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Owners' perspective of factors contributing to project delay: case studies of road and bridge projects in Saudi Arabia

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Abstract

Delays are a major cause for concern in the construction industry in Saudi Arabia. This paper identifies the main causes of delay in infrastructure projects in Mecca, Saudi Arabia, and compares these with projects around the country and other Gulf countries. Data was obtained from 49 infrastructure projects undertaken by the owner and were analyzed quantitatively to understand the severity and causes of delay. 10 risk factors were identified and were grouped into four categories. Average delay in infrastructure projects in Mecca was found to be 39%. The most severe cause of delay was found to be the land acquisition factor. This highlights the critical land ownership and acquisition issues that are prevailing in the city. Additionally, other factors that contribute to delay include contractors' lack of expertise, re-designing, and haphazard underground utilities (line services). It is concluded that the majority of project delays were caused from the owner's side as compared to contractors, consultants, and other project's stakeholders. This finding matched with the research findings of the Gulf Countries Construction (GCC) Industry's literature. This study fills an important practice and research gap for improving the efficiency in delivering infrastructure projects in the holy city of Mecca and Gulf countries at large.

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1. Introduction

The Kingdom of Saudi Arabia is experiencing a rapid growth in infrastructure, both in urban and rural areas. The government of Saudi Arabia is progressively allocating large amounts of resources and money to develop its infrastructure all over its territory. The strong economic position of the country has been driving these bold and dynamic decisions to invest in construction projects. To put this into perspective, between 2008 and 2013, the government spent close to USD \$574.7B on construction projects [1]. This high rate of spending has led many in the world to recognize the Saudi construction industry as the largest market in the Middle East. Looking ahead, construction industry analysts around the world expect this growth to advance even more by 2015 [2]. From the past three decades, all construction institutions in this region have agreed upon the fact that this industry is faced with the grave issue of inefficiencies, non-performance, and lack of delay factor analysis. In a survey of contractors and consultants of major construction projects, it was found that around 37% of construction projects were believed to be delayed by the contractors, and 84% of all the projects which were under the supervision of the consultants had gone through serious delays [3]. The researchers also reported that the average estimated time overrun amounted to 39% of the contractual time period. To support these claims, a study was conducted by Al Turkey with the aim of identifying the performance of the construction industry. It was found that more than 300 project managers from different sectors and disciplines in the construction industry agreed that 80% of the projects were subject to cost overrun, while 97% of the projects faced delay in project completion [4]. Contractors in Saudi Arabia estimate the total value of delayed public projects at nearly USD \$146.6B [5]. Mecca Al-Mukarramah is regarded as the holiest site in Islam and is the centre of the annual Islamic pilgrimage. This place holds a special position for the followers of the Muslim religion all over the world and receives over 20 million pilgrims during Umrah season [6]. The high volume of religious devotees and tourists in this city has led to the enormous infrastructure development in Mecca. The expansion of the Holy Mosque costed around USD \$10.6B in a span of 6 years (2010 to 2015). This enormous cost was to develop the 6000 square meter (sq.mt.) area around the holy mosque [7]. This indeed illustrates the high cost of construction and development in this famous city. Furthermore, land ownership is one of the major challenges that are faced by the developing authorities. Land rates around the central area of Mecca were around \$80,000/sq.mt. during 2008 [8]. This figure rose to \$133,000/sq.mt. during 2010 [9] and to \$400,000/sq.mt. during 2013 [10]. Consequently, the Saudi government spent over \$8.8 B for land acquisition between 2009 and 2010 [11]. This paper will provide a more thorough analysis of factors such as these which affect the timely delivery of projects.

