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Lee Morton-Shepherd; Samuel Laryea; Zamageda Zungu; Oscar Kwasafo

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Methods used by clients to determine contingency sums for construction projects in the Middle East

Lee Morton-Shepherd MSc
School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa

Samuel Laryea PhD
School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa (Orcid:0000-0001-6605-208X)

Zamageda Zungu MSc
School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa

Oscar Kwame Kwasafo MSc
School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa (Orcid:0009-0000-1366-8294)
(corresponding author: okkwasafo@gmail.com)

Contingency sums are vital to any project's cost budgeting, estimation and management of risk events. This study investigates the methods used by clients to determine contingency sums in project budgets and the key factors influencing the selection of a methodology for setting contingency. Questionnaire survey data collected from 53 respondents in client organisations were analysed using descriptive statistics. The findings show that there are two prevailing methods used by clients for setting project contingency sums in the Middle East, namely deterministic bottom-line percentage norms and quantitative statistical risk analysis (Monte Carlo simulation). These two methods, which were mostly used in oil and gas, energy and mining projects tend to be very process-driven and control-oriented due to the complexity and severity of risks associated with projects in these sectors. The primary factor influencing client selection of a contingency setting methodology was familiarity with the approach, followed by simplicity, accuracy, time availability and organisational mandate structure. This was the main reason the bottom-line percentage method approach is more widely used in practice, although the respondents recommended the statistical risk analysis approach over percentage norms as this provides a more tailored scientific approach that considers a project's bespoke risk profile.

Keywords: client/contingency/contracting/cost/Middle East/procurement/project budget/survey

1. Introduction

This paper examines the current approaches and methods used by clients to determine contingency sums and the factors influencing the selection of a methodology for setting contingency in project budgets. The study is based on client practices in the Middle East region, and the findings are internationally relevant because of the significant participation of international firms in the Middle East construction industry where the countries are building new infrastructure projects in sectors such as oil and gas, energy, mining, retail, leisure, entertainment, residential and commercial, infrastructure (e.g. ports), industrial and manufacturing to boost economic growth and develop their economies (Abdel-Monem *et al*., 2022; Waswa, 2022).

Ammar *et al*. (2023) define a contingency allowance as an amount included in project budgets to provide for uncertainties associated with a construction project. There are several varied techniques, models and industry norms available to professionals and clients when considering and setting project contingency levels. A review of the process and techniques for contingency determination by Adaurhere *et al*. (2021) based on 29 publications from 2000 to 2019 identified 12 different methods of contingency determination. However, there are few empirical studies on the application of these different methods in the research literature. In a key empirical study conducted in Hong Kong, Mak and Picken (2000) examined the contingency methods and levels in 332 building projects in Hong Kong. The contingency sums in 287 of the projects were estimated using the traditional method, which entails allowing for uncertainty by adding a percentage figure to the cost estimate of the works, whereas the contingency sums in 45 of the projects were estimated using a contemporary method known as Estimating using Risk Analysis (ERA), which helps to estimate the contingency of a project by identifying and costing risk events associated with a project and then adding this to a base estimate, which is an estimate of the known scope of works. Mak and Picken (2000) compared the contingency levels in the two sets of projects and found a significant difference in variation and consistency between the two groups. The ERA method was found to improve overall accuracy in estimating contingency amounts.

Therefore, it is well established in contemporary literature that systematic risk analysis provides a more logical basis for contingency (see e.g. Laryea, 2007; Panthi *et al*., 2009; Lam and Siwingwa, 2017). Several studies including Panthi *et al*. (2009) and Lam and Siwingwa (2017) have presented methodologies incorporating systematic risk assessment in the determination of contingency allowances. However, the research by Laryea and Hughes (2008)

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evaluated several formal and analytical models proposed by academic researchers for determining risk contingencies in projects and discussed why they are rarely used in practice. Moreover, key factors influencing contingency decisions include client-driven considerations, client-control factors, and project-specific risks (Ortiz *et al*., 2019). While previous studies have documented some methods (Abdel-Monem *et al*., 2022; Waswa, 2022; Ortiz *et al*., 2019), there is a gap in understanding the reasons behind clients' preferences for specific methods in practice. Thus, one of the current gaps in the literature relating to contingency determination for construction projects is an empirical understanding of the factors that inform the choice of a particular methodology by the project parties. This is one of the contributions of this current study. This study addresses this gap by exploring the factors that drive method selection, providing insights that can inform tailored approaches to contingency determination in construction projects.

