

Owners' Perspective of Factors Contributing to Project Delay: Case Studies of Road and
Bridge Projects in Saudi Arabia

by

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ABSTRACT

Delays are a major cause for concern in the construction industry both globally and locally in Saudi Arabia. This paper identifies the main causes of delay in infrastructure projects in the holy city of *Makkah* (Saudi Arabia) and compares these with projects around the rest of the country and other Gulf countries as well. Data were obtained from 49 infrastructure projects that were undertaken by the owner and were analyzed quantitatively to understand the severity and causes of delay. 10 risk factors were identified in this study and these factors were grouped into four categories. The average delay in infrastructure projects in the city of *Makkah* 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 is prevailing in *Makkah*. In addition to this, other factors include contractors' lack of expertise, haphazard underground utilities (line services), and re-designing. It is concluded that majority of delays were caused from the owner's side as compared to contractors, consultants, and other project's stakeholders. This finding was in line with the research findings of the Gulf Countries Construction (GCC) Industry's literature as well. This study will fill an important practice and research gap for improving the efficiency in project delivery for infrastructure projects in the holy city of *Makkah* and the Gulf countries at large.

Key words: *Delay, construction industry, Saudi Arabia, Risks, Roads and bridges.*

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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 huge amount of resources and money to develop its myriad infrastructure all over its territory. The strong economic position of the country has been driving these bold and dynamic decisions and abounding investments in construction projects. To put this into perspective, between 2008 and 2013, the government spent close to USD574.7 B on construction projects (Ventures Middle East, 2011). 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, the construction industry analysts around the world expect this growth to advance even more by 2015 (World Construction, 2012).

Form 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. Al-Ghafly (1995) surveyed the contractors and consultants of major construction projects. His findings showed that around 37% of the 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. The researcher also reported that the average estimated time overrun amounted to 39% of the contractual time period. To support his claims, a study was conducted by Al Turkey (2011) 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. Contractors in Saudi Arabia estimate the total value of delayed public projects at nearly USD146.6 B (Arab News, 2011).

Makkah Almukarramah is regarded as the holiest site in Islam religion and is a center of Muslim pilgrimage. This place holds a special position for the followers of Muslim religion all over the world and it receives over 20 million pilgrims annually (Irfan Mohammed, 2014). The high volume of religious devotees and tourists in this city has led to the enormous infrastructure development which is seen here. The expansion of the Holy Mosque has cost the government around USD10.6 B in just a span of 6 years (2010 to 2015). This enormous cost of development was to develop the 6000 sq.mt. area around the holy mosque (Qssas, 2014). 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 *Makkah* were around \$80,000/sq.mt. during 2008 (Al Thaqafi, 2008). This figure rose to \$133,000/sq.mt. during 2010 (CW Staff, 2010) and to \$400,000/sq.mt. during 2013 (Arab News, 2013). Consequently, the Saudi government spent over \$8.8 billion for land acquisition between 2009 and 2010 (Al Mufadhli, 2011).

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. Zain Al-Abiedien (1983) found that delays were a concern for over 70% of all the projects undertaken by the

Ministry of Housing and Public Works. Al-Sultan (1989) reported the same percentage of delays in construction projects even after six years. Al-Khalil and Al-Ghafly (1999) 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 (Assaf & Al-Hejji 2006). Projects in the *Makkah* (Western province) are not an exception to these delays.

With over 5 years of intensive work experience as a Project Manager for public infrastructure projects, the researcher himself believes that delays are a major hindrance during execution of public projects. While very limited research has been done till date that analyses the root cause of delays, it is a challenge for the industry professionals to understand it and then 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 *Makkah* province of Saudi Arabia. The objectives are to:

- i) Determine the performance of 49 infrastructure projects
- ii) Identify the causes of delay and the agencies responsible for each of them as per the owner's perspective
- iii) Compare the analyzed delay factors and case findings with other studies from Saudi construction 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 available on similar background.

