Journal of Engineering
Sciences Assiut University
Faculty of Engineering
Vol. 49, No. 4
July 2021
PP. 577 - 596

CAUSES OF DELAY AND COST OVERRUN FOR EDUCATIONAL BUILDING PROJECTS IN EGYPT

Mohamed Gebrel [1], Kamal A. Assaf [2], Moataz Awad Farag [3], and Alaa A. Mohamed [4]

[1] *Demonstrator, Civil Engineering Department, Faculty of Engineering, Sohag University, Egypt. mahamedgebrel4@gmail.com*
[2] *Associate. Prof. Civil Engineering Department, Faculty of Engineering, Assiut University, Egypt. kamal_assaf2000@yahoo.com*
[3] *Assistant. Prof. Civil Engineering Department, Faculty of Engineering, Minia University, Egypt. moutaz.farag@mu.edu.eg*
[4] *Assistant. Prof. Civil Engineering Department, Faculty of Engineering, Assiut University, Egypt. alaa_atif_abdelhafez@yahoo.com*

Received 24 March 2021; Revised 27 June 2021; Accepted 29 June 2021

Abstract

The construction industry is considered one of the most important industries in Egypt. The majority of construction projects are known to have time delays and cost overruns. The main contribution of this study is that it is the first study of its type that identifies causes of delay and cost overrun in educational building projects with its different types (public schools, private schools, public universities, and private universities) within Egypt. The research main objective is to identify the causes of delay and cost overrun in educational building projects in Egypt and evaluate their importance by the main project stakeholders (Consultants, Contractors, and Owners). This objective was accomplished by means of an extensive literature review and a questionnaire-

based survey. Forty causes of delay and cost overrun were gathered through the literature review and categorized into seven groups. The questionnaire was divided into three sections; the main section concentrated on the causes of delay and cost overrun in construction projects. Responses were gathered from 130 participants representing the key stakeholders participated in the project's construction. The analysis was conducted to determine the amount of delay and cost overrun experienced by the projects, in addition to the indices concerning the frequency of occurrence, impact on time and cost, and significance of the seven groups. As well, a ranking of the forty causes was performed to identify the most critical causes of delay and cost overrun in each type of educational building projects (public schools, private schools, public universities, and private universities). Concluded that the most common causes of delay and cost overrun between all types are: Price instability, Price escalation of material, delays in contractor's progress payment, financial problems, and contractor's difficulties in financing the project.

Keywords: Time Overrun, Cost Overrun, SPSS, Educational Building Projects, Egypt, Relative Importance Index (RII), Questionnaire Survey.

1 Introduction

The construction industry plays a significant role in the countries' economic growth in the Middle East and especially in Egypt Ezeldin et al. [1]. Construction projects play a very important role as the main driving force in the growth of several other sectors. Unfortunately, delay and cost overrun are the most common problems being suffered by the construction industry. Delay is defined as an "Act or event that increases the time needed to perform the contract scope of work, which demonstrates itself as further delays of work" Abd El-Razek et al. [2]. Whereas Assaf et al [3]. considered delay as time overrun that occurs after a contract's completion period ends or after the parties' agreed-upon deadline for completing a project. Consequently, delay is considered a costly one for both owners and contractors related to project termination, disputes among project parties, cost overrun, and impact on output quality. Most construction projects experience time and cost overruns, and the magnitude of these overruns vary greatly from project to project and country to country. (Famiyeh et al. [4]). Educational building projects differ from other building projects in that they are usually homogenous with regard to construction techniques, budgeting, and

schedules. (Samarghandi et al. [5]) In Egypt, educational construction projects are regarded as one of the most significant. The ministry of education receives 20% of the gross domestic product, and the authority of educational building receives about 12% from it. Therefore, one of the critical issues affecting the education system, in general, is the problem of time and cost overruns, which leads to the loss of the goal of expanding the establishment of more educational buildings to accommodate more students and reducing capacity. (Kholif et al. [6]). In Egypt, the causes of time and cost overruns have been studied in several previous studies. Most of these studies were in building, road, and infrastructure construction. Few studies were related to educational building projects. Although the study carried out by Kholif et al. [6] analyzed the delay and cost overrun in the educational building in Egypt, it was concerned only with public school's projects. As a result, the objectives of this study are:

- Identify the factors that cause time and cost overrun in educational building projects in Egypt.
- Rank these factors based on relative importance and impact on time and cost separately.

To achieve these objectives, a review of the past literature is presented. A questionnaire survey was conducted to identify the most important causes of delay and cost overrun. The identified causes were categorized according to their relative importance.

A number of researches and papers have been published to determine the causes and effects of delays in the construction projects.

The study conducted by Ezeldin et al. [1] in Egypt focused on the causes of delays in large construction projects. The research objectives were: identifying the most significant factors of projects delay and ranking them, and specifying the party responsible for the major factors of delays. The research identifies 31 common causes of delays collected from literature review and unstructured interviews. The delay causes were grouped into five main categories. A questionnaire survey with (35) professional experts was carried out. The top 12 causes identified in this study included one political cause, seven managerial causes, one financial-related cause, and three construction causes. Marzouk et al. [7] analyzed the causes of construction delays in Egypt. The data collection was through interviews with construction experts. Subsequently, preparation of questionnaire survey and distribution to 35 construction experts who represent consultants, owners, and contractor organizations.

