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RESEARCH ARTICLE

# The impact of major delay factors on project's phase: A comparative study

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### **Abstract**

Although works have been done in the past to identify the main causes of construction delays and their impacts, there was a gap in the study associated with the project life cycles. The main purpose of this study was to identify the impacts of the main causes of construction delays in projects life cycles defined for this study. With this in mind the major delay factors identified from the review of previous research works of selected countries, including Malaysia, Egypt, Hong Kong, and Jordan categorized into the project life cycle defined for this paper. Subsequently, the aggregate average relative importance was calculated for each phase and it was found that on the average the major delay factors play significant role in planning and design phase. And if the causes of construction delays in this phase can be controlled, it will play an important role in completing construction projects on time.

# Keywords

Project phase; Major factors; Importance index; Delay; Developing countries

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### 1. Introduction

Infrastructure projects in a country are one of the most important criteria for economic growth and development index [1]. And if it is accepted by all stakeholders, a modern construction method that is up-to-date can contribute as much as it needs to Williamson et al. [2]. However, due to its complexity and for various reasons, it is not contributing as much as it should, especially in developing countries. One of the major problems is the lack of completion of construction projects on time, citing research conducted in various countries. As a starting point, a study by Kazaz et al. [3] stated that construction delays are common in developing and newly industrialized countries. According to another study on construction delays,

the industry has been hampered by various causes of construction delays [4]. As a result, unnecessary debates have arisen between construction stakeholders [5]. Numerous other research works have been undertaken in various countries to identify the causes of construction delays and show ways to control them. To reduce the impact of delay factors, the use of life-cycle approach study methods has been common for decades [6]. This is because it is an appropriate for those who need complete construction life cycle information [7]. In addition, it plays an important role in streamlining the causes of construction delays [8].

Many researchers have divided the life cycle of a construction project into different phases. The study conducted by Hu [7] divided the life cycle of

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a construction project into concept and decision phase, design phase, the construction preparation phase, and construction phase. On the other hand, a study by Berawi et al. [8] divided the construction project life cycle into pre-design, design, tendering, construction, and commissioning phases. The main purpose of this study is to compare the impact of the main causes of construction delays in the construction life cycle by dividing the construction life cycle into a pre-project phase, planning and design phase, pre-construction phase, and construction phase.

# 2. Objective of the study

Although a number of studies have been conducted on the failure of construction projects as planned, there is a gap in the study of the impact of major factors into the construction life cycle. The main purpose of this study is to make an in-depth review on previous studies of construction delays and to identify the main causes and to compare their impact on the life cycle of construction projects described for this study.

### 3. Review of previous research works

An in-depth review of previous research works is a way for researchers to identify gaps in research, identify research methods, identify the purpose for which they have been developed, and identify their findings and solutions. With this in mind, an indepth review of previous research works on the causes of construction delays has been carried out.

Marzouk and El-Rasas [9], conducted a study to identify the causes of construction delays in Egyptian construction projects. They divided the 43 factors identified from review of literature into owner, consultant, contractor, material, labor and equipment, project, and external factor groups, and analyzed their impact on delay using frequency index severity index, importance index, and ANOVA. Finally, they noted that finance and payment of completed work by owner, the variation of the order, effect of subsurface condition, low productivity level of labor, ineffective planning and scheduling of the project, difficulties in financing project by the contractor, type of project bidding

and award, shortage of construction material in the market, late in revising and approving design documents by the owner, and unqualified workforce have all contributed to delays in Egyptian construction projects.

Fallahnejad [10], conducted research on the Iranian gas pipe line projects and identified 43 factors related to project delays. He classified the identified causes into client, consultant, contractor, material, external issues, communication, interface, contract, and labor and equipment categories and conducted a questionnaire for construction experts to determine their impact. Finally, after analyzing the response of selected professionals using relative frequency index, relative importance index, and correlation, he noted that imported materials, unrealistic project duration, client-related materials, land expropriation, change orders, contractor selection methods, payment to the contractor, obtaining permits, suppliers, and contractor's cash flow play a key role in delaying the projects.