1.1 Aim and specific objectives

The current study aims to identify the methods used by clients in the Middle East when determining contingency and the reasons for their preference for the methods used in practice. From the research aim, the following specific objectives were formulated:

- to determine the familiarity of client teams with the approaches and methodologies in the literature for determining contingency sums in project budgets
- to identify the methods used by clients in setting contingency in project budgets
- to determine the key factors influencing the selection of a methodology for setting contingency in project budgets.

The remainder of this paper is structured as follows: literature review, research design and methods, data collection, analysis and results, discussion of findings and conclusions (including implications of the study and recommendations for future research).

2. Literature review

The scope of the literature review was to discuss the methods used by clients to set project cost contingency levels in practice and factors that influence the choice of a methodology for contingency setting in project budgets.

2.1 Methods for setting contingency levels in project budgets

The study by Adaurhere *et al*. (2021) explains that the process of cost contingency determination entails identifying different scenarios of events and risks and developing the contingency allowance based on the identified risks.

The literature shows that several techniques and models have been theorised for setting project contingencies, including methodologies that are readily and regularly applied in practice (Ammar *et al*., 2023; Abdel-Monem *et al*., 2022; Ortiz *et al*., 2019). These methods vary in the level of inherent complexity, ranging from very simple to considerably more complex, as well as varying in the amount of effort and time involved in developing the relevant contingency recommendations/outputs.

In a study to investigate how contingency is determined on construction projects, Adaurhere *et al*. (2021) conducted a comprehensive review of methods and techniques for contingency determination based on an examination of 29 studies and identified 12 different methods used for contingency determination. The review also identified the type of projects where the methods tend to be commonly used (Adaurhere *et al*., 2021). These were:

- traditional percentage method: used on all project types
- method of moment: used in projects characterised by high complexity and significant uncertainty, for example large-scale infrastructure projects such as highways, bridges, tunnels, railways, energy and power, mining and other mega projects
- Individual risk-expected value: used in all project types
- Monte Carlo simulation: used in substantial capital projects
- factor rating: used in substantial capital projects
- range estimating: road construction projects
- regression: all construction projects, mostly building
- artificial neural networks: roads projects, oil and gas projects
- fuzzy sets: significant on building projects; few highway projects
- controlled interval and memory: risk modelling tailored to the contextual needs
- influence diagrams: multi-faceted construction projects
- theory of constraints: used on all project types.

The different methods identified by Adaurhere *et al*. (2021) for setting project contingencies can be grouped into three broad categories:

- deterministic methods
- probabilistic methods
- modern mathematical methods.

At the simple end of the scale are the deterministic models that generally involve either applying industry-accepted fixed rate percentage norms to the direct construction costs or using a more analytical and subjective percentage rate amount based on an expert's judgement/assessment of the variables in play on the respective project. The contingency sum in this approach is often based on a sliding scale/varying percentage of total direct costs of a project based on the relevant stage of development and level of project definition. However, this method fails to consider a project's specific nature, location, work/project type, characteristics, constraints and relative project risk profile in setting the project contingency level.

A more detailed and complex approach to setting project contingency levels is to adopt a probabilistic model approach (Youssef, 2014). This approach is generally reserved for larger-scale projects where the technical expertise and necessary statistical software (primarily Palisade's @Risk Software or other proprietary client software such as BRISK) are more readily available. In addition,

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the increased complexity and the level of effort/time associated with implementing this approach, for example conducting a team workshop and developing the probabilistic model for input into the relevant software, is deemed to be more beneficial and worthwhile on larger projects than it is on smaller/shorter gestation-type projects (Youssef, 2014). The probabilistic methods consider the variables on a project and mathematically consider their potential cost impact through a quantitative and statistical risk analysis process (Abdel-Monem *et al*., 2022; Akinradewo *et al*., 2019). This method develops a mathematical model that predicts a project's outturn cost at varying probability/confidence levels and provides the client and professional team a basis from which to determine the level of contingency for a project on a probabilistic basis aligned to their risk appetite or organisational governance requirements. Such methods include the examples in studies by Waswa (2022), Akinradewo *et al*. (2019), Youssef (2014) and Laryea (2007).

It has been further identified through a review of relevant literature that there are some less widely recognised methods available for setting project contingencies known as modern mathematical methods (Abdel-Monem *et al*., 2022; Waswa, 2022; Ortiz *et al*., 2019). These methods were reported in the studies by Zeng *et al*. (2007) and Laryea and Hughes (2008) as the least widely used and understood methods available for setting project contingency levels and include methods such as the fuzzy technique and artificial neural networks.

The study by Adaurhere *et al*. (2021) touched on the types of projects and instances where the 12 different methods are commonly used in practice. However, one of the current gaps in the literature relating to contingency determination for construction projects is an empirical understanding of the factors that inform the choice of a particular methodology by the project parties. This is one of the contributions of this current study.

