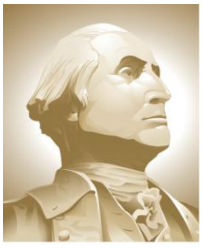

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

STUDYING THE EFFECT OF DECISION MAKING ON DELAYED CONSTRUCTION PROJECTS

BY

MOHAMED ALI YUSUF ALSENDI

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JANUARY 2015

MANAMA, KINGDOM OF BAHRAIN

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A RESEARCH REPORT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING MANAGEMENT, SCHOOL OF ENGINEERING AND APPLIED SCIENCE, THE GEORGE WASHINGTON UNIVERSITY

MANAMA, KINGDOM OF BAHRAIN

To my supportive parents

To my beloved wife for her encouragements

Acknowledgments

I would like to take this opportunity to thanks my supervisor Dr. Salah Alhamad, I owe you a huge debt of appreciation for your guidance to transfer my vision into reality, your encouragement made it easier to achieve it.

Next, to my classmate and sister Mrs. Nadia Daabis and her family for the great moments we spent together studying hard to accomplish our goals and for her ultimate support from the first day.

Second, specially dedicated to my parents for all the support, encouragements and believing in me to achieve my goals, words will never be fair to describe my true feelings.

Finally, to my beloved best friend, soul mate and wife, Enas, for her unconditional love, motivation and sacrifices. I would not have achieved this without your support and faith in me; you have been instrumental in instilling my confidence.

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Abstract

One of the most influencing factors affecting the architectural projects and their construction is delay. Both time and cost consuming factor. In a construction industry delay could be caused by several factors, these factors could be related human or not. Delay causes in the construction industry is mainly categorized into four categories known as, contractor determined factors, and client related factors, unforeseen factors and external factors. This study investigates the delay that takes place in architectural projects and assess the importance of knowing the factors that could cause delay. The report covers the four delay causes categories and embrace them through collecting data from the field to be analyzed. The methodology was a triple attack, where the study includes a questionnaire, interview and case studies. All method approached help in collecting a firm database. Via analysis, it is found that the client determined factors are the most influential factor among all, as the clients has the absolute control of delaying a project, while the remaining factors have limited abilities in affecting the project. It is very important for a key person in any party that is directly related to the construction process to utilize all available resources in planning and scheduling of an architectural project. Since financing, time estimating and key decision making are the most influential steps to minimize delay to its ground level in any given project.

Chapter 1

Introduction

1.1Introduction

Kingdom of Bahrain has increased the investment in Architectural and construction industry over the past years and its being increasing at a rapid pace. The haziness of construction projects are always related to its duration being very long, such characteristic would require the responsible personnel to coordinate and collaborate within the addressed parties. In construction projects, both academics and action takers have a dispute on the causes of construction projects' problems, but both agree that the main problem is the company's focus on optimization of the individual personnel rather than focusing on the long term efficiency of team performance. One of the other core issues faced by construction projects is the delay of completion, as nowadays, the number of delayed construction projects are raising and cost the caretakers a serious amount of time and money. Such market requires a very large capital and is impulsive by nature, but at the same time, it offers a low rate of return, as the risk of such projects is increasing day by day. Most risk associated with such industry would appear in the construction process, such risks are usually reduced or even resolved by designing an outsourcing to contract that sets other third parties to handle a particular job. As a construction business runner, risks is always there, and it always should be recognized and accepted beyond a certain level. No risks can be eliminated for good, but many techniques are used to decrease the risks occurred. In the construction industry, delay is a widespread topic, they almost act as the most associated risk in construction projects. Such delay will always lead to increase operation cost and create time overruns. The construction delay will always affect set of different leveled people, such people are the contractors, the business owner and even the assigned consultants. Such effects would cause to create a suspiciously environment and tension, limits growth in strained relationships and even would create cash-flow related problems. According to BNC (2012), almost half of the

construction industry budget worth of 730 billion are on hold and were delayed. Such a large amount would always create budget deficits in some of the companies, as some companies might declare bankruptcy due to such delays.

1.2 The research problem

"Whenever you see a successful business, someone once made a courageous decision." (Drucker, 2007). Decision a key part related with all details in our daily lives, from the simplest to the most complex decisions, decisions may be simple to take quick and routine or may be challenging and complicated which a hard ground of study before deciding. Appropriate decision making before starting of the project and approving the design concepts, working drawings, materials selections and logistic planning prior to construction stage can reduce many problems during later constructing stages. There is an urgent need for a decision making process to select the most advantageous solution in case of potential problems concerning construction cost or duration. A problem definition is raised in the form of a question, the definition is **"What are the main causes in Architectural projects' delays? How can we reduce them? What are the effects of such delays?"**

1.3 Research Aim & Objectives

The aim of the study is to **"Analyze the importance of decision making and its impacts on architectural projects"**. In order to achieve the aim, a few objectives is set to be covered and targeted through the study, the objectives are:

- Embrace the influence of decision making in construction projects
- Analyze the effects and influencers of decision making over time overrun and costs.
- Analyze and list the causes that lead to delays in Architectural projects.
- Emphasize on the effects of delay on construction projects
- Recommend upon how to minimize delay problems and what kind of decisions should take place.

1.4 The purpose of the study

Nowadays, the architectural projects faces several issues and obstacles prior to completion, it is very essential for constructors, engineers and even business owners to assess these issues earlier than starting of implementing the project. One of the most important factors that acts as a major obstacle is the delays of completing the projects. It acts as a main cause for time, money and efforts losses. The main aim of this research is to create a recommendation based upon an analysis of data collected from different parties via different methods. Ana analysis were based on different prospective of people within the construction industry and based upon different affecting factors.

1.5 The research questions:

In order to complete the study and meet the objectives, a set of questions is raised in order to be solved, through the answers all objectives will be met. The questions raised are as follow:

1) What are the main reasons of project delays?
2) What is the best way of minimizing the project delays?
3) What are the impacts of project delays?
4) How can the decision maker reduce the project cost provided that it will not affect architecture efficiency?
5) Why are time overrun and cost overrun considered two most frequent consequences of delays in construction project?

1.6 Organization of the study

The study will be conducted through completing a total of five chapters, chapter one will include an introduction to the study focusing on the goals set that should be covered in the report, and the second chapter will include a focus on previous publishing that is directly or not directly related to the topic. In chapter 3, the methodology will take place, upon how the researcher will collect new data and analyze, after that comes the fourth

chapter, which is all about the results collected from the methodology and analyzing them. At the end a conclusion will be drawn with recommending upon where the reader should focus in such cases. Mainly, the project will encompass the major topics encompassed in figure 1.1.

