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Major Causes Assessment of Construction Delays

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Abstract: Delays on construction projects constitute a major source of concern due to its associated cost increases and loss of revenue. The Gulf Cooperation Council (GCC), of which Oman is a member, faces huge delays on their projects. Such delays in the GCC were among factors fingered in the collapse of the UK's Carillion. Despite cultural similarities, substantial variability exists within the GCC construction sector which requires country-specific studies. The quest to understand delay causes results from the need to curtail wastes and adjust to the new regime of low commodity prices. There is a dearth of studies specific to the governorate of Muscat exploring the causes of delays and this study seeks to fill that gap. A structured survey questionnaire was administered at two independent events organized by the RICS and ICE in Muscat. The top causes of delays ranked using the Relative Importance Index (RII) include variation and changes in design, Poor site management and supervision, ineffective planning and scheduling, unclear and inadequate details in drawing, poor qualification of the contractors and technical staff, delay in material delivery, and shortage of labor. Contractors were found to be most likely to cause delays among the 6 categories of sources.

Keywords: Construction delays, Time overruns, GCC, Muscat, Oman.

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1. Introduction

The Sultanate of Oman is a member of the Gulf Cooperation Council (GCC), a group of oil and gas-rich countries within the Arabian Gulf. A common thread that runs across their various economies is a huge pipeline of on-going and planned megaprojects. It has been reported that Oman has a pipeline of about 700 projects worth a cumulative value of $230billion across all sectors (MEED, 2019). The payments for these megaprojects are hinged on revenues from their oil and gas wealth. However, given the price volatility which has bedeviled the oil and gas industry in recent times leading to a huge shortfall in revenue for these countries. There is now a growing urgency more than before to optimize every dollar spent and avoid delays as much as possible. Despite improvements in technology, estimating processes and scheduling tools, delays have continued to plague construction projects even in developed countries as evidenced by the CrossRail in the UK (London Assembly, 2019).

This was also the case with the Al Batinah expressway and the Muscat International airport, both of which faced considerable delays (Oyegoke and Al Kiyumi, 2017). Hence delayed completion or time overruns is a major problem that has bedeviled construction projects around the world (Tafazzoli and Shrestha, 2017). The issue has almost become intractable over the last 90-years period for which data is available (Flyvbjerg, 2016). A global construction survey of over 100 organisations found that only 25% of projects came in within 10% of their original deadlines in the 3 years prior (KPMG, 2015). Studies show that delays in construction projects are in the area of 45% in the UK (Davis et al., 2016).

In the GCC, about 70% of projects in Saudi Arabia (Assaf and Al-Hejji, 2006); 90% in the emirates of Abu Dhabi (Halloum and Bajracharya, 2012); and 50% across the UAE (Faridi and El-Sayegh, 2006). The story is not different in Qatar where 72% was reported for government projects (Senouci et al., 2016). In the sultanate of Oman, it was found that 40% of projects executed between 2007 and 2013 were delayed (Alnuaimi and Al Mohsin, 2013). The authors also found that the major causes of delays changed over time. It has been established that when projects are delayed, they result in one or a combination of the following negative effects viz: time overrun, cost overrun, disputes, arbitration, litigation, and total abandonment in extreme cases (Sambasivan and Soon, 2007). Other effects of delays include loss of reputation, loss of profits,

loss of revenues (Mukuka et al., 2015; Oyegoke and Al Kiyumi, 2017).