The top ten delay causes were determined according to the highest values of Frequency Index, Severity Index, and Importance Index. ANOVA method is carried out to test the causes of delay obtained from the questionnaire. Finally, the roadmap for prioritizing groups of delay causes is presented. In Ethiopia, Tilahun et al. [8] investigated and analyzed the causes of delay in educational building projects in Addis Ababa university. This study looked at a comprehensive list of construction delay factors that were collected from the literature. The basis of this study formed by questionnaires and personal interviews. concluded that the most important causes of delay were: Mistakes and discrepancies in design documents, Delay in material delivery, Shortage of construction materials, and Frequent change and variation order. Tawil et al. [9] considered several delay causes in higher learning educational buildings in Malaysia, which were: insufficient capital, delay in getting work approval, scarce construction materials, delay in receiving progress payments, and problems in contractor management. The study conducted by Rachid et al. [10] identified and assessed the causes of delay in the Algerian construction industry. questionnaires and direct interviews formed the data collection techniques. A literature review and feedback from construction experts and practitioners yielded 59 delay causes. the sample size is 52 construction experts, including 20 consultants, 16 contractors, and 16 clients. Results of this study showed that slow change orders and slow variation orders in extra quantities were the common causes of common delays between all parties. Susanti et al. [11] investigated the cost overrun and time delay in construction projects in Indonesia with a total of 36 completed questionnaire sets. the most important causes of cost overrun were: "owner additional required" for the owner and "rework" for the contractor. while the most important causes of time delay were: " inaccurate budgeting and resource planning" for the owner and "land acquisition" for the contractor. Nevertheless, the two parties agreed the inflation rate has the least impact on construction project delay. Prasad et al. [12] conducted a questionnaire survey to determine the root causes of delays in different types of projects. The questionnaire contained 60 causes, and interviewees were requested to evaluate the probability index, severity index, and relative importance index of the causes on a 5-point Likert scale. The Relative Importance Index (RII) of causes was calculated after evaluating 123 responses to rank the causes of delay. The most critical

causes of delay in all project types were found to be: contractor's financial problems, late payment from contractor to subcontractors/suppliers, delay in settlement of claims by the owner, and delay in payment for extra work/ variations. In another examination to analyze the major causes of poor time and cost performance in UAE construction projects Johnson et al. [13]. The top five causes for time overrun were: unrealistic schedules by clients, inaccurate time estimation by the consultants, design variation from client and consultant, change orders from clients and delay in obtaining government permits and approvals. Whereas, the top five causes of cost overrun were: poor cost estimation, financial constraints of the client, design variation, delay in client's decision-making process, and inappropriate procurement method. Famiyeh et al. [4] investigated the major causes of time and cost overruns in educational projects in Ghana. The most important causes that affect the time overrun were: financial problems, delays in contractor's payment, and underestimation of project cost. While the most important causes that affect the cost, overrun were material price fluctuation, financial difficulty by the client, and shortage of materials.

The research carried out by Kholif et al. [6] to investigate the causes of time and cost overrun in the educational building projects in Egypt concluded seven significant factors for time delay and cost overruns: High cost of skilled labor, High insurance, and high interest rates, inaccurate cost estimation, difficulties in getting a work permit from the government, financial difficulties of the contractor, bureaucracy in bidding/ tendering method, and incorrect in soil investigation.

This study is similar to that of Kholif et al. [6], but it differs in that it investigates the causes of delays in various types of educational buildings, as well as providing a more updated list of the causes of delays in educational construction projects in Egypt.

2 Methodology

It should be observed that only educational projects are concerned in the scope of this study. The research was carried out as follows:

In order to cover previous studies regarding project time and cost overrun, a literature review was carried out. The various causes that are expected to affect time and cost overrun will be clearly identified as a

result of this review. A questionnaire-based survey was carried out based on the previously identified factors in order to determine the most important causes of overruns for cost and time for educational buildings in Egypt. The questionnaire consists of three sections. The general information about the respondents was covered in the first section, such as profession and experience in the construction sector, as well as the type of educational buildings involved. The reasons for the time and cost overruns were focused on in the second section, which is considered the most important. Participants were asked to determine the frequency of the occurrence of delay factors and their impact on time and cost in the projects they participated in. The following table categorizes these factors.