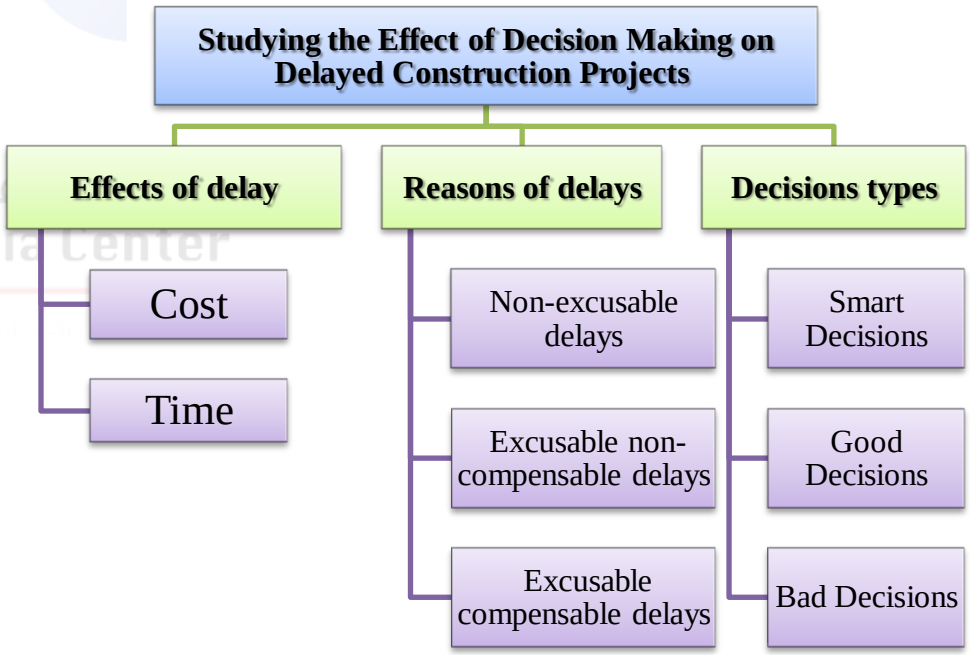

Figure 1-1 Study Organization

Chapter 2

Literature Review

2.1Introduction

Delay is one of the leading issues often faced the construction project sites. Delays may result in negative influence for example increased costs, loss of productivity and revenue, claims between the holders and contractors and contract termination. The issues of delays in the construction field spreader global. Usually if the construction projects are delayed, they are either extended or speeded and thus, incurs cost variation. Each project has an allowance of percentage of the total cost of project known as a contingency and it regularly based on agreement between both parties. Even though the parties in the contract decided upon the time extension and cost related to the delay, in most common cases there were difficulties between the owner and contractor as the contractor was eligible to claim variation. These circumstances generally involved interrogative the facts, causal factors and contract clarification. Hence, delays in construction projects lead to dissatisfaction to both the client and the contractor, the core role of the project manager is to insure that the projects are accomplished within the planned cost and time.

2.2 Cost overrun

Cost overruns in architectural industry entail the change of orders and some requests. Claim is defined as the anticipated adjustments in the negotiated contract or taken legal action against, (Abdul-Rahman, et al., 2006) identified two kinds of rates:

Variation in orders are a sign that architectural project program are not planed intended" (Acharya, et al., 2006) and are related to contract amendments such as add-ons, crossing out, or alteration in the contracts itself. These amendments would cause a change in the orders and would take further time to complete. The owners, contractors and even consultants are the only people whom had the given right to do any amendments to the

contract orders (Adnan, et al., 2008). There are two types of change orders, first is the "one sided", such a change in order is called when a single party, whether it's the owner, contractor or consultant sign the change conditions of the contract. While on the hand if changes are made by more than one party, as if it is a reciprocating agreement, such a change would be called a "two-pronged".

In a change order, an extra cost would appear, such extra cost would be referred as a cost addition to fee, and it should always be acknowledged by all parties, further to that, all parties have to decide whether whom shall cover the additional fees, and would handle the price of delays. In other terms, the change in orders is equally in law to the original contract, and nowadays, only few construction projects were preceded without any sudden change in orders from either part or by being indispensable due to some unanticipated circumstance (Adnan, et al., 2008). For that particular reason, it is nearly probable to reject the change in order, while work must take place in order to reduce the consequences of such change.

According to common contractual laws, any signed party has the right to amend to the contract at any given time. Such amendment would create extra costs and work, at the same time, these extra costs and time would necessary be a reason for delaying the completion of the project, as it be very independent from the contract and are a reason of an error occurred during the construction process.

2.3 Factors Affecting Cost-Overruns

The perceptions of cost overrun percentage and variation rate were used by (Abdul-Rahman, et al., 2006) to scrutinize the issue of cost increment. They measured that both cost overrun and transform order are affected by some factors, such as, the size of the project, construction type, bid differences and competition level.

Other than the previous, some non-quantifiable factors could play a role in impacting the cost overrun, such factors are the value of the contract documentation, the relational communication between parties and at a given time the contractors' policies. (Acharya, et al., 2006). Acharya (2006) found that cost overrun of a rate of 1-12% is more probable to arise in a bigger construction projects rather than the small projects, that is reason that the

project becomes more multifaceted leading to probable a larger cost overrun. In such case, the manager of a given large project could do exceptional efforts that reduces the overrun cost. In addition to that, Aibinu, et al., (2006) stated that if the projects honor amounts were higher than the government's approximation, a cost overrun is more likely to occur with a rate of 6% and higher. The following figure shows the main factors affecting cost overrun and delay.

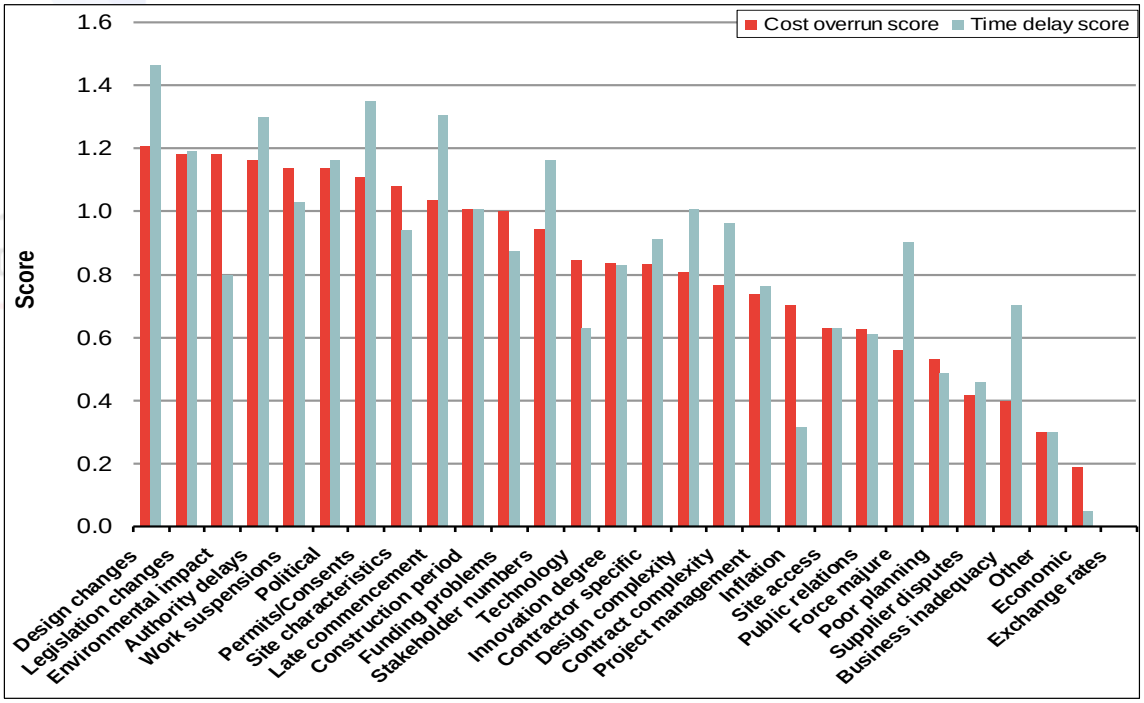

Figure 2-1 Cost Overrun and Time delay score

Source: RGL, Frontier Economics, Aecom

2.4 Causes of Time Delays

Non-excusable delays are commonly the accountability of the contractor. In study of non-excusable delays, (Ahmed, et al., 2002) deliberated approaches to document the causes of non-excusable delays by a fishbone figure and classification methodology,

