World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:18, No:3, 2024

Factors Contributing to Building Construction Project's Cost Overrun in Jordan

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***Abstract*—**This study examined the contribution of 36 factors to building construction project's cost overrun in Jordan. A questionnaire was distributed to a random sample of 350 stakeholders comprised of owners, consultants, and contractors, of which 285 responded. SPSS analysis was conducted to identify the top five causes of cost overrun, which were a large number of variation orders, inadequate quantities provided in the contract, misunderstanding of the project plan, incomplete bid documents, and choosing the lowest price in the contract bidding. There was an agreement among the study participants in ranking the factors contributing to cost overrun, which indicated that these factors were very commonly encountered in most construction projects in Jordan. Thus, it is crucial to enhance the collaboration among the different project stakeholders to understand the project's objectives and set a realistic plan that takes into consideration all the factors that might influence the project cost, which might eventually prevent cost overrun.

***Keywords*—**Cost, overrun, building construction projects, Jordan.

I. Introduction

THE economic growth of any country, whether it is a developed or a developing country, is affected by its construction industry sector [1]. According to the Department of Statistic's report Jordan's Gross Domestic Product (GDP) grew by 2.5% in 2022 compared to 2021. While agriculture achieved the highest growth rate in 2021 at 4.8%, contributing 0.28 percentage points to the overall growth rate, followed by the construction sector at 3.2%, contributing 0.10 percentage points. This clearly demonstrates how construction industry significantly adds to the economy of Jordan [2].

Although there are different criteria used globally to judge the success of any project, however, the specified time frame, budget, and quality satisfaction remain among the most common factors used by researches [3], [4]. According to Sweis et al. [5], 65% of public construction projects in Jordan suffer from cost overrun. This large percentage demonstrates how serious cost overrun is in threatening the stability of construction sector, and hence, affecting adversely the economy of Jordan. Therefore, there is a compelling need for investigating the factors that lead to cost overrun in construction projects. Such a step is very crucial since cost overrun constitutes the single most prominent element contributing to the failure of numerous construction projects.

Mukuka et al. [6] stated that cost overrun was a result of multiple factors in South Africa, and most of these factors occurred during the construction phase due to inexperienced contractors and poor management by the construction team. In Pakistan, Azhar et al. [7] identified nine factors underlying the incidence of cost overrun in local construction projects. According to their significance, these factors included: constant changes in the cost of raw and synthesized materials, expensive equipment, seeking low fare tenders, lack of good project management practices, inability to control expenses, separation of design and procurement stages with long intervals, improper cost approximation strategies, extra tasks, lack of preparation, and uncooperative legislative rules. Relatively similar factors were found in Gaza Strip as indicated by Al-Najjar [8] who arranged the nine causes of cost overrun: limited available resources, malpractice from contractors, consultant engineers and owners, lack of preparation and incomplete documentation of actions, disagreement among project administrators and lack of trust, slow processing of payments, delay in ordering materials and reviewing drawings, fluctuation in the domestic currency with respect to the American Dollar, changes in the cost of supplies, and bad weather conditions.

Sweis et al. [5] identified numerous factors implicated in cost overrun in construction projects in Jordan including the increase in the cost of fuel, alterations in the project design, imprecise calculation of the required materials, shortage of experienced personnel, unanticipated weather conditions, and lack of necessary equipment. Of these, 73% of all cost overrun cases were found to be due to governmental delays, bad weather conditions, and alterations in the project design. Bekr [9] investigated the causative factors leading to cost escalation in construction projects in Jordan. The author concluded that the most contributing factors to cost overrun were delays in projects commencement, changes in project design, large number of variation orders, and extra work requested from the owner, inappropriate design, improper planning and inaccurate scheduling, increase in materials prices due to inflation, unsettled work scope, incomplete contracts and documents during the bidding stage, inexperienced labours, flaws occurring during the execution phase, and bad quality of work.

According to Tarawneh et al. [10], the clients considered that financial, design, and competence issues have large effects on time delay and cost overrun, while the regulation and external issues have the minimum effect on time delay and cost overrun.

Literature review revealed that several factors contributing to cost overrun in construction projects worldwide. Since these factors were collected from different settings with different economical statuses, not all of them were applicable to Jordan.

