Underlying factors of cost overruns in developing countries: multivariate analysis of Jordanian projects

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Abstract. While all project parties agree that exceeding the budget results in project failures, most construction projects in Jordan are suffering from cost overruns. Understanding the root cause of the issue is critical to solve the problem comprehensively. However, the previous studies lack information on the underlying causes that are resulting in cost overruns among the nation’s construction projects. The principal purpose of this study is to identify the most significant causes of cost overruns in Jordanian construction projects. Therefore, the researcher used the quantitative approach for data collection through questionnaire survey among stakeholders in the construction project. This study uses the principles of multivariate statistics in analyzing the causes of cost overruns in Jordanian construction projects. The findings revealed that the four major underlying causes for cost overruns in Jordan are financial difficulties, materials issues, design issues and additional works. Besides, the results also revealed that high transportation cost, unrealistic contract duration, slow decision making, extra quantity during construction, inadequate funds for project financing, inconsistent cash flows and payment problems faced by the clients from the government are critical sub cause for cost overruns in the region. The findings on the critical and underlying causes for cost overruns may help industrial practitioners in developing strategies to achieve better project success.

Keywords: cost overrun, construction industry, developing countries, multivariate analysis.

1. Introduction

Construction industry is considered as a backbone of the economy in all countries where it is a major capital of different investments, which provides job opportunities for a huge number for competencies. In many countries, this industry accounts for 6 to 9% of the gross domestic product (GDP) which is rising up to 10%. Besides, it is the primary source of economic growth and provides about 10% of the country's GDP. It is also seen as a locomotive of physical advances that have importance and positive impacts on the economy of the country [1, 2, 3]. On the other hand, it helps to improve the quality of life by providing the necessary infrastructure such as schools, clinics, highways and other [4]. Despite the interest for this sector in Jordan, it is still suffering from obstacles and difficulties which affecting its success. Unfortunately, the construction industry in Jordan is not adequately prepared for the project management problems accompanying the anticipated boom in construction activities and the increasing complexity of projects [5]. Failed construction projects are a prevalent trend in Jordan where these highly lucrative schemes
usually end up as an expensive and costly project [6]. Besides, non-progressive construction projects in Jordan are marked by high costs, extra time, weak performance, low customer satisfaction and indifference to indicators of strategic project success [7]. Therefore, various problems appear during the project life cycle may affect its success where cost overrun is the most prominent.

Basically, cost is a major consideration in implementing building projects because it includes a risk of investment failure [8]. In addition, cost efficiency measures the degree to which the overall circumstances in the projected budget support the completion of a project [9]. However, construction projects face various challenges that hinder their completion within the specified budget. Cost overrun is a crucial problem in the construction sector that may cause lower productivity, project delays and disputes between parties [10]. Nowadays, this problem has become a frequent occurrence in most developing or developed countries. Developing countries identify themselves as countries that have not yet has accomplished a significant degree of industrialization with respect to their population [11]. These countries have a modest to low standard of living in most cases but are seeking greater economic and social development [12]. Therefore, trying to manage construction projects in developing countries require unique characteristics due to a number of issues ranging from political uncertainty to human resource unavailability and inflation rate and impact [13]. Therefore, it is essential to address and reduce the challenges that cause cost overrun. Previously, many researches attempt to study the causes of cost overrun in construction projects, yet few have analyzed these causes in the developing countries. Thus, this study focuses on determining the most important causes of cost overruns in Jordan by comparing the identified causes with those causes in other developing countries. It is very necessary to fully understand the similar causes between these countries, despite their economic, political and social differences.

The results of this study may help stockholders to understand the key causes of cost overruns in effectively strategizing to reduce their impacts on project performance. Therefore, this study aims to identify the most significant causes of cost overrun in construction projects in Jordan, as a first step to reduce its effect in Jordanian construction projects. In addition, the results may contribute in providing a checklist of the main causes of cost overrun, which enable project managers to use suitable approaches to reduce it in their projects. Furthermore, this study helps other researchers to study the solutions for these causes to improve the performance of the construction projects.