Table 1: Common factors causing time delay and cost overrun

No	Description of factors causing time and cost overrun	
1- Owner-related factors		**References**
1	Slowness in the decision-making process	[1], [2], [3], [4], [5], [8], [10]
2	Suspension of work	[1], [3], [5]
3	Delay to handover the site to the contractor	[3], [4], [5], [6], [7], [8], [9], [13]
4	Financial problems	[3], [4], [5], [7], [8], [9], [11], [12]
5	Change orders	[3], [4], [5], [6], [8], [11], [12], [13
6	Delays in contractors progress payment	[1], [2], [3], [4], [6], [7], [8], [9]
7	Contractual issue	[5], [8], [10], [11], [12], [13]
8	Poor management	[5], [6], [8], [11], [12], [13]
2- Contractor-related factors		**References**
9	Contractor’s difficulties in financing the project	[1], [2], [3], [4], [5], [10], [11],
10	Inadequate contractor experience	[2], [3], [4], [5], [7], [8], [10], [13]
11	Poor time management	[3], [4], [5], [7], [8], [10]
12	Lack of resources	[1],[11], [12], [13]
13	Contractor's failure to comply with the consultant's instructions	[2], [3]
14	Contractor don't review the design and make observations	[2],[10]
15	Inefficient quality control by the contractor during construction	[3], [4], [10], [11]
16	Poor communication with other parties	[2], [4], [6], [8], [12]
3- Design-related factors		**References**
17	Design changes by owner or his agent	[2], [3], [4], [7], [9], [10], [11]
18	Mistakes and discrepancies in the design documents	[2], [3], [4], [5], [6], [10], [13]
19	Unclear and inadequate details in drawings	[3], [5], [6], [10], [13]

No	Description of factors causing time and cost overrun	
4- Labor & equipment-related factors		**References**
20	Shortage of labor	[2], [3], [4], [5], [6], [7], [8], [10]
21	Poor labor efficiency	[2], [3], [10]
22	Low productivity of labors	[1], [3], [4], [5], [10], [11]
23	Labor injuries	[2], [3], [4], [10]
24	Wrong distribution of project equipment	[3], [7]
25	Shortage in equipment/insufficient numbers	[2], [3], [6], [10]
26	Equipment failure (breakdown)	[3], [5], [6], [8], [10], [11]
27	Decreased equipment efficiency	[2], [3], [4], [6]
5- Material-related factors		**References**
28	Shortage (availability) in construction materials	[2], [3], [5], [6], [8], [10], [12]
29	Price escalation of material	[2], [4], [5], [6], [7], [9], [10], [12]
6- Project-related factors		**References**
30	Effects of subsurface conditions (e.g., soil. High water table, etc.)	[2], [3], [5]
31	Insufficient available utilities on site	[1], [3], [4], [5], [6]
32	Unexpected underground condition	[1], [2], [4]
33	Project size	[4], [7], [10], [12]
7- Another-related factors		**References**
34	Weather conditions	[2], [3], [4], [5], [6], [7], [8], [9],
35	Environmental restrictions	[3], [4], [5], [13]
36	Changes in government regulations and laws	[1], [3], [5], [9], [10], [12]
37	Obtaining permits from government	[1], [2], [3], [4], [5], [6], [11], [13]
38	Price instability	[1], [2], [9], [10], [13]
39	Conflict, war, revolution, riot, and public enemy	[1], [5], [10]
40	Disputes between project parties	[1], [3], [5], [10], [12]

The third section of the questionnaire focused on the effects of construction delays in educational building projects. The score for the respondent ranges from 1 to 5 depending on the frequency and on the impact of the cause or effect of the delay on the project. A pilot study was conducted with the help of 5 experts in the field of construction with more than 15 years of experience in this field. The aim of this study was to omit the less important questions in the questionnaire in order to ensure clarity and feasibility before preparing the final formulation of the questionnaire. The questionnaire was distributed to a large group of stakeholders in the field of educational buildings in Egypt who represent the main parties for construction projects (owners, contractors, and consultants). The following statistical methods and indices were used to evaluate the collected data (section 2 of the questionnaire) concerning the delay and cost overrun factors.

1- Frequency index (FI): An equation is used to assess delay factors according to their probability of occurrence as determined by the respondents. (Ahmad et al. [14])

$$\boldsymbol{F.I} \cdot (\%) = \sum_{\boldsymbol{i=1}}^{\boldsymbol{5}} \frac{\boldsymbol{a_{if} * n_{if}}}{\boldsymbol{5 * N}} * \boldsymbol{100} \quad \boldsymbol{Equation(1)}$$

where a_{if} is the weighting of each response on the Likert scale (1 for rarely up to 5 for Always), n_{if} is the responses frequency degree, and N expresses the total number of responses, i=response category index.

2-Impact Index for Time (IIT): An equation is used to assess delay factors according to their impact on time as identified by the respondents. (Ahmad et al. [14])

$$\boldsymbol{I.I.T}(\%) = \sum_{\boldsymbol{i=1}}^{\boldsymbol{5}} \frac{\boldsymbol{a_{it} * n_{it}}}{\boldsymbol{5 * N}} * \boldsymbol{100} \quad \boldsymbol{Equation(2)}$$

where a_{it} is the weighting of each response on the Likert scale (1 for very low up to 5 for very high), n_{it} is the responses frequency degree, and N expresses the total number of responses, i=response category index.