In a similar study by Doloi et al. [11], analyzed the causes for construction delays in construction projects in India. First, they identified 45 delay causes for the study and categorized into projectrelated. site-related, process-related, humanrelated, authority related, and technical issues factor groups. And then prepared a questionnaire and distributed it to 110 selected samples. After collecting their responses, the impact of each factor was analyzed using factor analysis, regression analysis and relative importance index, and found that lack of commitment, inefficient site management, poor site coordination, improper planning, lack of clarity in project scope, lack of communication, and substandard contract play a significant role.

Kharashi et al. [12], in a study of the causes of construction delays in Saudi Arabia, categorized 112 factors that were found in an in-depth review into client-related, contractor related, consultant related, material related, labor-related contract related, and contractual relation related factor groups. To determine their impact on construction delays, questionnaire prepared and distributed to 200 selected professionals and analyzed their

responses using an average and correlation method. Although there is no agreement between the stakeholders based on the result obtained, a lack of qualified and experienced personnel was reported as the major cause.

Similarly, Assaf and Al-hejji [4] works on identifying the causes of delays in large construction projects. The 73 causes of construction delays identified in an in-depth review were categorized into project, owner, contractor, design, material, equipment, labor, and external factor groups, and a questionnaire was developed to determine their impact on construction delays and distributed to a sample of 66 selected from construction stakeholders. Finally, their responses were analyzed using the frequency index, the severity index, and the relative importance index, and change of order was a major factor in the delay in construction.

Sambasivan and Soon [13], in a study of the causes of delay in the Malaysian construction industry identified 28 causes and analyzed the impact of each factor under client-related, contractor related, consultant related, material related, labor and equipment category, contractrelated, contract relationship-related, and external factor groups. According to the results, contractor's improper contractor's planning, management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage play a significant role.

Faridi et al. [14], conducted a study on the causes of construction delays in the United Arab Emirates and calculated the importance index of various causes of construction delays under contractor, consultant/designer, owner, financial, planning and scheduling, contractual relationship, government regulations, and unforeseen conditions factor groups. As a result, they reported, preparation and approval of drawing, inadequate early planning of the project, slowness of the owner decision making process, shortage of manpower,

poor supervision and poor site management, the productivity of manpower, the skill of manpower, non-availability of materials on time, obtaining a permit from government officials, and financing by contractors during construction were the main factors.

Odeh and Battaineh [15], identified 52 causes of construction delays analyzed their impact on construction delay using relative importance index under client, contractor, consultant, material, labor and equipment, contract, contractual relationship, and external factor groups. According to the results, owner interference, inadequate contractor experience, financingand payments, labor productivity, slow decision making, improper planning, and subcontractors play a significant role.

# 4. Methodology

Although construction project phases are overlapped, four construction phases have been used to assist in this research, taking into account work sequences. The major delay causes identified in the in-depth review were categorized into project life cycles described in accordance with the criteria set out below.

- The first cycle was called a pre-project phase, and involved related factors, identifying the type of business, defining and developing strategic brief, feasibility study, investigating funding options, and feasibility study.
- The second cycle was called planning and design phase, and involved the causes of construction delays related to preparation and approval of design documents, preparation of bill of quantities, and scheduling.
- The third cycle was called the pre-construction phase, and involved the causes of construction delays related to bidding process, planning and scheduling of contractors, site mobilization and availability of site utilities.
- The fourth cycle was called the construction phase, and involved the causes of construction delays related to errors in construction, site management problem, supervision and control issues, and onsite construction material issues.

Next, a comparison of project life cycle was performed by calculating the aggregate impact of major construction delay factors in each project life cycle using the following formula used by Famiyeh et al. [16].

$$Aggregate RII = \sum \frac{RII}{N}$$
 (1)

$$Aggregate\ Mean = \sum \frac{Mean}{N}$$
 (2)

where RII is the relative importance index and N is the total number of delay causes in each phase and different from zero.

# 5. Result

In this section of the study, previous studies related to construction delays selected from five countries namely: Malaysia, Egypt, United Arab Emirates, Hong Kong, and Jordan are identified and reviewed in advance. As a result the ten major causes of construction delays and their impact have been identified. Subsequently, based on the criteria described in the methodology of this study, the major causes and their impacts that have been identified from the stated countries categorized into the four project phases defined for this study. Finally, the aggregate average impact of the construction delay factors in each project phase was calculated, and the results were described in detail in through Tables 1-5 and Figs. 1-5.