Research into delays is still in its infancy within the GCC and the sultanate of Oman in particular. Carillion's GCC projects were fingered as a major factor in its bankruptcy, reinforcing the need to understand construction delay issues in the region (Mor et al., 2018). Over the last decade, there have only been four published studies on construction delays in Oman focusing on three broad sectors - oil and gas (Ruqaishi and Bashir, 2013), Dams (Alamri et al., 2017), and mega projects (Alnuaimi and Al Mohsin, 2013; Oyegoke and Al Kiyumi, 2017) - within the construction industry. There has been no consensus on the most important causes of delays across these studies. In fact, the top three causes of delays found by the four articles differ despite all studies occurring within a 5-years span. For example, the most important causes of delay were found to be poor site management and supervision (Ruqaishi and Bashir, 2013), weather conditions (Alamri et al., 2017), ineffective planning and scheduling (Alnuaimi and Al Mohsin, 2013), and type of project bidding and award (Oyegoke and Al Kiyumi, 2017). Furthermore, consistent with the findings of Motaleb and Kishk (2010) and Alnuaimi and Al Mohsin (2013) that the causes change with time, it was observed that, though Ruqaishi and Bashir (2013) and Alnuaimi and Al Mohsin (2013) were published in the same year, they both differed in their ranking of the top 7 most imporant causes of delays. All past studies were country-wide even though there exist significant differences in terms of development across the four governorates. Taking this into cognizance, this study intends to focus on Muscat governorate alone, being the major commercial hub and seat of government. Therefore, this study seeks to assess the major causes of construction delays in Muscat governorate and compare the results with the most recent studies on delays in Oman.

2. Causes of delays

Construction delays is defined as the time that exceeds the contractual agreed completion date stated in the contract agreement (Assaf and Al-Hejji, 2006). The society of construction law (SCL) protocol in its definition breaks delays into two categories - Employer delay to completion and Contractor delay to completion (SCL Protocol, 2017). However, there are numerous causes of delays outside those attributable to the client and the contractor (Hinze, 2008). There are delays resulting from force majeure, consultants, suppliers, subcontractors, statutory authority and parties external to the contract (Emam et al., 2015). Delay causes prolongation and prolongation leads to increased cost (SCL Protocol, 2017). KPMG's 2019 Annual global construction survey found that for the middle 60% of companies, cost and time overruns still remained a major challenge (KPMG, 2019). At the global level, an analysis of over 104 published research articles related to delays across 45 countries with the intention of identifying the universal top 10 causes of delays revealed that change orders, delays in payments to contractors, poor planning and scheduling, poor site management and supervision, incomplete design, inexperienced contractors, contractor's financial difficulties, owners financial difficulties, resource shortages, and poor labour productivity/shortage of skills were the top universal causes of construction delays (Zidane and Andersen, 2018).

Eizakshiri et al. (2015) have questioned the 'intentionality' of studying project delays, arguing that researchers are unaware of the intents of the planners involved in planning the schedule for projects. The authors urge researchers to look beyond the simple cause-and-effect ideology which currently manifests across current delay studies. A similar argument has been posited by Flyvbjerg (2009) indicating that planners are sometimes 'deceptive' and hide the complexity involved in projects in order to get the projects approved. However, the first step in minimizing delays is to identify the causes that may lead to delays (Tafazzoli and Shrestha, 2017). While it may be difficult to discern the intentions of planners, it cannot be argued that the clients and contractors would hope for delays on their project despite all the negative consequences that come with delays. Hence, if for their sake only, it behooves the industry and researchers to continue seeking to identify the causes of delays within their localities and proffer solutions to them. A recent study of the universal causes of construction delays found the top 10 causes included: change orders, delays in contractor payments, poor planning and scheduling, poor site management and supervision, design issues, inexperienced contractors, contractors financial difficulties, clients' financial difficulties, resource shortages, and poor labour productivity (Zidane and Andersen, 2018). In addition to the top 10 universal causes above, two other causes which are very significant within the GCC include 'unrealistic contract duration' (Motaleb and Kishk, 2010; Almutairi, 2016; Emam et al., 2015; Oyegoke and Al Kiyumi, 2017; Mpofu et al., 2017) and Inclement weather (Alnuaimi and Mohsin, 2013; Gluszak and Lesniak, 2015; Al-Hazim et al., 2017).

