NEW ZEALAND PUBLIC–HOUSING PROJECT TENDER PRICE FORECAST: PRELIMINARY FINDINGS

Aurora Chen
Dr Niluka Domingo
Dr James Olabode Bamidele Rotimi

Business and Infrastructure

ABSTRACT

To make house prices affordable to first-home buyers on low-to-medium incomes, one of the solutions is the capped cost of public-housing projects. The accepted tender price forms the major portion of final project cost, and the level of the accuracy of the project's tender price determines the possibility of achieving the cost cap. Hence, exploring and developing effective tender price forecasting tools is worth researching. To achieve this goal, the literature suggests that an understanding of the tools and factors affecting the accuracy of public-housing tender price is crucial. There is little to no research into tender price forecasting tools and the factors affecting the accuracy and efficiency of public-housing tender prices in the context of Tāmaki Makaurau Auckland, Aotearoa New Zealand. This research aims to fill some of this gap. It is a first step in an ongoing programme of research that aims to develop a public-housing project tender-forecast tool.

The research aims to identify the possible tender price forecasting tools and the factors significantly affecting the accuracy of public-housing project tender prices in the context of Tāmaki Makaurau Auckland, Aotearoa New Zealand. Preliminary interviews were carried out. The sample was limited to experts with at least five years' public-housing tender experience in the Aotearoa New Zealand context. The frequency method was adopted to carry out data analysis.

All preliminary interview participants agreed that material cost, labour cost and quality of design information were the top three factors significantly affecting the accuracy of the tender price. The research identifies loopholes in the current public-housing project tender practices in the context of the Tāmaki Makaurau Auckland public-housing sector. The main contribution of this research is providing insights for public-housing project cost estimators who aim to balance the accuracy of tender price and the efficiency of tender process, by using the research findings to select the appropriate tendering forecast tools. The research also provides a base for future research to develop tender forecasting tools by using information gaps and current industry practice findings.

The data collected from this preliminary research are subjective; participants measured the importance of factors based on their own subjective opinions. There is no guarantee that the data collected fully reflect the opinions of the whole public-housing sector in the context of Tāmaki Makaurau Auckland. To overcome this limitation, the researchers will develop a questionnaire, and invite more eligible experts to complete the questionnaire as the next research step.

KEYWORDS

Accuracy of cost estimate, public-housing tender, tender price prediction

INTRODUCTION

All participants in the construction industry are concerned with pre-construction cost estimate. This is the first effort to estimate the cost of a project and is crucial during the initial decision-making processes for construction projects (Flanagan & Tate, 1997). The accuracy of the pre-construction cost estimate significantly affects the destiny of many projects and critically contributes to the successful project delivery. The process starts from the initial determination

of project viability and client feasibility, by setting up the cost limit, the cost budget and the cost target, then moves to the cost check and remedial actions (Smith et al., 2016).

The tender price established at the pre-contract stage forms the basis of the contract sum – it is the amount set up for the entire project and it is expected not to be overrun (Ashworth & Hogg, 2002). Those cost estimators working with public-housing projects are aware of these issues; further, to ease the housing-affordability crisis in Tāmaki Makaurau Auckland, public-housing projects in the area are cost capped (Kāinga Ora, 2021). Although cost overruns are not permitted, it is very difficult to find a project in which the final project cost is equal to or less than the tender price (Akintoye, 2000; Ashworth et al., 2013; Odeyinka et al, 2009). Hence, the cost cap creates the requirement for accurate tender price prediction.

Because of the importance of the accuracy of the tender price, exploring and developing effective forecasting tools is a worthwhile field for research. The first step in this study is to understand the factors affecting the accuracy of public-housing tender prices; the ultimate objective of this research is to identify factors and the extent of their impact on the accuracy of cost estimate in public-housing projects.

LITERATURE REVIEW

Tender price forecast methods

The tender price forecast can be achieved via either rate methods or price-index methods.

Rate methods

Dysert (2003) states that the tender price is formed from trade package items, which are identified from a construction project's scope statement, and are quantified and priced by the application of unit prices. Ashworth and Perera (2015) further point out that rate methods are highly dependent on the availability of cost data developed during different design stages. The detailed level of cost estimates developed throughout the whole design stage, from the single-rate method to the multiple-rate method, is illustrated in Figure 1. Each construction project is unique. When establishing the rate, the accuracy and completeness of design information, building functions, expected quality standards, quantities of the elements, site conditions and contingency are all items to be considered (Smith et al., 2016).

