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*Corresponding author: Serdar Durdyev,
Department of Engineering and
Architectural Studies, Ara Institute of
Canterbury, Christchurch, New Zealand
E-mail: durdyevs@ara.ac.nz

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Sanjay Kumar Shukla, Edith Cowan
University, Australia

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Significant contributors to cost overruns in construction projects of Cambodia

Serdar Durdyev^{1*}, Maksat Omarov², Syuhaida Ismail² and Mengheng Lim³

Abstract: Construction industry is one of the leading sectors with its remarkable contribution to the GDP and employment generation in Cambodia. However, one of the major challenges facing the construction industry in Cambodia is poor cost performance of the construction projects. Identifying and addressing the contributors to cost overruns in the residential building projects—which attracts the highest proportion of investment—is crucial for improving the cost performance of the sector. In the absence of related research in Cambodia, this study aims to fill a significant knowledge gap by investigating the key contributors to cost overruns in residential projects which are specific to the operational context of the Cambodia's residential building sector. Feedback from a survey of the sector's contractors and project managers was analysed using an exploratory factor analysis. Results showed three principal contributors to cost overruns which were extracted from 26 variables: Project and cost management, project finance and project risks factors. In diminishing order of influence, these accounted for 53, 22 and 16%, of the variance that characterized poor cost performance output in the sector. By focusing available

ABOUT THE AUTHORS

Serdar Durdyev is a lecturer of construction management at the Department of Engineering and Architectural Studies, Ara Institute of Canterbury, New Zealand. He is an author of various peer-reviewed articles in the area of construction management. His research areas are cost management, project scheduling, construction productivity, construction safety and Building Information Modeling.

Maksat Omarov is currently a PhD research candidate at the UTM Razak School, University of Technology Malaysia. He is currently motivated in researches involving project scheduling, transportation engineering and cost management.

Syuhaida Ismail is an associate professor of construction project management at the UTM Razak School, University of Technology Malaysia. She has authored or co-authored over 30 peer-reviewed scientific papers. Her research interest is in construction management, and green and sustainable construction.

Mengheng Lim is a research student at the Department of Civil Engineering, Zaman University, Cambodia. His research interest is in construction project management.

PUBLIC INTEREST STATEMENT

Construction industry has a significant contribution to the economic and infrastructure development of any nation. Despite its proven significance, most of the construction projects in Cambodia have been experiencing project cost overruns, which negatively affects the sector's performance and has to be addressed and overcome. Therefore, identification of the significant contributors to project cost overruns is crucial; hence, the contributors to cost overrun in the Cambodia's construction and real estate sector could be significantly reduced or controlled. Consequently, it will enhance the sector's cost performance and enable efficient delivery of construction projects within the allocated budget.

resources and efforts on these key factors in relation to their magnitudes of influence, contractors, project managers and clients could minimise the cost overruns and improve significantly cost performance of the sector and its contribution to the nation's economy.

Subjects: Construction Economics; Construction Management; Quantity Surveying; Building Project Management

Keywords: Cambodian construction industry; cost overruns; residential projects; Cambodia

1. Introduction

Construction industry is of great importance for the Cambodian economic growth and development, as it has forward and backward linkages with other sectors of economy (Durdyev, Omarov, & Ismail, 2017); and hence, due to this fact it has a very significant direct and indirect contribution to the GDP improvement, as well as provides the required infrastructure to improve the quality of life (Durdyev and Ismail, 2012a). Having stable, sustainably developing and growing construction industry is therefore important (Enshassi & Ayyash, 2014; Rahman, Memon, and Abd Karim, 2013), which underpins economic growth and recovery, and moreover has a multiplier impact on the wider economy (Durdyev and Ismail, 2012b). Construction in Cambodia, like in other countries, is one of the leading sectors, which contributes approximately 30.1% to the GDP, and moreover generates an employment with an average of 25% since 2007 (CIDP, 2014). However, due to the various internal and external causes (aim of this study), one of the major challenges facing the construction industry in Cambodia is poor cost performance of the construction projects (CIDP, 2015; United Nations Development Programme [UNDP], 2009). For instance, Thust (2013) and Durdyev et al. (2017) reported prevalence of cost overruns in the delivery of building projects in Cambodia. With the largest proportion of capital investment in the construction sector going to residential building development projects, improvement in construction cost performance of the industry is crucial to enable industry practitioners deliver on the increasing investors' expectations in Cambodia.

