

## DELAY IN CONSTRUCTION PROJECTS IN THE WESTERN PROVINCE OF SAUDI ARABIA: REASONS AND EXTENT

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### ABSTRACT

The main purpose of this study is to identify the primary factors leading to delays in public construction projects in the Western Province of Saudi Arabia and to measure the extent of such delays. Information on 57 delayed projects was available in the official lists of the relevant authorities. Questionnaires were sent to all three parties involved in constructing these projects. Only 32 clients, 30 consultants, and 32 contractors responded to the questionnaire. Based on the responses from the individual and combined perspectives of the three parties, the top 10 most significant delay causes were determined. The extent of delay was found to be severe, about 77% of projects suffered from a delay of up to 50% of the contract duration. According to contractors and owners, 75% of the projects under study were delayed between one month and one year, while this ratio was 70% based on the consultants' answers. The average delay was 13.25 months with a standard deviation of 16.78 months. The findings of the ANOVA testing revealed that the importance indices' means obtained from combined data from the three parties are statistically different. Post Hoc analysis using Scheffe's test revealed that the means of contractors and consultants differed significantly, while the other means were statistically equal at the 0.05 significance level. Based on the main findings, several recommendations were provided.

**KEYWORDS:** *Delay in construction projects, Main causes of delay, Extent of delay, Saudi Arabia.*

## 1. INTRODUCTION

The construction industry is one of the key contributors to any nation's economy. The activities related to this sector are crucial for achieving certain national development objectives. The delay in construction projects is an international phenomenon that affects many countries around the world causing a significant disruption to the countries' economic growth and development.

There is a large body of literature on the subject "projects' delays". The review presented in this section is a systematic literature review oriented to provide thorough coverage of main earlier studies, mainly in the region, that had been published in relation to the causes and extent of delays in construction projects.

### **Causes of delay**

The literature presents long lists of the delay causes in construction projects, for, example, Al-Khalil and Al-Ghafly, (2010) list sixty potential delay causes, Albogamy et al, (2012) identify sixty-three possible reasons for the delay, Bekr, (2015) mentioned that there are sixty-five possible causes compiled through the literature review, Assaf and Al-Hejji, (2006) presented seventy-three possible reasons for delays in construction projects in Saudi Arabia's Eastern Province. The longest list was presented by El-Razek et al (2008) which includes eighty-seven possible causes compiled from the literature. In these studies, the causes include financing problems, shortage or unqualified manpower, design changes by the owners, poor coordination between main and subcontractors, factors related to equipment, environmental factors, causes related to materials, complex rules & regulations, insufficient contractor experience, and ineffective project planning & scheduling by the contractors.

In order to focus on the most significant causes of delay, the top ten most important reasons for time delays in construction projects have been investigated by different studies. The results from six different studies are presented in Table 1. It is well noted from the table that contractors are responsible for the majority of delay causes (This is clear in all studies except Bekr, 2015 study). Similar studies such as Al-Hassan et al., (2018); and Al-Mudhaf et al, (2019) have also identified the top ten reasons for delays in construction projects in their countries. The causes presented in their studies mainly include poor planning, inadequate

resources, inadequate communication, poor coordination between main and sub-contractors, lack of materials, and changes in scope or design. According to Tumi et al, (2009), poor planning was the first reason for project delays in Benghazi followed by a lack of good communication. The third reason was design errors & shortage of material supply. Slow decision-making and financial issues consequently came in fourth and fifth place, respectively.

Rashid et al (2013) conducted a statistical analysis to investigate the important factors that contribute to delays in construction projects. The study's findings showed that factors related to clients, contractors, consultants, equipment, and materials significantly affect delays. While there is little variation in project delay that can be explained by general or labor-related issues. The study also suggests that a mechanism for prompt payments from the client to the contractor, as well as from the contractor to subcontractors, suppliers, and workers, should be developed.

### **Extent of delay**

Seventy percent of construction projects ran over schedule, and 76% of contractors and 56% of consultants reported that they were dealing with an average time overrun of 10 to 30% from the initial schedule, which resulted in a 50% cost overrun (Assaf and Al Hejji, 2006). In the UAE, 50% of construction projects are delayed (Faridi and El-Sayegh, 2006). In Australia, Bromilow (1974), found that the average time of delay in the construction industry surpassed 40% and that only one-eighth of contracts were finished by the anticipated completion. In Saudi Arabia, through the supervision of the Ministry of Housing and Public Works of different public projects, it was found that delayed projects accounted for 70% of the total number of projects executed by local contractors, (Zain Al-Abidien, 1983). Al-Sultan, (1989) compared the actual and planned time span of different types of public projects and came to the conclusion that time overruns occurred on 70% of Saudi Arabia's public projects. Albogamy et al, (2012), mentioned that almost 70% of public sector projects in Saudi Arabia have experienced delays. Al-Khalil & Al-Ghafly, (2010) found that the average delays of projects, as a percentage of the contract duration, were 37% and 84% based on contractors' and consultants' answers respectively. The authors attribute this big discrepancy between these ratios to the reason that the government does not assign consultants to small projects and therefore, the consultants' failure to consider a significant

proportion of small-scale projects that were not subjected to delays. The same study also determined that the average project duration was 39% longer than the agreed contract time.

