Author/s:
O'Leary, T;Vaz-Serra, P

Title:
Challenges in pricing preliminaries costs for contractors: An Australian case study

Date:
2025-01

Citation:
O'Leary, T. & Vaz-Serra, P. (2025). Challenges in pricing preliminaries costs for contractors: An Australian case study. Organization, Technology and Management in Construction: An International Journal, 17 (1), pp.126-142. https://doi.org/10.2478/otmcj-2025-0008.

Persistent Link:
https://hdl.handle.net/11343/357090

Research Paper **Open Access**

Timothy O'Leary*, Paulo Vaz-Serra

Challenges in pricing preliminaries costs for contractors: An Australian case study

DOI 10.2478/otmcj-2025-0008
Received: October 15, 2024; accepted: March 24, 2025

Abstract: The accurate estimation of project costs is pivotal for the ongoing financial success of construction companies. Despite the clear definition of direct costs in tendering information, indirect costs (also known as project overheads and preliminaries) are often overlooked or underestimated. These costs are influenced by various factors, including company resource availability, site and project characteristics, contractual conditions and procurement methods. The pricing of preliminaries is a complex task, and the varying nature of these costs, coupled with the lack of transparency in current pricing practices, can lead to significant discrepancies in tender pricing. The challenge is to identify what should be included in preliminaries and arrive at a value in practice. This research has explored how contractors' estimating departments address the complexities of pricing preliminaries for building and civil infrastructure works, particularly considering stringent contractual requirements and post-pandemic construction market disruptions. Through a literature review and an online survey of 30 senior estimators from major contractors, addressing 18 questions, the research sought to understand current practices, differing approaches and metrics employed in pricing preliminaries during the tendering stage. The multifaceted nature of preliminary studies was examined, offering a structured analysis of their categorisation, estimation methods, associated challenges and the impact of project delivery methods. The findings reveal that each contractor processes the pricing of preliminaries using certain tendering gateways and a variety of different metrics. This indicates that systematic risk and pricing models for contractors may lack a justifiable basis, with existing pricing models facing acceptance challenges across different contractors.

Keywords: contractor, costs, preliminaries, estimating, tendering

1 Introduction

Accurately estimating project costs is essential for the financial health of construction companies (Hills and Lee 2024). Tender documents usually specify direct costs clearly, but indirect costs, also known as project overheads and preliminaries, often do not receive adequate attention and are frequently underestimated. These costs are shaped by a variety of factors such as the availability of company resources, the specifics of the site and project, contractual terms and procurement strategies (Singla and Sridharan 2022). For instance, choosing to estimate materials, equipment and labour separately for a specific task can significantly influence preliminary expenses due to the increased need for coordination and supervision by site staff (Šiškina et al. 2009). On the contrary, opting for a subcontract that includes these costs can reduce the need for such management, as these responsibilities are taken on by the subcontractor.

Chan and Pasquire (2002) define project overheads and preliminaries as the general costs associated with providing services for the construction site and maintaining items of plant and equipment to undertake the works. These general additional costs also include insurance and staff accommodation, as well as head office expenses. Further delineating overheads and preliminary costs, Hesami and Lavasani (2014) categorise them into two components: (a) site and (b) company overhead costs. Site overhead components encompass staff wages, water and electricity, temporary offices, equipping roads and renting equipment. Meanwhile, office overhead costs cover head office staff salary, office rental, communication costs, insurance and taxes.

***Corresponding author: Timothy O'Leary,** Faculty of Architecture, Building and Planning, University of Melbourne, Parkville, Victoria 3010, Australia. E-mail: oleary.t@unimelb.edu.au
Paulo Vaz-Serra, Faculty of Architecture, Building and Planning, University of Melbourne, Parkville, Victoria 3010, Australia

Despite a common belief that project overheads and preliminaries account for a relatively minor percentage of the contract sum, ranging from 10% to 20% (Chan and Pasquire 2002), their estimation can be neglected in the cost estimation process, leading to potential problems for contractors. The CIOB Code of Estimating Practice (1997) provides comprehensive guidelines for estimating these items, emphasising that project overhead and preliminary costs consist of time-related expenses such as rental charges, salaries, and so on, and fixed costs such as dismantling costs. Moreover, inadequate estimation of preliminary costs poses a risk factor, especially if price escalation has not been considered (Pradeep et al. 2018). A precise and reliable set of comprehensive preliminaries can, however, aid in resolving disputes over the assessment of variations and the final account.

The significance of accurate cost estimation on construction contracts cannot be overstated, as inaccuracies can lead to either overestimating costs resulting in an unacceptably high bid for the tender or underestimating costs, thereby incurring losses on awarded contracts, a prevalent issue in the construction industry where profit margins are comparatively low (Akintoye 2000). This underscores the importance of accurate cost estimation as highlighted by several authors (Hicks 1992; Akintoye 2000; Chan and Pasquire 2002; Hesami and Lavasani 2014).

This research aims to improve preliminaries cost estimation and management practices by drawing on findings from a survey of Australian construction industry professionals, providing insights for optimisation. By analysing current practices in the Australian construction market and identifying critical factors influencing the pricing of preliminaries, this study seeks to create reliable guidelines for contracting organisations. Such guidelines are intended to accurately estimate overhead costs, maintain positive cash flow and prevent insolvency in a volatile market, thereby mitigating potential inaccuracies. The research addresses several key questions:

- How are Total Project **Construction Preliminaries Costs** allocated across various stages such as site establishment, insurance and permits, site supervision and running costs, final clean-up and handover, and head office overheads?
- What **forms of schedules for preliminaries** do builders use in the Estimating/Tender stage?
- What are the Administrative and Constructability challenges in Estimating Prelims?
- How do Contractors perceive the value of correct **Pricing of Preliminary Claims** and future claims for loss, expense and prolongation costs?
- What are the current rates of **Building Price Escalations** for various categories of Preliminary items and what metrics best estimate costs?

By addressing these questions, the study aims to contribute to more effective cost management practices in the construction industry.

2 Construction preliminaries costs literature review

Preliminaries play a pivotal role in shaping the overall cost framework of construction projects. They encompass a wide range of expenses that go beyond the direct costs of materials, equipment and labour. Preliminary costs are broadly categorised into project overhead costs and company's general overhead costs (Hesami and Lavasani 2014). Project overheads pertain to expenses directly associated with the construction site, such as staff wages, utilities and equipment rental. Conversely, general overhead costs relate to the contractor's administrative expenses incurred at the head office. This distinction is crucial for accurate cost allocation and management.

Existing literature is focused on examining and classifying effective factors affecting overhead costs in constructing projects in a specific type of projects, such as refurbishment or tall building (Abas et al. 2016; Shittu et al. 2022), while others focus on specific geographical locations, for example, Poland, UK, US, Nigeria, India, Iran, Sri Lanka, Palestine and Indonesia (Akintoye and Fitzgerald 2000; Odeyinka and Yusif 2003; Enshassi et al. 2008; Plebankiewicz and Leśniak 2013; Hesami and Lavasani 2014; Jaya and Frederika 2015; Erri Pradeep et al. 2019; Saini et al. 2021; Shittu et al. 2022; Singla and Sridharan 2022). Some of the existing studies only focus on specific contract types or protocol efficiencies for project preliminaries estimations (Abas et al. 2019), while others focus on a particular preliminaries cost estimation approach, such as the application of artificial neural networks (ANN), or use of historical overhead costs for estimation purposes, or probabilistic approach (Abdul-Malak and Azhari 2008; Chao 2010; Leśniak 2013; Chao and Kuo 2016; Leśniak and Juszczyk 2018). Some authors also focus on the risk management aspects of projects, such as accidents contingencies and the effects of accurate preliminaries estimation on risk contingency evaluations (Fiolet et al. 2016; Haupt and Pillay 2016).