Along with time and quality, cost is considered to be the most significant aspect of the construction management life cycle and as one of the main drivers of the project success (Durdyev, Ismail, & Abu Bakar, 2013; Rahman, Memon, & Abd Karim, 2013). Notwithstanding its proven significance, most of the construction projects (both in developing and developed countries) faced cost overrun when executed, which makes it a chronic problem in global manner (Azhar, Farooqui, & Ahmed, 2008). Similarly, due to the poor cost performance management, the construction projects in Cambodia are also suffering from cost overrun, which have to be prevented, as it will have a negative impact on construction stakeholders and ultimately on the overall economy of Cambodia.

Cost overrun is defined as the difference between final project cost and the cost agreed within the project contract (Shehu, Endut, & Akintoye, 2014). In case of its accurate estimation, cost can provide a good basis for construction project control; while it can be deceptive if it was underestimated, which can ultimately have a negative impact on clients and contractors (Odeck, 2004).

Cost overrun has been a topic discussed in numerous literatures, all of which supported that it is indeed a problem in construction projects (Shehu et al., 2014; Williams & Gong, 2014). It is claimed that root causes of this issue needed to be addressed to be able to find proper contingencies, if not solutions.

In the research conducted by Jackson (2002) the problems associated with cost overruns were illustrated in the UK construction industry. He concludes that the most accurate budget estimation could be done with the complete design information and the greatest risk is driven by the design change made by client. He further recommends spending more time in the pre-construction stage of the project to clearly define scope of a project and its complexity level.

Memon, Abdul Rahman, and Abdul Azis (2011) conduct a preliminary study on causative factors leading to construction cost overrun in Malaysia. Average index method is used to analyze the data to evaluate fifty-nine factors which are considered to have a causative impact on the construction cost. As a result, poor design and delays in design was found to be the most significant factors leading to construction cost overrun. The following factors are also listed among the top five factors contributing to cost overrun in construction projects: unrealistic contract duration and requirements imposed; lack of experience; late delivery of materials and equipment; and relationship between management.

In one of the recent studies, Doloi (2013) investigates attributes associated with cost performance in Australia. This study starts with a list of factors and then tries to find out which of these are the most significant by conducting a questionnaire survey method to let participators in the sector rank those factors.

Azis, Memon, Abdul Rahman, and Abd. Karim (2013) conducted a qualitative study adopting semi structural interview about major contributors to cost overrun in the large construction projects in Malaysia. Most influencing factors that contribute to cost overrun evaluated in this study are related with contractor's site management, information and communication and financial management.

Durdyev et al. (2013) conducted a survey to point out the vital factors that affect cost overrun in the residential projects in Turkey. The most significant factors causing cost overrun are listed under five main categories, but only three of them were noted to be essential, which are improper planning, inaccurate project cost estimation, high cost of needed resources (money, men, materials and machinery), lack of skilled workforce, price of construction materials and high land prices. More conclusions are drawn regarding sub-factors, including lack of coordination, cost of the reworks, inadequate duration of contract period, lack of communication between parties and poor on-site management.

Cheng (2014) conducted a mixed research, where Kawakita Jiro and Severity Index methods were adopted for qualitative and quantitative parts, respectively. Sixteen factors under four categories are found to be the most influencing to the cost of Taiwanese construction projects. The factors with the strongest influence are found to be as clearly define the scope of project in the contract, cost control and contract dispute. This study further recommends that pre-construction stage communication will help to understand what the client does really need, as well as clear understanding of the contract scope will avoid pricing disputes.

Several studies have investigated contributors to the cost overrun in other countries (Kaliba, Muya, & Mumba, 2009; Odeck, 2004; Shehu et al., 2014; Williams & Gong, 2014). However, the construction industry operators of Cambodia have limited resources to addressing the myriads of causes of cost overrun presented in the literature. Due to the strategic importance to the industry operators is the identification of the fewest number of contributors to the project cost overrun; this way, the industry operators can focus their efforts and available resources to addressing the most influential contributors for optimum and cost-effective results. The most significant contributors to cost overrun are industry-specific due to the differences in socio-cultural, legislative and regulatory environments within which construction operations are undertaken, hence the studies in other countries may not be completely applicable in the Cambodian construction industry context. In the absence of empirical studies on the cost overruns in Cambodia, this study aims to fill an important knowledge gap by researching on the subject, using the residential building projects as a starting point. Being the first study undertaken in the Cambodian construction context, this study aimed to identify and evaluate the contributors to the cost overruns in the Cambodian construction industry. To achieve the aim of this study the following key objectives will be undertaken:

- (1) To identify the contributors to the cost overruns in residential building projects of Cambodia.
- (2) To establish the principal factors affecting construction cost performance in the Cambodian context from the identified sets of variables.