Literature review is an important stage in conducting any research because it helps the researchers to enhance their knowledge in the research topic and oversee a broader perspective. It was found that all previous studies to analyze the delay factors in Saudi construction industry (by the Gulf Countries Construction industry – GCC) were completely based on literature reviews. For the evaluation part, researchers tend to conduct survey to assess the causes impact, severity and frequency. However, in this study, the author will identify the delay causes based on 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 its severity will be measured in terms of percentages. By assigning these delay factors to the responsible stakeholders, the root cause for majority of delay 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 *Makkah* province. The researcher has been working as a construction Project Manager for the Government for past 5 years. His forte is to manage and oversee the infrastructure (roads and bridges) projects in Makkah located at the Western province of Saudi Arabia. This study is limited to the constructions taking place only in the *Makkah* province mainly because of the

familiarity and expertise of the researcher in this 1,200 sq.km area. Moreover, all the cases in consideration, 49 in total, are either bridge or road projects. The reason for selecting these projects is because of the huge demand to construct and develop the infrastructure in this region to cater to 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 author intends to analyze a total of 49 construction projects in *Makkah* 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 the same, 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:

- i) Total cost of the project
- ii) Planned v/s actual start and completion date
- iii) Factors that caused delay in those projects

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

5. LITERATURE REVIEW

While reviewing literatures that has described about various cause and effects of delays in Saudi and other Gulf Countries' Construction (GCC), the severity of the situation was realized. The definition of delay in construction industry is the time overrun in the projects' planned schedule that was agreed upon by all the stakeholders of the project. For the client/owner, time delay causes 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 time, excess hire charges for plant and equipment, material and space utilization, loss or damage of construction materials, and inflation factors (Assaf and Al-Hejji, 2006). Any construction project's lifecycle can be broadly classified into three categories viz; conceptualization/pre-construction phase, design, and the construction phase. Most of the causes for delay happen during the construction phase because various unforeseen risks are continuously involved (Chan and Kumaraswamy, 1997).

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. 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 his agents such as design changes or late release of drawings. In these cases, the vendor receives compensation from the owner as indirect costs for his extra overhead costs (Gardezi, Manarvi, and Gardezi 2014).

In addition, there are two groups of causes of delay in construction industry that could be categorized according to (Ahmed et al., 2003) 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. Whereas the external causes for delay are out of control for the owners, contractors, and consultants. These external causes could be:

- i) Acts of God
- ii) Shortage of building materials in the market
- iii) Unavailability of proper equipment in the market
- iv) Adjustments in government's laws and regulations

Similarly, various other studies have been performed in the construction industry with an aim to determine the causes of delay. The following studies have been identified in GCC countries:

- i) Albogamy (2012) conducted a survey to assess the relative importance of 63 delay factors in Saudi Arabia and found that the owner/client and contractor related factors are the most critical reasons of delay. The top six delay factors with highest impact on the Saudi construction projects are: low performance of the selected contractors in the

Saudi government, tendering system (lowest bidder), delays in sub-contractors tasks, poor experience and skill of the contractors' technical staff, poor planning and scheduling by contractor, owner's payment delays, and design changes by the owner.

- ii) Mahamid (2013) identified 35 delay factors and conducted a survey to identify the contributors of delay in public infrastructure projects in Saudi Arabia. This survey was completed by 22 public owners of construction projects and concluded that the most critical causes of delay are the bid award for lowest price, poor site management, poor communication and coordination between construction parties, payments delay, poor labor productivity, and rework.
- iii) Assaf and Al-Hejji (2006) identified 73 causes of delay and found that 70% of construction projects experienced time overruns. They conducted a survey and found that the most common cause of delay between all parties (contractors, owners and consultants) are the change orders. They added that owners specified that causes of delays are related to contractors and labors considering the causes of ineffective planning and scheduling, poor site management, shortage and poor productivity of labors and poor qualification of contractor technical staff. However, all parties agreed that traffic control and restrictions at site are the least important causes of delay. Finally, the study concluded that owners and consultants identified that low bid awarding system is the highest frequent factor of delay.
- iv) Assaf (1995) identified 56 causes of delay and conducted a survey which concluded that the most important delay factors according to owners were design errors, inadequate labor skills, and labor shortages. Whereas the most important delay

factors according to contractors are preparation and approval of shop drawings, delays in contractors' progress, payment by owners, and design changes by owners.