Inclement weather is an issue in tropical environments. However, in the GCC with its arid climate, temperatures have been known to cross the 50 degrees Celsius mark. During the summer months, GCC rules prohibit construction workers from working outside between 12 PM and 3 PM. This prohibition impacts productivity when the workers return to work at 3 PM. Researchers into delays have also categorised the causes of delays according to the source. In one study, the culprits were ranked with the client, labour and equipment related causes found to contribute to delays than contractor, materials and designer related issues (Shahsavand et al., 2018). In other studies, the client was found to be the major source of delays (Alnuaimi and Mohsin, 2013; Rachid et al., 2018); while another study found the contractor to be the major source of delays (Albogamy et al., 2012). Comparing the most recent publications on delays across the GCC against the universal top 10 causes by Zidane and Andersen, (2018) revealed something very interesting. As can be seen in Table 1 below, Oman and the UAE had 5 of its top 10 causes reflected in the universal top 10 while Kuwait and Qatar had only 3 each with Saudi Arabia having 4 of its top 10 delay causes reflected in the universal top 10. A very interesting observation across Saudi Arabia, Qatar and Kuwait publications is that "Clients financial difficulties" was not an issue across these three countries. Furthermore, Qatar and Kuwait publications on construction delays showed that "contractor financial difficulties" was also not an issue, hence was not a factor assessed in their studies.

Table 1. Comparison of top 10 Universal delay causes against GCC country-specific top 10s

Rank	Universal top 10 causes	OM	UAE	KSA	KW	QTR
1	Change order	5	3	19	16	2
2	Delays in payments to contractors	10	66	5	4	15
3	Poor planning and scheduling,	4	4	4	2	3
4	Poor site management and supervision	11	10	18	39	16
5	Incomplete design	12	9	19	18	8
6	Inexperienced contractors	9	19	3	3	N/A
7	Contractor's financial difficulties,	2	25	8	N/A	N/A
8	Owners financial difficulties,	27	30	N/A	N/A	N/A
9	Resource shortages,	19	61	31	31	14
10	Labour productivity/shortage of skills	16	7	12	28	19
	Causes in top 10 universal	**5**	**5**	**4**	**3**	**3**
	Number of causes assessed	44 causes	88 causes	40 causes	63 causes	88 causes
		Oyegoke and Al Kiyumi (2017)	Mpofu et al., (2017)	Al Bogamy et al., (2012)	AlMutairi (2016)	Emam et al., (2015)

Table 1. Crosstab of Qualification vs Years of experience

	1-5 Years	5-10 Years	10-15 Years	15-20 Years	Over 20 Years	**Total**
PhD	0	1	0	0	1	**2**
M.Sc	1	0	2	2	2	**7**
B.Sc	8	2	6	8	7	**31**
PGD/Dip	1	0	1	0	0	**2**
Others	0	1	0	0	2	**3**
Total	**10**	**4**	**9**	**10**	**12**	**45**

3. Methodology

The study involved a literature review of previous studies on delays at the global, regional and country level in Oman. A questionnaire based on an analysis of the available literature and past studies conducted within Oman was designed. Purposive sampling technique (Dolores and Tongco, 2007), was used for the administration of the questionnaires. This was achieved by negotiating with the representatives of the Royal Institution of Chartered Surveyors (RICS) Oman chapter and the Institute of Civil Engineering (ICE) Oman chapter. They assisted in distributing the questionnaires to their members during their individual CPD events. Forty-five questionnaires were returned completely filled out of the 96 that were distributed. The number of respondents was comparable with previous studies conducted in Oman with 32 respondents, 59 respondents, and 53 respondents used by Alnuaimi and Al Mohsin (2013), Ruqaishi and Bashir (2013), and Oyegoke and Al Kiyumi (2017), respectively. While the response may be seen as low, it has been found that the average response rate for survey data collection from organisations was 35.7% (Baruch and Holtom, 2008). The response rate for this study was 46.9%. IBM SPSS version 21 was used to perform ANOVA and Independent sample T-test and inference drawn from the data. The Relative Importance Index (RII) was used to rank the delay causes.

$$\text{RII} = \frac{\Sigma \boldsymbol{W}}{\boldsymbol{A\ x\ N}} \quad (1)$$

Where: W = the weight given to each factor by the respondents ranges from 1 to 5 (where "1" is "lowest" and "5" is "highest"); A = highest weight which is 5 in this study; and N = total number of respondents. The RII was used by 3 of the 4 delay studies conducted in Oman including Alnuaimi and Al Mohsin (2013), Alamri et al., (2017) and Oyegoke and Al Kiyumi (2017). The use of a similar ranking technique would enable better comparision of the findings with past studies. The values for the RII are between 0 to 1, the closer to 1 the variables' values are the more important the variable is. Spearman's rho was also computed using Microsoft excel to compare the global ranking and the current study's rankings.