Through the paper, a delay [in the construction industry] will be referenced as the time overrun in the projects' planned schedule that was agreed upon by all the stakeholders of the project [12]. For the client/owner, time delays cause a loss of revenue. This is due to the absence or delay in revenue generation from the proposed construction after completion. For a contractor, delay causes cost overruns due to compensation of wages for prolonged times, excess hire charges for plant and equipment, material and space utilization, loss or damage of construction materials, and inflation factors [12]. Any construction project's lifecycle can be broadly classified into three categories: conceptualization/pre-construction phase, design, and construction phase. Most of the causes for delay happen during the construction phase because various unforeseen risks are continuously involved [13]. Various delay factors could be categorized based on the direct and indirect consequences upon the financial budget of the project. Delays could be also categorized into excusable and inexcusable delays [14]. Inexcusable delays are the ones caused exclusively by the vendor, sub-contractors, or suppliers. There is no compensation to the contractor in this case and the contractor is obliged to proceed with their job or pay for the damages to the client as liquidated damages. If liquidated damages are not included in the contract, compensations could be made to the contractor as actual damages. The first type of excusable delays is the non-compensable which are caused by other stakeholders or risks out of the client or contractor control such as unexpected acts of government, fire, or unusual weather. Usually, the vendor in these cases does not have the right for financial compensation but he has the right to time extensions. The second type of excusable delays is compensable which is caused by the actions or act of the client/owner or client's agents such as design changes or late release of drawings. In these cases, the vendor receives compensation from the owner as indirect costs for the extra overhead costs [14]. In addition, there are two groups of causes of delay in the construction industry that could be categorized into internal and external causes. Internal causes of delay which are caused from the three main parties (clients, contractors, and consultants) in the construction projects [15]. Whereas, the external causes for delay are out of control for the owners, contractors, and consultants. These external causes could be:

- Natural disasters
- Shortage of building materials in the market
- Unavailability of proper equipment in the market
- Adjustments in government's laws and regulations

2. Problem

In view of the large scale investment and the need for fast paced development, cost and time overruns are a serious issue. Research findings indicate that around 70% of the construction projects in Saudi Arabia have faced delays. It has been found that delays were a concern for over 70% of all the projects undertaken by the Ministry of Housing and Public Works [16]. Al-Sultan [17] reported the same percentage of delays in construction projects even after six years. Al-Khalil and Al-Ghafly [18] in their investigation found that 72% of the total projects undertaken were delayed during this period. This trend continued even during 2006, it was found in the Eastern Province that 70% of projects faced time overruns by 10% to 30% of the estimated project schedule [12]. Projects in Mecca (Western province) are not immune to these delays. With over 5 years of intensive work experience as a Project Manager for public infrastructure projects, the main researcher believes that delays are a major hindrance during execution of public projects. While very limited research has been done which analyzes the root cause of delays, it is a challenge for the industry professionals to understand it [19]. They are aiming to solve these issues to enhance the project delivery mechanisms.

3. Research Aim and Objectives

This paper identifies and examines the causes of delay in the construction of infrastructure (roads and bridges) projects in the Mecca province of Saudi Arabia. The objectives are to:

1. Identify causes of delay in Gulf Countries Construction (GCC) industry.
2. Determine the schedule performance of 49 infrastructure projects.
3. Identify the causes of delay and the parties responsible for each of them as per the owners' perspective.
4. Compare the analyzed delay factors and case findings with other studies from Saudi and Gulf Countries Construction (GCC) industry.

4. Research Methodology

This study uses a quantitative approach to analyze delay factors and will be conducted in three phases: literature review, analysis of the collected data, comparing the delay factors and findings of this case study with other related literatures. It was found that all previous studies analyzing the delay factors in Saudi and Gulf countries construction industry were completely based on literature reviews. Most researchers tend to conduct survey to assess the causes impact, severity and frequency of delay factors. However, in this study, the authors will identify the delay causes based on a real time quantitative performance analysis of all the infrastructure projects under consideration. After that, these delay factors will be evaluated by their frequency of occurrence on 49 projects and the severity will be measured in terms of percentages. By assigning these delay factors to the responsible stakeholders, the root cause for the majority of delays and the responsible party will be determined.

