STRUCTURAL RELATIONSHIPS MODELOF DELAY FACTORS IN MAKKAH CONSTRUCTION INDUSTRY

NASHWAN HAMID YAHYA AL-EMAD

UNIVERSITI TUN HUSSEIN ONN MALAYSIA
STRUCTURAL RELATIONSHIPS MODEL OF DELAY FACTORS IN MAKKAH CONSTRUCTION INDUSTRY

NASHWAN HAMID YAHYA AL-EMAD

A thesis submitted in fulfillment of the requirement for the award of the Degree of Master of Civil Engineering

Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia

SEPTEMBER 2016
For my beloved father & mother for their support and prayers
For my beloved wife & daughter (WEDD) who supported me in all my endeavours
ACKNOWLEDGEMENT

First of all, I am much grateful to Allah SWT, for HIS blessings and granting me the strength and opportunity to complete this work.

I am extremely grateful to my supervisor Professor Dr. Ismail Abdul Rahman for his unconditional support and outstanding guidance. Without his professional supervision, this thesis would not have been the same as presented. I am really thankful to my co-supervisor Dr. Sasitharan Nagapan who was very kind with me and made all possible supports and helps throughout my study.

I would like to appreciate my parents for their continuous prayers. Also, It is my paramount responsibility to tribute my beloved wife who encouraged me to pursue my master degree study and stay together with me in Saudi Arabia, Makkah city and take care of herself during her pregnancy period and take care of my 1st daughter (WEDD) until completion of this study. I have no words to describe my gratitude for their sacrifices and prayers.

I take this opportunity to extend my heartfelt thanks to lecturers, academic and non-academic staff of Universiti Tun Hussein Onn Malaysia for all continuous supports during this challenging journey.

Finally, I would like to thank those who have directly or indirectly helped me in completing this study including friends, colleagues and construction practitioners in Makkah city.
ABSTRACT

Even though construction industry contributes significantly to the development but it faces many challenges including delay. There are several research works on the delay that focusing on delay factors globally including Saudi Arabia. Hence this study was intended to identify the delay factors faced by Makkah construction industry and also to establish structural relationship of the factors toward the construction delay. A literature review that was carried out and found eighty one delay factors recorded from previous research works carried out in different countries including Saudi Arabia. Based on these factors, a pilot study involved twenty eight construction experts who are working in Makkah construction projects was carried out to determine the factors’ validity and relevancy. Result has reduced to thirty seven factors which subsequently being used in actual survey questionnaire. Two hundred fifty questionnaires were distributed among construction practitioners in Makkah city. Only one hundred valid responses were collected and considered for analysis. Ranking analysis using Average index approach (AI) found ten most significant factors causing construction delay are Difficulties in financing project by contractor, Poor coordination between parties, Shortage of manpower, Delays in producing design documents, Improper planning and scheduling of the project, Delay in progress payments, Low productivity level of labour, Poor communication between parties, Unqualified workforce and Poor contract management. Then, the data were further used to develop structural relationship model of the delay factors using SmartPLS software. Based on the model, it was found that group’s factor which has the highest impact on construction delay with path coefficient β-value of 0.452 is the client and consultant group. Overall performance of the model can be summarized as having moderate explaining power ability with $R^2$ value of 0.197 which means that the model is valid to represent construction industry in the city of Makkah. By identifying these factors, it will provide awareness to Makkah construction’s community in avoiding any potential delay in handling their construction projects.
ABSTRAK

Industri pembinaan menyumbang dengan ketara dalam pembangunan namun menghadapi banyak cabaran termasuk kelewatan. Terdapat beberapa penyelidikan yang memfokuskan faktor kelewatan secara global termasuk di Arab Saudi. Oleh itu, kajian ini bertujuan mengenal pasti faktor kelewatan dalam industri pembinaan di Mekah dan membangunkan hubungan berstruktur bagi faktor kelewatan terhadap pembinaan. Kajian literatur yang dijalankan mendapat 81 faktor kelewatan direkodkan daripada pelbagai negara termasuk Arab Saudi. Seterusnya, kajian rintis dijalankan meliputi 28 pakar yang bekerja dalam projek pembinaan di Mekah bagi menentukan kesahan dan kebolehpercayaan faktor. Analisis keputusan kajian telah mengurangkan sebanyak 37 faktor yang digunakan untuk borang soal selidik yang sebenar. Sebanyak 250 borang soal selidik diedarkan kepada pengamal pembinaan di bandar Mekah dan hanya 100 jawapan yang sah telah dikumpulkan. Analisis kedudukan menggunakan kaedah Average Index (AI) mendapatkan 10 faktor yang penting yang menyebabkan kelewatan adalah kesukaran kontraktor dalam kewangan projek, koordinasi yang lemah antara pihak, kekurangan tenaga kerja, kelewatan penghasilan dokumen rekabentuk, perancangan dan penjadualan projek yang lemah, kelewatan dalam bayaran kemajuan kerja, tahap produktiviti pekerja yang rendah, komunikasi yang lemah antara pihak, tenaga kerja yang tidak berkelayakan, dan pengurusan kontrak yang lemah. Data selanjutnya digunakan bagi membangunkan model hubungan berstruktur bagi faktor kelewatan menggunakan perisian SmartPLS. Model kajian mendapat kumpulan klien dan perunding menunjukkan kesan tertinggi dalam kelewatan pembinaan dengan nilai pekali β adalah 0.452. Prestasi keseluruhan model boleh dirumuskan sebagai sederhana berdasarkan nilai R2 adalah 0.197 yang menunjukkan model adalah sah untuk mewakili industri pembinaan dalam bandar Mekah. Pengenalpastian faktor kelewatan ini menyediakan kesedaran kepada komuniti pembinaan di Mekah dalam mengelakkan potensi kelewatan dalam mengendalikan projek pembinaan.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>xiv</td>
</tr>
</tbody>
</table>

## CHAPTER 1

1.1 Background 1
1.2 Problem Statement 2
1.3 Aim and Objectives 3
1.4 Hypothesis of the Study 3
1.5 Scope of the Study 3
1.6 Research Questions 4
1.7 Significance of the Study 4
1.8 Theoretical Framework of the Study 5
1.9 Thesis Structure 6

## CHAPTER 2

2.1 Introduction 7
2.2 Makkah Construction Industry 7
2.3 Delay in Construction Projects 9
2.4 Definition of Construction Delay 9
2.5 Types of Construction Delay
  2.5.1 Non-Excusable delays
  2.5.2 Excusable Non-Compensable Delays
  2.5.3 Excusable Compensable Delays
  2.5.4 Concurrent Delays
2.6 Effects of Construction Delay
2.7 Construction Delay Factors
2.8 Research Gap
2.9 Summary

CHAPTER 3
3.1 Introduction
3.2 Research Flowchart
3.3 Questionnaires Development
3.4 Measurement Scales
3.5 Pilot Study
3.6 Actual Survey
3.7 Analysis Methods
3.8 Reliability
3.9 Descriptive Analysis
3.10 Factor Analysis
3.11 PLS-SEM Model Development
3.12 Summary

CHAPTER 4
4.1 Introduction
4.2 Pilot study Analysis
  4.2.1 Respondent’s Demography
  4.2.2 Delay Factors Relevancy
4.3 Actual Survey
  4.3.1 Sampling Statistics
  4.3.2 Respondents’ Demography
  4.3.3 Reliability Test
  4.3.4 Ranking of Delay Factors
4.4 Conclusion
Chapter 5