**Table 1: The top ten causes of delay presented in six different studies.**

<p><b>Albogamy et al, 2012. (Saudi Arabia)</b></p> <ol style="list-style-type: none"> <li>1. Low performance of the lowest bidder contractor in the Government Tendering system.</li> <li>2. Delays in sub-contractors work.</li> <li>3. Poor qualification, skills and experience of the contractor's technical staff.</li> <li>4. Poor planning and scheduling of the project by the contractor.</li> <li>5. Delay in progress payments by the owner.</li> <li>6. Shortage of qualified engineers.</li> <li>7. Delay in preparation of shop drawings</li> <li>8. Cash flow problems faced by the contractor.</li> <li>9. Inadequate early planning of the project.</li> <li>10. Non-utilization of professional construction contractual management.</li> </ol>	<p><b>Bekr, 2015. (Iraq)</b></p> <ol style="list-style-type: none"> <li>1. Security measures.</li> <li>2. Government change of regulations and bureaucracy.</li> <li>3. Official and non-official holidays.</li> <li>4. Low performance of lowest bidder contractors in the government tendering system.</li> <li>5. Design and changes by owner.</li> <li>6. Design changes by consultants.</li> <li>7. Delay in progress payments by the owner.</li> <li>8. Problems with local community.</li> <li>9. Owner's lack of experience in construction.</li> <li>10. Economic local and global conditions.</li> </ol>
<p><b>Al-Khalil &amp; Al-Ghafly, 2010. (Saudi Arabia)</b></p> <ol style="list-style-type: none"> <li>1. Cash flow problems faced by the contractor.</li> <li>2. Difficulties in financing the project by the contractor.</li> <li>3. Difficulties in obtaining work permits.</li> <li>4. Government tendering system requirement of selecting the lowest bidder contractor</li> <li>5. Delay in progress payments by the owner.</li> <li>6. Effects of subsurface conditions (type of soil, utility lines, water table).</li> <li>7. Delay in mobilization.</li> <li>8. Changes in the scope of the project.</li> <li>9. Ineffective planning and scheduling of the project by the contractor.</li> <li>10. Shortage of manpower (skilled, semi-skilled, unskilled labor)</li> </ol>	<p><b>El-Razek et al, 2008. (Egypt)</b></p> <ol style="list-style-type: none"> <li>1. Financing by contractor during construction.</li> <li>2. Delays in contractor's payment by owner.</li> <li>3. Design changes by owner or his agent during construction.</li> <li>4. Partial payments during construction.</li> <li>5. Non-utilization of professional construction/ contractual management.</li> <li>6. Slow delivery of materials.</li> <li>7. Difficulty of coordination between various parties working on the project.</li> <li>8. Slowness of the owner decision making process</li> <li>9. The relationship between different subcontractors' schedules.</li> <li>10. Preparation of shop drawings and material samples</li> </ol>
<p><b>Durdyev et al, 2017. (Cambodia)</b></p> <ol style="list-style-type: none"> <li>1. Lack of experienced construction manager.</li> <li>2. Lowest bidder selection.</li> <li>3. Funding shortage by owner.</li> </ol>	<p><b>Islam et al, 2015. (Bangladesh)</b></p> <ol style="list-style-type: none"> <li>1. The shortage of materials on site.</li> <li>2. Unrealistic project scheduling.</li> <li>3. Late material delivery.</li> <li>4. Shortage of skilled labor.</li> </ol>

4. Lack of proper management.	5. The complexity of the project.
5. Improper planning and scheduling.	6. Labor absenteeism.
6. Lack of skilled workers.	7. Late payment by the owner for completed work.
7. Site constraints.	8. Poor site management.
8. Contractors' cash flow problems during construction.	9. Delay by subcontractor, and
9. Escalation of resources price.	10. Accidents due to poor site safety.
10. Contractors' excessive workload.	