Aibinu, et al., (2006) The material related delays could include, but not limited to, delays that are behind the schedule of delivery, or it could be the condition of a given material or product. While labor related delays, are delays that are affected by the personnel of the

project and could include motivation or even poor communication. Equipment related delays are delays that occurs due to lack of planning for required equipment. While the unacceptable planning could arise because of the inexperienced personnel. The financial related delays are delays that relate to the payment delays and financial planning of a project. Poor control and chaotic conditions could result in improper planning and would cause delays in the project. Weak planning is a serious influence which could greatly disturb the completion of a project within the required time horizon. At the end is the subcontractor related delays, which are usually caused by both parties, the contractor and the agency as well, such delays could be caused by slow mobilization of assigned team.

2.5 Delays in Construction

Linguistically, delay refers to a period of time when something has to wait because of a problem that makes it slow or late. It also means a situation in which something does not happen when it should. (OALD, 2010). In architecture, many researchers give different definitions to the word delay, for example, (Aibinu and Jagboro, 2002) consider delay as a mutual condition when the both parties bequeath to the incompletion of the project, prearranged or settled under approved upon period of contract. (Zou, et al., 2008) believe that architectural projects are delicate to be influenced by many reasons such as financial, environmental and even political.

Ozdemir (2010) observed that the architectural projects have a very appalling readiness for dealing with delay. Delay study is normally either unnoticed or achieved one-sidedly by minimally adding an unforeseen event. Patrons or regulars are no longer satisfied with only gratifying insignificant cost, sufficient purposeful work, swelling rates of interest, rising prices and other fiscal forces, but are also concerned making use of the unswerving latent time to complete the construction project (Nkado, 1995). Ajanlekoko (1987) asserted that the construction project showed poor timed-performance.

The primary apprehension of any contractor is to guarantee that the premier potential performance manner is achieved in architectural project release. Accordingly, many foremost architectural projects are unsuccessful to meet agreed upon deadlines. In a architectural project, where time period is equivalent to money, time management is

decisive (Duran, 2006), thus envisaging a probability that programmed delay has a chief role in general project accomplishment (Luu et al., 2009).

Persistent occurrences of non-excusable delays undoubtedly indication to contractors in the most architectural industry to at any rate is responsive to the regular issues aiding in non-excusable delays and then to take precautions to avoid reappearance. Even though performance is calculated against the achievement of the construction project purpose, it is only practicable if the sources and results of non-excusable delays can be lessened through good deeds in justifying compensable delays.

According to (Kraiema et. al. 2007), when a delay takes place, it is essential to consign accountability and enormity and it is often complicated to analyze the decisive legal responsibility in delay issues. (Acharya et al. 2006) believe that delays in architectural projects may be due to different parties for example, the patron, the dealer, the counselors, acts of God, or a third party and they may occur near the beginning or near the ending of the architectural job. (Bushbait and Cunningham, 2008) see that whatever the case may be, consulting a fair and suitable damage settlement is gainful to all parties. Thus, determining the time-span of the project delay serves as an indispensable piece of information for the scheduled time of accountability, which may be an exceedingly multifaceted operation in cases with synchronized causes.

2.6 Delay in Architectural Work

According to (Trauner, 2009), on architectural projects, in addition to other projects for which agreed upon deadlines are used to organize and plan work; it is not infrequent for delays to arise. Delay in any aspect of the architecture work affect -in turn- either a project or some other deadlines, for example signpost, will be carried out later. Before discussing and analyzing delay, a clear considerate of the sorts of delays is required. Delay in project implementation is a main difficult in the most architectural field.

According to Al-Khalil and Al-Ghafly (1999), delay crops up in average architectural projects and also big architectural work. Almost projects carried out in recent years in many countries challenged delay in delivery problems. An architectural project is

frequently qualified as doing well if it was accomplished before deadline, within budget limits, in line with the qualifications and to owner approval (Majid, 2006).

2.7 Types of Causes of Delay in Architectural Projects

2.7.1 Inexcusable delays (non-excusable delays)

According to Fugar and Baah (2010), this kind of delay is due to the contractor or suppliers only. The task of contractor is normally not to reprieve and consequently, he must make up time lost by means of increasing of velocity or compensating the stalkholder. This reparation may come from either settling damages or actual damages, in case of there are no liquidated damages section in the agreement. Liquidated damages are generally calculated as a rate based on cost estimation, the owner is anticipated to acquire in the event of not on time completion due to the contractor (Soon, 2010). These delays may be due to productivity under-allocates, inappropriate planning of architecture work or scheduling, weak management of site and supervision, flawed architectural methods, equipment or machines breakdowns, or untrustworthy subcontractors or suppliers. An example of a non-excusable delay would be when a contractor is unable to provide adequate workers to carry out the job on time (Majid, 2006) .

Non-excusable delays are widespread in various architectural projects and lead to substantial losses to project parties. It is extensively conventional that architectural project scheduling plays a main part in project management due to its significant impact on project accomplishment (Luu et al., 2009). The common consequences of schedule delays include behind schedule architectural project achievement, augmented cost, and architectural project disorder, inefficiency, differences of opinion and desertion or contracts annihilation. Consequently, timetable delays in architectural projects increase frustration in all the parties involved (Majid, 2006).

2.7.2 Effects of Non-Excusable Delays

Aibinu and Jagboro (2002) had an extensive research about the effects of delays in architectural projects by different spots around the world. They came up with six identified effects, these effects were dispute, cost overrun, time overrun, total

abandonment, litigation and arbitration. Through the survey they made, they found that the most influencing effects were time and cost overruns.

Aibinu and Jagboro (2002) suggested some solutions such as recurrent progress gathering; accurate opening time approximation; giving bids to the practiced supplier and contractor; suitable importance on knowledge; community participation; systematic control mechanisms; wide-ranging contract documents; capable strategic planning; apparent information and declaration channels; and use of state-of-the-art technology.

Aibinu and Jagboro (2002) recognized two approaches for diminishing time overruns: speeding up of project statues. It may necessitate guaranteeing sufficient and reachable sources of financial support till the project accomplishment point; assigning adequate time and money at the earlier of design phase; choosing an experienced consultant and a trustworthy contractor to complete the architectural work; execution pre-architectural planning of project tasks and materials needs; assigning a self-determining supervisor to examine the effort; and ensuring well thought-out delivery of sources.

Odeh and Battaineh (2002) suggested that refining the situations of architectural projects necessitates putting liquidation damage sections into effect and offering rewards for untimely achievement; hiring specialized manpower in the architectural industry through pertinent training and categorization of craftsmen; using a new approach to agreement award measures by giving less influence to money prices and more weight to capability and preceding performances of contractors; and applying innovative approaches for agreements, such as design-build and architectural management-type contracts.