2.2 Factors influencing project contingency levels

The factors that contribute to uncertainty are likely to influence contingency levels to varying extents. From a client perspective, the key factors that influence contingency allocation in a project can be broadly categorised as follows (Ammar *et al*., 2023; Ortiz *et al*., 2019):

- *Client-driven factors:*
  - client or employer type (public/private, listed/not listed, primary industry)
  - client's contingency philosophy (conservative/liberal, discretionary discipline)
  - contracting strategy (engineering, procurement, and construction (EPC), design and build (D&B), traditional, management contracting, construction management)
  - procurement strategy (lump sum, reimbursable, cost plus, single/multiple contracts).
- *Client control factors (within sphere of influence):*
  - base estimate reliability and confidence level (as discussed in Section 5.3)
  - experience level of project team (including relevant experience in project sector)
  - level of project definition (inception, concept, schematic, detailed, issued for construction (IFCs)).
- *Project-specific risk factors:*
  - location of project (onshore, off-shore, marine, urban/rural, congested/open)
  - nature of the project (greenfield/brownfield, heavy process, building, infrastructure)
  - nature of the works (demolitions, shoring, piling, pipelines, road works, vertical construction, etc.)
  - inherent project risks (combination of all the above factors coupled with further unknown elements such as ground conditions, productivity rates/resource availability, risk of delay in design deliverables or materials or equipment, errors and omissions, and the like).

These factors have been broadly grouped into three main categories, as shown above, to highlight that a number of these factors are within the control of the client/project team and need to be sufficiently understood and managed, to mitigate project risk and target delivering the project within budget. The influential factors within the client's control could potentially be classified as the 'known' unknowns, or at a minimum could be considered as factors or elements with a greater degree of clarity, visibility and 'knowability'.

The literature review identifies a range of methods for setting contingency levels in project budgets, from simple deterministic models to complex probabilistic and modern mathematical approaches (Adaurhere *et al*., 2021; Ortiz *et al*., 2019; Ahn and Park, 2018). Simpler methods, such as percentage-based models, are popular across project types due to ease of use, while probabilistic methods, such as Monte Carlo simulation, are more commonly applied to large-scale projects for their ability to address project-specific risks. However, these complex methods require substantial technical resources, which limits their use.

Key factors influencing contingency decisions include client-driven considerations (e.g. employer type, contracting strategy), client control factors (e.g. estimate reliability, project team experience), and project-specific risks (e.g. location, project nature). While previous studies have documented these methods (Abdel-Monem *et al*., 2022; Waswa, 2022; Ortiz *et al*., 2019), there is a gap in understanding the reasons behind clients' preferences for specific methods in practice. This study addresses this gap by exploring the factors that drive method selection, providing insights that can inform tailored approaches to contingency determination in construction projects.

3. Research design and methods

A suitable research design was needed to investigate the research objectives to a high degree of internal validity. This led to the choice of a survey research strategy (Saunders *et al*., 2024). The purpose of the survey was to develop an understanding of client methods used in practice to calculate project contingency levels, while also gathering information on the main factors influencing

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the level of contingency in construction projects. The survey research design is detailed below.

The respondents were required to answer specific research questions such as the methods utilised for setting project contingency levels. The survey was also designed to gather additional data on the prevalence, shortcomings, strengths and weaknesses, as well as opportunities for improvement and the perceived success rate of the various methods used to set project contingency levels within client and professional organisations based on their first-hand experience and application of the stated methods in practice within the construction industry (Saunders *et al*., 2024). This included specific questions on (1) the primary methods employed to determine contingency sums, (2) the extent of use of each method, and (3) factors influencing the selection of contingency setting methods (e.g. familiarity, accuracy, simplicity).

The development of the instrument was cognisant of the response time recognising that people's time is valuable, and therefore limited responses to pre-selected options/answers where possible, to minimise the time required to complete the survey to under 10 minutes. Thus, a comparison evaluation of pertinent literature was used to adapt the questionnaire's items from earlier investigations. The pre-selected answers also allowed for standardised responses and easier grouping/comparison of the data collected.

Respondents for the survey were selected based on purposive sampling to ensure they had relevant expertise in cost contingency determination. The criteria for selecting professionals were based on the position in the organisation and years of experience in practice, with emphasis on their involvement and knowledge in setting client contingency budgets; thus, the criteria ensured that respondents who occupied such positions as quantity surveyors, commercial and contract managers, project managers and project control officers were at least a year old in contingency setting practice in the industry in the context of project budgeting and cost estimating/management and have been involved in its determination in client organisations. Only respondents who met the criteria were administered the survey. The SurveyMonkey was designed to terminate once respondents chose options outside the set criteria and direct e-mailing of questionnaires was done purposively to professionals known to the researcher to be involved in the area of focus of this research.

