

Causes of Delay on Large Building Projects in Qatar

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Abstract— The construction industry is of high importance to the economy of most countries. However, it is notorious for projects overrunning time and cost. Several studies have been conducted to define causes of delay in completing construction projects. This research has employed a wide variety of analytical methods to conclude the most precise statistical ranking of causes of delay. Moreover, the delays for construction projects differ from one country to another and even between types of project within the same geographic location. The aim of this study is focused on identifying the causes of delays in large building projects in Qatar. A comprehensive literature review was carried out in neighbouring Gulf countries. The causes of delays are identified from literature and assessed in exploratory interviews with industry experts in Qatar to investigate the relevance of each cause. A survey questionnaire was prepared and was subject to pilot interviews prior to issuing it to practitioners, including clients, consultants, and contractor organisations. Results reveal that the top five factors causing delay to large building projects are: slow decision-making; discrepancies between specifications and drawings; major changes in design during construction; delay in the settlement of contractor claims; and unreasonable project time frames.

Index Terms— Construction Management, Delay Causes, Project Management.

I. INTRODUCTION

PROJECTS in many industries fail to achieve their goals. The construction sector is one business that is notorious for continuous failures to meet time and budget constraints. Whilst, construction is a major contributor to economies across the globe, it can be a source of waste of scarce resources. The effect of construction contribution to economies depends on levels of development in countries; where there are higher levels of development, the lower the construction contribution to economic growth. Some parts of the world are currently undertaking massive developments such as Gulf Cooperation Council (GCC) countries, where lots

of construction activity is progressing and planned for the future in fields such as infrastructure, housing and oil and gas. Qatar is a good example of building projects booming due to several factors such as the award of the FIFA World Cup and the National Development Strategy contained in Qatar's National Vision 2030. Construction for the World Cup involves massive projects related to stadia, hotels, infrastructure, and transport systems. It has been announced that \$205 billion investments are planned for five years i.e. between 2015 and 2020. This considerable investment in construction projects requires that there is an understanding of challenges by analysing historical reasons for delay and by investigating earlier projects in order to plan to avoid such causes.

In this study, it is intended to investigate the causes of delay in building projects which are a considerable share of construction activities within Qatar in particular and GCC countries in general. The objectives of this research are to: (1) understand the factors that contribute to building project delays in GCC countries and in particular to those related to Qatar; (2) examine and validate the importance of these factors in Qatar's context; (3) propose changes that can reduce the effect of the most significant factors to delay on future projects; and (4) recommend a future research roadmap to enhance project management of construction projects.

II. LITERATURE REVIEW

The systematic quantitative literature review results showing a number of studies in each country are mapped with project types in Table 1. It was found that four studies investigated contributors to building project delay. In this section relevant studies are going to be explored; for a comprehensive literature survey of delay causes in GCC countries, refer to the work by Emam *et al.*¹.

Building projects have been subject to numerous studies within GCC countries due to the increase in volume of work. It was found that four studies with a particular focus on building projects in Kuwait, Qatar and Saudi Arabia were conducted. The country with the most studies in relation to building projects is Kuwait with two studies (Al-Tabtabai²; Koushki *et al.*³). Al-Tabtabai² dedicated his study to governmental building and housing projects in Kuwait. The study identified 53 causes of delays; the significances of causes were investigated by conducting an on-line survey questionnaire with 48 participants. Surveyed results were analysed using

Manuscript received June 15, 2015.

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relative importance which suggested that delays are attributable to poor project management, client administration and bad site supervision practices. Koushki et al.³ studied reasons for delay on private residential buildings in Kuwait. The study used a qualitative approach where 450 personal interviews were conducted with owners of private housing projects. The study concluded that three major factors contribute to delay on this particular type of project thus: lack of owner experience, financial constraints, and changes to design requirements and specifications.

In the context of Qatar, Jurf and Beheiry⁴ studied delay contributors to residential compound projects. These complex projects have a specific nature of repetitive typical units. The study was conducted by surveying 20 industry experts and the collected data were analysed using relative importance to identify factors influencing schedule and cost at different project phases. The conclusions on causes of time over-run were delay in material deliveries, design changes, labour unavailability, and inaccurate estimates at tenders.

TABLE 1 RESULTS OF QUANTITATIVE LITERATURE REVIEW (EMAM ET AL.¹)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total
Buildings	-	2	-	1	1	-	4
Construction	-	-	1	-	4	3	8
Oil & Gas	-	-	1	-	1	1	3
Pipeline	-	-	-	-	1	-	1
Road	1	-	-	-	-	-	1
Infrastructure	-	-	-	-	-	1	1
Total	1	2	2	1	7	5	18

Assaf et al.⁵ explored causes of delays on large building projects in the Eastern Province of Saudi Arabia. The study identified 53 causes of delay and used them to administer a survey to 48 participants representing owners, consultants and contractors. Responses were analysed using relative importance and rank agreement. The results showed a high degree of agreement between contractors and consultants and lower level of agreement with owners. The most significant factors influencing project delays were found to be: shop drawings preparation and approval processes, poor progress of contractors, late payment by owners, and negative cash flow during construction phases.

