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A Study on the Contractor Opinion of Delays in Construction Projects in the Makkah Region- KSA

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Abstract - *A contractors' survey has been conducted to investigate the causes of delay in construction projects in the Makkah region of Saudi Arabia. The aim is to determine the most significant delay factors from the contractors' point of view. The study is part of a series designed to explore in-depth causes of delays from different stakeholders in the construction industry. A comprehensive survey of seventy-three questions under eight groups has been used to explore a wide range of possible delay factors.*

The highest ten factors in frequency relative importance index (RII) are found to be (1) delay in decision-making commensurate with the agreement of the parties to the project (RII = 0.89), (2) unqualified and unskilled workforce; low productivity of labor; hazardous substance (RII = 0.87), (3) suspension of work; change to the project by the owner; delays due to unrealistic enforced contract duration; delay in the approval of submittals, design drawings, shop drawings; lack of design team experience and frequent design errors; delay due to late salary and compensation. (RII = 0.86). Notably, none of these factors are related to the contractor.

In the overall average of the impact index of the whole groups, the highest was the delays due to the owner group (RII Av. = 0.84), followed by delays due to the consultant supervisor and designer (RII Av. = 0.82), followed by delays related to the site (RII Av. = 0.81). The average RII values for the rest of the eight categories are quite close.

The highest overall average frequencies are related to the contractor (RII Av. = 0.71) followed by the labor (Av. RII = 0.70) followed by the consultant supervisor (RII Av. = 66) followed by the owner (RII Av. = 65).

***Key Words*: Delays, Construction Projects, Contractor, Relative importance index, Time overrun, Cost overrun, disputes, litigation.**

1.INTRODUCTION

The Makkah region construction sector has received billions of U.S. dollars from the Saudi Arabia government in mega projects, both super and in recent years. These construction projects have unique features in their magnitude and nature. Construction delay is a significant problem facing the construction industry in Saudi Arabia in general and the Makkah region specifically. It is widespread, and its economic and social impact is often discussed on various levels of authorities.

The Saudi Ministry of Municipal and Rural Affairs (MOMRA) and the Ministry of Transportation acknowledged public construction project delays. They reported that about 75% of the projects exceeded their scheduled time (MOMRA, 2017).

Delays often resulting in time overrun, cost overrun, disputes, litigation, and sometimes complete abandonment of projects (Sambasivan and Soon, 2007). Delays have a direct impact on the expected output and revenues since the contractors are relying on a limited number of projects.

Queries into the causes of delay often evolve disputes and legal actions (Bolton, 1990). Today, many stakeholders in construction are becoming increasingly concerned about the duration of construction projects because of increasing interest rates, inflation, commercial pressures (Nkado, 1995).

Many projects are of such a nature that the client will suffer hardship, expense, or loss of revenue if the work is delayed beyond the time specified in the contract (Clough, 1986). The delay has cost consequences for the contractor standby costs of non-productive workers, supervisors, equipment, expenses caused by disrupted construction and material delivery schedules, and additional overhead expenses (Clough, 1986).

2. OBJECTIVE AND METHODOLOGY

This study is part of a series of studies aiming to identify the major causes of delays of construction projects in the Makkah region of Saudi Arabia based on the opinions of various stakeholders. In this part, the views of contractors have been investigated. This would help to draw a clearer picture of the delay problem facing construction projects and would help decision-makers to build an appropriate strategy to deal with the situation.

A hundred comprehensive questionnaire containing seventy-three possible delay factors has been handed over to various construction projects across the Makkah region. The questionnaire has been constructed following a detailed literature review. The questionnaire was designed to cover the opinions of multiple stakeholders, including the owner, the contractor, the consultant, the subcontractor, the supplier, and others. The response of each stakeholder has been documented separately. In this study, only the contractor responses of twenty-nine contractor firms and personals were investigated and documented. Participants

were first asked to give general information related to their job designation, industry type, total experience in construction in years, the sector/ownership, the size of their company or organization. They were requested to rate each factor of delay on a 5-point scale, of which 5 means the highest effect, and the value 1 is the lowest in both impact and frequency. A hundred questionnaires were distributed by hand, and thirty-six have been received.