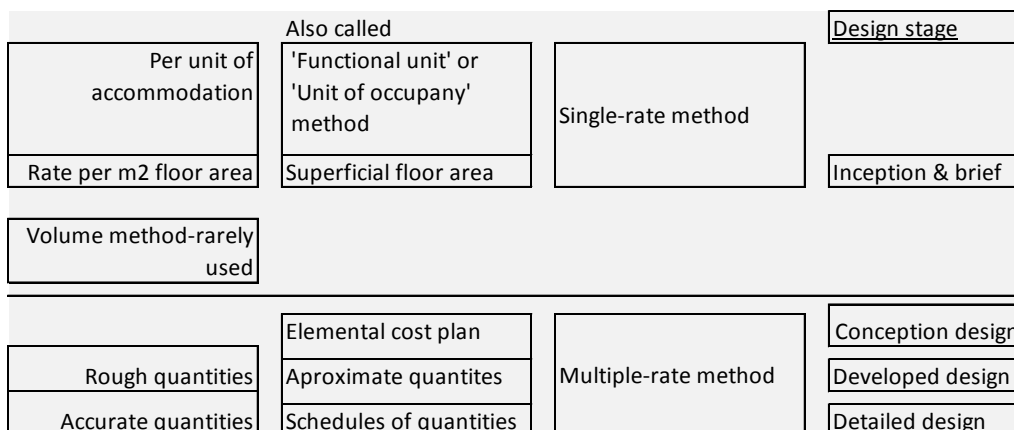|	Also called		Design stage
Per unit of accommodation	'Functional unit' or 'Unit of occupany' method	Single-rate method	
Rate per m2 floor area	Superficial floor area		Inception & brief
Volume method-rarely used			
	Elemental cost plan		Conception design
Rough quantities	Aproximate quantites	Multiple-rate method	Developed design
Accurate quantities	Schedules of quantities		Detailed design

Figure 1. Summary of rate methods.

Price index methods rely heavily on cost information and the trend of cost movement over a period of time, because building costs, market conditions and inflation, etc., will change during this period of time. The collected data, therefore, must be converted to a current date or appropriate future timescale. Under the price index method, the conversion process is achieved by means of index numbers, which measure the change that has occurred from one period to another. Ashworh and Perera (2015) state that the tender index includes weighted items (factors affecting tender price) in the order of their importance within the index, based on the 'basket of goods' principle. Figure 2 indicates the most prominent indices available in the global context.
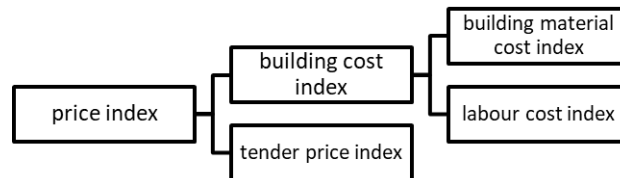

Figure 2. Summary of price index methods.

The building cost index measures the change in contractor's costs. It is built on a combination of labour costs, material costs, plant/equipment and overhead expenses (Smith et al., 2016). Some countries may not have a building cost index; in that case, only a material cost index and a labour cost index are available. Compared with a building cost index, a material cost index and a labour cost index can only measure the trend of material costs or labour costs, they can't provide the pattern of overall changes in contractors' costs.

The tender price index is based on what the client is prepared to pay for the building. Therefore, besides all the items covered by the building cost index, it also considers the allowance of market conditions and profit margins, and the reflection of cost fluctuations. From a client's perspective, the tender price index focuses on the tendering market, and hence is much more useful in updating the prices in a design budget (Fleming & Tysoe, 2007).

Factors affecting tender price accuracy

Many researchers have studied the factors influencing tender price and have tried to categorise and rank them. The discussion below covers the main groups of factors that could affect the tender price.

Factors related to project characteristics

It is widely accepted that this group of factors has a strong impact on the accuracy of the tender price. The factors in this category could include, but are not limited to, buildability, scale of project, construction techniques, location, programme, access and structural type (Ji et al., 2014). Most researchers have identified project scale and scope, location and buildability as the top three factors affecting the accuracy of tender price (Akintome, 2000; Dysert, 2006; Elhag et al., 2005). The project's scale and scope determine the project's size, complexity, duration and construction methodology, and inevitably affects the project's cost (Ashworth & Perera, 2015). In addition, the more complicated and the larger a project is, the longer the project's duration will be, which increases the risk of onsite and offsite expenses going over budget (Akintoye, 2000). Location is tightly linked to delivery cost (Ji et al., 2014). However, this research only studies the Tāmaki Makaurau Auckland market, hence location does not provide too much variability.