2. Literature review

2.1 Cost overrun in construction projects

Cost overrun of the construction project is the actual cost exceeding the cost estimated at the beginning of the project. In other words, cost overrun can be defined as the escalation in project costs that entails unforeseen costs incurred over the budgeted level due to an underestimation of real budgeting costs [14]. Park and Papadopoulou [15] pointed out that cost overrun is defined to be additional expenditure beyond the amount negotiated between the owner and the contractor expended in each project. Another description of cost overrun given as a change in the value of the contract divided by the value originally awarded [16]. Several studies have expressed cost overrun by calculating the percentage of cost overrun as per the following expression [17, 18]:

\[
\text{Cost Overrun} = \frac{\text{Actual Cost} - \text{Estimated Cost}}{\text{Actual Cost}}
\]  

(1)

It is a common issue in developing countries, surpass 100% of expected costs [19] which differs from project to project, as reported by various studies in different countries. For example, in the Netherlands, the average cost overrun for 87 projects was 10.3% [17]. While, another study in Slovenia Scenario for 92 traffic structures revealed that the cost overrun was
51% [20]. Different percentages for cost overrun of projects from various developing countries were summarized in Table 1.

Table 1. Average percentage of cost overruns in various developing countries

| No. | Country           | Average percentage of cost overrun | Reference |
|-----|-------------------|------------------------------------|-----------|
| 1   | Ghana             | 75%                                | [21]      |
| 2   | Malaysia          | 2.08%                              | [22]      |
| 3   | South Africa      | 5% to 94%                          | [23]      |
| 4   | India             | 73%                                | [24]      |
| 5   | Nigeria           | 17.34%                             | [25]      |
| 6   | Pakistan          | 10% to 60%                         | [26]      |
| 7   | Bosnia and Herzegovina | 6.84%           | [20]      |

Cost overrun is the result of one or several factors that have been very critical to the determination of costs and successful performance [27]. Therefore, it is important to determine the causes of cost overrun in finding the appropriate solutions and this need the join cooperation of the stakeholders in the project.

2.2 Causes of cost overruns in construction projects

Work in construction projects is characterized as teamwork that requires cooperation and coordination between all parties of the projects. Therefore, all parties are accountable for project success or failure. Each of them is accountable for the different interrelated tasks to reach a full-scale project [28]. Therefore, all parties are responsible for the cost overrun issue in a construction project.

The rise in cost overrun is attributable to four factors, as stated by [29], namely external risk, project technical complexity, insufficient project management and unrealistic assumptions attributable to the uncertainties involved. Various studies have investigated the most important causes of cost overrun in construction projects. For example, the study in Thailand conducted by Sriprassert [30], stated that poor quality of materials causes cost overrun in construction projects due to the loss of materials during implementation. In addition, he mentioned that ineffective project management and poorly defined cost control systems contribute to the cost overrun issue.

Poor materials may also influence the efficiency of construction projects, which will be reworked to achieve the required specifications. According to reworking of defined defective components during maintenance, 6 to 15% of the construction costs are considered to be the wastage [31]. A study in Jordan suggested that the most prominent cost overrun factors in the public sector are rises in production costs due to inflation, production shortages, design changes, rises in fuel costs, poor work experience, incorrect takeoffs, lack of communication, lack of local regulatory expertise and uncertain weather conditions [32].

There are no limited causes for cost overrun in construction projects, it results from various causes. For example, the study by Bekr [16] in Jordan, revealed that the most significant causes of cost overrun in construction projects in Jordan are schedule delay, regular design changes, additional works and changes on request of the owner, errors in design, inadequate planning and timelines, inflation or prices fluctuation, change the scope of work by owner, incomplete drawings or detailed design at the time of tender, lack of skilled site workers, construction defects and work failures. It remains a big problem for construction projects which resulting in increased strain for all related stakeholders [33]. The impact of cost overrun is not only reflected on the project and its participants but also shows its impact on the country's overall economy.
3. Methodology

3.1 Study design

In achieving the aim of this study, the researchers have used the quantitative approach because it includes objective and accurate data measures [34]. Besides, quantitative approach can be used by collecting numerically validated data to classify the knowledge of the subject of study [35]. Specifically, the researchers adopted a quantitative study by using the questionnaire survey to gather the data. It was used because it is a fairly fast and inexpensive technique of gathering data from a large number of individuals on a particular subject and offers replies to similar questions from all surveyed individuals [36]. It also can sample a big population with reduced costs and effort and allow to generalize the findings [37].