5.1 Introduction 52
5.2 Factor Analysis 52
5.3 Procedures of Conducting Factor Analysis 53
5.4 Sampling Adequacy Test 54
5.5 Results of Factor Analysis 55
5.6 Relocation of Delay Factors 58
5.7 Conclusion 61

Chapter 6

6.1 Introduction 62
6.2 Development of PLS Model 62
   6.2.1 Model’s Data 64
   6.2.2 Model’s Construction 65
   6.2.3 Run PLS Algorithm 67
6.3 Assessment on Measurement Model 69
   6.3.1 Model’s Performance 70
   6.3.2 Discriminant Validity 74
6.4 Assessment on Structural Model 76
   6.4.1 Impact Path Coefficients (β-value) 77
   6.4.2 Explanatory Power 78
   6.4.3 Hypothesis Testing (t-value) 78
   6.4.4 Model’s Relative Impact (MRI) 80
   6.4.5 Model’s Predictive Relevance (MPR) 85
6.5 Conclusion 93

Chapter 7

7.1 Introduction 94
7.2 Conclusion of the Findings 94
   7.2.1 Objective 1: To Determine Significant
      Construction’s Delay Factors for Makkah city 94
   7.2.2 Objective 2: To Classify the Construction Delay
      Factors 95
   7.2.3 Objective 3: To Develop Structural Relationships
      Model of Delay Factors 95
7.3 Limitation of the Study 95
7.4 Recommendation for Practice 96
7.5 Recommendation for Future Research 96

REFERENCES 98
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Effects of Construction Delay</td>
<td>12</td>
</tr>
<tr>
<td>2.2</td>
<td>Delay Factors in Construction Industry</td>
<td>16</td>
</tr>
<tr>
<td>3.1</td>
<td>Significant Scale’s level</td>
<td>26</td>
</tr>
<tr>
<td>4.1</td>
<td>Respondents’ Demography in Pilot Study</td>
<td>33</td>
</tr>
<tr>
<td>4.2</td>
<td>Sorted AI for Relevancy</td>
<td>34</td>
</tr>
<tr>
<td>4.3</td>
<td>Criteria for Factors’ Relevancy</td>
<td>37</td>
</tr>
<tr>
<td>4.4</td>
<td>Survey Statistics</td>
<td>39</td>
</tr>
<tr>
<td>4.5</td>
<td>Respondents’ Demography in Actual Survey</td>
<td>39</td>
</tr>
<tr>
<td>4.6</td>
<td>Ranking of Delay Factors</td>
<td>42</td>
</tr>
<tr>
<td>4.7</td>
<td>Criteria for Analysing Level of Significance</td>
<td>44</td>
</tr>
<tr>
<td>4.8</td>
<td>The 10 Most Significant Factors Causing Construction Delay</td>
<td>45</td>
</tr>
<tr>
<td>5.1</td>
<td>KMO and Bartlett's Test (SPSS Outputs)</td>
<td>54</td>
</tr>
<tr>
<td>5.2</td>
<td>Factor Analysis Loading Results</td>
<td>55</td>
</tr>
<tr>
<td>5.3</td>
<td>Classification of Delay Factors</td>
<td>59</td>
</tr>
<tr>
<td>6.1</td>
<td>Systematic Evaluation of Measurement Model (Hair et al., 2014)</td>
<td>68</td>
</tr>
<tr>
<td>6.2</td>
<td>Systematic Evaluation of Structural Model (Henseler et al., 2009)</td>
<td>68</td>
</tr>
<tr>
<td>6.3</td>
<td>Iteration 1 Loadings of Individual Item Reliability</td>
<td>71</td>
</tr>
<tr>
<td>6.4</td>
<td>Iteration 1 Convergent Validity of Measurement Model</td>
<td>72</td>
</tr>
<tr>
<td>6.5</td>
<td>Summary of Iteration Process Measurement Model</td>
<td>73</td>
</tr>
<tr>
<td>6.6</td>
<td>Convergent Validity of Measurement Model</td>
<td>73</td>
</tr>
<tr>
<td>6.7</td>
<td>Analysis of Cross Loading of Factors</td>
<td>74</td>
</tr>
<tr>
<td>6.8</td>
<td>Analysis of Average Variance Extracted (AVE)</td>
<td>76</td>
</tr>
<tr>
<td>6.9</td>
<td>Results of Hypothesis Testing</td>
<td>79</td>
</tr>
</tbody>
</table>
6.10: Analysis of Effect size ($f^2$)  
6.11: Predictive Relevance Analysis Based on Effect Size ($q^2$)
LIST OF FIGURES

1.1: Theoretical Framework 5
2.1: Grand Mosque with High Rise Towers 9
3.1: The flow chart of this research 24
5.1: Steps in Factor Analysis 53
6.1: Hypothetical Model of Construction Delay’s Factors 63
6.2: Creating the project worksheet in SmartPLS (Data input) 65
6.3: The Constructed PLS Model 65
6.4: Run PLS Algorithm Screenshot from SmartPLS Software 67
6.5: Parameters Details Resulted from Iteration 1 70
6.6: Path Coefficients values (β) of Structural Model 77
6.7: t-values from Bootstrapping 79
6.8 (a) & (b): $R^2$ Values for DDF Dependent Variable 81
6.9 (a) & (b): $R^2$ Values for PMCAF Dependent Variable 82
6.10 (a) & (b): $R^2$ Values for ICTF Dependent Variable 83
6.11(a) & (b): $R^2$ Values for LAB Dependent Variable 84
6.12: $Q^2$ Values of Cross Validated Redundancy 86
6.13 (a) & (b): $Q^2$ Values of DDF Dependent Variable 87
6.14 (a) & (b): Q2 Values of PMCAF Dependent Variable 88
6.15 (a) & (b): Q2 Values of ICTF Dependent Variable 89
6.16 (a) & (b): $Q^2$ values of LAB dependent variable 90
6.17: The Developed Hypothetical PLS-SEM Model of Construction Delay 92
6.18: Final PLS-SEM Model of Construction Delay Factors 92
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Questionnaire Form for Pilot Study</td>
<td>107</td>
</tr>
<tr>
<td>B</td>
<td>Questionnaire Form for Actual Survey</td>
<td>113</td>
</tr>
<tr>
<td>C</td>
<td>PLS Measurement Assessment Results</td>
<td>117</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Background

Construction industry is one of the important industries which contribute significantly to the economy development of a country. It is a highly dynamic sector and plays vital role to the socio-economic growth of a country (Memon, 2013 & Nagapan, 2014). Also, it enhances the quality life of the surrounding community by providing necessary facilities such as roads, hospitals, schools, hotels and other. Thus, it is important to make the construction projects to complete successfully within the time, budget and desired quality.

