial projects"), 40%. Only one-third of participants show interest in public projects; two-third are more attracted to private and partnerships projects. Moreover, 80% submit at least 15 bids yearly, 76% of which are exceed $1 million [20% exceed $50 million and 20% are between $25 million and $50 million]. 41% have succeeded in more than 50% of their bids. Participants also reported participation in various bidding methods: open competitive (35%), selected (59%) and negotiated (6%). These attributes of show participants have the requisite competence and experience to add value to the research.

Data Analysis

Suitability and Cleaning

Analyses were undertaken using the 26th edition of Statistical Package for Social Sciences (SPSS26). Internal reliability of data was tested using the Cronbach's Alpha Reliability Estimate (α). Outcomes show the factors were slightly inconsistent internally (α=0.686). When "Project stakeholders" was deleted, the remaining 18 variables became internally consistent (modified α=0.703). Further, a series of Shapiro-Wilk (SW) tests were conducted to check the data distributions for normality. Level of significance, p, was less than 0.05 for all the variables; thus 'precise' normality is violated. Two approaches are applicable. One, by employing non-parametric statistical tests. The other way is by checking data distributions for 'approximate' normality towards achieving a reasonable level of accuracy. The latter is preferred widely (Kwak & Kim, 2017; Matulová & Rejentová, 2021; Razali & Wah, 2011). This is because non-parametric tests are less comprehensive and are often affected by

accuracy issues and procedural limitations. The validity of approximate normality was tested using graphical (Q-Q plots) and numeric methods (Skewness and Kurtosis).

Q-Q plots did not show significant variations between the snake-like data distributions and the data on straight lines. Whilst this supports approximate normality, graphical interpretations are vulnerable to subjectivity. Therefore, Kurtosis and Skewness were also calculated (maximum Skewness = 0.546; Maximum Kurtosis = 0.668). Therefore, approximate normality is accepted for all the variables (Razali and Wah 2011). Consequently, $H_{1\text{-}3}$ were tested using parametric alternatives.

Population tendencies

The Likert scale used in the study is 5-point, 1 being extremely unimportant and 5 being critically or extremely important to decision making. None of the factors was rated at major significance or above ($\mu \geq 4.0$). Compared to the factors relating contractors' and clients' attributes published elsewhere (in Olatunji et al. (2022) and Olatunji and Ramanayaka (2023)), evidence shows project-related factors are statistically less important to bidders. Whereas about 65% and 47% of characteristics of contractors and clients, respectively, were rated at major significance or above($\mu \geq 4.0$), compared to 0% in factors relating to project attributes being analysed in this study.
The
None of the factors was rated at major significance or above ($\mu \geq 4.0$). Compared to the factors relating contractors' and clients' attributes, published elsewhere, evidence shows project-related factors are statistically less important to bidders. Whereas about 65% and 47% of characteristics of contractors and clients, respectively, were rated at major significance or above($\mu \geq 4.0$), compared to 0% in factors relating to project attributes being analysed in this study.

Insert Table 3shows the descriptive and inferential statistics relevant to the significance of the decision factors. Although sample means (μs) and standard deviations are given, all interpretations were made with respect to the population mean (μ). Therefore, a series of one sample t-tests were conducted. The null and alterative hypotheses were set as:

H_0: $\mu = \mu_h$ i.e. population mean is equal to the hypothesised mean.
H_a: $\mu \neq \mu_h$ i.e. population mean is not equal to the hypothesised mean.

By observing the sample means and standard deviations values, hypothesised means (μ_h) were set for each variable. When the level of significance, p, was above or equal to 0.05 ($p \geq 0.05$), μ_h was accepted as the population mean, μ. Only the accepted μ_h values are shown in

None of the factors was rated at major significance or above ($\mu \geq 4.0$). Compared to the factors relating contractors' and clients' attributes, published elsewhere, evidence shows project-related factors are statistically less important to bidders. Whereas about 65% and 47% of characteristics of contractors and clients, respectively, were rated at major significance or above($\mu \geq 4.0$), compared to 0% in factors relating to project attributes being analysed in this study.

Insert Table 3. The factors are ranked in the table using μ (largest to smallest), followed by μs (largest to smallest) and standard deviation (smallest to largest) in the presence of identical incidents.

Design quality (PRO9), Project cash flow requirements (PRO14), and Potential safety hazards (PRO13) are rated at the top with μ=3.8. Closer to them are Project by contract value (PRO2) and project complexity (PRO8), rated at μ=3.7. In summary, nearly 89% of the PRO factors are rated between 'minor' and 'major' significance ($3.0 \leq \mu \leq 3.9$). Local customs and culture (PRO7), μ=2.9) and local climate (PRO8), μ=2.7) were rated the least significant factors.

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Insert Table 3

Correlation Analyses

To obtain a holistic understanding of the bidding factors, it is also critical to understand how they are interrelated. Pearson's correlations were calculated for all variables. To test H_2 at a=0.05, null and alterative hypotheses were set as:

$H_{0:}$ There are no significant linear correlations among the decision factors (r=0); and

H_a: There are significant linear correlations among the decision factors (r≠0)

shows only statistically significant correlations ($p \leq 0.05$), with p values obtained. All the factors except Project start time (PRO03) and Project cash flow requirements 14 (PRO) indicate at least one statistically significant association. These associations are categorised as weak ($0.2 \leq r < 0.4$), moderate ($0.4 \leq r < 0.6$), strong ($0.6 \leq r < 0.8$) or very strong ($r \geq 0.8$). In Figure , weak correlations are eliminated to enhance the clarity of the illustration, except on one occasion (see the caption of Figure 1).

There are 'very strong' correlations between Type of equipment required (PRO16), Type of labour required (PRO17) and Type of material required (PRO18). These factors represent project's resource requirements. They were internally consistent statistically ($\alpha = 0.943$). Thus, they were formed int a sub-group factors, named 'Project Resources' (Figure 2).

also shows PRO5, 6, 7 and 11 have significant statistical correlations with PROs16-18. However, *a* values reduced when they were added to the 'Project Resources' sub-group. Thus, they are co-located in another sub-group.

There is a strong correlation between Project Complexity (PRO8) and Design quality (PRO9), r=0.761. The Cronbach Alpha value (a=0.861) applies as though they are internally consistent as a group. Thus, in Figure 2, they are clustered as a sub-group named 'Design Quality and Clarity'. Similarly, Project location (PRO4) and Site accessibility (PRO5) are strongly correlated (r=0.714). With an internal consistency (a) of 0.833, they are clustered as 'Bidder's Mobility'. These two factors also have moderate to weak correlations with PROs16-18. However, they reduce internal consistency when combined as a single group. Thus, they are clustered into separate groups.

The least important bidding decision factors, PRO6 (Local climate) and PRO7 (Local customs and culture) indicate a moderately strong relationship (r=0.589). Reliability statistics indicates that they are internally consistent as a group (a=0.738). Thus, they are clustered as 'Local Ecology'. In addition, both factors are moderately correlated with PRO4, which is already clustered under 'Bidder's Mobility'. This can be understandable as project location can influence local weather as well as culture. When it is added to the group, the Cronbach Alpha value increases up to 0.799. Therefore, PR04 is considered as a common attribute between 'Local Ecology' and 'Bidder's Mobility' (Figure 3).

Project duration (PRO1) and Project size by contract value (PRO2) are moderately correlated (r=0.468). They can be considered as the indications of project's magnitude. However, they are not internally consistent as a group (a=0.622). Thus, they cannot be clustered. The associations among Required method of construction (PRO11), Potential environmental issues (PRO12) and Potential safety hazards (PRO13) are also statistically significant. They are internally consistent as a group (a=0.718). Therefore, they are included in a sub-group entitled: 'Construction Methodology and Impact'. Project prestige (PRO10) and type of project or nature of work (PRO15) are correlated with a moderate strength too (r=0.542). Since they are internally consistent (a=0.701), they are clustered as 'Project Outlook'.

Insert Table 4.

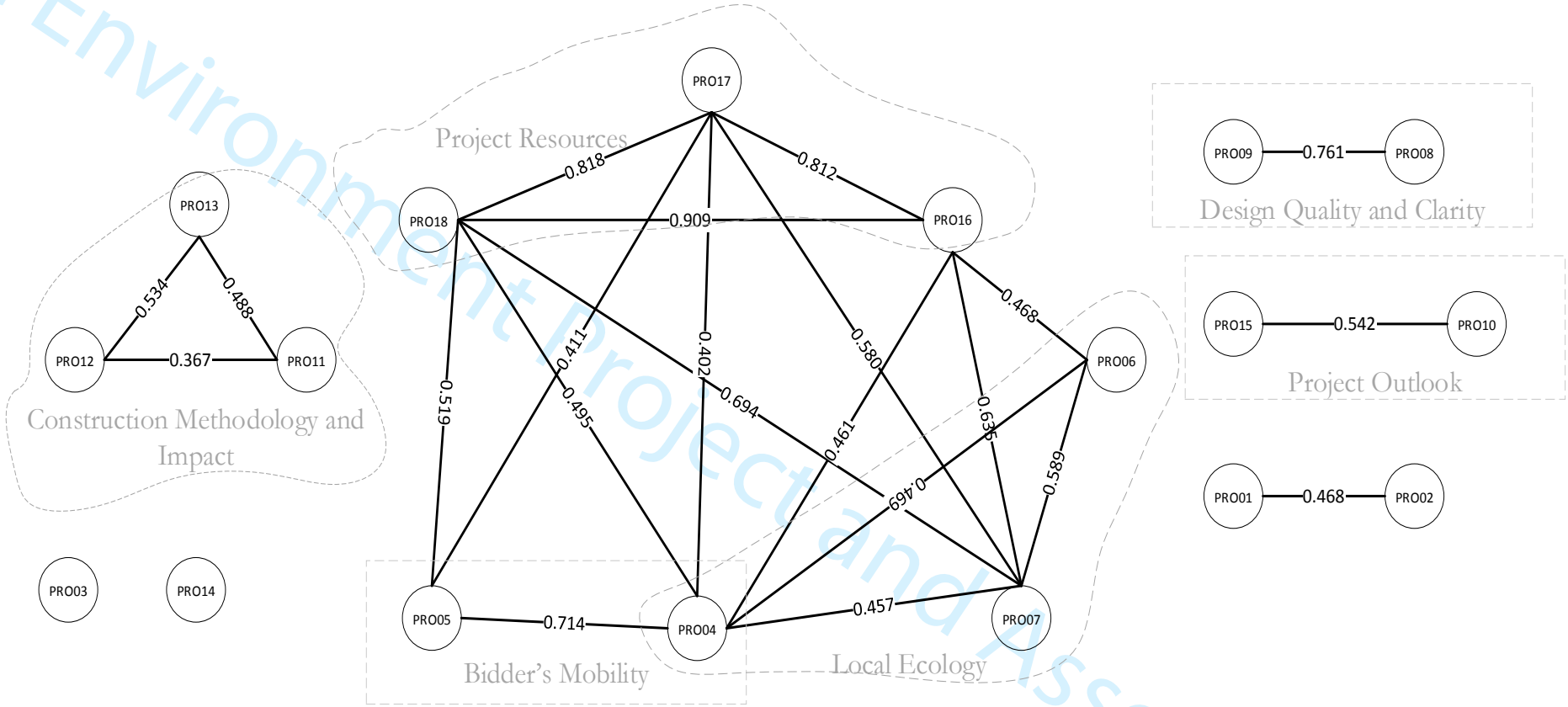

Figure 2: Structural model of project-related factors in bid decisions.

