Prioritizing Delay Causes in the Egyptian Building Construction Projects

Nehal Elshaboury¹, Hassan Alaa², Abobakr Al-Sakkaf^{3,4}, Ghasan Alfalah⁵, Eslam Mohammed Abdelkader⁶

¹Construction and Project Management Research Institute/Housing and Building National Research Centre Giza, Egypt ²Construction Engineering Department/British University in Egypt ³Department of Building, Civil, and Environmental Engineering, Concordia University Montréal, QC, Canada ⁴Department of Architecture & Environmental Planning/College of Engineering & Petroleum/Hadhramout University Mukalla, Yemen ⁵Department of Architecture and Building Sciences/King Saud University Riyadh, Saudi Arabia ⁶Structural Engineering Department/Faculty of Engineering/Cairo University Giza, Egypt nehal_ahmed_2014@hotmail.com; hassan137248@bue.edu.eg; abobakr.alsakkaf@concordia.ca; galfalah@ksu.edu.sa; eslam_ahmed1990@hotmail.com

Abstract - Delay is considered one of the most common problems in construction projects. Therefore, this study investigates the main causes of delay in the Egyptian building construction projects from the perception of contractors, consultants, and owners. The delay causes are identified based on an extensive literature review. These factors are categorized into owner-related, consultant-related, contractor-related, material-related, labour and equipment-related, and external-related categories. Questionnaire surveys are conducted and distributed among twenty-two experts to determine the relative importance of each cause. The study reveals that the top five causes of delay in building projects are financial problems by contractors, fluctuation in prices, delay in preparing and approving shop drawings, shortage of labours, and errors in soil investigation. Finally, the possible ways of reducing project delays are recommended. Proper communication and coordination between project parties as well as clear identification of the roles and responsibilities of project stakeholders are listed as the key actions that could be undertaken to mitigate the delay causes. This study serves as an assistance tool for construction professionals and academicians to avoid causes of delay in building projects in Egypt.

Keywords: Delay, Building projects, Relative importance index, Recommendations, Egypt.

1. Introduction

The construction industry is regarded as one of the most critical contributors to Egyptian growth and development. This industry contributed 10.3% of the gross domestic product of Egypt during the year 2017-2018 [1]. Moreover, it provided around 3.7 million jobs, representing 20% of total workers in the domestic market [2]. A successful construction project is characterized by on-time and within budget completion. Besides, it has to comply with the specifications and ensure the stakeholders' satisfaction. However, the uncertainty and uniqueness associated with construction projects will probably lead to their late deliveries [3]. Assaf and Al-Hejji [4] indicated that 76% of contractors and 56% of consultants have been facing an average time overrun of 10 to 30% that causes a 50% cost overrun. It was reported that 50% of the construction projects in the United Arab Emirates encountered construction delay [5]. Therefore, the delay is considered one of the most common problems that causes many adverse effects on construction projects [6].

Delay could be defined as a time overrun beyond the project completion date. Besides, it leads to revenue loss from the owner's perspective because of the lack of production facilities and rentable space. From the contractor's perspective, delay

leads to higher overhead costs because of the higher material costs through inflation, extended working periods, and higher labour costs. Therefore, the delay could negatively impact the project duration, cost, and quality [7]. The main causes of delay could be summarized as follows: technical issues, natural conditions, and problems related to owner, subcontractor, or contractor [8]. The causes of delay must be well understood and analysed to take the necessary actions that prevent their occurrences from the first place [9]. Therefore, this research aims to identify the primary sources of project delay in the construction sector and the remedial measures for delays.

2. Literature Review

Several studies have been performed to assess the delay causes in construction projects around the world. This research has been conducted in different countries because the delay factors differ from one country to another, from one time to another, and from one project to another [3]. Marzouk and El-Rasas [10] analysed the most significant delay causes in the Egyptian construction projects using frequency index, severity index, and importance index. The delay factors were prioritized in the following order: owner-related, contractor-related, external-related, consultant-related, labour and equipment-related, project-related, and material-related factors. Amoatey et al. [11] attempted to analyse the delay causes and effects in Ghanaian housing construction projects using relative importance index (RII) and correlation analysis. The most critical delay factors were stated as follows: delay in payment to contractor/supplier, inflation/price fluctuation, increased price of materials, funding from the sponsor/client, variation orders, and poor financial market.