3-Impact Index for Cost (IIC): An equation is used to assess delay factors according to their impact on cost as identified by the respondents. (Ahmad et al. [14])

$$\boldsymbol{I.I.C}(\%) = \sum_{\boldsymbol{i=1}}^{\boldsymbol{5}} \frac{\boldsymbol{a_{ic} * n_{ic}}}{\boldsymbol{5 * N}} * \boldsymbol{100} \quad \boldsymbol{Equation(3)}$$

where a_{ic} is the weighting of each response on the Likert scale (1 for very low up to 5 for very high), n_{ic} is the responses frequency degree, and N expresses the total number of responses, i=response category index.

4- Relative importance index (RII): The Relative importance index for time and The Relative importance index for cost can be calculated as follow (Ahmad et al. [14]):

RII (time) = Relative importance index for time

$$\mathbf{RII(time) = FI * IIT} \qquad \boldsymbol{Equation(4)}$$

RII (cost) = Relative importance index for cost

$$\mathbf{RII(cost) = FI * IIC} \qquad \boldsymbol{Equation(5)}$$

Cronbach's Alpha: Cronbach's alpha, which is most used on Likert scale questions to determine the reliability of the scale, is used to measure the survey's internal consistency. The test results are shown in table 2. acceptable; the value of Cronbach Alpha in this survey is 0.961, confirming the questionnaire's reliability.

Table 2: Test results of Cronbach's alpha reliability analysis

Description	Number of items	Cronbach's alpha
Frequency responses	40	0.941
Impact on time responses	40	0.956
Impact on cost responses	40	0.956
Overall questionnaire	120	0.961

Spearman's Rank Correlation: Spearman's rank correlation is a non-parametric test. Such tests have the great advantage of not requiring hypothesis normality or homogeneity of variance hypothesis. Correlation is characterized as a measure of the relation between various parties and, hence, the strength of the relationship and its direction. This test is used to ascertain the strength of the degree of agreement between the various parties (consultants, contractors, and owners). The coefficient of correlation ranges from -1 to +1, in which -1 indicates an ideal negative relationship, while +1 is an ideal positive relationship. Spearman's coefficient r is used to calculate and compare the relationship between two parties' rankings for one explanation for the delay while disregarding the third party ranking.it is computed using the following equation: (Ahmad et al. [14])

$$\boldsymbol{rs = 1 - \left[\frac{6\sum d^2}{n^3 - n}\right]} \qquad \boldsymbol{Equation(6)}$$

Where: r is the Spearman's correlation coefficient among two parties, d expressed the difference between ranks assigned to variables for every cause, and n is that the number of pairs of rank.

3 Analysis and results

The collected data were statistically analyzed to determine the respondent's perception about the factors of time and cost overrun in educational building projects. Prior to data analysis, the following characteristics of the respondents were investigated and presented:

3.1 General Information of the Participants:

3.1.1 *Organization Type*

From Figure 1, it is seen that majority of the respondents belong to contractor's organizations (48%) followed by consultants (30 %), and only 22% of responses were collected from the owner's representative.

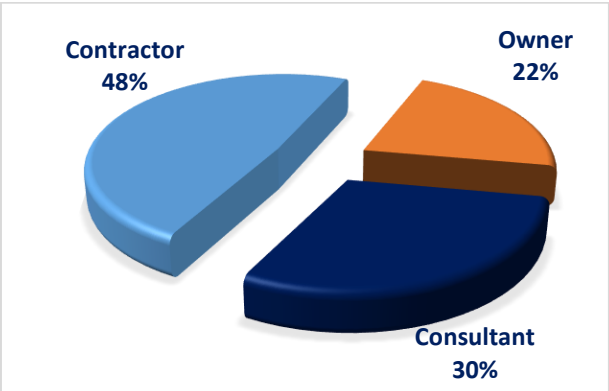

Figure 1. Respondent's organization type

3.1.2 *Profession of Respondents*

From Figure 2, it is seen that the maximum number of the respondents was Site engineers (30.77%), and the minimum was Quality Observer (2.3%).

3.1.3 *Sector Type*

Figure 3 shows that 49 % of respondents worked in the public sector, 46% in the private sector, and only 5 % in other sectors.

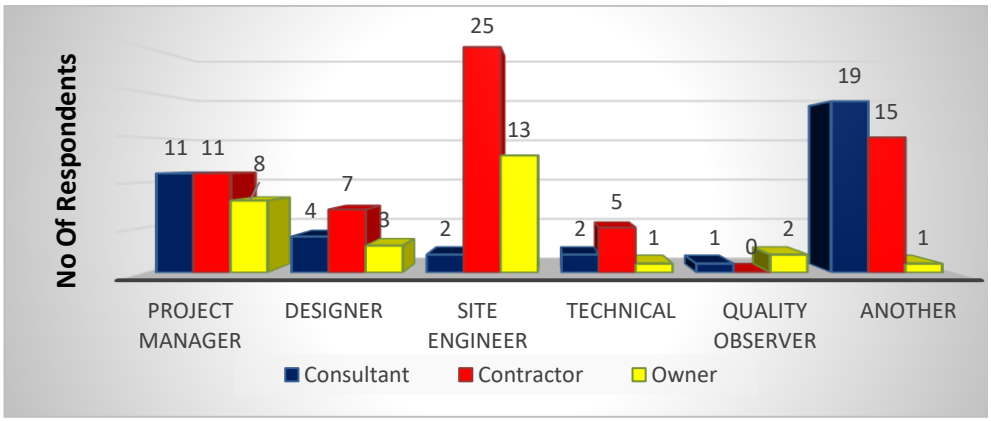

Figure 2. Respondent's profession in Construction

3.1.4 *Educational Building Type*

Figure 4 shows that 43 % of respondents worked in public school projects, 38% in public university projects, 10% in private school projects and 9 % in private university projects.