Source: Authors' work

Note: Figure 2 only shows variables with significant statistical correlations – level: moderate and above ($r \geq 0.4$). This is to enhance clarity, except PROs 10 and 11, where associated correlation is within a cluster as identified in the text (Table 4).

Effect of Demographic Variables on Bid Decision Factors

The following variables were considered as sample requisites:

- Aspects *i.e.*, sub-sector of the construction industry where participant's view is situated.
- Firm size *i.e.*, size of participant's firm.
- Clientele *i.e.*, nature of clients in participant's market.
- Success of winning *i.e.*, participant's history of winning; and
- Bidding method *i.e.*, the bidding method where participant had practised.

To test H_3, H_0 and H_a were set as:

H_0: the population means are equal across the groups.

H_a: the population means are not equal across the groups.

One-way ANOVA test was used to test H_3, except for *Aspects*. Considering sample requisites, only contractors and consultants can be considered under *Aspects*. Thus, independent sample t-test was used. Levene's test was used to check the assumption of homogeneity of variance. When one-way ANOVA indicated a statistically significant difference among the groups, Tukey's test was used for post-hoc analysis to find nuances within each group.

Aspects

As shown in Table 5, *p*-values were greater than 0.05 only for PRO1 (Project duration) and PRO13 (Potential safety hazards). Therefore, population means are significantly different amongst contractors and consultants. Further, the assumption of equal variance was satisfied under the t-test for PRO1 ($F=0.022$, $p=0.889$) and PRO13 ($F=3.034$, $p=0.089$). The negative *t* value indicates PRO1 is more significant to consultants than to contractors. In contrast, PRO13 is more significant to contractors than to consultants.

Insert Table 5

Tukey Honesty Significance Difference Test Statistics

PROs 12 and 13 were applicable. As reported also in Table 5, One-way ANOVA indicates a significant statistical difference amongst the means of Clientele Groups, in Potential environmental issues (PRO 12) (F=5.002, *df*=2; *p*=0.013), and firm sizes, in Potential safety hazards (PRO 13) (F=3.441, *df*=3, *p*=0.014). Further, Levene's statistics for PRO 12 (F=1.076, *p*=0.349) and PRO 13 (F=1.772, *p*=0.166) confirms the assumption of homogeneity of variances was satisfied. Tukey test shows the mean difference is significant only between small firms of fewer than 20 employees and multinationals. Apparently, public project contractors pay more attention to environmental issues than private sector clientele, whilst small firms consider safety hazards more significantly than multinational firms. The study did not suggest significant statistical difference participants' perceptions regarding 'success of winning' and 'bidding method'.

Implications and Discussion of Findings

The centrality of the findings of this study is that projects must reflect deliberate attributes, and these must be constructed consciously by project owners to attract bidders' participation. As the findings suggest, this phenomenon is critically important to every project stakeholder (see summary of findings in Table 6). For greater clarity, the study supports its underlying theory that project selection outcomes can be made more proficient by unbundling integrated decision factors, and by understanding the internal workings of each cluster. Of the 19 project-related factors analysed in the study, 7 are most critical (PRO 4-7 & 16-18), grouped into the subthemes of bidder's mobility, local ecology and availability of resources for the project. Contractors will participate in bidding if project is located outside their locality only if they are not averse to extended mobility and access to project site is not overly constrained. These two variables are ranked amongst the top 10 decision factors. Further, contractors will participate in bidding if their business motivation does not find local climate, customs and culture and access to site unsurmountable. Except site access issues (PRO05), all the variables in the Local Ecology cluster are ranked in the bottom 10 decision factors. Availability of resources are also important: contractors are not likely to bid for a project unless the labour, materials and equipment they require for the project are available. Although these factors are also ranked in the bottom 10 decision factors,

their strong correlation with contractors' mobility and project's local ecology is well defined in the structural model reported in Figure 2.

Insert Table 6

Beyond these, it is also clear in Figure 2 that there are four other clusters that shape contractors' project selection decisions. These clusters are largely orthogonal – they can be decided without significant recourse to other clusters or factors. For example, construction methodology is defined by the method of work mandated by the client, potential environmental issues as well as safety hazards. For example and greater clarity, Frangioudakis Khatib et al. (2023) have explained what may happen when asbestos is discovered on a construction site in Australia – protracted delay due to increased regulation and exposure to major health risks. Whilst two of these factors are also ranked in the bottom 10, '*potential safety hazards*' ranks amongst the top 3. Meanwhile, design quality is another orthogonal cluster, explained by quality of project design (ranked No 1) and complexity of project (ranked No 5). Findings also show contract descriptors such as project duration (ranked No 13) and contract value (ranked No 4) are another orthogonal cluster, whilst nature and prestige of project are another cluster, name project outlook. Project start time and cashflow arrangements are rated as important (ranked as No 7 and No 2, respectively). However, not of these two factors have significant correlation with any other factor, not fit into a cluster.

The additionality of these findings can be discussed variously. Projects are the main stay of construction businesses; they fuel commercial aspirations of businesses (Winch, 2024). Without projects, the construction industry will lose its essence and will diminish global economy in terms of fixed assets, national income, resource employment and the culture of soft innovation that the industry is reputed for (Smith et al., 2016). Thus, the eco-system of project is important to government just as it is to other construction stakeholders. If one party is deficient in their project obligations, the ecosystem of project development would be impacted. An understanding around this will help stakeholders to learn, unlearn and improve their project experiences. In line with these fundamental understanding, one clear implication of the findings of this study is that stakeholders have varying views about project attributes that attract optimal bid

participation. For example, as shown in Table 5, contractors pay more attention to environmental issues in public projects than they do in private projects – because of intense public scrutiny and government's strict regulations (Wang et al., 2019), whilst small firms consider safety hazards more significantly than multinational firms – the former must be meticulous on safety precautions to which the latter has devised instruments and the knowledge-power to dissipate liabilities (Ringleb & Wiggins, 2018; Wöll & Sulíková, 2023). We also found contractors are more attentive to environmental considerations than project owners. Consistent with Seymour (1992), the former is more regulated than the latter and are answerable to the consequential costs of environmental damages arising from their work. Further, we found small firms are more conscious about safety than large firms.

These nuanced views cannot be subsumed as though unitary. We found *Project stakeholders* is such a complex scenario. This is because many parties hold varying stakes, views and objectives in a project. As such varying viewpoints cannot be summed up, a single Likert scale may not be appropriate to measure participant's perception regarding their view of all *Project stakeholders*. Further, results show factors lack internal consistency statistically until stakeholders' nuances were captured distinctly. These points of variance include sub-sectoral attributes that are peculiar to projects environment e.g. unlike in the private sector, public sector projects are malleable to political dynamism, they are run under mandated management processes and can be vulnerable to multiple stakeholders (Akwei et al., 2020). Efficiencies and inefficiencies in these are enough to trigger systemic successes or failures in projects (Fourie & Poggenpoel, 2017).

Another major implication of the findings of this study is that project attributes are of less statistical importance to bidders than contractors' and clients' attributes. Apparently, project owners and contractors often see themselves as more important that the very essence of their coming together. Without diminishing the separate importance of the trio – projects, contractors and project owners, a common characteristic of systemic failure in projects is that human parties often misplace an ideal understanding of projects – multifacetedly complex, driven by non-linear factors and nuanced objectives of varying role-players.

Bryde and Robinson (2005) report this as a commonplace problem – a *curse syndrome* when parties are overly optimistic or choose to misrepresent project realities. When

realities contradict players' expectations, failure becomes apparent. This is not only when completion or satisfaction becomes impracticable, rather attendant commonplace experiences become unwanted. For greater clarity, when project owners fail to convince potential bidders that they are well motivated to succeed, bidders are unlikely to participate. For their motivation to succeed to become evident, projects must be clear on resource requirements, design must be accurate and local ecology must support project. Further, construction method must be implementable, and consideration must be given to bidder's mobility and their objective to remain in business. Although, post-hoc analyses of these factor show varying considerations by stakeholders across industry sub-sectors (private vs public), functional lines (contractors vs consultants) and first sizes, contractors' handling of these factors is very crucial. Their bids will fail if they refuse to consider these factors as appropriate, or when they win, they are likely to become a victim of *utility of winning* – a situation where a consistent winner becomes complacent and become less competitive than usual. The situation of a perpetual looser is worse: the confidence to win disappears, and the cost of a loss becomes a burden for a potential success.

CONCLUSIONS

Project attributes must facilitate success. They need to be made obvious and convincing, rather than being prohibitive and complex. Further, value sharing is important in this: it is impossible to unify the transactional interests of every project stakeholder such that the importance of project is not relegated below individual party's interests. Being open to the expectations and requirements of other parties is a key milestone in successful project delivery. When this fails to happen, projects suffer and every party to it becomes worse off. Thus, this study concludes that bidders are attracted to participate optimally in project biddings when the resources needed for the project are available to them, when such bidders are able mobilise to the project's jurisdiction, and if the ecology of the project supports their business philosophy and strategy. Further, optimum bidders' participation is also shaped by their risk appetite, current workload and project outlook. These are influenced by obvious commercial benefits motivated by transparent payment mechanisms and cashflow outlay. Design quality and feasibility of bidder's preferred construction methods are also important. Where these are impossible to achieve, project success

could become compromised. Nonetheless, this study has had some limitations. Sample size is small and a large proportion of participants in the study resident in Western Australia, even though they have had significant international experience. These limitations do not render the findings of the study less valid.

References

Aboelmagd, Y. M. (2018). Decision support system for selecting optimal construction bid price. *Alexandria engineering journal*, *57*(4), 4189-4205.

Ahmed, M. O., El-adaway, I. H., Coatney, K. T., & Eid, M. S. (2016). Construction Bidding and the Winner's Curse: Game Theory Approach. *Journal of Construction Engineering and Management*, *142*(2), 04015076. https://doi.org/doi:10.1061/(ASCE)CO.1943-7862.0001058

Akwei, C., Damoah, I. S., & Amankwah-Amoah, J. (2020). The Effects of Politics on the Implementation of Government Programs/Projects: Insights from a Developing Economy. *Politics & Policy*, *48*(6), 1161-1201. https://doi.org/https://doi.org/10.1111/polp.12384

Al-Arjani, A. H. (2002). Type and size of project influences on number of bidders for maintenance and operation projects in Saudi Arabia. *International Journal of Project Management*, *20*(4), 279-287.

Albalate, D., & Bel, G. (2012). *The economics and politics of high-speed rail: Lessons from experiences abroad*. Lexington Books.

Amiel, Y., & Cowell, F. (1998). The measurement of poverty: An experimental questionnaire investigation. *Empirical Economics, 22*, 571-588.

Apanaviciene, R., & Juodis, A. (2006). Predicting effectiveness of construction project management: Decision-support tool for competitive bidding. *Operational Research*, *6*, 347-360.

Bacon-Shone, J. (2013). *Introduction to quantitative research methods*. Graduate School, The University of Hong Kong.

Bageis, A. S., & Fortune, C. (2009). Factors affecting the bid/no bid decision in the Saudi Arabian construction contractors. *Construction Management and Economics*, *27*(1), 53-71.