3.2 Questionnaire survey development

The first stage of this study is data collection through reviews on the previous studies on the causes of cost overrun in construction projects. As shown in Appendix 1, the collected causes were which grouped into nine major groups, namely design and contract related factors, estimation related factors, planning and schedule related factors, project management related factors, labor related factors, financial related factors, materials and machinery related factors, construction phase related factors and external related factors.

The previous literature reviews provide a clear view of cost overrun issue in the construction projects by identifying its main causes. These causes become a starting point in achieving the study's objectives. However, these causes were related to construction projects in different countries that differ in terms of economic, social and political conditions. Therefore, the study sought to emphasize on the specificity of the construction projects in Jordan to ensure a realistic and clear picture of the reality. Thus, the current study attempts to bridge the knowledge gap related to the reasons for exceeding costs in Jordan due to the limited studies in it. Whereas, most of the previous studies rely solely on statistical analysis to determine the causes without the root causes being.

At the second stage of this study, the previous collected data was used in designing the preliminary questionnaire. Subsequently, a pilot study was used to check the validity of the initial questionnaire, which involved eight management experts in the construction sector in Jordan. They were asked to complete the survey and describe any difficulties, confusion or uncertainty that they have encountered in answering questions [38]. The comments and notes based on the pilot study were made to prepare the final questionnaire to be distributed to the targeted respondents.

4. Data collection

The process of collecting data has been executed in construction companies in Jordan, which include a large number of engineers with a wide range of disciplines and expertise. The respondents in this study were engineers working in the field of construction projects in various companies (consultants, owners and contractors). The respondents were asked to identify the most significant causes of cost overrun in construction projects on the basis of their education, working experience and their position in the company. Furthermore, a scale of five-point from 1 to 5 was used in the questionnaire to examine the importance of each cause, which are strongly disagree, disagree, neutral, agree, strongly agree, respectively. There were a total of 350 questionnaires were given to the engineers in construction projects. There are 268 questionnaires out of total distributed questionnaires were returned with 76.57% response rate. The returned data were reviewed and deemed suitable for the data analysis.
5. Data analysis

5.1 Normalization

The collected data through questionnaire survey were analyzed using the Statistical Package for the Social Sciences (SPSS) software, where the mean, median and standard deviation were determined for each cause. Based on the values of mean, the normalization test was adopted to determine the critical causes of cost overrun by using the following equation [39]:

\[
\text{Normalization value} = \frac{\text{mean} - \text{minimum mean}}{\text{maximum mean} - \text{minimum mean}} \ldots \ldots (2)
\]

5.2 Relative Important Index (RII)

The Relative Important Index (RII) was used to rank the causes based on the values of the means. This method has been commonly used for assessing attitudes toward surveyed factors in construction research to compare the relative importance of the factors [40, 41]. It was used by various studies that are concerned with construction projects to rank various variables according to its importance. For example, Sambasivan and Soon [42] have used this test to assess the relative importance of the several causes of delays and their impact.

The value of RII ranged from 0 to 1 [37] where the highest value indicates the high significance of the item as a cause of cost overrun in construction projects. The value of (RII) was determined by using the following equation [43, 44]:

\[
\text{RII} = \frac{\sum_{i=1}^{5} W_i X_i}{A \times N} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3)
\]

Where:
- \(W\) – Weighting for each cause
- \(X\) – Frequency for each cause
- \(A\) – Top weight (5)
- \(N\) – the number of respondents.