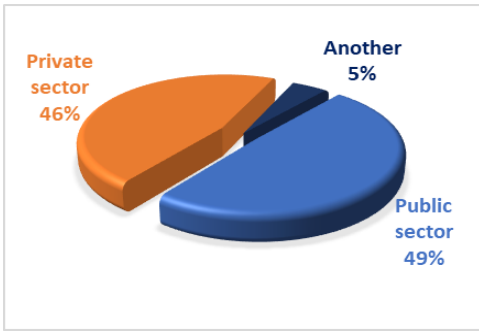

Figure 3. Type of sector

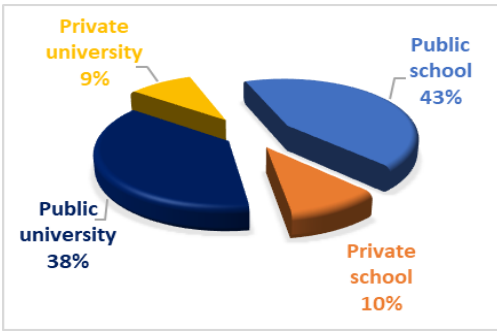

Figure 4. Educational building type

3.1.5 *Experiences of Respondents*

Figure 5 & Figure 6 show the experience of respondents in construction projects in general and educational building projects specifically.

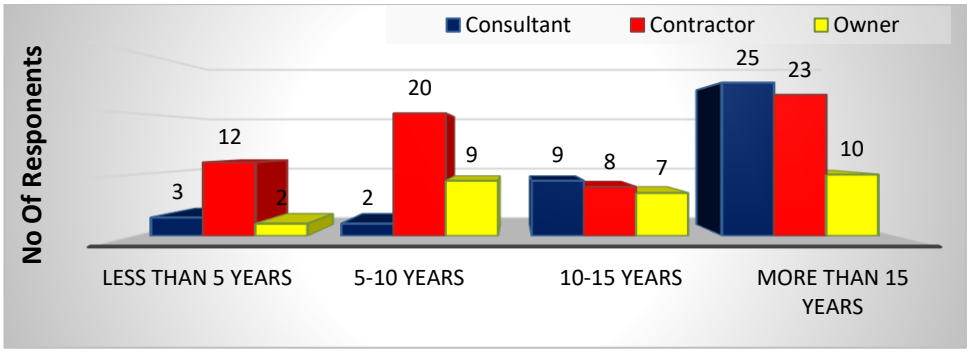

Figure 5. Respondent's Experiences of Construction projects

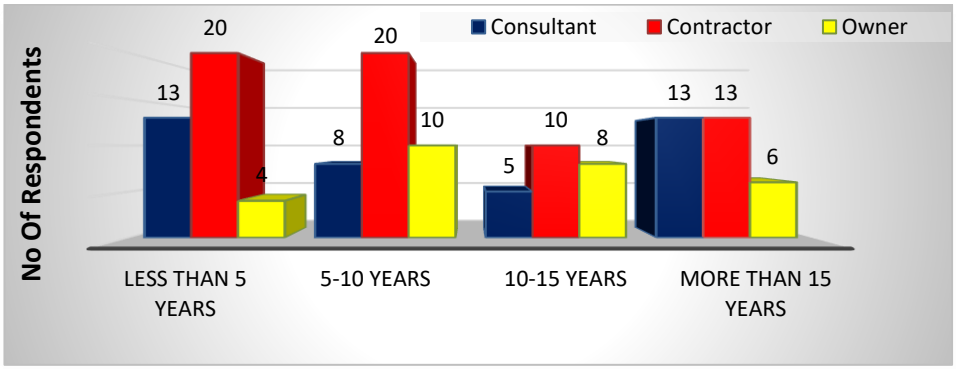

Figure 6. Respondent's Experiences of Educational building projects

3.2 Ranking of Delay Causes:

The top ten delay factors that are ranked according to Frequency Index (F.I), Impact index time (I.I.T), and Impact index cost (I.I.C) are listed in Tables 3–5, respectively.