There were a total of 45 respondents to the survey. In terms of academic qualifications, 40 of the respondents possess a bachelor's degree and above while 2 respondents had a diploma including 3 with 'other' qualifications. The result also shows that 35 respondents had industry experience of more than 5 years while 10 respondents had 5 years or less, as shown in Table 2.

In terms of sectoral distribution, 27 of the respondents work with private organisations while 18 work in public/government organisations. There was only 1 architect, 24 engineers, 4 contractors, 6 clients and 10 'others' who did not fit into the available classifications. It

is instructive to note that, in the GCC, most of the Quantity surveyors have a civil engineering background, hence the high representation despite getting a larger proportion of the respondents from RICS CPD event.

The reliability test conducted on the data returned a Cronbach's alpha value of α=0.863 indicating a very good reliability. The normality tests indicates that the data is normally distributed with the Kolmogorov-Smirnov and Shapiro-Wilk both returning D (45)=0.104, ***P***=0.200 and D(45)=0.967, ***P***=0.223 respectively. The ANOVA tests conducted revealed that there was no statistically significant difference in ranking in terms of respondents' background [F(4,40)=0.714, ***P***=0.587]; academic qualifications [F(4,40)=1.331, ***P***=0.275] and years of experience [F(4,40)=0.901, ***P***=0.473]. The results are shown below in Table 3.

Table 2. ANOVA and T-test results

ANOVA analysis	**F**	***P*-value (Sig)**
Respondents' background	0.714	0.587
Academic qualification	1.331	0.275
Years of experience	0.901	0.473
Sector **(Independent sample T-test result)**		0.358

An independent sample T-test also found no significant difference between the public (M=3.47, SD=0.416) and private (M=3.35, SD=0.457) sector, t (43) =-0.930, ***P***=0.358. Essentially, all respondents' characteristics did not have any moderating impact on the ranking of the major causes of delays assessed.

From the RII ranking shown on Table 4. It can be seen that consistent with the universal top 10 ranking (Zidane and Andersen, 2018), 'Variations and change orders' was ranked the most important cause of delays in Muscat. Interestingly and consistent with the assertions of Motaleb and Kishk (2010) and Alnuaimi and Mohsin (2013), the most important factors change with time. None of the earlier Oman-based studies of delays including Alnuaimi and Al Mohsin (2013), Ruqaishi and Bashir (2013), Alamri et al. (2017) and Oyegoke and Al Kiyumi (2017) reported 'Variations and change orders' as its most important cause of delays. However, consistent with this study, 'Variations and change orders' is ranked number 1 in the U.S (Tafazzoli and Shrestha, 2017) and the UAE (Motaleb and Kishk, 2010).

The second ranked cause of delay was 'poor site management and supervision', and in an earlier study conducted in Oman, it was ranked as the most important cause of delay (Ruqaishi and Bashir, 2013). It is important to point out that the earlier study was in the oil and gas sector. The 3rd ranked cause of delays was 'ineffective planning and scheduling', and it is interesting to also note that an earlier Oman-based study had also found this to be the most important cause of delays (Alnuaimi and Mohsin, 2013). This cause was also found to be the second most important in the UAE (Faridi and El-Sayegh, 2006; Ren et al., 2008). It is instructive to note that 'type of project bidding and award' ranked as the most important in an Oman-based study by Oyegoke and Al Kiyumi (2017) was ranked at 33rd place in the current study. Weather condition, which was also ranked as the most important by another Oman-based study (Alamri et al., 2017), was ranked in 28th in this current study as shown in Table 5. The computed Spearman's rho returned a value of rs = 0.68, indicating a positive correlation between the universal rankings and those for this current study.

