

University of Bahrain
College of Engineering
Department of Mechanical Engineering



Investigating and Analyzing Delays Factors and their Impact on Private Building Construction Projects in Bahrain

A Thesis submitted in partial fulfilment of the requirements for the
master's degree in Engineering Management

Prepared by:

Dalal A. Razaq S. Mohd Al-wedaei

ID: 20163145

Supervised by:

Dr. Yusuf Al-Malki

Assistant Professor

University of Bahrain

Kingdom of Bahrain

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بسم الله الرحمن الرحيم

Abstract

Construction industry has boomed recently in Bahrain. However, delays issues in construction are significant and that impact projects delivery within planned timeframe, cost, and quality standards. From here this research has a vitality of investigating and analysing delay factors which affect building construction projects in Bahrain specially in private sector. Fifty (50) delay factors and their background were stated through a comprehensive analysis of previous related literatures. This research followed non-random sampling method as the questionnaire was distributed to the main project parties including contractors, consultants, and clients/owners to provide their opinions regarding those delay factors by online and face to face. Population size of this research was N=5902 and total of 134 responses was collected. Factors of delays were classified through this study into eight categories: materials-related, equipment-related, manpower-related, project management-related, consultant-related, client/owner-related, governmental-related and external-related factors. Delay factors of this study were analysed and ranked by using Kruskal Wallis/Mann-Whitney and Relative Importance Index (RII) methodology. Kruskal Wallis/Mann-Whitney and Relative Importance Index (RII) for both frequency and severity of delay factors were applied to determine means and key delay factors influencing building construction projects. Based on overall results, key influencer factors are “continuous changes order by owner”, “poor site management & Ineffective control system”, “unrealistic cost estimation (underpriced) & cash flow”, “lack of skilled manpower”, “owner interference in construction operations”, “un-realistic contract duration”, “decision making sluggish by owner”, “poor communication skills between contractor PM & project parties”, “claims between client & the main contractors” and “inaccurate project planning & scheduling by contractor”. Thus, respondents agreed that contractors and owners are the most responsible parties for construction delays. Although, this research was conducted on Bahrain building construction projects, but it can be applied to other countries and further studies.

Dedication

I would like to dedicate this study to my lovely parents, husband, sisters, family and friends as they were my inspiration source who providing me with moral, motivation and financial support.

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Chapter 1: Introduction

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1.1 Introduction

The construction industry is a wide and complex industry in comparison with other industries as each project has its own characteristics and specifications which make it unique even if there are identical construction projects. Construction industry includes all civil engineering works such as construction, demolition and maintenance of buildings and infrastructures (Shebob, 2012).

All construction projects should be delivered within budget, on time, and with the expected quality to be successful. Construction delays are almost inevitable in construction projects around the world, and these variations lead to disruptions and increased costs (Malak et al., 2020). The range of delays varies from project to project and can last from one day to multiple years. It is rare for a construction project to be completed according to its original plans and within budget. A project that is completed on time, within budget, and with the expected quality without any delays can be classified as an efficient and successful project. (Venkatesh & Venkatesan, 2017).

Moreover, delaying construction negatively affects the owners in their revenues and cost the contractors some of their overhead costs. Generally, delays in construction projects are caused by owners, contractors, consultants, and other functions. Some of the unpredictable delay factors are design and project scope changes during implementation, unavailability of resources, poor risk management, bad communication between parties, contractual conditions and external factors like unpredictable weathers and disasters (Shebob et al., 2011).

According to Dannible & McKee LLP (2019), number of private projects has increased recently, especially buildings due to the small sizes

of the organisations. Therefore, it's easier to collect data and access to experts in the private sectors. In addition, private sector has more flexibility in their logistics and delivering the project as it usually extends their finish date of the project (Planit, 2016).

Therefore, the main purpose of this research is to investigate, categorize and rank factors of delay in building construction projects in Bahrain using a methodology of Relative Importance Index (RII). As well as, to find solution of pre-act of risks and reduce the impact of delays in construction projects. The researcher will collect data using literatures and quantitative method (survey). Questionnaires will be distributed to owners, contractors, consultants, and experts in construction projects to fulfill all research questions. Data and information collection will be based on previous related studies, results of questionnaire will be analyzed using “Statistical Package for Social Science (SPSS)” for ranking delay factors in terms of their relative importance index. Besides, "Microsoft Excel” software will be used to fulfill the same goal.

1.2 Research Problems

Construction & Real Estate industry are considered as a leading sector in Bahrain as it grew rapidly in 2021 by 0.8% according to E-Government Authority report. The expected growth rate in Global Data report regarding Bahrain's construction industry is 4.3% between 2022-2025 (GlobalData, 2021). In 2008, the gross revenue of construction industry amounted to BD 2442 million. 76% of these revenues is for buildings construction (Nebrida, 2021).

Therefore, Bahraini citizens should realize the importance of construction sector especially buildings in playing a key role in economic development. To increase the economy in line with 2030 vision, the

construction industry should be managed well through developing the basic concepts, necessary permits, standards along with delay factors to ease playing its significant role.

Bahrain's construction projects might face many obstacles during implementation. Most construction projects were delayed by time overruns, cost overruns or quality. There are lots of projects that are suspended due to insufficient fees. In addition, some projects were stopped. Therefore, to minimize delays in construction projects and manage the project properly to deliver it on time, within budget and according to quality standards, delay factors will be analyzed and ranked in Bahrain construction projects using the suitable statistical tests.

1.3 Research justification

Construction sector in Bahrain recently has attracted investors to invest in. Construction projects nature is complex at all stages beginning with design, construction methods to end with delivering the projects in timely frame, within cost and quality confirmation. Recently, engineers and researchers pay all their attention to the phenomenon of delays in building construction projects in order to develop the process of construction in both private and government sectors.

Rashid (2020) was investigated delay factors and their effects on construction projects, he found that contractors and clients have the highest significant effects on delay while labor and general factors have insignificant impacts on delays of projects. The highest ranked effect was cost-overrun so its important to consider financial issues in construction project management. This results matching findings of Yap et al's (2021) which considered contractors and clients among the highest responsible parties in delaying construction projects in Malaysia using importance index

of both frequency and severity. Also, he identified the most important managerial capabilities which impact the delay in construction projects such as managing competencies, communications, coordination, financial and site.

Hoque et al's (2023) analysed construction causes of delays in Bangladesh context using RIIs, all of participant's agreed that owner is the first responsible for delay followed by consultant and contractor. Also, he determined the most principal effects of delay to be time overrun and cost overrun. Tariq and Gardezi (2023) in their study focused on identifying delays and conflicts in construction projects globally based on previous literatures only without doing any questionnaire or interviews, finance difficulties by client, project planning and scheduling, materials related issues, continuous order changes, and Lack of communication were the common top ranked factors.

One of the most popular delayed construction projects in Bahrain are the marine west located in Al-Budayie. It opened to bidders to invest in after delaying of approximately six years. The started date of marine west project was in 2007 and stalled in 2010 due to financial standoff (Writer(b), 2022). Another stalled construction project in Bahrain is Juffair Views which started on 2007 and delayed by approximately ten years, Ramee Group bought Juffair Views project, and it is planned to be completed by 2017 through public auction. The project was delayed as developer reports, due to the shortage of materials and manpower by the contractor as well as the financial crisis at that time (Moseley, 2017). To reduce the number of stalled real estate projects (construction projects) in Bahrain, the researcher aims to develop research to pre-act and identify delay factors which affect completion duration of construction projects and set a recommendation to solve or limit the problem of delays.