Table 3: Top ten important factors based on frequency index

No	DELAY FACTOR	FI	Group
38	Price instability	0.832	Another
29	Price escalation of material	0.808	Material
6	Delays in contractors progress payment	0.791	Owner
9	Contractor's difficulties in financing the project	0.754	Contractor
4	Financial problems	0.751	Owner
1	Slowness in the decision-making process	0.737	Owner
5	Change orders	0.718	Owner
11	Poor time management	0.709	Contractor
22	Low productivity of labors	0.702	Equipment
37	Obtaining permits from government	0.702	Another

Table 4: Top ten important factors based on impact index of time

No	DELAY FACTOR	IIT	Group
4	Financial problems	0.829	Owner
29	Price escalation of material	0.809	Material
9	Contractor's difficulties in financing the project	0.803	Contractor
38	Price instability	0.800	Another
6	Delays in contractors progress payment	0.797	Owner
1	Slowness in the decision-making process	0.777	Owner
28	Shortage (availability) in construction materials	0.768	Material
20	Shortage of labor	0.752	Equipment
37	Obtaining permits from government	0.746	Another
5	Change orders	0.740	Owner

Table 5: Top ten important factors based on impact index of cost

No	DELAY FACTOR	IIC	Group
29	Price escalation of material	0.834	Material
38	Price instability	0.829	Another
4	Financial problems	0.820	Owner
6	Delays in contractors progress payment	0.805	Owner
9	Contractor's difficulties in financing the project	0.789	Contractor
28	Shortage (availability) in construction materials	0.754	Material
22	Low productivity of labors	0.751	Equipment
1	Slowness in the decision-making process	0.748	Owner
17	Design changes by owner or his agent	0.742	Design
5	Change orders	0.737	Owner

3.3 Relative Importance Index (for time and cost):

Table 6 shows the ranking of the top delay factors due to their relative importance indices. From these rankings, many causes have high ranks and appear in the first 10th of ranking due to their relative importance indices for time and cost such as Price instability, Price escalation of material, Delays in contractors progress payment, Financial problems, Contractor's difficulties in financing the project, Slowness in the decision-making process, and Design changes by the owner or his agent.

3.4 Ranking of Delay Factors Based on Type of Projects:

The respondents were asked to respond to the survey based on the type of educational construction projects in which they were involved. The survey responses were evaluated separately for each project category, and the top factors for time and cost overruns are presented in Tables 7, 8, 9, and 10. Every effort was made in this study to present valid results free from bias or errors. But since the sample size of private school and private university projects was

relatively small, the results of these projects may need further examination before generalization. It is worth noting that "price instability" and " Price escalation of material " have an impact on all types of projects.

Table 6: Ranking of top factors due to their RII (overall).

No	DELAY FACTOR	RII (time)	Rank	RII (cost)	Rank	Group
38	Price instability	0.666	1	0.690	1	Another
29	Price escalation of material	0.654	2	0.673	2	Material
6	Delays in contractors progress payment	0.630	3	0.636	3	Owner
4	Financial problems	0.623	4	0.616	4	Owner
9	Contractor's difficulties in financing the project	0.605	5	0.595	5	Contractor
1	Slowness in the decision-making process	0.573	6	0.551	6	Owner
5	Design changes by owner or his agent	0.531	7	0.529	7	Owner
37	Obtaining permits from government	0.523	8	0.479	17	Another
28	Shortage (availability) in construction materials	0.521	9	0.511	11	Material
11	Poor time management	0.516	10	0.515	10	Contractor

Table 7: Top factors affecting time and cost overrun in public school projects.

No	DELAY FACTOR	RII (time)	Rank	RII (cost)	Rank	Group
38	Price instability	0.707	1	0.723	1	Another
29	Price escalation of material	0.683	2	0.703	2	Material
6	Delays in contractors progress payment	0.679	3	0.693	3	Owner
4	Financial problems	0.668	4	0.652	4	Owner
9	Contractor's difficulties in financing the project	0.632	5	0.640	5	Contractor
1	Slowness in the decision-making process	0.595	6	0.603	6	Owner
37	Obtaining permits from municipality (government)	0.581	7	0.558	9	Another
28	Shortage (availability) in construction materials	0.566	8	0.569	8	Material
5	Change orders	0.557	9	0.554	10	Owner
12	Lack of resources	0.552	10	0.528	18	Contractor

Table 8: Top factors affecting time and cost overrun in private school projects.

No	DELAY FACTOR	RII (time)	Rank	RII (cost)	Rank	Group
29	Price escalation of material	0.652	1	0.652	2	Material
9	Contractor's difficulties in financing the project	0.640	2	0.565	9	Contractor
17	Design changes by owner or his agent	0.636	3	0.568	7	Design
38	Price instability	0.628	4	0.652	1	Another
6	Delays in contractors progress payment	0.627	5	0.602	4	Owner
5	Change orders	0.603	6	0.567	8	Owner
10	Inadequate contractor experience	0.592	7	0.592	5	Contractor
11	Poor time management	0.592	8	0.628	3	Contractor
37	Obtaining permits from municipality (government)	0.588	9	0.479	25	Another
8	Poor management	0.552	10	0.528	18	Contractor

Table 9: Top factors affecting time and cost overrun in public university projects.