Saudi Arabia is the largest exporter of oil in the world and this contributes to the growth of its economy. With good economy, Saudi Arabia is experiencing rapid construction growth in all aspects of construction projects both in urban and rural areas (Samargandi et al., 2013). In view of that Saudi Arabia is the largest construction markets in the Middle East in both of its public and private sectors, where the public sector pertains to the government ministries responsible for infrastructure and national development projects and the private sector comprises the construction projects privately owned or subsidized either by a family corporation or a conglomerate (Al-Emad & Nagapan, 2015). Saudi Arabia’s construction industry is considered the second-largest sector that contributes in the economy of the country after oil. According to Central Department of Statistics & Information, Saudi Arabia (2016), the construction industry contributes to GDP of the country with value amounted SR. 31369 million .The government is progressively allocating huge amount of money to develop its myriad construction projects all over the country
including Makkah city. Mostafa & Al-Buzz (2015) stated that more than USD 100 billion has been allocated for the construction projects which are being constructed in Makkah city including Grand mosque (Al-Haram mosque) in order to improve services being rendered to millions of pilgrims who come for Hajj and Umrah.

However, there are many challenges faced by the Saudi Arabia construction industry and one of them is project delay issue. A study conducted by Assaf & Al-Hejji (2006) found that around 70% of all public sector construction projects experienced delay due to several factors in construction projects in Saudi Arabia. In addition, Al-Emad & Nagapan (2015) mentioned that one of the major issues engulf the construction industry in Saudi Arabia is delay in completing the project within the specified duration. Thus, it is very important to address the factors causing construction delay to ensure the success of construction projects in Saudi Arabia. This study focused on identifying the significant delay factors encountered by Saudi Arabia construction industry focusing on construction projects in the city of Makkah.

1.2 Problem Statement

Construction activities are subjected to the influence of highly changing variables and unpredictable factors which may affect the construction success. The variabilities are from different sources such as the performance of construction parties, resources availability, environmental conditions, involvement of other parties, contractual relations, design errors, unexpected site conditions, increases in project scope, and other project changes. As a consequence of these variabilities, most of the construction industries around the world are facing problems and most commonly is delay of the construction projects. Without exception, Saudi Arabia construction industry is also facing construction delay that resulted in negative impact to the industry image (Sweis et al., 2008). This negative impact has motivated many researchers (Assaf et al., 1995; Al-Khalil & Al-Ghafly, 1999; Assaf and Al-Hejji, 2006; Al-Kharashi & Skitmore, 2009; Albogamy et al., 2012; Mahamid, 2013; Mahamid, 2014; Alotaibi at al., 2014; and Elawi, 2015) to explore the construction delay issue. These previous studies had identified several factors causing construction delay in Saudi Arabia. However, only one of the studies focused on
Makkah city conducted by Elawi (2015) that identified delay factors related to the infrastructure projects (roads and bridges) using univariate analysis which did not consider the relationships between the factors. Hence, there is a need to explore delay factors for all types of construction projects as Makkah city is now experiencing mega development and this will benefit the construction practitioners. Therefore, this study not only identifies the significant delay factors for all types of construction projects but also establishes relationships between the factors using multivariate approach. By identifying the significant delay factors, it will be helpful in controlling any potential delay faced by the construction community in Saudi Arabia for their future projects in order to achieve successful completion of construction projects within the stipulated times.

1.3 **Aim and Objectives**

This study is aimed to establish relationships of construction delay factors of Makkah construction industry. In order to achieve this aim, the following objectives are set:

I. To determine significant construction’s delay factors for Makkah city.

II. To classify the construction delay factors.

III. To develop structural relationships model of delay factors.

1.4 **Hypothesis of the Study**

There are many issues faced by Makkah construction industry and one of them is delay in completing the construction projects according to the stipulated duration of the project. This delay issue normally occurred in due to several causative factors. Hence, this study hypothesized that there are many factors contributing to the project delay however these factors has several level/degree of significance in contributing to the delay of the project which need to be uncovered.

1.5 **Scope of the Study**

This study was carried out in Saudi Arabia focusing on construction industry of Makkah city only. All the respondents of this study were the construction
practitioners who are involving in construction projects in Makkah city, Saudi Arabia. This study adopted a quantitative approach where the collected data were obtained from the construction practitioners including contractor, consultants and project management parties. It used a questionnaire survey to extract the knowledge and experience of the selected respondents. The collected data from the survey was analysed using descriptive method and also multivariate analysis of PLS-SEM modelling approach to establish structural relationships model of the delay factors.

1.6 Research Questions

Based on the problem statement of the study, the research questions are formulated to help researcher into achievable objectives. This research focuses on the following research questions:

i. What are the relevant factors contributed to construction delay?
ii. What is level of significance of each factor in causing the delay?
iii. How to do these factors related between them in contributing to the delay?

1.7 Significance of the Study

This study has identified significant factors which contribute to delay in construction projects for Makkah situation. It not only identified the factors but also able to show the structural relationship between these factors toward the delay of the construction projects using advance multivariate technique of Partial Least Square approach to Structural Equation Modelling (PLS-SEM). Developed PLS-SEM model is an exploratory model for explaining the impact of various factors on construction delay. This model will help construction community to understand the impact of various factors on construction delay. Study findings revealed that consultant and client related factors (CCF) are major contributors to construction delay. Hence, these outcomes from this study will benefit not only the researchers but also the construction practitioners in avoiding any potential delay of their projects.
1.8 Theoretical Framework of the Study

A framework portrays an overview of how the study is planned which include procedures, data collection techniques, statistical tools for analysis and reporting of data. Theoretical framework of this study comprises of three major components which are general concept of issues on construction industry, issues of delay in construction projects and establishment of relationship among the delay factors. This framework is demonstrated as in Figure 1.1.

![Diagram](image)

**Figure 1.1: Theoretical Framework**

Figure 1.1 presents that at the initial stage of this study a comprehensive literature review was required. The literature review covers complete review of issues related to construction industry including delay. This study adopts a systematic research methodology which enables appropriate data collection, analysis and interpretation of the findings. Data was collected quantitatively using questionnaire tool. Collected data was analysed using univariate and multivariate analysis approach then presented in tabular form and descriptively explained.
1.9 Thesis Structure

The thesis for this study has been structured into seven chapters as follows:

- Chapter 1: Describes the introduction and needs of this study. It contains background, problem statement, aim & objectives, hypothesis, scope, research questions, significance of this study, theoretical framework and thesis structure.

- Chapter 2: Discusses the overview of Makkah construction industry and also focuses on detailed review of previous research works related to delay issues including definition, type, effects and factors. All these information are gathered to provide a comprehensive understanding on delay issues in construction industry.

- Chapter 3: This chapter explains the methodology of this study adopted for carrying out this research work. It also presents the processes of questionnaire developments, the details about the methods used for data collection and analysis techniques.

- Chapter 4: Discusses the determination of delay factors’ level of significance based on the collected data from the questionnaire survey. It also highlights the most significant factors causing construction delay in Makkah construction industry.

- Chapter 5: This chapter describes the application of factor analysis approach to classify construction delay factors into groups. It demonstrates the procedures of carrying out the analysis together with the assumptions involved.

- Chapter 6: Explains the development processes of PLS-SEM model and the assessments which carried out on the model to establish structural relationships model of the delay factors for Saudi Arabia construction industry.

- Chapter 7: The final chapter presents the conclusion for the overall findings of this study. It also discusses the limitations of the study, also highlighted the recommendations for practice as well as recommendations future research.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This Chapter provides an overview of the construction industry in Makkah city. Also, it describes in details the literature review related to construction delay issues which include definitions, types, effects and construction delay factors. Besides that, this chapter discusses the detail review related to construction delay factors.