3. RELATED STUDIES

Ahmed et al. (2003) grouped delays causes into two categories; internal and external causes. Internal reasons were referring to the stakeholder, such as contractor, client, and consultant). External causes are the causes beyond the control of the parties of the project. These include natural disasters such as hurricanes, floods, earthquakes, inflation, economic recession, and other uncontrollable issues, short of materials and supply.
Bolton (1990) classifies delays in terms of financial compensation as follows:
1. Excusable but non-compensable delay; these are delays caused not by the default of any parties.
2. Compensable delay; these delays result from the owner in case of not comply with the contract condition, such as payment due on time.
3. Inexcusable delay; these delays result from a contractors fault or any parties under his responsibility in the contract agreement these including subcontractors, independent laboratory, rented equipment, and materials supplier.
This review has underscored that the factors causing delay vary from a country to another and from a project to another.

Ogunlana et al. (1996) suggested that there are specific problems that cause delays in construction in developing economies: (a) infrastructure inadequacies, (b) problems related to clients and consultants, and (c) issues related to contractors.

Chalabi and Camp (1984) had established that in developing countries, unskilled labor and lack of management at the early stages of the project were major factors in delay and in the cost overrun in all undertakings.

Hemanta Dolli (2012) construction project in India from the factor analysis, most critical factors of construction delay were identified as (1) lack of commitment; (2) inefficient site management; (3) poor site coordination; (4) improper planning; (5) lack of clarity in project scope; (6) lack of communication; and (7) substandard contract.

Mohammadsoroush Tafazzoli (2017) the most important causes of construction delays in the U.S. Using the relative importance index method, the study shows the values of the 30 factors that effecting delays where the most critical is the results show that excessive change orders and secondly the time-consuming decision processes taken by the owners are the two main factors that have the more excellent value respectively in the importance index.

Borcherding and Garner (1981) using the activity model to evaluate direct work concerning other activities. This study concern mainly with delays caused by labor. The study showed that 42% of the time was direct work, and 68% contribute to delays and supported employment.

Liou and Borcherding (1986) conducted a study to determine the percentage of direct work and delay time and sportive labor for eleven nuclear power plants and four fossil fuel power plants. The data shows the immediate time, delays, and support time was as follows 45 labor sample labor productivity and delay was the only factor in the study. The result of the course showed the following:

	Direct work	delay	Supportive work
Nuclear plant	32.3	50.4	18.3
Fossil fuel	37.7	46.8	15.6

Adrian (1974) developed the MPDM (method productivity Delay Model) based on a cycle time method. The methods used several factors that affect delays and productivity.
The model showed that 50% are delays and supportive work, and only 50% relates to direct employment. The main problem with applying this method; the decision to use the mean of delay cycle and the non-delay cycle is arbitrary because the cut-off points between delays and none delays cycles are undefined and may be applied to limited site construction.

Abdulghafour A. B. (1998) developed the average and distribution model of productivity (ADMP) for sixteen highway tasks in Tennessee, USA. The study aimed to determine the task duration and the causes of delay in highway projects. The result of the survey indicated that the most significant factor is the way of deciding task duration based on experience only. Furthermore, the research collected and analyzed data of 16 highway tasks and select the 95% confidence of task duration using a statistical equation. The approach was to look at delays as a collective of all variables and compute the equation to find the time of tasks. Also, it has been found that delay may have many factors and variables; therefore, they should be examined collectively. Also, the study showed that the contractor dominates most of the delay factors.

Baldwin et al. (1971) study is one of the early studies to present the causes of delays in construction in the USA. They identified seventeen delay factors where the top five were weather, labor supply, subcontractors, design changes, approval of shop drawings, and foundation conditions.

Arditi et al. (1985) conducted a study in Turkey, and twenty three causes of delay were found. Top on their findings was a

shortage of materials, difficulty receiving payments from agencies, contractors' problems in getting loans and credit purchase, and organizational characteristics. Sullivan and Harris (1986) established 19 causes of delays. With waiting for information, variation orders, and ground problems ranked highest.

Sambasivan and Soon (2007) concluded their critical review of the causes of delay by identifying the leading reasons. These include poor planning, poor site management, financial issues, a hold of material delivery, and management problems.

Lim and Mohamed (2000) identified planning (project management) as one of the main problems in construction delays in Malaysia. They ranked lack of experience, lack of site supervision, and lack of appropriate labor skills in this order as the main problems. Sweiss et al. (2008) suggested that the leading causes be grouped into three categories, which are input factors (concerned with labor, material, and equipment), the internal environment (contractor, owner, and consultants), and exogenous factors such as weather and government regulations.