No	DELAY FACTOR	RII (time)	Rank	RII (cost)	Rank	Group
29	Price escalation of material	0.646	1	0.666	2	Material
38	Price instability	0.643	2	0.673	1	Another
4	financial problems	0.610	3	0.607	3	Owner
6	Delays in contractors progress payment	0.601	4	0.604	4	Owner
9	Contractor's difficulties in financing the project	0.598	5	0.573	5	Contractor
1	Slowness in the decision-making process	0.561	6	0.522	6	Owner
5	Change orders	0.507	7	0.510	7	Owner
28	Shortage (availability) in construction materials	0.500	8	0.470	11	Material
20	Shortage of labor	0.498	9	0.453	13	Equipment
11	Poor time management	0.495	10	0.476	10	Contractor

3.5 Ranking of Sources (Groups) of Delays:

The causes of time and cost overruns are classified into seven groups. Table 11 shows the ranking of these groups based on a relative importance index for time and a relative importance index for cost. According to the results in this table, the most common causes of time and cost overruns are related to material, followed by owner. In contrast, project and other related factors are less important.

Table 10: Top factors affecting time and cost overrun in private university projects.

No	DELAY FACTOR	RII (time)	Rank	RII (cost)	Rank	Group
38	Price instability	0.607	1	0.650	1	Another
1	Slowness in the decision-making process	0.575	2	0.575	3	Owner
29	price escalation of material	0.547	3	0.587	2	Material
4	financial problems	0.538	4	0.550	4	Owner
6	Delays in contractors progress payment	0.524	5	0.537	5	Owner
17	Design changes by owner or his agent	0.513	6	0.477	8	Design
9	Contractor's difficulties in financing the project	0.475	7	0.500	6	Contractor
11	Poor time management	0.454	8	0.478	7	Contractor
21	Poor labor efficiency	0.454	9	0.401	18	Equipment
28	Shortage (availability) in construction materials	0.454	10	0.454	10	Material

Table 11: Main groups ranking

Group of delay causes	RIIT	Rank	RIIC	Rank
Material	0.6180	1	0.6223	1
Owner	0.5271	2	0.5246	2
Design	0.5198	3	0.5232	3
Contractor	0.5146	4	0.5049	4
Equipment	0.4997	5	0.4955	5
Another	0.4842	6	0.4768	6
Project	0.4624	7	0.4696	7

3.6 Discussion of Results

The top 10 causes leading to delay of educational building projects in Egypt are found to be (1) Price instability, (2) price escalation of material, (3) Delays in contractors progress payment, (4) financial problems, (5) Contractor's difficulties in financing the project, (6) Slowness in the decision-making process, (7) Shortage (availability) in construction materials, (8) Change orders, (9) Poor time management and (10) Design changes by owner or his agent. The result of this study is like the findings of the other studies. A study conducted by Tawil et al. [9] on higher learning educational buildings in Malaysia found that factors such as Delays in contractors progress payment, financial problems, Shortage (availability) in construction materials, Poor time management are the leading causes of time overrun. Another study conducted by Johnson et al. [13] found that the most important causes of delay were financial problems, Slowness in the decision-making process, Change orders,

Design changes by owner or his agent. Similarly study on the time overrun in the construction projects in Egypt done by Ezeldin et al. [1] also found the factors causing the time overrun in the construction projects like the present study. Only educational building projects in Egypt were used in the analysis, which looked at 40 causes of time and cost overruns. Aside from these explanations, there was a need to investigate other elements that contributed to project time and cost overruns. Other sector projects may be examined in future research. A cross-sectional perspective of various projects would also be quite interesting.

4 Conclusions

This paper analyzed the causes of time and cost overrun in educational building projects in Egypt. literature review and pilot study identified 40 causes of time and cost overruns. Questionnaire surveys were used to gather feedback from the major stakeholders involved in the project's construction (consultants, owners, and contractors), and they all agreed that their projects suffered time and cost overrun. The top factors for time and cost overrun in the different types of educational buildings were determined based on the highest values of Frequency Index, Impact Index, and Relative Importance Index. The main contribution of this research is that it is the first study of its type that identifies causes of delay and cost overrun in educational building projects with its different types within Egypt. The research was limited to only educational building projects in Egypt with its different types (public schools, private schools, public universities, and private universities). Both consultants and owners point out that the serious and critical causes of time and cost overrun are those related to contractors and labour. Contractors, on the other hand, indicate that the most important sources are from owners and consultants. In conclusion, the most common causes of time and cost overrun in all types of educational buildings were: Price instability, Price escalation of material, and Delays in contractors progress payment. The findings from this research will serve as a guideline to educational building project stakeholders of Egypt that is the government, business organizations, contractors, consultants, and the community at large. They will be aware of the time delay and cost overrun factors that can result in the delay of projects right from the inception phase

References

[1]. Ezeldin, A. S., & Abdel-Ghany, M. (2013). Causes of construction delays for engineering projects: An Egyptian perspective. In AEI 2013: Building solutions for architectural engineering (pp. 54-63).

[2]. Abd El-Razek, M. E., Bassioni, H. A., & Mobarak, A. M. (2008). Causes of delay in building construction projects in Egypt. Journal of construction engineering and management, 134(11), 831-841.

[3]. Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. International journal of project management, 24(4), 349-357.

[4]. Famiyeh, S., Amoatey, C. T., Adaku, E., & Agbenohevi, C. S. (2017). Major causes of construction time and cost overruns. Journal of Engineering, Design and Technology.