2.1 Forms of schedules for preliminaries costs

The estimation of project preliminaries is an essential aspect of construction cost calculation. There are several methods for the calculation of preliminary items. First, some industry guidelines should be considered while estimating preliminary items. For instance, The CIOB Code of Estimating Practice (CIOB 2018) comprises comprehensive guidelines for estimating project overhead items (Chan and Pasquire 2002). According to this Code, project overhead costs consist of certain time-related expenses (e.g., rental charges, salaries) and fixed costs (e.g., installation, dismantling costs) (Chan and Pasquire 2002; Shittu et al. 2022). Fixed charges are generally independent of duration, while time-related charges depend on the project's duration (Shittu et al. 2022). By identifying and categorising these cost items, estimations can be made similar to unit rate calculations (Chan and Pasquire 2002); various textbooks use the CIOB Code as a basis for estimating project overheads.

To establish reliable and accurate preliminary costs, contractors can employ various approaches such as using one-off, time based, provisional sum or measurable items as much as possible (Abas et al. 2016). Thorough planning and understanding the complexity of the construction project are crucial for the effective management of preliminaries. The distinction between variable and fixed costs is crucial for determining the relevant costs for changes in contract quantities. Variable costs change in proportion to the volume or quantity of construction activity, while fixed costs remain constant, regardless of the fluctuations in volume. Most activities involve a combination of variable and fixed costs. For example, job-site shops have fixed costs, such as setup expenses and variable costs, including wages paid to workers based on the number of items fabricated. General and administrative costs, such as office rent and salaries, are typically considered as fixed costs within a specific time period, even though they may vary across different periods.

Furthermore, estimating project overheads as a percentage of the contract value is common, especially for small-scale, repetitive works (Chan and Pasquire 2002). However, this approach may lead to underestimation, as many preliminary items do not exhibit a linear relationship with the value of works. Researchers have explored different methods and models for estimating project overhead costs. Chao (2010) developed a case-based reasoning (CBR) model for supervision cost estimation. The model was compared with other existing methods, highlighting the need for more accurate and sophisticated estimation approaches. Abas et al. (2016) mentioned that, sometimes, preliminaries are commonly priced using summation rates based on loose general descriptions and the contractor's own interpretation. They suggest that breaking down the lump sum item into smaller items could provide better accuracy and be defined in simpler terms with basic components, which would anticipate risk costs and prevent overrun costs. Additionally, some researchers have explored the use of artificial intelligence (AI) and other advanced estimation models, such as ANN and fuzzy modelling, for cost estimation (Nabil and El-Riyati 2015) and the advantages of using building information modelling (BIM) (Naderi et al. 2024).

The Australian New Zealand Standard Method of Measurement (ANZSMM) for Building Works guides quantity surveyors to a list of measuring preliminaries for pricing by contractors. This is based on the client's requirements and likely contractor's costs broken into two main categories, being Contractual and Site Conditions, with 42 individual subcategories (see Table 1).

The method provides for several other guidance rules of measurement that invoke drawing attention to such things as, adjoining buildings, limitations on access to working or storage space and the requirements of the contract in relation to these preliminary items. Table 2 provides an alternative approach to the listing of preliminaries by individual Contractors rather than professional client-side quantity surveyors.

2.2 Constructability challenges

The constructability choice of the project delivery method has a direct impact on the allocation of risk among parties involved in the contract, which in turn affects the estimation of overhead costs, loading criteria and recording efforts (Singla and Sridharan 2022). Different project delivery methods, such as design-build (DB), design-bid-build (DBB) and item rate contracts, have varying degrees of risk allocation between the client and contractor, which can affect the control of overheads and the accuracy of quantity estimation. For instance, DB projects with lump sum payments require tight monitoring and control of overhead costs to achieve cost savings and increase profit margins. By contrast, DBB projects and item rate contracts shift the risk of quantities to the client and compensate the contractor for any increase in original quantities. However, fixed sum or lump sum contracts used in DB projects do not have such provisions, necessitating greater control on overhead costs regardless of any quantity estimation errors during bid submission (Singla and Sridharan 2022). Interviewees agreed that project delivery models have a

Tab. 1: List of suggested categories from the ANZSMM

Contractual	Site conditions
1. Working hours	20. Charts, schedules
2. Rates and wages and prices of materials	21. Notice board
3. Sub-letting	22. Setting out works
4. Progress and final certificates and	23. Temporary installations
5. Variations	24. Services
6. Dates for commencement and completion	25. Telephone calls
7. Bonus for early completion	26. Temporary screens, fences, hoardings, guard rails, etc.
8. Liquidated damages	27. Temporary roads, tracks, crossing, etc.
9. Rise and fall	28. Temporary sheds, sanitary accommodation, etc.
10. Exemption from duty sales or other taxes	29. Duties and attendance
11. Issue and return of documents	30. Work outside the contract
12. Discrepancies	31. Supplied goods
13. Submission of priced bills of quantities	32. Samples
14. Contract agreement stamp	33. Testing
15. Payment of taxes	34. Advertising
16. Notices, permits, fees	35. Footpath levels
17. Liability	36. Plant equipment and attendant labour
18. Bonds, guarantees	37. Scaffolding
19. Payment of extra monies	38. Attendance
	39. Protection
	40. Cleaning
	41. Handing over
	42. Defects liability

ANZSMM, Australian New Zealand Standard Method of Measurement.

Tab. 2: Examples of preliminaries schedules from two Australian contractors under two different procurement methods

Case A (construction only – BB)	Case B (design and build – DBB)
Labour and supervision	Supervision
Site supervision	Project Manager, Site Manager, Design Manager, Cost Planner, Administrator, Assistant Administrator, Design and Documentation Coordinator, Site Coordinators, Site Supervisors, Site Supervisors, Services Manager, Construction Planner, Quality Manager, Site Secretary, Tenancy Coordinator, OH&S Manager
Other	Contractors Labour
As built drawings and documentation, operation and maintenance manuals	Cleaning Labour and others
Insurances	Fees & insurances
Authority charges	Building administration fund (building control commission)
Authority service provider headwork fees and charges	Hoarding & gantry permits
Professional indemnity and insurance	Crossing fees
Contract works insurance	Value management facilitator
Public liability insurance	Consultants design fees
Professional indemnity & insurance	5% insurance bonds
Workers compensation	Professional indemnity insurance

(*Continued*)

Tab. 2: Continued

Case A (construction only – BB)	Case B (design and build – DBB)
Plant & equipment	Contractors' legal fees
Bank guarantees	Contractors all risk insurance
Security – Bank guarantees charges	Public liability insurance
Fees and charges for the erection of scaffold systems, hoardings and gantries, the establishment of construction zones, footpath closures and tower crane loading zones	Plant and equipment insurance
Building permit	Warranties and guarantees
Construction industry levy	Plant & equipment insurance (contractors plant)
Main site office purchases and consumables	Site purchases and consumables
Loose furniture signage	Safety notices/inductions/safety signage
Consumption costs	Establish first aid station and consumables
Car parking	Payroll delivery, postage, couriers, kitchen supplies, etc.
Plan printing	Plan printing for trade packages (procurement)
Information management & document control systems	Progress photographs
Courier charges	Parking costs for contractor employees
Small tools	Couriers
Small tools	Small tools, nails and charges, etc. – (Built personnel)
Site establishment	Site setup
Fencing, gantries, security gates	Hoardings, fences and gates
Hoardings, fences and compounds	Gantries and overhead protection – Site camp
Temporary roads tracks crossings	Make good pavements
Temporary fencing or tree protection fencing	Site signs
Temporary services	Temporary services
Site radio communications	Power consumption during construction
Temporary electrical services	Water consumption during construction
Temporary hydraulic services	Temporary water, sewer and fire protection – Site construction
Access lighting	Temporary electrical services – Site construction
Task lighting	Fire extinguishers on site
Telephone	Site telephones and radios – MC personnel
ICT	Site telephones and radios – Trade contractors
Site offices & accommodation	Site offices & accommodation
Construction worker amenities client office	Temporary site accommodation – MC & client personnel
	Worker amenities, change, ablution, etc. – Total workforce
	Site office equipment and furniture
	Site office running costs, consumables, etc.
General works	Surveying, cleaning and protection
Survey	Setout and survey – Base grids
Dilapidation survey	Setout and survey – Detail trade survey
Lift opening temporary barricades	Existing conditions survey
Waste management	Waste minimisation programme
Safety requirement including OH&S requirements	Rubbish Bin hire – Tenancy fitouts
Safety site access control	Progressive cleaning – Tenancy fitouts
Dust control	Cleaning