2.7.3 Excusable delays

Non-compensable delays

Fugar and Baah, (2010) stated in their recent research that non-compensable delays are delays that are produced by a third party. Such causes are acts of god, extraordinary weather, even political decisions by the government in its autonomous capacity.

Compensable delays

Compensable delays are due to the owner or his agents (Fugar and Baah, 2010). A sample of compensable delays would not to achieve the release of drawings on time by the owner's architect. An excusable, compensable delay regularly leads to a timetable conservatory and the owner may bear financial damages on the request of the contractor (Soon, 2010). The contractor deserves further unforeseen costs for total and unabsorbed field and home office overhead.

2.8 Causes of Delay

Mezher and Tawil (1998) both conducted a survey to assess the delays of architectural projects, where their survey was based on the perception of owners, engineering firms and contractors. They found that each party was more concern with some factors over the others, as the contractors found their main concern in the monetary issues, while engineering firms thought that project management is the major cause for project delays, while the contractors on the other hand thought that the contractual relationship is playing the main role in delaying a certain project. Other survey conducted by Chan and Kumaraswamy (1996) focused on delays but from the prospective of clients, consultants and contractors. In their survey, they found five main factors that create project delays, these factors are unforeseen ground conditions, variations by clients, variations by work, poor site management and slow decision making. On the other hand, they found that payment arrangements plays a major role in affecting time overrun and cost overrun. Assaf, Al-Khalil and Al-Hazmi (1995) further pinpointed to groundwork and drawing agreements, as they though that design amendments are of the major delay creators. And they stated that from the view of supplier, the relationship between the supplier and the project owner might sluggish the decision making process and causes delays.

2.9 Literature summary

Whenever a delay does occur, its implications to the future performance of the project can be instantaneously unwavering and counteractive action can be taken to reduce any unenthusiastic collision on project efficiency. The contractor is expected to have control over the non-excusable delays and, in all probability, to do more to prevent them. Perception of the fundamental factors that donate to reasons for non-excusable delays would assist make out and prevail over the tribulations faced by contractors during the construction process. Although several factors contribute to project delays, the consequence of non-excusable delay factors that are merely the contractor's contribution is apparent in this research.

There are numerous factors that encourage delay on construction projects, however in this study the factors causing delay are ranked according to the mean index score. The factors includes: lack of funds to finance the project to completion, changes in drawings, lack of effective communication among the parties involved , lack of adequate information from consultants, slow decision making and contractor’s insolvency, variations. Also, there are project management problems, faults and differences in contract documentation, equipment availability and failure, mistakes during construction, bad weather, and fluctuations in prices of building materials, incorrect overall organizational structure linking to the project and labor strike.

	Major Causes					Author
	1	2	3	4	5	
Vietnam (a)	Poor site management and supervision	Poor site management and assistance	Financial difficulties of owner	Financial difficulties of contractor	Design Change	Le-Hoai et. Al. 2007
Malaysia (b)	Improper planning	Site management	Inadequate contractor experience	Finance and payment of completed works	Subcontractors	Sambasivian, 2007
Jordan (b)	Financial difficulties faced by contractor	Too many change order from the owner	Poor planning and scheduling by the contactor	Presence of unskilled labours	Shortage of Technical professionals with the contractor	Sweis, 2007
South Korea (b)	Public interruptions	Changed site condition	Failure to provide site	Unrealistic time estimation	Design error	Acharya et al. 2006
Hong Kong (b)	Inadequate resources due to contractor/lack of capital	Unforeseen ground conditions	Exceptionally low bids	Inexperienced contactor	Works in conflicts with exciting Utility	Lo, 2006
UAE (b)	Preparation and approval of drawings	Inadequate early planning of the project	Slowness of the owner's decisions making process	Shortage of manpower	Poor supervision and poor site management	Faridi, 2006
Nigeria (b)	Contractor's financial difficulties	Client's cash flow problem	Architects incomplete drawing	Subcontractor's slow mobilization	Equipment breakdown and maintenance problem	Aibinu, 2006
Saudi Arabia (b)	Changes in orders by owner during construction	Delay in progress payments	Insufficient planning and scheduling	Shortage of labour	Difficulties in financing contract	Assaf 2006
Kuwait (b)	Change orders	Financial constraints	Owner's lack of experience	Materials	Weather	Koushki, 2005
(c)	Contractor	Materials	Financial constraints	Change orders	Weather	
Ghana (a)	Monthly payment difficulties	Poor contract management	Material procurement	Inflation	Contractor financial difficulties	Frimpong, 2003
Jordan (b)	Poor design	Changes in orders/design	Weather	Unforeseen site conditions	Late deliveries	Al-Moumani 2000
Saudi Arabia (b)	Cash flow problem financial difficulties	Difficulties in obtaining permits	"Lowest bid wins"system			Al-Khal 1999
Lebanon (b)	Owner's more concern in financial issues	Contractors regarded the contractor relationship the most important	Consultant considered project management most important			Mezher et al. 1998
Saudi Arabia (b)	Slow preparation and approval of shop drawings	Delays in payment to contractors	Changes in Design/Design errors	Shortage of Labour supply	Poor workmanship	Assaf et al. 1995

Table 2-1 Major Delay Causes across Different Countries

Adapted from Australasian Journal of Construction Economics and Building (2012)

(a): Delay and cost overruns; (b) Delays only; (c) Cost overruns only

Chapter 3
Research Methodology

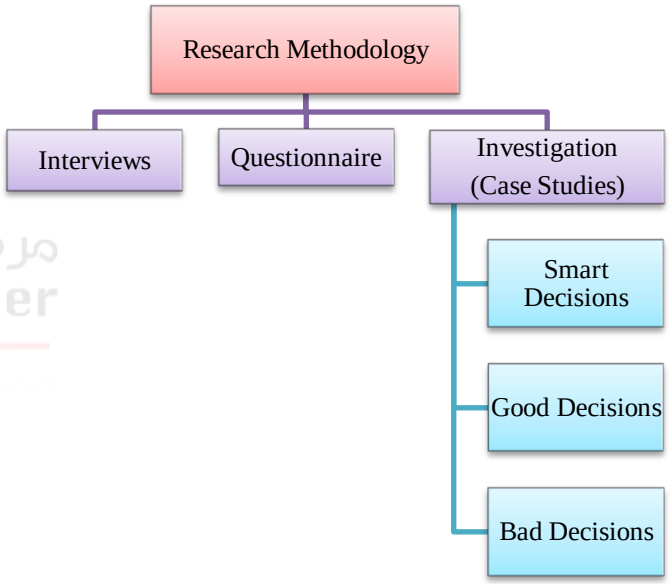

Figure 3-1 Research Methodology

3.1 Introduction

The research methodology is a process based upon the first phase of the project, which is the literature review. The literature was done to identify key information that would help in utilizing and identifying delay trends in the construction industry in general. The results came in handy, as the causes of delays were analyzed and set to be a milestone to the research methodology. To analyze the causes of delay, and be more specific to the causes of delay in the kingdom of Bahrain, a methodology is set to cover that aspect, via which a questionnaire is set to collect information from different set of people that has direct relation to the construction industry. Followed by an interview with two experienced consultants that works in the construction business. In addition to that, the research methodology used covered analyzing a live case studies upon which decisions were taken in delay situations, which aids in analyzing the right decision to be taken in such a scenario.

3.2 Project Methodology

The projects methodology was aimed to target public projects, where main and minor data has been taken to assess the greatest reason causing delays in the construction field in the Kingdom of Bahrain.