This research will focus on investigating and analysing factors of delay in building construction projects of private sector in the region of Bahrain, this will be evaluated accordance to frequency of occurrence (F.I) and degree of severity (S.I) of delay factors which will be collected through structured questionnaire distributed to civil experts by using some of statistical analyses through identifying the Relative Importance Index (RII) for each delay factor to rank them and measure their priority in construction projects during implementation phase. The analysis done through this research is intended to prevent and minimize construction delays in building construction projects.

1.4 Research Questions

In this literature review, the researcher will explore the questions from earlier research about analyzing the impact of delays in building construction projects which can be applied both in Bahrain and abroad. The following questions will be discussed and answered in detail through this paper.

- A. What are the most significant factors that delay building construction projects in the private sector in the kingdom of Bahrain?
- B. What are the frequency of occurrence and severity degree of delay factors?
- C. What are the ranking of delay factors based on their relative importance?
- D. How to reduce the impact of delay factors on building construction projects in Bahrain?

1.5 Research Objectives

This thesis focuses on identifying and analyzing the causes of construction delays at preliminary stages of construction using statistical methods which are Kruskal Wallis/Mann-Whitney tests and Relative Importance Index (RII) to identify cause of delays and ranking them in private building construction projects in Bahrain. The main goals of this research will be summarized as follows:

1. To demonstrate all possible delay factors which affects building construction projects completion period and illustrate the most significant delay factors caused by construction parties for each group.
2. To conduct surveys with owners, contractors and consultants in the construction industry to identify the Means for both frequency and severity of delay factors to determine the significance differences.
3. Identify Relative Importance Index (RII) for each cause of delays to rank them in private building construction projects in Bahrain.
4. Identify recommendations to reduce delay factors impacts.

1.6 Research Significance

The aim of this research is to provide essential information about the impact of delays on building construction projects based on previous studies and experts' responses. The importance of this research is reflected in researchers, engineers, and specialists of the construction industry.

For Researchers: This topic opens prospects for future projects to be adopted and implemented in different countries, where the researcher can identify the factors affecting the total duration of submission of building construction projects.

For Engineers and Specialists: It is necessary for engineers and experts to fully know the factors affecting construction projects, as these factors depend on the type, size, and characteristics of the project, which differ from one project to another. This research presents them by using SPSS program, to detect these causes and prevent their occurrence in building construction projects in Bahrain.

1.7 Literature Gap

Researches targeting the challenges facing private building construction projects in Bahrain is limited. While some studies completed in Bahrain focus on delays in road construction projects and construction projects in the public sector. Globally, there are many studies that have addressed delay factors in construction projects in general, but there is an urgent need to conduct studies that focus specifically on the local context in Bahrain. This literature gap can improve private sector efficiency and reduce the delays in building construction projects in Bahrain.

1.8 Research Framework

To investigate and rank causes of delays in building construction projects in Bahrain, many steps will be applied in this research as showed in Figure 2 such as:

1. Conduct a comprehensive literature review based on previous related studies. Furthermore, collect data of delay factors and categorize them with reference to experts of building construction.
2. Design the main questionnaire with data of delay factors and other general information of respondents.
3. Distribute the questionnaires to the clients, contractors and consultants in the construction industry, especially in buildings to

identify and rank delay factors and other information and collect responses.

4. Develop a quantitative data analysis by compiling results and performing statistical analysis using applicable software package, i.e. SPSS 20.
5. Discuss the results and generalize the findings to write the final valuable conclusion & recommendations.

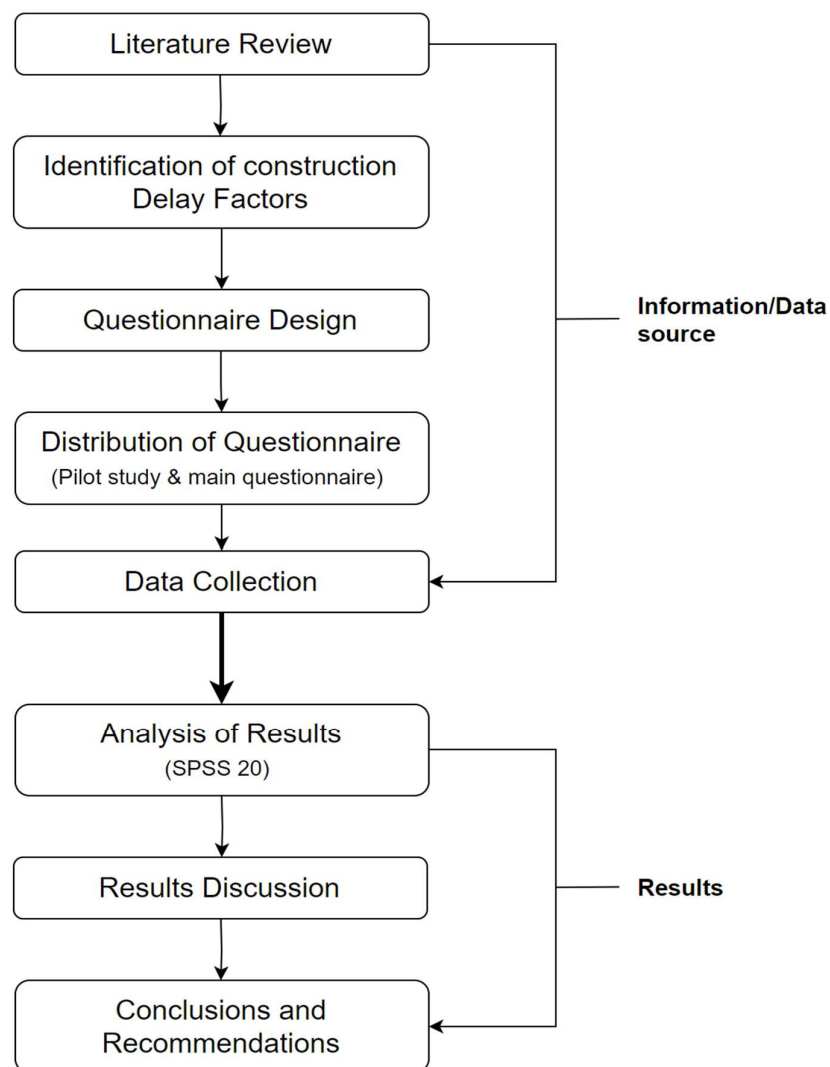


Fig 1: Research Framework

1.9 The Study's Setting

This thesis consists of five chapters, arranged in the following sequence:

Chapter 1: Introduction

This chapter outlines a brief introduction about thesis topic beside the general information about delays and their effects on building construction projects in the private sector in Bahrain, followed by research problem, research justification, research questions, main objectives, and the significance of the research. Additionally, literature gap, research framework and thesis outline are defined.

Chapter 2: Literature Review

This chapter consists of three main parts. Part one offers an overview about construction industry in Kingdom of Bahrain. Part two discusses delays in construction projects, followed by some of delayed projects in Kingdom of Bahrain. Also, identifying delay factors which may affect the completion time of construction projects and their types. Part three examines related previous studies on the impact of delays factors in buildings construction projects.

Chapter 3: Research Methodology

This chapter presents the methodology used. As well as, all mathematical analysis and tools (Questionnaire) used to deliver and support the study.

Chapter 4: Results & Discussion

This chapter discusses the results acquired by this study through applying statistical analysis method such as Kruskal Wallis/Mann-Whitney and Relative Importance Index (RII).

Chapter 5: Conclusion and Recommendations

The last chapter summarizes the research outcomes and offers recommendations for the longer-term studies.

Chapter 2: Literature Review

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2.1 Introduction

This chapter discusses the qualitative component of the mixed method research strategy which is explained in details in chapter 3. It will explore construction industry in Bahrain, construction delays and examples of delayed projects in Bahrain, types of delays, delay factors in construction projects as well as the previous related studies.