(*Continued*)

Tab. 2: Continued

Case A (construction only – BB)	Case B (design and build – DBB)
Progressive cleaning	Site security
Final cleaning	Protective clothing
Site security control	Protection of finished works
Safety equipment	Maintenance and maintenance of protection of finished works
PPE	Supervision during defects liability period
Jersey barriers	Defect rectification during defects liability period
Materials handling	Cranage
Tower crane	Fixed tower cranage for the works including crew, crane base, erection, dismantling, hire, running costs, maintenance, tower sections, landing platforms, jumping, ties, communications and sundries, etc.
Tower crane crew including driver and dogmen	Trade mobile cranage including erection, dismantling, running costs, etc.
Mobile cranes for beam & panel lifts outside to tower crane capacity	Mobile cranage for establishment of contractor and client site accommodation
Mobile crane for general steel erection, facade, loading, service etc.	Mobile cranage for establishment of trade contractor site accommodation
Scaffolds	Scaffold and construction work method
Scaffolds	Internal and external scaffold
Temporary structures	Provision and maintenance of temporary roads
Temporary screens prevention items	Gantries and overhead protection – Site construction
Elevated work •	Construction loads, temporary propping, perimeter and void safety rails attached to formwork etc.
	Lift barricades
Hoisting	Hoisting
Hoists, hoist driver, forklifts, loading platforms, banksman/traffic control flag men, concrete pumping equipment, pumps, lines, booms, etc.	Man and material hoists for the works including driver, base, erection, dismantling, hire, running costs, maintenance, sections, landing platforms, gates, jumping ties, communications and sundries, etc.
Elevated platforms, scissor lifts, boom lifts, knuckle booms, cherry pickers, swing stages etc.	Maintenance of permanent builders' lifts

BB, bid-build; DBB, design-bid-build; ICT, Internet Communication Technologies; MC, Management Contractor; OH&S, Occupational Health and Safety; PPE, Personal Protective Equipment.

significant role in overhead estimation efforts and accuracy, although little research has been conducted in this area (Singla and Sridharan 2022).

Overall, while the literature highlights the importance of project delivery methods on overhead estimation efforts and accuracy, further research is needed to identify specific factors and approaches to improve these processes in different types of construction projects. After analysing the existing resources, it is concluded that the literature in this area is heavily focused on examining correlations based on the type of projects and is almost exclusively based on overseas construction markets, such as India, Nigeria, Iran, UK, Poland, and Palestine (Akintoye and Fitzgerald 2000; Odeyinka and Yusif 2003; Enshassi et al. 2008; Plebankiewicz and Leśniak 2013; Hesami and Lavasani 2014; Jaya and Frederika 2015; Nabil and El-Riyati 2015; Erri Pradeep et al. 2019; Saini et al. 2021; Shittu et al. 2022; Singla and Sridharan 2022). As a result, a gap in research on Australian construction projects was detected, which should take multiple factors into account beyond merely the project type, or a specific estimation approach.

2.3 Pricing of preliminary claims

A significant benefit of accurate preliminary estimation is its role in preventing future claim disputes. Claim disputes often arise when the estimated costs and resources

allocated for preliminary estimation prove to be insufficient or inadequate. This can lead to delays, additional expenses and disagreements between project stakeholders. Saini et al. (2021) highlighted that the indirect cost incurred during a project is often overlooked, and it is one of the major causes of various claims with respect to contract conditions.

Chan (2012) emphasises the importance of proper planning and identification of cost items, including the preliminaries at the tender Stage. The author highlighted that failure to do so may result in unnecessary claim disputes, particularly in the case of protests or strikes from the public. And that this could lead to an adverse effect on the image of the project owner and a delay in the project, which would result in additional project overhead expenses borne by the contractor.

In some contracts, contractors are instructed to spread or allocate their overhead and profit costs across all pay items in the schedule of values, and this leads to disputes and claims in the construction industry (Nabil and El-Riyati 2015). In addition, the authors highlighted the importance of solid evidence and documentation instead of vague presentations to resolve overhead disputes. This behaviour positively affects the resolution of claims of suspension, delay by the owners and termination, minimising disputes with the owners in determining contractor financial damages. Furthermore, Haupt and Pillay (2016) emphasised the significance of indirect costs of injuries and fatalities that should be considered while estimating for project overheads. These costs included loss of productivity, disruption of schedules, administrative time for investigations and reports, training of replacement personnel, wages paid to the injured workers, clean up and repair, adverse publicity, third-party liability claims and equipment damage.

2.4 Building price escalations

The importance of considering price escalation of buildings while estimating construction preliminaries is critical. The preliminary costs are affected by factors such as inflation, escalation and risk, which require estimation and contingency planning. Chan (2012) explains that local contractors manage their projects on a portfolio basis to maximise their returns, and in times of economic downturn, project overhead costs become more vulnerable to escalation. The regional economic situation plays a vital role, and contractors need to stay alert in the dynamic business environment. The importance of assessing escalation and contingencies is emphasised by Dell'isola (2003), because these factors are real costs that have not been specifically identified at the time an estimate is prepared. Dell'isola (2003) also notes that risk is a significant factor in determining a project's cost and any transfer of risk to a contractor will likely result in a higher price for the work. Lastly, it is mentioned that inflation affects construction costs, and other factors like demand and economic boom also play a role in determining the price of construction (Hesami and Lavasani 2014).

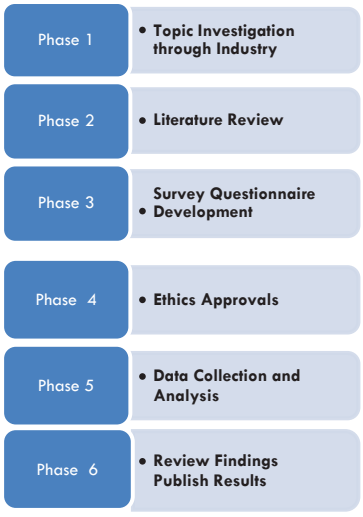
Increasingly, in a climate of heightened inflationary cost pressures, contractors are pushing for the risk of cost escalation to be directly addressed in construction contracts, no longer comfortable with common mitigants such as one-off contingencies. In the absence of an appropriate cost escalation clause, there is a greater risk of disputes arising as increased costs become practically unmanageable, and contractors consider walking away from projects (with or without a legal right to do so). This can have a significant impact on project delivery.

3 Research methodology

This study reflects a quantitative expert survey to explore the impact of organisational practices on the pricing strategies for preliminaries. It was crucial to focus on both experienced senior estimators and financial controllers responsible for determining pricing strategies. The framework of the method conducted is shown in Figure 1, with an explanation of the key activities in each phase under the headings of the right-hand column of this diagram.

To explore the impact of organisational practices on the pricing strategies for preliminaries, it was crucial to focus on both senior estimators and financial controllers responsible for determining pricing strategies. Several organisations, including peak industry bodies, were contacted to provide advice as an objective was to conduct an in-depth examination of preliminaries influencing tenders and how contractors account for these at the tender stage. Capturing the context within which pricing decisions are made was also essential. This was to inform the questionnaire survey format and scope. A considered approach based on the authors' prior industry experience and lengthy teaching practice in this field was needed to understand how contractors identify and calculate costs for preliminary activities during the tender phase. The final phase of the study was to draw on the results of the Contractors Preliminaries survey and to publish the results here.