3.3 Questionnaire

3.3.1 Design of questions

The questionnaire contains two main sections, first section were set to cover all participants information (e.g. name, role, years of experience, gender and nationality). The second section is the question section, which includes a set of questions designed to aid the participants rank the causes of delay and assess which delay factor is the more influencing. The questionnaire has been wisely designed to avoid numerous limitations related with questionnaire surveys. In order to decrease the chance of the respondents to avoid the uncertainty of the terminology and outline of the questions, the questionnaire was leading on one consultant and three contractor respondents. Based on their comment some adjustments has been done.

3.3.2 Sample

The study was focused on participants in construction filed; for example (owners, contractors, quantity surveyors and consultants) in Kingdom of Bahrain. These experts were selected to reflect the construction industry and will be able to deliver a truthful data regarding the delay difficult according to their experiences.

3.3.3 Data Analysis

The collected data are analyzed by evaluating their importance, in order to evaluate the importance of a given answer the relative importance index is used “RII”.

The purpose of the study was to form the relative importance of the numerous influences recognized as liable for project delay. The score for each factor is calculated by summing up the scores given to it by the respondents. The following formula was used to calculate the relative importance index (RII)

$$\mathbf{RII = \Sigma PiUi / N (n)} \qquad \mathbf{(1)}$$

Where,

Pi = participant rate on a given answer

Ui = the weight given to the answer level

N = number of participants

n = maximum score given to an answer

The equation (1) above was calculated to find the RII for the delay factors and the categories. The indexes were ranked for clients, contractors and consultants. The group index is the average of RII of the delay reasons in each category. You may refer to a sample of a ranking table in appendix D

3.4 Interview

3.4.1 Design of Questions:

Two set of questions were carefully designed in order to obtain the necessary information from the targeted participants. The questions covers the two main topics of the study, cost overrun and project delay, the questions are as follow:

1) What are the influences led to cost overrun? Why?

2) What are the reasons cause the delays in the project duration

3.4.2 Interviewed participants:

Interview has been made with two consultants that are directly related to construction process on a daily basis. These consultants are best candidates for such interview, as their knowledge will directly aid the study. However, they both preferred not to mention their names and they only shared their answers for academic purposes only.

3.5 Case Studies

3.5.1 Samples

Three case studies were chosen to be analyzed, in order to access the decision made by each project manager or the party responsible for constructing and managing the project. The case studies were carefully chosen to cover three sets of decision, smart, good and bad decision.

Chapter 4

Results and Analysis

4.1 Introduction

This project categorizes the most important reasons for non-excusable delays consistent with occurrence basis, makes out the foremost factors helping those reasons and then discloses apposite means of diminishing these delays. This chapter analysis the data collected from the three methods used to assess delays and cost overruns. The following results will cover the delay causes of a construction project and ranked upon its importance, through which the questionnaire was distributed to industry-specific people that helped in drafting a well based analysis. Followed by an interview with two consultants that helped in identifying the main cause of delays in a GCC based project and the main reasons beneath cost overrun. In the end, three case studies were taken into consideration to analyze the type of decision taken during a delay problem occurred in each case.

4.2 Questionnaire

A questionnaire was handed out to random samples of 100 participants that have direct relation to the construction and architectural industry, these experts comes from a variety of companies acting as engineers, consultants and contractors. The responses came in handy, as 70% of the participants did answer the questionnaire. The 75 responses were analyzed and all necessary information were extracted.