Bhandari, P. (2021). *Correlational Research: When & How to Use*. Retrieved Retrieved on May 23, 2025 from https://www.scribbr.com/methodology/correlational-research/

Bowman, E. H. (1982). Risk seeking by troubled firms. *Sloan Management Review (pre-1986)*, *23*(4), 33-42.

Bowron, R. (2025, Feb. 21, 2025). *Research Design and Methods: Setting up the Research Design*. Austin Peay State University. Retrieved Accessed May 19, 2025 from https://libguides.apsu.edu/c.php?g=923794&p=7115026

Bryde, D. J., & Robinson, L. (2005). Client versus contractor perspectives on project success criteria. *International Journal of Project Management*, *23*(8), 622-629. https://doi.org/https://doi.org/10.1016/j.ijproman.2005.05.003

Carpenter, N., & Bausman, D. C. (2016). Project delivery method performance for public school construction: Design-bid-build versus CM at risk. *Journal of Construction Engineering and Management*, *142*(10), 05016009.

Chileshe, N., Edwards, D. J., Kavishe, N., & Haupt, T. C. (2020). Perception on challenges impacting bid decision of indigenous building contractors in Dar Es Salaam, Tanzania. *Journal of Engineering, Design and Technology*, *18*(6), 1641-1662.

Chileshe, N., Kavishe, N., & Edwards, D. J. (2021). Critical factors influencing the bid or no-bid decision of the indigenous small building contractors in Tanzania. *Construction Innovation*, *21*(2), 182-202.

Dewulf, G., Blanken, A., & Bult-Spiering, M. (2012). *Strategic issues in public-private partnerships*. Wiley Online Library.

Dodanwala, T. C., & Santoso, D. S. (2024). Critical Factors Influencing the Bid/no-Bid Decisions of Small and Medium-Sized Contractors in Sri Lanka. *International Journal of Construction Education and Research*, 1-26.

Dyer, D., & Kagel, J. H. (1996). Bidding in common value auctions: How the commercial construction industry corrects for the winner's curse. *Management Science*, *42*(10), 1463-1475.

Fallowfield, L. (1995). Questionnaire design. *Archives of disease in childhood, 72*(1), 76.

Flanagan, R. (2002). Keynote: Managing Risk for an Uncertain Future - A Project Management Perspective. Symposium on Project Management: Impresario of the Construction Industry, Hong Kong.

Fourie, D., & Poggenpoel, W. (2017). Public sector inefficiencies: Are we addressing the root causes? *South African Journal of Accounting Research*, *31*(3), 169-180. https://doi.org/10.1080/10291954.2016.1160197

Frangioudakis Khatib, G., Collins, J., Otness, P., Goode, J., Tomley, S., Franklin, P., & Ross, J. (2023). Australia's Ongoing Challenge of Legacy Asbestos in the Built Environment: A Review of Contemporary Asbestos Exposure Risks. *Sustainability, 15*(15), 12071.

Green, S. D. (1999). A participative research strategy for propagating soft methodologies in value management practice. *Construction Management & Economics, 17*(3), 329-340.

Harris, C., Hodges, J., Schur, M., & Shukla, P. (2003). *Infrastructure Projects: A Review of Canceled Private Projects*. T. W. Bank.

Harris, F., McCaffer, R., Baldwin, A., & Edum-Fotwe, F. (2021). *Modern construction management*. John Wiley & Sons.

Holt, C. A., & Sherman, R. (1994). The Loser's Curse. *The American Economic Review*, *84*(3), 642-652. http://www.jstor.org/stable/2118072

Hyari, K. (2017). Contractors' Bidding Behavior in First-Price Sealed Auctions for Construction Projects. *International Journal of Innovation, Management and Technology*, *8*(1), 54-59.

Kwak, S. G., & Kim, J. H. (2017). Central limit theorem: the cornerstone of modern statistics. *Korean J Anesthesiol*, *70*(2), 144-156. https://doi.org/10.4097/kjae.2017.70.2.144

Li, G., Chen, C., Zhang, G., & Martek, I. (2020). Bid/no-bid decision factors for Chinese international contractors in international construction projects. *Engineering, Construction and Architectural Management*, *27*(7), 1619-1643.

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2010). *Essentials of research design and methodology* (Vol. 2). John Wiley & Sons.

Matulová, M., & Rejentová, J. (2021). Efficiency of European airports: Parametric versus non-parametric approach. *Croatian Operational Research Review*, *12*(1), 1-14.

McLucas, A. C. (2003). Incorporating soft variables into system dynamics models: a suggested method and basis for ongoing research. Proceedings of the 21st international conference of the System Dynamics Society.

Menezes, F. Z. (2023). *Brazil tries another go at bullet train project*. Retrieved 29 February, 2024 from https://brazilian.report/business/2023/03/05/another-bullet-train-project/

Mishra, K., Bahadur, K., & Aithal, P. (2020). Association of Number of Bidders and Minimum Bid Ratio (AEr) with Effect of E-bidding of Different Project. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *5*(2), 201-215.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.

Nicholls, D. (2009). Qualitative research: Part one – Philosophies. *International Journal of Therapy and Rehabilitation, 16*(10), 526-533. https://doi.org/10.12968/ijtr.2009.16.10.44562

Olatunji, O. A., Ramanayaka, C., Rotimi, J. O., & Rotimi, E. O. (2022). Analysis of contractors' administrative characteristics in bid decision factors. *Engineering, Construction and Architectural Management*, *Corrected Proof*, https://doi.org/10.1108/ECAM-1112-2021-1063.

Olatunji, O. A., & Ramanayaka, C. E. D. (2023). Client attributes that motivate contractors' bid decision. *Built Environment Project and Asset Management*, *13*(6), 799-812. https://doi.org/10.1108/BEPAM-11-2022-0181

Oo, B. L., Lim, T. H. B., & Runeson, G. (2022). Critical factors affecting contractors' decision to bid: A global perspective. *Buildings*, *12*(3), 379.

Oyeyipo, O. O., Odusam, K. T., Ojelabi, R. A., & Afolabi, A. O. (2016). Factors affecting contractors' bidding decisions for construction projects in Nigeria. *Journal of construction in developing countries*, *21*(2), 21-35.

Plöger, W., Scholl, D., & Seifert, A. (2018). The quasi-experimental attitude of teachers: the development of a questionnaire. *Journal of Education for Teaching, 44*(4), 415-430.

Priemus, H. (2004). Dutch Constructing Fraud and Governance Issues. *Building Research and Information*, *32*(4), 306 - 312.

Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wil, Kolmogrov-Smirnov, Lilliefors and Anderson-Darling test. *Journal of Statistical Modeling and Analytics*, *2*(1), 21-33.

Ringleb, A. H., & Wiggins, S. N. (2018). Liability and large-scale, long-term hazards. In *Economics and Liability for Environmental Problems* (pp. 427-448). Routledge.

Sajid, Z. W., Aftab, U., & Ullah, F. (2024). Barriers to Adopting Circular Procurement in the Construction Industry: The Way Forward. *Sustainable Futures*, 100244.

Salkind, N. J. (2010). *Encyclopedia of research design* (Vol. 1), Sage Publications

Seymour, J. F. (1992). Liability of Government Contractors for Environmental Damage. *Public Contract Law Journal*, 491-571.

Shokri-Ghasabeh, M., & Chileshe, N. (2016). Critical factors influencing the bid/no bid decision in the Australian construction industry. *Construction Innovation*, *16*(2), 127-157.

Signor, R., Love, P. E., & Olatunji, O. (2016). Determining overpricing in Brazilian infrastructure projects: A forensic approach. *Journal of Construction Engineering and Management*, *142*(9), 06016001.

Smith, J., Jaggar, D., Love, P. E. D., & Olatunji, O. A. (2016). *Building Cost Planning for the Design Team* (Third ed.). Routledge.

Snee, R. D., & Rodenbaugh, W. F., Jr. (2002, Sep 2002). The project selection process. *Quality Progress*, *35*(9), 78-80. https://www.proquest.com/magazines/project-selection-process/docview/214742472/se-2?accountid=14647

Somboonpisan, J., & Limsawasd, C. (2021). Environmental weight for bid evaluation to promote sustainability in highway construction projects. *Journal of Construction Engineering and Management*, *147*(4), 04021013.

Stephen, U., & Andrew, W. (2017). Contractor tendering research: going beyond bid/no-bid and markup models. *Proceedings of the Institution of Civil Engineers - Management, Procurement and Law*, *170*(6), 255-262. https://doi.org/10.1680/jmapl.17.00039

Wang, J., Xu, Y., & Li, Z. (2009). Research on project selection system of pre-evaluation of engineering design project bidding. *International Journal of Project Management*, *27*(6), 584-599.

Wang, N., Ma, M., Wu, G., Liu, Y., Gong, Z., & Chen, X. (2019). Conflicts concerning construction projects under the challenge of cleaner production – case study on government funded projects. *Journal of Cleaner Production*, *225*, 664-674. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.03.315

Winch, G. M. (2024). An Action Theory of the Project. *Project Management Journal*, *Ahead-of-Print*, https://doi.org/10.1177/87569728241270574. https://doi.org/10.1177/87569728241270574

Wöll, V., & Sulíková, R. (2023). A Comparison of the Strategies of SMEs and Large Companies in the Field of Occupational Safety. In N. Kryvinska, M. Greguš, & S. Fedushko (Eds.), *Developments in Information and Knowledge Management Systems for Business Applications: Volume 6* (pp. 301-324). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-27506-7_12

Zaqout, I. S., Islam, M. S., Hadidi, L. A., & Skitmore, M. (2022). Modeling bidding decisions and bid markup size for construction projects: A fuzzy approach. *Engineering Applications of Artificial Intelligence*, *113*, 104982.

Project Attributes Influencing Contractors' Bid Decision

February 2025

ABSTRACT

Purpose: This study investigates attributes of projects that attract and retain bidders' interest towards achieving optimal participation in bidding processes. When such participation is inadequate, outcomes are vulnerable to commercial improprieties as though winner's and loser's curse syndrome.

Research design: 19 factors decision factors underlying project selection were extracted from literature. They were formed into a structured questionnaire, administered to project selection stakeholders. 49 samples were analysed, 92% of whom were based in Western Australia. Means between participants' subgroups were tested using t-test. Relationships between variables were measured, culminating into a structural model where decision factors were clustered into themes.

Findings: Project selection decisions are motivated by project resource requirements, design quality and clarity, project's local ecology, construction methodology and impact as well as bidder's mobility and project outlook. Post-hoc analysis shows varying considerations by stakeholders across industry sub-sectors (private vs public), functional lines (contractors vs consultants) and firm sizes.

Implications: Projects have default attributes to attract bidders' participation. These attributes only need to be made obvious and convincing, rather than being prohibitive and complex. Further, value sharing is important in this: it is impossible to unify the transactional interests of every project stakeholder. Being open to the expectations and requirements of other parties is a key milestone in successful project delivery.

Originality: This study unbundles project selection research. Whilst extant studies that report a global view of decision factors are inconclusive and indexical, this current study narrows 19 critical decision factors relating to project attributes into six themes that are easier to uptake and disseminate.

Keywords: bidding, loser's curse, price, post-hoc analysis, procurement, project success, reductionism, structural model and winner's curse.