Several organisations, including peak industry bodies, were contacted to provide advice as an objective was to conduct an in-depth examination of preliminaries influencing tenders and how contractors account for



Informal Interviews
Industry & Peak Body Stakeholder Consultation. Estimating Roles, Positions and Experience. Demographics and Background Information.

Literature Review
Review of Existing studies/publications. Content Analysis of Industry Codes. NVivo Cluster Analysis.

Questionnaire
Qualtrics Instrument, Set up Question Block, Workflow and Distribution modes. Testing, Import/Export, Report Features.

Ethics Protocols
Human Ethics Application, Consent and Plain Language Forms, Declarations and Final Approvals, Data repository.

Data
Qualtrics Survey Launch and Close out. Descriptive statistics, Likert scale data count and tabulations. Mean scores and open-ended written responses groupings.

Publication and Peer Review
Report writing, Formal Academic Paper Submission and Peer Reviews.

Fig. 1: Research methodology framework.

these at the tender stage. Capturing the context within which pricing decisions are made was also essential. This was to inform the questionnaire survey format and scope.

A considered approach based on the authors' prior industry experience and lengthy teaching practice in this field was needed to understand how contractors identify and calculate costs for preliminary activities during the tender phase. The final phase of the study was to draw on the results of the Contractors Preliminaries survey and to publish the results here.

To develop the survey/questionnaire, a roadmap was prepared to identify the main categories of items highlighted in the literature and some references in professional publications and standards. These categories and items were examined in conjunction with the best practices suggested by the courses in estimation and cost management. To rate the degree of importance of a series of questions related to the way they addressed preliminary cost using a five-point Likert scale, from 1 (not at all important) to 5 (very important) and percentage of perception of the relative importance of different topics, participants were asked to rank between 0% and 100%. In addition, open questions were included to include comments from the experts. There is some research indicating that a 10-point Likert-type scale is more efficient as an operating measurement model than a 5-point Likert-type scale (Coelho and Esteves 2007). A 5-point Likert scale was used in this survey as it still provides enough points to differentiate respondents' answers, is suitable for unipolar constructs, and enables response reliability and statistical validity while being easy to interpret and use.

After the analysis and identification within the literature on main categories, they were grouped into six overarching areas:

(i) Total preliminaries costs
(ii) Forms of schedules for preliminaries
(iii) Administrative challenges
(iv) Constructability challenges
(v) Pricing of preliminary claims
(vi) Building price inflation.

In addition to the literature review, two examples were elected from different contractors to cross-check and validate for the Australian construction industry. In compliance with the university ethics requirements, the first section outlined the project aims and tasks, as well as the individuals and organisations involved in the research.

An online survey/questionnaire using Qualtrics software, as recommended by the University of Melbourne, was drafted, and 16 questions (Q1–Q16) were prepared:

- Q1 and Q3 collected data on the respondents' experience with types of projects, contract values and types of schedules used.
- Q4–Q6 and Q10 were designed to collect data on time-related payment stages, administrative and buildability challenges, and the front-loaded approach to preliminary costs.
- In Q2, Q7, Q8, Q12 and Q16, a simplified number of six categories were prepared based on the literature and industry cases to allow to be included in the survey:

a) Establishment and disestablishment of the site (getting the site up and running, and then shutting it down)
b) Supervision, Site Staff, Admin staff, Labourers, etc.
c) Running costs (keeping the site going – Staff excluded)
d) Final cleaning & handover, commissioning (some costs at the end of the job)
e) Insurances, guarantees and fees, permits, paperwork, etc.
f) Head office overheads and other costs (e.g. finance, contingency, etc.) .

Q2 addressed the way estimators distribute percentual costs for each of these categories, and Q7 and Q8 addressed how this category could be treated, or opportunities based on their experiences (for these questions, the site setup was divided into two additional subcategories: cranage, including associated labour and waste management). Q12 addressed the impact of price escalation on each of these categories and Q16 addressed the use of metrics to price these items.

Respondents were selected based on their experiences and current activities. During the first 2 months, phone contact was made with each of the companies to identify key personnel (senior estimators) actively involved in the estimation and pricing of preliminaries. In addition, senior estimators in Australian construction companies were contacted using LinkedIn and other network means available from the university. After identification of the name and email address of the most suitable contact within each organisation, an email was sent with an accompanying letter explaining the research project, and an invitation to participate in the survey. Conducted at the beginning of 2023, the survey was open for a duration of 3 months.

Of the 95 companies considered eligible to participate in this research and contacted, 16 declined to participate, and the link for the online survey was sent via email to senior estimators with 10 or more years of experience at the remaining 79 companies. Of the 79 companies that sent questionnaires, 33 were received and accessed, but only 30 were fully completed within the timeframe allocated for the survey. Considering the limitation of the number of companies with the research scope and the required experts' availability, 31.58% of responses are acceptable (Vaz-Serra and Mitcheltree 2020). In addition, with a sample size of 30 for each question, we can have the confidence that using the Likert scale is likely to yield statistically valid answers (Boone and Boone 2012; Sullivan and Artino 2013).

4 Findings

The results of the first question of the survey, which looked at the projects that the respondents were involved in by type and value, indicated that more than 75% of the respondents were involved in non-residential commercial projects, and close to 57% were involved in large projects valuing more than AUS$100 M. And, as expected, less than 40% were engaged in civil works (see Table 3).

The results of the second question of the survey, which looked at the percentage of preliminaries costs per activity and perhaps not surprisingly at least in Australia due to the high level of labour costs due to some restrictions in working hours and union's requirements (see Table 4).

Looking at different types of schedules used by contractors when pricing the preliminaries costs (see Table 5), the most prevalent schedule, chosen by 65% of the respondents, is the 'Company standard schedule (from Estimating Dept.)'. This finding aligns with previous literature that highlights the importance of internal company standards in estimating construction project costs (Akintoye and Fitzgerald 2000). Interestingly, none of the industry standard proformas appeared to be in use by our survey respondents. This rather stark finding may point to the decline in production of industry standard and agreed measured Bills of Quantities with a defined preliminaries items Bill.

Tab. 3: Projects involved by respondents by type and value

Sub-questions	Projects ($1 m – $5 m)	Projects ($5 m – $20 m)	Projects ($20 m – $100 m)	Projects ($100 m plus)	Not active in this _category of projects
Commercial all types (non-residential)	17.86	25.00	32.14	57.14	14.29
Residential work	10.71	17.86	10.71	35.71	46.43
Civil works	7.14	10.71	17.86	14.29	60.71
Refurbishment and alterations	21.43	17.86	32.14	10.71	50.00
Fit out works	25.00	21.43	32.14	10.71	42.86

Tab. 4: Percentage of preliminaries costs per activities (scale 0–100)

Sub-questions	Mean (%)
Supervision, site staff, admin staff, labourers, etc.	44.57
Running costs (keeping the site going – Staff excluded)	12.48
Establishment and disestablishment of the site (getting the site up and running, and then shutting it down)	12.40
Insurances, guarantees and fees, permits, paperwork, etc.	11.51
Head office overheads and other costs (e.g. finance, contingency, etc.)	9.90
Final cleaning & handover, commissioning (some costs at the end of the job)	9.14

Tab. 5: Types of schedules of preliminaries used at the estimating/tender stage

Sub-questions	Total (%)
Company standard schedule (from Estimating Dept.)	65.00
Combination standard schedules and external sources e.g. quotations, pricelists	30.00
Company standard schedule (from Bid Manager/Finance Dept.)	5.00
Once off unique project schedule based on contract conditions	0.00
Industry-standard schedule based on standard proformas (ASMM, CIOB, MBA, RICS etc.)	0.00

ASMM, Australian Standard Method of Measurement; CIOB, Chartered Institute of Building; MBA, Master Builders Association; RICS, Royal Institution of Surveyors.

