

Ranking of Delay Factors for Makkah's Construction Industry

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Abstract. This paper presents identification of significant delay factors encountered by Makkah's construction industry using quantitative approach. A structured questionnaire developed based on literature review was verified through pilot study involved selected construction experts. Questionnaire survey was conducted amongst Makkah construction practitioners include contractors, consultants and project management consultancy. The survey managed to collect 100 valid responses which were used to rank the factors using average index approach. Results of the analysis for 10 most significant factors causing construction delay in Makkah construction industry are Difficulties in financing project by contractor, Poor coordination between parties, Shortage of manpower, Delays in producing design documents, Improper planning and scheduling of the project, Delay in progress payments, Low productivity level of labour, Poor communication between parties, Unqualified workforce and Poor contract management. This finding is helpful to Makkah construction's community particularly projects' stakeholders in avoiding potential delay for their future projects.

1 Introduction

Saudi Arabia experiences rapid construction growth in the past decade both in urban and rural areas [1]. There are many challenges faced by the Saudi Arabia construction industry and one of them is project delay [2]. A study conducted by [3] found that around 70% of all public sector construction projects were delayed due to several factors. Hence, this study focused on construction delay factors encountered in Makkah city development.

2 Literature review

Literature review has shown that there are several studies on identifying factors causing delays in construction projects in many parts of the world which also includes Saudi Arabia. Several articles have identified delay factors in construction projects in numerous manners. Based on these articles, 81 common delay factors to construction projects were

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extracted for the questionnaire formulation. These factors were verified in pilot study to determine its relevancy to Makkah construction. Outcome of the pilot study was only 37 delay factors are considered relevant to Makkah construction environment.

3 Methodology

Data was collected using questionnaire survey from targeted respondents of the construction community in Makkah city. The questionnaire was designed based on the literature review and validated through the pilot study. Respondents were requested to indicate the level of significance on the identified 37 delay factors using a 5-point likert's significance scale. The measurement scale for this research was adopted from [4] i.e. 1 = not significant, 2 = slightly significant, 3 = moderately significant, 4 = significant and 5 = very significant. Questionnaire was distributed to the targeted respondents who are contractors, consultants and project management consultancy (PMC) through site visit and electronic communication. This study managed to secure 100 valid responses from the survey were received back within a stipulated period of one month of data collection.

3.1 Sampling size

Sample size of this study was determined using the following formula [5].

$$SS = \frac{Z^2 \times P (1 - P)}{C^2} \quad (1)$$

where,

SS = Sample Size

Z = Z value (1.96 for 95% confidence level)

P = percentage picking a choice, expressed as a decimal (0.5 used for sample size needed)

C = margin of error (9 %)

$$SS = \frac{1.96^2 \times 0.5 (1 - 0.5)}{0.09^2} = 96.04 \cong \approx 96 \quad (2)$$

Therefore, 100 valid responses used in this study are greater than 96 as minimum samples.

4 Data analysis

The questionnaire form comprises of two parts where the first part is respondents' demographic and the second part is list of delay factors which had been validated by the experts. The demography of the respondents is presented in Table 1.

Table 1 indicates the respondents' demography on their eligibility in giving their expert opinions regarding the delay issues experienced in the construction projects in the city of Makkah. Majority of the respondents are having bachelor degree, working experiences for more than 15 years, holding high position in their company and working in large construction projects.

Table 1. Respondents' demography.

Category	Items	Numbers of respondents	Percentage of respondents
Qualifications	Master	16	16%
	Bachelor	78	78%
	Diploma	6	6%
Working Experience (years)	0-5	16	16%
	06-Oct	32	32%
	Nov-15	33	33%
	16-20	7	7%
	21-25	6	6%
	More than 25	6	6%
Position	Manager	29	29%
	Engineer	60	60%
	Technical Staff	11	11%
Project Contract Amount (Saudi Riyal)	Below SR 10M	3	3%
	SR 10-100M	15	15%
	SR 100M-1B	16	16%
	Above SR 1B	66	66%

4.1 Ranking of delay factors

Before the collected data can be used for further analysis, its stability and consistency were analysed using Cronbach's alpha value. According to [6], if Cronbach alpha value is less than 0.3, the reliability is considered low and data cannot be accepted and if the Cronbach alpha value is more than 0.7 the reliability is considered high. For this research the overall alpha value on the 37 delay factors is 0.942 which consider accepted and reliable. Ranking of the delay factors is based on the average index score of each factor [7]. However, there are possibilities that the factors having same average index score and to resolve this is by introducing standard deviation attained by each factor. Standard deviation (SD) is the amount of variation or dispersion of a set of data values and when SD value is close to 0 it indicates that the data points tend to be very close to the mean (also called the expected value) of the set. Hence this study used two parameters that are average index score and SD to decide the rank of the delay factors. If the factor's average index score is at tie with other factor, then factor with smaller standard deviation should be adjusted for higher ranking. In this case, average index and standard deviation of 37 delay factors was calculated where the average index (AI) values are in the range of 3.98 to 2.79. It was found that 5 sets of factors are at tie ranks (i.e. at numbers 13, 17, 22, 26 and 29) and was resolved by using standard deviation where the ranks of the factors are adjusted accordingly. Results of ranking analysis show 10 most significant factors causing construction delay based on 100 valid responses from experts of Makkah construction industry are presented in Table 2.