INTRODUCTION

Contractor must participate adequately and appropriately in bidding processes for procurement to be truly successful. However, normative literature has overlooked the setting of appropriate conditions for an *optimal* bid participation to occur. For example, literature is not definitively clear on project attributes that attract and retain the interest of serious bidders. In addition, there is no consistent relationship between project types and sizes, and optimal number of bidders (Dyer & Kagel, 1996). Whilst large projects may attract more restrictive bidding conditionalities than smaller projects, there is no science behind the number of bidders that is appropriate for a project or how construction projects can be primed to attract an appropriate number of bidders' interests. Without a clear understanding of these conditions, *optimal* bid participation is impossible. Further, common regrets of *optimal* bid participation have been reported in normative literature to include winner's curse and loser's curse (Priemus, 2004; Signor et al., 2016). Winner's curse is an eventuality where a bid winner under- or overestimates the true cost of a project whilst attempting to survive intense competition or choose to lower their motivation and expectation in a quasi-desperate attempt to acquire new project so they can keep their business running (Ahmed et al., 2016). Holt and Sherman (1994) also argue winner's regret can arise from 'utility of winning', a situation where a perpetual winner becomes overly confident; thus, overprice their tender. Loser's curse, on the hand, is a situation where a bidder underprices their tender, perhaps due to repeated previous losses, inadequate or misaligned information during tender action, intense competition or an irrational intention to mislead project owners (Holt & Sherman, 1994). Harris et al. (2021) explain the cost of a failed bid also goes into every new bid, thereby raising the new bid and making them less competitive than they should.

The objective of this study to investigate project attributes that help facilitate optimal participation of contractors in bidding. This study unbundles bid decisioning with a focus on the roles of project attributes, with a view to understanding key elements and the associativity amongst them to trigger optimal bid participation. Rationales for this unbundling have been canvassed by several studies: previous analysis on the subject have been superficial, replicative, inconclusive, and cumbersome when integrated (Olatunji & Ramanayaka, 2023; Stephen & Andrew, 2017). Review of literature and development of new evidence are reported below.

REVIEW OF LITERATURE

Research problemization

The centrality of this study is that bidders' participation is critically important to project delivery processes. Such participation could be measured for adequacy and quality of outcomes. None of these has been addressed adequately in extant studies. However, both can be measured from the perspective of project attributes e.g. by examining project attributes that attract and retain bidders' motivation and how these shape their outcomes. For example, Mishra et al. (2020) analyse 315 road projects in India's Butwa and Shivpur Divisions, completed between 1972 and 1976. They found an average of 4–12 bidders per project was able to trigger a competition that achieved winning bids – of about 13–28% below owners' pre-construction estimates. Al-Arjani (2002) also investigates 200 maintenance projects in Saudi Arabia. They found owners awarded contracts for small projects (below SR3 million) when at least one bidder had participated, and large projects (exceeding SR100 million) when up to 15 bidders have competed. In addition, Hyari (2017) examines 1,396 construction projects undertaken in Jordan between 2004 and 2015. They report an average of 5-11 bidders participated in bidding. Apparently, it is impossible to determine a perfect number of bidders required for a bidding process to be effective across all jurisdictions and project sizes and types. However, evidence is clear on procurement outcome when contractors are unwilling to participate in bidding. These include extended delays, high costs, renegotiations and outright cancellations (Albalate & Bel, 2012; Dewulf et al., 2012; Menezes, 2023). Further, a World Bank study by Harris et al. (2003) reports an investigation of 2,500 infrastructure projects between 1990 and 2001, worth $750 billion in private investment commitments in developing countries. They found participation had fallen and investments had plummeted to less than half of their peak by 2001. Whilst it is arguable that there are many explanations to botched procurement processes, it is equally necessary to conclude that bidding participation issues stall development aspirations and investments, and more efforts are needed to ensure key players' interests are attracted and retained throughout project development processes.

Bid decisions and project attributes

Snee and Rodenbaugh (2002) describe a project as a problem that is scheduled for solution. Flanagan (2002) outlines how project phenomena are sufficiently complex

and are laden with multidimensional risks. The risks start with analysing stakeholder's own capacity against project attributes and ecosystems and determining the potential additionality of participation. The decision of whether to bid or refrain from bidding is complex. It revolves around personal, project, and economic factors. These factors range from the commercial attractions in project economics to climate factors around the project. For example, contractors seek potential for profitable commercial activities when considering their project selection commitments (Harris et al., 2021). In doing this, they seek and absorb significant risks (Bowman, 1982). As Bageis and Fortune (2009) report, contractors deploy varying risk assessment systems depending on their tolerance. These include the various factors identified and analysed adaptively in reaching a decision to bid or not to bid. At a personal level, these factors include contractors' interest and willingness to participate. At the project level, they include the selection of a suitable project with considerable commercial motivation. At economic level, participation is justified based on company's financial position and market forces. Contractors' organizational size and project owner's capacity, their appetite for success and reputation are critical decision factors also (Bageis & Fortune, 2009).

Oo et al. (2022) report five key financial attributes of projects that inform a contractor's decision to participate in bidding. These include project size, payment mechanism, project owners' reputation in the market and financial authority, as well as their financial performance in past projects. The centrality of Oo's work is that owners' financial capacity and contractor's ability and motivation for profit remain the main drivers of project selection and bid participation. This can be summed up to mean contractors are reluctant to participate in projects if they cannot see a reasonable propensity to make appropriate profit or impact when they participate in a project. Zaqout et al. (2022) support the notion that contractors prioritize profit margins and markups in most of their bid decisions. The authors reported 48 factors that shape contractors' acceptable markup decisions. Their conclusion is that contractors focus on the project's context, risks, and uncertainties to decide on an optimal markup.

Dodanwala and Santoso (2024) report the significant role of organizational size in the decision to participate or refrain from bidding. They found small-sized contractors allocate higher decision weight to project size, current workload, project finance, business overhead, and client's proactiveness in the payment process. On the other hand, medium-sized contractors decide based on the project type, project size,

current workload, availability of skilled staff, and project duration. Li et al. (2020) report on similar statistics for the role of the contractor's size in bid decisions. They found contractors' size has a significant positive impact on making bid decisions.

Contractor's risk tolerance is another important factor. Shokri-Ghasabeh and Chileshe (2016) report 26 factors and project attributes that inform bid decisions. Their top bid decision factors include project risk, client financial capability, future benefits and profitability, and intensity of competition. Their findings highlight how contractors' risk tolerance generally decreases with the size of their organization, with medium and small-sized contractors assigning a higher weight to project risks. However, Oyeyipo et al. (2016) found the number of bidders and the intensity of competition between them seldom have significant impact on bid decision. The variation in the two findings is significant. One, it is convenient to associate them with the contextual variability of the studies. Shokri-Ghasabeh and Chileshe (2016) report on Australia, a structured market, whereas Oyeyipo et al. (2016) report on Nigeria, a developing ecosystem where solutions to extant seemingly chaotic challenges remain soft and incipient. Nevertheless, there was a consensus in the two studies on the importance of the owners' financial capability and availability of capital and resources.

According to Li et al. (2020), project's location, and the cultural customs of the people in project proximity are important decision factors. They found contractors' capability to work in diverse cultures, with the ability to deal with risks associated with host localities. Their findings show the foremost factor considered in international bid decisions is the host's cultural risks. Macro-economic issues such as rates of inflation, foreign currency exchange and security are key issues also. Contractors also consider the strength of the local justice system, political stability, and security of the banking and financial market of the host country. Further, Chileshe et al. (2021) report 11 contextual project attributes for indigenous contractors in relation to bidding. They include contractor's current workload, project size, profitability, type, and need for work. However, contrary to Li et al. (2020), Chileshe et al. (2021) found the statistical significance of weather in project selection considerations is low.

Project attributes reported in literature are relative to availability of project resources, bidder's mobility, local ecology, project outlook, design quality and clarity, construction methodology, and impact. This study also follows a systematic literature review (SLR) approach to further investigate these factors thematically. Preferred

reporting items for systematic and meta-analyses (PRISMA) review technique proposed by Moher et al. (2009) was followed. PRISMA has been used by multiple studies in construction and project management for similar purposes (Oo et al., 2022; Sajid et al., 2024). Table 1 lists the search strings used for this study, which comprised a combination of the pre-decided keywords. These were "project attributes," "project factors," "contractor," and "bid decision". Scopus and Web of Science (WoS) repositories were used to retrieve relevant articles. They represent a significant repository of scholarly publications in the subject area being investigated. The search period was kept between the year 2000 and onwards to keep a recent focus on the factors. Article types were limited to original research and review papers. All other types of articles and those not published in the English language were discarded. A total of 13 papers were retrieved from Scopus, and 43 were retrieved from WoS repositories. After removing duplicates, a total of 44 articles were used for the final review. This procedure helped systemically retrieve relevant articles and identify the key decision factors for project bid participation used by the contractors.

Insert Table 1

Figure 1 shows a network visualization of the most occurring keywords in the retrieved articles in the retrieved articles. Four research themes or clusters emerged based on the network mapping: performance, business, project, and management. As shown in Figure 1, performance cluster houses keywords such as options, governance, uncertainty, and success. Management cluster houses keywords such as complexity, delivery methods, risks, and management models. Project cluster include administrative decisions, costs, bidding considerations, and the severity of market competition. Business cluster include factors of culture, project identification, and location. Overall, top keywords include project management (n=16), construction (n=10), performance (n=8), decision uncertainty (n=7), framework/model (n=7), and complexity (n=5) – where ***n*** is the number of papers reviewed.

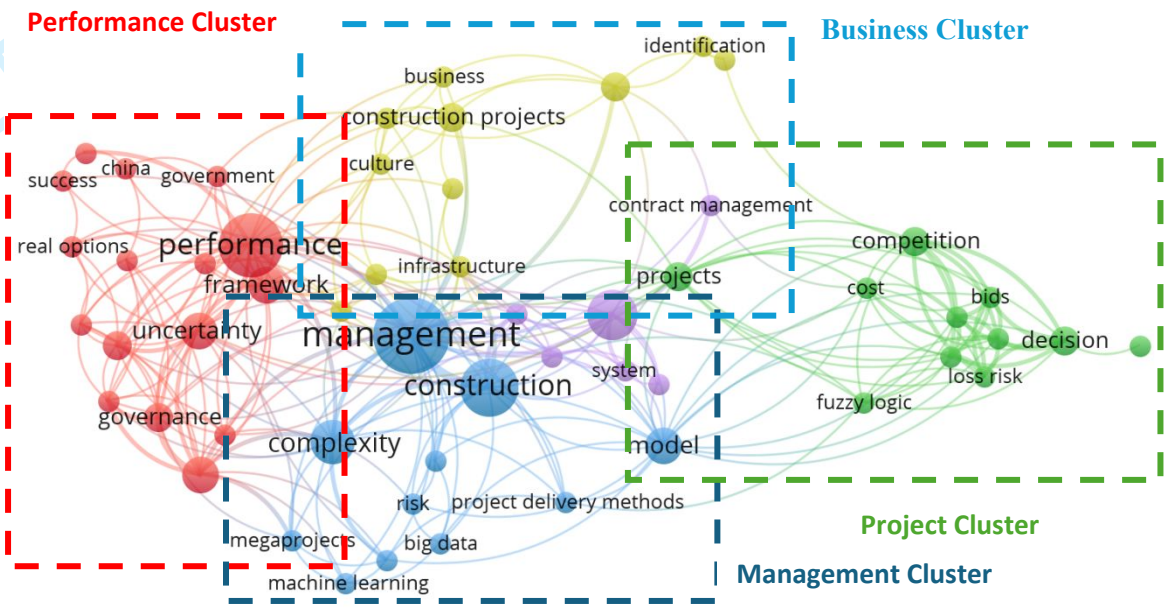

Figure 1: Network visualization of keywords

Source: Authors' work

RESEARCH DESIGN

The detailed review of literature identifies 19 factors, shown in Table 2, which lists the factors and how they apply in bid participation decision-making. In consonance with previous studies where these factors have been extracted, the strategy of the current research is to treat the factors as hard variables. Nicholls (2009) describes hard variables as though their remits and characters have been established definitively in extant studies and can be assessed by research participation without significant knowledge augmentation. This is different to soft variables that are intended to emerge from the various unique lenses of research participants. Research techniques that deliver the best results in hard and soft methodologies have been argued in normative literature. Hard variables are best assessed using quantitative methods, whilst qualitative methods are most suitable for soft variables (Bowron, 2025; Green, 1999; Marczyk et al., 2010; McLucas, 2003; Salkind, 2010).