5.3 Exploratory factor analysis (EFA)

Meanwhile, the EFA is used to assess the factor and factor loading of the calculated variables and to validate what the basic or pre-established theory is supposed to do [45]. Furthermore, it was used to categorize and quantify priorities. It defines an extremely small number of items that could be used to describe interrelated relationships among sets of several factors [26]. This technique helps this study to identify the most significant causes of cost overrun by reducing the number of initial variables to a fewer set of variables [32]. Moreover, it is commonly used by other researchers in construction projects. For example, it used to define crucial factors influencing the cost efficiency of public construction projects in Ethiopia [47].

6. Results and discussions

The respondents in this study were from different engineering disciplines as most of them were civil engineers which contributed to 76.1% of the total respondent. As for work experience, approximately 68.7% of the participants had more than 5 years of experience, while 30.43% of them had experience above 15 years. The majority of the respondents of 80.6% had a bachelor degree while 15.30% of them had a master degree. Regarding the type of organization, most respondents are contractors (44%), while the rest of them are consultants (38.10%) and owners (17.90%).
The practical experience of respondents from different groups shows a strong understanding of the problems faced by the construction projects. As a consequence, this experience, along with the educational level, contributes to the identification of the most prominent causes of overrun costs in construction projects.

There are 55 critical causes that were considered in this study based on the normalization value of more than 0.50 as summarized in the Appendix 1. The average value of RII for these causes was 0.7440. Therefore, the most important critical causes of cost overrun are causes that have RII value equal or more than the average value, which are used in the factor analysis, as shown in Table 2.

### Table 2. Mean, SD, Normalization and RII for the most important critical causes of cost overrun

| Items   | Mean   | SD    | Normalization | RII   | Rank |
|---------|--------|-------|---------------|-------|------|
| MMRF15  | 3.9515 | 1.0356| 1.0000        | 0.7903| 1    |
| DCRF4   | 3.9515 | 1.0392| 1.0000        | 0.7903| 1    |
| MMRF14  | 3.9403 | 1.0654| 0.9849        | 0.7881| 2    |
| CPRF6   | 3.9030 | 1.0520| 0.9347        | 0.7806| 3    |
| FRF2    | 3.8955 | 1.1789| 0.9146        | 0.7776| 4    |
| FRF4    | 3.8881 | 1.1229| 0.9146        | 0.7776| 5    |
| FRF5    | 3.8731 | 1.0804| 0.8945        | 0.7746| 6    |
| FRF12   | 3.8731 | 1.0770| 0.8945        | 0.7746| 6    |
| CPRF7   | 3.8694 | 1.1358| 0.8894        | 0.7739| 7    |
| FRF11   | 3.8545 | 1.1438| 0.8693        | 0.7709| 8    |
| FRF1    | 3.8358 | 1.2404| 0.8442        | 0.7672| 9    |
| DCRF5   | 3.8246 | 1.1130| 0.8291        | 0.7649| 10   |
| PMRF6   | 3.8022 | 1.1260| 0.7990        | 0.7604| 11   |
| LRF8    | 3.7948 | 1.1280| 0.7889        | 0.7590| 12   |
| ERF6    | 3.7799 | 1.1351| 0.7688        | 0.7560| 13   |
| DCRF3   | 3.7799 | 1.1151| 0.7688        | 0.7560| 13   |
| LRF2    | 3.7724 | 1.1630| 0.7588        | 0.7545| 14   |
| CPRF29  | 3.7500 | 1.0245| 0.7286        | 0.7500| 15   |
| MMRF17  | 3.7463 | 1.0823| 0.7236        | 0.7493| 16   |
| FRF3    | 3.7463 | 1.0926| 0.7236        | 0.7493| 16   |
| MMRF2   | 3.7313 | 1.1128| 0.7035        | 0.7463| 16   |
| MMRF1   | 3.7201 | 1.0741| 0.6884        | 0.7440| 17   |
| CPRF14  | 3.7201 | 1.0458| 0.6884        | 0.7440| 17   |