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Based on experience with the local challenges facing the construction sector in Jordan and literature review, 36 relevant factors were chosen to be included in the questionnaire considering the local economic situation, constructional regulations, conditions, and geographical nature in Jordan. This paper focuses on identifying the factors that lead to cost overrun to avoid its impact on the local economy.

II. Methodology

Cost overrun is defined as the difference between the final actual cost of a project at the date of completion and the accepted project price by both the contractor and the owner. Subsequently, cost overrun in any project is the difference between actual cost and the final accepted project price, while cost overrun percentage is calculated by:

$$\%\ \text{Cost overrun} = \frac{\text{Actual cost} - \text{Accepted project price}}{\text{Accepted project price}} \text{ X } 100\% \quad (1)$$

A questionnaire in both English and Arabic languages was prepared and tested for validity through piloting to experts with long experience in the local construction sector including Professors from the Department of Civil Engineering at the University of Jordan as well as consultants and engineers from the Jordanian Ministry of Public Works and Housing (MPWH). Comments and suggestions raised by these experts were considered to modify the contents of the questionnaire to produce an easily comprehended survey.

Data collected from the questionnaire were of ordinal scale used with a 5-point Likert scale; ranking the causative factors of cost overrun based on their significance from the perception of participants. The integers assigned to reflect the level of influence were (0, 1, 2, 3, and 4), with 0 reflecting a nonsignificant factor and 4 reflecting an extremely significant factor.

The target population consisted of three parties: owners of public and private building construction projects, contracting companies, and consulting companies. According to the Jordan Construction Contracting Association (JCCA) Annual Report [11], contracting companies are classified into six categories as the first degree represents the largest companies, whereas the sixth degree represents the smallest. Only large contracting companies (first to third) are authorized to execute building projects and were included in the target population. The owners who were involved in the target population consisted of governmental agenesis and owners of private projects. Similarly, the consulting companies consisted of all consulting companies that were registered with the MPWH.

Random samples were selected from the contracting and consulting companies to decide the sample size [12]:

$$\text{nf} = \frac{ns}{(1+ns/P)} \quad (2)$$

where nf: the final sample size. $ns = \frac{t^2 \times P \times q}{e^2}$, where t represents the value of alpha (0.05) which equals 1.96 for any sample size ≥ 120; P & q represent the estimated variance which equals 0.5, and e represents the accepted margin of error for the mean being estimated; *P*: the population.

Thus, the final sample size for the contracting and consulting companies were 112 and 109 respectively. Convenience sampling was used for the owners.

To measure a questionnaire's validity two tests were conducted as following; first *Criterion Validity* using Spearman's test by taking a sample consisting of 30 participants to measure the internal consistency of the questionnaire, followed by computing the correlation coefficients of each paragraph in one field and that of the whole field; second, *Construct Validity* using Spearman's test to measure the correlation coefficient of one field and that of all the fields of the questionnaire that have the same level of Likert scale. Reliability was done by comparing the scores obtained in the same questionnaire by the same participant in two different occasions using Cronbach`s Coefficient Alpha.

The SPSS was used to run the statistical analysis. Spearman's Coefficient was used to test the validity, Cronbach's' Alpha Coefficient was used to test the reliability, the relative importance index and standard deviation were used to investigate the perception of participants in relation to ranking the factors causing cost overrun, and finally Kendall's Concordance Test (W) was used to test the agreement among participants with respect to their responses.

III. Validity

This section presents the results of testing the criterion and construct validity using Spearman's coefficient. Tables I-III show that the values of Spearman's coefficient were more than 0.5 indicating that there was a strong correlation between each factor and the whole group. Also, the p-values were less than 0.05. Hence, there was a statistically significant correlation between each factor and the whole group.

In terms of construct validity, Table IV shows that the values of Spearman's coefficient were more than 0.7 which indicates that there was a strong correlation between each group and other groups. Also, the p-values were less than 0.05. Hence, there was a statistically significant correlation between each group and other groups.

Table V shows that the values of Cronbach's' Alpha Coefficient varied between 0.826 and 0.906. Also, the value of Cronbach's Alpha Coefficient for all the factors was 0.948. These values were more than 0.7, indicating that the questionnaire was reliable.

IV. Analysis & Results

A total of 350 questionnaires were distributed to the target population of which 285 questionnaires were collected at the end of the study. Thus, the overall response rate in this study was above 80%.