Larsen et al. [12] evaluated the impact of delay factors on the time, cost, and quality of public construction projects. Moreover, the delay factors were ranked using the RII and tested using Friedman's and Wilcoxon's tests. The authors identified the five main causes of delay as lack of funding, delay caused by other authorities, poor planning, errors or omissions in construction work, and problems in identifying needs. Durdyev et al. [13] assessed the consultants' and contractors' perceptions on the relative importance of delay causes in the Cambodian construction industry using RII. Results showed that shortage of materials on-site, unrealistic project scheduling, late delivery of materials, shortage of skilled labours, project complexity, labour absenteeism, late payment by the owner for the completed work, poor site management, delay by the subcontractor, and accidents on site are ranked as the main causes of project delays in Cambodia.

Gebrehiwet and Luo [3] discussed the typical causes and impacts of delay in the Ethiopian construction projects using RII and correlation coefficient. The authors concluded that the influential causes of delay are corruption, unavailability of utilities at site, inflation, price increase of materials, lack of high-quality materials, late issuance of design documents, slow delivery of materials, late approval and receipt of completed work, poor site management and performance, late release of budget/funds, and ineffective project planning and scheduling. Soliman [14] investigated the delay causes in Kuwait construction projects and the possible ways to prevent their occurrence and mitigate their effects. The recommendations comprised modifications of contract clauses, revision of awarding systems, shortening of the documentary period, and change of contract documents.

Shahsavand et al. [7] revealed the main causes of delay in the Iranian construction projects from the client's, consultant's, and contractor's perspective. The relative importance of these causes was evaluated using RII and statistical package for social sciences (SPSS). The delay factors were prioritized in the following order: client-related, labour and equipment-related, contractor-related, material-related, design-related, external, and consultant-related factors. Alsuliman [15] investigated the causes of delays in public construction projects in Saudi Arabia. The causes of delay were divided into three categories: factors before the award of tenders, factors during the award of tenders, factors after the award of tenders, and general factors. The effect of these factors on the schedule delay was calculated using a simplified formula. Hossain et al. [16] analysed the causes of delays in different types of Kazakhstan's construction projects. Besides, the delay factors were studied based on different views of project parties. Finally, the recommendations and remedial measures for the delays were provided.

3. Research Methodology

The proposed model involves the following points:

- 1. Reviewing the literature related to the main causes of delay in the construction sector.
- 2. Evaluating the collected factors by distributing, collecting, and analyzing questionnaire surveys among different experts in the construction sector (i.e., owners, consultants, and contractors).
- 3. Implementing data analysis to rank the delay causes using the relative importance index as in Eq. (1) [3].
- 4. Taking the possible measures to avoid delays in building projects.

$$RII = \frac{\sum W}{A * N} \tag{1}$$

Where; W represents the rating given to each factor by the respondent, A represents the highest weight, and N represents the total number of responses. It could be noted that a higher value of this index indicates greater importance of the delay factor.

4. Data Collection

There are two primary sources of data collection in this research, namely literature review and questionnaire surveys. The preliminary list of delay factors in building construction projects was identified based on an extensive literature review, as summarized in Table 1 [17, 10, 18, 19, 20]. The definitions for each delay factor are provided in Table 2. The collected delay causes are then evaluated by conducting twenty-two questionnaire surveys among a broad spectrum of experts in the building construction industry, respectively. These experts are classified, according to their expertise, into three categories: owner, consultant, and contractor. The structure of the questionnaire consists of three parts: informed consent form, respondent's information, and questions about factors affecting delay in the construction industry as well as their mitigation measures. The consent form informs the participant about the purpose of the study and the benefits of participation. In the general information part, the participants are asked about their names, occupation, and years of experience. In the last part of the questionnaire, the experts are requested to state the relative importance of the delay causes in the Egyptian construction industry. The experts shall express their preferences linguistically according to Likert scale, which ranges from "1", which means the lowest impact, to "5", which means the highest impact. Finally, the experts are requested to recommend the possible actions to mitigate these concerns.