As detailed in Table 1, the first column indicates the major delay causes and their reference number for Malaysian construction projects, and the second column indicates the relative importance index of each major delay factors. In addition, the values given in column 3, 4, 5, and 6 in the last row of Table 1 indicates the aggregate impact of major construction delay causes on projects lifecycle in Malaysia. As shown in Fig. 1, the percentage impact of major delay factors in Malaysian construction project is 0% in the pre-project phase, 81.5% in the planning and design phase, 78.3% in the pre-construction phase, and 76.8% in the construction phase.

**Table 1.** Major delay factors and their average relative importance index on project life cycles in the case of the Malaysian construction industry.

Major construction delay factors [13]	RII	Pre- project phase	Planning and Design phase	Pre- construction phase	Construction phase
*Contractor's improper planning	0.815		*(0.815)		
*Contractor's poor site management	0.813				*(0.813)
*Inadequate contractor experience	0.783			*(0.783)	
*Inadequate client's finance and payments for completed work	0.780				*(0.780)
*Problems with subcontractors	0.771				*(0.771)
*Shortage in material	0.771				*(0.771)
*Labor supply	0.757				*(0.757)
*Equipment availability and failure	0.755				*(0.755)
*Lack of communication between parties	0.755				*(0.755)
*Mistakes during the construction stage	0.753				*(0.753)
			0.815	0.783	0.769

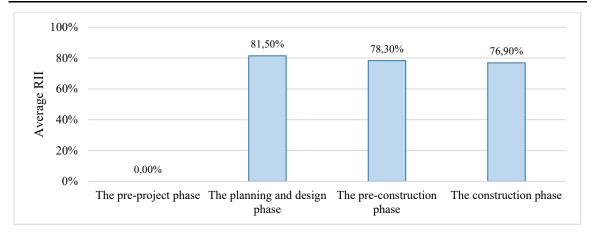


Fig 1. The average relative importance index of major delay factor in the Malaysian construction industry

As detailed in Table 2 below, the first column indicates the major delay causes and their reference number for Egyptian construction projects, and the second column indicates the relative importance index in percent of each major delay factors. In addition, the values given in column 3, 4, 5, and 6 in the last row of Table 2 indicates the aggregate impact of major construction delay causes on projects lifecycle in Malaysia. As shown in Fig. 2, the percentage impact of major delay factors in Egyptian construction project is 0% in the preproject phase, 53.1% in the planning and design phase, 53.27% in the pre-construction phase, and 55.127% in the construction phase.

As detailed in Table 3, the first column indicates the major delay causes and their reference number for UAE construction projects and the second column indicates the average mean of each major delay factors. In addition, the values given in column 3, 4, 5, and 6 in the last row of table 3 indicates the aggregate impact of major construction delay causes on projects lifecycle in UAE. As shown in Fig. 3, the aggregate mean impact of major delay factors in UAE construction project is 0 in the pre-project phase, 2.462 in the planning and design phase, 2.275 in the pre-construction phase, and 2.315 in the construction phase.

As detailed in Table 4, the first column indicates the major delay causes and their reference number for Hong Kong construction projects and the second column indicates the relative importance index of each major delay factors. In addition, the values given in column 3, 4, 5, and 6 in the last row of Table 4 indicates the aggregate relative importance index of major construction delay causes on projects lifecycle in Hong Kong. As shown in Fig. 4, the aggregate relative importance index of major delay factors in Hong Kong construction project is 0% in the pre-project phase, 77.5% in the planning and design phase, 0% in the pre-construction phase, and 77.4% in the construction phase.

As detailed in Table 5, the first column indicates the major delay causes and their reference number for Jordanian construction projects and the second column indicates the relative importance index in percent of each major delay factors. In addition, the values given in column 3, 4, 5, and 6 in the last row of Table 5 indicates the aggregate relative importance index of major construction delay causes on projects lifecycle in Jordan. As shown in Fig. 5, the aggregate relative importance index of major delay factors in Jordanian construction project is 0% in the pre-project phase, 63.93% in the planning and design phase, 59.63% in the prephase. and 53.601% construction in construction phase.