McCord et al. (2015) identified deficiencies in site management, ineffective communication strategies, and a lack of coordination between key stakeholders involved in the construction process as the key findings.

Fallahnejad (2013) concluded that the ten most important causes of delay were; imported materials, unrealistic estimation of project duration, client-related materials, land exploration, change orders, contractor selection methods, payment to the contractor, obtaining permits, suppliers and contractors cash flow.

4. DATA COLLECTION AND ANALYSIS

In this study, a questionnaire has been developed, consisting of seventy- three causes of delay. The questionnaire was organized in the form of an importance scale. Respondents were asked to indicate by ticking a column of the impact and frequency of each of the causes and of construction delay in terms of 5 = very important, 4 = important, 3 = somewhat important, 2 = less important and 1 = not important. A hundred questionnaires were distributed by hand to the contractor in the Makkah region of Saudi Arabia. Twenty-nine forms were filled, received, and processed.
The survey data were grouped into nine significant classifications: owner, consultant designer, supervisor, contractor, material, labor, site, and external factors. A ninth group is left for the participants to add whatever they think of furtherer causes of delay. The groups and various causes of delays are as follows:

1. Delays related to the owner or owner representative
2. Delays related to consultant supervisor.
3. Delays due to designer.
4. Delays due to the contractor.
5. Delays related to material.
6. Delays related to labor.
7. Delays related to the construction site.
8. Delays related to external factors.
9. Other.

Relative importance index (RII)
The relative importance index has been used to identify the importance of the impact of each cause of delay along with the frequency of that cause. The relative importance index (RII) was calculated using the following formula (Fagbenle et al., 2004):

$$RII = \frac{\sum P_i U_i}{N(n)}$$

Where,
RII = relative importance index
Pi = respondents rating of the cause of delay
Ui = number of respondents placing identical weighting/rating on the cause of delay
N = sample size
n = the highest attainable score on the cause of delay

5. RESULTS AND DISCUSSION

The following are the tabulated values of RII for the impact and frequencies of all seventy-three expected delay factors, followed by a discussion of the observed values for each of the eight groups.

Table 1: 1 Delay related to owner or owner representative, impact RII, rank, frequency RII and rank.

1 Delays related to owner or owner representative	Impact RII	Rank	Freq. RII	Rank
Delay in decision-making commensurate with the agreement of the parties to the project	0.89	1	0.78	1
Suspension of work	0.86	2	0.63	8
Delay in revising and approving documents by the owner	0.84	3	0.71	3
Delay in delivering construction site to contractor	0.82	5	0.44	11
Delay of financing and payments by owner	0.84	3	0.76	2
Changes to the project by owner	0.86	2	0.61	9
Re-tendering due to over budget	0.83	4	0.53	10
Unrealistic enforced contract duration	0.86	2	0.67	6

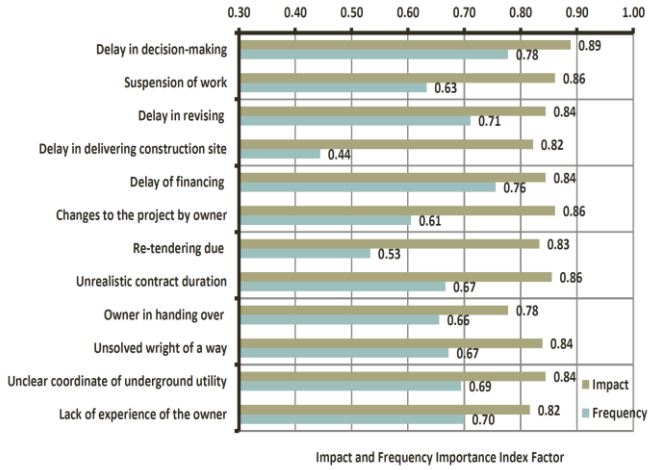


Figure 1: Delays related to the owner or the owner representative, impact, and frequency.