6.1 Agreement between stakeholders

The construction project consists of three main parties related to the project, which are owner, consultant and contractor. During this study, the views of each of these three parties were analyzed in determining the most significant causes of cost overrun in Jordanian construction projects. The statistical differences between the answers of the three parties were measured by using the ANOVA test, which based on the two levels of hypotheses as follows:

\[ H_0: \mu_{\text{owner}} = \mu_{\text{consultant}} = \mu_{\text{contractor}} \]

\[ H_1: \mu_{\text{owner}} \neq \mu_{\text{consultant}} \neq \mu_{\text{contractor}} \]

The ANOVA test results revealed that there is one of the most important causes of cost overrun has statistical differences between the three parties, this cause is DCRF5 (incomplete drawings or detailed design at the time of tender). This difference between the three parties is due to the different responsibilities and duties in the construction project in determining the most important causes of cost overrun. In addition, each party has a different view of the success of the project. For example, the owner seeks to finish the project within the budget and time allocated. While the consultant focuses on the quality requirement and the contractor focuses on how to finalize the project with the expected profit.
In addition, the same test was used to measure the statistical differences in opinion between two separate groups of the respondents. The results in Table 3 revealed that there is a significant statistical difference in opinion to determine the important causes of cost overrun between consultant and contractor with a significance level of less than 0.05. This difference is related to the importance of drawings according to the consultant, which are considered to be the key documents on the site to make the necessary decisions for the project. In addition, the consultant has focused on the quality as defined in the drawings and documents of the project. On the other hand, the contractors do not give much importance to the detailed drawing but mainly focused to execute the construction and complete it according to the limited time for the project.

Table 3. The results of ANOVA test

|                           | Sum of Squares | df | F      | Sig.  |
|---------------------------|----------------|----|--------|-------|
| Owner and Consultant      | 2.00           | 1  | 1.925  | 0.167 |
| Owner and Contractor      | 0.660          | 1  | 0.470  | 0.494 |
| Consultant and Contractor | 8.180          | 1  | 6.843  | 0.010 |

6.2 Causal factors for cost overruns

Factor analysis is a data reducing technique used to reduce the number of different factors in the components to a small number of factors [48]. It is used in this study to define the important components of cost overrun causes in Jordanian construction projects using SPSS software. The first step in the factor analysis is to create the correlation matrix of variable. The aim of creating a matrix of co-relation was to achieve the matrix determinant, which was suitable in defining multi-co-linearity and data uniqueness [49]. In addition, it is useful to check the sampling adequacy by measuring the Kaiser-Meyer-Olkin (KMO). For data being adequate, the obtained KMO value must be more than 0.5 [50], where the determination of the correlation matrix must be more than 0.00001. In this study, the KMO value is 0.927, which means that the variables are acceptable to be used in factor analysis. In addition, the extraction of factors was carried out to show the total variance, which was 64.14% in the current study, as shown in Table 4. To obtain easily understood factor loadings, a VARIMAX rotation was conducted on the factors to reduce the number of factors on which the determinants have a significant load [51]. The factor with factor loading of less than 0.50 was ignored; therefore, three factors were ignored in this study. The factors included in the components were with factor loading equal to or more than 0.50, as in Table 4. In addition, the components for cost overrun causes were summarized in Figure 1.

Table 4. The results of factor analysis loading

| Code | Causes of cost overrun | Component Factor |
|------|------------------------|------------------|
|      |                        | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| FRF1 | Delay in progressive payment by | 0.773    |         |          |          |
| FRF2 | Owner’s financial difficulties | 0.736    |         |          |          |
| FRF3 | Inconsistent cash flows | 0.818    |         |          |          |
| FRF4 | Payment problems faced by contractors | 0.756    |         |          |          |
| FRF5 | Payment problems faced by clients from government | 0.723    |         |          |          |
| FRF11 | Inadequate funds for project financing | 0.641    |         |          |          |
| FRF12 | Funds and associated auxiliaries not ready | 0.556    |         |          |          |