III. METHODOLOGY

This study follows a mixed research method; it blends qualitative and quantitative techniques to validate outcomes. The first stage in achieving the objectives of the study comprised an in-depth literature review for neighbouring countries that have similar characteristics to Qatar. In order to ensure a comprehensive survey of literature, it was decided to adopt the systematic literature review methodology developed by Pickering and Jason⁶. The methods commence by

identifying search keywords that are then executed in numerous scientific databases. The search results are filtered for their relevance to the study. Related studies are used to determine additional resources that were not found by keywords combinations from the first search. Other keywords are identified from the found papers and applied to search databases. This process iterates until no further studies are found. Relevant papers are reviewed and critically evaluated; process illustration is shown in Figure 1.

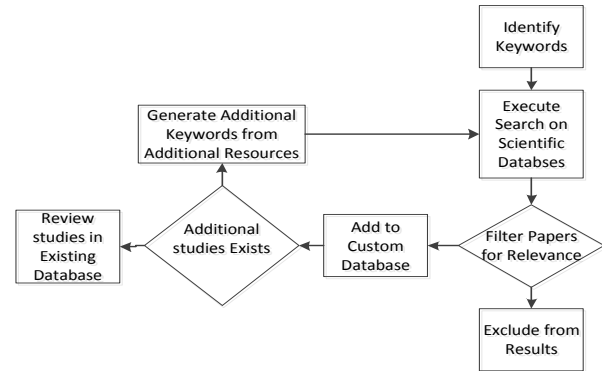


Fig. 1. Systematic Literature review inspired from Pickering and Jason⁶.

The literature review identified causes of delays to construction projects in similar studies conducted in neighbouring countries. These defined reasons for delay were used for investigating their relevance to Qatar by means of semi-structured interviews with four construction professionals. The qualitative method was selected to validate defined causes of delay and their importance to Qatar to gain more in-depth explanation and additional factors that are limited to Qatar. Upon the validation of contributors to construction delays, an on-line survey questionnaire was administered to construction professionals involved in building projects within Qatar. The survey was sent to a random sample of 190 construction professionals; 31 people completed the survey with a response rate of 16.3%. It is acknowledged that client representation within the sample is limited, and does not allow divergence to population means.

TABLE 2 PARTICIPANTS' DISTRIBUTION

	Client	Consultant	Contractor	Overall
Participants	2	9	20	31
Percentage returned	6.5%	29.0%	64.5%	16.3%

A. Survey Design

The survey was designed in two main parts. The first part collected personal, professional and project information about participants. The gathered information provides an understanding of the participants as the location of the organisation in relation to the supply chain, the seniority level within the organisation, and their experience. The project related section collects data on the size of the project, procurement arrangement, contractual agreement, and project

type. The second part of the survey targets obtaining frequency and severity information from participants about 88 identified causes of delay in Qatar. Factors were clustered into four different groups to corresponding sources of delay i.e. contractors, consultants, clients, and external factors. The frequency is measured in the second part by means of a Likert-scale with the possible selections: always coded as 4, often 3, sometimes 3, rarely 1 and never 0. Meanwhile, the severity information is obtained by impact scale with the following choices; very high coded as 4, high 3, moderate 2, low 1, and very low 0.

B. Data Analysis

The statistical survey analysis technique and indices used in this study were severity index, frequency index and importance index as follows:

Frequency and severity indices formulas are used for the purpose of ranking causes of delays based on their frequency as selected by participants

$$(F.I.)(\%) = \sum a \left(\frac{n}{N} \right) * \left(\frac{100}{4} \right) \quad (1)$$

$$(S.I.)(\%) = \sum a \left(\frac{n}{N} \right) * \left(\frac{100}{4} \right) \quad (2)$$

where 'a' is, the constant expressing weighting given to each response (ranges from 0 to 4), 'n' is the frequency of the responses, and 'N' is total number of responses. The relative importance index of each individual cause is calculated from the result of multiplying the frequency index (1) and severity index (2) as shown in formula (3).

$$(IMP.I)(\%) = \frac{(F.I.)(\%)*(S.I.)(\%)}{100} \quad (3)$$

C. Rank Correlation

The Spearman's rank correlation is used to measure the level of agreement or disagreement of each two parties based on the importance index. The used formula Eq. (4) shows the calculation method of the correlation factor.

$$r_s = 1 - \left[6 * \sum \frac{d^2}{(n^2 - n)} \right] \quad (4)$$

where 'rs' is Spearman's rank correlation coefficient between two parties; 'd' is the difference in rank assigned to variables of each cause; n is the number of ranks.