From Table 1 and Figure 1, the delay in decision-making commensurate with the agreement of the parties to the project; the owner occupies the highest relative importance in impact and frequency. Unrealistic enforced contract duration, suspension of works, and changes to the project by the owner rank second in impact but very low in frequency. Delay of financing and payments by owner occupies third importance in impact and second in frequency. Delay in revising and approving documents by the owner comes third in impact and frequency index. Delays due to unclear coordinate of underground utility and delays due to unsolved right-of-way also come third in impact but very low in frequency index. Delay by owner in handing over process or approval of completed work seems insignificant in both impact and frequency. The overall average of the impact is relatively high (RII = 0.79), while the frequency is relatively low in most factors (RII = 0.59).

Also, it has been observed that the values of the RII for impact are close to each other with high costs. These costs indicate the importance of this category from the contractor's perspective.

2 Delays related to Consultant supervisor	Impact RII	Rank	Freq. RII	Rank
Lack of supervisor consultant experience and wrong approval	0.83	2	0.66	4
Delay in approval of submittals, design drawings, shop drawings, and sample materials, etc	0.86	1	0.79	1
Mistakes or discrepancies in documents or specifications issued by consultants	0.79	3	0.68	3
Poor communication and coordination with other parties	0.83	2	0.69	2
Negligence of finishing the work according to the schedule	0.79	3	0.68	3
Average	**0.82**		**0.66**	

Table 2: Delays related to consultant supervisor, impact RII, rank, frequency RII and rank.

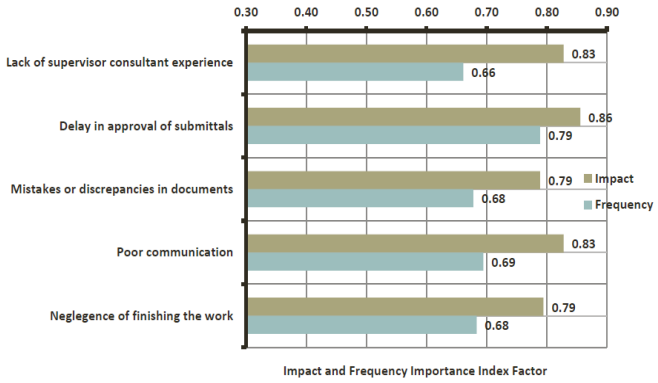


Figure 2: Delays related to consultant supervisor, impact, and frequency RII.

In the group of delays related to consultant supervisor of Table 2 and Figure 2. Delay in approval of submittals, design drawings, shop drawings, sample materials, etc., seems to have significant and the highest RII in impact and frequency. Lack of supervisor consultant experience and wrong approval, poor communication and coordination with other parties, is second in impact. Mistakes or discrepancies in documents or specifications issued by consultants and negligence of finishing the work according to the schedule occupies the third position in impact. Poor communication and coordination with other parties are second in frequency. This is quite interesting since the dominant workers in the construction industry in the Makkah region are foreigners. The overall average impact has a significant impact on RII (RII = 0.82) and relatively low frequency (RII = 0.66). This might be a subjective opinion that needs to be verified with the stakeholders' surveys.

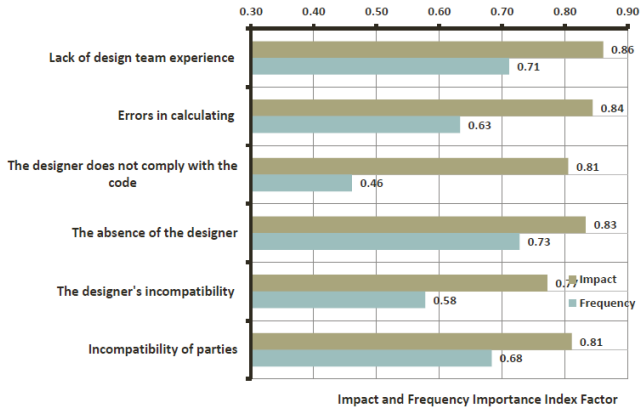


Figure 3: Delays due to designer, their RII impact, and frequency.

In the group of delays related to the designer of Table 3 and Figure 3, delays due to lack of designer experience seem to have significant and the highest RII in impact and second in frequency. Errors in calculating the initial project time are second in impact but fourth in frequency. The absence of the designer while modifying the design or correcting the wrong designs occupies the third position in impact but first in frequency. The overall average of impact has significant

values (RII = 0.82) but not as high in frequency (RII = 0.63). This might be a subjective opinion that needs to be verified with the stakeholders' surveys.