2.2 Construction Industry in Bahrain

According to Economic Development Board EDB Bahrain (2022), Bahrain has a free economy and strategic location in the heart of the Arabian Gulf. It is portal to enter the Middle East region and an opportunity to invest with the lowest capital possible. Due to the agreement of free trade with the united states, Bahrain's Foreign Direct Investment (FDI) increased by around USD 1.766 and to achieve 73% (y/y). Ministry of Finance and National Economy (2022) reports that Bahrain growth rate (GDP) has increased within the second quarter of 2022 from 5.5% to be 6.9%, which is the highest GDP scored over the last 11 years in Bahrain. All these indicators show the strength of Bahrain economy.

Construction industry is a major player for all other sectors, as all sectors of industry first build facilities and then start the investments. Bahrain has recently witnessed a boom in its economy, as the government's priorities were evident in the development of both housing and infrastructure projects which can increase the contribution of construction sector in the growth of economy (Abusafiya & Suliman, 2017). In addition, expanding circle of communications is important to enhance country's livelihood and attract different countries to invest in, thus Bahrain's construction economy will flourish (Altoryman, 2014).

Construction projects face plenty of challenges during implementation phase in terms of cost and time overruns, workmanship quality, claims and disputes between involved parties etc (Nebrida, 2021).

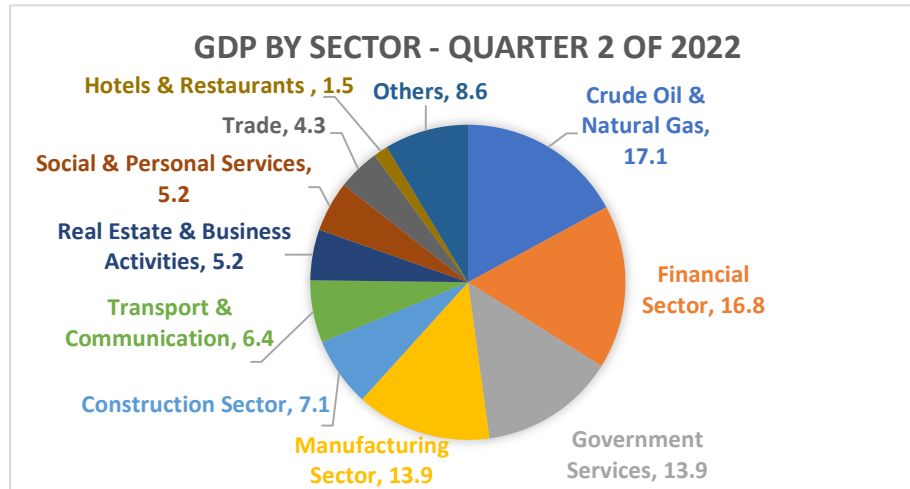


Fig 2: Real GDP of Sectors in Bahrain from Ministry of Finance and National Economy, 2022

Ministry of Finance and National Economy (2022) mentioned that construction sector has great influence toward economy as it grew by 2.6% (y/y), building projects has increased by 1.6% (y/y). The non-oil sectors growth by 9.0% highly influence Bahrain's economy growth rate (GDP). Financial sector led this growth, followed with Government services and manufacturing sector, construction industry, transportation and communication sectors with rate of 16.8%, 13.9%, 7.1% and 6.4% respectively from the total real GDP as shown in Figure 1.

Nebrida (2021) found that the growth rate of construction industry in Bahrain market expected to increase with 4% rate by 2023 and 4.6% growth annually within (2024 - 2027). Construction growth rate is assisted by the support of oil investments, infrastructure investments and building investments. Additionally, Bahrain's infrastructure investment amounted by BD11.3 billion. (Globaldata, 2021) illustrated that Diyar al-Muharraq project and Bahrain international airport expansion project running to

BD3.4 billion and BD2.8 billion respectively. Based on the contribution of construction industry in GDP, construction activities placed in Bahrain and construction market value, construction industry performance in Bahrain seems to behave good.

2.3 Delays in Construction Projects

Sweis et al. (2008) defined construction delays as the time lag in activities completion or late starts in doing activities where it requires more time expansion in order to complete tasks. Delay in construction projects is a common phenomenon due to the multiplicity of inputs and resources diversity. Moreover, because of the wait this phenomenon pauses the development process of construction in the government and private sectors.

Delay is a complex problem, expensive and risky. Delays negatively affect owners (clients), consultants and contractors in terms of performance and money. It possesses a considerable effect on construction projects as well. As construction projects often face various types of delays that may lead to cost overruns, schedule slippage, and conflicts between project stakeholders. Schedule delays can lead to increase in the project costs, lost productivity, and delayed revenue streams. Increased costs may lead to project budget constraints and affect the financial viability of the project. Delays can also lead to contractual disputes and legal claims, hurt the relationship between the owner and contractor. Therefore, it is important to effectively identify, evaluate and manage delays to minimise their impact on the construction project (Venkatesh & Venkatesan, 2017). Success of construction projects are met if the project were delivered on time, within the planned budget and conform to standard quality (Mohamed, 2015).

Construction project delays can be categorised into four main categories, owner-induced, contractor-induced, consultant-induced and external-induced. "Owner-caused" delays can occur due to delays in providing necessary permits, approvals, or financing. Delays caused by contractors can arise due to poor management, insufficient resources or unforeseen site conditions. "consultant-caused" delays can happen due to poor planning and poor design. Factors beyond either party's control, such as weather, labour strikes, or natural disasters, can cause external delays (Sweis et al., 2008).

For instance, da Costa (2020) reported that construction of Berlin Brandenburg (BER) Airport in Germany in 2017 experienced significant delays delaying the airport's opening for several years. Originally planned for a 2011 opening date, the project was delayed due to "flawed" fire safety systems, construction errors, and problems with the airport's bag-handling system.

Construction delay had significant financial consequences, as the airport had already spent billions of euros on construction costs, and the financial losses were significant due to the delay. In addition, the airport faced legal claims from airlines and other stakeholders who invested in the project based on the original opening date. To manage this delay, the project team implemented various strategies then airport finally opened in 2020, after nearly a decade; than originally planned, with a total construction cost of more than 6 billion euros.

2.3.1 Delayed Construction Projects in Bahrain

The Supreme Judicial Council (SJC) stated that some Stalled Real Estate projects in Bahrain have been successfully completed after a delays obstacles, including Marine Breeze 1 & 2 and Dar Al-Ezz 2 & 3 (GDN,2022). Marine Breeze situated in Al-Durrat Marina which

comprises of two residential towers 1&2 provided with 82 deluxe units (Weetas, 2014). Dar Al-Ezz 2 & 3 located in Al-Busaiteen & Al-Sayh.

In addition, GDN (2022) illustrated that there is stalled projects were offered in public auctions which are Juffair Views and Amwaj Gateway. Juffair Views project was proposed in 2007 comprises of 81 flats, but it was robbed in 2009. Then, it successfully sold in auctions coordinated by government, Savills and Stalled Real Estate projects Authority for BD3.5 million (Moseley, 2017). Amwaj Gateway project composed of twin-towers accommodating 384 flats and two-story buildings boasts 93 houses as well as the hotel tower. The area of the project is about 33000 m². It is one of the largest stalled projects in Bahrain which adopted by Esterad Amwaj group for BD 75 million (Writer(a), 2020).

Dauids (2018) presents Cityview residential tower case which is situated in Seef District. It comprises of eighty eight (88) apartments and other facilities such as public swimming pool, Spa, gym and health club. The client of Cityview project is Ithmaar Development Company (IDC), the consultant was Dheya Tawfiqi Engineering Consultancy Bureau (DTEB) and the main contractor of the project is Poullaides Construction Company (PCC). The tower delivery were delayed and postponed by approximately 7 years after holding on 2011 to be delivered on 30th of April, 2018.