IV. RESULTS AND DISCUSSION

The on-line questionnaire responses were analysed and results are reported in this section. Causes of delay are grouped into four categories according to attributable source i.e. clients, consultants, contractors, and external factors.

The primary factors due to contractors are improper technical study during bidding, delay in materials delivery and changes to material specifications. These factors were

discussed with construction experts during interviews to gain in-depth understanding. It was stated that due to time constraints during tender stages, contractors tend to carry out rough estimates based on previous experiences within Qatar. This might lead to unexpected conditions that were overlooked during tender stages such as ground conditions, underground water levels, and unconsidered complexity in executing tasks that were considered typical during the estimation phase. The consequences of inadequate technical studies are underestimated schedule provisions and unavailability of required resources for performing works. Subsequently, this will contribute to interrupted project activities, failure to arrange proper resources or will result in elongated durations for scheduled tasks. Materials delivery delays were argued to be attributable to two main causes thus; limited port capacity in Doha, and lack of local manufacturing facilities which compels suppliers to purchase materials from abroad. The last factor of delay associated with contractors is deviating from materials specification where alternatives are proposed for several reasons including cost savings, value engineering and immediate availability of substitutes. According to experts, often these deviations involve extended periods of approvals that lead to losing time even in case of local availability. Whilst these factors are of high importance, they are ranked of lower urgency than those of consultants and clients.

TABLE 3: TOP CONTRACTOR FACTORS CAUSING DELAY

Description	Frequency %	Impact %	RII %	Overall Rank
Improper technical study during the bidding stage	0.70	0.81	0.57	7
Delay in materials delivery	0.69	0.81	0.56	10
Changes in materials specifications	0.67	0.81	0.55	12

Consultants were criticised for causing project delays with a considerable emphasis on their contributions to design components such as discrepancies between specifications and drawings, changes to design during construction stages, and delay in solving design problems. Lack of coordinated designs was considered the factor of highest influence to project delay by designers. These discrepancies were argued to be resultant of geographic spread of designers in different offices around the world. In addition, there was slow adoption of new collaboration tools such as building information modelling (BIM) as reported by Ahmed et al.⁷ in a survey conducted on barriers and usages of this technology in Qatar. Interviewees stressed that changes in construction projects are inevitable but the timing of these changes cause undesirable impacts such as schedule over-runs and budget excesses. There is a correlation between discrepancies and design changes along with owners' limited knowledge of construction. The third cause of delay by designers is slow resolution of design problems. Interviewed professionals emphasised the possibility to mitigate effects of design coordination by using the state-of-art technologies for communication and collaboration such as BIM.

TABLE 4: TOP CONSULTANT FACTORS CAUSING DELAY

Description	Frequency %	Impact %	RII %	Overall Rank
Discrepancies between specifications and drawings prepared	0.76	0.83	0.63	2
Major change of design during construction	0.71	0.88	0.62	3
Delay in solving design problems	0.71	0.80	0.57	8

Survey participants ranked three factors attributable to clients from the top ten factors causing delay to construction project completion. These factors are commercial and planning aspects of projects. The top clients' contributor is slow decision-making; this is linked to bureaucratic processes of decision-making which is due to lack of delegation and evading decision-making and associated accountabilities to individuals. Interview participants emphasised the consequence of the deliberate postponement of claims resolutions to the back-end of projects. These determinations are usually subject to amicable settlement as a part of a 'deal' at project completion. Unreasonable project durations were reinforced as a re-occurring issue across different developers in Qatar. The time frames are set to be considerably less than reasonable length to complete works. Contractors participate in tenders and submit offers knowing that completion dates will not be met and depend upon extension of time and completion claims to avoid penalties associated with late project handovers.

TABLE 5: TOP CLIENT FACTORS CAUSING DELAY

Description	Frequency %	Impact %	RII %	Overall Rank
Slow decision-making	0.73	0.87	0.63	1
Delay in the settlement of contractor claims	0.73	0.82	0.60	4
Unreasonable project time frame	0.69	0.85	0.59	5

A. Groups Ranking

The four main groups were ranked to identify influences of groups to delaying projects. It was observed that consultants related causes were ranked as the highest influence to delaying projects completion. This is attributable to dependencies on design activities and their subsequent knock-on effect on succeeding tasks such as procurement and construction.