Most respondents had a work experience of more than 15 years with 32.3%, then those who had a work experience of five to ten years came afterwards with 24.6%. The majority of respondents came from organizations located in the middle region with 69%, while those who participated from the north

region had the lowest percentage with 14%. This can be since the population distribution is highest in the middle region of Jordan, Amman. Similarly, it was found that most respondents work in the middle region with 56.8%, then those who work in all regions came next with 21%, while those who work in the south region came last with 10.2%. In terms of work experience in the construction field, most respondents have implemented or supervised more than twenty projects with 37.2% which indicates that most respondents have strong experience in the construction field.

TABLE I
CRITERION VALIDITY FOR FACTORS RELATED TO CONTRACTORS

Factors	Spearman's Coefficient	P-value
Internal Factors		
Bad labour management (allocation of workers) at the site	0.572	< 0.001
Bad storage of materials inside work location	0.533	< 0.001
Errors occurring during the execution stage from the contractor	0.516	< 0.001
Lack of contractor's experience	0.775	< 0.001
Lack of communication and poor coordination between consultants & contractors	0.759	< 0.001
Lack of communication and poor coordination between contractors` crew	0.649	< 0.001
Lack of trust between consultant and contractor	0.652	< 0.001
Late in materials delivery	0.499	< 0.001
Malpractices from contractor engineers	0.672	< 0.001
Poor management in planning and scheduling	0.577	< 0.001
Misunderstanding of contract documents	0.765	< 0.001
Misunderstanding of project plans	0.725	< 0.001
Technologies not involved in the work executed	0.537	< 0.001
Unskilled labours	0.655	< 0.001
External Factors		
Bad weather conditions	0.690	< 0.001
Fluctuation in materials prices (cement, steel & fuel)	0.699	< 0.001
High inflation rate	0.786	< 0.001
Unavailability of resources	0.607	< 0.001
Uncooperative legislative rules	0.791	< 0.001
Unforeseen ground conditions	0.786	< 0.001

TABLE II
CRITERION VALIDITY FOR FACTORS RELATED TO OWNERS

Factors	Spearman's Coefficient	P-value
Clearances are not available upon request	0.555	< 0.001
Large number of variation orders	0.504	< 0.001
Inadequate duration provided in the contract	0.594	< 0.001
Inadequate quantities provided in contract	0.572	< 0.001
Delay in reimbursement	0.662	< 0.001
Malpractices of owner engineers	0.558	< 0.001
Separation between execution stage & design stage	0.672	< 0.001
Slow decision-making process from owner side	0.600	< 0.001
Incomplete bid documents	0.480	< 0.001
choosing the lowest price in contract bidding	0.638	< 0.001

The main objective of this study is the identification of the factors contributing to cost overrun in building construction projects in Jordan. The questionnaire identified 36 factors contributing to cost overrun from literature, experience, and expert opinions, and asked the participants to identify how significant these factors are contributing to cost overrun from their own perspective. To identify the most significant factors, factors were ranked according to their significance based on respondents' perspective using Relative Importance Index (RII).

TABLE III
CRITERION VALIDITY FOR FACTORS RELATED TO CONSULTANTS

Factors	Spearman's Coefficient	P-value
Errors occurring during the execution stage from the consultant	0.685	< 0.001
Lack of communication between owner & consultants	0.631	< 0.001
Lack of supervision	0.769	< 0.001
Malpractices from consultant engineers	0.653	< 0.001
Slow response from consultant	0.706	< 0.001
Lack of consultant experience	0.548	< 0.001

TABLE IV
CONSTRUCT VALIDITY

Factors	Spearman's Coefficient	P-value
Factors related to owners	0.812	< 0.001
Factors related to consultants	0.855	< 0.001
Factors related to contractors	0.776	< 0.001
External factors	0.872	< 0.001

TABLE V
RELIABILITY TEST

Factors	Cronbach's' Alpha Coefficient
Factors related to contractors	0.906
External factors	0.873
Factors related to owners	0.826
Factors related to consultants	0.832
Overall factors	0.948

Equation (3) was used to calculate RII:

$$RII = \frac{\sum W}{AN} \times 100\% \quad (3)$$

where W: The weight given to each factor by the respondent; A: The highest weight (which was 7 in this study); N: The total number of samples.

Tables VI-IX represent the RII, standard deviation, and the ranking of the factors identified by the respondents. It can be seen that the standard deviation of the factors varied between 0.908 and 1.23, which indicates that the variation among respondents in terms of ranking the factors contributing to cost overrun was relatively low. This is a good indication which demonstrates a relatively high level of agreement among the respondents.