The research method for this study is a detailed analysis and quantitative comparison of delay factors for 49 infrastructure projects in the Mecca province. One of the researchers has been working as a construction Project Manager for the Saudi Arabia government for past 5 years [19]. His responsibility is to manage and oversee the infrastructure (roads and bridges) projects in Mecca located at the Western province of Saudi Arabia. This study is limited to the constructions taking place only in the Mecca province mainly because of the familiarity and expertise of the main researcher in this 1,200 sq.km area [19]. Moreover, all of the cases in consideration (49 in total) are either bridge or road projects. The reason for selecting these projects is because of the demand to construct and

develop the infrastructure in this region to support the millions of devotees that come for their pilgrimage for Hajj and Umrah. The second stage will focus on analyzing the case study findings; the authors intend to analyze a total of 49 construction projects in Mecca province. The aim of this comprehensive analysis is to determine the major risks factors that affects the project's performance and the stakeholder responsible for causing those risks (i.e. client, contractor, consultant, and other stakeholders). The data for these construction projects were obtained from the owner and it contains the following information:

1. Total cost of the project
2. Planned vs. actual start and completion date
3. Factors that caused delay in those projects

In the third stage, authors will compare the risk factors with other similar research studies carried out in the Saudi construction industry and the Gulf States construction industries in order to find out whether or not the risk factors in the authors' data are similar to other local studies in the industry.

5. GCC Literature Review

While reviewing the literature that has described various causes and effects of delays in Saudi and other Gulf Countries' Construction industries, the severity of the situation became clear. Various studies have been performed in GCC countries with an aim to determine the causes of delay on construction projects [12, 20, 21, 22, 23, 24, 25, 26, 27, and 28]. The top ranked causes of delay in the previous 10 studies are shown in Table 1. Contractor lack of experience received the highest rank as it was among the main causes of delay for all of the 10 studies. The second most frequent delay factor was the financial constraints by the owner. This factor was documented in 9 studies. Found in 6 studies, the most frequent delay factors included ineffective planning and scheduling by a contractor, poor site management and supervision by a contractor, and delay in performing inspection and approval by a consultant. 5 studies indicated facing unidentified design errors/changes and slow decision-making by owners as problematic. Change orders and type of project bidding and award (lowest bidder) are ranked fifth, as they occurred in 4 studies. Subsequently, Table 2 shows the responsible parties of the identified causes of delay in GCC studies by showing the percentages of the causes of delay. Owner-related causes were the highest as they were responsible for 49.2% of the time extensions. Contractor-related causes were ranked second, since contractors were responsible for 36% of the time extensions causes.

Table 1: Top ranked causes of delays in the GCC studies.

	Risk Factor	Frequency	%	Related to
1	Contractor lack of experience	10	16.3 %	Contractor
2	Financial constraints by the owner	9	14.7 %	Owner
3	Ineffective planning and scheduling by contractor	6	9.8%	Contractor
4	Delay in performing inspection and approval by consultant	6	9.8 %	Consultant
5	Poor site management and supervision by contractor	6	9.8%	Contractor
6	Design errors/changes	5	8.2 %	Owner
7	Slow decision making by owner	5	8.2 %	Owner
8	Type of project bidding and award (lowest bidder)	4	6.5 %	Owner
9	Change orders	4	6.5 %	Owner
10	Materials in market	3	5 %	Other
11	Difficulties in obtaining work permits	3	5 %	Owner
		latoT	61	

Table 2 - Responsibility percentages of the causes for each party For GCC Studies.

	Group of Risk	%	Frequency
1.	Owner-related	49.2	30
2.	Contractor-related	36	22
3.	Consultant-related	9.8	6
4.	Other	5	3
	Total	100%	61