The Fig.6 shows the percentage of the average relative importance index of the identified major delay factors from Malaysia, Egypt, UAE, Hong Kong, and Jordan. On average in all of the countries, the major delay factors have a significant impact on the planning and design phase of the project's life cycles.

**Table 2.** Major delay factors and their average relative importance index on project life cycles in the case of the Egyptian construction industry.

Major construction delay factors [9]	RII (%)	Pre-project phase	Planning and Design phase	Pre-construction phase	Construction phase
*Finance and payments of completed work by the owner	58.40				*(58.4)
*Variation orders/changes of the scope by the owner during construction	56.57				*(56.57)
*Effects of subsurface conditions	56.47				*(56.47)
*Low productivity level of labors	55.61				*(55.61)
*Ineffective planning and scheduling of project	55.36		*(55.36)		
*Difficulties in financing project by the contractor	54.96				*(54.96)
*Type of project bidding and award	53.27			*(53.27)	
*Shortage of construction materials in the market	51.24				*(51.24)
*Late in revising and approving design documents by owner	50.84		*(50.84)		
*Unqualified workforce	48.64				*(48.64)
			53.1	53.27	55.127

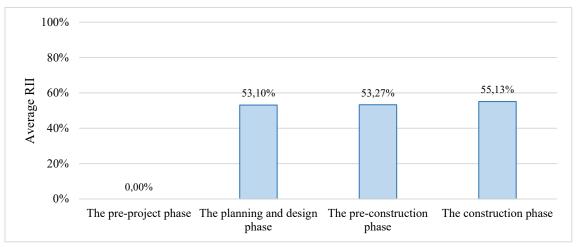


Fig 2. The average relative importance index of major delay factor in the Egyptian construction industry

**Table 3.** Major delay factors and their average relative importance index on project life cycles in the case of the UAE construction industry.

Major construction delay factors [14]	Average mean	Pre-project phase	Planning and Design phase	Pre-construction phase	Construction phase
*Preparation and approval of drawings	2.495		*(2.495)		
*Inadequate early planning of the project	2.429		*(2.429)		
*Slowness of the owner's decision-making process	2.398				*(2.398)
*Shortage of manpower	2.348				*(2.348)
*Poor supervision and poor site management	2.337				*(2.337)
*Productivity of manpower	2.297				*(2.297)
*Skill of manpower	2.281				*(2.281)
*Non-availability of materials on time	2.280				*(2.28)
*Obtaining permit/approval from the municipality/different government authorities	2.275			*(2.275)	
*Financing by the contractor during construction	2.261				*(2.261)
			2.462	2.275	2.315

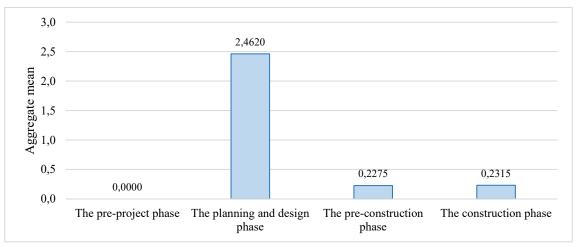


Fig 3. The average relative importance index of major delay factor in the UAE construction industry

**Table 4.** Major delay factors and their average relative importance index on project life cycles in the case of the Hong Kong construction industry.

Major construction delay factors [17]	RII	Pre-project phase	Planning and Design phase	Pre-construction phase	Construction phase
*Poor site management and supervision	0.825				*(0.825)
*Unforeseen ground condition	0.814				*(0.814)
*Delays in design information	0.775		*(0.775)		
*Lack of communication between consultant and contractor	0.774				*(0.774)
*Inadequate contractor experience	0.771				*(0.771)
*Low speed of decision making involving all project teams	0.761				*(0.761)
*Client-initiated variations	0.757				*(0.757)
*Necessary variations of works.	0.756				*(0.756)
*Delays in subcontractors' s work	0.755				*(0.755)
*Improper control over site resource allocation	0.754				*(0.754)
		0	0.775	0	0.774

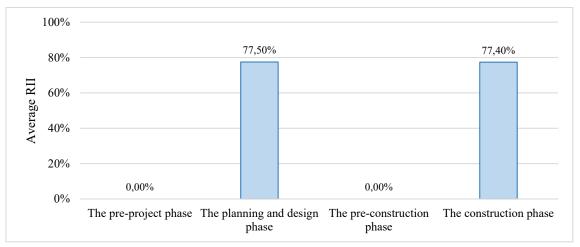


Fig 4. The average relative importance index of major delay factor in the Hong Kong construction industry

**Table 5.** Major delay factors and their average relative importance index on project life cycles in the case of the Jordanian construction industry.