No.	Causes of Delay	Kazaz et al. [17]	Marzouk and El-Rasas [10]	Owolabi et al. [18]	Bekr [19]	Srdić and Šelih [20]
1	Delay in revising documents		✓			\checkmark
2	Financial problems by contractor	✓	✓	\checkmark	✓	
3	Late payment by owner for the completed work	~	~	~	~	
4	Design changes	\checkmark		\checkmark	✓	\checkmark
5	Late delivery of materials		\checkmark		✓	
6	Modification in contract	\checkmark		~		
7	Improper coordination between project parties	~	1	~	~	
8	Slow decision making		×	\checkmark	✓	\checkmark

Table 1: Delay causes in construction projects collected from the literature.

No.	Causes of Delay	Kazaz et al. [17]	Marzouk and El-Rasas [10]	Owolabi et al. [18]	Bekr [19]	Srdić and Šelih [20]
9	Delay in preparing and approving shop drawings		1		~	\checkmark
10	Shortage of materials		\checkmark		✓	
11	Poor site management	\checkmark	\checkmark		\checkmark	\checkmark
12	Improper management of owner				✓	\checkmark
13	Poor production rate of labors	\checkmark	\checkmark		\checkmark	
14	Errors in construction	\checkmark	\checkmark	\checkmark	\checkmark	
15	Errors in design				\checkmark	
16	Shortage of equipment			\checkmark	✓	
17	Shortage of labors	\checkmark	\checkmark		✓	
18	Errors in soil investigation				✓	
19	Unskilled labors		\checkmark			\checkmark
20	Conflicts between project parties	\checkmark	\checkmark	\checkmark	✓	
21	Bad weather conditions	\checkmark	\checkmark	\checkmark	✓	
22	Natural disasters		\checkmark			
23	Fluctuation in prices	✓	✓	✓	✓	
24	Legal disputes					\checkmark
25	Variation order		\checkmark			\checkmark
26	Discrepancies in contract documents	\checkmark		\checkmark		
27	Improper management of materials	\checkmark				
28	Transportation circumstances	\checkmark				

Table 2: Descriptions of delay causes in construction projects.

No.	Factor	Definition
1	Delay in revising documents	Construction projects require several essential documents that define the scope of work and the required work procedures. However, late review of these documents is considered one of the main causes of delays in construction projects.
2	Financial problems by contractor	It is the contractor's responsibility to calculate a project cash flow because any financial related problems will slow the progress of the work on site.
3	Late payment by owner for the completed work	The owner shall pay the contractor to perform the required work on time because any delay in payments will negatively influence the project's progress and lead to cost overrun and extension of time.
4	Design changes	The design changes could significantly impact the time and cost required to execute the construction project.
5	Late delivery of materials	Late delivery of materials is argued to be one of the most critical factors that cause a delay in construction projects.
6	Modification in contract	The contract documents manage the relationships between project parties. Hence, contract modifications lead to construction delays that cause added costs and disputes.
7	Improper coordination between project parties	The owner, contractor, and consultant shall co-operate to ensure project completion on time. Thus, it is essential to investigate the project delay in case of poor coordination and communication between project parties.
8	Slow decision making	The lack of clear guidelines acts as the main cause of slow decision making, leading to schedule delays and cost overruns.
9	Delay in preparing and	The delay in preparing or reviewing shop drawings could be a source of disputes and delays in

No.	Factor	Definition
	approving shop drawings	construction projects.
10	Shortage of materials	The shortage of materials is considered one of the critical factors that might disturb the project activities and delay the project's execution.
11	Poor site management	The poor site management of an inexperienced contractor might influence the project's schedule and budget.
12	Improper management of owner	The improper management from the owner's perspective might lead to an extensive delay in the project.
13	Poor production rate of labors	The low production rate of labors might extend the project's completion deadline with additional cost.
14	Errors in construction	The contractor is accountable for selecting the most efficient construction method and the sequence of work in the project. Nonetheless, errors encountered in the construction will result in rework and project delay.
15	Errors in design	The presence of any design errors will require additional work to correct these errors, which will ultimately lead to project delay.
16	Shortage of equipment	The shortage of equipment is considered one of the key factors that delay the project's execution.
17	Shortage of labors	The shortage of labors is regarded as one of the significant factors that impact the project's schedule and budget.
18	Errors in soil investigation	Errors in soil investigation are one of the most critical causes of delays in construction projects.
19	Unskilled labors	The use of unskilled labors can substantially impact the project's performance in terms of quality, cost, and duration.
20	Conflicts between project parties	The construction projects involve multiple parties that have different backgrounds, aims, and objectives. Therefore, any conflicts between these parties will lead to several problems in the project.
21	Bad weather conditions	Bad weather conditions cause work disruptions, financial losses, and significant project delays.
22	Natural disasters	Natural disasters lead to suspension of the project and, in some cases, destruction of the completed work in the construction sites.
23	Fluctuation in prices	Changes in the prices of materials and other supplies hinder the project's completion within the assigned budget.
24	Legal disputes	The contractual and legal disputes within the project parties might affect their performances and lead to project delays.
25	Variation order	The most common effects of variation orders in construction projects are delay in completion and increased project cost.
26	Discrepancies in contract documents	Discrepancies in contract documents might lead to an increase in project cost, delay in project duration, or compromise in project quality.
27	Improper management of materials	The improper management of materials (i.e., bad qualities or wrong quantities of materials) will negatively impact the project's quality, duration, and budget.
28	Transportation circumstances	Traffic problems can impact the delivery of materials and equipment on-site and lead to project delays.