- v) Al-Khalil and Al-Ghafly (1999) conducted a survey to determine the most important causes of time extensions in public utility projects in Saudi Arabia from the point of view of owners, consultants and contractors which ranked 60 causes of delay. The 10 most important delay causes included the poor qualification of the contractor's technical staff, contractor's poor coordination with the project stakeholders, owner's failure and poor communication with the government authorities and construction parties and the government low bid awarding system.
- vi) Al-Kharashi and Skitmore (2009) conducted a survey to assess the causes of delay and found that the most influential cause of delay in the Saudi construction industry is the shortage of experienced and qualified professionals in the industry. Additional important causes include owners and contractor's poor communication with the construction stakeholders, suspension of work and late approving of design by owners, delay in contractor's submissions, ineffective planning and site management by contractors, frequent changes of subcontractors, poor qualifications of contractors' technical staff and type of projects awarding system (lowest bidder).
- vii) Alnuamimi and Al Mohsin (2013) conducted a field study of construction projects in Oman to identify the causes of delay and found that 40% of projects were delayed. The main causes of delay included changing in initial design, lack of experienced contractors and subcontractors and lack of communication between the construction parties.

- viii) Fraidi and Al-Sayegh (2006) spread a questionnaire to professionals in the UAE construction projects (contractors and consultants) to assess and rank 44 causes of delays and found that 50% of the projects encounter delays. The top significant causes of delays include inadequate early planning of projects, preparation and approval of drawings, lateness of owner's decisions, poor supervision and poor site management of contractors, lack of skills and productivity of manpower and lack of communication of getting approvals from different governmental parties.
- ix) Koushki, P. Al-Rashid, K. and Kartam, N. (2005) conducted a survey to evaluate the causes of delays in the construction of private residential projects in Kuwait. According to the opinion of owners of this type of projects, the main causes of time extensions are orders changes because of designs deficiencies, clients' lack of experience and lack of experienced contractors' staff.
- x) Hassan, R. Suliman, S. and Al Malki, Y. (2014) investigated the causes of delay in road projects in Bahrain by evaluating the frequency and severity of 47 causes of delay. The survey field results showed that the most significant causes related to contractors include shortage and inexperienced contractors' manpower, lack of equipment, poor planning and scheduling and ineffective communication between contractors and other stakeholders. the significant causes related to utilities and services included late response from utilities organizations, alteration of obstructing lines of services and undefined or imprecise locations of services networks in design's drawings. Furthermore, the most important causes related to government regulations were complications in getting work permits, bid award system for lowest price and

land acquisition. Finally, the main causes related to owners and consultants included suspension of works, major changes of design and scope and delay in decision making.

The top ranked causes of delay in the previous 10 studies are summarized in appendix A. Table 1, shows a comparison between each GCC study the most frequent risk factors of delays as mentioned in GCC studies.

Ranking of the main causes of delay as identified in the GCC studies (based on its frequency of occurrence) is mentioned in Table 2. Contractor experience got the highest rank as it was the main cause of delay for all of the 10 studies. The second most frequent delay factor was the financial constraints by the owner as this cause accrued in 8 studies. Facing unidentified design errors/changes occurred in 3 case studies. Delay in performing testing and inspection by consultant, and type of project bidding and award (negotiation, lowest bidder) are ranked fourth and fifth respectively as they occurred in 3 studies.