4 Delays due to Contractor	Impact RII	Rank	Freq. RII	Rank
Difficulties in financing the project	0.83	3	0.67	12
Poor management of the	0.83	3	0.82	2
Deficiency in planning and scheduling	0.85	1	0.72	8
Rework due to errors during construction	0.83	3	0.77	5
Delays related to sub-contractor's work	0.84	2	0.84	1
Lack of experience of contractor	0.77	7	0.59	13
Inappropriate construction methods	0.79	6	0.56	15
Poor communication and coordination	0.76	8	0.58	14
Unsafe practice at site	0.79	6	0.78	4
Inadequate Equipment on site	0.69	9	0.76	6
Lack of skilled labor	0.82	4	0.71	9
Lack of technical skilled of project manager	0.84	2	0.67	12
Lack of managerial of skills of project manager	0.81	5	0.78	4
Lack of risk evaluation	0.85	1	0.79	3
Poor estimate of task duration and scheduling	0.82	4	0.78	4
Inadequate training and adapting new techniques	0.79	6	0.74	7
Lack of evaluation in increase and decrease in the schedule periodically	0.82	4	0.77	5
Size of work is more than the resources owned by the contractor	0.79	6	0.68	11
Lack of training	0.76	8	0.70	10
Lack of support from the executive management	0.81	5	0.53	16
Ignoring the sequence suggested by the supervisor and the owner	0.76	8	0.71	9
Average	0.80		0.71	

Table 4: Delays due to the contractor, Impact RII, Rank, Frequency RII and Rank.

Table 4 and Figure 4 contain the delays RII due to the contractor group, including 21 questions regarding delays due to the contractor's performance. Deficiency in planning and scheduling the project and lack of risk evaluations are the highest in impact RII in this group, but not as frequent as other factors. Delays related to subcontractors' works seemed to be the most frequent in this group and second in RII impact. Lack of technical skills of the project manager is also ranking second in impact but very low in frequency index. Difficulties in financing the project, poor management of the site, and rework due to errors during construction occupied the third-highest impact RII. The low estimate of task duration and scheduling ranks fourth most important in both impact and frequency. Lack of skilled labor also ranks fourth in impact but relatively low in frequency. Inadequate equipment on-site, lack of training, and adopting new techniques, ignoring the sequence suggested by the supervisor and the owner, inadequate equipment on site, and poor communication with other parties are low in impact and very low in frequency.

The overall averages of the impact and frequency are relatively high, and they are
(RII = 80) and (RII = 71), respectively. This is interesting since it represents a self-confession of one of the primary stakeholders. However, some items have not been given the expected values. This might be due to the bios opinion on behalf of the contractor.