Major construction delay factors[18]	RII (%)	Pre-project phase	Planning and Design phase	Pre-construction phase	Construction phase
*Inadequate management and supervision by the contractor	68.45				*(68.45)
*Client's changes in the design	64.99				*(64.99)
*Inadequate planning and control by the contractor	64.67				
*Using lowest bid that leads to low performance	63.93		*(63.93)		
*Changes in the extent of the project	62.38				*(62.38)
*Errors in design and contract documents	59.63			*(59.63)	
*Progress payments are not made in time by the client	59.35				*(59.35)
*Rework due to mistakes during construction	59.21				*(59.21)
*Changes in the original design	57.8				*(57.8)
* Low-level productivity	56.63				*(56.63)
		0	63.93	59.63	53.601

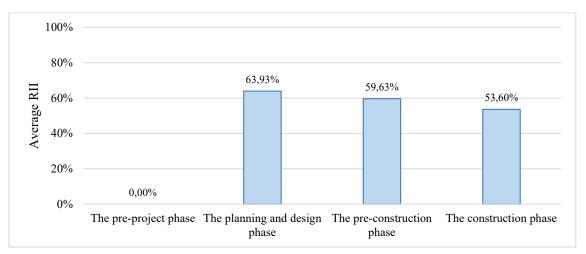


Fig 5. The average relative importance index of major delay factor in the Jordanian construction industry

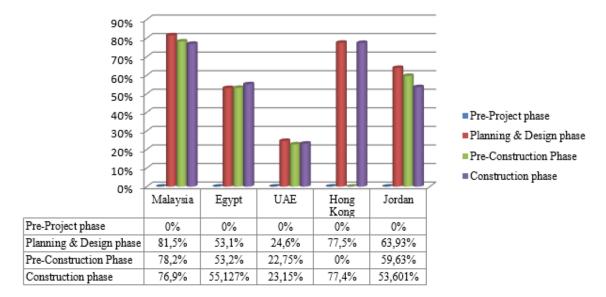


Fig 6. The percentage of the average relative importance index for the selected countries

# 6. Discussion

Based on the methodology part, the major delay factors identified from Malaysia, Egypt, United Arab Emirates, Hong Kong, and Jordan have been assigned to pre-project phase, the planning and design phase, the pre-construction phase, and the construction phase. Next, the impact on each life cycle was calculated using an equation 1 that had previously been used by Famiyeh et al. [16]. On the other hand, the results shown in Figs. 1 and 3, and 4 indicate that from the construction life cycles used in this study, the aggregate impact of the delay causes in the planning and design phase of Malaysia, United Arab Emirates, and Hong Kong is (RII=81.5),(RII=2.42),and (RII=77.5)respectively. This makes it one of the leading phases, and is closely related to the study of Lau and Kong [19]. In a study conducted by Lau and Kong [19] to identify the impacts of five defined constraints on construction life cycles, the three constraints: the economic constraint, the legal constraint, and the environmental constraint have a significant impact on the planning phase. A study conducted by Zwikael [20] in Australia found that paying close attention to this phase can make construction projects more successful and this means that the results of this study are reinforced.

Although, as shown in Fig. 2, in Egyptian construction projects the planning and design phase does not take precedence over the construction phase, it has a comparable impact with construction phase, and as a general result, the planning and design phase is predominant with construction delays.

### 7. Conclusion

As aimed, previously conducted research works have been selected from Malaysia, Egypt, United Arab Emirates, Hong Kong, and Jordan and, the major construction delay factors have identified. Based on the method, the main factors identified were assigned to the pre-project phase, planning and design phase, pre-construction phase, and construction phase, and the average impacts were calculated. As a result, for the selected countries it has been understood that the average impact of the delay factors play significant role in planning and design stage.

# **Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

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