The distribution of various types of preliminary costs, fixed, time-related or a combination of both impacts the total preliminaries' costs. To that question, the average of respondents suggests (for the WHOLE duration of the project) the most significant portion of preliminary costs, with a mean value of 45.49% (see Table 6). Furthermore, the chart reveals that 'combined fixed charge and time charge' throughout the project have a mean value of 19.83%, accounting for approximately 20% of the total preliminary costs. This implies that a significant portion of the preliminary costs involves costs that are fixed for the entire project duration, as well as costs that are variable and dependent on the project's progress. This finding aligns with the understanding that contractors often use an all-in rate to lump overhead and profit together on top of direct costs when preparing bids (Chao and Kuo 2016).

Tab. 6: Percentage of preliminaries costs time-related (scale 0%–100%)

Sub-questions	Mean (%)
Time-related (for the WHOLE duration of the project)	45.49
Combined fixed charge and time charge during the WHOLE project	19.83
Fixed (once-off payment)	18.95
Time-related but for only a shorter duration or phase of the project (not required for all the project)	15.73

'The fixed, once-off payment' has a mean value of 18.95%, which is like the 'combined fixed charge and time charge during the WHOLE project'. It suggests that there are certain costs that are only incurred once and do not depend on the duration of the project. These costs could be associated with obtaining permits, licenses and other necessary paperwork, as mentioned in the previous literature (Nabil and El-Riyati 2015).

Finally, time-related costs for only a shorter duration or phase of the project that are not required for the entire project have a mean value of 15.73%. This result is unsurprising, as some preliminary costs are specific to certain project stages and are not necessary throughout the entire project. Overall, this chart provides valuable insights into the distribution of preliminaries costs and their various types, highlighting the significance of 'time-related costs for the whole duration of the project' as the most critical preliminary item. These findings can guide cost estimators and project managers in accurately estimating and budgeting for preliminaries costs in construction projects (Haupt and Pillay 2016).

4.1 Administrative challenges

The process of estimating construction preliminaries faces several administrative challenges. Akintoye and Fitzgerald (2000) identified several factors that lead to inaccuracy in cost estimation, including insufficient tender document analysis, lack of understanding of project requirements, poor comprehension of site requirements and lack of historical data on past estimates that can be counted as administrative challenges involved in the estimation of project preliminaries. They also noted the shortcomings in skills, knowledge and data for cost estimating, such as a lack of training, practical experience and knowledge of computer applications. The authors further discussed the move from analytical estimating to commercial estimating, the variability in subcontractors' prices and the

de-skilling of estimators, who rely on subcontractors for specialist knowledge. Chen et al. (2008) noted that the low-profit margin in the construction market adds pressure to produce accurate estimates (Chen et al. 2008). Eldosouky et al. (2014) stressed the need for effective risk management to turn knowable unknowns into known unknowns.

Furthermore, Abas et al. (2019) advised ensuring that all vague or indeterminate areas are clarified, and uncertainties are excluded from tender documentation, to minimise associated administrative challenges. To estimate at a detailed level, the estimator must mentally construct a project, select materials, methods, equipment and crews to fit the design, and estimate the costs of performing the required work using the best information available. The estimator should not select information for its convenience or appearance of objectivity but should base it on the realities of the current project. The estimator must have the vision to see beyond the obvious components and their primary costs of construction.

Administrative challenges in estimating preliminaries can be related to understanding client expectations. Enhancing communication and collaboration with clients, conducting thorough needs analysis, and clarifying project requirements can help mitigate challenges associated with complexity and ensure successful project delivery (Abas et al. 2016). This was confirmed from the responses of the experts in this project; it is evident that the most significant administrative challenge is the 'Understanding of client main expectations, goals, and specifications', with a mean of 3.29 among all respondents (see Table 7). These findings align with the existing literature that emphasises the role of complexity in construction projects and the importance of understanding client expectations.

At the conceptual stage of design, close collaboration between the owner and the designer is crucial for establishing the scope and general characteristics of a project. Moreover, as the design progresses and the project moves towards the construction phase, it becomes essential to have contract prices based on adequate estimating detail. The findings again align with existing literature, and 'Late responses from Designers/Engineers to queries raised' was rated as the second most relevant concern for the experts with a high mean of 3.24 on the 5-point Likert scale. The challenges arising from late responses by designers/engineers to queries raised can disrupt the flow of information and decision-making processes, potentially leading to delays in project progress and coordination issues. Timely and efficient communication between stakeholders, particularly between designers/engineers and other project team members, is crucial for ensuring smooth project execution and minimising the impact of such challenges.

Tab. 7: Administrative challenges in estimating preliminaries (Likert scale 1–5)

Sub-questions	Mean
Understanding of the client's main expectations, goals and specifications	3.29
Insufficient preparation time during the tender period	3.24
Costs of permits, consultants, special environmental requirements	2.94
Late responses from designers/engineers to queries raised	2.88
External factors, unions, pandemic (COVID)	2.82
Ambiguities/omissions within the tender or contract documents	2.59
Difficulty obtaining bank guarantees/insurance, financial markets	2.59
Unreliable historical cost information/subcontractor pricing	2.41
Providing for project IT services and client expectations on reporting	2.41
Lack of itemised bills of quantities for prelims	1.76

The third most crucial factor among the listed aspects of administrative challenges is 'External Factors, Unions, Pandemic (COVID)', with a mean of 2.84. It is also worth mentioning that this factor is sometimes perceived as very important since it cannot be foreseen during the preliminary items' estimation. However, in the event of this factor, it can be very critical for administrative personnel. The literature emphasises the importance of effective risk management in dealing with uncertain events and factors that cannot be predicted during the preliminary estimation of items (Eldosouky et al. 2014). While some risks can be identified and managed through proper risk identification and mitigation strategies, there are unknown unknowns or emergent risks that cannot be anticipated until they actually occur (Eldosouky et al. 2014).

When considering both important and very important factors, the fourth crucial challenge is the 'Insufficient preparation time during the tender period'. By contrast, the least significant factors among administrative challenges in estimating preliminaries are 'Lack of itemised Bills of Quantities for Prelims', followed by 'Ambiguities/Omissions within the tender or contract documents' and 'Providing for project IT services and Client expectations on reporting'.

4.2 Buildability/constructability challenges

According to Table 8, it can be concluded that for the respondents, the most important constructability challenge

Tab. 8: Buildability/constructability challenges in estimating preliminaries (Likert Scale 1–5)

Field	Mean
Complexity of work, e.g. site restrictions, high lifting, material handling (Cranages, Alimaks, etc.)	3.53
Different methodologies adopted within contractors and subcontractors	3.40
Access and temporary works required in each construction stage	3.27
Alternative construction methods suggested by the construction manager	3.13
Having access to existing site facilities on REFURBISHMENT projects	3.13
Difficulties in clarifying methodology and programming the works at tender time	2.87
Difficulty in predicting weather-related events with construction phases	2.73
Temporary accommodations and site amenities, including subcontractors and client needs	2.73
Regulatory issues, codes and byelaws affecting site operations (dust, noise, etc.)	2.67
Storage and parking areas	2.67
Poor responses from designers/engineers to technical queries raised	2.60

in estimating preliminary price is the 'Complexity of work, e.g. site restrictions, high lifting, material handling (Cranages, Alimaks, etc.)' with a 53.33% rate. The second most important factor is 'Different methodologies adopted within Contractors and Subcontractors' with a 46.47% rate. Examining the important factors in the buildability/constructability challenges list for estimating prelims, it is clear that 'Access and temporary works required in each construction stage' with a 53.33% rate, is the third most important factor. 'Alternative construction methods suggested by the construction manager' is also considered a very important challenge among the list of potential constructability challenges for estimating preliminaries. On the contrary, some factors that can be challenging for estimators are 'Regulatory issues, codes and byelaws affecting site operations (Dust, Noise, etc.)' with a 60.00% rate, and 'Poor responses from Designers/Engineers to technical queries raised' with a 53.33% rate. This finding underscores the impact of project complexity on the estimation process and highlights specific factors that contribute to the challenges faced by construction professionals.