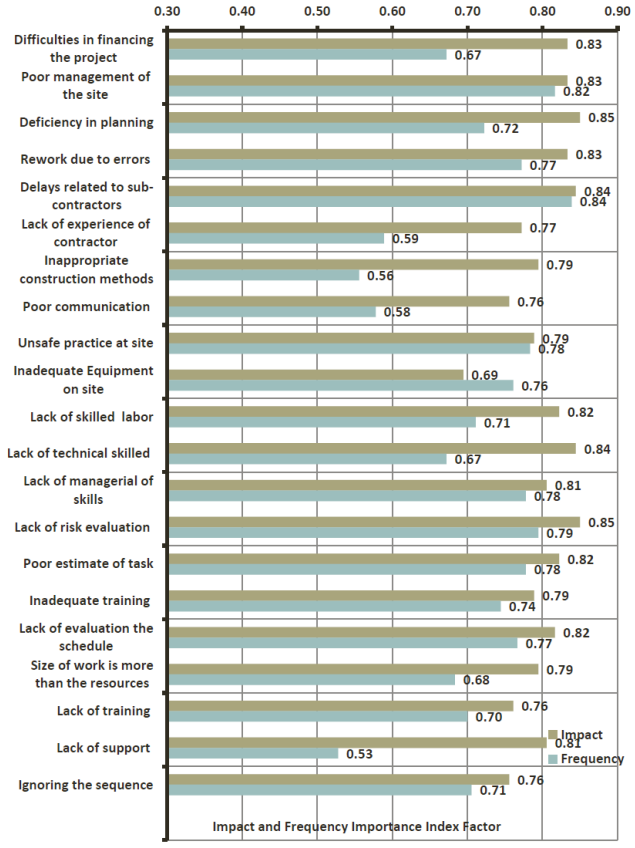


Figure 4: Delays due to the contractor, Impact and Frequency RII

5 Delays related to Material	Impact RII	Rank	Freq. RII	Rank
Rejection of materials that do not meet specifications requirements	0.79	1	0.58	3
Lack of material close the site	0.77	3	0.46	4
Delays due to material delivery	0.79	1	0.64	1
Changes in material types and specifications during construction	0.77	3	0.61	2
Inflation and escalation of material prices	0.78	2	0.64	1
Average	0.79		0.59	

Table 5: Delays related to the material, impact RII, Rank, frequency RII and rank.

In Table 5 and Figure 5, delay factors related to the material are presented. Delay due to materials delivery ranks the highest in both impact and frequency. The rejection of materials that do not meet specifications requirements ranks highest in impact with high RII but third in frequency. Inflation and escalation of material prices are second in impacts but first in frequency. It seems that the overall

impact for the material group is high with (RII = 0.79), while the frequency is relatively low (RII = 0.59).

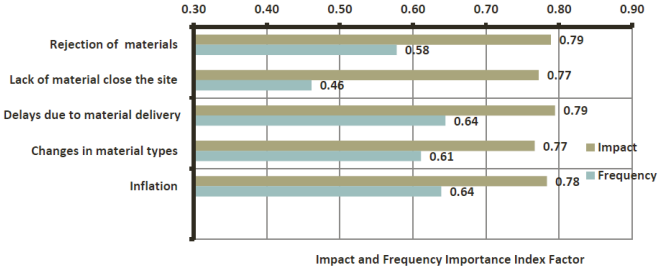


Figure 5: Delays related to the material, impact, and frequency RII.

Delays related to labor impact are presented in Table 6 and Figure 6. Unqualified and unskilled workforce and low productivity of labor seem to be the most significant factor of delay in impact, while workers used for more extended hours ranked highest in frequency but the least in impact. Late of salary and compensation factor ranks second in impact and frequency. Inadequate crew size ranks third in impact and relatively low in frequency. The strike seems to be insignificant for both impact and frequency. The overall average in this group is relatively high in impact and frequency, and they are (RII = 0.80) and (RII= 0.71), respectively.

6 Delays related to Labor	Impact RII	Rank	Freq. RII	Rank
Late start and early finish	0.80	4	0.75	4
Inadequate crew size	0.81	3	0.71	6
Unqualified and unskilled workforce	0.87	1	0.71	6
Low productivity of labor	0.87	1	0.77	3
Strike	0.71	6	0.32	7
Lack of motivation	0.76	5	0.74	5
Late of salary and compensation	0.86	2	0.79	2
Workers used for longer hours	0.51	7	0.81	1
Average	**0.77**		**0.70**	

Table 6: Delays related to Labor Impact RII Rank Freq. RII Rank

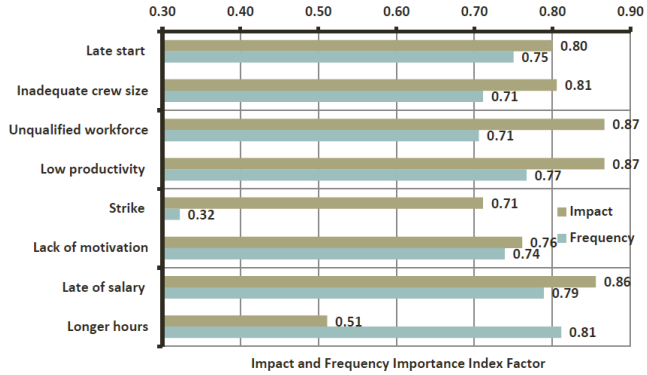


Table 7 and Figure 7 presents delay factors related to the construction site. Hazardous substance occupies the highest rank of importance index in impact with significant value (RII = 0.87) but very low in frequency (RII = 0.44). The inappropriate number of equipment or incompatibility between them comes second in impact but first in frequency. Unforeseen site conditions rank third in impact but relatively low in frequency. The average overall impact is relatively high (RII = 0.81), while the frequency index is relatively low (RII = 0.56).