TABLE 6: GROUPS RANKING

Group	RII	Rank
Consultant Delays	0.44	1
Client Causes	0.43	2
Contractors Delay	0.36	3
External	0.28	4

Client related causes group was ranked second due to the significance of financing, cash flow and decision-making. These are inter-related to procuring materials and ability to

paying suppliers and subcontractors to ensure works' continuity.

The second section of the survey was divided into 15 categories of questions. These categories were ranked and results support design importance discussion. The categories and their ranking are reported in Table 7.

TABLE 7: CATEGORIES RANKS

Categories	RII	Rank
Consultant Design	0.54	1
Government Related	0.48	2
Client Finance	0.43	3
Client Contract	0.43	4
Reviews and Approvals	0.43	5
Client Management	0.42	6
Contractor Material	0.39	7
Contractor's Management	0.39	8
Contractor Manpower	0.38	9
Consultant Management	0.36	10
Consultant Personnel	0.36	11
Contractor Finance	0.34	12
Site Conditions	0.25	13
General	0.19	14
Equipment	0.17	15

B. Rank Agreement

Rank correlation using Spearman's correlation test was conducted to explore the level of agreements between stakeholders on categories of delay causes. The reported results in Table 8, shows a high level of agreement between clients and consultants. However, investigating correlations between contractors and both consultant and clients revealed a lower level of agreement on ranking categories. These findings are in line with Assaf et al.⁵ that concluded the same and supports the argument about adversarial relationships between clients or consultants and contractors on the other side.

TABLE 8: SPEARMAN'S RANK AGREEMENT

	Spearman's Coefficient
Clients - Consultants	0.70
Clients - Contractors	0.15
Consultants - Contractors	0.39

C. Comparative Study

A comparative study with the only published paper on causes of delay in Qatar was conducted. The results of the analysis are reported in Table 8. The variances in ranks are explainable due to different factors between residential complexes and large buildings projects such as: owner types, value and complexities associated with projects, and specification of required materials. The owners of large projects are more sophisticated organisations with more complex and bureaucratic structures that affect decision-making swiftness. However, compound developers are either small companies or even individuals with full decision-making

authority. This explains the variance between the two studies with regard to slow decision-making variances. Discrepancies between specification and drawings are of higher importance in large building than compounds due to the difference in complexity. Housing complexes are usually typical houses with repeating construction activities which reduces risks of contradictory information. Variances related to delays to claims settlement and issuing change orders late are consequences of decision-making swiftness. The larger effect of materials late delivery in large projects is attributable to their specifications which often require overseas purchasing to fulfil requirements. It was observed that changes in scope has higher importance to compound projects; this was further investigated and results revealed that compounds that are usually possessed by individuals are subject to continuous changes based on their personal preferences. In addition, owners of such compounds often have limited or no construction knowledge which causes contradictory and continuous changes to project scope without acknowledgement to time or associated cost.

TABLE 8: COMPARATIVE STUDY WITH JURF AND BEHEIRY⁴

Description	Rank	Jurf and Beheiry ⁴	Rank Change
Slow decision-making	1	15	14
Discrepancies between specifications and drawings prepared	2	9	7
Major change of design during construction	3	3	-
Delay in the settlement of contractor claims	4	10	6
Unreasonable project time frame	5	8	3
Delay in issuance of change orders	6	11	5
Improper technical study during the bidding stage	7	8	1
Delay in solving design problems	8	9	1
Changes in the scope of the project	9	3	6
Delay in materials delivery	10	5	5
Delay in issuing the drawings	10	12	2

V. CONCLUSION

The aim of this study was to investigate significant factors contributing to delays of large building projects in Qatar. The earlier literature studying neighbouring countries were reviewed to identify common reasons for delay. A quantitative systematic literature review was adopted to ensure inclusion of all studies on GCC countries and identify gaps. The process concluded by defining 120 causes of delay that were filtered to 88 relevant to Qatar. The identified factors were administered in an on-line survey that was responded to by 31 participants from various stakeholders. The results were analysed using statistical tools for ranking, rank agreement, and compared with an earlier study in Qatar. The top five factors were: slow decision-making; discrepancies between specifications and drawings prepared; major change of designs during construction; delay in the settlement of contractor claims; and

unreasonable project time frames. The study also concluded that there are significant differences between contractors' views and both clients and consultants which reinforce interview outcomes of the adversarial relationship between these stakeholders. On the contrary, clients and consultants reflected an acceptable level of agreement. It is acknowledged that number of participants from client organisations does not allow results to be generalised.

Future research can potentially focus on other projects types such as utilities and oil and gas. Also, focus on study factors that cause variations of causes of delay such as client organisation types, contract arrangements, project types, and geographical locations. These research areas will help decision-makers to realise root causes and instigate corrective action to mitigate their impact.

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