2. Research method

This study adopts a two-stage descriptive survey method, which is consistent with the exploratory nature of the research goal (Eiselen, Uys, & Potgieter, 2005). In addition, the empirical data needed to achieve the research objectives comprised survey-based opinions of respondents. The sampling frames for the data gathering comprised membership directories of the Cambodia Constructors Association (CCA) and the Board of Engineers Cambodia (BEC). First stage pilot interviews were held with a convenience sample of 2 contractors and 2 project managers that were willing to devote quality time for in-depth interviews. Constructs generated at the interviews were used to design open-ended questionnaire for second stage quantitative data gathering. The questionnaire was pre-tested for relevance and clarity before being administered to the target population. This helped to improve the quality of the questionnaire design and its appeal for optimized response rate (Durdyev & Ismail, 2017). The open-ended sections of the questionnaire served to explore further constructs which were not included in the subsets of variables for rating.

To minimize sampling bias and to give equal participation opportunity to prospective respondents in the two sampling frames for the study, census survey was carried out through the help of the secretariats of both organizations. Emails bearing links to the online survey were sent to members encouraging them to respond before the cut-off date set for receiving responses.

3. Data analysis

The key objective of this study was to analyse and prioritize the factors that could significantly lead to cost overrun in residential building development projects. The nature of the research objective focused primarily on evaluation of measures of association among the underlying variables that were identified during the pilot interviews as potentially causing cost overruns in the residential building projects. The ultimate aim is to evaluate whether sufficient inter-correlations existed among the set of variables and if so, to extract some principal contributors that could significantly explain the observed variances among the variables; these are the key contributors to be recommended as the key focus for the project team's efforts and resources in order to prevent cost overruns in the residential projects in Cambodia. Durdyev and Mbachu (2017) recommends factor analysis approach as an appropriate analytical method to use consistent with the research objective and empirical data for the study.

4. Research findings and discussions

4.1. Survey results

Invitations for the survey participation were extended to the 60 members that comprised the two sampling frames for the study; namely, contractors registered with the Cambodia Constructors Association (CCA), project managers registered with the Board of Engineers Cambodia (BEC). By the cut-off date set for the survey, 43 usable responses were received; this represented approximately 72% usable response rate. Majority of the responses (i.e. 72%) were from project managers. Detailed analysis of the demographic profiles of the respondents showed that the majority (i.e. 60%) occupied high-ranking positions as project managers, directors or associate directors with approximately 10 years of work experience in the construction industry of Cambodia. The profile and experience of the majority of the respondents added to the quality of the feedback and the findings of the study.

4.2. Contributors to the cost overruns in Cambodian residential building projects

The first objective of this study is to identify the contributors to the cost overruns in the residential projects within the Cambodian construction industry. This objective was undertaken through a thorough review of the relevant literature and modified during the pilot interview stage of the study, where 26 contributors were identified. These are presented in Table 1 with a robust literature backing.

In comparison with the outcomes of the previous studies (Cheng, 2014; Durdyev et al., 2013; Jackson, 2002; Kaliba et al., 2009; Odeck, 2004; Shehu et al., 2014; Williams & Gong, 2014), the 26 contributors identified at the pilot interview phase do not add to existing literature as nothing new was found.

Table 1. Contributors to the cost overruns identified via pilot interview stage

| Rank | Contributor | Reference |
|------|--|---|
| 1 | Inaccurate estimation | Odeck (2004); Azhar et al. (2008); Kaliba et al. (2009); Durdyev and Mbachu (2011); Memon et al. (2011); Durdyev et al. (2013); Rahman, Memon, Abdul Azis and Abdullah (2013); Doloi (2013); Shehu et al. (2014); Enshassi and Ayyash (2014); Cheng (2014); Abdul Ghani and Ismail (2017) |
| 2 | Lack of communication on site | |
| 3 | Lack of skilled workforce | |
| 4 | Poor project management | |
| 5 | Unsuitable construction method | |
| 6 | Financial difficulties faced by contractor | |
| 7 | Escalation in material prices | |
| 8 | Poor cost control | |
| 9 | Low speed of decision-making | |
| 10 | Delays (in construction activities) | |
| 11 | Labor productivity | |
| 12 | Inadequate monitoring and control (of construction activities) | |
| 13 | Mistakes during construction | |
| 14 | Unrealistic contract duration | |
| 15 | Financial difficulties faced by owner | |
| 16 | High cost of imported material | |
| 17 | Slow payment of completed works | |
| 18 | Late payment by owner to contractor | |
| 19 | Reworks | |
| 20 | Additional works | |
| 21 | Material shortage | |
| 22 | High land prices | |
| 23 | Change orders | |
| 24 | High interest rates charged by bankers on loans received by contractor | |
| 25 | Inclement weather (causing delays) | |
| 26 | High cost of skilled labor | |