Subsequently, Table 3 shows the responsible parties of the identified causes of delay in GCC studies by showing the responsibility percentages of the causes of delay. Owner related causes were the highest as they were responsible for 57% of the time extensions. Contractor related causes were ranked the second as contractors were responsible for 29% of the time extensions causes.

Table 1

Comparison of the major risk factors of delay with each study

	1	2	3	4	5	6	7	8	9	10	Freq.
Major Risk factors for the given case studies	Albogamy 2012 KSA	Mahamid 2013 KSA	Assaf 2006 KSA	Assaf 1995 KSA	Al-Khalil 1999 KSA	Al-Kharashi 2009 KSA	Alnuamimi 2013 Oman	Fraidi 2006 UAE	Koushki 2005 KUW	Hassan 2014 BAH	
1. Contractor experience	√	√	√	√	√	√	√	√	√	√	10
2. Financial constraints by owner	√	√	√	√	√	√			√	√	8
3. Design changes	√			√			√				3
4. Delay by Consultants						√		√		√	3
5. Issues in tendering and bidding	√	√	√								3
6. Materials in market						√	√				2
7. Change orders			√						√		2
8. Decision making								√		√	2
9. Difficulties in obtaining work permits					√					√	2

Table 2

Frequency of GCC Studies

	Risk Factor	Frequency	%	Related to
1	Contractor experience	10	28.6 %	Cont.
2	Financial constraints by the owner	8	22.9 %	Owner
3	Design errors/changes	3	8.6 %	Owner
4	Delay in performing testing and inspection by consultant	3	8.6 %	Cons.
5	Type of project bidding and award (negotiation, lowest bidder)	3	8.6 %	Owner
6	Materials in market	2	5.7 %	Other
7	Change orders	2	5.7 %	Owner
8	Decision making	2	5.7 %	Owner
9	Difficulties in obtaining work permits	2	5.7 %	Owner
	TOTAL	35		

Table 3

Responsibility percentages of the causes for each party FOR GCC Studies.

	Group of Risk	%	Frequency
1.	Owner related	57.2	20
2.	Contractor related	28.6	10
3.	Consultant related	8.6	3
4.	Other	5.6	2
		100%	35

6. DISCUSSION AND ANALYSIS

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 *Makkah* province. The table in appendix B shows the collected data of 49 case studies for roads and bridges projects from the *Makkah* province. It shows the project type either road or bridge project or both 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, line services, re-designing, 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 GC and changing consultants during project execution.

Following Table 4 shows the ranking of main identified causes of delay in the studied projects based on the frequency of occurrence of each cause. Land acquisition got the highest rank as it was 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 and not having enough equipment as this cause accrued in 12 cases with an average of 56% time extension for the effected projects. Facing unidentified line services

(underground utilities) in the design rank third in severity as it occurred in 9 cases with an average of 48% time extension of the effected projects. Re-designing ranked fourth in severity of delay as it occurred in 8 projects with an average of 49% time extension of the effected projects.

Table 4

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%	Contr.
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%	Contr.
10. Change of consultant during project execution	1	39%	Cons.

Four delay factors are related to the owners as shown in table 5. Land acquisition is the most frequent and severe cause of delay that affects the projects in *Makkah*. This factor is related to the owners as they are the responsible for getting the ownership and preparing the project site before beginning construction. Assaf (1996) stated that “more than two-thirds of the total cost of some public projects in *Makkah* may be held in legal battles between land owners”. Land ownership issue consumes long time to be resolved legally which affect the assigned projects in time extensions and extra expense to the owner adds to the original cost of the projects. The factor of line services or underground utilities as it may be called 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 full design before beginning construction.

Three factors of delays are related to contractors. Lack of expertise in the contractors’ managers and technical staff caused a massive time extensions in *Makkah* projects. Causes of delay that results from other governmental agencies are categorized as others. Miscommunication and lack of coordination with other agencies considerably affected the project in *Makkah* to complete on time as well. *Makkah* is continuously witnessing unprecedented construction development by different government organizations and direct co-ordination between these organizations is weak and projects are often mismatched (Assaf 1996).