Factors related to client characteristics

The client is the core of a construction project, and determines each element of the project's delivery. Research into the impact of client characteristics points out that every client is unique; hence, clients can be categorised into different groups, as shown in Figure 3. The client's attitude towards the project will depend on the category that they belong to (Masterman, 2001).
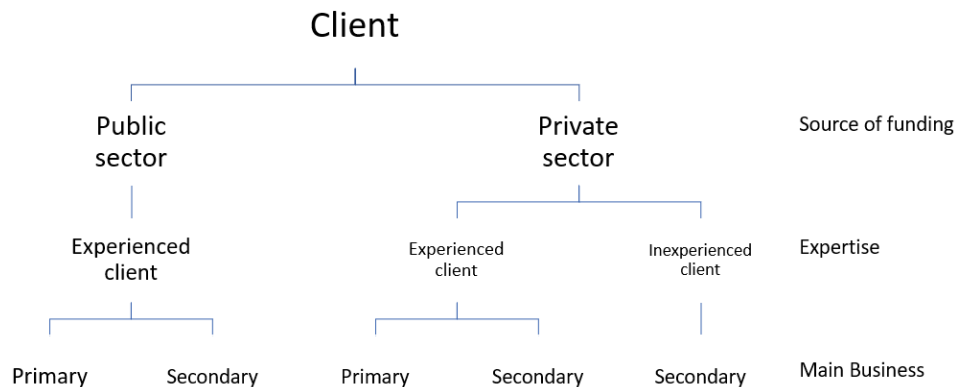

Figure 3. Client categories.

Besides the client category as discussed above, the client's experience and expertise, the budget that they can afford, the functionality requirements, quality expectations and the time allowance of the construction project are factors that need to be considered carefully (Akintome, 2000; Ashworh & Perera, 2015; Dysert, 2006; Elhag et al., 2005; Masterman, 2001).

The proposed research focuses on clients from the public sector. These clients, whose primary business is construction, are always experienced. They have detailed knowledge and understanding of the construction-project delivery process, they have sufficient expertise in managing and controlling construction projects, and they are highly likely to have in-house construction managers and/or designers. As a result, they have the ability to "produce a comprehensive initial brief incorporating prioritized objective for the project's time, cost, quality and functionality" (Masterman, 2001, p. 7).

Factors related to design parameters

The factors in this category include, but are not limited to, completeness and comprehensiveness of the design information, accuracy of the design information, the designer's experience and expertise, availability of historical data, the procedure of updating information, and the time allowance for preparing the design (Dysert, 2006; Elhag et al., 2005). The completeness, comprehensiveness and accuracy of the design information are the crucial factors in this category (Ashworth & Perera, 2015). Poor design or insufficient design information could significantly affect the accuracy of the tendering price, as the estimate of this price must be based on the available information; vague or incorrect design parameters mean the estimator is unable to retrieve accurate data from the design documents (Akintoye, 2000; Hastie et al., 2017; Liu et al., 2016; Urquhart et al., 2017). Poor design could lead to more project variations, since there is greater potential for design changes at the construction stage (Adafin et al., 2016; Ji et al., 2014). Meanwhile, poor quality of design information can lead to additional administrative costs (i.e., costs relating to requesting extra information, and dispute-resolution costs). Therefore, poor design information is likely to hinder the reliability of the tender price (Laryea & Lubbock, 2013; Love et al., 2019).

External factors and market conditions

This group of factors includes cost, availability and supply of materials, labour and equipment, stability of market conditions, labour productivity, government policies and level of competition (Akintoye, 2000; Dysert, 2006; Odusami & Onukwube, 2008). The authors acknowledge that the first three factors are the key ones in this group and have higher impact on tender forecast accuracy.

The findings are supported by survey studies undertaken in other countries. Elhag et al. (2005) carried out a study in the United Kingdom and examined factors affecting tender price accuracy from the standpoint of quantity surveyors who were members of the Royal Institute of Chartered Surveyors (RICS). Odeyinka et al. (2010) also produced a similar study from the standpoint of project type. A two-dimensional scaling was used to rank the factors' importance. The top-ranked factors were design parameters, material cost and labour cost.