4.2.1 Participants Frequency

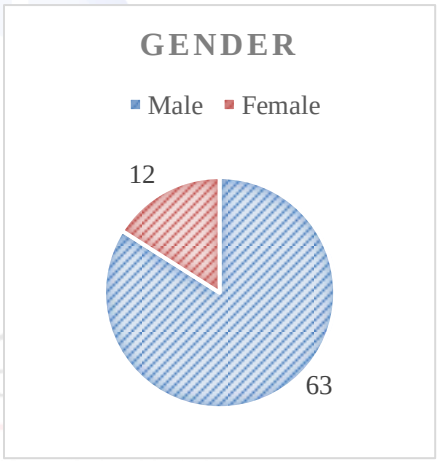

Figure 4-1 Participants Gender Frequency

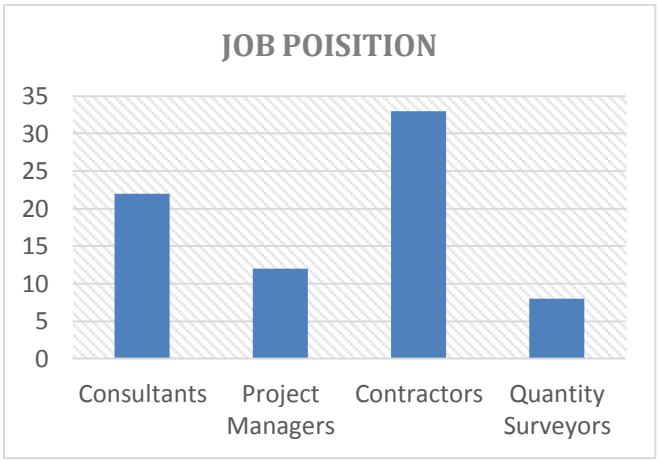

Figure 4-2 Participants Job Position Frequency

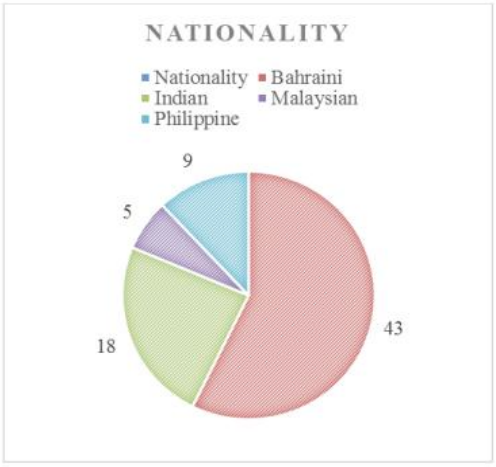

Figure 4-4 Participants Nationality Frequency

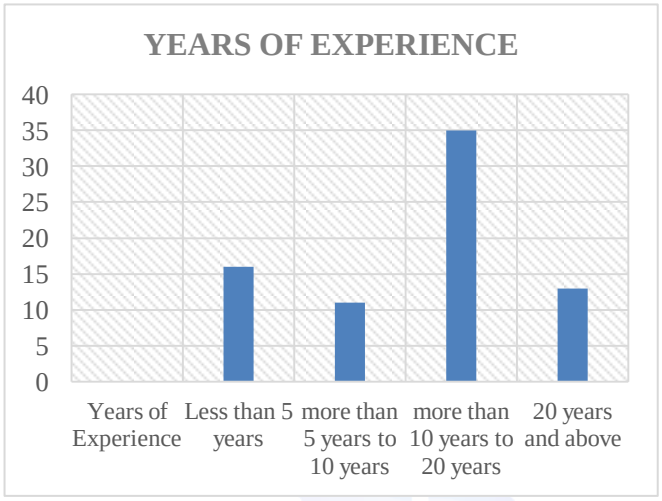

Figure 4-3 Participants Years of Experience

4.2.2 Importance Table:

Order	Number	Cause	Type of Factor	RII
1	19	Design changes by owner or his agent during construction	Client Determined	0.983
2	18	Delay in approving design documents	Client Determined	0.966
3	4	Unclear and inadequate details in drawings	Unforseen	0.954
4	15	Change orders	Client Determined	0.949
5	17	Changes in material types and specifications during construction	Client Determined	0.943
6	6	Delay in reviewing and approving design changes	Unforseen	0.914
7	22	Legal disputes between project participants	External Determined	0.891
8	20	Poor communication and coordination with other parties	Client Determined	0.869
9	11	Inappropriate construction methods	Contractor Determined	0.863
10	2	Design errors made by designers	Unforseen	0.794
11	5	Delay in preparing interim payment certificates	Unforseen	0.794
12	1	Delay in assessing/evaluating major changes in the scope of work	Unforseen	0.789
13	14	Absenteeism	Contractor Determined	0.771
14	25	Delay in manufacturing materials	External Determined	0.771
15	9	Inadequate contractor experience	Contractor Determined	0.754
16	16	Delay in payments	Client Determined	0.754
17	27	Environmental and social factors	External Determined	0.720
18	8	Financial indiscipline/dishonesty	Contractor Determined	0.709
19	10	Incompetent project team	Contractor Determined	0.686
20	12	Poor site management and supervision	Contractor Determined	0.663
21	13	Poor procurement of construction materials	Contractor Determined	0.606
22	3	Inadequate site investigation	Unforseen	0.560
23	23	Shortage of construction materials	External Determined	0.543
24	26	Accidents during construction	External Determined	0.400
25	7	Delay in performing inspection and testing	Unforseen	0.389
26	24	Unexpected surface & subsurface conditions (such as soil, high water table)	External Determined	0.274
27	21	Unfavorable weather conditions	External Determined	0.240

Table 4-1 Ranking Delay Causes according to its RII

Causes of delay

Table 4-1 shows the 27 causes of delay that have been recognized in the methodology. These causes are grouped into 4 categories: unforeseen factors, contractor related factors, external factors and client related factors.

Contractor factors

Seven contractor-related reasons of delay has been recognized and grouped. A single cause of the contracted related delay list was ranked in the top then, represented as the inappropriate construction method. As Contractors have to guarantee that all necessary equipment, resources and tools to be fully utilized and prepared well prior to start of construction process. This cause is highly under-appreciated and should be resolved via using an efficient flow of information.

External factors

Out of seven external factors identified earlier, only one factor made it to the top ten list, where dispute could affect majorly in delaying the project. Normally disputes would occur between all parties, such case is when a project manager set a time and cost estimating different than the agreed between the other party members. But in other hand, the management could affect other factors than the external, such as inappropriate handling of equipment.

Client factors

As it seems, the client determined factors concord the top ten list, this results is not shocking to the readers, since the survey was handed out to the opposite party. Mostly, what affects delay the most is changes in order, changes in design, and changes in material type and approval of final drawings. This excessive change could lead to significant disruption and delay in the project and would require a reschedule of plan and extra costs to be paid.

4.2.1 Questionnaire findings

The study investigated the delay in construction projects, via collecting data from clients, contractors and consultants. The statistics received were examined by abstracting the ranking made on each of the causes and ranking them again due to their relative importance index. The data collected showed that the top ten causes are as follow:

1) Design modifications by holder or his agent during the executing phase
2) Delay in approving design working drawings
3) Blurred and insufficient details in shop drawings
4) Change orders
5) Alterations in material selection and specifications during executing phase
6) Delay in reviewing and approving design changes
7) Legal disputes between project participants
8) Low communication and coordination between the involved parties
9) Inappropriate construction systems
10) Design errors made by designers

The 27 factors analyzed were categorized, this categorization helped in realizing that the causes of delays are not as equally important, where the major causes of delays are the client based delays, then in second place comes the unforeseen factors, followed by the contractor ending with the external determined factors.

4.3 Case studies

4.3.1 Case Study 1

Project name: Villamar development – Bahrain Harbor

Location: Manama – Kingdom of Bahrain

Budget: US$ 450 million

Type: Residential

Start: 2006

Area: 32,000 square meter

Developer: Gulf Holding Company

Reason of failure as Century 21 Bahrain real estate announced that Villamar launched a successfully funding to start the project, but when the developer company decided to use the amount funds to start several other projects, the cost decision has been taken to raise a fund through selling the residential apartments in the well located area in the town, although the idea of buying an apartment were new to the locals in the year 2006 and few swallow the idea and accepted it which lead to fail of raising sufficient funds to continue the aggressive plans, in that moment the failure has begun which cause shortage of funds to complete the main project.

The decision taken of raising funds and start selling the apartments is a smart one but the way of applying it in the middle of project not in a prior stage and spending the original funds has become a bad decision specially after the financial crises in 2007 which affected all the architectural projects.

In my opinion in order to complete the project, they should find an investor whom willing to buy the hold project with low price and continue it or open the door for the rich families to unit and invest and own the majority of share hold of the project because it an iconic design and it could be the landmark of Kingdom of Bahrain. In addition, replacing

the idea of residential building to commercial building and a 5 star hotel is a common sense as it the more successful in that area.

4.3.2 Case Study 2

Project name: Aldar headquarters building

Location: Al Raha Beach, Abu Dhabi - United Arab Emirates

Budget: US$ 272 million

Type: Commercial offices

Start: 2010

Area: 61,900 square meter

Developer: ALDAR Laing O'Rourke

The vanguard of circular structure in the Middle East, it was voted the "Best Futuristic Design" by The Building Exchange (BEX) Conference held in Spain. The structure of AlDar is succeeded over the use of diagonal grid of steel. Developer describes the building as "The Circle signifies unity, stability, rationality. It is also the symbol of infinity, without beginning or end, perfection, the ultimate geometric symbol. It represents a completeness which encompasses all space and Time." The client has set a 30 months to complete the project, they were playing against the time factor. The work began in the foundations before the completion of the set of working drawings and designs of the building itself, so the decision was a smart and risky as well. Therefore the use of precautionary reinforcements in the foundations and the work of 400 concrete columns under the ground on the two parts, part works on friction flattened to install sand and rock from the bottom and the rest of the reinforced concrete columns descend deeper into the rock to distribute the weight of the massive building in the ground. Moreover steel structure (under cladding glass) from the top has get a light settlement so they took the decision using a lifting concrete until the completion of the exterior skeleton structure to carry out its own weight to distributed to the land.

4.3.3 Case Study 3

Project name: The United Tower

Location: Bahrain bay - Bahrain

Budget: US$ 240 million

Type: Commercial offices and hotel

Start: 2009

Developer: Cooperation Investment House

The United Tower consist of 50 floor level and it will house the five-star Wyndham Grand Collection Manama over 14 floors of its 50-storey. The tower rises from an octagonal floor plate, twisting counter clockwise that boasts continual 360 degree views of the bay and the bay. The owner required a desire iconic shape that won't cost him a lot, having an octagonal floor and rotate it over the core which leads the projected area to be a cantilevers instead of doing a rotated column. Such a good decision has saved cost and time as well; the construction method will be a routine which it's easier rather than each part of the tower required an attention.