However, as pointed out in the preceding section on Knowledge Gap, the construction industry operators in Cambodia have limited resources for addressing so many contributors to the cost overruns. Due to its strategic importance to the construction operators, identification of the fewest number of factors that have the greatest contribution to the cost overruns is important. This knowledge can help the industry operators to focus their efforts and available resources to addressing the most influential contributor for maximum results. This is the focus of the second objective of the study.

4.3. Primary contributors of the cost overruns in the residential projects in Cambodia

The second objective of the study is to establish the principal factors from the identified contributor variable sets that could significantly explain the observed variances among the variables. Survey respondents’ ratings of the 26 contributors identified in the pilot interviews were analysed using the SPSS-based exploratory factor analysis as described in the Data Analysis section.

Total Variance Explained output table of the SPSS showed four principal contributors extracted from the 26 items. Result of parallel analysis test confirmed the initial three factors as having higher eigenvalues than those obtained from the Monte Carlos simulations. The first principal contributor (i.e. Component 1) with initial eigenvalue of 12.132 explained 52.7% of the variance in the contributing items. Component 2 with initial eigenvalue of 5.125 explained 22.3%, while Components 3 with eigenvalue of 3.72

explained 16.2% of the variance. Cumulatively, these four components or principal contributors explained over 90% of the variance in the 26 contributing items. Other test results are as follows.

Result of the Kaiser-Meyer-Olkin (KMO) test showed a coefficient value of 0.84. The result indicates a strong measure of sampling adequacy, as this value is greater than the threshold coefficient of 0.7 (Jang, Kim, Kim, & Kim, 2011). This result indicates that the multi-collinearity structures among the variables are sufficient for further factor analysis procedure to the level of extraction of the principal components from the underlying variables. Field (2009) supports the result, as KMO values between 0.8 and 0.9 are considered great, therefore result is justified or in another words, for the data in this study Factor Analysis is appropriate.

Result of the Bartlett’s test of sphericity is found to be significant ($p < 0.05$). IBM (2015) recommends the Bartlett’s test of sphericity for testing the null assumption that the extracted principal components or factors make unique contributions to the outcome being investigated and are uncorrelated with each other. The Bartlett’s test of sphericity result therefore reinforces the validity and reliability of the three principal components extracted from the 26 items (Yong & Pearce, 2013).

The Factor Matrix output of the SPSS is shown in Table 2. The table shows the extraction of the three principle contributors and the variables that loaded on them. A closer look at the table showed

Table 2. Contributors to the cost overruns identified via pilot interview stage

| No | Factors | Component | | |
|----|--|--------------|-------|-------|
| | | 1 | 2 | 3 |
| 1 | Inaccurate estimation | <i>0.848</i> | 0.322 | |
| 2 | Rework | <i>0.598</i> | 0.442 | |
| 3 | Delays | <i>0.545</i> | | |
| 4 | Poor project management | <i>0.756</i> | | |
| 5 | Unsuitable construction method | <i>0.687</i> | | |
| 6 | Poor cost control | <i>0.654</i> | 0.621 | |
| 7 | Low speed of decision-making | <i>0.684</i> | | |
| 8 | Lack of skilled workforce | <i>0.769</i> | | |
| 9 | Labor productivity | <i>0.642</i> | | |
| 10 | Inadequate monitoring and control | <i>0.568</i> | | |
| 11 | Unrealistic contract duration | <i>0.558</i> | | |
| 12 | Lack of communication on site | <i>0.793</i> | | |
| 13 | Change orders | <i>0.577</i> | 0.465 | |
| 14 | High cost of imported material | | 0.789 | |
| 15 | Slow payment of completed works | 0.472 | 0.575 | |
| 16 | Late payment by owner to contractor | | 0.681 | |
| 17 | High land prices | | 0.693 | |
| 18 | High interest rates charged by bankers on loans received by contractor | | 0.575 | |
| 19 | High cost of skilled labor | | 0.553 | |
| 20 | Mistakes during construction | | | 0.474 |
| 21 | Financial difficulties faced by contractor | | | 0.724 |
| 22 | Escalation in material prices | | | 0.685 |
| 23 | Financial difficulties faced by owner | | | 0.837 |
| 24 | Additional works | 0.472 | | 0.598 |
| 25 | Material shortage | | 0.435 | 0.632 |
| 26 | Inclement weather | | | 0.465 |

Note: Italic values show that those factors loaded to that specific component.