Ahmad et al. (2012) studied construction costs influencing factors for Industrialized Building System (IBS) projects in Malaysia. They applied the Relative Importance Index (RII) to rank the importance of factors, and found that unforeseeable fluctuation of material and labour cost was higher than other factors.

Ji et al. (2014) and Adafin et al. (2016, 2020) investigated the whole Aotearoa New Zealand construction market by computing the mean rating of all responses to a particular variable to measure respondents' level of agreement. Their studies found that unforeseeable material and labour cost escalation, quality and comprehensiveness of design information, and the client's characteristics were the top three factors affecting tender-forecast accuracy.

Knowledge gap in the existing literature

Although there are studies of the factors affecting the accuracy of tender pricing in overseas contexts, studies about public-housing projects in Aotearoa New Zealand are scarce. How these tender-forecast methods work in the Tāmaki Makaurau Auckland market, how these factors influence tender-forecast accuracy still needs investigation. To develop a tender forecast tool with a balance of tender accuracy and tender efficiency, current industry practices and requirements need to be tested, especially from the view of public-housing project clients. It is in this gap that our study finds its significance.

RESEARCH METHODOLOGY

This is a preliminary study in a research project. The aim of this study is to establish the perceptions about the current circumstances of tender price forecasting, and the factors and biases affecting the accuracy of public housing tender prices in Tāmaki Makaurau Auckland, Aotearoa New Zealand. Hence, ontology is the appropriate research philosophy to employ, at it emphasises existing knowledge and the nature of knowledge, and describes what knowledge is (Fellows & Liu, 2022).

Ontology can be characterised as objectivist or constructivist. In accordance with Bryman and Bell (2011), objectivism means social phenomena and their meanings are independent of human observation, while constructivism refers to reality being determined by social factors. This study requires an ontological constructivist approach, as the researchers need to understand the social factors affecting the accuracy of tender price forecast and the data are experts' opinions, which are subjective.

Because this research requires a constructivist approach, the data collection of current industry practices of public-housing project tender forecasting was required, as the basis of future theoretical development. Therefore, a deductive approach was applied in this study. As illustrated in the figure below, the researcher first determined the research topic, then a three-step approach was applied: the researchers conducted a literature review, interviews and data analysis to get preliminary findings.
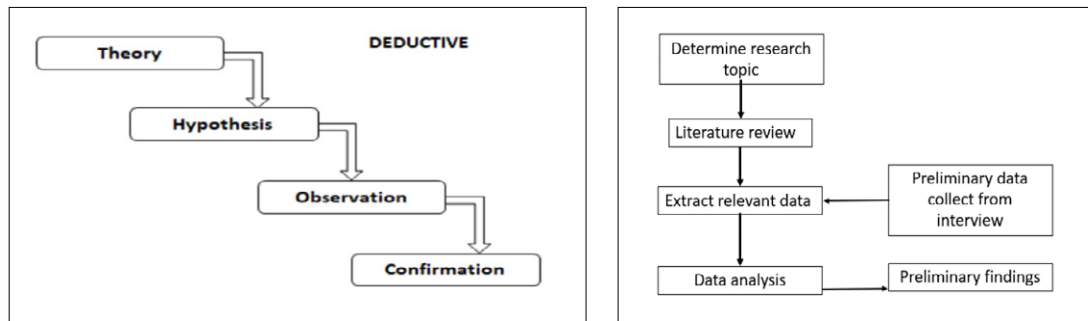
Figure 4. Research approach.

Firstly, the researchers reviewed literature sources, and identified tender price forecasting approaches, tender price indexes, and the key factors that could affect tender price accuracy. Secondly, interviews were conducted with experts who had at least five years' public housing project tendering experience. Lastly, the researchers used the percentage method to analyse the data.

The interview method is used to establish the perceptions of a targeted group. This is especially applicable to this research topic as the data collected are expected to reflect the industrial insights and opinions of the clients of public-housing projects. An interview generates standardised answers from pre-written questions, and allowed the participants in this study to provide information about the tender price prediction approaches they use, or have never used, and to describe the factors that could affect tender price accuracy. A further benefit is each interview participant answered the same questions, which adds to the validity of the results.

The interview questions were grouped into three manageable themes. The first part focused on the participants' activities of reviewing and monitoring tender price trends. The second part collected information on the tools the participants use to forecast public housing project tender prices. The last part concentrated on the participants' opinions of the factors affecting the accuracy of public-housing tender prices. Below is the full list of interview questions.

TABLE 1. PRELIMINARY INTERVIEW QUESTION LIST.