5. Results and Discussion

There are several causes of delay in the Egyptian building construction projects. This highlights the necessity of focusing on the most key problems within the construction industry and the opportunities for controlling and reducing project delays. The identification of delay factors is carried out through the primary data collection method (i.e., literature review). As stated previously, twenty-eight factors are identified and clustered in three categories. The significance levels of these delay factors are determined using RII through questionnaire surveys. Fig. 1 determines the number of the responses for each score, ranging from 1 being "not at all important" to 5 being "very important".

The RII of each factor is calculated by assigning values to the available options in the questionnaire; 1 to "not at all important", 2 to "of little importance", 3 to "moderately important", 4 to "important", and 5 to "very important". The RII of the delay factors in the building projects in Egypt are shown in Fig. 2. It is found that the five most influential delay factors are financial problems by contractor, fluctuation in prices, delay in preparing and approving shop drawings, shortage of labors, and errors in soil investigation. These factors are validated by being compared against the results mentioned in other studies [10]. According to severity, frequency, and importance indices, these factors are stated as being among the top ten delay causes. On the other side, the five least important causes of delay are modifications in contract, improper management of owner, improper management of materials, bad weather conditions, and legal disputterthermore, the recommended actions to avoid the causes of project delays are listed in this section. From the owner's perspective, the following actions must be taken: a) specifying a detailed and realistic project duration in the contract, b) ensuring the availability of the required funds, c) making due payments to the contractor for the completed works, d) defining the scope of work appropriately, e) hiring an experienced contractor with a good reputation, f) dealing with a consultant with high expertise and good reputation, g) preparing an accurate feasibility study and financial plan, h) acquiring the needed approvals from the relevant authorities, and i) preparing complete, correct, and unambiguous tender documents. From the contractor's point of view, the following points must be satisfied: a) conducting a comprehensive cash flow analysis, b) making an appropriate selection of subcontractors based on qualifications and experience, c) ensuring efficient site management and supervision, d) providing training to the workers to improve their skills, e) using modern technologies on-site, f) applying health and safety regulations on-site, and g) monitoring and reporting any causes of delays in the construction site. The following courses of action must be made by the consultants: a) evaluating and controlling variation orders, b) avoiding delay to the contractor's queries, and c) approving the submitted shop drawings promptly. Finally, it could be observed that proper communication and coordination between project parties, and clear identification of the roles and responsibilities of project stakeholders are listed as the key actions that could be undertaken to mitigate the delay causes.



Fig. 1: Frequencies of importance level for delay factors.



Fig. 2: Relative importance indexes of significant causes of construction project delays.

6. Conclusion

This study investigated the fundamental causes of delays in the Egyptian building construction sector. The preliminary list of delay causes was identified based on an extensive literature review. The collected factors were then analyzed by conducting questionnaire surveys among construction practitioners. The feedback of respondents was evaluated using the relative importance index method. It was found that the five major significant delay factors are: 1) financial problems by the contractor, 2) fluctuation in prices, 3) delay in preparing and approving shop drawings, 4) shortage of labors, and 5) errors in soil investigation. On the other side, the five least significant delay factors are: 1) modification in contract, 2) improper management of owner, 3) poor management of materials, 4) bad weather conditions, and 5) legal disputes. Finally, the research also recommended the possible ways of reducing project delays. This implies that construction frontline players shall pay attention to the most common factors causing delays in the Egyptian building projects with respect to their magnitudes of influence. Moreover, the findings of this research provide project stakeholders with the appropriate solutions for countering any delays. This will ultimately reduce resources, time, and cost and enhance the performance of construction projects to improve the nation's economy.