The significant delay factors in Table 2 are elaborated in more details in accordance to previous researchers who had carried out similar research in different parts of Saudi Arabia construction industry and also Nashwan Al-Emad's experiences who is working in Makkah city as civil engineer.

Table 2. 10 Most significant factors causing construction delay

Code	Construction Delay Factors	AI	SD	Ranking
F26	Difficulties in financing project by contractor	3.98	1.223	1
F17	Poor coordination between parties	3.83	1.025	2
F33	Shortage of manpower	3.80	1.110	3
F6	Delays in producing design documents	3.75	0.989	4
F3	Improper planning and scheduling of the project	3.72	1.215	5
F27	Delay in progress payments	3.70	1.202	6
F35	Low productivity level of labour	3.67	1.045	7
F18	Poor communication between parties	3.66	0.997	8
F34	Unqualified workforce	3.59	1.147	9
F2	Poor contract management	3.56	1.157	10

4.1.1 Difficulties in financing project by contractor

Difficulty in financing project by contractor is considered as the most significant contributor to construction delay in Makkah city as ranked by all parties with highest average index score of 3.98. Nevertheless, this factor is certainly true for contractors where they are required to start the work once been awarded and requires initial adequate finance for that matter before the payment from the clients can be disbursed. Availability of cash flow is very important for a contractor to carry out the construction activities. Also, most of the main contractors outsource their works to sub-contractors, the failure for contractor to pay to sub-contractors on time resulting in slowing down the progress of the work due to reduce number of workers hired by sub-contractors and un-availability of construction materials. Hence, adequate cash flow and financial stability of contractors is very important in keeping construction progress as planned. This finding concurrently matches with the findings carried out in different parts of Saudi Arabia construction industry by [3, 7-12].

4.1.2 Poor coordination between parties

Poor coordination between parties was ranked as the 2nd significant factor causing construction delay with average index value 3.83 and standard deviation value is 1.025. Coordination is important within multi-participant environment as in most construction projects implementing in Makkah city. First attribute under this factor includes ineffective coordination among construction parties (Client, Consultant, Contractor and stakeholders), lack of coordination between design team and main contractor, lack of coordination between general contractor and subcontractors and also, ineffective coordination among the contractors' departments. Second attribute related to poor coordination is at design phase between client, stakeholders etc. can lead to serious project delay and is subjected to variation claims by the Contractor, also, non -availability of drawings on time is generally due to lack of coordination between construction site and design office. To prevent this problem, a proper coordination system between project parties should be established to increase the project performance. This result is in line with the results found in Saudi Arabia construction industry done by [13].

4.1.3 Shortage of manpower

Shortage of manpower factor is ranked as the 3rd most significant contributor to construction delay with average index score of 3.80 and standard deviation value is 1.110. Other research works related to Saudi Arabia construction industry [3, 7, 10, 12] also found that shortage of manpower as an important causes of delay in construction. This is certainly true for Saudi Arabia where the locals are not willing to work on construction site. This has resulted to contractors importing labour and therefore reducing their ability to judge the level of skill of their employees. Thus, the quality of labour available is generally quite poor, which leads to low productivity and poor quality of work consequently time delay will be experienced which affects the overall project schedule.

4.1.4 Delays in producing design documents

Delay in producing design documents is the 4th major factor contributing to construction delay in Makkah construction projects with average index score of 3.75 and standard deviation value is 0.989. Poor design and delays in design documents are a common problem that occurs in construction projects. Knowledge and well experience of the designer to all materials, equipment and project specifications is an important attribute for developing a comprehensive design documents system. Besides that, time limitation given to designers during design phase occasionally force the designer to wrap up the necessary design works at a lower quality. If inadequate time is given, the design cannot be developed in a proper manner. This may eventually cause misunderstandings between construction players working on the project. This will automatically give negative effect to projects schedule.