Table 3. Cronbach's Alpha test results

| Component | Cronbach's Alpha | Result |
|--------------|------------------|-----------------------------------|
| Component #1 | 0.938 | > 0.7 (high internal consistency) |
| Component #2 | 0.875 | > 0.7 (high internal consistency) |
| Component #3 | 0.845 | > 0.7 (high internal consistency) |

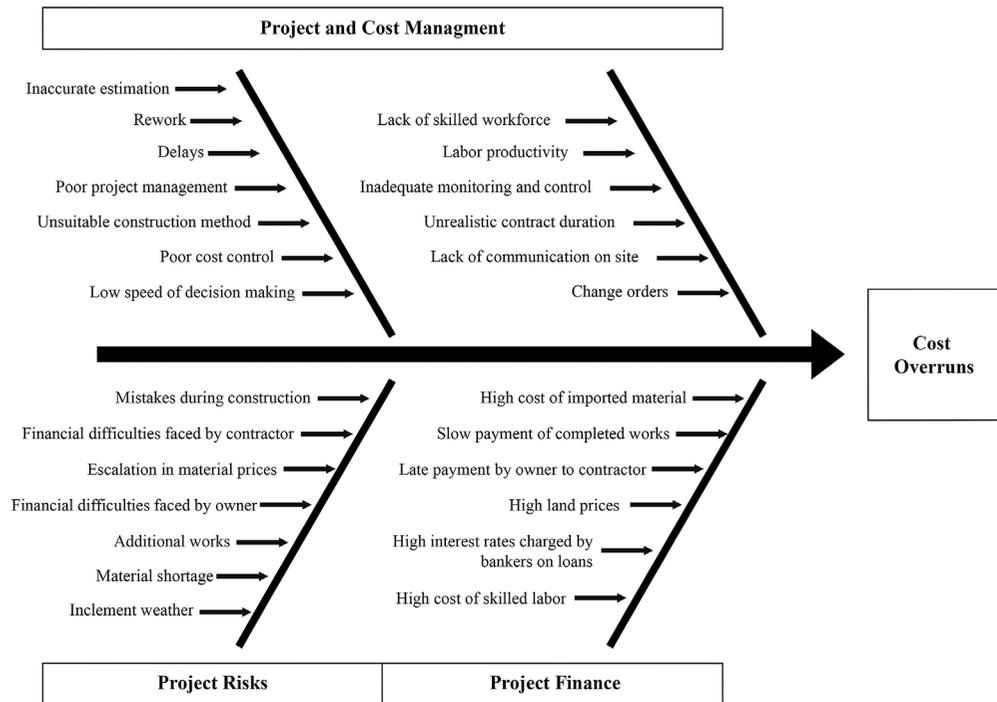
that no item loading was less than 0.3 which indicates the strong representation of the items by the extracted factors (Yong & Pearce, 2013). Also the data-set has several high loading scores, which indicates that the dimensions of the factors are better accounted for by the variables. Consequently, there are a few cross-loadings, which is an evidence for that the items are uni-dimensional as reliable measures of the extracted factors.

Table 2 shows that thirteen of the 26 items loaded strongly on Component 1 with a few cross-loadings. Based on the nature of the underlying constructs and a reasonable interpretation of what they are measuring (Bryman & Cramer, 2011), the component is named project and cost management. Inaccurate estimation loaded most strongly on this factor with a value of 0.848. Component 2, which is named project finance loaded with six items and high cost of imported material loaded most strongly on this principal contributor with a score of 0.789. The last Component 3, which is named project risks loaded with seven items and financial difficulties faced by owner loaded most strongly on this principal contributor with a factor loading of 0.837.

Once the components are classified and entitled, Cronbach's alpha coefficient is further calculated to verify the internal consistency of the contributors that loaded on each component. The "Alpha if item removed" option of the test helped to determine whether or not the removal of any items would improve the reliability of a particular factor scale that showed unsatisfactory Cronbach's Alpha value—i.e. less than 0.7 (Bryman & Cramer, 2011). The result of the SPSS-based Cronbach's alpha test presented in Table 3 showed that all the extracted components achieved high internal consistency (i.e. > 0.7 alpha value). The "Alpha if item removed" column of the SPSS output showed that removing any item under each component resulted in lowering the initial Cronbach's alpha value. This indicated that these items are all measuring the same construct and therefore there will no basis for removing any item from the list (Tabachnick & Fidell, 2007).