2.2 Makkah Construction Industry

Makkah city is the most populous city in Saudi Arabia and it is located in western part of the country. According to Saudi Arabia Economic Report (2010), Makkah city has an area of 1200 km² and a population of 1,674,600 people. Makkah city is considered the holiest site for Muslims all across the world due to the presence of the Al-Haram Mosque which in its premises contains the “KAABA” where Muslims are required to perform Hajj at least once in their lives, where Umrah is optional in the city of Makkah.

Due to the religious significance of the Al-Haram mosque, Muslims from across the globe travel to the city of Makkah for performing annual Hajj. Makkah city receives around 2 million pilgrims during annual Hajj and for the rest of the year more than 20 million people visit the city for performing Umrah (Mostafa & Al-Buzz, 2015), the real estate, infrastructure, hospitality and retail sectors are among those most likely to benefit. Demand for hotel rooms in the city of Makkah is very high, especially during Ramadan and Hajj season. The hotels are usually fully occupied during these seasons. However, with availability of numerous hotels,
Makkah city still has lack of sufficient rooms to accommodate the visitors. Majority of Makkah’s old buildings and architecture was demolished and being replaced with numerous mega structural projects around Al-haram mosque as depicted in Figure 2.1.

Mostafa & Al-Buzz, (2015) stated that more than USD100 billion has been allocated for the construction projects which are being constructed in Makkah city including Grand mosque (Al-Haram mosque) in order to improve services being rendered to millions of pilgrims from all over the world who come for Hajj and Umrah. According to Elawi, (2015) the expansion of the Holy Mosque has costed the government around USD10.6 billion in just a span of 6 years (2010 to 2015).

A number of mega and popular projects are available and currently under construction in Makkah city. For example, the Abraj Kudai, currently under construction is the largest hotel in the world with contract amount USD 3.5 billion (Husein, 2013) and expected to open its doors in 2017. The complex consists of 12 towers ranging in height from 30 to 45 stories, including a bus station, residential apartments, hotel rooms, shopping mall, restaurants, conference centre and car park (Husein, 2013).

The Grand Mosque is now loomed over by the third tallest building in the world, the Abraj Al-Bait (Makkah Royal Clock Tower Hotel), home to thousands more luxury hotel rooms. In the western edge of the city, the Jabal Omar development project now rises, which is situated on 57 acres of land incorporating includes 37 towers with a total built-up area of 2 million square meters (21.5 million square feet) of space, accommodating hospitality, residential, retail, commercial and religious facilities. Furthermore, The Grand Mosque is undergoing expansion to double the capacity of its prayer halls – from 3 million worshippers currently to nearly 7 million by 2040 (Elawi, 2015). Planned like a vast triangular slice of cake, the extension goes so far back that most worshippers won’t even be able to see the Kaaba. Figure 2.1 shows the actual shape after completion of Grand Mosque and surrounded by high rise towers.
Delay in Construction Projects

Delay is one of the major problems that are encountered by construction sectors. This problem can lead to many negative effects such as lawsuits between owners and contractors, increased costs, loss of productivity and revenue, and contract termination (Menesi, 2007). Although delays are a common trait of all construction projects, its magnitude varies from one project to another ranging from days to months and even years (Masood et al., 2015). Definition, types, effects and factors of construction delays are discussed in more details in following sub-section.

Definition of Construction Delay

Delay in construction projects has been a research topic for decades (Doloi et al, 2012). One of the major issues engulf the construction industry is delay in completing the project within the agreed duration (Al-Emad & Nagapan, 2015). Delay is acknowledged as the most common, costly, complex and risky problem encountered in construction projects (Shi et al., 2001). Many researchers from different countries have defined project delay in different ways. Delay is defined as “the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project” (Assaf & Al-Hejji, 2006). Pai & Bharath, (2013) defined delay as a slowing down of work without
stopping it entirely. It also refers to the long construction period due to the problems that occurred during the implementation of the project (Kikwasi, 2012). For owner, delay means the loss of income and unavailability of facilities; as for contractors it means loss of money for extra spending on equipment, materials, hiring the labor and loss of time (Haseeb et al., 2011). According to Hasan et al. (2014), delay in construction can be defined as postponing the project completion time due to predicted and unpredicted causes. Based on Ismail (2014) delay can be defined as late completion of activities to the planned schedule due to excusable and non-excusable delay. According to Alotaibi et al. (2014), delays are defined as incidents that lead to an extension in the time agreed within a contract to complete a project.

Therefore, the definition of construction delay for this study is failure to achieve project’s milestone activities as planned due to different causative factors.

2.5 Types of Construction Delay

According to Ahmed et al. (2002), Menesi (2007) & Hamid et al. (2015) delays can be grouped into four broad types based on contractual frameworks as following:

I. Non-Excusable Delays
II. Excusable Non-Compensable Delays
III. Excusable Compensable Delays
IV. Concurrent Delays

These four types of construction delays are elaborated in more details as follows:

2.5.1 Non-Excusable delays

A non-excusable delay is a delay which is caused solely by the contractor or its suppliers and can be within the Contractor’s control (Hamid et al., 2015 and Tumi et al., 2009 & Gardezi et al., 2013). For instance, contractor slow progress, subcontractor slow progress, broken equipment, difficulties in financing project by contractor, poor site management and supervision by contractor, poor communication and coordination by contractor with other parties, and inadequate planning and scheduling. This type of delays is inherently the contractor’s
responsibility and no relief is allowed. Therefore, non-excusable delays usually result in no additional money and no additional time being granted to the contractor.

2.5.2 Excusable Non-Compensable Delays

When a delay is caused by factors that are not foreseeable, beyond the contractor’s reasonable control and not attributable to the contractor’s fault or negligence; thus it may be “excusable”. Also, it can be defined as when neither the owner nor the contractor is responsible for the delay. These delays are arising from risk events that are beyond the control of both parties. This may include inclement severe weather, Act of God such as flood and wind damage, Wars, and unforeseen site conditions as well as contract modifications (Ahmed et al., 2002; Alaghbari 2007; Menesi 2007; Hamid et al., 2015 and Tumi et al., 2009). Accordingly, the contractor will not receive compensation for the cost of delay, but he will be entitled for an additional time to complete his work and is relieved from any contractually imposed liquidated damages for the period of delay.

2.5.3 Excusable Compensable Delays

Excusable compensable delay is a delay where the contractor is entitled to a time extension and to additional compensation (Ahmed et al., 2002; Alaghbari 2007; Menesi 2007; Hamid et al., 2015). This type of delays is caused by the owner or the owner's agents. Several examples include changing in major scope of the work by owner during construction, suspensions and/or interruptions to all or part of the work caused by an act or failure to act by the owner resulting from non-compliance and/or breach of an obligation, stated or implied, in the contract (Hamid et al., 2015). Thus the contractor is entitled not only to an extension of time but also to an adjustment for any increase in costs caused by the delay;

2.5.4 Concurrent Delays

Concurrent delay can be defined when more than one type of delay happens at the same time and both, either together or independently impacts the project’s progress
Concurrent delays occur when both owner and the contractor are responsible for the occurrence of the delay.

### 2.6 Effects of Construction Delay

When construction projects are experiencing delay, this delay can lead to many negative effects in which it has an adverse influence to the project’s stakeholders particularly clients and contractors such as time and cost overrun, disputes, arbitration, total abandonment and litigation. Several researchers highlighted the effect of delay in construction projects as presented in Table 2.1.