4.3 Uncertainties in costs overrun and savings

Q7 and Q8 were related to the main concerns on cost uncertainties when pricing preliminaries, threats and opportunities (Overrun & Savings), not including the costs associated with the construction methodology and programme. Interestingly, respondents highlighted that site staffing, including general labour, was the main cause of cost increase/overrun. On the contrary, activities such as Site setup, including accommodation, hoardings and gantries, and General running costs were highlighted as the potential to gain savings (Tables 9 and 10).

Based on the chart presented, it can be inferred that the most probable cause of cost increase or overrun in the preliminaries is related to 'Site staffing including general

Tab. 9: Most likely elements of preliminaries where costs **increase/overrun** occur, apart from any costs associated with a *programme (delay or gain)*

Answer	%
Supervision, site staff, admin staff, labourers, etc.	43.34
Cranage, including associated labour	20.00
Final cleaning & handover, commissioning (some costs at the end of the job)	10.00
Site setup, including accommodation, hoardings, gantries, etc.	10.00
Running costs (keeping the site going – staff excluded)	6.67
Insurances, guarantees and fees, permits, paperwork, etc.	6.67
Waste during construction, rubbish removal, etc.	3.34

Increases and Overruns and not the opposite of Decreases or Underuns.

Tab. 10: Most likely elements of preliminaries where cost **savings** occur, apart from any costs associated with a *programme E(delay or gain)*

Answer	%
Site setup, including accommodation, hoardings, gantries, etc.	28.57
Running costs (keeping the site going – staff excluded)	23.81
Waste during construction, rubbish removal, etc.	14.29
Insurances, guarantees and fees, permits, paperwork, etc.	9.52
Supervision, site staff, admin staff, labourers, etc.	9.52
Final cleaning & handover, commissioning (some costs at the end of the job)	9.52
Cranage, including associated labour	4.76

Savings and not the opposite of Cost Additions.

labour' which constitutes 43.33% of all the listed categories. The next most significant factor contributing to a potential cost increase is 'Cranage including associated labour', which accounts for 20.00% and highlights the importance of the 'Complexity of work e.g. site restrictions, high lifting, material handling (Cranages, Alimaks, etc.)' as a constructability challenge during preliminaries estimation.

Other factors on the list, which together account for less than 40%, include 'Site setup including accommodation, hoardings, gantries, etc.', 'Cleaning, Defects Liabilities, handover and commissioning', 'General running costs', 'Permits, securities, insurances, etc.' and 'Waste during Construction, Rubbish removal etc.'

Regarding Q9 on the construction methodology and the impact of the involvement of construction managers during the tendering stage, supporting the pricing process of estimating preliminary costs, the comments received highlighted that the smarts introduced by the construction managers are critical to understanding the solutions that will be used to build the project and the need for temporary identification and proper pricing of the required preparatory works. However, respondents highlighted that some construction managers can increase the preliminary allowances, including extra contingency items that will take the risk of a less competitive bid proposal. Some of the comments received:

- 'The input of the Construction Managers is critical to price the necessary temporary works needed to build each solution. However, their involvement can also sometimes increase the preliminary allowance due to some conservative approaches'.
- 'It has great value, but it needs to be involved early in the tender period, not last week'.
- 'Correct and likely scenarios are anticipated to ensure that an adequate budget is accounted for'.
- 'I consider the input from the construction manager regarding the buildability solutions to be highly valuable. It forms the basis of the prelims pricing and has the added benefit of having the construction manager's buy-in regarding monetary allowances'.
- 'Critical to improving accuracy. Working every day or week longer in a competitive environment on large projects can result in failure. Preliminaries, at 18%–20% of a project's cost, are usually the largest cost component'.

4.4 Front-loaded payments, procurement options and price escalation

Based on the results of the survey, there is no clear consensus among experts regarding whether preliminaries costs should be front-loaded. Approximately one-third (33.33%) of the respondents believe that the costs may or may not be front-loaded, while just over one-fourth of the experts (26.67%) believe that preliminaries costs should be front-loaded in payment schedules. The remaining votes were split equally (13.33%) between those who strongly agree, strongly disagree or have a probable disagreement with front-loading preliminaries costs (see Table 11).

Table 12 presents the annual escalation rates of building prices for various categories of Preliminaries over a period of 12 months. The categories include the establishment and disestablishment of the site, insurances, permits, paperwork, supervision, site staff, admin staff, labourers, running costs, final cleaning and handover, and office overheads and other finance-related costs. The mean values of these categories range from 6.8 to 5.07, with 'supervision, site staff, admin staff, and labourers' experiencing the highest annual escalation rate.

It is worth noting that the experienced annual price escalation rates for these categories are almost equally weighted, indicating a balanced impact on the overall cost of the project. However, the higher escalation rate for 'supervision, site staff, admin staff, and labourers' means that this category has a more significant impact on the cost of the project over time. Furthermore, the 'establishment and disestablishment of the site' category has

Tab. 11: Preliminary costs should be front-loaded into payment schedules

Answer	%
Definitely not	13.33
Probably not	13.33
Might or might not	33.33
Probably yes	26.67
Definitely yes	13.33

Tab. 12: Impact of building price escalation (annual %) on estimating preliminaries

Categories	Mean
Supervision, site staff, admin staff, labourers, etc.	6.80
Insurances, guarantees and fees, permits, paperwork, etc.	6.40
Running costs (keeping the site going – Staff excluded)	6.00
Final cleaning & handover, commissioning (some costs at the end of the job)	5.87
Head office overheads and other costs (e.g. finance, contingency, etc.)	5.20
Establishment/disestablishment of the site (getting the site up and running and then shutting it down)	5.07

the lowest experienced annual price escalation rate. This may be because the costs associated with this category are mainly one-time expenses and do not change significantly over time.

These findings align with existing literature, emphasising the significance of price escalations and contingency costs which are real costs that often have not been precisely identified at the time of estimation preparation (Dell'isola 2003).

The results of the survey indicate that the most equitable procurement options for contractors are 'Cost plus Contracts or Time and Materials Contracts', which account for 33.33% of the responses. Following closely is 'Construction Management Agreement/Management Contracting' with a rating of 25.93% (see Table 13). These options are distinctly more highly rated than the other procurement options, which range from 7.41% to 11.11%. By contrast, 'Term (unit price/schedule of rates) Contracts' is considered the least equitable procurement option, with a rate of only 3.70%. According to the existing literature, the procurement arrangement is among the factors that may impact the overall project overheads expenditure and project success (Chan 2012; Shittu et al. 2022; Singla and Sridharan 2022).

4.5 The use of metrics to estimate preliminaries for contractors

Single and multiple parameter estimating methods, also called metrics, such as the square meter of floor area method, as well as ratio factors based on predominant cost components (Odeyinka and Yusif 2003) can be very useful for estimating preliminaries. Hesami and Lavasani (2014) highlighted the significance of site layout factors, such as site shape, site coverage and infrastructure, in determining overhead costs.

Tab. 13: Better procurement options and risk allocation for estimating Preliminaries costs

Responses	%
Cost plus contracts or time and materials contracts	33.33
Construction management agreement/ management contracting	25.93
Design and build (or novated D&C)	11.11
Lump sum (fixed price) contracts	11.11
Alliance/joint venture contracting	7.41
Procurement options are not that relevant	7.41
Term (unit price/schedule of rates) contracts	3.71

Q10 aimed to identify the various values that can be useful for calculating the costs of preliminary items in construction projects, such as 'Establishment of the site', 'Insurances, Guarantees and fees, levies', 'Site Supervision and Administration', 'Site Running Costs (staff excl.)', 'Final Clean and Handover, Commissioning', and 'Head Office Overheads and other, Finance'.