## 2. OBJECTIVES AND METHODOLOGY

Due to the rapid growth in the construction industry in Saudi Arabia and the associated delays, the improvement of public project performance through cost reduction, project completion within the budget, and schedule restrictions is one of the main objectives and policies of the Saudi Arabian government. The Western Province of Saudi Arabia is one of the most rapidly developing regions in the country, with many construction projects underway. Unfortunately, these projects often experience delays due to a variety of factors. As a result, the province is facing increased costs and decreased efficiency in its construction projects. The authors are aware that the delay problem is becoming a rising issue and a significant concern for many private and public authorities. Therefore, the **objectives** of the study are to identify the major causes of delay; to determine the extent of the delay, and to statistically assess the differences of opinion among the three parties involved in the study regarding the importance of causes of delay. It is hoped that achieving these objectives will provide a close picture of the problem and may help decision-makers in the area tackle the problem even partially.

To attain the needed data, a field survey study using a structured questionnaire that is directed to the main three categories of projects' stockholders i.e. the owners, the consulting engineers, and the contractors. The questionnaire was designed to cover mainly the following issues: general information about the respondent and the project, the causes of delay, the frequency and severity of the causes, and the extent of the delay.

This study is limited to the delayed public projects within the five years 2017-2021. The available official lists of the relevant authorities contained information for 57 delayed projects. Questionnaires were sent to the main stakeholders of the entire lists. The data from the respondents were used in the analysis. Figure 1 summarized the methodology adopted in this study.

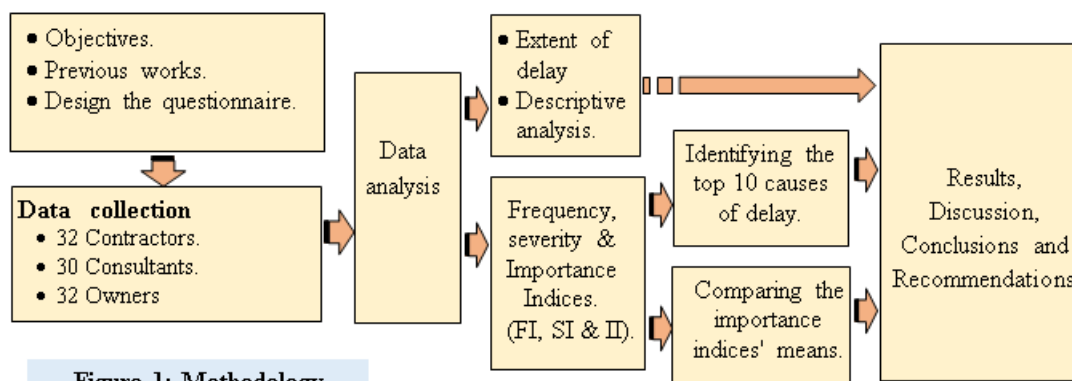


Figure 1: Methodology

## DATA ANALYSIS AND DISCUSSION

A questionnaire with twenty-five most significant causes of delays (shown in Table 2), which were identified from the literature, researchers' expertise, and expert engineers, was sent to the three main stakeholders of the 57 delayed projects that were listed officially in the branches of the Ministry of Municipal, Rural Affairs and Housing in the Western province of KSA. The participants were asked to weigh the frequency and severity of the given causes. Only 32 clients, 30 consultants, and 32 contractors responded. Extracted data were analyzed and presented in the following sections.

### a) The top ten most important causes of delay

The frequency and severity indices ( $FI$ , &  $SI$ ) were calculated, for each cause and for each party involved in the survey, using the following equations.

$$FI = \left[ \frac{(w_1 * n_1) + (w_2 * n_2) + (w_3 * n_3) + (w_4 * n_4)}{N * w_m} \right] * 100$$

$$SI = \left[ \frac{(w_1 * n_1) + (w_2 * n_2) + (w_3 * n_3) + (w_4 * n_4)}{N * w_m} \right] * 100$$

Where:  $w_1$ ,  $w_2$ ,  $w_3$ , and  $w_4$ , are the weights assigned based on Likert scale shown in Table 3.

$n_1$ ,  $n_2$ ,  $n_3$  and  $n_4$  are the frequency of respondents for each weight.