**Table 2.1: Effects of Construction Delay**

<table>
<thead>
<tr>
<th>No.</th>
<th>Effects of Construction delay</th>
<th>Country</th>
<th>References</th>
</tr>
</thead>
</table>
| 1   | ▪ Cost Overrun  
▪ Time Overrun  
▪ Disputes  
▪ Arbitration  
▪ Litigation and  
| 2   | ▪ Cost Overrun  
▪ Time Overrun  
▪ Disruption of traffic movement and  
▪ Delay of other projects related to the main project | Bahrain  | Hasan et al., (2014)                             |
| 3   | ▪ Time overrun  
▪ Cost overrun  
▪ Negative social impact  
▪ Idling resources  
▪ Disputes  
▪ Arbitration  
▪ Delaying by the client to return the loans  
▪ Poor quality of work due to hurrying the projects  
▪ Delaying in getting profit by clients  
▪ Bankruptcy  
▪ Litigation,  
▪ Create stress on contractors,  
▪ Total abandonment and  
▪ Acceleration losses | Tanzania | Kikwasi, (2012)                                  |
Table 2.1: (Continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Effects of Construction delay</th>
<th>Country</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>▪ Time overrun</td>
<td>Pakistan</td>
<td>Masood et al., (2015)</td>
</tr>
<tr>
<td></td>
<td>▪ Cost overrun</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Arbitration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Loss of interest of stakeholders and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Black listing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Cost overrun</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 presents several effects of delay on construction projects found by previous research which carried out in different countries.

2.7 Construction Delay Factors

Delay in construction can occur due to many causative factors. It is very important to identify those factors which cause the delay in construction projects. Since, many research works had been carried out in determining these factors. Thus a comprehensive literature review was carried out to uncover these factors causing construction delay for further investigation in Makkah construction industry.

Assaf et al. (1995) investigating the large building projects in a survey of 56 main causes of delay. Contractors considered the most important delay factors include: the preparation and approval of shop drawings, payment delay by owner, and design changes. While, the consultant considered the most important delay factors were cash problems, the relationship between different subcontractor schedules, and slow decision making by the owner. The owner considered the most important delay factors were design errors, excessive bureaucracy in project owner organization, labour shortages and inadequate labour skills.

Al-Khalil & Al-Ghaflay (1999) conducted a study to determine the most important causes of delay in public utility projects. A questionnaire was carried out among contractors; consultants, and owners, 60 potential delay factors were identified. All parties agreed that among the most important causes are cash flow
problems, financial difficulties by the contractor, difficulties in obtaining permits, and the requirement to select the lowest bidder without regard to prequalification.

Assaf and Al-Hejji (2006) directed their research efforts toward large construction projects in the eastern province of Saudi Arabia. A survey questionnaire with 73 identified causes was conducted. The reported findings are 70% of studied projects were delayed with an average overrun of 10% to 30% of the original duration and the significant cause reported by various stakeholders was change orders. They found that the most important causes of delay includes: the change orders by owner during construction, delay in progress payments, ineffective planning and scheduling by contractor, poor site management and supervision by contractor, shortage of labours, difficulties in financing by contractor, changes in government regulations, traffic control and restrictions at site, effect of social and cultural factors and accidents during construction.

Another study related to Saudi Arabia was carried out by Al-Kharashi & Skitmore (2009) the survey covers a sample of 86 clients, contractors and consultants working in the Saudi construction industry. The survey contained seven groups: client, contractor, consultant, materials, labour, contract and contractual relationship related causes. They outlined the most influencing current cause of delay is the lack of qualified and experienced personnel. The findings show the five causes that have the greatest effect on delays for each respondent group (owner, contractor & consultant). The client-related causes are Lack of finance to complete the work by the client, slow decision-making by the owner followed by Suspension of work by the owner, Difficulties in obtaining work permits and Non-payment of contractor claim. On the other hand, the contractor related causes are replace key personnel, Slow decision making by the owner, Owner’s poor communication with the construction parties and government authorities, Interference by the owner in the construction operations and Poor communication by owner and other parties. The consultant related causes as suspension of work by the owner, Owner’s poor communication with the construction parties and government authorities, Replace key personnel, Lack of finance to complete the work by the client and Delay in approving sample materials by owner.

Albogamy et al. (2012) addressed the main causes of delay in public building projects in KSA and outlined the top 10 factors causing delays are Low performance of the lowest bidder contractor in the Government tendering system, delays in sub-
contractors work, poor qualification, skills and experience of the contractor’s technical staff, poor planning and scheduling of the project by the contractor, delay in progress payments by the owner, shortage of qualified engineers, delay in preparation of shop drawings, cash flow problems faced by the contractor, inadequate early planning of the project, and non-utilization of professional construction contractual management.

Later on Albogamy et al. (2013) conducted a comparative study between Saudi Arabia and Jordan. The data was gathered via questionnaire, by including a list of 63 crucial delay factors. The findings discovered the top 10 causes of delay: Low performance of lowest-bidder contractor in tendering system, Delay in subcontractors’ work, Poor qualifications, skills and experience of the contractor’s technical staff, Poor planning and scheduling of the project by the contractor, Delay in progress payments by the owner, Design changes by the owner, Shortage of qualified engineers, Delay in preparation of shop drawings, Cash-flow problems faced by the contractor, and Inadequate early planning of the project.

Mahamid (2013) explored the owners’ perspectives on causes of delays for public construction projects in Saudi Arabia. There were 22 public owners participated in a questionnaire with 35 identified causes of delay. Results from the study suggested the top reasons for public project delays are: bid award for lowest price, poor site management, poor communication and coordination between construction parties, payments delay, poor labor productivity, and rework.

Mahamid (2014) conducted a research to identify the common direct and indirect dispute causes in residential building projects in Saudi Arabia. The study involved questionnaire survey which was distributed to 120 contractors. The study identified the top five severe direct dispute causes are: delay in progress payment by owner, unrealistic contract duration, change orders, poor quality of completed works, and labor inefficiencies respectively. While the top five severe indirect dispute causes are: inadequate contractor’s experience, lack of communication between construction parties, ineffective planning and scheduling of project by contractor, cash problems during construction, and poor estimation practices.

Emam et al. (2015) carried out a comprehensive quantitative literature review from previous work in Gulf Cooperation Council (GCC) countries. The top ten causes of delay were identified using frequency analysis from identified publications and reported as: Finance and slow payments, Ineffective planning and scheduling,
Shortage of materials, Poor site management, Design change by owners, Slow decision-making by Owners, Delays by subcontractors, Slow process of permits, Weather conditions and Poor communication and coordination

Alotaibi et al., (2014) carried out a research work through a review of relevant literature; they examined the critical factors contributing to the construction delays in KSA. The study revealed the most critical factors contributing to construction delay in KSA are Ineffective planning and scheduling of the project by the contractors, Poor qualification, skills and experience of the contractors’ staff, Delay in progress payment by the client and Changes during construction.

Recently a research carried out by Elawi, (2015) in infrastructure projects (roads and bridges) in Makkah city and found that the average delay in infrastructure projects is 39%. He stated the 5 top factors contributing to construction delay in Makkah province including: land acquisition, Contractor’ lack of expertise, Redesigning, Line services (Utilities and underground services), and Clashes with other Ministries.

Literature review for this study reviewed 40 articles published in different countries including Saudi Arabia. This resulted in identification of 81 delay factors as shown in Table 2.2.