Regarding the 'Establishment of the site' item, Table 14 indicates that a quarter (26.67%) of the respondents believe that the 'SITE area m^2 based' metric is a useful factor for pricing. However, the majority of the participants who responded in choosing the various options suggest that there are other factors such as 'project size (GFA) area based', 'project size m^2 HEIGHT and VOLUME considered', or 'project value $' that need to be considered while pricing this item. Additionally, preliminary estimating techniques and indirect cost estimation methods are employed in pricing construction site establishment.

The next item, 'Insurances, Guarantees and fees, levies', is almost unanimously (93.33%) believed to depend on 'project value $'. Regarding this result (Saini et al. 2021; Shittu et al. 2022), discuss various factors affecting the value of preliminaries, which may include the contract sum, size of the building, complexity of the structure, price index and total floor area. These factors can influence the pricing of various project components, including insurance, guarantees, fees and levies.

The 'Site Supervision and Administration' cost, according to the majority of the experts, depends also on other factors not listed in the survey. Nonetheless, over a quarter (28.57%) of the respondents suggest that 'project size m^2 HEIGHT and VOLUME considered' can be a useful factor for calculating this item. For the 'Site Running Costs (staff excl.)' item, almost a quarter (22.58%) of the respondents suggest that factors other than 'project value, site and project size m^2' can be a useful factor for pricing this item.

The literature also supports these findings, highlighting the fact that the project size, height and volume are crucial factors for pricing preliminaries, which similarly influence the pricing of site supervision and administration as well as site running costs in construction projects (Odeyinka and Yusif 2003; Chan 2012; Hesami and Lavasani 2014; Saini et al. 2021; Shittu et al. 2022).

For the 'Final Clean and Handover, Commissioning' item, 60% of the experts believe that 'project size (GFA) area based' can be used as a metric, while another quarter (28.57%) suggests that 'project size m^2 HEIGHT and VOLUME considered' could be useful.

Tab. 14: Values (metrics) most useful in the pricing preliminaries categories

Question	Site area m² based	Project size (GFA) area based	Project size m² height and volume considered	Project value $	Other
Establishment and disestablishment of the site (getting the site up and running, and then shutting it down)	26.67	10.00	14.29	6.45	19.35
Insurances, guarantees and fees, permits, paperwork, etc.				93.33	3.23
Supervision, site staff, admin staff, Labourers, etc.		20.00	28.57	9.68	19.35
Running costs (keeping the site going – Staff excluded)		10.00	28.57	9.68	22.58
Final cleaning & handover, commissioning (Some costs at the end of the job)		60.00	28.57	3.23	12.90
Head office overheads and other costs. (e.g. finance, contingency, etc.)				53.33	22.58

GFA, Gross Floor Area.

Finally, for the 'Head Office Overheads and other, Finance' item, more than half (53.33%) of the experts believe that 'project value $' is the most useful factor for pricing, while just under one-quarter suggests that there are other factors that are not listed in this chart.

5 Discussion

The way contractors estimate preliminaries can vary and this research study underscores the complex nature of these costs, highlighting their critical role in estimating the overall costs of construction projects. Distinguishing between project preliminaries and company overheads is essential for precise cost allocation, indicating that a nuanced understanding of these expenses is vital for successful construction initiatives' successful management and profitability.

Notably, the survey underscores the significant portion of preliminaries consumed by supervision, staffing and labour costs (+45%), reflecting the construction industry's labour-intensive character and their current high costs. This insight advocates for a sophisticated approach to managing human resources costs, which is pivotal for project execution and financial health. Interestingly, the main concern about increasing preliminary costs was staff and labourers (+43%), while opportunities for saving were in site setup and running costs (staff excluded). Due to the anticipated need to have the financial capacity to set up the site, two out of every five respondents believed that preliminary costs must be front-loaded on payment schedules. In addition, they believe that Site staff and labourers had the largest impacts on the estimation price escalation, followed by insurance and guarantee costs.

Administrative challenges play a significant role in estimating preliminaries, with the survey highlighting the crucial need for understanding client expectations and responding efficiently to design queries. These results advocate for enhancing communication and collaboration among clients and design consultants, suggesting that bridging the gap in expectations and execution is key to managing construction project uncertainties. Furthermore, the survey indicates that late responses from architects and engineers to queries pose significant barriers, pointing to the need for improved coordination and information flow to ensure better pricing accuracy.

The findings draw attention to the critical impact of constructability challenges on the estimation of preliminary costs. Issues such as site constraints and the methodologies employed by contractors and subcontractors emerge as critical factors. These challenges necessitate comprehensive planning and the adoption of inventive strategies to mitigate potential complications. The emphasis on complexities like site restrictions and high-lifting demands underscores the importance of anticipatory planning and solution-oriented project management to navigate these hurdles successfully. Analysis of procurement preferences reveals that respondents prefer cost-plus contracts or time and materials contracts. This inclination towards more collaborative procurement strategies reflects the industry's acknowledgement of the unpredictable nature of construction projects and the necessity for methods that effectively accommodate such variability.

The survey's indication of the underutilised potential of BIM in estimating preliminaries signals an opportunity for technological progress. Despite the recognised advantages of BIM in enhancing project management and coordination, its application in preliminary cost estimation

remains limited. This gap identifies a promising area for further investigation and development, aiming to capitalise on technological advancements to refine the accuracy and efficiency of preliminary cost estimations.

6 Conclusions

Individual Contractors will price preliminaries costs by variance, dictated mainly from the way the business organisation is structured and the company's internal practices, yet many external factors such as site characteristics and location are also highly relevant. This research helps to understand a little better how currently senior estimators are pricing preliminaries and their main concerns in managing uncertainties. The results of the survey show how the estimation of construction preliminaries is challenging due to their more subjective nature being classified as costs outside of the main physical priced works (i.e. the bricks, steel and concrete that are the physical building elements).

Difficulty in pricing also relates to differing locational factors and regulatory requirements across various projects. Changing market conditions including building price escalation effects are also a factor. Project complexity and the lack of knowledge and experience of the project and site manager(s) can lead to additional challenges and there is a consistent theme of the potential of any project time overruns to substantially and/or disproportionately increase preliminaries costs. Therefore, by conducting thorough and accurate estimations, potential risks and cost implications can be identified and accounted for in advance, reducing the likelihood of claim disputes.

Construction manager feedback from the project site can benefit the estimator by minimising reliance on simplistic judgement promoting more accurate and reliable estimation of both fixed and time-related charges. Reliable preliminary items estimates can be established by using different approaches, and structured site feedback can benefit estimators in achieving more accurate results. Accurate preliminaries estimation fosters transparency, accountability and fairness, thereby promoting smoother project execution and fostering positive relationships among stakeholders.

The results of the survey indicate that while some respondents believe that the listed metrics are useful in calculating the costs of preliminary items, the majority suggest that other factors need to be considered. This highlights the need for estimators to have a comprehensive understanding of the project's specific requirements and to use their professional judgement to accurately price each preliminary item.

7 Limitations and future research

This study is subject to limitations, including a focus on Australian contractors and a sample size of 30 respondents. While the findings provide valuable insights, future research could expand on these themes by incorporating larger sample sizes and exploring advanced digital tools for preliminary estimation, AI and the impact of external social/economical/political/natural disruptions like global financial crisis or Corona Virus Disease of 2019 (COVID-19) pandemic.

8 Data availability statement

The refined survey data (outside of data presented in this paper) that support the findings of this study are available on request from the corresponding author.

References

Abas, A. A., Ismail, F., & Ismail, Z. (2016). Complexity of project and impacts on preliminaries of construction project at tender stage. Paper presented at the 7th International Conference on Postgraduate Education, Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia, December 1, 2016.