6. Performance of Mecca Projects

The main aim of this study is to identify the causes of delay and the responsible party for these causes according to the owner's perspective in road and bridge projects in Mecca province. The collected data of the 49 case studies include the project type and the contract cost for each project. The total value of the projects into consideration is \$ 937,914,590.97. Time extension percentage out of the original contract duration is shown for every project and the average delay percentage for all the projects is 38.88%. The causes of delay in the studied projects were identified according the owners' perspective and the main causes are land acquisition, contractors' lack of expertise, re-designing, line services, clashes with other Ministries, design conflicts between owners, re-study the design because of valleys, variation in estimated quantities between the design and construction phases, differences in opinions from the Ministry of Traffic, deliberate delay in construction by the general contractor and changing consultants during project execution. Table 3 shows the ranking of main identified causes of delay in the studied projects based on the frequency of occurrence of each cause. Land acquisition was the highest rank as it is the main cause of delay for 15 projects with an average of 35% time extension for the effected projects. The second is the contractors' lack of expertise as this cause accrued in 12 cases with an average of 56% time extension for the effected projects. Re-designing ranked third in severity of delay as it occurred in 10 projects with an average of 45% time extension of the effected projects. Facing unidentified line services (underground utilities) in the design rank fourth in severity as it occurred in 9 cases with an average of 48% time extension of the effected projects.

Table 3 - Ranking the Risk factors for the research case studies

	Risk Factor	Frequency	% Delay	Related to
1	Land acquisition	15	35%	Owner
2	Contractor' lack of expertise	12	56%	Contractor
3	Re-designing	10	45%	Owner
4	Line services (Utilities and underground services)	9	48%	Owner
5	Clashes with other Ministries	5	22%	Other
6	Design conflicts between owners	2	20%	Other
7	Variation in estimated quantities between designer and GC (General Contractor)	2	28%	Owner
8	Differences in opinions from the Ministry of Traffic	1	12%	Other
9	Deliberate delay in construction by the GC	1	22%	Contractor
10	Change of consultant during project execution	1	39%	Consult

Four delay factors are related to the owners as shown in tables 4. Land acquisition is the most frequent and severe cause of delay that affects the projects in Mecca. This factor is related to the owners as they are the responsible party for preparing the project site before beginning construction. Previous researchers have stated that "more than two-thirds of the total cost of some public projects in Mecca may be held in legal battles between land owners" [29]. Land ownership issues are long in duration and must be resolved legally, which affects the assigned projects in time extensions and an extra expense to the owner adds to the original cost of the projects. The factor of line services or underground utilities is also related to the owner as he is the responsible party for knowing all the existing line services within the project site before starting construction. This issue needs more coordination with other agencies

to inform the contractor about all the line services to avoid any time delays. Re-designing issues are also related to the owner as all the projects were design-bid-build and the owner gives the contractor a full design before the beginning of construction. Two factors of delays are related to contractors. Lack of expertise in the contractors' managers and technical staff caused a massive time extensions in Mecca projects. Causes of delay that results from other governmental agencies are categorized as 'Other.' Miscommunication and lack of coordination with other agencies considerably affected the project in Mecca to complete on time as well. Mecca is continuously witnessing unprecedented construction development by different government organizations and direct co-ordination between these organizations is weak and projects are often mismatched [29].

Table 4 - Categorizing the Risk Factors for each party

No.	Risk Factors	Category (related to)
1	Land acquisition	Owner
2	Line services	
3	Re-designing	
4	Variation in estimated quantities	Contractor
5	Contractors' lack of expertise	
6	Deliberate delay in construction by the GC	Contractor
7	Change of consultant during project execution	Consultant
8	Differences in opinions from the Ministry of Traffic	Other Stakeholders (local public, land owners, etc.)
9	Clashes with other Ministries	
10	Miscommunication between various stakeholders	

Table 5 shows the percentage of delays caused by respective parties among the 49 infrastructure projects. Owner related delays turned out to be the highest, as they were responsible for 53% of project delays, i.e. 26 out of 49 projects were delayed due to the owner. This is similar to the GCC studies as owner related causes were the highest with 49.2% occurrence rate. Contractor related causes were ranked the second as contractors were responsible for 27% project delays affecting 13 projects out of the 49 into consideration. This is also similar to the GCC studies as contractors were responsible for 36% of the time extension causes. Causes of delays that results from miscommunication and lack of coordination with other agencies affected 9 projects and responsible for 19% of the time extensions in the 49 cases.