|      | Causes of cost overrun | Component Factor |
|------|------------------------|------------------|
|      |                        | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| MMRF1 | Fluctuations of material prices | 0.770    |         |          |          |
| MMRF2 | Inflation in the prices of construction | 0.788    |         |          |          |
6.2.1. Financial difficulties
This factor explained a variance of 45.270%, which related to the financial difficulties during the project life cycle. This component consisted of seven causes with the factor loading ranged from 0.556 to 0.818, these causes namely delay in progressive payment by owners, owner’s financial difficulties, inconsistent cash flows, payment problems faced by contractors, payment problems faced by clients from government, inadequate funds for
project financing and funds and associated auxiliaries not ready. Financial matters are considered as critical issue in the construction projects, as it is the operator of project inputs. The financial problem starts with payment delays from owners to contractors, which in turn affects the financial condition of the contractor. The majority of studies agreed that the financial difficulties of owners are one of the major causes of cost overrun in the construction industry [52]. Late payments by the clients to contractors have been identified as a key cause, followed by financial problems for the contractor [53]. The contractor, in this case, becomes unable to cover the financial obligations required of him to implement the project. The insufficient funding by the government and payment delays from the government to project owners are critical causes of cost overrun in construction projects. Therefore, it is important to focus on studying the project at the planning stage accurately to be based on it, to determine the appropriate value of funding, while adding a small percentage to avoid any emergency during implementation. This issue could be solved by making certain adjustments in the strategy for allocating budgets to various types of projects [54]. In addition, owners must prepare the appropriate project fund by developing a financial way of paying the contractor as provided in the contract [51].

6.2.2. Materials cost.
This component is related to materials used during project life cycle, which consisted of five causes with a variance of 7.394%. In addition, the factor loading for these causes are ranged from 0.636 to 0.788. The causes are namely fluctuations of material prices, inflation in the prices of construction materials, fuel cost increase, high transportation cost and inaccurate material estimates. It was found that construction materials would account for 50 to 60% of the cost of the project [55]. Often the project life cycle is long; consequently, there is a change in the prices of materials that affect the cost of the project. In addition to construction materials, construction projects are greatly affected by changes in the prices of fuel derivatives since most of the mechanisms in the project depend on it. In Jordan, the prices of fuel derivatives are adjusted monthly due to the change in prices globally. Therefore, the high cost of fuel clearly affects the cost of the projects in addition to its impact on other materials due to the high manufacturing and transportation fees. This negatively affects the cost of the project, so it must be taken into account when estimating the cost of the project at the planning stage.

6.2.3. Design issues.
All features of this factor refer to issues related to the design process. The factor explains a variance of 7.394% as this component consists of six causes, with the factor loading ranged from 0.518 to 0.780. As shown in Table 4 it comprises of frequent design changes, incomplete drawings or detailed design at the time of tender, unrealistic contract duration, slow decision making, delay in subcontractor's work and delays in decision making and approval of drawings. The most important stage in the life cycle of the project is the design stage in which drawings and documents are prepared to estimate the cost and time of the project. However, the critical causes of cost overrun are related to the design stage, which needs serious attention to improve it. Moreover, frequent design changes are a common problem in the majority of construction projects, where the project rarely devoid of design changes during the project life cycle. Any change to the design would impact the limited cost of the project, the number of materials needed, the type of materials needed and the work required [43]. Because of this, design changes considered by various studies as one of the main causes of cost overrun in construction projects [56, 57, 51, 32, 58, 59]. As a result of the quantity and variety of work in construction projects, the contractor uses sub-contractors to complete the various works in the project. Some of the sub-contractors are delay in completing the work required of them where this delays the completion of the project which incurs additional costs. Therefore, continuous work scheduling is necessary in avoiding any possible damages.