[5]. Samarghandi, H., Mousavi, S., Taabayan, P., Mir Hashemi, A., & Willoughby, K. (2016). Studying the Reasons for Delay and Cost Overrun in Construction Projects: The Case of Iran.

[6]. Kholif, W., Hosny, H., & Sanad, A. (2013). Analysis of time and cost overruns in educational building projects in Egypt. International Journal of Engineering and Technical Research, 1(10), 1-8.

[7]. Marzouk, M. M., & El-Rasas, T. I. (2014). Analyzing delay causes in Egyptian construction projects. Journal of advanced research, 5(1), 49-55.

[8]. Tilahun, S. (2016). Cause and Effects of Delay on Educational Building Projects in Addis Ababa University Case Study.

[9]. Tawil, N. M., Khoiry, M. A., Arshad, I., Hamzah, N., Jasri, M. F., & Badaruzzaman, W. H. W. (2013). Factors contribute to delay project construction in higher learning education case study UKM. Research Journal of Applied Sciences, Engineering and Technology, 5(11), 3112-3116.

[10]. Rachid, Z., Toufik, B., & Mohammed, B. (2019). Causes of schedule delays in construction projects in Algeria. International Journal of Construction Management, 19(5), 371-381.

[11]. Susanti, R. (2020, January). Cost overrun and time delay of construction project in Indonesia. In Journal of Physics: Conference Series (Vol. 1444, No. 1, p. 012050). IOP Publishing.

[12]. Prasad, K. V., Vasugi, V., Venkatesan, R., & Bhat, N. S. (2019). Critical causes of time overrun in Indian construction projects and mitigation measures. International Journal of Construction Education and Research, 15(3), 216-238.

[13]. Johnson, R. M., & Babu, R. I. I. (2020). Time and cost overruns in the UAE construction industry: a critical analysis. International Journal of Construction Management, 20(5), 402-411.

[14]. Ahmad, S. A., Issa, U. H., Farag, M. A., & Abdelhafez, L. M. (2013). Evaluation of risk factors affecting time and cost of construction projects in Yemen. International journal of management, 4(5), 168-178. Vince A, Pine WJ, Lum P. The Bailey method—achieving volumetric and HMA compatibility. Course Materials and Handouts (2009)

Abbreviations

F.I: Frequency Index
I.I.T: Impact Index on Time
I.I.C: Impact Index on Cost
RII(Time): Relative Impact Index on Time
RII(Cost): Relative Impact Index on Cost
rs: Spearman Rank Correlation Coefficient

JES, Assiut University, Faculty of Engineering, Vol. 49, No. 5, September 2021, pp. 577 – 596

أسباب التأخير وتجاوز التكاليف في مشروعات المباني التعليمية في مصر

الملخص

تعتبر صناعة البناء من أهم الصناعات في مصر. من المعروف أن معظم مشروعات البناء معرضة لتأخير الوقت وتجاوز التكاليف. المساهمة الرئيسية لهذه الدراسة أنها الدراسة الأولى من نوعها التي تحدد أسباب التأخير وتجاوز التكلفة في مشاريع الأبنية التعليمية بأنواعها المختلفة (المدارس الحكومية والمدارس الخاصة والجامعات الحكومية والجامعات الخاصة) داخل مصر. الهدف الرئيسي من هذه الدراسة هو التعرف على أهم أسباب التأخير وتجاوز التكلفة في مشروعات الأبنية التعليمية في مصر وتقييم أهميتها من قبل أصحاب المصلحة الرئيسيين في المشروع (المستشارون والمقاولون والملاك). تم تحقيق هذا الهدف من خلال مراجعة الدراسات السابقة ومسح شامل باستخدام استبيان. تم جمع أربعين سببًا للتأخير وتجاوز التكلفة من خلال مراجعة الأدبيات وتم تصنيفها في سبع مجموعات. تم تقسيم الاستبيان إلى ثلاثة أجزاء. ركز الجزء الرئيسي على أسباب التأخير وتجاوز التكاليف في مواقع البناء. تم جمع الإجابات من ١٣٠ مشاركا يمثلون أصحاب المصلحة الرئيسيين المشاركين في بناء المشروعات. تم إجراء التحليل لتحديد مقدار التأخير وتجاوز التكلفة التي تعرضت لها المشاريع، بالإضافة إلى المؤشرات المتعلقة بتكرار حدوثها، وتأثيرها على الوقت والتكلفة، وأهمية المجموعات السبع. كما تم إجراء تصنيف للأربعين سببًا لتحديد أهم أسباب التأخير وتجاوز التكلفة في كل نوع من مشاريع المباني التعليمية (المدارس الحكومية والمدارس الخاصة والجامعات الحكومية والجامعات الخاصة). تم استنتاج أن الأسباب الأكثر شيوعًا للتأخير وتجاوز التكلفة بين جميع الأنواع هي: عدم استقرار الأسعار، ارتفاع أسعار المواد، التأخير في دفع المستخلصات من قبل المالك، صعوبات في تمويل المشروع من ناحية المقاول، المشاكل المالية المتعلقة بالمالك.