Tables VI-IX show that the first factors related to contractors, external factors, owners, and consultants are "Misunderstanding of project plans", "Unavailability of resources", "Large number of variation orders", and "Lack of consulting experience" respectively. Also, the tables show that the RII values varied between 60.492% and 86.52%. Such findings indicate that all factors were considered of high significance in terms of their contribution to cost overrun from respondents' perspectives. "Large number of variation orders" was ranked first as the most significant factor, while "errors

occurring during the execution stage from the consultant" was ranked last in terms of its contribution to cost overrun.

TABLE VI
RANKING OF THE FACTORS CONTRIBUTING TO COST OVERRUN RELATED TO CONTRACTORS

Factor	RII	SD	Rank within the Group	Rank among all Factors
Bad labours management (allocation of workers) at the site	67.650	1.01626	12	29
Bad storage of materials inside work location	64.982	1.10904	14	31
Errors occurring during the execution stage from the contractor	65.334	1.07096	13	30
Lack of contracting experience	78.106	1.00429	2	6
Lack of communication and poor coordination between consultants & contractors	77.544	1.12698	3	7
Lack of communication and poor coordination between contractors` crew	73.544	1.08495	7	14
Lack of trust between consultant and contractor	71.508	1.09356	9	18
Delay in materials delivery	69.824	1.05355	10	20
Malpractices from contractor's engineers	75.790	0.95565	5	9
Poor management in planning and scheduling	75.228	0.96374	6	10
Misunderstanding of contract documents	73.474	1.05925	8	15
Misunderstanding of project plans	79.508	1.07275	1	3
Technologies not involved in the work executed	68.702	1.09745	11	23
Unskilled labours	76.632	1.02076	4	8

TABLE VII
RANKING OF THE FACTORS CONTRIBUTING TO COST OVERRUN RELATED TO EXTERNAL FACTORS

Factor	RII	SD	Rank within the Group	Rank among all Factors
Bad weather conditions	68.000	0.95387	6	27
Fluctuation in materials prices (cement, steel & fuel)	74.316	0.94567	2	12
High inflation rate	71.790	1.00521	4	17
Unavailability of resources	75.158	1.05198	1	11
Uncooperative legislative rules	69.334	0.98032	5	21
Unforeseen ground condition	73.754	0.99860	3	13

TABLE VIII
RANKING OF THE FACTORS CONTRIBUTING TO COST OVERRUN RELATED TO OWNERS

Factor	RII	SD	Rank within the Group	Rank among all Factors
Clearances are not available upon request	67.790	1.04775	10	28
Large number of variation orders	86.526	0.90898	1	1
Inadequate duration provided in the contract	68.562	1.09057	8	24
Inadequate quantities provided in contract	79.650	0.95112	2	2
Delay in reimbursement	68.912	1.28151	7	22
Malpractices from owner's engineers	68.280	1.03315	9	26
Separation between execution stage & design stage	73.264	1.16229	6	16
Slow decision-making process from owner's side	73.544	1.18426	5	14
Incomplete bid documents	79.158	1.08364	3	4
Awarding the lowest price in contract bidding	78.596	1.16673	4	5

TABLE IX
RANKING OF THE FACTORS CONTRIBUTING TO COST OVERRUN RELATED TO CONSULTANTS

Factor	RII	SD	Rank within the Group	Rank among all Factors
Errors occurring during the execution stage from the consultant	60.492	1.14269	6	34
Lack of communication between owners & consultants	70.176	1.23794	2	19
Lack of supervision	63.228	1.14538	5	33
Malpractices from consultants' engineers	68.842	1.08169	3	25
Slow response from consultants	64.280	1.20144	4	32
Lack of consulting experience	73.404	1.03970	1	15

V. CONCLUSIONS

The construction industry contributes to the growth and sustainability of Jordan's national economy. However, many construction projects in Jordan suffer from cost overrun which results in projects failure ultimately. Analysis revealed that for the factors contributing to cost overrun; "Misunderstanding of project plans" ranked first within the group related to Contractors and third among all factors; while "Unavailability of Resources" ranked first related to External Factors and eleventh among all factors; as for Owners "Large number of variation orders" ranked first both within the group and among all factors; finally for Consultants "Lack of consulting experience" ranked first within the group and fifteenth among all factors.

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