7. References

- Mena, "Egypt's growth rate hit 5.3% in FY 2017/2018: Minister", <u>https://www.egypttoday.com/Article/3/54715/Egypt-s-growth-rate-hit-5-3-in-FY-2017</u>, 2018.
- [2] Egypt today staff, "Construction sector provides 3.7M jobs: Min", https://www.egypttoday.com/Article/3/44450/Construction-sector-provides-3-7M-jobs-Min, 2018.
- [3] T. Gebrehiwet, and H. Luo, "Analysis of delay impact on construction project based on RII and correlation coefficient: Empirical study", Procedia Eng, vol. 196, pp. 366-374, 2017.
- [4] S.A. Assaf, and S. Al-Hejji, "Causes of delay in large construction projects," Int J Proj Manag, vol. 24, no. 4, pp. 349-357, 2006.
- [5] A.S. Faridi, and S.M. El-Sayegh, "Significant factors causing delay in the UAE construction industry," Constr Manag Econ, vol. 24, no. 11, pp. 1167-1176, 2006.
- [6] M.H. Fallahnejad, "Delay causes in Iran gas pipeline projects," Int J Proj Manag, vol. 31, no. 1, pp. 136-146, 2013.
- [7] P. Shahsavand, A. Marefat, and M. Parchamijalal, "Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol," Eng Constr Archit Manag, vol. 25, no. 4, pp. 497-533, 2018.
- [8] S. Sivaprakasam, S. Dinesh, and J. Jayashree, "A review on causes of delay in construction projects", IJSRD, vol. 5, no. 2, pp. 1108-1110, 2017.
- [9] P. Turkar, and M.R. Apte, "Delay causes and importance of corrective actions on them," Int Res J Eng Technol, vol. 3, no. 6, pp. 863-866, 2016.
- [10] M.M. Marzouk, and T.I. El-Rasas, "Analyzing delay causes in Egyptian construction projects," J Adv Res, vol. 5, no. 1, pp. 49-55, 2014.
- [11] C.T. Amoatey, Y.A. Ameyaw, E. Adaku, and S. Famiyeh, "Analysing delay causes and effects in Ghanaian state housing construction projects," Int J Manag Proj Bus, vol. 8, no. 1, pp. 198-214, 2015.
- [12] J.K. Larsen, G.Q. Shen, S.M. Lindhard, and T.D. Brunoe, "Factors affecting schedule delay, cost overrun, and quality level in public construction projects," J Manage Eng, vol. 32, no. 1, pp. 04015032, 2016.
- [13] S. Durdyev, M. Omarov, and S. Ismail, "Causes of delay in residential construction projects in Cambodia," Cogent Eng, vol. 4, no. 1, pp. 1-12, 2017.
- [14] E. Soliman, "Recommendations to mitigate delay causes in Kuwait construction projects," Am J Civ Eng, vol. 5, no. 6, pp. 253-262, 2017.
- [15] J.A. Alsuliman, "Causes of delay in Saudi public construction projects," Alex Eng J, vol. 58, no. 2, pp. 801-808, 2019.

- [16] M.A. Hossain, D. Raiymbekov, A. Nadeem, and J.R. Kim, "Delay causes in Kazakhstan's construction projects and remedial measures," Int J Constr Manag, pp. 1-19, 2019.
- [17] A. Kazaz, S. Ulubeyli, and N.A. Tuncbilekli, "Causes of delays in construction projects in Turkey," J Civ Eng Manag, vol. 18, no. 3, pp. 426-435, 2012.
- [18] J.D. Owolabi, L.M. Amusan, C.O. Oloke, O. Olusanya, P. Tunji-Olayeni, D. Owolabi, and I. Omuh, "Causes and effect of delay on project construction delivery time," Int J Educ Res, vol. 2, no. 4, pp. 197-208, 2014.
- [19] G. Bekr, "Causes of delay in public construction projects in Iraq," Jordan J Civ Eng, vol. 9, no. 2, pp. 149-162, 2015.
- [20] A. Srdić, and J. Šelih, "Delays in construction projects: Causes and mitigation", OTMC, vol. 7, no. 3, pp. 1383-1389, 2015.