The survey was distributed through two main media, the first being online through the website SurveyMonkey and the second being a targeted distribution of the survey instrument by e-mail to professionals involved in setting client contingency budgets as mentioned above. This was a one-time cross-sectional survey of the industry. While online surveys provided broad reach, they could introduce self-selection bias, as only those with access to and familiarity with the platform might respond. E-mail distribution allowed for targeted engagement with identified professionals but might have led to selection bias by excluding those outside the researcher's network or without access to professional mailing lists. However, using this mixed distribution strategy helped to address the biases by ensuring diverse participation across platforms while acknowledging limitations in accessibility and network reach.

The survey responses were intended to provide insights into construction project contingency levels and the methods used to set those contingency levels, which were then analysed using descriptive statistics while applying positivistic logic through the process. The findings consolidate the information using a mixture of graphical and commentary narratives while drawing logical conclusions, where possible, from the information gathered.

It is necessary to clarify three points relating to the scope of the research design and data collection. Firstly, the focus of the study was on the client side of projects. The scope of the research was limited to the methods used for setting project contingency levels in practice within client-side organisations in the construction industry and does not consider the contingency approaches and methods adopted by construction contractors or other industry organisations. Secondly, the scope was limited to cost contingency. This refers to the methods used for setting a project's cost contingency and the associated methodologies utilised. The research design does not cover methods used for dealing with time-based contingency functions of a project to support the delivery of projects within schedule. Thirdly, the research scope does not cover contingency management, that is, methods used in administrating/managing contingency funds in the implementation phase of projects.

4. Data collection, analysis and results

4.1 Profile of respondents

The survey was distributed using both SurveyMonkey and e-mail online media to 104 persons with 53 eventual respondents, generating a response rate of around 51%. The respondents included quantity surveyors, commercial and contract managers, project managers and project control officers as these professionals are deemed to be involved in setting client contingency budgets. All 53 respondents worked for a client organisation at the time of the survey. This was regulated by purposively limiting survey instrument distribution to client organisation personnel only. The respondents were predominantly employed by large organisations with over 250 employees, which would suggest the responses are relevant to mature organisations with highly process-driven approaches to the management of projects.

While different sectors of the economy may adopt different approaches to project management and cost control, different sectors within the construction industry may also adopt different approaches to their project management and cost control methodologies. It was therefore prudent to determine in which sector the respondents principally worked and obtained the bulk of their

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work experience to inform which sub-sector of the construction industry the responses predominantly pertained to. About 87% of the respondent's work within the oil and gas, energy and mining sectors, which tend to be very process driven and control oriented due to the complexity and extreme risks associated with executing works within these sectors. The others were in retail, leisure and entertainment and residential and commercial sectors.

It was also important to determine the respondent's primary function in their organisation to determine their relative closeness to the financial, estimating and budgeting processes of their projects. With a total of 47 out of 53 (88.66%) respondents being project managers and commercial professionals within the construction industry, most respondents were involved in the contingency setting and budgeting and cost control processes of their projects.

The average experience of respondents was generally very high with 50 of 53 (94.34%) of the respondents having over 10 years of experience and over 60% of the surveyed population having more than 20 years of experience in contingency setting practice in the industry in the context of project budgeting and cost estimating/management and have been involved in its determination in client organisations. This level of experience indicates that the responses provided should be relatively robust (Bonett and Wright, 2015). The majority of respondents had extensive formal educational training, with nearly 50% of the population having a postgraduate level of education and over 75% of the population having a relevant tertiary level of education or qualification. The demonstrated high level of formal education above combined with the extensive level of industry experience was a strong basis for the reliability and suitability of the data to address the research objectives and questions posed at the outset.

The countries of the 53 respondents were Iraq, UAE, Qatar, Bahrain, Saudi Arabia and Kuwait. The respondents were exceedingly familiar with the term project cost contingency in the context of construction projects, with over 96% stating they were familiar with the application, development and setting of project contingency levels, while over 85% of those surveyed stated they were directly involved in the process of assessing project contingency levels. The combination of respondent characteristics relating to their education, experience and primary role in projects provides a high level of credibility and validity to the study findings (Bonett and Wright, 2015).

4.2 Analysis and results

The analysis and results from the responses provided by the 53 experienced professionals involved in activities relating to contingency setting in client project budgets and the four specific objectives are presented in this section.