4. Solutions to construction delays

Humans remain the heart and soul of projects (KPMG, 2019). Therefore, any solution to delays being proposed must include site operatives and not just technology. Up-skilling the workforce, delivering improved productivity and containing costs are priorities (DBEIS, 2016). In terms of mitigating the effects of delays, it has been suggested that acceleration of site activities along with developing effective client project management skills and the inclusion of adequate contingency would forestall delays (Aibinu and Jagboro, 2002).

Foreman delay survey, which involves asking foremen to record causes of delays on site over the life of a project and the data is then analysed and used to solve delay problem on future projects has also been suggested (Hinze, 2008). Other researchers have suggested the use of reference class forecasting as a way of de-biasing projects to eliminate optimism bias, a common problem among construction planners (Flyvbjerg and Budzier, 2018). Traditional approaches involving disciplined stage-gate systems, adequate scope definition and rigorous benchmarking have also been suggested (Ahiaga-Dagbui, 2019). Given the inherent uncertainties associated with construction projects, it has also been suggested that completion dates be given in a 'range' rather than a specific calendar date (HoC, 2019). In the 2019 annual construction survey, leaders expressed concerns over the ability of the next generation to fully grasp the fundamentals of project delivery and feel this challenge cannot be solved purely by technology (KPMG, 2019). Hence, it is being argued that clients should hire project management companies during the early stages to assist in developing achievable goals and deliverables (Alnuaimi and Al Mohsin, 2013).

Although the client has been found by many studies to be the most important source of delays (Shahsavand et al., 2018; Emam et al., 2015), this study however found, consistent with earlier work by Albogamy et al. (2012) that the contractor was the most important source of delay issues, as shown in Table 5.

Table 3. RII causes of delays in Muscat rankings

	Causes of delay	Rank	RII	Party causing delays
1	Variation and changes in design	1	0.836	Client
2	Poor site management and supervision	2	0.813	Contractor
3	Ineffective planning and scheduling	3	0.782	Contractor
4	Unclear and inadequate details in drawing	4	0.778	Consultant
5	Poor qualification of the contractors and technical staff	5	0.764	Contractor
6	Delay in material delivery	6	0.747	Materials
7	Shortage of labor	7	0.742	Labor
8	Unrealistic contract duration	8	0.738	Contractor
9	Subcontractor issues	9	0.733	Contractor
10	Unqualified work force	10	0.729	Labor
11	Delays of statutory approvals	11	0.724	External
12	Low productivity level of labors	12	0.716	Labor
13	Material procurement	13	0.711	Contractor
14	Delay in client approval	14	0.707	Client
15	Design errors	15	0.707	Consultant
16	Delay in payment to contractors	16	0.698	Consultant
17	Delays in producing design documents	17	0.689	Consultant
18	Shortage of material suppliers	18	0.689	Materials
19	Inadequate experience in consultant	19	0.68	Consultant
20	Contractor financial problems	20	0.676	Contractor
21	Communication between designers and contractor	21	0.676	Consultant
22	Communications between the parties	22	0.671	External
23	Client's slowness in making a decision	23	0.667	Client
24	Unrealistic designs and drawings	24	0.667	Consultant
25	Site condition (ground problems)	25	0.636	External
26	Lack of needed equipment	26	0.631	Contractor
27	Quality and specifications of materials	27	0.627	Materials
28	Heat and bad weather conditions	28	0.627	External
29	Delays of inspection and testing of work	29	0.622	External
30	Global financial crisis	30	0.622	External
31	Mistakes during construction	31	0.618	Contractor
32	Inappropriate government policies	32	0.618	External
33	Type of project bidding and award	33	0.609	Client
34	Client financial difficulties	34	0.582	Client
35	Working hour restrictions	35	0.573	Labor
36	Change in material cost	36	0.569	Materials
37	Labor accidents	37	0.502	Labor
38	Wrongly shipped orders	38	0.498	Materials