Marine west project located at Budaiya Village. It is one of the longest stolen projects in Bahrain as it has been suspended for more than 12 years. The project consists of 11 residential towers with more than 1000 appartements and five stars hotel. Marine west project was launched in 2007, it was called \$750 million scheme and was expected to have been completed in 2010. The project still on hold despite the huge numbers of

foreign investors, that's due to the worldwide financial crisis as claimed by the developer (Writer(b), 2022).

2.4 Types of Delays in Construction Projects

2.4.1 Critical/Non-Critical Delays

Keane & Caletka (2009) explained in their book that during analysis of the project delays the focus is on delays that affects the overall progress of the project. Delays impact project completion or the final milestone are considered a critical delays while delays that do not affect project completion or the final milestone are considered as Non-critical delays.

The concept of "critical" delays emerges from critical path scheduling, where the identification of critical activities is the core part of this scheduling, but all projects, regardless of the type of scheduling used, contain "critical" activities, if those activities are delayed, they will be delayed the end date of the project or the date of the final cut-off point. In some contracts, the term "work item control" is used to refer to critical activities or critical work (Keane & Caletka, 2009).

2.4.2 Excusable/Non-Excusable Delay

2.4.2.1 Excusable Delays

Culfik et al. (2014) defined the excusable delays as the delays which occur as a result of events that fall outside the control of the contractor or subcontractor, and are usually unexpected. Examples of reasons for delays are excused: labor strikes, fires, floods, fate, changes occur with owner, unpredictable weather, site conditions variations and Errors and omissions in plans and specifications such as design problems, variations in site conditions or hidden conditions, unusually severe weather conditions,

interference by third parties, failure to take action by government agencies, such as inspections and building inspections (Abdalall, 2017).

There are three main cases that represent the excused delay as seen by Bramble and Collahan (2010):

1. Unexpected events: These are reasons that refer to future events that do not currently exist and are beyond the control of the Contractor, such as unpredictable weather conditions, acts of God, and earthquakes.
2. Events outside the control of the contractor are those causes that occur that the contractor cannot control or that are not within his responsibility such as strikes.
3. Events without fault, fault or negligence which are events in which the contractor is innocent and has no relation such as changes by the owner.

Excusable delays can be categorized into two distinct classes: compensable excusable delays and non-compensable excusable delays. Compensable excusable delays caused by the owner, within his control, from his agents or owner representatives in construction project. It is also caused by owner's fault, negligence or are caused by the engineer or the owner's consultant, whether by the owner's disposal or not, and often this delay leads to an increase in the project's time period and exposes the owner to material damages and claims by the contractor for compensation (Hamzah et al., 2011) and (Mohammed & Isah, 2012). In contrary, non-compensable excusable delays are defined as delays caused by a third party or by accidents beyond the control of both parties to the contract, contractor or owner. contractor is allowed to obtain time extension of the contract at the discretion of the owner or his engineer without paying the associated damages (Ibironke et al., 2013; Mohammed & Isah, 2012).

2.4.2.2 Non-Excusable Delays

Non-excusable delays or un-justified delays are delays caused by the contractor, its supplier or his subcontractor, whether by contractor's action or not (Bramble and Collahan, 2010). Culfik et al. (2014) defines un-excused delays as an events fall within the control of contractor, these delays are common in various construction projects and cause great losses to the project parties (Abdalall, 2017).

This type of delays considered to be a breach implementation of contract done by the contractor. The contractor has the ability to seek compensation from both subcontractors and suppliers; however, the entitlement to claim compensation and exemption from the owner is not granted. It is not allowed to extend contract period or obtain the costs associated with delays caused by owner (Ibironke et al., 2013).

Contractor has two cases to deal with unexcused delays. The first case is compensating the owner for lost or wasted time by accelerating the completion of project in order to avoid paying penalties, contractor spends additional expenses to complete the project on schedule. The second case is the situation remains as it is, thus the project is delayed, the contractor pays penalty of delay and compensation. whether it is liquidated damages or compensation for the actual damages claimed by the owner (Mohammed & Isah, 2012). Value of delay penalty is imposed on contractor according to contract terms and conditions, and these penalties are deducted from his dues.

Examples of non-excusable delays causes are listed by (Hamzah et al., 2011), poor site management and supervision by the contractor, difficulties in financing the project by the contractor, poor qualifications of the contractor's technical staff, the contractor's failure to provide adequate

manpower to complete the project on time and the delay resulting from the lack of materials and equipment needed for work.

2.5 Identification of Delay Factors

Delay factors in tables below will be demonstrated and categorized through reviewing ten past related literatures (Fashina et al., (2021), (Yap et al., 2021), (Sanni-Anibire et al., 2020), (Tafesse, 2020), (Suliman et al., 2017), (Al-Hammadi, 2016), (Mohamed, 2015), (Altoryman, 2014), (Aziz, 2013), (Shebob, 2012). The four main groups of delay factors are contractor-related delay factors which sub-categorized into materials, manpower, equipment and project management related factors. consultant-related delay factors, client-related delay factors, governmental-related delay factors and external factors. On the basis of previous literatures, Table 1. clarify delay factors in building construction project.

2.5.1 Contractor-related delay factors

According to Abiodun et al. (2017) contractor incurs the full construction project responsibility, main contractor is responsible of owner protection from project delays. Therefore, contractor must have the ability to complete the project within time, budget and quality as planned. The capability of successful delivering the project rely on process of project management and resources availability such as material, workforce and equipment (shebob, 2012). Hence, this literature divided contractor related delay factors to four sub-groups (i.e. material-related, equipment-related, manpower-related and project management related).

2.5.1.1 Material-related

Material Management (MM) is a contractor responsibility, it is an important process in preliminary phases as well as implementation phase. If there is shortage noticed, contractor is the main responsible to resort

different suppliers in order to save time and avoid delays. Additionally, specifications changes can delay the project due to waiting line of owner acceptance.

One of the main elements in construction projects that occupies a large space is materials, which constitute about 50%-60% of the total price of the project. The presence of materials in sufficient quantity, affordable price and adequate quality ensures that the project is not delayed, as contractor works to search for materials at a reasonable price and store them properly to be used sustainably and utilized (Vipin & Rahima Shabeen, 2019). This group identifies all factors of delays caused by material provided by the contractor to complete the project.

2.5.1.2 Equipment-related

One of contractor tasks is equipment acquisition, failure and misuse of equipment can lead to delay and deceleration the completion of the project. Equipment used can be either rented or owned by contractor but it mostly owned due to frequent used (Shebob, 2012). Cranes, graders and trucks are examples of equipment used in construction site.

2.5.1.3 Manpower (Workforce)-related

Workforce related group is related to human chosen to employ in construction project site. It is from project engineers to foreman and electrical engineers. Failed manpower selection will lead to pure failure of the project in terms of quality, price and schedule (Shebob, 2011).

2.5.1.4 Project Management-related

It is the set of reasons resulting from failure of contractor's experience toward project management process, which causes time and cost overruns.

Success of any project requires contractor to plan, coordinate, schedule the project and effectively supervise (PMI, 2017).

Project management is known as the art of directing material and coordinating human resources through project life cycle by using of modern techniques to achieve the specified aims considering the factors of quality, timing, and cost. Ineffective project planning and scheduling will lead to delays (Takagi & Varajão, 2020). On the other hand, there is project financing management which may delay projects due to difficulties payment suffered by the contractor.

2.5.2 Consultant-related delay factors

It is a group of issues that originate from the consultant and that cause delay in completing the project on time according to the contract.

The owner appoints a consultant to carry out the tasks of the project. The consultant's tasks are to design the project (including architectural, structural, mechanical, and electrical designs). He or she is also has the responsibilities of preparing project documents (such as drawings, specifications, bills of quantities, and bidding documents). In this group, the tasks of consultant are to complete construction phase, starting with reviewing and approving the design of drawings, monitoring the performance of contractors and supervising the implementation of works (Mpofu, 2017).