4.2.1 Familiarity with contingency assessment methodologies

The data in Figure 1 show cost contingency is included in most projects involving the respondents. Eleven respondents (over 20%) confirmed that 100% of their projects included a

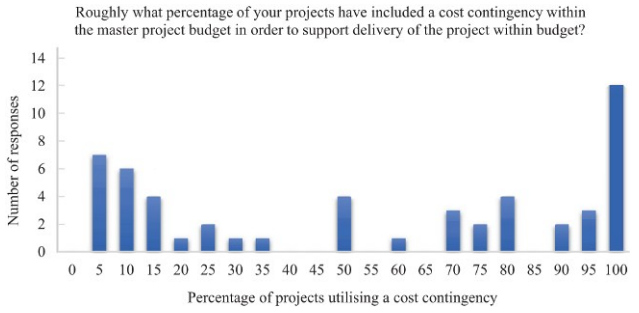


Figure 1. Percentage of respondent's projects that included cost contingency

contingency to support project delivery. Fourteen respondents (26%) confirmed that more than 75% of their projects included a contingency sum within the master budget. This demonstrates the respondents are familiar with the concept of cost contingency, which confirms their suitability to address the research objectives.

The findings in Figure 1 indicate that cost contingency is a critical component of project budgets particularly in the financial planning stage. Contingency can be considered as a recommended practice component to support successful project delivery within budget. This notion was affirmed by not a single respondent recommending the application of a zero per cent contingency for any stage of a project, right from inception at Stage 0 Strategic Definition through to Stage 5 Manufacturing and Construction (RIBA, 2020).

Figure 2 shows the familiarity of the respondents with the different contingency assessment methodologies. The leading methodologies that they were aware of or familiar with were the deterministic 'Traditional Percentage Norms' approach (66%) and the probabilistic 'Statistical Risk Analysis' approach (62%).

4.2.2 Methods used for setting contingency

Figure 3 shows that over 64% of the respondents have used a deterministic bottom-line percentage approach, while slightly

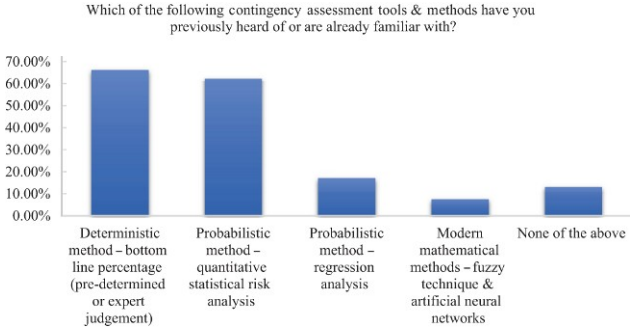


Figure 2. Respondent's familiarity with relevant contingency setting methods

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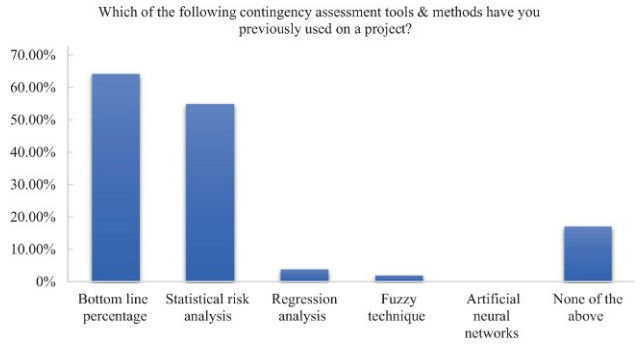


Figure 3. Respondent's experience in adopting relevant contingency setting methods

fewer respondents (55%) have used a statistical risk analysis approach to setting project contingency levels. The more complex approaches such as regression analysis, fuzzy techniques and artificial neural networks were much less used by the respondents with only around 10% or fewer respondents stating they were familiar with these approaches to setting project contingency levels.

It was noteworthy from comparing Figures 2 and 3 that although the levels of familiarity with both the bottom-line percentage and statistical risk analysis approaches were very similar, 66% and 62%, respectively, the proportions of the respondents who had actually implemented the respective methodologies on their own projects diverged more significantly, with 64% having utilised the bottom-line percentage approach on their projects, compared with only 55% having utilised statistical risk analysis on their projects. It could be argued that despite the relatively similar levels of knowledge of the respective techniques among the respondents, the simplicity, objectivity and speed of implementation of the deterministic bottom-line percentage approach leads it to be more widely adopted and implemented on construction projects.