6.2.4. Additional works
Two causes are involved in this component with a variance of 4.607%. While the factor loading for the two causes are 0.715 and 0.724. These two causes are related to any additional works during the life cycle of the project such as extra quantity during construction and additional works at owner request. During the implementation stage of the project, some works may need to be added by the owner. This is one of the main causes of cost overrun in construction projects. It can be avoided by containing the owner in the design stage so that any additional work required can be added in this stage. In addition, increases in quantities occur in construction projects as a result of inaccurate quantity calculations at the start of the project. Comparison of the quantity of materials in the bill of quantities (BQ) with the actual quantities placed is a common method for cost control, a surplus of materials consumption on-site will require verification for additions otherwise it indeed constitutes a cost overrun [60].

6.3 Comparison between developing countries
This section compares the most important causes of cost overruns of construction projects in developing countries. Only studies from the last five years were included in this comparison to learn about new causes that have emerged with the development in the construction projects in recent years. The comparison allows this study to determine the most common causes of cost overrun in construction projects among developing countries, by identifying the most frequent causes in these countries. According to Table 5, the majority of developing countries during the last five years have suffered from fluctuations in the prices of construction materials, which considered one of the most critical causes that lead to cost overrun in the construction projects. This issue has become an accompaniment to the project due to the long duration of the construction projects in addition to the long time between bid pricing and the awarding of the bid to the contractor. The second common cause between the developing countries is delay in progressive payment by owners. Most developing countries are experiencing difficulties in providing funding for construction projects due to resource constraints in these countries. As a result, they tend to borrow funds from foreign countries, which require a long-term process for project progress payments, which means late payment by the owner to the contractor. As a matter of fact, the financial situation of the contractor will be affected by this delay, and the success of the project will also be affected. Many studies confirmed that the provision of having necessary funding for the project before referring the project to the contractor. The other causes, such as mistakes in design, frequent design changes, and unrealistic contract duration, are common causes in developing countries. These causes occur as a result of weak design stage outputs due to the inefficiency of the designer, lack in reviewing the designs, owner not involved in the design process and insufficient design time. Moreover, change orders and delay in completion date are the major results of poor design in construction projects. Minor shortfalls during the design process may thus have significant consequences for the project's lifecycle costs [61, 62]. Therefore, the design stage was considered as the cornerstone of the project. Another common cause between the developing countries is the delay decision making and approval of drawings. This is due to the centralization of decision-making in construction projects that require serious action that will take a long time. As a result, it sometimes leads to a stop to work, because work in construction projects is linked to one another. This leads the contractor to claim from the owner for the financial damages resulting from the delay. Construction projects in Jordan have been distinguished from other developing countries by identifying eight causes as important causes of cost overruns. Three of them related to the difficulties in providing the funds for the projects, inconsistent cash flow, extra quantities and inaccurate material estimates during construction. Every country has a special system in the arrangement of the progress payments in construction projects, which depending on the country’s budget. In addition, construction projects in Jordan faced an increase in fuel more than other developing countries, where this problem is serious which has a clear impact on transport costs. On the other hand, Jordan depends on foreign labor, so a shortage of labor occurs at certain periods during the year that are reflected in the delays in subcontractor works.
### Table 5. The causes of cost overrun in developing countries