Question No.	Questions
1	Do you monitor tender price movement?
2	How often do you monitor the trends in tender-price movement?
3	How many quarters ahead do you forecast tender price?
4	Do you have a specific model(s) to forecast tender price?
5	If not, what forms the basis of your tender price forecast?
6	Is your tender price forecast model publicly accessible?
7	Do you monitor the accuracy of your tender price forecast?
8	What are the major determinants of the accuracy of the tender price forecast?

Non-random purposive sampling was used to select the sample, to ensure the appropriate candidates were interviewed (Denscombe, 2007). The participants were quantity surveyors with at least five years' public-housing project tendering experience in Aotearoa New Zealand. A convenience sampling approach was used to collect participants' responses: the researcher invited colleagues and clients with at least five years' public-housing project tender experience to be the interview participants. Considering the experience of the participants in public housing projects, the researcher expected that they had connections with other potential respondents, therefore some of the them were asked to distribute the interview as well.

To reflect how often the interview participants selected a response, data was analysed by calculating the percentage of each response's frequency. The individual formula was:

(Frequency of the response /number of interview participants) x 100%

FINDINGS AND DISCUSSION

Years of public-housing project tendering experience

All 11 respondents are quantity surveyors with at least five years' tendering experience for public-housing projects. As shown in Table 2, 9% of the respondents have 6–10 years' experience; 27.3% of them have 11–15 years' experience; 27.3% of them have 16–20 years' experience; 18.2% of them have 21–25 years' experience; and 18.2% have 25+ years' experience. There is a balance of years of experience among the respondents. The participants' quantity-surveyor and procurement-manager roles, plus their public-housing tendering experience ensured rich and comprehensive data collection.

TABLE 2. YEARS OF PUBLIC-HOUSING PROJECT TENDERING EXPERIENCE.

Years of experience	0–5 yrs	6–10yrs	11–15yrs	16–20yrs	21–25yrs	25+ yrs
Number of participants	0	1	3	3	2	2
% of participants	0	9%	27.3%	27.3%	18.2%	18.2%

The research data were analysed by using the percentage method. The researchers calculated the percentage of respondents' answers to recognise the general practices in tendering for public-housing projects.

Tender price reviewing and monitoring

Questions included in this part ask for respondents' frequency of tender price monitoring. Their overall responses are identified in Table 3.

TABLE 3. FREQUENCY OF TENDER PRICE MONITORING.

Do you forecast tender price movement?					
Answer	Yes	No			
Number of participants	10	1			
% of participants	91%	9.1%			
How often do you monitor the trends in the tender price movement?					
Answer	Never	Rarely	Quarterly	Annually	Bi-annually
Number of participants	1	1	2	6	1
% of participants	9.1%	9.1%	18.18%	54.55%	9.1%
How many quarters ahead do you forecast tender price?					
Answer	None	2 quarters	3 quarters	4 quarters	4+ quarters
Number of participants	1	4	2	4	0
% of participants	9.1%	36.4%	18.18%	36.4%	0.0%

Ten out of 11 participants do review the tender price trend. However, over 50% of the participants review the trend annually or even biannually. When predicting the future tender price trend, the participants only focus on up to one-year short-term forecasting. This means an insufficiency of quarterly-based review and monitoring activity and the absence of long-term tender price forecast activity.

Tools of public-housing project pender price forecast

The aim of these questions was to explore whether the interview participants adopted tender-forecast model(s) to predict the tender price trend. Their overall responses are identified in Table 4.

TABLE 4. METHODOLOGY OF PUBLIC-HOUSING PROJECT TENDER PRICE FORECAST.

Do you have specific model(s) to forecast tender price?					
Answer	Yes	No			
Number of participants	0	11			
% of participants	0%	100%			
If yes, what model do you adopt?					
Answer	Not applicable				
Number of participants	11				
% of participants	100%				
If yes, is your model publicly accessible?					
Answer	Not applicable				
Number of participants	11				
% of participants	100%				
If no, what forms the basis of your tender price forecast?					
Answer	Organistion's historical data	QV Costbuilder labour and cost data	RLB labour index	RLB material index	Stats NZ labour index and material index
Number of participants	11	4	1	1	1
% of participants	100.0%	36.4%	9.1%	9.1%	9.1%

The particpants' answers clearly indicate there is no tender price model used. All participants rely heavily on their own historical cost databases. Of all the participants, 36.4% refer to the QV Costbuilder data occasionally, and very few participants refer to other cost data resources, such the labour index and material index published by Stats NZ or RLB.