Table 5

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	

1	Contractors' lack of expertise	CONTRACTOR
2	Deliberate delay in construction by the GC	

1	Lack of expertise	CONSULTANT

1	Differences in opinions from the Ministry of Traffic	OTHER STAKEHOLDERS (local public, land owners, etc.)
2	Clashes with other Ministries	
3	Miscommunication between various stakeholders	

Table 6

Responsibility percentages of the causes for each party

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

Table 6 shows the percentage of delays caused by respective parties among the 49 infrastructure projects that were into consideration. 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 57% occurrence. 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 29% 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.

7. COMPARSION WITH OTHER STUDIES IN THE GCC CONSTRUCTION INDUSTRY

The final stage of this case study was to compare the obtained results with the same of GCC studies and evaluate the similarities and differences in them. Table 7 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 because of the special situation in *Makkah* land ownership as mentioned earlier and because of the type 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 of the delay factors and ranking of them were the same as analyzed in GCC studies. This indicates the need of collaborative efforts by the Government officials and all the contractors in this industry to eliminate these delay causes and help improve the productivity of all the stakeholders.

Table 7

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	Albogamy 2012 KSA	Mahamid 2013 KSA	Assaf 2006 KSA	Assaf 1995 KSA	Al-Khalil 1999 KSA	Al-Kharashi 2009 KSA	Alnuamimi 2013 Oman	Fraidi 2006 UAE	Koushki 2005 KUW	Hassan 2014 BAH	Freq.
Land acquisition										√	1
Contractor' lack of expertise	√	√	√	√	√	√	√	√	√	√	10
Re-designing	√			√				√	√	√	5
Line services		√			√	√	√			√	5

CONCLUSION

Increasing need for infrastructure development aided by huge capital reserves of the Kingdom of Saudi Arabia has led to a tremendous growth in the construction industry of this country. In this study of delay factor analysis for infrastructure projects in the *Makkah* province of Saudi Arabia, it was realized that the major cause for delay was attributed by the owner's side. 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 *Makkah* province was found to be 39% of the estimated project schedule. Delay factors that contributed for the majority of time overrun were; land acquisition, contractor's 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 *Makkah* province. This is mainly due to the historical, religious, and topographical features of this special province in Saudi Arabia.

Delays owing to the owner 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 (29%), and consultants owed to 1% of the delays. This finding was completely in line with the case studies and researches done by the Gulf Countries Construction (GCC) industry. According to the GCC, owners caused 57% of the delay, followed by contractor (29%), and finally miscommunications between different stakeholders caused delays in 6% of the total projects as observed in their case studies.

Recommendations: Taking clues from other developing and developed countries, it was realized that the first and most important step in actively and consistently preventing land conflicts will always be to establish an adequate institutional framework and to re-establish (traditional) values by creating incentives, checks and balances as well as sanctions aiming at positively influencing people's behavior (Babette Wehrmann, 2008). Other steps to ease land acquisitions would be to frame a Land Acquisition Law, zoning of the region to fix a base price for the land, and setting up of Fast Track Courts/Liaison committees to resolve land acquisition disputes.