Table 4. Ranking of categories responsible for delays

	Causes of delay	Rank	RII	Responsible Party	RII Score
1	**Contractor Related Causes**				
1	Lack of needed equipment	26	0.631	Contractor	
2	Contractor financial problems	20	0.676	Contractor	
3	Material procurement	13	0.711	Contractor	
4	Unrealistic contract duration	8	0.738	Contractor	
5	Subcontractor issues	9	0.733	Contractor	
6	Poor site management and supervision	2	0.813	Contractor	
7	Ineffective planning and scheduling	3	0.782	Contractor	
8	Poor qualification of contractor and technical staff	5	0.764	Contractor	
9	Mistakes during construction	31	0.618	Contractor	**0.718**
2	**Consultant Related Causes**				
1	Unrealistic designs and drawings	24	0.667	Consultant	
2	Delays in producing design documents	17	0.689	Consultant	
3	Inadequate experience of consultant	19	0.68	Consultant	
4	Communication between designers and contractor	21	0.676	Consultant	
5	Unclear and inadequate details in drawing	4	0.778	Consultant	
6	Design errors	15	0.707	Consultant	**0.700**
3	**Client Related Causes**				
1	Type of project bidding and award	33	0.609	Client	
2	Client financial difficulties	34	0.582	Client	
3	Delays in payments to contractor	16	0.698	Client	
4	Variation and changes in design	1	0.836	Client	
5	Client's slowness in making decision	23	0.667	Client	
6	Delay in client approval	14	0.707	Client	**0.683**
4	**Labour Related Causes**				
1	Low productivity level of labors	12	0.716	Labor	
2	Unqualified work force	10	0.729	Labor	
3	Shortage of labor	7	0.742	Labor	
4	Working hour restrictions	35	0.573	Labor	
5	Labor accidents	37	0.502	Labor	**0.652**
5	**External Related Causes**				
1	Inappropriate government policies	32	0.618	External	
2	Delays of inspection and testing of work	29	0.622	External	
3	Global financial crisis	30	0.622	External	
4	Delays of statutory approvals	11	0.724	External	
5	Site condition (ground problems)	25	0.636	External	
6	Heat and bad weather conditions	28	0.627	External	
7	Poor of communications between the parties	22	0.671	External	**0.646**
6	**Materials Related Causes**				
1	Change in material cost	36	0.569	Materials	
2	Wrongly shipped orders	38	0.498	Materials	
3	Quality and specifications of materials	27	0.627	Materials	
4	Delay in material delivery	6	0.747	Materials	
5	Shortage of material suppliers	18	0.689	Materials	**0.626**

5. Conclusions

As GCC continues to open its doors to more foreign investments and construction contractors from the west, it is important that prospective contractors understand the nature of the construction industry in the region. The GCC countries may share very similar societal norms, however, nuances exist across the various borders as it relates to the construction sector. This study sought to identify the major causes of delays in the governorate of Muscat in the sultanate of Oman. It found that variations and change orders, poor site management and supervision and ineffective planning and scheduling were the most important causes of delay. The results of this study differed significantly from all four earlier Oman-based studies on the subject matter. However, it is noteworthy that the results were very similar to the universal top 10 causes (Zidane and Andersen, 2018). Furthermore, the variation of the results with earlier Oman-based studies affirms the assertion that delay causes were country-specific (Mpofu et al., 2017) and time related (Alnuaimi and Mohsin 2013). Therefore, solutions should evolve based on the local environment in order to be effective. Furthermore, the adoption of BIM technologies with its clash-detection capabilities would go a long way in minimizing Change order issues and design detailing problems. Training programmes to improve the skills of operatives needs to be considered and planners need to be held responsible for faulty or unrealistic scheduling. The three major contract parties (client, contractor and consultants) all have responsibilities which when properly executed would bring down many of the issues to an acceptable level.

Practical implications: studies such as this are very important given the manner in which globalization has broken down borders and allowed western contractors to now operate in the middle east. A major cause of Carillion's collapse was its operations in the GCC where it has joint ventures in many of the countries in the region. With studies such as this one, intending western contractors would be better prepared with risk-hedging strategies to overcome the problems identified in this study.

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