2.5.3 Owner-related delay factors

It is a group of issues that are attributable to the owner and that lead to the occurrence of delay in completing the project, and because the duties of the owner are onerous because the nature of the hardship projects requires administrative management of the projects, so the owner often employs a

project manager with an equal amount of money. Among the reasons that lead to the delay in completing the projects are due to the owner: The time set for implementation in the contract is unrealistic (Mpofu, 2017).

2.5.4 Governmental rules/regulations-related delays

The study of Nawafleh (2018) relied on the inclusion of the subgroup “reasons related to government instructions” that belongs to the main group “other factors”, but the researcher includes it as a main group.

2.5.5 Externality-related delay factors

It is a group of reasons that cannot be controlled by the main parties to the project and that cannot be predicted, such as weather... etc., which cause delays in the completion of the project (Nawafleh, 2018).

Table 1. Construction Delay Factors

Material-Related Delay Factors	
1	Lack of material availability in the local market
2	Lateness in delivering materials & long lead items
3	Quality of materials used
4	Prices fluctuation of materials
5	Materials specifications changes
Equipment-Related Delay Factors	
1	Equipment shortages
2	Old technological equipment
3	Inappropriate equipment used
4	Equipment failure
Workforce-Related Delay Factors	
1	Lack of skilled manpower
2	Delayed mobilization of labour
3	Regulation of recruitments process
4	Absence and Sickness of Labours
Project Management-Related Delay Factors	
1	Poor site management & Ineffective control system
2	Rectification Works due to poor PM role
3	Lack of contractor's PM experience
4	Poor communication skills between contractor PM & project parties
5	Inaccurate project planning & scheduling by contractor
6	Ineffective quality control/Assurance system
7	Unrealistic cost estimation (under-priced) & cash flow
8	Claims between contractor and subcontractor
9	Claims between client & the main contractors

10	Engaging the contractor in other critical projects at the same time
Consultant-Related Delay Factors	
1	Poor design and lack of coordinated drawings
2	Delaying the approval of project documents
3	Discrepancies between drawings and specifications prepared by consultant
4	Imprecise time estimation
5	Unrealistic cost estimation
6	Slow responses by the consultant towards required design changes/variations
7	Unqualified/inexperienced consultant's supervision staff
8	Poor communication skills between consultant and parties
Owner-Related Delay Factors	
1	Decision making sluggish by owner
2	Continuous changes order by owner during construction
3	Uncooperative owners
4	Lack of owner experience in construction field
5	Late payment by owner (financial difficulties)
6	Un-realistic contract duration
7	Shortage of coordination between owner and other parties
8	Work suspension by owner
9	Settling financial payments of contractor delayed by owner
10	Owner interference in construction operations
11	Lack knowledge of client's own requirements while designing the project
Governmental Rules/Regulations-Related Delays	
1	Governmental construction regulations changes
2	Complexity of obtaining necessary construction building permits
Externality-Related Delay Factors	
1	Inclement weather conditions
2	Traffic flow
3	Accident occurs in construction site (LTI)
4	Unforeseen conditions of the site (nature & location of the site)
5	Crisis & Political issues
6	Escalation of the claims and disputes to the court

2.6 Previous Related Studies

Mohamed (2015) determined in his study the major causes of project delays and effects in construction industry in Sudan. The research includes thirty-two (32) factors of delays divided into six categories related to clients, contractors, consultants, governmental, environment and other factors. Results of Mohamed's study indicate the common causes of project delays in construction field in ascending order as follows: fluctuation of market prices, materials shortage, imprecise estimation of time,

construction errors during implementation and inappropriate planning. He concludes that construction delays can rise issues of cost overruns, losses, overrun of time, social and litigation. Most of delay factors are clients and contractors responsibility.

Alaghbari¹² et al (2018) identified the five delays factors categories in terms of management, finance, technology, equipment & materials and externality factors. His study intends to specify the most important causes of construction delays among thirty two (32) factors in Sana'a – Yemen. Factors of construction delay appears in ascending rank as follows: Lateness of contractors in payments, difficulties in financing the project by the client, non-experience contractors and consultants, poor project management and insufficient funds for professional execution of the project. Results of questionnaire dispersed to the architects and structural engineers illustrate that managerial and financial factors are the most common causes of delays in construction projects. All categories of factors lead to Time Overruns excluding the financial factors.

Abusafiya & Suliman (2017) study refers to cost overruns delays, forty five (45) factors were stated to be analysed by contractors, consultants and clients in Bahrain construction industry. Results of survey obtained are changes of design, errors in construction and delayed schedules are the main three significant factors that lead to cost overruns delays in Bahrain.

Culfik et al (2014) infer that construction project delays phenomenon is widespread globally. The delay in this research refer to be time overruns occurs in the project which affect the total completion date of the project. Questionnaire developed fifty one (51) factors to be answered according to perspectives of consultants, contractors and clients on causes of construction delays in Turkey construction industry. Culfik et al's study denoted the most five significant delay causes of construction project in

Turkey according to all involved parties which are owner procrastination and suspension of project, delayed payment to the contractor by owner, “unrealistic project duration”, owner sluggishness in making decisions related to project and planning deficiencies.

Aziz (2013) discusses in his study the importance of time management in construction projects which can lead to project success. Delay in time is a global common problem occurs frequently or permanently in all construction projects. Aziz’s study attempts to demonstrate the most common causes of delays in construction projects after the revolution of 2010 in Egypt construction industry. Questionnaire were developed by the researcher to be done by experts and brain storming as well. Ninety nine (99) factors that delay construction projects in Egypt were mentioned and categorized into nine categories as follows: (consultant-related, contractor-related, design-related, equipment-related, external-related, labor-related, material-related, owner-related and project-related factors). The research attempts to include both public and private sectors as well as the local construction enterprises.

The major delay factors in Egyptian construction projects are payment’s progress delay by owner, different payoffs tactics, equipment shortage, planning and schedule is in-effective and bad management of the site. All these factors must be treated to mitigate and reduce construction delays to develop management system and deliver the project within budget, time and level of quality.

Mahdi and Soliman (2021) clarify the significant causes of delays in construction projects in all Arabic Gulf countries as all projects suffer from project delays (e.g. Oman, United Arab Emirates (UAE), Saudi Arabia (KSA), Qatar and Kuwait). The main objective of this research is the

mitigation of construction delays in all Arabic Gulf countries (GCC) due to the commonality.

There are fourteen (14) common delay causes illustrated by this study in all GCC. Poor project site management is the major delay factor. Eight management-related causes have been recorded. The second top-ranked cause is related to unavailability of resources, and it is followed by governmental regulations delay causes. Classifications of delay causes mostly have a certain criteria, but this research analyse the similarities of ranking procedures in KSA, Qatar, Kuwait and Oman based on the spearman correlation coefficient.

Shebob et al (2011) states in his study that delays play a crucial role in construction industry which influence all involved parties either financially or social impact. Shebob et al's research aims to focus on construction delays in Libyan projects through identification and ranking factors of delay which divided into contractor-related factors (materials, equipment, labour and project management), Consultant-related factors, factors related to owner and external delay factors. Also, analysing the effect of delay factors on building construction projects. Ranking delay factors based on frequency of occurrence and severity degree of delay factors in construction projects through questionnaire distributed randomly to owners, consultants and contractors who works in construction industry. The 5 most important factors which highly affected construction projects are un-skilled labours, project scope changes, slow process of giving instructions, lack of consultant's experience and the delays of contractor's receiving the site of the project.