7 Delays related to Construction site	Impact RII	Rank	Freq. RII	Rank
Lack of equipment or maintenance	0.81	4	0.73	2
Unforeseen site conditions (Unexpected subsurface conditions, e.g., soil, high water table, etc.)	0.82	3	0.52	5
Inappropriate number of equipment or incompatibility between them	0.83	2	0.78	1
Restriction at job site (Poor site access, traffic congestion)	0.81	4	0.53	4
Lack of site utilities or services such as (water, electricity, etc.)	0.79	6	0.44	8
Accident during construction	0.80	5	0.47	6
Problem with nearby structure or facilities (Disturbance to public activities, effect of social and cultural factors)	0.77	7	0.47	6
Hazardous substance	0.87	1	0.44	8
Difficulties on the project site	0.81	4	0.72	3
Security and restrictions	0.79	6	0.46	7
Average	**0.81**		**0.56**	

Table 7: Delays related to the construction site, impact RII, rank, freq. RII and rank.

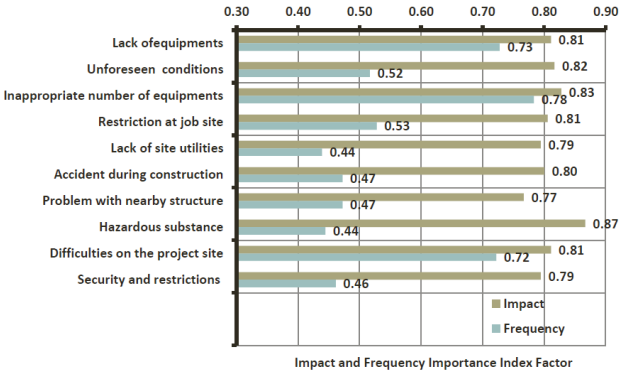


Table 7: Delays related to the construction site, impact, and freq. RII.

Delays related to external factors are summarized in Table 8 and Figure 8. The weather factor occupied the highest rank in impact and frequency. This is highly expected due to the high temperature in Makkah for most of the year. Delay due dispute comes second in impact and frequency. Delaying force majeure is relatively low in both impact and frequency. The overall average in this group is relatively high in impact RII = 0.76 but is very low in frequency, RII = 0.5.

8 Delays related to External factors	Impact RII	Rank	Freq. RII	Rank
Weather factor (heat, flood, etc.)	0.81	1	0.75	1
Changes in government regulations and laws	0.77	3	0.42	4
Delay in performing final inspection and certification by a third party	0.74	5	0.47	3
Global financial crisis	0.76	4	0.42	4
Force Majeure (earthquake, flood, etc.)	0.72	6	0.42	4
Delay due dispute	0.78	2	0.51	2
Average	**0.76**		**0.50**	

Table 8: Delays related to external factors, impact RII, rank, frequency RII and rank.

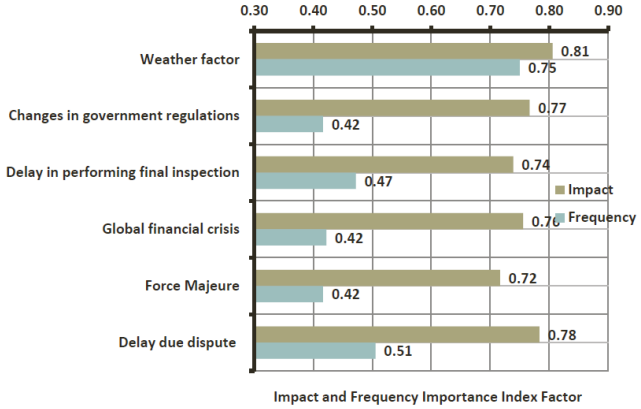
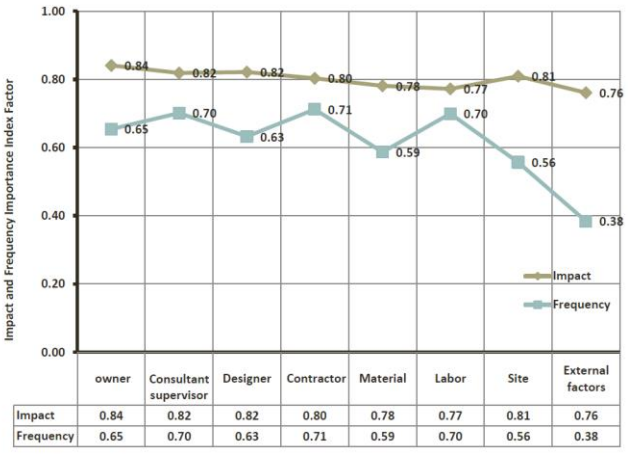


Figure 8: Delays related to external factors, impact, and frequency RII.