Subsequently, respondents were required to indicate their recommended method for contingency setting. As shown in Figure 4, about 45% of the respondents opted to recommend a statistical

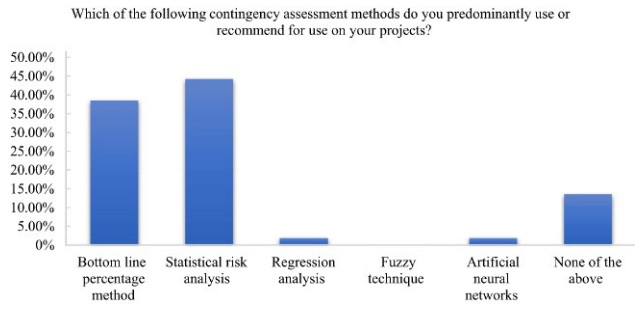


Figure 4. Respondent's recommended contingency setting method

risk analysis approach, while 39% recommended the bottom-line percentage norms approach.

One reason the respondents recommend the statistical risk analysis approach more frequently than the bottom-line percentage approach is because the contingency assessment is a more tailored scientific approach that considers a project's bespoke risk profile, which will inevitably drive to some degree the level of accuracy of the project's contingency allocation and projection of the probabilistic final out-turn cost of the project.

The survey results also combine to corroborate that the majority of clients and projects in the Middle East adopt either one of the two main methodologies being considered in this study, namely the bottom-line percentage norm and statistical risk analysis approaches. This is evidenced by the fact that a combined total of 84% of the respondents recommend either of these two methodologies to their clients and for their projects.

4.2.3 Factors influencing methodology selection

Figure 5 shows that the primary factor influencing professionals in selecting the contingency setting methodology for their projects was the familiarity of the individual and team with the particular methodology, with over 32% claiming this is the single biggest factor influencing their selection process. It can be argued that the favouring of familiarity is inherently human nature, with resistance to change being a large obstacle to progress in several large organisations as postulated in some psychological studies (Ortiz *et al*., 2019; Youssef, 2014). This barrier could be overcome through communication, education and a willingness to adapt.

Familiarity was closely followed by simplicity as the second most predominant factor influencing the selection process, with around 23% of respondents claiming this to be their biggest consideration when selecting their approach to setting project contingencies. This mentality could be driven by the ease of implementation on a project and broad-based understanding combined with the ability to explain such approaches to a wider audience, although it could

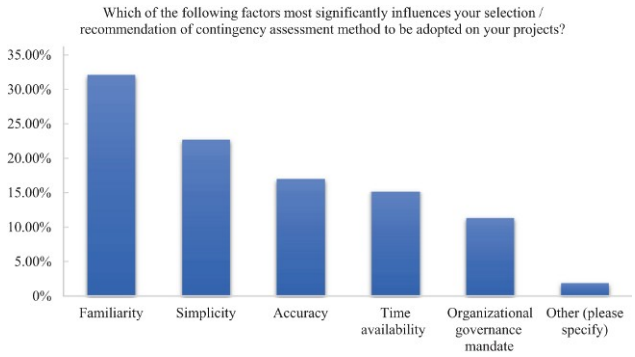


Figure 5. Factors influencing respondent's recommended contingency method

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also stem from project time pressures whereby the project team is not afforded the luxury of time to develop a cost model and conduct a full-blown statistical risk analysis workshop.

It was interesting to note from the data that accuracy was only ranked as a third-placed consideration for industry professionals who opted for familiarity and simplicity over the accuracy level of the contingency allocation. This seems surprising considering that the primary objective of setting and allocating contingency funds to a project is to support the improved accuracy of estimating the project's final out-turn cost and delivering within budget; however, it appears the prevalent mindset views the contingency setting process as a tick box exercise to provide some level of insurance against project cost over-runs. However, it could also be postulated that professionals and project teams consider absolute accuracy in predicting a project's final out-turn cost an impossible task and hence limit their efforts in striving for such utopia and settle for familiarity and simplicity.

It was also noted that only 11% of the respondents stated that their organisations' governance process and procedures mandated the contingency setting methodology used in their projects. This is an unexpectedly small percentage considering the large proportion of respondents currently working in large organisations of over 250 employees which tend to be mature and very process driven. It could be that this low percentage could either be driven by the comparative immaturity of those organisations in the regional geographic area being studied or there could potentially be a gap in the development or communication of the incumbent processes and procedures in those organisations.

5. Discussion of findings

Three main points relating to the specific objectives are discussed in this section.

5.1 Familiarity with contingency-setting methods in the literature

The findings relating to the respondents' familiarity with contingency-setting methods in the literature are presented in Figure 2.