Table 5 - Responsibility percentages of the causes for each party

No.	Categories	%	No. of Projects (out of 49)
1.	Owner-related	53	26
2.	Contractor-related	27	13
3.	Consultant-related	1	1
4.	Other Stakeholders	19	9

7. Comparison of Mecca Projects and other Studies in the GCC Construction Industry

The final stage of this study was to compare the obtained results from the Mecca projects with the GCC studies and evaluate the similarities and differences in them. Table 6 shows a comparison between the top four causes of delays in the 49 case studies and the GCC studies. Land acquisition is the most frequent cause in the case studies and it is only mentioned in one GCC study. This is due to the special situation in Mecca considering land ownership issues as mentioned earlier and the type of case studies (roads and bridges). Contractor' lack of expertise is mentioned in all the GCC studies which highlights the issue of having inexperienced contractors in the GCC. Re-designing and line services were mentioned in half of the GCC studies (5 papers). It was found that almost all of the delay factors (except Land acquisition) and their ranking were the same as analyzed in the GCC studies.

Table 6 - Comparison between the Major Risks Factors for the Research Case studies and GCC Studies

	1	2	3	4	5	6	7	8	9	10	
Major Risk factors for the research case studies	[27]	[20]	[12]	[21]	[24]	[28]	[23]	[22]	[26]	[25]	Freq.
	SA	SA	SA	SA	SA	SA	Oman	UAE	KUW	BAH	

1. Land acquisition										√	1
2. Contractor' lack of expertise	√	√	√	√	√	√	√	√	√	√	10
3. Re-designing	√			√				√	√	√	5
4. Line services		√			√	√	√			√	5

Countries' abbreviations Saudi Arabia (SA), United Arab Emirates (UAE), Kuwait (KUW), and Bahrain (BAH).

8. Conclusion

Increasing need for infrastructure development aided by sufficient capital reserves of the Kingdom of Saudi Arabia has led to a tremendous growth in the construction industry. This growth is being decelerated by the significant impacts of construction delays. In this delay factor analysis of infrastructure projects (roads and bridges) in the Mecca province of Saudi Arabia, it was realized that the major cause for delay was attributed to the owner's. Among 10 different delay factors that were categorized under owners, contractors, consultants, and other stakeholders, it was found that 'land acquisitions' caused the majority of delay in infrastructure projects. The average time overrun for 49 infrastructure projects in the Mecca province was found to be 39% of the estimated project schedule. Delay factors that contributed for the majority of time overruns were; land acquisition, contractor' lack of expertise, re-designing, and line services (haphazard underground utilities). The severest among these was found to be the issue of land acquisition which contributed to majority of the time delay in infrastructure projects in the Mecca province. This is mainly due to the historical, religious, and topographical features of this special province in Saudi Arabia. Delays owing to the owners were found to be the highest as they were responsible for 53% of the time delays (26 out of 49 projects). Contractors were responsible for 27% project delays among the 49 projects. This was followed by miscommunication between various stakeholders (19%). This finding matched with the studies done in the Gulf Countries Construction (GCC) industry. In the analysis of the GCC studies, it is found that owners were responsible for causing 49.2% of the delay and contractors caused 36% of the delay.

The delivery of projects depends on the efforts of different parties and they contribute to project delays differently. Further research should be applied to investigate how the parties' roles in the project's process can be coordinated and effectively employed to enhance processes and avoid parties from causing risks that affect the projects' completion times. Similar research can be performed in other project types to investigate the root causes of project delays with evaluating the effect and involvement of project parties to the delays. For example, the problem of owners' managerial activities and their involvement need to be reconsidered and investigated to reduce their liability. The authors also recommend further research should be applied to implement strategies used by other countries to actively and consistently prevent land ownership conflicts by developing an adequate institutional framework that organize this major issue and reduce land acquisition disputes. In addition, the contractors' lack of experience is a major issue in all GCC industries and better prequalification and selection systems should be developed and implemented to hire experts who do not have technical risks.

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