Shebob et al's study comprise of statistical tests and analytical case study of Libyan building project to set the possible duration of project and measure the sensitivity of factors causes delays in construction projects

using Monte Carlo Simulation technique (MCS) through @Risks simulation software. Results obtained using simulations indicate the possibility of project delays between 97 to 103 days compared to the planned period, which allows the project managers to re-schedule their projects in order to minimize risk of delays in construction project.

Al-Hammadi (2016) discusses factors categories which related to Project, contractor “(Technical, Reputations, management ability, Organization culture)”, owner, Consultant, Client, Financing, Design, Plant/equipment, Materials, Manpower and External environment factors. The five major causes of delaying building construction projects in Saudi Arabia especially in Riyadh Province with regard time and cost delays are making decisions slowly by client, contractor payment delayed by client, long process of payment by client, continuous order changes done by client and un-cooperative clients.

Yap et al. (2021) indicates that the top 10 major factors are ineffective schedules and planning, In-competent sub-contractors, order changes by owner, poor site management, slowness of making decisions by owners, poor communication with project parties, poor coordination, mistakes during construction process, difficulties of finance of contractors and un-skilled manpower. This study consists of 52 delay factors were derived from previous literatures and the study obtained in Malaysia by surveying 148 practitioner from Malaysia.

Khan & Gul (2017) research aims to list the most five critical factors of delay by identifying 29 delay factors from literatures and exploring its effect by doing interviews with construction experts. Relative importance index (RII) were used in this study to rank the delay factors which categorized to design-related, financial-related, technical-related, labour-related and external-related factors. Top five factors identified as poor

communication with (RII = 0.749), changes of government rules with (RII = 0.736), In-appropriateness of specifications with (RII = 0.733), unstable political with (RII = 0.734) and difficulties in finance by contractors with (RII = 0.705).

In addition, delay groups were ranked also using RII to be the highest influencer factors is related to design (RII = 3.5) and external (RII = 3.42). followed by technical, labour and lastly the financial related factors.

Table 2. Comparative study for the top three delay

	Major Three Delay Factors		
	1	2	3
Present Study Bahrain	Continuous changes order by owner during construction	Poor site management & Ineffective control system	Unrealistic cost estimation (under-priced) & cash flow
Bahrain (Abusafia & Suliman, 2017)	Frequent design changes	Mistakes during construction	Schedule delay
Saudi Arabia (Al-hammadi, 2016)	Slowness of owner decision making process	Delay in contractor's payment by owner	Delay in progress payment by owner
United Arab Emirates (Mpofu et al., 2017)	Unrealistic contract duration imposed by client	Incomplete design at the time of tender	Too many scope changes & change orders
Arabic Gulf Countries (Mahdi & Soliman, 2021)	Shortages of resources	Inefficiency of management teams	Governmental regulation obstacles
Arabic Gulf Countries (Sanni-Anibire et al., 2020)	Client's cash flow problems/delays in contractor's payment	Contractor's financial difficulties	Poor site organization and coordination between various parties
Sana'a-Yemen (Alaghbari12 et al., 2018)	Delay in receiving progress payments by contractors	Financial difficulties faced by clients	Inadequate experience of contractor/ consultants

Bangladesh (Hoque et al., 2023)	Delay in progress payments	Rework due to mistakes during construction	Lack of skilled labor
Malaysia (Yap et al., 2021)	Lack of proper planning and scheduling	Too many change orders by clients	Lack of competent site management and supervision
Turkey (Culfik et al, 2014)	Owner suspension of the project	Delayed payment to contractor by owner	Unrealistic project duration
Hargeisa (Fashina et al., 2021)	Honouring payment progressively	Underestimation or overestimation of the project cost	Delay in the approval of major changes in the work scope
Kuantan (Ghazali, 2017)	Inclement weather condition	Late in revising and approving design documents	Delays in contractor's claim's settlement and labor productivity
Nigeria (Kasimu & Isah, 2012)	Financial capability of the contractor	Financial difficulties of the owner	Equipment availability of the contractor
Sudan (Mohamed 2015)	Fluctuation of market prices	Material shortages	Imprecise estimation of time
Egypt (Aziz, 2013)	Payment's progress delay by owner	Different payoffs tactics	Equipment shortages
Globally (Tariq and Gardezi, 2023)	Finance difficulties by client	Project planning and scheduling	Materials related issues

2.7 Summary and Gap Identification

Knowledge gap of this literature is to focus on Relative Importance Index methodology using statistical packages software (SPSS) in Bahrain's building construction projects, to identify and analyse the main delay factors in Bahrain's construction projects. Therefore, the main purpose of this research is to determine the delay causes in early stages using methodology of Relative Importance Index (RII) to pre-act of risks and reduce the impact of delays in construction projects by @SPSS software.

Project management process is important to certainty the delivery of the projects in timely, within cost and conform to quality specifications. Construction industry in Bahrain has boomed recently which has great impact on the economy, consequently construction delays are a significant issue due to the frequent occurrence in each project. Construction delays are divided into critical/non-critical delays to specify whether the delay affect the total duration of completion, and excusable/non-excusable delays to assess contractors responsibility of that delays.

Delays factors identified and collected from previous related literature reviews to count 50 causes for delays. Identifying delay factors are in terms of materials-related delay factors, equipment-related factors, manpower-related delay factors, factors related to project management, consultants related factors, clients/owners related delay factors, factors related to governmental regulations and externality-related delay factors. The research tends to focus on frequently occurrence (F.I) of delay factors and its severity scale (S.I) to be the bases of the process of ranking the most significant delay factors using statistical method of Relative Importance Index (RII).

Chapter 3: Research Methodology

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3.1 Introduction

Research methodology chapter includes both design approach and method used to perform and interpret research findings. This research is a quantitative descriptive research which will be used to collect data and answer research questions. Theoretical part will be constructed through developing concepts of delays and listing delay factors based on previous studies. Quantitative methods applied by developing and distributing the structured questionnaire to the targeted population within building construction industry.

The targeted population of this research is clients, consultants and contractors were involved in building construction projects who were selected using sampling formula obtained by Kish (1965) and nominated clients. Research comprises of two types of data, primary data acquired by using a structured questionnaire while the secondary data (delay factors) were identified and categorized through related articles studies within the last 10 years.

This chapter provides research's methodology which involve research design, research tools, data collection and the statistical tests to be performed in the study. Data collection consists of literature data collection, questionnaire design and development and sample size of population.

Reliability and clarity of the questionnaire will be tested through pilot study. Practitioners were selected carefully who have experience more than ten years in building construction projects. Pilot study questionnaire were distributed via emails and face-to-face to ten civil engineers and project managers but only seven responses were received.

3.1 Research Design

Research design is to determine the scientific tools used to collect the observations and describe the characteristics of population in order to test research hypotheses or research questions. Observations can be collected either through surveys, field research, experiment research or secondary data (Abbott & McKinney, 2013). A “Descriptive Research (Survey)” approach was applied here in this research to examine the relationships between delay factors and identify the most significant factors of delay in building construction projects from perspective of the representative population.

Methodology of this research done through listing delay factors from previous literatures, determination of population size and sample size, instrument building (create the main questionnaire), then pilot study were done by experts to test questionnaire reliability. The next step was doing the final questionnaire development. The final steps were the statistical analysis for the collected data and reporting the conclusion with recommendations.

3.2 Research Tools

Statistical Package for the Social Science (SPSS) software is a widely used and well-known statistical tool. SPSS 20 will be used in this research to analyse the collected data from the questionnaire using Kruskal Wallis/Mann-Whitney and Relative Importance Index (RII). Also, Microsoft Excel software will be integrated in the analysis.

Questionnaire will be distributed to building construction companies in Bahrain manually (Face to Face), through e-mail and online google form.