The findings demonstrated a high degree of familiarity with the traditional method and statistical risk analysis methods commonly recommended by professional associations. The different methods identified by Adaurhere *et al*. (2021) for setting project contingencies were grouped into three broad categories; deterministic methods, probabilistic methods and modern mathematical methods. The results indicate that deterministic and probabilistic methods are the most familiar methods used in contingency settings, which aligns with the findings of Adaurhere *et al*. (2021). In a further review of relevant literature, findings indicated that modern mathematical methods were less widely recognised and less commonly used for setting project contingencies (Abdel-Monem *et al*., 2022; Waswa, 2022; Ortiz *et al*., 2019). These methods were reported in the studies by Zeng *et al*. (2007) and Laryea and Hughes (2008) as the least widely used and understood methods available for setting project contingency levels and include methods such as the fuzzy technique and artificial neural networks. Similarly in this research, modern mathematical methods are recorded as the least familiar methods for setting project contingency levels. Thus, the respondents were less familiar with the proliferation of formal and analytical methodologies proposed in the research literature by academic researchers. The paper by Laryea (2007) discussed some of the reasons the theoretical methods proposed by academic researchers are rarely used in practice. One key reason for the low usage of such theoretical methods is their lack of empirical basis and practical implications for which reason they are unpopular in actual practice.

5.2 Methods used in setting contingency

Figure 3 shows the findings relating to the prevalent methods utilised to set project cost contingency levels within client organisations in the Middle East region. The prevalent methods utilised for setting project contingency levels within organisations in the Middle East were either the traditional percentage norm approach and statistical risk analysis approach, with over 95% of those surveyed stating they would recommend and/or had utilised these methods on their projects. Fewer than 5% of respondents had utilised any of the other methods (regression analysis, fuzzy techniques and artificial neural networks combined).

The results of this study generally aligned well with similar studies conducted in some African countries, where the findings mirrored the findings of this study with the two main methods being utilised to set project contingency levels being the bottom-line percentage/expert judgement method and the quantitative statistical risk modelling method (Abdel-Monem *et al*., 2022; Ortiz *et al*., 2019).

There were, however, some stark contrasts identified between this study and the methods used in some African countries, highlighting some divergence between the African and Middle East regions. It was distinguished through a review of other studies conducted in the field that professionals and markets in Africa tended to favour the traditional percentage norm approach due to a lack of resources (both expert personnel and advanced systems), as well as lacking structured benchmarking of historical data points (Ammar *et al*., 2023; Abdel-Monem *et al*., 2022; Ortiz *et al*., 2019). Further insights from the study conducted in Nigeria by Ameh and Osegbo (2011) from the perspectives of construction firms indicate that firms heavily rely on expert judgement in the absence of structured historical project data, with the study proceeding to discuss the widespread use of percentage-based contingencies and expert judgement in construction projects, especially where there is limited availability of historical data or advanced risk management tools.

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The findings also align with a study in South Africa by Windapo and Cattell (2013), which found that similar challenges were being encountered in more mature African markets, including relative to the approaches being adopted for project risk management and contingency setting techniques. The study highlighted the reliance on simpler contingency-setting methods such as expert judgement and bottom-line percentage approaches due to limited historical data and lack of available technical expertise to support the use of more sophisticated methods such as statistical risk modelling for the setting of project contingency levels.

However, there are instances in the literature whereby clients of larger-scale projects may prefer more sophisticated and scientific methodology when addressing and setting project cost contingency levels. A study by Baloyi and Bekker (2011) examined how a blended approach of expert judgement and risk-based approaches was utilised for major projects associated with the FIFA World Cup hosted in South Africa in 2010. The study highlighted the fact that the South African construction industry is gaining some traction in the utilisation of more scientific approaches to contingency settings.

There is further evidence from Pretorius *et al*. (2012) who assessed the maturity of construction project management in South Africa, including how contingency levels are set and managed on projects. The study found there was a push towards the application of more risk-based type approaches within more mature organisations, while less mature organisations still opted for simpler methods such as the bottom-line percentage norms approach. These results, while not an industry-wide phenomenon, still demonstrate a maturation of the African market and the early-stage adoption of more scientific contingency-setting methods on projects in Africa.

The findings from this current study in the Middle East found there was an almost even split between the use of bottom-line percentage norms and statistical risk modelling approaches being used on construction projects in the region. This Middle East market is, however, heavily reliant on the recruitment of professionals from more mature European/US/Australasian resource pools (Kertechian *et al*., 2023), which could be considered as the driving force behind higher adoption rates of more scientific approaches.

5.3 Factors influencing the selection of a methodology for setting contingency

The five key factors that influence the selection of a methodology for contingency levels in project budgets according to the results are presented in Figure 5.