Table 2.2: Delay Factors in Construction Industry

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors causing construction delay</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unrealistic contract duration</td>
<td>Mahamid (2014); Ejaz et al. (2013) &amp; Emam et al., (2015)</td>
</tr>
<tr>
<td>2</td>
<td>Unrealistic requirements imposed</td>
<td>Al-Kharashi &amp; Skitmore (2009); Ejaz et al. (2013) &amp; Emam et al., (2015)</td>
</tr>
<tr>
<td>3</td>
<td>Type of construction contract</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>4</td>
<td>Overdependence on the lowest tender amount in contractor selection</td>
<td>Al-Khalil &amp; Al-Ghaflly, (1999); Assaf and Al-Hejji (2006); Al-Kharashi &amp; Skitmore (2009); Albogamy et al. (2012); Albogamy et al. (2013) &amp; Mahamid, (2013); Albogamy et al. (2013); Marzouk &amp; El-Rasas (2014); Ejaz et al. (2013) &amp; Islam et al., (2015)</td>
</tr>
<tr>
<td>5</td>
<td>The scope of the project is not well defined</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>6</td>
<td>Inadequate project structure</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>7</td>
<td>Poor contract management</td>
<td>Albogamy et al. (2012); Frimpong et al. (2003); Le-Hoai et al. (2008); Omoregie and Radford (2006) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>8</td>
<td>Inadequate early planning of the project</td>
<td>Albogamy et al. (2012) &amp; Albogamy et al. (2013)</td>
</tr>
<tr>
<td>9</td>
<td>Inadequate early scheduling of the project</td>
<td>Albogamy et al. (2012) &amp; Albogamy et al. (2013)</td>
</tr>
<tr>
<td>10</td>
<td>lack of teamwork</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
<tr>
<td>No.</td>
<td>Factors causing construction delay</td>
<td>References</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Interference by owner in the construction operations</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>12</td>
<td>Late in approving design documents by owner</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>13</td>
<td>Excessive bureaucracy by owner’s administration</td>
<td>Assaf et al. (1995); Tumi et al., (2009)</td>
</tr>
<tr>
<td>14</td>
<td>Suspension of work</td>
<td>Al-Kharashi &amp; Skitmore (2009); Hasan et al., (2014)</td>
</tr>
<tr>
<td>15</td>
<td>Delay in approving shop drawings by owner</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>16</td>
<td>Delay in approving material samples</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>17</td>
<td>Variations orders</td>
<td>Alotaibi et al. (2014) &amp; Mahamid (2014); Albogamy et al. (2012); Albogamy et al. (2013); Mahamid; 2013; Emam et al. (2015); Alotaibi et al. (2014) &amp; Mahamid, 2014; Albogamy et al. (2013); Apolot et al. (2011); Le-Hoai et al. (2008); Omorogie and Radford (2006) &amp; Ismail (2014)</td>
</tr>
<tr>
<td>18</td>
<td>Delay in issuance of change orders</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>20</td>
<td>Owner’s lack of experience in construction business</td>
<td>Al-Kharashi &amp; Skitmore (2009); Koushki et al (2005)</td>
</tr>
<tr>
<td>21</td>
<td>Delay in progress payment by owner</td>
<td>Assaf et al. (1995); Assaf and Al-Hejji (2006); Albogamy et al. (2012); Albogamy et al. (2013); Mahamid; 2013; Emam et al. (2015); Alotaibi et al. (2014) &amp; Mahamid, 2014; Albogamy et al. (2013); Apolot et al. (2011); Frimpong et al. (2003); Fugar &amp; Agyakwah-Baah (2010); Le-Hoai et al. (2008); Mezher &amp; Tawil, (1998); Ejaz et al. (2013) &amp; Emam et al. (2015); Vaardini (2015) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>22</td>
<td>Poor communication between owner and other parties</td>
<td>Al-Kharashi &amp; Skitmore (2009); Mahamid, (2013); Emam et al. (2015); Koushki et al (2005); Hasan et al., (2014); Sambasivan &amp; Soon (2007); Tumi et al., (2009); Ruqaishi and Bashir, (2014); Ismail (2014) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>23</td>
<td>Poor coordination between owner and other parties</td>
<td>Mahamid, (2013); Emam et al. (2015); Koushki et al (2005); Ismail (2014) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>24</td>
<td>Owner’s failure to coordinate with Government authorities during planning stage</td>
<td>Al-Khalil &amp; Al-Ghaflly, (1999)</td>
</tr>
<tr>
<td>26</td>
<td>Ineffective planning of project</td>
<td>Assaf and Al-Hejji (2006); Al-Kharashi &amp; Skitmore (2009); Albogamy et al. (2012); Albogamy et al. (2013); Emam et al. (2015); Alotaibi et al. (2014); Mahamid (2014); Albogamy et al. (2013); Marzouk &amp; El-Rasas (2014); Toor and Ogunlana (2008); Koushki et al (2005); Enshassi et al. (2009); Frimpong et al. (2003); Hasan et al., (2014); Sambasivan &amp; Soon (2007); Tumi et al., (2009); Faridi &amp; El-Sayegh (2006); Mezher &amp; Tawil, (1998); Ruqaishi and Bashir, (2014); Akogbe et al., (2013); Ejaz et al. (2013); Ismail (2014); Memon et. al. (2011); Gajare et al., (2014); Islam et al., (2015); Vaardini (2015) &amp; Masood et al., (2015)</td>
</tr>
</tbody>
</table>
Table 2.2: (Continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors causing construction delay</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Ineffective scheduling of project</td>
<td>Assaf and Al-Hejji (2006); Albogamy et al. (2012); Albogamy et al. (2013); mam et al. (2014); Alotaibi et al. (2014); Mahamid (2014); Albogamy et al. (2013); Marzouk &amp; El-Rasas (2014); Toor and Ogunlana (2008); Koushki et al (2005); Enshassi et al. (2009); Frimpong et al. (2003); Hasan et al., (2014); Sambasivan &amp; Soon (2007); Tumi et al., (2009); Faridi &amp; El-Sayegh (2006); Mezher &amp; Tawil, (1998); Ruqaiashi and Bashir, (2014); Akogbe et al., (2013); Ejaz et al. (2013); Ismail (2014); Memon et. al (2011); Gajare et al., (2014); Islam et al., (2015); Vaardini (2015) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>28</td>
<td>Poor site management</td>
<td>Assaf and Al-Hejji (2006); Al-Kharashi &amp; Skitmore (2009); Mahamid (2013); Emam et al. (2015); Marzouk &amp; El-Rasas (2014); Toor and Ogunlana (2008); Koushki et al (2005); Enshassi et al. (2009); Fugar &amp; Agyakwah-Baah (2010); Le-Hoai et al. (2008); Sambasivan &amp; Soon (2007); Faridi &amp; El-Sayegh (2006); Ruqaiashi and Bashir, (2014); Ejaz et al. (2013); Kikwasi (2012); Ismail (2014); Memon et. al (2011) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>29</td>
<td>Poor site supervision</td>
<td>Al-Khalil &amp; Al-Ghaifly, (1999); Assaf and Al-Hejji (2006) &amp; Al-Kharashi; Skitmore (2009); Marzouk &amp; El-Rasas (2014); Toor and Ogunlana (2008); Koushki et al (2005); Enshassi et al. (2009); Fugar &amp; Agyakwah-Baah (2010); Le-Hoai et al. (2008); Sambasivan &amp; Soon (2007); Faridi &amp; El-Sayegh (2006); Ruqaiashi and Bashir, (2014); Ejaz et al. (2013); Kikwasi (2012); Ismail (2014); Memon et. al (2011) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>30</td>
<td>Frauds practices by contractor</td>
<td>Al-Kharashi; Skitmore (2009); Omoregie and Radford (2006)</td>
</tr>
<tr>
<td>31</td>
<td>Inaccurate technical study of projects time by contractor during the bidding stage</td>
<td>Mahamid (2014); Enshassi et al. (2009); Frimpong et al. (2003); Fugar &amp; Agyakwah-Baah (2010); Le-Hoai et al. (2008); Tumi et al., (2009); Mezher &amp; Tawil, (1998); Omoregie and Radford (2006); Kaming et al. (1997) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>32</td>
<td>Poor qualification of contractor’s staff assigned to the project</td>
<td>Al-Khalil &amp; Al-Ghaifly, (1999); Assaf and Al-Hejji (2006); Al-Kharashi &amp; Skitmore (2009); Albogamy et al. (2012); Albogamy et al. (2013); Albogamy et al. (2013); Albogamy et al. (2013); Koushki et al (2005); Hasan et al., (2014); Ruqaiashi and Bashir, (2014); Ejaz et al. (2013) &amp; Islam et al., (2015)</td>
</tr>
<tr>
<td>33</td>
<td>Shortage of technical professionals in the contractor's organization</td>
<td>Al-Kharashi &amp; Skitmore (2009); Albogamy et al. (2012); Albogamy et al. (2013); Albogamy et al. (2013); Fugar &amp; Agyakwah-Baah (2010); Mezher &amp; Tawil, (1998) &amp; Islam et al., (2015)</td>
</tr>
<tr>
<td>34</td>
<td>Inadequate Contractor experience</td>
<td>Albogamy et al. (2012); Albogamy et al. (2013); Mahamid (2014); Elawi (2015); Enshassi et al. (2009); Sambasivan &amp; Soon (2007); Kaming et al. (1997); Memon et. al (2011) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>35</td>
<td>Ineffective monitoring of the project progress by the contractor</td>