4.4 Interview Analysis

4.4.1 Question 1: What are the factors led to cost overrun? Why?

First consultant said that "Client change orders cause a lot of variations and claims because the client has less experience in vision of the processed project. A clear vision and an excellent architectural consultant are indeed to ensure that the client requirements have been transferred into reality". Second consultant has different perspective of view which is "During construction, contractor claims and variation gets on the table because the QS engineer didn't notice that the lowest bid hasn't cover all the project in details from the soil investigation till turning the key".

4.4.2 Question 2: What are the reasons cause the delays in the project duration?

In one hand, the consultant said “Government legal requirements and documentation process could bury the project from the beginning, taking approvals from Municipalities and Electrical and Water Authority has hold us many times from proceeding and changed our duration time although we were expecting it but yet they surprise us of amounts of delay”. In the other hand, the second consultant says “Working based on the project timesheet and setting a mile stones will guarantee time efficiency, working without a clear planning and path will definitely maximize the project duration and the contractor workers will get board of the project and won’t work as professional as they started”.

Chapter 5

5 Conclusion and Recommendation

5.1 Conclusion

Analysis was carried out on the effect of delay on the project work. Time overrun, increase in final cost of project, wastage and under-utilization of man-power and resources, tying down of client capital due to non-completion of the project, dispute among parties involved were ranked highest. Time is factor that is very essential in all activities that has to be carried out, in the contract document a specific time phase is given for delivery of project and if the time is being exceeded more money is often spent which could lead to increase in final cost of project and also wastage and under-utilization of man-power and resources. The client's capital has to be withheld due to non-completion of the project which could result into dispute, litigation and arbitration among the workers and management. Also delay can lead to reduced profit for builder and abandonment of building project by the client.

The outcome of analysis from this study can be said to be of great relevance to the construction industry. Majority of the respondents are fully involved in the construction industry with at least 10 years of construction experience, meaning that the respondents have wealth of knowledge and could supply the necessary information on the question sent out in the questionnaires. The professionals represented were the client having the highest percentage of 51.1% of causes of delay in construction project followed by the contractors having 35.5% then the consultants having the least percentage of 13.3%.

There are many factors that induce delay on construction projects, however in this study the factors are limited to 27 factors causing delay and they were ranked according to the mean index score. The factors includes: lack of funds to finance the project to completion, changes in drawings, lack of effective communication among the parties involved , lack of adequate information from consultants, slow decision making and

contractor's insolvency, variations. Also, project management problem, mistake and discrepancies in contract document, equipment availability and failure, mistakes during construction, bad weather, and fluctuation in prices of building materials, inappropriate overall organizational structure linking to the project and labor strike.

5.2 Recommendations

Out of the study, it is shown that in order to reduce the delays of projects to it minimal levels, all parties show follow the following five pinnacle methods:

Make sure that there are adequate financing resources available at all times.

1- Make sure that the project manager are up to level of quality required in meeting the plans and schedule
2- Always optimize available resources at all times
3- Continuous and frequent progress update meetings among all parties
4- Award bid to the most proficient contractors, not necessarily the one with the lowest price.

Among these five methods, four methods are found to be among the highest ranking methods known to be diminishing project delays. Among all methods, it is very important and essential to provide sufficient sources of financing. Both project managers and clients should always diminish the probability of the lack of cash incident at all times.

These methods are not specifically made for a single type of delay as it could be used for all types of delay, whether it is excusable or not. On the other hand, time estimation should always be accurate, that in order to deliver materials, in such case, it is very essential to record all necessary information and suggest that all information should be developed in a qualitative flow. Moreover, all parties should align with each other, especially the client, whom depending upon the studies earlier played the major role in affecting the time schedule with his/her change of order in the last time.

5.3 Limitations

The number of contractors and consultants that participated in the study were limited to ten only. Further studies suggest that it is essential to engage more participants and clients as well. In addition, live case studies should take place to qualitatively measure the affects of delays on real projects and what type of delays that could occur in different sets of construction projects.

Appendix A

Questionnaire Sample

16th Dec, 2014

Dear Participant,

My name is **Mohammed Ali Alsendi** and I am a graduate student at **George Washington University**. For my final project, I am investigative **Effect of Decision Making on Delayed Construction Projects**.

I am inviting you to participate in the following questionnaire made to analyze the importance of project delays, their effects, and causes and finally recommend a method to minimize such delays.

I would appreciate your participation and thank you in advance for your sincere answers.

Sincerely,

Mohammed Alsendi

+973 – 38888208 / archalsendi@gmail.com

Questionnaire

Nationality: _____ Years of experience:

Position: _____ Age:

No.	Cause	1	2	3	4	5
		Higher				Least
Causes of delay						
1	Delay in assessing/evaluating major changes in the scope of work					
2	Design errors made by designers					
3	Inadequate site investigation					
4	Unclear and inadequate details in drawings					
5	Delay in preparing interim payment certificates					
6	Delay in reviewing and approving design changes					
7	Delay in performing inspection and testing					
Contractor Determined Factors						
8	Financial indiscipline/dishonesty					
9	Inadequate contractor experience					
10	Incompetent project team					
11	Inappropriate construction methods					
12	Poor site management and supervision					
13	Poor procurement of construction materials					
14	Absenteeism					
Client Determined Factors						
15	Change orders					
16	Delay in payments					
17	Changes in material types and specifications during construction					
18	Delay in approving design documents					
19	Design changes by owner or his agent during construction					
20	Poor communication and coordination with other parties					
External Determined factors						
21	Unfavorable weather conditions					
22	Legal disputes between project participants					
23	Shortage of construction materials					

20	Poor communication and coordination with other parties				
External Determined factors					
21	Unfavorable weather conditions				
22	Legal disputes between project participants				
23	Shortage of construction materials				
24	Unexpected surface & subsurface conditions (such as soil, high water table)				
25	Delay in manufacturing materials				
26	Accidents during construction				
27	Environmental and social factors				