While the key factors that influence contingency allocation in a project, according to Ammar *et al*. (2023) and Ortiz *et al*. (2019), can be broadly categorised to include client-driven considerations (e.g. employer type, contracting strategy), client control factors (e.g. estimate reliability, project team experience) and project-specific risks (e.g. location, project nature), the primary factor influencing client selection of a contingency setting methodology for their projects was familiarity with the particular methodology. This was followed by simplicity, accuracy, time availability and organisational mandate structure as the key influencing factors.

It can be argued that the favouring of familiarity is inherently human nature, with resistance to change being a large obstacle to progress in several large organisations as postulated in some psychological studies (Ortiz *et al*., 2019; Youssef, 2014). This barrier could be overcome through communication, education and a willingness to adapt.

The points relating to simplicity and flexibility were also highlighted in a study by Laryea and Hughes (2008) when discussing key reasons, the proliferation of formal and analytical models proposed by academic researchers are rarely used in practice. Academic researchers and organisations seeking to develop analytical approaches and models for client contingency in project budgets should pay attention to these findings in the design and application of any proposed methodologies.

Analytical models proposed by academic researchers should enable those responsible for construction projects to process risk information quickly, simply, economically, sensibly, realistically, justifiably, flexibly, and easily. Even for clients who do not face the problem of competition when it comes to the allocation of risk contingencies, they still need to keep projects within the stipulated budgets to have them approved. Therefore, the reality of the user's constraints should be considered in the development of formal and analytical models by academic researchers.

6. Conclusions, implications and recommendations

The main purpose of the current study was to examine the methods for setting contingency in client project budgets and the factors influencing the selection of a contingency-setting method by client teams. The responses provided by 53 experienced professionals were analysed using descriptive statistics while applying positivistic logic through the process to generate findings that have been discussed to inform three key conclusions in this section.

For the first objective, the evidence showed that the respondents allocate contingency in project budgets, and they are significantly familiar with various methods for setting contingency. While the findings may reflect Middle East practices, they may also reflect wider international practices given the presence of several international firms and professionals working on construction projects in Middle East countries. One practical implication here is for practitioners to be more familiar with which methods are best suited for different types of projects and circumstances to support effective and appropriate contingency allocation in project budgets.

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For the second objective, the prevalent methods used for setting project contingency levels within client organisations in the Middle East were either the traditional bottom-line percentage norm approach or the statistical risk analysis (Monte Carlo simulation) approach, with over 95% of respondents stating they would recommend and/or had used these methods on their projects. Other methods such as fuzzy techniques, regression analysis and artificial neural networks were far less prevalent in practice and several respondents were not even familiar with or aware these other techniques existed. Fewer than 5% of respondents stated that had utilised any of the other methods (regression analysis, fuzzy techniques and artificial neural networks combined). This shows that formal and analytical models and approaches proposed by academic researchers in the research literature are rarely used in practice. The key implication of this conclusion is presented below.

For the third objective, five key factors were identified to influence the selection of a methodology for contingency levels in project budgets. Academic researchers and organisations seeking to develop analytical approaches and models for client contingency in project budgets should pay attention to these findings in the design and application of any proposed methodologies.

Three additional implications of the study are presented as follows. The first one relating to the second objective is for academic researchers. The findings show that most respondents were not familiar with, or do not use the theoretical approaches proposed by academic researchers. This implies that more models would not necessarily help. The need is for practical tools that are responsive to the commercial environment of projects. A second implication relating to the second objective is for industry practitioners seeking to work with construction client organisations in the Middle East, particularly the countries involved in this study. Knowledge of the two main methods used by clients is essential for professional integration into their projects. The third implication relating to the third objective relates to the factors that clients take into consideration to select a method for setting contingency sums. The reasons articulated by the respondents in relation to the third objective should be taken into account by academic researchers in the development or modelling of any new or alternative approaches for contingency sum determination. Commercial and academic developers of contingency models should take these factors into account to make their solutions attractive to clients.

This study has revealed two main methods used by clients to determine contingency sums in construction project budgets. Future research in this area should conduct a comprehensive study which compares the efficacy of the two approaches when it comes to contingency sum determination in practice and also in relation to the project outcomes. In other words, which of the two methods helps to arrive at the most appropriate contingency sum for a project? This will guide clients in selecting an appropriate method for contingency setting. Further studies should explore the effectiveness of different methods across varying project sizes and types. Further studies should also explore how artificial intelligence can be used to enhance contingency setting in project budgets.

Data availability statement

Data used are available from the corresponding author by request.

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