In parallel with the objectives of this study, contributors to the cost overruns in Cambodian residential projects are identified and based on the SPSS exploratory factor analysis the identified contributors are presented and listed under the extracted factors, which are project and cost management, project finance and project risks, as shown in the Ishikawa fishbone diagram (refer to Figure 1).

Figure 1. Ishikawa fishbone diagram of the contributors to cost overruns.



5. Conclusions

Notwithstanding its contribution, the construction industry does not look promising due its cost performance. However, construction cost performance could be improved by either eliminating factors having a negative affect or taking a control on them. A questionnaire survey was designed by including the factors causing cost overruns in the construction projects reported in the relevant literature. Only 43 usable responses (of 60 distributed) were received by the cut-off date set for the survey. The survey participants comprised two sampling frames for the study; namely, contractors of the CCA and project managers of the BEC. The profile and experience of the majority of the respondents added to the quality of the feedback and the findings of the study. This study investigated the key contributors to cost overrun in the residential building projects which are specific to the operational context of the Cambodia’s residential building sector. Feedback from a survey of the sector’s contractors and project managers was analysed using exploratory factor analysis via SPSS. Results showed three principal factors contributing to cost overrun which were extracted from 26 causing variables: project and cost management, project finance and project risks factors.

The reliability and validity of the research design and the findings were evaluated via prescribed quality assurance tests, including Kaiser-Meyer-Olkin measure of sampling adequacy, Bartlett’s test of sphericity, and Cronbach’s alpha test of internal consistency. Results of the tests confirmed the reliability and validity of the research design and the findings.

Based on the research outcomes, it can be inferred that the project management team must invest their efforts into the accurate cost estimation of a construction project as it will lead to an improper resource allocation, which is therefore is the basis of sound construction project planning. Although the labour skill at first looks like does not have a direct impact on a project cost, survey results show that lack of skilled workforce in the country has been perceived to be the most significant factor causing a project cost overrun. Therefore for the significant improvement in cost performance in the industry this must be addressed and overcome. In collaboration with government authorities and institutions, industry operators have to invest more effort and resources into providing training for workers at various levels prior to starting construction projects, which will reduce the dependency on expensive foreign workers.

Incline towards the usage of the construction materials exist in the market would also be significant to reduce project cost overruns. Construction clients as they are a significant figure in the decision-making process of the selection of the construction methodology and materials, could be encouraged to use mainly local construction material for their construction projects.

Consequently, it is recommended that contractors, project managers and clients should focus available resources and efforts on the identified key factors in relation to their magnitudes of influence. Although the outcomes of this study were a short scoping exercise, it has formed a significant base for future cost overruns work within Cambodia. Due to the lack of available information, this study did not provide data on the size of cost overruns in Cambodia. However, the scope of the findings is sufficient to draw the big picture of the construction cost performance in the industry and further improvements are crucial for cost efficiency. By doing so, the contributors to cost overrun in the Cambodia's construction and real estate sector could be significantly reduced or controlled. This will enhance the sector's cost performance and enable efficient delivery of construction projects within the allocated budget.

Outcomes of this study were mainly influenced by the feedback from project managers in Cambodia. However, for a more reliable outcome, it is recommended in the future to capture feedback of other stakeholders, such as contractors, construction clients, sub-contractors and suppliers.

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Author details

Serdar Durdyev¹
E-mail: durdyevs@ara.ac.nz
ORCID ID: <http://orcid.org/0000-0003-1781-1830>
Maksat Omarov²
E-mail: maksatomar@gmail.com
ORCID ID: <http://orcid.org/0000-0002-1532-5735>
Syuhaida Ismail³
E-mail: syuhaida.kl@utm.my
ORCID ID: <http://orcid.org/0000-0001-6058-7497>
Mengheng Lim³
E-mail: mhim1@zamanu.edu.kh

¹ Department of Engineering and Architectural Studies, Ara Institute of Canterbury, Christchurch, New Zealand.

² UTM Razak School of Engineering and Advanced Technology, Kuala Lumpur, Malaysia.

³ Department of Civil Engineering, Zaman University, Phnom Penh, Cambodia.

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