3.3 Data Collection

Collecting and analyzing data through questionnaires is preferable as it works effectively with the large responses from the target population. Hence, the methodology used in this research in data collection and analysis procedures of causes of delays in building construction projects is a structured questionnaire (survey) which used as a part of the descriptive research design as it one of the most notably methodologies used in previous studies in construction industry.

3.3.1 Literature data collection

Previous literatures was reviewed by researcher in order to demonstrate the major construction delay causes which will investigated through this research. In this study, more than 10 related studies published within the past 15 years were designated to outline the delay factors and categorize them. Accordingly, fifty delay factors were demonstrated and categorized into eight groups (categories) to consistent with another equivalent research.

3.3.2 Sample size

Calculation of sample size can be through numerous types of formulas. Sudman, as cited by (Israel, 2009), suggested a minimum of 100 samples should be obtained in the survey. Researchers usually increase the sample size by 10% - 30% to account for non-responders. Population of this research is known. Thus, researcher will adopt the sampling formula provided by (Kish, 1965) using a 95% confidence level,

$$n = \frac{n'}{(1 + \frac{n'}{N})} \quad (\text{Equation 3.1})$$

$$n' = \frac{S^2}{V^2}$$

$$S^2 = P(1 - P)$$

Where.

n = Sample size for finite population

N = Population size

n' = Sample size

P = Population proportion assumed to be 0.5 to obtain the maximum possible sample size).

S = Maximum standard deviation in the population.

V = Acceptable margin of error (Confidence interval)

The most significant criteria to be indicated in order to identify the valuable sample size is the precision level (standard sampling errors V), confidence level (Z) and variability degree (P). In this research, assumptions of equation 3.1 were adopted to use 95% confidence level, tolerate 5% confidence interval and target the maximum population variability with proportion of 50% (P = 0.5) (Israel, 2009).

The representative population targeted in this research are clients, contractors and consultants and includes the project managers in kingdom of Bahrain. Where the population covered consultants registered within the Council for Regulating the Practice of Engineering Professions which consist of 1997 licensed engineers (CRPEP, 2022), No. of licensed engineers among contractors listed under the business licensing system seems to be 2340 (SIJILAT) at Ministry of Industry and Commerce (MIC, 2021). Eng. Wael bin Nasser Al Mubarak, indicated that the number of building permits submitted and issued through the Benayat system during year of 2022, amounted to 1565 permits where they represent the

clients/owners (Ministry of Municipalities of Affairs and Agriculture, 2022). The calculated representative population of this study is (N = 5902).

$$S^2 = 0.5 (1 - 0.5) = 0.25$$

$$n' = \frac{0.25^2}{0.05^2} = 100$$

$$n = \frac{100}{(1 + \frac{100}{5902})} = 98.33 \cong 99$$

As mentioned before, the recommended minimal sample size is 100 and the computed sample size is 99. Thus, the minimum acceptable sample size for this study is 100. However, the adjusted sample size to the account of non-responders is **[n = 100 (1+0.3) = 130 target sample]**.

Number of licensed engineers in contracting firms represents 40% of total sample [130*0.40 = 52]. Engineering offices (consultants) participant with 34% of total sample [130*0.34 = 44.2 $\cong$ 45] and building permits (clients/owners) scored 26% of total sample [130*0.26 = 33.8 $\cong$ 34] to be distributed into clients either by consultants/contractors nominates or convenience of the researchers from the expert engineers in construction of buildings.

3.3.3 Questionnaire design (Instrumentation)

Questionnaire developed in this research was adapted, as an existing instrument were transform into new instrument to suit research's objectives and situation (Hasan's et al. (2014) and Shebob (2012)), it distributed to construction companies working in Bahrain and which are specialists in building construction projects. After designing the main questionnaire, the pilot study was conducted to test the validity and reliability of all questions in the survey. Hertzog (2008) illustrated that to have the reasonable number

of participants, samples size should range from 10% - 40% of actual study per group. For pilot study, ten copies of determined questionnaire distributed to building engineers to clarify and check the questionnaire readability. Responses conducted through pilot study were seven responses, their feedback were considered in the questionnaire development. A copy of some reviews is illustrated in Appendix (A).

The main survey was segmented with introduction and two main parts, (1) and (2). A copy of the questionnaire is attached in Appendix (B).

The questionnaire introduction consists of description, purposes, objectives and general definitions of the survey. Section (1) comprises all the personnel information of respondents, (e.g. education level, experiences and projects). Section (2) is about fifty (50) delay factors lists or called causes of delay in construction projects especially in building. Consultants, contractors and owners were requested to fulfil the questionnaire based on their work experience in building construction projects.

Delay factors identified in this research are categorized into five main categories namely delays related to contractors which were grouped into four sub-categories such as materials-related delays, equipment-related delays, manpower-related delays, and delays related to project management. In addition, delays related to consultants, delays related to owners, delays owe to government regulations/rules and external delays. In the questionnaire, two main questions were inquired for each delay factor as listed below in addition to ranking each factor.

1- How frequently does this delay factor (cause of delay) occur in building construction projects?

2- How severe is this delay factor (cause of delay) in building construction projects?

Frequency of occurrence were rated in the questionnaire at five - point scale to be as always, frequently, sometimes, rare and never (on 5 to 1 point scale). Likewise, severity degree were sorted as very severe, severe, fairly severe, little effect and no effect rated (on 5 to 1 point scale). As mentioned before, the data collected through this questionnaire will be analysed statistically using SPSS and other suitable software like Microsoft excel.

3.3.4 Sampling method and distribution

Questionnaire developed were distributed Face to Face (convenience sampling) to list of construction companies, by e-mail and through online form of questionnaire (Snow-ball sampling). Thus, the research sampling method applied here in this research is non-random (non-probability) as not all the populations have equal chance to contribute in the survey. The targeted sample size is 131 with non-participants and non-responders' consideration. Number of responses of questionnaire totally is 134 thus response rate can be calculated as follows in Table 10.

Table 3. Distribution Breakdown of Questionnaire

Distribution Method	Total Responses	Contractors	Consultants	Clients/Owners
Face to Face & by E-mail	69	34	15	20
Online (Goggle Form)	65	19	32	14
Total	134	53	47	34

$$Response Rate = \frac{134}{131} * 100 = 102.29\% \text{ which is considered excellent.}$$

3.4 Statistical Methods

Frequency Index (F.I) and Severity Index (S.I) method were used in analyzing research data as explained in (Assaf & Al-Hejji, 2006). All equations details are shown below.

3.4.1 Reliability Test and Validity of Data

Golafshani (2003) declares reliability of data in the quantitative research indicates the consistency of results over time and their accuracy during implementation of similar methodologies as reliability refers to the degree of reproducibly of results. Thus, researchers who implied certain methodology at a different time period with consistent conditions will obtain the same results.

Reliability Test can be assessed through several ways like test-retest, alternate-form, internal consistency (Cronbach's coefficient alpha), interobserver and intraobserver reliability (Litwin & Fink, 1995). In this research, the reliability of the collected data was assessed utilizing the Cronbach's coefficient alpha test.

Validity refers to the extent of research tool's measurement and what is intended to measure or how accurately is the results. To be precise, quantitative validity is related to repeat experiments and extract valuable results from scores gained from sampling and data collection through certain statistical methods. In contrast, qualitative validity adopts distinct methods and special techniques to confirm the validity and accuracy of research results (Creswell, 2009).

In this research, validity assessed through questionnaire's content validity as well as construct validity. The questionnaire developed from previous literatures, checked that all objectives were fulfilled and verified by reviewing it by building construction projects experts opinions before

generalization of the final developed questionnaire. As well as, the validity of the results was assessed utilizing the Spearman's Rho correlation test.