Appendix B

Case Studies Project Images

Figure 5-1 Conceptual design of Villa Mar

Figure 5-2 Recent image of Villa Mar project

Figure 5-3 Side View of Aldar Project

Figure 5-4 Helicopter View of Aldar Project

Figure 5-6 Recent image of The United Tower

Figure 5-5 Conceptual design of The United Tower

Appendix D

Sample RII on Delay Causes

Relative importance index (RII) Factors	Clients		Contractor		Consultant		Overall
	RII	Rank	RII	Rank	RII	Rank	Rank
Delay in honoring payment certificates	0.831	1	0.932	1	0.852	1	1
Underestimation of cost of projects	0.824	2	0.845	5	0.792	3	2
Underestimation of complexity of projects	0.784	6	0.824	8	0.792	3	3
Difficulty in accessing Bank credit	0.797	4	0.858	2	0.755	9	4
Poor supervision	0.743	10	0.858	2	0.773	5	4
Underestimation of time for completion by contractors	0.757	8	0.764	12	0.801	2	6
Shortage of materials	0.696	17	0.851	4	0.759	8	7
Poor Professional Management	0.804	3	0.73	17	0.764	7	8
Fluctuation of prices	0.757	8	0.811	9	0.736	11	8
Poor Site management	0.797	4	0.743	15	0.75	10	10
Construction methods	0.743	10	0.791	10	0.736	11	10
Delay in instructions from consultants	0.709	16	0.831	7	0.708	17	12
Late deliveries of materials	0.655	25	0.838	6	0.731	13	12
Lack of Programme of Works	0.73	12	0.709	20	0.769	6	14
Delay by sub-contractors	0.696	17	0.791	10	0.731	13	14
Poor design	0.73	12	0.757	14	0.727	15	16
Breakdown of equipments	0.764	7	0.743	15	0.704	20	17
Client initiated variations	0.716	14	0.764	12	0.708	17	17
Obtaining permit from municipality	0.689	21	0.723	19	0.676	22	17
Insufficient communication between parties	0.662	23	0.73	17	0.681	21	17
Necessary variations	0.696	17	0.689	22	0.667	23	21
Shortage of skilled labour	0.689	17	0.581	28	0.718	16	21
Legal disputes	0.716	14	0.628	26	0.653	25	23
Unfavourable Site conditions	0.696	17	0.669	23	0.639	27	23
Foundation conditions encountered on site	0.655	25	0.608	27	0.708	17	25
Discrepancy between design specification and building code	0.642	27	0.649	24	0.662	24	25
Bad weather conditions	0.635	28	0.709	20	0.597	28	27
Mistakes with soil investigations	0.662	23	0.579	29	0.648	26	28
Unskilled equipment operators	0.601	29	0.635	25	0.588	29	29
Accidents during construction	0.554	30	0.486	30	0.565	30	30
Shortage of unskilled labour	0.473	31	0.446	31	0.468	31	31
Public holidays	0.432	32	0.412	32	0.403	32	32

Table 5-1 Relative Importance Index Sample

Appendix E

Questionnaire Results

No.	Cause	1 Highest	2	3	4	5 Least	RII
	Causes of delay						
1	Delay in assessing/evaluating major changes in the scope of work	6	52	12	5		0.79
2	Design errors made by designers	49	5	11	10		0.79
3	Inadequate site investigation	1	5	55	8	6	0.56
4	Unclear and inadequate details in drawings	64	7	4			0.95
5	Delay in preparing interim payment certificates	8	60	7			0.79
6	Delay in reviewing and approving design changes	59	16				0.91
7	Delay in performing inspection and testing			5	53	8	0.39
	Contractor Determined Factors						
8	Financial indiscipline/dishonesty	55	5	4	8	3	0.71
9	Inadequate contractor experience	59	3	3	6	4	0.75
10	Incompetent project team	29	19	10	7	10	0.69
11	Inappropriate construction methods	40	24	11			0.86
12	Poor site management and supervision	28	11	14	10	12	0.66
13	Poor procurement of construction materials	2	9	50	11	3	0.61
14	Absenteeism	21	29	15	9	1	0.77
	Client Determined Factors						
15	Change orders	65	4	4	2		0.95
16	Delay in payments	32	16	22	4	1	0.75
17	Changes in material types and specifications during construction	53	16	6			0.94
18	Delay in approving design documents	53	21	1			0.97
19	Design changes by owner or his agent during construction	71	2	2			0.98
20	Poor communication and coordination with other parties	61	3	7	3	1	0.87
	External Determined factors						
21	Unfavorable weather conditions			3	7	65	0.24
22	Legal disputes between project participants	53	11	6	5		0.89
23	Shortage of construction materials		10	48	11	6	0.54
24	Unexpected surface & subsurface conditions (such as soil, high water table)			2	15	58	0.27
25	Delay in manufacturing materials	3	58	9	3	2	0.77
26	Accidents during construction		2	5	63	5	0.40
27	Environmental and social factors	4	57	9	5		0.72

Table 5-2 Relative Importance Index on Questionnaire Results

Appendix C

Questionnaire Result Charts

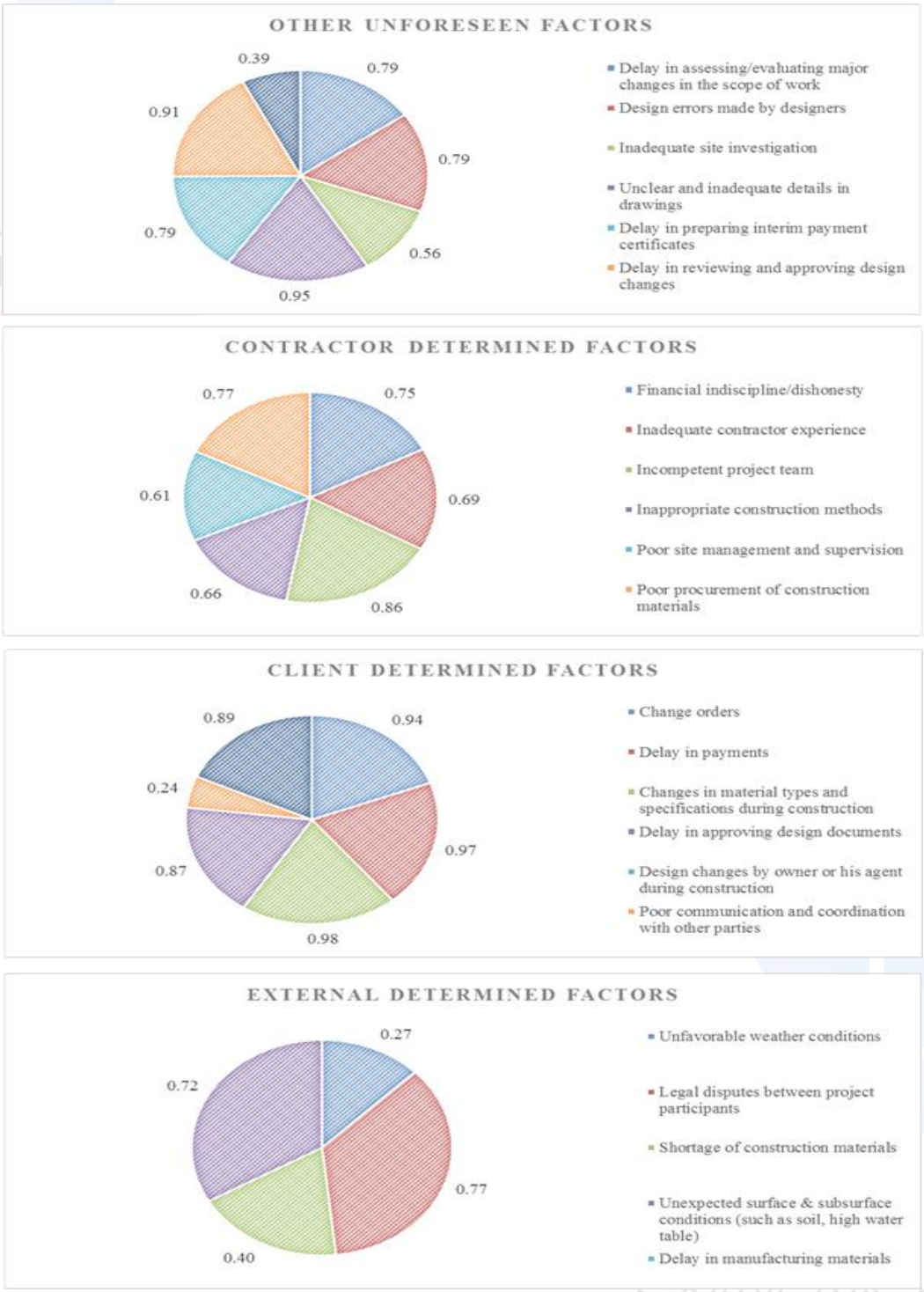

Figure 5-7 Results Charts

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