Abas, A. A., Ismail, F., & Ismail, Z. (2019). Reliable description of preliminaries item using civil engineering preliminaries protocol (CEPP) in conventional contracts. In *MATEC Web of Conferences*, 2019. EDP Sciences, 03006.

Abdul-Malak, M. A., & Azhari, S. (2008). Use of historical overhead costs for estimation and control purposes. In: *AEI 2008: Building Integration Solutions*.

Akintoye, A. (2000). Analysis of factors influencing project cost estimating practice. *Construction Management and Economics, 18*, pp. 77-89. doi: 10.1080/014461900370979

Akintoye, A., & Fitzgerald, E. (2000). A survey of current cost estimating practices in the UK. *Construction Management and Economics, 18*, pp. 161-172. doi: 10.1080/014461900370799

Boone, Jr., H. N., & Boone, D. A. (2012). Analyzing Likert data. *Journal of Extension, 50*(2), pp. 1-6. doi: 10.34068/joe.50.02.48

Chan, C. T. (2012). The principal factors affecting construction project overhead expenses: An exploratory factor analysis approach. *Construction Management and Economics, 30*, pp. 903-914. doi: 10.1080/01446193.2012.717706

Chan, C. T. W., & Pasquire, C. (2002). Estimation of project overheads: A contractor's perspective. In: *18th Annual ARCOM Conference*, pp. 2-4. Held at the University of Northumbria in Newcastle upon Tyne, United Kingdom, 2nd to 4th September 2002.

Chao, L. C. (2010). Estimating project overheads rate in bidding: DSS approach using neural networks. *Construction Management and Economics, 28*, pp. 287-299. doi: 10.1080/01446190903473782

Chao, L.-C., & Kuo, C.-P. (2016). Probabilistic approach to determining overhead-cum-markup rate in bid price. *Procedia Engineering, 164*, pp. 243-250. doi: 10.1016/j.proeng.2016.11.616

Chen, J. H., Yang, L. R., Chen, W., & Chang, C. (2008). Case-based allocation of onsite supervisory manpower for construction projects. *Construction Management and Economics, 26*, pp. 805-814. doi: 10.1080/01446190802014778

CIOB. (2018). *New Code of Estimating Practice*. John Wiley & Sons, New Jersey, USA.

Coelho, P. S., & Esteves, S. P. (2007). The choice between a fivepoint and a ten-point scale in the framework of customer satisfaction measurement. *International Journal of Market Research, 49*, pp. 313-339. doi: 10.1177/147078530704900305

Dell'isola, M. D. (2003). Detailed cost estimating. *Excerpt from Architect's Handbook of Professional Practice*. pp. 1-13. J. A. Demkin (Ed.) John Wiley & Sons, New Jersey, USA.

Eldosouky, I. A., Ibrahim, A. H., & Mohammed, H. E.-D. (2014). Management of construction cost contingency covering upside and downside risks. *Alexandria Engineering Journal, 53*, pp. 863-881. doi: 10.1016/j.aej.2014.09.008

Enshassi, A., Abdul Aziz, A. R., & El Karriri, A. A. (2008). Investigating the overhead costs in construction projects in Palestine. *Journal of Financial Management of Property and Construction, 13*, pp. 35-47. doi: 10.1108/13664380810882066

Erri Pradeep, A., Yiu, T., & Amor, R. (2019). Leveraging blockchain technology in a BIM workflow: A literature review. In: *International Conference on Smart Infrastructure and Construction 2019 (ICSIC) Driving Data-Informed Decision-Making*, University of Cambridge, UK, ICE Publishing, pp. 371-380.

Fiolet, J.-C., Haas, C., & Hipel, K. (2016). Risk-chasing behaviour in on-site construction decisions. *Construction Management and Economics, 34*, pp. 845-858. doi: 10.1080/01446193.2016.1207790

Haupt, T. C., & Pillay, K. (2016). Investigating the true costs of construction accidents. *Journal of Engineering, Design and Technology, 14*, pp. 373-419. doi: 10.1108/JEDT-07-2014-0041

Hesami, S., & Lavasani, S. A. (2014). Identifying and classifying effective factors affecting overhead costs in constructing projects in Iran. *International Journal of Construction Engineering and Management, 3*, pp. 24-41. doi: 10.5923/j.ijcem.20140301.03.

Hicks, J. C. (1992). Heavy construction estimates, with and without computers. *Journal of Construction Engineering and Management, 118*, pp. 545-560. doi: 10.1061/(ASCE)0733-9364(1992)118:3(545)

Hills, R., & Lee, S. (2024). *Willis's Elements of Quantity Surveying*. John Wiley & Sons, New Jersey, USA.

Jaya, N. M., & Frederika, A. (2015). An identification of construction project overheads for sustainable cost management and controlling practices (CMCPs). *Applied Mechanics and Materials, 776*, pp. 121-126. doi: 10.4028/www.scientific.net/AMM.776.121

Leśniak, A. (2013). The application of artificial neural networks in indirect cost estimation. In: *AIP Conference Proceedings*. American Institute of Physics, pp. 1312-1315.

Leśniak, A., & Juszczyk, M. (2018). Prediction of site overhead costs with the use of artificial neural network based model. *Archives of Civil and Mechanical Engineering, 18*, pp. 973-982. doi: 10.1016/j.acme.2018.01.014

Nabil, I., & El-Riyati, A. (2015). An overhead costs assessment for construction projects at Gaza Strip. *American Journal of Civil Engineering, 3*, pp. 95-101. doi: 10.11648/j.ajce.20150304.11

Naderi, M., Nazari, A., Shafaat, A., & Abrishami, S. (2024). Enhancing accuracy in construction overhead cost estimation: A novel integration of activity-based costing and building information modelling. *Smart and Sustainable Built Environment*. *14*(3), pp. 758-775. doi: 10.1108/SASBE-07-2023-0180.

Odeyinka, H. A., & Yusif, A. (2003). An assessment of the accuracy of quantity surveyors' preliminary cost estimates in Nigeria. *Construction Engineering, 18*, pp. 33-38.

Plebankiewicz, E., & Leśniak, A. (2013). Overhead costs and profit calculation by Polish contractors. *Technological and Economic Development of Economy, 19*, pp. 141-161. doi: 10.3846/20294913.2012.763008

Pradeep, P., Seneviratne, L. I. P., Rathnayake, U., & Melagoda, D. (2018). Impact of using minimum preliminary items for building works in Sri Lankan construction industry.

Saini, A., Khursheed, S., Paul, V. K., & Kumar, K. (2021). Analysis of indirect cost of construction projects in India. *International Journal of Sustainable Building Technology, 4*, pp. 9-23. doi: 10.37628/ijsdt.v4i2.864

Shittu, A. A., Idiake, J. E., Akanmu, W. P., & Mac-Barango, D. O. (2022). Effect of cost of scaffolding on cost of preliminaries in multi-storey building projects in Abuja, Nigeria.

Singla, H. K., & Sridharan, S. (2022). Factors influencing the level of accuracy and compromise in overhead estimation for construction projects in India: An exploratory investigation. *Engineering, Construction and Architectural Management, 29*, pp. 4040-4060. doi: 10.1108/ECAM-04-2021-0362

Šiškina, A., Juodis, A., & Apanavičiene, R. (2009). Evaluation of the competitiveness of construction company overhead costs. *Journal of Civil Engineering and Management, 15*, pp. 215-224. doi: 10.3846/1392-3730.2009.15.215-224

Sullivan, G. M., & Artino, Jr., A. R. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education, 5*(4), pp. 541-542. doi: 10.4300/JGME-5-4-18

Vaz-Serra, P., & Mitcheltree, H. (2020). Understanding the key master of construction project management graduate competencies required to meet industry needs in Australia. *International Journal of Construction Education and Research, 17*(3), pp. 222-241. doi: 10.1080/15578771.2020.1739177