Insert Table 2

Bacon-Shone (2013) explains quantitative research techniques to include the use of structured questionnaire, where variables are listed for relevant participants to input their opinions in ways that new evidence can be built. Bowron (2025) explains this could be in four forms: descriptive, correlational, experimental and quasi-experimental. Descriptive questionnaires are used often used to measure characteristics, behaviours or attitudes of a population, and are often aimed at explaining the current status of a phenomenon in reference to a norm or standard (Fallowfield, 1995). Correlational questionnaires are used to investigate the strength of association between multiple variables (Bhandari, 2021). In contrast, experimental questionnaires are used to measure cause-and-effect relationships between two variables (Amiel & Cowell, 1998). Quasi-experimental questionnaires are used to measure cause-and-effect relationships without relying on random assignment – e.g. see Plöger et al. (2018).

The current study uses experimental techniques to obtain data from participants such that the cause-and-effect relationships between decision factors and bidders' participation in bidding can be measured. All the factors extracted from literature were designed into a structured questionnaire survey, administered to industry practitioners. Human research ethics protocol of the research was approved as per standard procedure. A total of 49 participants returned fully completed questionnaires following purposive snowball sampling approach that lasted 6 months.

The following hypotheses were tested:

H_1: Project-related factors are significant decision attributes for bidding from bidder's perspectives.

H_2: There is significant association amongst project-related decision factors.

H_3: Bidder's demographic variables of aspect, firm size, clientele, success of winning, and bidding method moderate participants' perceptions regarding the significance of project-related decision factors in the bidding process.

Demographics

In addition to participants' basic information such as age, gender, educational attainment, and work experience, measurement also captured information about core business operations of participants, their predominant sector, number of submissions per annum and average contract value. However, they were not

considered under H_3 as the sample sizes of their sub-categories was inadequate. Further, geographic location is not included in the analysis because 92% of the participants were from Western Australia. 51% of participants are contractors. 43% are claims consultants. 6% are manufacturers and clients who possess considerable understanding who undertake significant tasks in relation to tender action. 51% work for large national and multinational firms. 49% are employees of small and medium-sized firms. 90% are involved in construction projects and construction related supplies. 10% provide consultancy services in relation to contract claims and research.

Further, participants were asked to indicate the sub-sector of construction where they submit the most bid. 20% are most prominent in residential projects; industrial projects, 6%; "others" (specified by participants as "commercial projects"), 40%. Only one-third of participants show interest in public projects; two-third are more attracted to private and partnerships projects. Moreover, 80% submit at least 15 bids yearly, 76% of which are exceed $1 million [20% exceed $50 million and 20% are between $25 million and $50 million]. 41% have succeeded in more than 50% of their bids. Participants also reported participation in various bidding methods: open competitive (35%), selected (59%) and negotiated (6%). These attributes of show participants have the requisite competence and experience to add value to the research.

Data Analysis

Suitability and Cleaning

Analyses were undertaken using the 26th edition of Statistical Package for Social Sciences (SPSS26). Internal reliability of data was tested using the Cronbach's Alpha Reliability Estimate (α). Outcomes show the factors were slightly inconsistent internally (α=0.686). When "Project stakeholders" was deleted, the remaining 18 variables became internally consistent (modified α=0.703). Further, a series of Shapiro-Wilk (SW) tests were conducted to check the data distributions for normality. Level of significance, p, was less than 0.05 for all the variables; thus 'precise' normality is violated. Two approaches are applicable. One, by employing non-parametric statistical tests. The other way is by checking data distributions for 'approximate' normality towards achieving a reasonable level of accuracy. The latter is preferred widely (Kwak & Kim, 2017; Matulová & Rejentová, 2021; Razali & Wah, 2011). This is because non-parametric tests are less comprehensive and are often affected by

accuracy issues and procedural limitations. The validity of approximate normality was tested using graphical (Q-Q plots) and numeric methods (Skewness and Kurtosis).

Q-Q plots did not show significant variations between the snake-like data distributions and the data on straight lines. Whilst this supports approximate normality, graphical interpretations are vulnerable to subjectivity. Therefore, Kurtosis and Skewness were also calculated (maximum Skewness = 0.546; Maximum Kurtosis = 0.668). Therefore, approximate normality is accepted for all the variables (Razali and Wah 2011). Consequently, H_{1-3} were tested using parametric alternatives.

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Population tendencies

The Likert scale used in the study is 5-point, 1 being ~~highly insignificant~~extremely unimportant and 5 being critically ~~significant~~or extremely important to decision making. None of the factors was rated at major significance or above (μ≥4.0). Compared to the factors relating contractors' and clients' attributes ~~summarised in Tables 4 (a&b),~~ published elsewhere (in Olatunji et al. (2022) and Olatunji and Ramanayaka (2023)), evidence shows project-related factors are statistically less important to bidders. Whereas about 65% and 47% of characteristics of contractors and clients, respectively, were rated at major significance or above(μ≥4.0),

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Insert Table 3shows the descriptive and inferential statistics relevant to the significance of the decision factors. Although sample means (μs) and standard deviations are given, all interpretations were made with respect to the population mean (μ). Therefore, a series of one sample t-tests were conducted. The null and alterative hypotheses were set as:

H_0: $\mu = \mu_h$ i.e. population mean is equal to the hypothesised mean.
H_a: $\mu \neq \mu_h$ i.e. population mean is not equal to the hypothesised mean.

By observing the sample means and standard deviations values, hypothesised means (μ_h) were set for each variable. When the level of significance, p, was above or equal to 0.05 ($p \geq 0.05$), μ_h was accepted as the population mean, μ. Only the accepted μ_h values are shown in ~~Table III~~

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Insert Table 3. The factors are ranked in the table using μ (largest to smallest), followed by μs (largest to smallest) and standard deviation (smallest to largest) in the presence of identical incidents.

Design quality (PRO9), Project cash flow requirements (PRO14), and Potential safety hazards (PRO13) are rated at the top with μ=3.8. Closer to them are Project by

contract value (PRO2) and project complexity (PRO8), rated at μ=3.7. In summary, nearly 89% of the PRO factors are rated between 'minor' and 'major' significance ($3.0 \leq \mu \leq 3.9$). Local customs and culture (PRO7), μ=2.9) and local climate (PRO8), μ=2.7) were rated the least significant factors.

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Insert Table 3

Correlation Analyses

To obtain a holistic understanding of the bidding factors, it is also critical to understand how they are interrelated. Pearson's correlations were calculated for all variables. To test H_2 at a=0.05, null and alterative hypotheses were set as:

H_0: There are no significant linear correlations among the decision factors (r=0); and

H_a: There are significant linear correlations among the decision factors ($r \neq 0$)

~~Table IV~~

shows only statistically significant correlations ($p \leq 0.05$), with p values obtained. All the factors except Project start time (PRO03) and Project cash flow requirements 14 (PRO) indicate at least one statistically significant association. These associations are categorised as weak ($0.2 \leq r < 0.4$), moderate ($0.4 \leq r < 0.6$), strong ($0.6 \leq r < 0.8$) or very strong ($r \geq 0.8$). In Figure , weak correlations are eliminated to enhance the clarity of the illustration, except on one occasion (see the caption of Figure 1).

There are 'very strong' correlations between Type of equipment required (PRO16), Type of labour required (PRO17) and Type of material required (PRO18). These factors represent project's resource requirements. They were internally consistent statistically ($\alpha = 0.943$). Thus, they were formed int a sub-group factors, named 'Project Resources' (Figure 2). ~~Table IV~~

also shows PRO5, 6, 7 and 11 have significant statistical correlations with PROs16-18. However, *a* values reduced when they were added to the 'Project Resources' sub-group. Thus, they are co-located in another sub-group.

There is a strong correlation between Project Complexity (PRO8) and Design quality (PRO9), r=0.761. The Cronbach Alpha value (a=0.861) applies as though they are internally consistent as a group. Thus, in Figure 2, they are clustered as a sub-group named 'Design Quality and Clarity'. Similarly, Project location (PRO4) and Site accessibility (PRO5) are strongly correlated (r=0.714). With an internal consistency (a) of 0.833, they are clustered as 'Bidder's Mobility'. These two factors also have moderate to weak correlations with PROs16-18. However, they reduce internal consistency when combined as a single group. Thus, they are clustered into separate groups.

The least important bidding decision factors, PRO6 (Local climate) and PRO7 (Local customs and culture) indicate a moderately strong relationship (r=0.589). Reliability statistics indicates that they are internally consistent as a group (a=0.738). Thus, they are clustered as 'Local Ecology'. In addition, both factors are moderately correlated with PRO4, which is already clustered under 'Bidder's Mobility'. This can be understandable as project location can influence local weather as well as culture. When it is added to the group, the Cronbach Alpha value increases up to 0.799. Therefore, PR04 is considered as a common attribute between 'Local Ecology' and 'Bidder's Mobility' (Figure 3).

Project duration (PRO1) and Project size by contract value (PRO2) are moderately correlated (r=0.468). They can be considered as the indications of project's magnitude. However, they are not internally consistent as a group (a=0.622). Thus, they cannot be clustered. The associations among Required method of construction (PRO11), Potential environmental issues (PRO12) and Potential safety hazards (PRO13) are also statistically significant. They are internally consistent as a group (a=0.718). Therefore, they are included in a sub-group entitled: 'Construction Methodology and Impact'. Project prestige (PRO10) and type of project or nature of work (PRO15) are correlated with a moderate strength too (r=0.542). Since they are internally consistent (a=0.701), they are clustered as 'Project Outlook'.

Insert Table 4.