The limitation of the client's own historical data is that it is unable to reflect the whole public-housing-sector tender price.

The indexes the participants adopt are not sufficient to form a tender price. All the indexes adopted belong to the building-cost index, which measures the contractor's labour and material costs. However, when a client considers a tender price, besides the contractor's labour and material costs, other important elements of the tender price are plant cost, overheads and profit margin (Fleming & Tysoe, 2007). This information is absent from the labour index and material index. There is no finding of the adoption of the tender price index by any interview participant.

Factors affecting accuracy of the public-housing project tender price

The aim of these questions is to gather information about the key factors that affect the accuracy of public-housing project tender prices. Participants' overall responses are identified in Table 5 below.

As shown in Table 5, labour costs, material costs, plant costs and design information are the factors identified by over 90% of the interview participants. They believe these factors significantly affect the accuracy of the tender price. The findings are similar to the studies of tender accuracy of other types of construction projects (Ashworth & Perera, 2015).

TABLE 5. FACTORS AFFECTING THE ACCURACY OF THE PUBLIC-HOUSING PROJECT-TENDER PRICE.

Do you monitor the accuracy of your tender price forecast?				
Answer	Yes	No		
Number of participants	11	0		
% of participants	100%	0%		
Factors that affect accuracy of tender price				
Answer	Accuracy of labour costs, material costs & plant costs	Accuracy of design information	Project scale and scope	Market stability
Number of participants	11	10	7	5
% of participants	100%	90.9%	63.64%	45.45%

CONCLUSION

Although there are some overseas studies of public-housing tender price forecasting, there has been very little research undertaken in the Aotearoa New Zealand context. It is impossible to draw conclusions based on overseas studies and apply them to the Tāmaki Makaurau Auckland market. This study has investigated the public-housing project tender practice in Tāmaki Makaurau Auckland through a literature review and interviews. The study highlights the industrial circumstances and practice occurring in this market.

The main contribution of this research is providing the insights for public-housing project cost estimators who aim to balance the accuracy of the tender price and the efficiency of the tender process, by using the research findings to select the appropriate tendering forecast tools. The study findings provide a base for the development of future tender-forecasting tools.

This study shows the participants' tender price forecasts only focuses on the short term of less than one year. There's no coverage of long-term tender price forecasting. Secondly, although a construction project's cost estimate can't be 100% accurate (Flanagan & Norman, 1983), a reasonably accurate tender price provides significant value to the quantity surveyor in providing a reasonably realistic construction-project price prediction to help the client to check the public-housing project's feasibility and to ensure the project's cost is within budget. Hence, identifying the factors that could affect the accuracy of costing public-housing projects is an important job. This study has found that the accuracy of tender prices could be significantly affected by labour costs, material costs and the quality of design information.

The researchers have also found a gap in the current public-housing tendering practice, based on the responses to our interviews. The current public-housing project tendering price relies on the actual cost data retrieved from an organisation's own historical database. There's no adoption of the tender index model as a fast and efficient method to forecast the tender price (Fleming & Tysoe, 2007). There is no existing tender price index (TPI) in the Aotearoa

New Zealand context to date. Future research could focus on developing a TPI system to achieve the target of efficiency.

The data of factors affecting the accuracy of tender prices collected from these preliminary interviews are subjective, being the participants' own opinions on the importance of factors. Because of the small sample size, it is not likely that data collected fully reflect the opinions of the whole public-housing sector in the context of Tāmaki Makaurau Auckland, Aotearoa New Zealand. To address this limitation, the researchers will develop a questionnaire, and invite more eligible experts to complete it as the next research step, as the more sampling the researchers collect, the less biased the results will be.

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AUTHORS

Aurora Chen has a Master of Construction with Distinction in Quantity Surveying, and is a Lecturer in the School of Building Construction at Unitec, Te Pūkenga. Her research interests include construction economics, construction law, construction contract administration and procurement.

Dr Niluka Domingo has a PhD in Construction, and is a Senior Lecturer in the School of Built Environment at Massey University. Her research interests include construction waste minimisation, sustainable construction, construction project management, construction productivity and performance improvement, construction cost estimates, construction economics, offsite manufacturing and disaster management.

Dr James Olabode Bamidele Rotimi has a PhD in Construction, and is an Associate Professor in the School of Built Environment at Massey University. His research interests include construction project management, construction supply-chain management, post-disaster reconstruction and disaster reconstruction legislation.