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APPENDIX A

THE MAIN CAUSES OF DELAY IN THE PREVIOUS STUDIES IN GCC

APPENDIX A: Main causes of delay in the previous Studies in GCC

Reference	Country	Top 6 Causes of delay in each study
1. Albogamy, A (2012)	Saudi Arabia	<ol style="list-style-type: none"> 1. Low performance of lowest-bidder contractor in tendering system 2. Delay in sub-contractors' work 3. Poor qualifications, skills and experience of the contractor's technical staff 4. Poor planning and scheduling of the project by the contractor 5. Delay in progress payments by the owner 6. Design changes by the owner
2. Mahamid, I 2013	Saudi Arabia	<ol style="list-style-type: none"> 1. bid award for lowest price 2. payments delay 3. Poor communication and coordination between construction 4. Parties 5. poor labor productivity 6. Poor site management
3. Assaf,S and Al-Hejji,S 2006	Saudi Arabia	<ol style="list-style-type: none"> 1. Change orders. 2. Type of project bidding and award (negotiation, lowest bidder,) 3. Delay in progress payment 4. Ineffective planning and scheduling by contractor. 5. Poor site management by contractor. 6. Shortage of labors.
4. Assaf et al 1995	Saudi Arabia	<ol style="list-style-type: none"> 1. Design errors made by designers 2. Excessive bureaucracy in project-owner operation 3. By contractor during construction 4. Labor skill 5. Unavailability of professional construction management 6. Cash problems during construction

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APPENDIX A: Main causes of delay in the previous Studies in GCC.(CONTINUED)

Reference	Country	Top 6 Causes of delay in each study
5. Al-Khalil, M., and Al-Ghafly, M. 1999	Saudi Arabia	<ol style="list-style-type: none"> 1. Cash flow problems faced by the contractor 2. Difficulties in financing the project by the contractor 3. Difficulties in obtaining work permits 4. Ineffective planning and scheduling of the project by the contractor 5. Improper technical study by the contractor during the bidding stage 6. Delay in progress payments by the owner.
6. Al-Kharashi, A., and Skitmore, M. (2009)	Saudi Arabia	<ol style="list-style-type: none"> 1. Lack of finance to complete the work by the client (owner) 2. Contractor experience. 3. Shortage of manpower and skilled. 4. Shortage of construction materials in market. 5. Original contract duration is too short. 6. Late in approving and reviewing design documents by consultant.
7. Alnuamimi, A. and Al Mohsin, M. 2013	Oman	<ol style="list-style-type: none"> 1. Owner instructs additional works 2. Owner instructs modification to design 3. Natural growth of the project was not anticipated at the design stage.(different quantity between design and site) 4. Design errors 5. The contractor misuses variations instructions. 6. Shortage of manpower.
8. Fraidi, A. and Al-Sayegh, S. 2006	UAE	<ol style="list-style-type: none"> 1. Preparation and approval of drawings.(consultant) 2. Inadequate early planning of the project. 3. Slowness of the owner's decision-making process. 4. Shortage of manpower (contractor) 5. Poor supervision and poor site management (contractor) 6. Productivity of manpower.

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APPENDIX A: Main causes of delay in the previous Studies in GCC.(CONTINUED)

Reference	Country	Top 6 Causes of delay in each study
9. Koushki, P. Al-Rashid, K. and Kartam, N. 2005	Kuwait	<ol style="list-style-type: none"> 1. Change orders. 2. Financial constraints. 3. Owner's lack of experience. 4. Materials. 5. Weather. 6. Contractor.
10. Hassan, R. Suliman, S. and Al Malki, Y. 2014	Bahrain	<ol style="list-style-type: none"> 1. Budget availability for the project 2. Delay in decision making by the owner 3. Land acquisition. 4. Delay in performing testing and inspection by consultant. 5. Unclear or undefined of services network in drawings.(services and utilities) 6. Difficulties in obtaining work permits.

APPENDIX B:

DATA COLLECTION OF THE 49 ROADS AND BRIDGES PROJECTS

APPENDIX B: Data collection of the 49 Roads and Bridges projects

No	Type of project	Contract cost	Risk Factor	Delay
1	Bridge+ road	\$ 92,108,944.11	Land acquisition	36%
2	Bridge+ road	\$ 23,565,659.33	Land acquisition / Line services	23%
3	Bridge+ road	\$ 176,963,823.32	Land acquisition/Line services	47%
4	Bridge+ road	\$ 96,174,262.75	Land acquisition	72%
5	Bridge+ road	\$ 31,095,704.80	Line services / Re-designing	66%
6	Bridge+ road	\$ 111,468,841.85	Land acquisition - Re-designing/ Line services	77%
7	Bridge+ road	\$ 33,020,109.87	Line services / and Land acquisition	81%
8	Bridge+ road	\$ 17,433,269.33	Line services / Re-designing	40%
9	Bridge+ road	\$ 17,018,496.00	Line services / Re-designing	14%
10	Bridge+ road	\$ 57,019,160.00	Land acquisition	14%
11	Bridge+ road	\$ 20,533,333.21	Differences with Ministry of Traffic	12%
12	Bridge+ road	\$ 18,251,114.67	Re-designing for the train line design	75%
13	Bridge+ road	\$ 71,620,956.00	Line services / Re-designing	37%
14	Bridge	\$ 27,573,333.33	Redesign the bridge / Change the consult	39%
15	Road	\$ 6,666,666.67	Land acquisition	24%
16	Road	\$ 1,969,600.00	Clashes with other Ministries	19%
17	Road	\$ 6,608,906.40	Clashes with other Ministries	13%
18	Road	\$ 4,376,026.93	Contractor' lack of expertise	92%
19	Road	\$ 1,362,266.67	Land acquisition	17%

(CONTINUED)

APPENDIX B: Data collection of the 49 Roads and Bridges projects. (CONTINUED)

No	Type of project	Contract cost	Risk Factor	Delay
20	Road	\$ 2,666,666.67	Land acquisition	41%
21	Road	\$ 5,108,500.00	Variation in estimated quantities	33%
22	Road	\$ 1,956,920.00	Contractor' lack of expertise	10%
23	Road	\$ 7,422,800.00	Contractor' lack of expertise	146%
24	Road	\$ 7,076,133.33	Contractor' lack of expertise	157%
25	Road	\$ 7,076,133.33	Contractor' lack of expertise	53%
26	Road	\$ 2,133,333.33	Contractor' lack of expertise	18%
27	Road	\$ 23,565,659.33	Re-designing	44%
28	Road	\$ 1,339,333.33	Land acquisition	16%
29	Road	\$ 264,853.33	Contractor' lack of expertise	48%
30	Road	\$ 2,210,131.20	Contractor' lack of expertise	21%
31	Road	\$ 6,288,378.67	Design conflicts between owners	16%
32	Road	\$ 20,928,590.93	Design conflicts between owners	24%
33	Road	\$ 2,666,665.20	Clashes with other Ministries	31%
34	Road	\$ 2,666,666.13	Re- designing	16%
35	Road	\$ 2,666,665.20	Deliberate delay by the GC	22%
36	Road	\$ 2,666,666.37	Land acquisition	10%
37	Road	\$ 2,666,666.59	L.A / Clashes with other Minis.	23%
38	Road	\$ 1,299,200.00	Land acquisition	23%

(CONTINUED)

APPENDIX B: Data collection of the 49 Roads and Bridges projects. (CONTINUED)

No	Type of project	Contract cost	Risk Factor	Delay
39	Road	\$ 1,627,026.67	Land acquisition / Electrical cables	44%
40	Road	\$ 2,288,194.67	Land acquisition	39%
41	Road	\$ 3,212,618.67	Re-designing	37%
42	Road	\$ 3,614,666.67	Variation in estimated quantities	22%
43	Road	\$ 1,274,098.67	Contractor' lack of expertise	32%
44	Road	\$ 2,748,184.37	Clashes with other Ministries	37%
45	Road	\$ 2,210,131.20	Contractor' lack of expertise	35%
46	Road	\$ 1,732,873.33	Clashes with other Ministries	20%
47	Road	\$ 906,360.00	Contractor' lack of expertise	32%
48	Road	\$ 266,666.67	Land acquisition	31%
49	Road	\$ 2,666,665.20	Contractor' lack of expertise	26%
TOTAL		\$ 937,914,590.97		AVG:38.88%