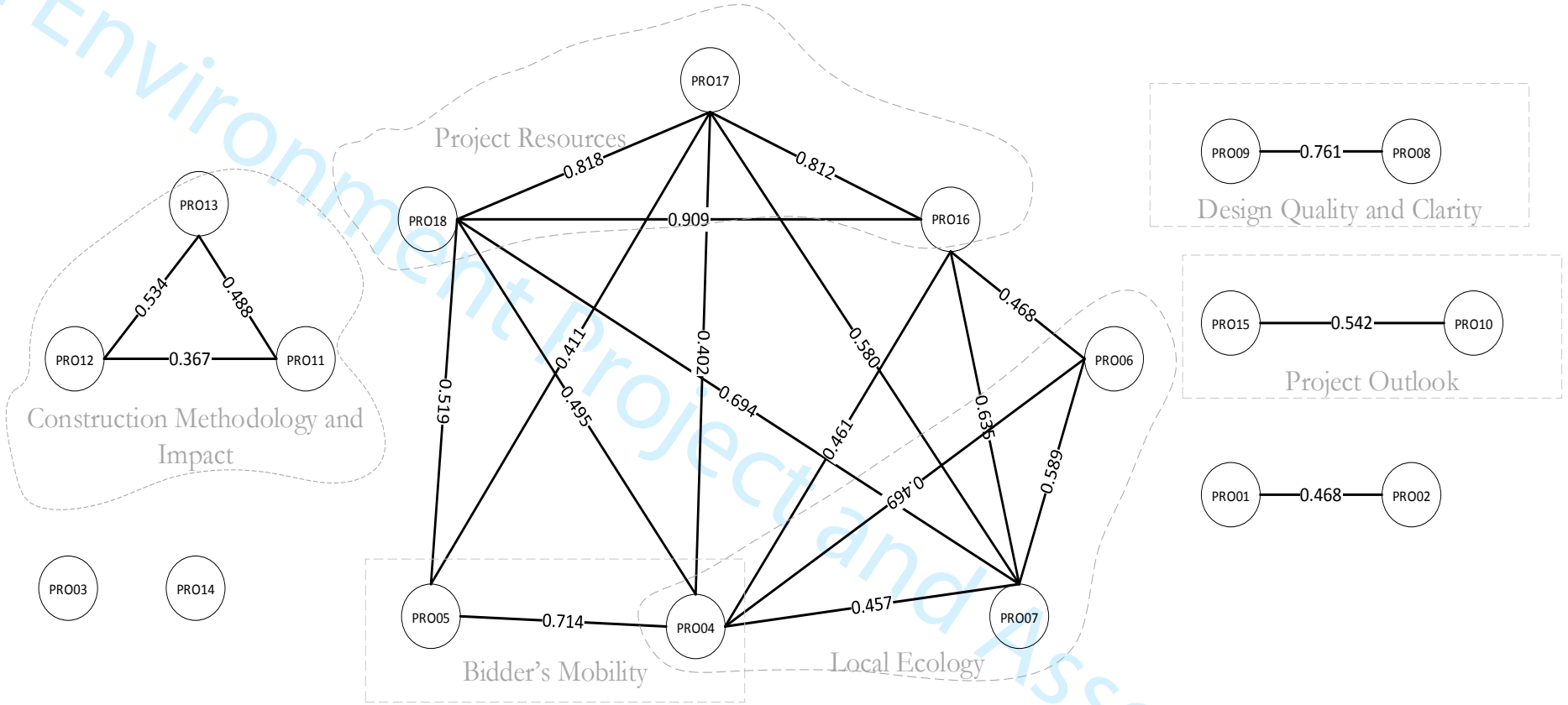

Figure 2: Structural model of project-related factors in bid decisions.

Source: Authors' work

Note: Figure 2 only shows variables with significant statistical correlations – level: moderate and above (r≥0.4). This is to enhance clarity, except PROs 10 and 11, where associated correlation is within a cluster as identified in the text (Table 54).

Effect of Demographic Variables on Bid Decision Factors

The following variables were considered as sample requisites:

- Aspects *i.e.*, sub-sector of the construction industry where participant's view is situated.
- Firm size *i.e.*, size of participant's firm.
- Clientele *i.e.*, nature of clients in participant's market.
- Success of winning *i.e.*, participant's history of winning; and
- Bidding method *i.e.*, the bidding method where participant had practised.

To test H_3, H_0 and H_a were set as:

H_0: the population means are equal across the groups.

H_a: the population means are not equal across the groups.

One-way ANOVA test was used to test H_3, except for *Aspects*. Considering sample requisites, only contractors and consultants can be considered under *Aspects*. Thus, independent sample t-test was used. Levene's test was used to check the assumption of homogeneity of variance. When one-way ANOVA indicated a statistically significant difference among the groups, Tukey's test was used for post-hoc analysis to find nuances within each group.

Aspects

As shown in Table ~~V~~5, *p*-values were greater than 0.05 only for PRO1 (Project duration) and PRO13 (Potential safety hazards). Therefore, population means are significantly different amongst contractors and consultants. Further, the assumption of equal variance was satisfied under the t-test for PRO1 (F=0.022, *p*=0.889) and PRO13 (F=3.034, *p*=0.089). The negative *t* value indicates PRO1 is more significant to consultants than to contractors. In contrast, PRO13 is more significant to contractors than to consultants.

Insert Table 5

Tukey Honesty Significance Difference Test Statistics

PROs 12 and 13 were applicable. As reported also in Table 5, One-way ANOVA indicates a significant statistical difference amongst the means of Clientele Groups, in Potential environmental issues (PRO 12) (F=5.002, *df*=2; *p*=0.013), and firm sizes, in Potential safety hazards (PRO 13) (F=3.441, *df*=3, *p*=0.014). Further, Levene's statistics for PRO 12 (F=1.076, *p*=0.349) and PRO 13 (F=1.772, *p*=0.166) confirms the assumption of homogeneity of variances was satisfied. Tukey test shows the mean difference is significant only between small firms of fewer than 20 employees and multinationals. Apparently, public project contractors pay more attention to environmental issues than private sector clientele, whilst small firms consider safety hazards more significantly than multinational firms.

~~Insert Table 6~~

The study did not suggest significant statistical difference participants' perceptions regarding 'success of winning' and 'bidding method'.

Implications and Discussion of Findings

The centrality of the findings of this study is that projects must reflect deliberate attributes, and these must be constructed consciously by project owners ~~to~~to attract bidders' participation~~, and t~~. As the findings suggest, this phenomenon is critically important to every project stakeholder (see summary of findings in Table 6). For greater clarity, the study supports its underlying theory that project selection outcomes can be made more proficient by unbundling integrated decision factors, and by understanding the internal workings of each cluster. Of the 19 project-related factors analysed in the study, 7 are most critical (PRO 4-7 & 16-18), grouped into the subthemes of bidder's mobility, local ecology and availability of resources for the project. Contractors will participate in bidding if project is located outside their locality only if they are not averse to extended mobility and access to project site is not overly constrained. These two variables are ranked amongst the top 10 decision factors. Further, contractors will participate in bidding if their business motivation does not find local climate, customs and culture and access to site unsurmountable. Except site

access issues (PRO05), all the variables in the Local Ecology cluster are ranked in the bottom 10 decision factors. Availability of resources are also important: contractors are not likely to bid for a project unless the labour, materials and equipment they require for the project are available. Although these factors are also ranked in the bottom 10 decision factors, their strong correlation with contractors' mobility and project's local ecology is well defined in the structural model reported in Figure 2.

Insert Table 6

Beyond these, it is also clear in Figure 2 that there are four other clusters that shape contractors' project selection decisions. These clusters are largely orthogonal – they can be decided without significant recourse to other clusters or factors. For example, construction methodology is defined by the method of work mandated by the client, potential environmental issues as well as safety hazards. For example and greater clarity, Frangioudakis Khatib et al. (2023) have explained what may happen when asbestos is discovered on a construction site in Australia – protracted delay due to increased regulation and exposure to major health risks. Whilst two of these factors are also ranked in the bottom 10, '*potential safety hazards*' ranks amongst the top 3. Meanwhile, design quality is another orthogonal cluster, explained by quality of project design (ranked No 1) and complexity of project (ranked No 5). Findings also show contract descriptors such as project duration (ranked No 13) and contract value (ranked No 4) are another orthogonal cluster, whilst nature and prestige of project are another cluster, name project outlook. Project start time and cashflow arrangements are rated as important (ranked as No 7 and No 2, respectively). However, not of these two factors have significant correlation with any other factor, not fit into a cluster.

The additionality of these findings can be discussed variously. Projects are the main stay of construction businesses; they fuel commercial aspirations of businesses (Winch, 2024). Without projects, the construction industry will lose its essence and will diminish global economy in terms of fixed assets, national income, resource employment and the culture of soft innovation that the industry is reputed for (Smith et al., 2016). Thus, the eco-system of project is important to government just as it is to other construction stakeholders. If one party is deficient in their project obligations, the ecosystem of

project development would be impacted. An understanding around this will help stakeholders to learn, unlearn and improve their project experiences. In line with these fundamental understanding, one clear implication of the findings of this study is that stakeholders have varying views about project attributes that attract optimal bid participation. For example, as shown in Table ~~7~~5, contractors pay more attention to environmental issues in public projects than they do in private projects – because of intense public scrutiny and government's strict regulations (Wang et al., 2019), whilst small firms consider safety hazards more significantly than multinational firms – the former must be meticulous on safety precautions to which the latter has devised instruments and the knowledge-power to dissipate liabilities (Ringleb & Wiggins, 2018; Wöll & Sulíková, 2023). We also found contractors are more attentive to environmental considerations than project owners. Consistent with Seymour (1992), the former is more regulated than the latter and are answerable to the consequential costs of environmental damages arising from their work. Further, we found small firms are more conscious about safety than large firms.

These nuanced views cannot be subsumed as though unitary. We found *Project stakeholders* is such a complex scenario. This is because many parties hold varying stakes, views and objectives in a project. As such varying viewpoints cannot be summed up, a single Likert scale may not be appropriate to measure participant's perception regarding their view of all *Project stakeholders*. Further, results show factors lack internal consistency statistically until stakeholders' nuances were captured distinctly. These points of variance include sub-sectoral attributes that are peculiar to projects environment e.g. unlike in the private sector, public sector projects are malleable to political dynamism, they are run under mandated management processes and can be vulnerable to multiple stakeholders (Akwei et al., 2020). Efficiencies and inefficiencies in these are enough to trigger systemic successes or failures in projects (Fourie & Poggenpoel, 2017).

Another major implication of the findings of this study is that project attributes are of less statistical importance to bidders than contractors' and clients' attributes. Apparently, project owners and contractors often see themselves as more important that the very essence of their coming together. Without diminishing the separate importance of the trio – projects, contractors and project owners, a common characteristic of systemic failure in projects is that human parties often misplace an

ideal understanding of projects – multifacetedly complex, driven by non-linear factors and nuanced objectives of varying role-players.

Bryde and Robinson (2005) report this as a commonplace problem – a *curse syndrome* when parties are overly optimistic or choose to misrepresent project realities. When realities contradict players' expectations, failure becomes apparent. This is not only when completion or satisfaction becomes impracticable, rather attendant commonplace experiences become unwanted. For greater clarity, when project owners fail to convince potential bidders that they are well motivated to succeed, bidders are unlikely to participate. For their motivation to succeed to become evident, projects must be clear on resource requirements, design must be accurate and local ecology must support project. Further, construction method must be implementable, and consideration must be given to bidder's mobility and their objective to remain in business. Although, post-hoc analyses of these factor show varying considerations by stakeholders across industry sub-sectors (private vs public), functional lines (contractors vs consultants) and first sizes, contractors' handling of these factors is very crucial. Their bids will fail if they refuse to consider these factors as appropriate, or when they win, they are likely to become a victim of *utility of winning* – a situation where a consistent winner becomes complacent and become less competitive than usual. The situation of a perpetual looser is worse: the confidence to win disappears, and the cost of a loss becomes a burden for a potential success.