<td>Al-Kharashi &amp; Skitmore (2009); Apolot et al. (2011) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>36</td>
<td>Ineffective controlling of the project progress by the contractor</td>
<td>Al-Kharashi &amp; Skitmore (2009); Apolot et al. (2011) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>No.</td>
<td>Factors causing construction delay</td>
<td>References</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>37</td>
<td>Incompetent subcontractors</td>
<td>Al-Kharashi &amp; Skitmore (2009); Albogamy et al. (2012); Albogamy et al. (2013); Emam et al. (2015); Albogamy et al. (2013); Koushki et al. (2005); Le-Hoai et al. (2008); Sambasivan &amp; Soon (2007); Ruqaiishi and Bashir, (2014); Akogbe et al., (2013); Omoregie and Radford (2006); Ismail (2014) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>38</td>
<td>Delay in preparation of shop drawings</td>
<td>Assaf et al. (1995); Albogamy et al. (2012); Albogamy et al. (2013); Mezher &amp; Tawil, (1998); Ismail (2014); Faridi &amp; El-Sayegh (2006); Akogbe et al., (2013) &amp; Ismail (2014)</td>
</tr>
<tr>
<td>40</td>
<td>Difficulties in financing project by contractor</td>
<td>Assaf et al. (1995); Al-Khalil &amp; Al-Ghaffly, (1999); Assaf and Al-Hejji (2006); Albogamy et al. (2012); Albogamy et al. (2013); Emam et al. (2015); Mahamid (2014); Marzouk &amp; El-Rasas (2014); Toor and Ogunlana (2008); Kazaz et al. (2012); Frimpong et al. (2003); Le-Hoai et al. (2008); Hasan et al., (2014); Tumi et al., (2009); Faridi &amp; El-Sayegh (2006); Mezher &amp; Tawil, (1998); Akogbe et al., (2013); Ejaz et al. (2013); Kikwasi (2012); Memon et al. (2011); Islam et al., (2015) &amp; Vaardini (2015)</td>
</tr>
<tr>
<td>41</td>
<td>Poor communication between contractor and other parties</td>
<td>Al-Kharashi &amp; Skitmore (2009); Mahamid (2013); Emam et al. (2015) &amp; Mahamid (2014); Koushki et al. (2005); Hasan et al., (2014); Sambasivan &amp; Soon (2007); Tumi et al., (2009); Ruqaiishi and Bashir, (2014); Ismail (2014) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>42</td>
<td>Poor coordination between contractor and other parties</td>
<td>Mahamid (2013) ; Emam et al. (2015); Koushki et al. (2005); Ismail (2014) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>43</td>
<td>Delay in performing inspection</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>44</td>
<td>Delay in approving major changes in the scope of work</td>
<td>Albogamy et al. (2012)</td>
</tr>
<tr>
<td>45</td>
<td>Delay in approving shop drawings by consultant</td>
<td>Assaf et al. (1995)</td>
</tr>
<tr>
<td>46</td>
<td>Late in approving design documents by consultant</td>
<td>Al-Kharashi &amp; Skitmore (2009); Marzouk ; El-Rasas (2014); Ejaz et al. (2013) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>47</td>
<td>Design changes by consultant</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>48</td>
<td>Poor qualification of consultant engineer’s staff assigned to the project</td>
<td>Mahamid (2013) &amp; Le-Hoai et al. (2008)</td>
</tr>
<tr>
<td>49</td>
<td>Inadequate consultant experience</td>
<td>Albogamy et al. (2013) &amp; Hasan et al., (2014)</td>
</tr>
<tr>
<td>50</td>
<td>Mistakes in design documents</td>
<td>Assaf et al. (1995); Kazaz et al. (2012); Enshassi et al. (2009); Le-Hoai et al. (2008); Hasan et al., (2014); Tumi et al., (2009); Mezher &amp; Tawil, (1998); Akogbe et al., (2013); Omoregie and Radford (2006); Kaming et al. (1997); Ejaz et al. (2013); Kikwasi (2012); Ismail (2014) &amp; Emam et al., (2015)</td>
</tr>
<tr>
<td>51</td>
<td>Changes in design documents</td>
<td>Assaf et al. (1995); Kazaz et al. (2012); Enshassi et al. (2009); Le-Hoai et al. (2008); Hasan et al., (2014); Tumi et al., (2009); Mezher &amp; Tawil, (1998); Akogbe et al., (2013); Omoregie and Radford (2006); Kaming et al. (1997); Ejaz et al. (2013); Kikwasi (2012); Ismail (2014) &amp; Emam et al., (2015)</td>
</tr>
<tr>
<td>52</td>
<td>Delays in producing design documents</td>
<td>Al-Kharashi &amp; Skitmore (2009); Toor and Ogunlana (2008) &amp; Enshassi et al. (2009)</td>
</tr>
</tbody>
</table>
Table 2.2: (Continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors causing construction delay</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>Insufficient data collection and survey before design</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>55</td>
<td>Complexity of project design</td>
<td>Al-Kharashi &amp; Skitmore (2009)</td>
</tr>
<tr>
<td>56</td>
<td>Poor communication between consultant and other parties</td>
<td>Mahamid (2013); Emam et al. (2015); Mahamid (2014); Koushki et al. (2005); Hasan et al., (2014); Sambasivan &amp; Soon (2007); Tumi et al., (2009); Ruqaishi and Bashir, (2014); Ismail (2014) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>57</td>
<td>Poor coordination between consultant and other parties</td>
<td>Mahamid (2013); Emam et al. (2015); Koushki et al. (2005); Ismail (2014) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>58</td>
<td>Delay in materials delivery</td>
<td>Al-Kharashi &amp; Skitmore (2009); Koushki et al. (2005); Enshassi et al. (2009); Mezher &amp; Tawil, (1998); Ruqaishi and Bashir, (2014); Omoregie and Radford (2006); Ejaz et al. (2013) &amp; Ismail (2014)</td>
</tr>
<tr>
<td>59</td>
<td>Late procurement of materials</td>
<td>Al-Kharashi &amp; Skitmore (2009); Frimpong et al. (2003); Faridi &amp; El-Sayegh (2006); Akogbe et al., (2013); Omoregie and Radford (2006) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>60</td>
<td>Changes in material types during construction</td>
<td>Al-Kharashi &amp; Skitmore (2009) &amp; Kazaz et al. (2012)</td>
</tr>
<tr>
<td>62</td>
<td>Shortage of construction materials in market</td>
<td>Al-Kharashi &amp; Skitmore (2009); Toor and Ogunlana (2008); Enshassi et al. (2009); Fugar &amp; Agyakwah-Baaeh (2010); Hasan et al., (2014); Tumi et al., (2009); Omoregie and Radford (2006); Ismail (2014) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>64</td>
<td>Shortage of equipment</td>
<td>Al-Kharashi &amp; Skitmore (2009); Hasan et al., (2014) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>65</td>
<td>Lack of high-technology mechanical equipment</td>
<td>Al-Kharashi &amp; Skitmore (2009); Ejaz et al. (2013) &amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>66</td>
<td>Delay in equipment delivery</td>
<td>Al-Kharashi &amp; Skitmore (2009); Enshassi et al. (2009); Ejaz et al. (2013) &amp; Ismail (2014)</td>
</tr>
<tr>
<td>67</td>
<td>Shortage of manpower</td>
<td>Assaf et al. (1995); Assaf and Al-Hejji (2006); Al-Kharashi &amp; Skitmore (2009); Toor and Ogunlana (2008); Koushki et al. (2005); Le-Hoai et al. (2008); Hasan et al., (2014); Faridi &amp; El-Sayegh (2006); Mezher &amp; Tawil, (1998); Ejaz et al. (2013); Memon et al. (2011) &amp; Islam et al., (2015)</td>
</tr>
<tr>
<td>69</td>
<td>Low productivity level of labour</td>
<td>Assaf and Al-Hejji (2006); Mahamid (2013); Marzouk &amp; El-Rasas (2014); Sambasivan &amp; Soon (2007); Faridi &amp; El-Sayegh (2006); Kaming et al. (1997) &amp; Gajare et al., (2014)</td>
</tr>
<tr>
<td>70</td>
<td>Labour Absenteeism</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
<tr>
<td>71</td>
<td>Effects of subsurface conditions</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
</tbody>
</table>
### Table 2.2: (Continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors causing construction delay</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>Bureaucracy in Government agencies</td>
<td>Assaf and Al-Hejji (2006); Emam et al. (2015); Mezher &amp; Tawil, (1998) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>74</td>
<td>Effect of weather</td>
<td>Assaf and Al-Hejji (2006); Emam et al. (2015); Koushki et al. (2005); Frimpong et al. (2003); Le-Hoai et al. (2008); Omoregie and Radford (2006); Kaming et al. (1997); Ejaz et al. (2013)&amp; Masood et al., (2015)</td>
</tr>
<tr>
<td>75</td>
<td>Effect of social and cultural factors</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
<tr>
<td>76</td>
<td>land acquisition</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
<tr>
<td>77</td>
<td>Traffic control of the project</td>
<td>Assaf and Al-Hejji (2006)</td>
</tr>
<tr>
<td>80</td>
<td>Economic instability</td>
<td>Al-Kharashi &amp; Skitmore (2009); Enshassi et al. (2009) &amp; Ejaz et al. (2013)</td>
</tr>
<tr>
<td>81</td>
<td>Political insecurity</td>
<td>Al-Kharashi &amp; Skitmore (2009); Enshassi et al. (2009) &amp; Ejaz et al. (2013)</td>
</tr>
</tbody>
</table>