$W_m$  = The highest weight in Likert scale used in the questionnaire

$N$  = Total Number of respondents

Based on the frequency and severity indices, the importance indices were calculated as follows:

$$II (\%) = (FI * SI) / 100$$

**Table 2: List of possible causes of delay considered in the survey.**

Cause No.	Description of the Cause of delay
1	Incomplete or weak studies and design work.
2	The nature of the project, its proximity to vital sites, peak traffic, and the presence of site obstacles (topography, previous infrastructure, etc.).
3	Procedures for obtaining the necessary permits to start the business.
4	The project site overlaps with public or private property.
5	The estimated cost of the project is not sufficiently studied.
6	Delay in financing and disbursement from the owner.
7	Climatic conditions and weather conditions.
8	Seasons such as religious, tourist, and holiday seasons.
9	Corona pandemic.
10	Contractor delay in starting work.
11	The poor financial efficiency of the contractor to run the business.
12	Poor technical efficiency of the contractor, which causes errors in the implementation of the project.
13	Problems between main contracting and subcontractors.
14	A shortage of materials needed for the project, a delay in their supply.
15	Lack of equipment needed for the project and its outdated conditions.
16	Lack of manpower or lack of skilled manpower for the project.
17	The presence of more than one project by the contractor and the inability to manage them with high efficiency negatively affects his performance.
18	Poor planning and poor management of the project-based contractor.
19	Contractor's failure to respond to correspondence and actions taken regarding project work.
20	Penalties for failure to complete the on time in the contracts are useless.
21	Poor coordination of the consultant with related parties (owner-contractor).
22	Slow response from the consultant or the owner to the contractor's inquiries.
23	Delay in approving samples by the consultant or the owner.
24	Delay in receiving the finished parts from the consultant.
25	Poor efficiency of the consultant engineers supervising the project.

**Table 3: Likert scale used to weight the Frequency and Severity of delay causes.**

Description	Frequency scale				Severity scale			
	Not frequent	Sometimes	Often	Always	Not severe	Fairly severe	Severe	Very severe
Weight	1	2	3	4	1	2	3	4

The importance indices were ranked and the top ten causes of delay were determined from two scenarios: individual perspectives of contractors, consultants, and owners, and integrated perspectives for all survey respondents. Results are shown in Table 4. Significant variations in how the three categories of respondents rate the priority of causes were observed, particularly between contractors from one side and owners/consultants on the other side. Comparing the top ten causes ranked by the three categories, it was found that contractors

and consultants shared three causes (Table 4 - a & b), contractors and owners shared one cause (Table 4 - b & c), while consultants-owners shared seven causes (Table 4 - a & c). The low level of sharing similar causes between contractors and the other parties might be attributed to the conflict of interest between these parties.

It was noticed that contractors, consultants, and the consensus ranking all placed "**Corona pandemic**" as the top cause of delay (Table 4- a, b & d). However, this is an infrequent/non-repeated cause. If removed, the top cause of delay according to the consensus ranking would be "**The procedures for obtaining the necessary permits to start the business.**" This might be attributed to the bureaucracy in related agencies that complex procedures of finishing tasks. The list of the obtained top ten causes of delay based on the **consensus** opinion is shown below Table 4.

#### **b) Possible additional reasons for delay**

The questionnaire's final section contained an open-ended question. Participants were asked to use that section, as a platform to discuss any further causes of delays they believe should be considered. Different causes were mentioned but most of those causes were restatements of causes already in the questionnaire. However, two additional causes are worth mentioning here, this includes one cause mentioned by some contractors i.e. corruption among some of the related agencies. Another possible cause was mentioned by some consultants which is awarding some projects to contractors with no experience in a similar field. These possible causes are needed to be considered in future studies.

#### **c) Extent of delay**

Results showed that severe delay in the construction industry exists in the western province of Saudi Arabia, in terms of frequency and duration. About 77 % of projects had delays up to 50% of the contract duration. The mean of delay was found to be 13.25 months with a large standard deviation of 16.78 months. This large variation is attributed to some extreme delay periods, which work as outliers in the data making large variations about the mean. Owners and contractors reported that 75% of projects had delays of one month to one year, while consultants found this ratio to be 70%. Additionally, owners reported that about 19% of projects had delays between 1 to 5 years, and about 6% were delayed for more than 5 years.



When the delays were studied as a percent of the total contract period, it was found that the minimum and maximum percent of delays were 1.7% and 266.7% with a mean of 45.02% and a standard deviation of 47.17%.

#### d) Comparing means

A one-way ANOVA test at a 5% significance level was used to study the equality of means of the importance indices based on the Owners (*O*), Consultants (*Cs*), and Contractors' (*C*) answers. The test was run under the following null and alternative hypotheses.

$$H_0: \mu_o = \mu_c = \mu_{cs}$$

$H_1$ : At least two means are not equal

The results in Table 5 showed that the sig. value was less than 0.05, indicating that there are significant differences between at least two means. The ANOVA test tells us that there are significant differences between at least two means, but it does not state which two means are different. In order to distinguish between means that are equal and those that are not, Post Hoc multiple comparison testing was then conducted. Scheffe's test revealed that the means of contractors and consultants differed significantly, while the other means were statistically equal at the 0.05 significance level as presented in Table 6.