CONCLUSIONS

Project attributes must facilitate success. They need to be made obvious and convincing, rather than being prohibitive and complex. Further, value sharing is important in this: it is impossible to unify the transactional interests of every project stakeholder such that the importance of project is not relegated below individual party's interests. Being open to the expectations and requirements of other parties is a key milestone in successful project delivery. When this fails to happen, projects suffer and every party to it becomes worse off. Thus, this study concludes that bidders are attracted to participate optimally in project biddings when the resources needed for the project are available to them, when such bidders are able mobilise to the project's jurisdiction, and if the ecology of the project supports their business philosophy and strategy. Further, optimum bidders' participation is also shaped by

their risk appetite, current workload and project outlook. These are influenced by obvious commercial benefits motivated by transparent payment mechanisms and cashflow outlay. Design quality and feasibility of bidder's preferred construction methods are also important. Where these are impossible to achieve, project success could become compromised. Nonetheless, this study has had some limitations. Sample size is small and a large proportion of participants in the study resident in Western Australia, even though they have had significant international experience. These limitations do not render the findings of the study less valid.

References

Aboelmagd, Y. M. (2018). Decision support system for selecting optimal construction bid price. *Alexandria engineering journal*, *57*(4), 4189-4205.

Ahmed, M. O., El-adaway, I. H., Coatney, K. T., & Eid, M. S. (2016). Construction Bidding and the Winner's Curse: Game Theory Approach. *Journal of Construction Engineering and Management*, *142*(2), 04015076. https://doi.org/doi:10.1061/(ASCE)CO.1943-7862.0001058

Akwei, C., Damoah, I. S., & Amankwah-Amoah, J. (2020). The Effects of Politics on the Implementation of Government Programs/Projects: Insights from a Developing Economy. *Politics & Policy*, *48*(6), 1161-1201. https://doi.org/https://doi.org/10.1111/polp.12384

Al-Arjani, A. H. (2002). Type and size of project influences on number of bidders for maintenance and operation projects in Saudi Arabia. *International Journal of Project Management*, *20*(4), 279-287.

Albalate, D., & Bel, G. (2012). *The economics and politics of high-speed rail: Lessons from experiences abroad*. Lexington Books.

Amiel, Y., & Cowell, F. (1998). The measurement of poverty: An experimental questionnaire investigation. *Empirical Economics, 22*, 571-588.

Apanaviciene, R., & Juodis, A. (2006). Predicting effectiveness of construction project management: Decision-support tool for competitive bidding. *Operational Research*, 6, 347-360.

Bacon-Shone, J. (2013). *Introduction to quantitative research methods*. Graduate School, The University of Hong Kong.

Bageis, A. S., & Fortune, C. (2009). Factors affecting the bid/no bid decision in the Saudi Arabian construction contractors. *Construction Management and Economics*, *27*(1), 53-71.

Bhandari, P. (2021). *Correlational Research: When & How to Use*. Retrieved Retrieved on May 23, 2025 from https://www.scribbr.com/methodology/correlational-research/

Bowman, E. H. (1982). Risk seeking by troubled firms. *Sloan Management Review (pre-1986)*, *23*(4), 33-42.

Bowron, R. (2025, Feb. 21, 2025). *Research Design and Methods: Setting up the Research Design*. Austin Peay State University. Retrieved Accessed May 19, 2025 from https://libguides.apsu.edu/c.php?g=923794&p=7115026

Bryde, D. J., & Robinson, L. (2005). Client versus contractor perspectives on project success criteria. *International Journal of Project Management*, *23*(8), 622-629. https://doi.org/https://doi.org/10.1016/j.ijproman.2005.05.003

Carpenter, N., & Bausman, D. C. (2016). Project delivery method performance for public school construction: Design-bid-build versus CM at risk. *Journal of Construction Engineering and Management*, *142*(10), 05016009.

Chileshe, N., Edwards, D. J., Kavishe, N., & Haupt, T. C. (2020). Perception on challenges impacting bid decision of indigenous building contractors in Dar Es Salaam, Tanzania. *Journal of Engineering, Design and Technology*, *18*(6), 1641-1662.

Chileshe, N., Kavishe, N., & Edwards, D. J. (2021). Critical factors influencing the bid or no-bid decision of the indigenous small building contractors in Tanzania. *Construction Innovation*, *21*(2), 182-202.

Dewulf, G., Blanken, A., & Bult-Spiering, M. (2012). *Strategic issues in public-private partnerships*. Wiley Online Library.

Dodanwala, T. C., & Santoso, D. S. (2024). Critical Factors Influencing the Bid/no-Bid Decisions of Small and Medium-Sized Contractors in Sri Lanka. *International Journal of Construction Education and Research*, 1-26.

Dyer, D., & Kagel, J. H. (1996). Bidding in common value auctions: How the commercial construction industry corrects for the winner's curse. *Management Science*, *42*(10), 1463-1475.

Fallowfield, L. (1995). Questionnaire design. *Archives of disease in childhood, 72*(1), 76.

Flanagan, R. (2002). Keynote: Managing Risk for an Uncertain Future - A Project Management Perspective. Symposium on Project Management: Impresario of the Construction Industry, Hong Kong.

Fourie, D., & Poggenpoel, W. (2017). Public sector inefficiencies: Are we addressing the root causes? *South African Journal of Accounting Research*, *31*(3), 169-180. https://doi.org/10.1080/10291954.2016.1160197

Frangioudakis Khatib, G., Collins, J., Otness, P., Goode, J., Tomley, S., Franklin, P., & Ross, J. (2023). Australia's Ongoing Challenge of Legacy Asbestos in the Built Environment: A Review of Contemporary Asbestos Exposure Risks. *Sustainability, 15*(15), 12071.

Green, S. D. (1999). A participative research strategy for propagating soft methodologies in value management practice. *Construction Management & Economics, 17*(3), 329-340.

Harris, C., Hodges, J., Schur, M., & Shukla, P. (2003). *Infrastructure Projects: A Review of Canceled Private Projects*. T. W. Bank.

Harris, F., McCaffer, R., Baldwin, A., & Edum-Fotwe, F. (2021). *Modern construction management*. John Wiley & Sons.

Holt, C. A., & Sherman, R. (1994). The Loser's Curse. *The American Economic Review*, *84*(3), 642-652. http://www.jstor.org/stable/2118072

Hyari, K. (2017). Contractors' Bidding Behavior in First-Price Sealed Auctions for Construction Projects. *International Journal of Innovation, Management and Technology*, *8*(1), 54-59.

Kwak, S. G., & Kim, J. H. (2017). Central limit theorem: the cornerstone of modern statistics. *Korean J Anesthesiol*, *70*(2), 144-156. https://doi.org/10.4097/kjae.2017.70.2.144

Li, G., Chen, C., Zhang, G., & Martek, I. (2020). Bid/no-bid decision factors for Chinese international contractors in international construction projects. *Engineering, Construction and Architectural Management*, *27*(7), 1619-1643.

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2010). *Essentials of research design and methodology* (Vol. 2). John Wiley & Sons.

Matulová, M., & Rejentová, J. (2021). Efficiency of European airports: Parametric versus non-parametric approach. *Croatian Operational Research Review*, *12*(1), 1-14.

McLucas, A. C. (2003). Incorporating soft variables into system dynamics models: a suggested method and basis for ongoing research. Proceedings of the 21st international conference of the System Dynamics Society.

Menezes, F. Z. (2023). *Brazil tries another go at bullet train project*. Retrieved 29 February, 2024 from https://brazilian.report/business/2023/03/05/another-bullet-train-project/

Mishra, K., Bahadur, K., & Aithal, P. (2020). Association of Number of Bidders and Minimum Bid Ratio (AEr) with Effect of E-bidding of Different Project. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *5*(2), 201-215.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group~~*, †~~. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.

Nicholls, D. (2009). Qualitative research: Part one – Philosophies. *International Journal of Therapy and Rehabilitation*, *16*(10), 526-533. https://doi.org/10.12968/ijtr.2009.16.10.44562

Olatunji, O. A., Ramanayaka, C., Rotimi, J. O., & Rotimi, E. O. (2022). Analysis of contractors' administrative characteristics in bid decision factors. *Engineering, Construction and Architectural Management*, *Corrected Proof*, https://doi.org/10.1108/ECAM-1112-2021-1063.

Olatunji, O. A., & Ramanayaka, C. E. D. (2023). Client attributes that motivate contractors' bid decision. *Built Environment Project and Asset Management*, *13*(6), 799-812. https://doi.org/10.1108/BEPAM-11-2022-0181

Oo, B. L., Lim, T. H. B., & Runeson, G. (2022). Critical factors affecting contractors' decision to bid: A global perspective. *Buildings*, *12*(3), 379.

Oyeyipo, O. O., Odusam, K. T., Ojelabi, R. A., & Afolabi, A. O. (2016). Factors affecting contractors' bidding decisions for construction projects in Nigeria. *Journal of construction in developing countries*, *21*(2), 21-35.

Plöger, W., Scholl, D., & Seifert, A. (2018). The quasi-experimental attitude of teachers: the development of a questionnaire. *Journal of Education for Teaching*, *44*(4), 415-430.

Priemus, H. (2004). Dutch Constructing Fraud and Governance Issues. *Building Research and Information*, *32*(4), 306 - 312.

Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wil, Kolmogrov-Smirnov, Lilliefors and Anderson-Darling test. *Journal of Statistical Modeling and Analytics*, *2*(1), 21-33.

Ringleb, A. H., & Wiggins, S. N. (2018). Liability and large-scale, long-term hazards. In *Economics and Liability for Environmental Problems* (pp. 427-448). Routledge.

Sajid, Z. W., Aftab, U., & Ullah, F. (2024). Barriers to Adopting Circular Procurement in the Construction Industry: The Way Forward. *Sustainable Futures*, 100244.

Salkind, N. J. (2010). *Encyclopedia of research design* (Vol. 1), Sage Publications

Seymour, J. F. (1992). Liability of Government Contractors for Environmental Damage. *Public Contract Law Journal*, 491-571.

Shokri-Ghasabeh, M., & Chileshe, N. (2016). Critical factors influencing the bid/no bid decision in the Australian construction industry. *Construction Innovation*, *16*(2), 127-157.

Signor, R., Love, P. E., & Olatunji, O. (2016). Determining overpricing in Brazilian infrastructure projects: A forensic approach. *Journal of Construction Engineering and Management*, *142*(9), 06016001.

Smith, J., Jaggar, D., Love, P. E. D., & Olatunji, O. A. (2016). *Building Cost Planning for the Design Team* (Third ed.). Routledge.

Snee, R. D., & Rodenbaugh, W. F., Jr. (2002, Sep 2002). The project selection process. *Quality Progress*, *35*(9), 78-80. https://www.proquest.com/magazines/project-selection-process/docview/214742472/se-2?accountid=14647

Somboonpisan, J., & Limsawasd, C. (2021). Environmental weight for bid evaluation to promote sustainability in highway construction projects. *Journal of Construction Engineering and Management*, *147*(4), 04021013.