### 2.8 Research Gap

Time is one of the important domains of construction project success. Any delay to project completion can result to monetary loss, emotionally disturb or legal dispute. Delay issue is dynamic in nature where it is subjected to types of construction, location/environment, culture of the practitioners and others. Literature review indicates many researches on construction delay issues including identification of delay factors which had been carried out around the world including Saudi Arabia. However most of these studies, ended up in identifying the delay factors without further investigate the relationships between these factors. Because of the variability of construction delay issue, this study was intended to explore the delay issue for all mega construction projects confined within the Makkah city. The study then narrow its scope to relevant identify delay factors for all verity of construction projects and further investigate the structural relationships between these factors in contributing to projects delay. Hence, this study is relevant not only to research activity but also by construction community in Makkah where the researcher is working.
2.9 Summary

This Chapter has presented a comprehensive literature review which was carried out to understand the issues of construction delay and also the factors that causing it. It started by providing an overview of the construction industry in Makkah city. Also, it provides a detailed review of previous studies which were carried out in different parts of Saudi Arabia. Furthermore, it discusses the literature review of previous studies on construction delay factors which were conducted in various countries including Saudi Arabia resulted in identifying 81 common delay factors. These factors were considered for further investigation in identifying relevant delay factors to Makkah construction industry.
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This study was carried out based on quantitative approach using structured questionnaire survey to understand the perception of construction’s practitioners who are working in Saudi Arabia towards factors contributing to construction delay. This Chapter describes the methodology used for this study. It starts with a research flowchart, then data collection process, analysis methods adopted for this research work and finally the summary of this chapter.

3.2 Research Flowchart

Research methodology for this study highlights the processes required to achieve the aim and objectives of this research. The following flowchart indicates the stages of carrying out this research. The figure comprises nine essential stages for carrying out this study. It starts from literature review, followed by questionnaires development, conduct pilot study, questionnaire improvement, carry out actual survey, descriptive analysis, factor analysis approach, model development and finally thesis writing. These processes are illustrated as flowchart diagram as Figure 3.1.

Based on Figure 3.1, the preliminary data for this research was collected through a comprehensive literature review from the previous studies which carried out by previous researchers in different parts of Saudi Arabia. The literature review for this research was done through books, internet, thesis, international conference papers and articles. In this process, all the delay factors from previous researchers
were identified through a detailed review of academic articles. Based on the findings from chapter 2, this study was able to identify 81 common delay factors related to construction industry.

![Flow chart of research process](image)

**Figure 3.1: The flow chart of this research**

After that the questionnaire was developed and then the pilot study survey was carried out and distributed to 28 construction practitioners who involved in Makkah construction industry to determine the relevancy of the identified factors to Makkah construction industry. Based on pilot survey, the questionnaire was improved, rephrased and the identified factors were reduced to 37 factors which are considered relevant. Subsequently, the actual survey was carried out among the
REFERENCES


Developing Country. *Journal of Civil Engineering and Architecture Research, 2*(9), 947-955.