Figure 9 shows the average RII for the impact and frequency of the eight categories. It looks from the contractor's point of view that all eight types share relatively high and relatively close values of RII Impact (around 0.8). The highest frequency RII values are around 0.7 for three types: (1) contractor, (2) supervisor, and (3) labor.



	owner	Consultant supervisor	Designer	Contractor	Material	Labor	Site	External factors
Impact	0.84	0.82	0.82	0.80	0.78	0.77	0.81	0.76
Frequency	0.65	0.70	0.63	0.71	0.59	0.70	0.56	0.38

Figure 9: Average RII for the impact and frequency of the eight categories

Table 9 contains the highest-ranking impact RII values for all categories. Notably, the highest three factors in impact are not associated with the contractor. This might be a subjective response that required further investigation through comparisons with other stakeholders' responses.

It is interesting to have the contractor categories occupy the highest frequency of delay. This is highly expected since the contractor is responsible for the execution of the project. Therefore, delays appear directly on his performance, while the owner and consultant indirectly contribute to delays. Also, the category of the contractor contains 21 factors versus 5, 6, or 7 for the others. Some responses in the contractor categories are quite vague, which might inspire conflicting evaluations. However, the contractors' responses to some factors is objective and reliable. Variations in the contractors' survey values may reflect the culture of admitting inadequate performance. Notably, external factors are the least frequent factor of delay.

Rank	Delay Factors	Category	RII
1	Delay in decision-making commensurate with the agreement of the parties to the project	owner	0.89
2	Unqualified and unskilled workforce	labor	0.87
2	Low productivity of labor	labor	0.87
2	Hazardous substance	labor	0.87
3	Suspension of work	owner	0.86
3	Chang to the project by the owner	owner	0.86
3	Delays due to unrealistic enforced contract duration	owner	0.86
3	Delay in approval of submittals, design drawings, shop drawings	consultant supervisor	0.86
3	Lack of design team experience and frequent design errors	consultant designer	0.86
3	Delay due to late salary and compensation.	labor	0.86
4	Delays due to deficiency in planning and scheduling of project	contractor	0.85
4	Delays due to lack of risk evaluation	contractor	0.85

Table 9: The highest individual ranking impact RII values globally.

6. CONCLUSIONS

Following the investigation of contractor survey for seventy-three possible factors causing a delay in construction projects in the Makkah region, Saudi Arabia, the highest ten factors in frequency relative importance index are found to be (1) delay in decision-making commensurate with the agreement of the parties to the project (RII = 0.89) (2) unqualified and unskilled workforce; low productivity of labor; hazardous substance (RII = 0.87) (3) suspension of work; change to the project by the owner; delays due to unrealistic enforced contract duration; delay in the approval of submittals, design drawings, shop drawings; lack of design team experience and frequent design errors; delay due to late salary and compensation (RII = 0.86). Notably, none of these factors are related to the contractor.

In the frequency index, delays related to subcontractors' works rank number 1 (RII = 0.84) followed by poor management of the site and lack of task distribution with frequency (RII = 0.82) followed by workers used for long hours (RII = 81).

In the overall average of the impact index of the whole groups, the highest was the delays due to the owner group (RII Av. = 0.84), followed by delays due to the consultant supervisor (RII Av. = 0.82) and designer (RII Av. = 0.82), followed by delays related to the site (RII Av. = 0.81). The average RII values for the rest of the eight categories are quite close. Although the contractors are represented by 21 factors of delays, it is unexpected to observe that the contractor's category response ranks fifth in the overall

average impact (RII Av. = 80). This could be because the survey represents the contractor's opinion.
The highest overall average frequencies are related to the contractor (RII Av. = 0.71) followed by the labor (Av. RII ≈ 0.7) followed by the consultant supervisor (RII Av. = 66) followed by the owner (RII Av. = 65).

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