Stephen, U., & Andrew, W. (2017). Contractor tendering research: going beyond bid/no-bid and markup models. *Proceedings of the Institution of Civil Engineers - Management, Procurement and Law*, *170*(6), 255-262. https://doi.org/10.1680/jmapl.17.00039

Wang, J., Xu, Y., & Li, Z. (2009). Research on project selection system of pre-evaluation of engineering design project bidding. *International Journal of Project Management*, *27*(6), 584-599.

Wang, N., Ma, M., Wu, G., Liu, Y., Gong, Z., & Chen, X. (2019). Conflicts concerning construction projects under the challenge of cleaner production – case study on government funded projects. *Journal of Cleaner Production*, *225*, 664-674. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.03.315

Winch, G. M. (2024). An Action Theory of the Project. *Project Management Journal*, *Ahead-of-Print*, https://doi.org/10.1177/87569728241270574. https://doi.org/10.1177/87569728241270574

Wöll, V., & Sulíková, R. (2023). A Comparison of the Strategies of SMEs and Large Companies in the Field of Occupational Safety. In N. Kryvinska, M. Greguš, & S. Fedushko (Eds.), *Developments in Information and Knowledge Management Systems for Business Applications: Volume 6* (pp. 301-324). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-27506-7_12

Zaqout, I. S., Islam, M. S., Hadidi, L. A., & Skitmore, M. (2022). Modeling bidding decisions and bid markup size for construction projects: A fuzzy approach. *Engineering Applications of Artificial Intelligence*, *113*, 104982.

~~Amiel, Y., & Cowell, F. (1998). The measurement of poverty: An experimental questionnaire investigation. *Empirical Economics, 22*, 571-588.~~

Bacon-Shone, J. (2013). *Introduction to quantitative research methods*. Graduate School, The University of Hong Kong.

Bhandari, P. (2021). *Correlational Research: When & How to Use*. Retrieved Retrieved on May 23, 2025 from https://www.scribbr.com/methodology/correlational-research/

Bowron, R. (2025, Feb. 21, 2025). *Research Design and Methods: Setting up the Research Design*. Austin Peay State University. Retrieved Accessed May 19, 2025 from https://libguides.apsu.edu/c.php?g=923794&p=7115026

Fallowfield, L. (1995). Questionnaire design. *Archives of disease in childhood, 72*(1), 76.

Frangioudakis Khatib, G., Collins, J., Otness, P., Goode, J., Tomley, S., Franklin, P., & Ross, J. (2023). Australia's Ongoing Challenge of Legacy Asbestos in the Built Environment: A Review of Contemporary Asbestos Exposure Risks. *Sustainability, 15*(15), 12071.

Green, S. D. (1999). A participative research strategy for propagating soft methodologies in value management practice. *Construction Management & Economics, 17*(3), 329-340.

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2010). *Essentials of research design and methodology* (Vol. 2). John Wiley & Sons.

McLucas, A. C. (2003). Incorporating soft variables into system dynamics models: a suggested method and basis for ongoing research. Proceedings of the 21st international conference of the System Dynamics Society,

Nicholls, D. (2009). Qualitative research: Part one – Philosophies. *International Journal of Therapy and Rehabilitation, 16*(10), 526-533. https://doi.org/10.12968/ijtr.2009.16.10.44562

Plöger, W., Scholl, D., & Seifert, A. (2018). The quasi-experimental attitude of teachers: the development of a questionnaire. *Journal of Education for Teaching, 44*(4), 415-430.

Salkind, N. J. (2010). *Encyclopedia of research design* (Vol. 1). sage.

Tables

Table I: Search strings and results

Database	Search strings	Synthesis step	Irrelevant or duplicate	Total relevant
Scopus	(TITLE-ABS-KEY ("Project attribute*") OR TITLE-ABS-KEY ("Project factor*") AND TITLE-ABS-KEY (contractor) AND TITLE-ABS-KEY ("bid decision" OR "bid*" OR tender OR contract)) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))	Basic search	NA	17
		English only	1	16
		Article type limit	2	14
		Time limit	1	13
		Topic relevance	0	13
		Detailed review		13
Web of Science	"Project attribute*" (All Fields) or "Project factor*" (All Fields) and contractor (All Fields) and "bid decision" OR "bid*" OR tender OR contract (All Fields)	Basic search	NA	200
	Refined By: Languages: English, Document Types: Articles or Review Articles; Dates 01/2000 to 01/2025	English only	0	200
		Article limit	50	150
		Topic relevance	117	43
		Detailed review		43
	Total retrieved for detailed review			56
	Irrelevant and duplicates across the databases			12
	Final shortlist			**44**

Source: Authors' work

Table 2: Project attributes and their explanation

Rank	Factor Name	Explanation	Selected Reference
1	Design quality	Completion and sophistication of design documents, including the quality of available information in contract documents.	Wang et al. (2009)
2	Project cash flow requirements	Availability of required finances and access to funds in a timely manner	Aboelmagd (2018)
3	Potential safety hazards	Presence of safety risks, and necessary instruments to handle hazards.	Oyeyipo et al. (2016)
4	Project size in terms of the contract value	Magnitude of project in terms of scope, work quality, contractual requirements, and associated costs.	Zaqout et al. (2022)
5	Project complexity	Degree of novelty, difficulty, uncertainty, and their influence on project.	Apanaviciene and Juodis (2006)
6	Type of project or nature of work	Nature and type of work involved in project.	Bageis and Fortune (2009)
7	Project start time	Planned start time of project	Dodanwala and Santoso (2024)
8	Site accessibility	Terrain of proximity and ease of access to project site.	Chileshe et al. (2020)
9	Project prestige	Social expectations surrounding the project.	Oyeyipo et al. (2016)
10	Project location	Significance of project's locality.	Chileshe et al. (2020)
11	Potential environmental issues	Environmental issues and concerns surrounding the project.	Somboonpisan and Limsawasd (2021)
12	Required method of construction	Novelty and complexity of construction method mandated for project.	Carpenter and Bausman (2016)
13	Project duration	Timeframe for project completion.	Dodanwala and Santoso (2024)
14	Type of equipment required	Availability and familiarity with the equipment needed for the project.	Aboelmagd (2018)
15	Labour required	Desired skillset required for the work.	Oyeyipo et al. (2016)
16	Materials required	Availability and affordability of materials required for work.	Shokri-Ghasabeh and Chileshe (2016)
17	Local culture and customs	Cultural texture of residents, acceptance, and behaviour towards the project	Li et al. (2020)
18	Local climate	Weather conditions of project locality.	Chileshe et al. (2021)
19	Project Stakeholder management	Management of expectations of various stakeholders involved in the project	Winch (2024)

Source: Authors' work

Table 3: Mean tendencies of the sample and population

Rank	Factor Name	Factor code	Sample mean (μs)	Standard dev.	Population Mean*	t	df	Sig.**
1	Design quality	PRO09	3.63	0.859	3.8	-1.364	48	0.179
2	Project cash flow requirements	PRO14	3.62	1.028	3.8	-1.238	49	0.222
3	Potential safety hazards	PRO13	3.52	1.054	3.8	-1.878	49	0.066
4	Project size in terms of the contract value	PRO02	3.56	0.812	3.7	-1.219	49	0.229
5	Degree of project complexity	PRO08	3.44	0.951	3.7	-1.933	49	0.059
6	Type of project or nature of work	PRO15	3.29	0.979	3.5	-1.532	48	0.132
7	Project start time	PRO03	3.20	0.926	3.5	-1.528	49	0.133
8	Site accessibility	PRO05	3.14	1.030	3.4	-1.784	49	0.081
9	Level of project prestige	PRO10	3.14	1.061	3.4	-1.697	48	0.096
10	Project location	PRO04	3.12	1.003	3.4	-1.974	49	0.054
11	Potential environmental issues	PRO12	3.12	1.118	3.4	-1.77	49	0.083
12	Required method of construction	PRO11	3.10	1.165	3.4	-1.821	49	0.075
13	Project duration	PRO01	2.94	1.058	3.2	-1.738	49	0.088
14	Type of equipment required	PRO16	2.90	1.129	3.2	-1.878	49	0.066
15	Type of labour required	PRO17	2.88	1.100	3.1	-1.414	49	0.164
16	Type of material required	PRO18	2.82	1.155	3.1	-1.714	49	0.093
17	Local customs and culture	PRO07	2.65	1.128	2.9	-1.532	48	0.132
18	Local climate	PRO06	2.44	1.013	2.7	-1.814	49	0.076

* Hypothesised at (μ_h)

** 2-tailed.

Source: Authors' work

Table 4: Person's correlation matrix

PRO2	0.468**											
PRO5		0.714**										
PRO6		0.469**	0.389**									
PRO7		0.457**	0.380**	0.589**								
PRO9						0.761**						
PRO12									0.367**			
PRO13									0.488**	0.534**		
PRO15			0.309*				0.313*	0.542**				
PRO16		0.461**	0.468**		0.635**				0.365**			
PRO17		0.402**	0.411**	0.341*	0.580**				0.344*		0.812**	
PRO18		0.495**	0.519**	0.331*	0.694**				0.287*		0.909**	0.818**
	PRO1	**PRO4**	**PRO5**	**PRO6**	**PRO7**	**PRO8**	**PRO9**	**PRO10**	**PRO11**	**PRO12**	**PRO16**	**PRO17**

**p<0.01; *p<0.05.

Source: Authors' work

Table 5: Independent sample t-test and Tukey HSD test statistics for Interaction terms* of Potential safety hazards

	t-test statistics					95% Confidence Interval	
Factors	**t**	**df**	**Sig****	**Mean Diff.**	**Std. Error Diff.**	**Lower**	**Upper**
PRO1	-2.211	41	0.033	-0.697	0.315	-1.333	-0.060
PRO13	2.784	41	0.008	0.810	0.291	0.222	1.397
	Tukey HSD test statistics						
Dependent Variables	Group 1	Group 2					
PRO12	Private	Public	0.013	-0.957*	0.323	-1.74	-0.17
PRO13	Small	Multinational	0.014	1.429	0.45	0.23	2.63

* Project duration, firm sizes and types as interaction terms

**2-tailed

Source: Authors' work

Table 6: Summary of findings

Factor (PRO)	Factor Name	Inclusion/exclusion	Sub theme
01	Project duration	Included	Contract descriptor
02	Project size in terms of the contract value	Included	Contract descriptor
03	Project start time	Orthogonal	
04	Project location	Included	Bidder's mobility
05	Site accessibility	Included	Bidder's mobility/ Local ecology
06	Local climate	Included	Local ecology
07	Local customs and culture	Included	Local ecology
08	Degree of project complexity	Included	Design quality
09	Design quality	Included	Design quality
10	Level of project prestige	Included	Project outlook
11	Required method of construction	Included	Construction methodology & impact
12	Potential environmental issues	Included	Construction methodology & impact
13	Potential safety hazards	Included	Construction methodology & impact
14	Project cash flow requirements	Orthogonal	
15	Type of project or nature of work	Included	Project outlook
16	Type of equipment required	Included	Project resources
17	Type of labour required	Included	Project resources
18	Type of material required	Included	Project resources
19	Project Stakeholder management	Excluded	