4.1.5 Improper planning and scheduling of the project

In this study improper planning and scheduling of the project was indicated as one of the significant factor causing construction delay in Makkah city. It has an average index value 3.72 and standard deviation value is 0.1215. Effective planning and scheduling plays a very important role in success of any project. Results of this survey ranked ineffective planning and scheduling of the project as the 5th significant cause of construction delay. Previous researcher e.g., [3, 8, 9, 12, 14] also conducted a research works in different parts of Saudi Arabia and has determined inadequate planning and scheduling of projects as one of the most important causes of project delay. This problem can be overcome by implementing techniques for managing projects with planning and scheduling software packages, as well as contractors should establish a dedicated team for planning, follow-up the progress of the work in daily basis and pending issues.

4.1.6 Delay in progress payments

This the 6th significant factor found by this research with average index and standard deviation values of 3.70 and 1.202 respectively. Progress payment delay is probably the most common source of construction disputes among parties involved. Failure to provide steady monthly progress payment by owner to main contractor will cause work progress delay because there is inadequate cash flow to support construction expenses especially for those contractors who are not financially sound. To reduce this dispute cause, owners should pay progress payment on time and contractors should manage their financial resources and plan cash flow by utilizing progress payment efficiently and effectively. This result in line with the results found by [3, 8, 9, 10, 13, 14] in several parts of Saudi Arabia.

4.1.7 Low productivity level of labour

Low productivity of labour is certainly affecting the activities duration and consequently the total project duration. This factor ranked as the 7th significant factor causing construction delay with average index score 3.670 and standard deviation value 1.045. Low productivity of the labours could be due to several factors including non-availability of materials, tools and equipment, unskilled manpower hired and also labours are not receiving their salaries on time. This has an adverse impact on the project progress. To overcome this problem, it should hire skilled manpower and provide sufficient construction tools and equipment in order to improve and achieve productivity level. This result is in line with the results carried out in Saudi Arabia construction industry by [3, 7, 13].

4.1.8 Poor communication between parties

Poor communication between parties is ranked as the 8th most significant factor contributing to construction delay with average index value 3.66 and standard deviation value is 0.997. Since there are many parties involved in the project (client, consultant, and contractor) then communication between these parties is very important for project success. This problem invariably leads to rework, and then project will experience delay. Hence, in order to reduce the risk of project delay, it is imperative to establish proper formal communication channels among all project parties during all project phases. This result supported by [8] in his study conducted in the northern part of Saudi Arabia.

4.1.9 Unqualified workforce

In this study, unqualified workforce is indicated as one of the significant contributors to the construction delay in Makkah city with average index score 3.59 and standard deviation value 1.147. Normally, project could experience less progress due to lack of adequate numbers of skilled labour. It will encounter improper execution or rework and this will leads to delay of construction activities and consequently time delay will be experienced. This findings match with the result found by [7, 8, 10] in Saudi Arabia construction industry.

4.1.10 Poor contract management

Poor contract management was ranked by all respondents as the 10th factor causing construction delay with average index and standard deviation values 3.56 and 1.157 respectively. Competence and professionalism of project team plays a key role to a successful project and to prevent the project from facing construction delay. Poor contract management is usually caused by lack of management skills and shortage of professional experts among the project practitioners. As a result of poor contractual skills, the project could experience negative effects to duration of project .This finding in line with the finding found by [7, 9].

5 Conclusions

This paper has presented a descriptive analysis to determine the ranking of delay factors faced by Makkah's construction industry. A total of 37 delay factors were analysed using average index approach and found that 10 most significant factors causing construction delay in Makkah construction industry are Difficulties in financing project by contractor,

Poor coordination between parties, Shortage of manpower, Delays in producing design documents, Improper planning and scheduling of the project, Delay in progress payments, Low productivity level of labour, Poor communication between parties, Unqualified workforce and Poor contract management. It hoped that, these findings will help the authority, researchers and construction players (contractor, consultant and client) to minimize any potential delays occurred in construction industry.

6 Recommendations

Based on the outcome of this study, all Makkah construction practitioners should consider the following points in order to minimize and control construction delays:

- i) Contractor should manage his financial resources and plan cash flow by utilizing progress payment effectively and efficiently to avoid any disruption of the project's progress financially.
- ii) Client should pay progress payment to the contractor on time to enable the contractor to finance the project.
- iii) Proper coordination system between project parties should be established to increase the project performance.
- iv) Contractor should establish a dedicated team for planning, follow-up the progress of the work in daily basis and pending issues.
- v) It is imperative to establish proper formal communication channels among all project parties throughout project lifecycle.
- vi) Contractor should hire competences and professionalism to his organization in order to prevent the project from facing construction delay.
- vii) Contractor should hire enough number of skilled labours and motivate them to improve productivity of construction activities.
- viii) Producing design documents should be on time, otherwise delay in producing design document will affect slowness of site executions.

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