**Table 4(a-d): The top 10 significant causes of delay based on the importance indices (II).**

(a)			(b)		
Consultants			Contractors		
Rank	Cause No. *	II	Rank	Cause No. *	II
1	9	48.1	1	9	54.8
2	20	43.1	2	6	51.5
3	10	39.6	3	3	50.8
4	15	39.3	4	4	47.7
5	3	38.2	5	14	46.7
6	16	37.7	6	2	42.5
7	6	36.5	7	24	40.9
8	11	35.7	8	23	40.5
9	19	35.4	9	21	38.6
10	17	33.9	10	1	38.6
11**	14	31.9	11**	22	38.5

(c)			(d)		
Owners			Consensus opinion		
Rank	Cause No. *	II	Rank	Cause No. *	II
1	18	47.0	1	9	45.0
2	16	42.0	2	3	41.1
3	17	42.0	3	6	40.4
4	11	41.9	4	15	38.1
5	10	40.7	5	16	37.8
6	15	39.0	6	14	36.8
7	12	38.0	7	20	36.5
8	13	38.0	8	17	36.0
9	20	37.4	9	11	35.7
10	3	34.2	10	2	35.6
			11**	10	35.5

\* For the description/name of the cause of the delay, refers to Table 2.

\*\* If cause No. 9 "i.e. Corona pandemic" was ignored, the tenth cause would be as shown in the last rows in the previous tables.

**The top ten causes of delay based on the consensus opinion "Corona pandemic was ignored".**

1. Procedures for obtaining the necessary permits to start the business.
2. Delay in financing and disbursement from the owner.
3. Lack of equipment needed for the project and its outdated conditions.
4. Lack of manpower or lack of skilled manpower for the project.
5. A shortage of materials needed for the project, a delay in their supply.
6. Penalties for failure to complete the on time in the contracts are useless.
7. The presence of more than one project by the contractor and the inability to manage them with high efficiency negatively affects his performance.
8. The poor financial efficiency of the contractor to run the business.
9. The nature of the project, its proximity to vital sites, peak traffic, and the presence of site obstacles (topography, previous infrastructure, etc.).
10. Contractor delay in starting work.

### 3. CONCLUSION AND RECOMMENDATIONS

This study has explored the delay in projects' construction by examining its causes, and extent. The top ten significant causes of delays from the three parties' points of view along with the consensus opinion were presented. The survey respondents agreed that the projects they worked on were delayed significantly. The findings from the ANOVA testing demonstrate that there is statistical inequity between the means of the important indices for the three parties. Post-hoc analysis test showed that the means for contractors and consultants

differed significantly, while the other means were statistically equal. The following recommendations are made based on findings that were primarily reached through the consensus point of view.

1. When the Corona epidemic was ignored, the "**Procedures for getting the essential permits to start the business**" was identified as the first significant source of delay. Therefore, construction unions or any similar agency should give a sound to the relevant agencies to simplify the process of obtaining the needed permits.
2. The owner's "**delay in financing and disbursement**" was the second-most significant factor. To reduce the effect of such a cause, adding explicit articles in bidding documents to regulate/control owner delays should be made.
3. Among the top ten important causes of delay there were six causes related to the contractors. Therefore, the process of selecting the appropriate contractor should be revised/updated and new selection criteria may be added.
4. Some respondents add corruption among certain organizations with ties to the construction industry as a potential cause of delays. This reason has not been found in the literature and should be explored further.

**Table 5: One-way ANOVA regarding Importance Indices (II) Means.**

		Sum of Squares	df	Mean Square	F	Sig.
II	Between Groups	630.970	2	315.485	4.872	.010
	Within Groups	4662.704	72	64.760		
	Total	5293.674	74			

**Table 6: Multiple Comparisons (Scheffe' test).**

Dep. Variable	(I) Owners or Contractors or Consultants	(J) Owners or Contractors or Consultants	Mean Difference (I-J)	Std. Error	Sig.
II	Owners	Contractors	-4.41600	2.27613	.160
		Consultants	2.61200	2.27613	.521
	Contractors	Owners	4.41600	2.27613	.160
		Consultants	7.02800*	2.27613	.011
	Consultants	Owners	-2.61200	2.27613	.521
		Contractors	-7.02800*	2.27613	.011
* The mean difference is significant at the 0.05 level.					

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