| Code   | Country Surveyed | References | Jordan | Afghanistan | Malaysia | Saudi Arabia | Ethiopia | Pakistan | India | Iran | Oman | Pakistan |
|--------|------------------|------------|--------|-------------|----------|--------------|----------|----------|-------|------|------|----------|
|        |                  | Current study | [2]    | [63]        | [64]     | [65]         | [66]     | [67]     | [68]  | [69] | [70] | [Total]  |
| Design Issues |                |            |        |             |          |              |          |          |       |      |      |          |
| DCRF4  | Frequent design changes | √ | √ | √ | √ | 3 |
| DCRF5  | Incomplete drawings detailed design at the time of tender | √ | √ | √ | √ | 2 |
| ERF6   | Unrealistic contract duration | √ | √ | √ | √ | 3 |
| PMRF6  | Slow decision making | √ | √ | √ | √ | 3 |
| LRF8   | Delay in subcontractor's work | √ | √ | √ | √ | 3 |
| CPRF29 | Delays in decision making and approval of drawings | √ | √ | √ | √ | 3 |
| Financial Difficulties |                |            |        |             |          |              |          |          |       |      |      |          |
| FRF1   | Delay in progressive payment by owners | √ | √ | √ | √ | 5 |
| FRF2   | Owner's financial difficulties | √ | √ | √ | √ | 2 |
| FRF3   | Inconsistent cash flows | √ | √ | √ | √ | 1 |
| FRF4   | Payment problems faced by contractors | √ | √ | √ | √ | 3 |
| FRF5   | Payment problems faced by clients from government | √ | √ | √ | √ | 2 |
| FRF11  | Inadequate funds for project financing | √ | √ | √ | √ | 1 |
| FRF12  | Funds and associated auxiliaries not ready | √ | √ | √ | √ | 1 |
| Materials cost |                |            |        |             |          |              |          |          |       |      |      |          |
| MMRF1  | Fluctuations of material prices | √ | √ | √ | √ | 5 |
| MMRF2  | Inflation in the prices of construction materials | √ | √ | √ | √ | 3 |
| MMRF14 | Fuel cost increase | √ | √ | √ | √ | 1 |
| MMRF15 | High transportation cost | √ | √ | √ | √ | 1 |
| MMRF17 | Inaccurate material estimates | √ | √ | √ | √ | 1 |
| Additional Works |                |            |        |             |          |              |          |          |       |      |      |          |
| CPRF6  | Extra quantity during construction | √ | √ | √ | √ | 1 |
| CPRF7  | Additional works at owner request | √ | √ | √ | √ | 2 |
7. Conclusion

Cost overrun occurs in a construction project due to various causes where some of it can be controlled, while others cannot be controlled. Therefore, cooperation between all parties involved in the project must be undertaken to reduce the negative effects of cost overruns. This study has applied the quantitative approach to determine the most important causes for cost overruns in construction projects in Jordan. Considering that Jordan is one of the countries that suffer from cost overruns in its projects. On the basis of the results in this study, the most important causes were within four major components, such as financial difficulties, materials cost, design issues and additional works.

This study examined the various causes of cost overruns, which are related to most issues related to construction projects. Therefore, the results were comprehensive, as they included new causes that were not addressed in other studies in Jordan. For example, the high cost of transportation is one of the important causes of cost overrun in this study. In addition, this research explained the impact of inadequate funding for the project, which contributes to several other causes which have not been found in other studies. It also revealed the importance of the planning stage of the project life cycle in reducing the causes of cost overrun at the construction stage.

By comparing the results of the current study with other studies conducted in developing countries during the last years, it was found that the most common causes in developing countries were as follows fluctuations of material prices, delay in progressive payment by owners, payment problems faced by contractors, inflation in the prices of construction materials, mistakes in design, frequent design changes, unrealistic contract duration and delay in decision making and approval contract duration.

Through the results of this study, it is clear the importance of providing the necessary financing for the project before awarding it as it reduces many of the causes of cost overruns as the financial difficulties of both the owner and contractor. In addition to the need to prepare designs and tender documents with a high degree of accuracy with a focus on clarity of the entire details to avoid any modifications to the designs. Besides, the designs should be reviewed by the specialists after the design completion by the design team. This would improve the cost performance in construction projects.

The identification of the most significant causes of cost overruns in construction projects in developing countries leads other researchers to look for other causes based on the results of this study. Moreover, highlighting these factors allows stakeholders in construction projects to create reasonable strategies to prevent them as much as possible and therefore to be able to finish the project with the lowest cost overrun.

In the current study, the findings revealed that most of the crucial causes were due to a fault at the initial stage of the project. This research, therefore, leads to encouraging project owners to improve processes and methods used in the initial phases to reduce the cost overrun as much as possible. The findings are expressed in the following phases of the project life cycle, which conclude with a minimum cost overrun.

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