3.4.2 Normality Test

Normality test is required as the statistical analysis method depends on distribution of the data. Statistical approaches classified as non-parametric for data with non-normally distributed data and parametric tests for normally distributed data.

One of the common tests to examine the normality is Kolmogorov-Smirnov (K-S) Test. K-S test is a non-parametric test which test the null hypothesis of normally distributed data and alternative hypothesis which do not follow normal distribution.

Data are normally distributed with P-value > 0.05 . from results illustrated in chapter 4, data have non-normally distribution. Thus, non-parametric approaches were performed in this research.

3.4.3 Kruskal Wallis/Mann-Whitney Tests

In this research, Kruskal Wallis/Mann-Whitney Tests were applied individually for all categories to figure out whether there is a significant difference between all demonstrated construction delay factors for frequency of occurrence and severity degree. Kruskal Wallis Test used to compare more than two factors while Mann-Whitney Test compare two factors. The desired significance level is 5% (0.005). Responses mean is the input of SPSS software and the output obtained using "Analyse" tool and Kruskal Wallis/Mann-Whitney for both frequency and severity degree.

3.4.3 Relative Importance Index (RII)

Assaf & Al-Hejji (2006) formulated equation of frequency index to be used in ranking construction delay factors on a basis of frequently occurrence of delay causes from perspective of participants.

$$(F.I.)(\%) = \sum_{a=1}^5 a \left(\frac{n}{N} \right) \times \frac{100}{5} \dots \dots \dots \text{Equation (3.2)}$$

whereas.

a: “constant expressing weighting give to each response” (ranges from 1 for never up to 5 for always).

n: “Frequency of the responses”

N: “Total number of responses”

Furthermore, severity index formula obtained to ranking causes of construction delay builds on degree of severity from participants perspective.

$$(S.I.)(\%) = \sum_{a=1}^5 a \left(\frac{n}{N} \right) \times \frac{100}{5} \dots \dots \dots \text{Equation (3.3)}$$

whereas.

a: “constant expressing weighting give to each response” (ranges from 1 for little effect up to 5 for very severe).

n: “Frequency of the responses”

N: “Total number of responses”

The 5 Likert – Scale were used in the questionnaire for both frequency of occurrences and severity degree as described in Table 11.

Relative Importance Index (R.I.I%) is referred to present the importance level of delay factor. (R.I.I%) is a function of severity and frequency indices. Equation of relative importance index as depicted below:

$$(R.I.I)(\%) = \frac{(F.I.)(\%) \times (S.I.)(\%)}{100} \dots \dots \dots \text{Equation (3.4)}$$

3.5 Summary

Research design used in analysing delay factors in building construction projects through this research is descriptive research design which includes quantitative method such as (survey). The theoretical part of this research used to understand thesis topics while the quantitative data analysis done using questionnaire was to investigate the main responsible parties in building delays and figure out the significant causes by ranking them based on their importance. Before the final questionnaire, pilot studies were done with statistician and building construction experts to assess questionnaire's clarity and its convenience with the research objectives.

The responses were analysed using various techniques and statistical procedures, including Spearman's rho correlation coefficient, Cronbach's coefficient alpha, Kruskal Wallis/Mann-Whitney Tests and Relative Importance Index (RII).

Chapter 4: Results and Discussion

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4.1 Introduction

This chapter will analyse and discuss the data collected by the questionnaire including validity test, reliability test, descriptive statistics and analysis. There is several tests and methods have been applied validity test (Spearman's correlation test), reliability test (Cronbach's coefficient alpha), descriptive statistics, Kruskal Wallis/Mann-Whitney tests and Relative Importance Index (R.I.I%)

4.2 Validity Test

Validity of the research instrument (Questionnaire) were tested using Spearman's rho correlation test to assess the agreement levels between parties (contractor, consultant, client). The results as shown in Table (12) shows a good correlations between responses, correlation results indicated the significant correlation at 0.01 level (2-tailed).

Table 4. Spearman's rho correlation between main project parties

Spearman's Correlations						
			Contractor-related factors	Consultant-related factors	Client-related factors	
Spearman's rho	Contractor-related factors	Correlation Coefficient	1.000	.496**	.568**	
		Sig. (2-tailed)	.	.000	.000	
		N	134	134	134	
(Frequency of occurrence)	Consultant-related factors	Correlation Coefficient	.496**	1.000	.527**	
		Sig. (2-tailed)	.000	.	.000	
		N	134	134	134	
	Client-related factors	Correlation Coefficient	.568**	.527**	1.000	
		Sig. (2-tailed)	.000	.000	.	
		N	134	134	134	
	**. Correlation is significant at the 0.01 level (2-tailed).					
	Spearman's Correlations					
				Contractor-related factors	Client-related factors	Consultant-related factors
Spearman's rho	Contractor-related factors	Correlation Coefficient	1.000	.697**	.598**	
		Sig. (2-tailed)	.	.000	.000	
		N	134	134	134	
(Severity Degree)	Client-related factors	Correlation Coefficient	.697**	1.000	.702**	
		Sig. (2-tailed)	.000	.	.000	
		N	134	134	134	
	Consultant-related factors	Correlation Coefficient	.598**	.702**	1.000	
		Sig. (2-tailed)	.000	.000	.	
		N	134	134	134	
**. Correlation is significant at the 0.01 level (2-tailed).						

4.3 Reliability Test (Cronbach's coefficient alpha)

Consistency of data obtained through questionnaire to be quantified by using reliability coefficient (Cronbach's Alpha). The method employed here in this research to test data reliability is (Cronbach's coefficient alpha) as noted previously in chapter 3. (Prihatnawati, Amin, and Muhdhar, 2017; Putra, Husna, and Gunawan, 2018; Suciati et al., 2019; Ardayati and Herlina, 2020) demonstrated that reliability of data great than 0.80 considered to be excellent, and data between 0.70 to 0.80 considered to be good, as cited by (Divayana et al., 2021).

The average coefficient reliability of frequency of occurrence is 0.792 which is considered as good value while the coefficient of degree of severity is 0.795 which is also considered good value as detailed in Table 13. Which means the collected data is reliable and consistent.

Table 5. Reliability for Questionnaire Subscales

Subscales	Cronbach's Alpha			
	Frequency of occurrence	Internal Consistency	Severity degree	Internal Consistency
Materials	0.704	Good	0.733	Good
Equipment	0.804	Excellent	0.761	Good
Manpower	0.711	Good	0.708	Good
Project management	0.874	Excellent	0.885	Excellent
Consultant	0.833	Excellent	0.878	Excellent
Client/Owner	0.874	Excellent	0.890	Excellent
Governmental regulations rules	0.763	Good	0.742	Good
Externality	0.772	Good	0.764	Good
Cronbach's Alpha (Total)	<u>0.792</u>	<u>Good</u>	<u>0.795</u>	<u>Good</u>

4.4 Normality Test

Kolmogorov-Smirnov Test was performed to check normality of data, the findings indicated that the data are not normally distributed. As noted in the methodology chapter, data is normally distributed with a sig. greater than or equal to 0.05. All P-values as shown in Table 14 were less than 0.05, except consultant and external related factors regarding the severity. Because the measured data is not normally distributed, nonparametric tests were performed to examine them.

Table 6. Normality Test using Kolmogorov-Smirnov test

Tests of Normality						
	Frequency of Occurrence			Severity Degree		
	Kolmogorov-Smirnov ^a			Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.	Statistic	df	Sig.
Materials related factors	.099	134	.003	.084	134	.023
Equipment related factors	.118	134	.000	.090	134	.010
Manpower related factors	.123	134	.000	.136	134	.000
Project management factors	.099	134	.003	.097	134	.004
Consultant related factors	.092	134	.007	.073	134	.075
Client/owner related factors	.077	134	.050	.081	134	.033
Governmental regulations and rules related factors	.154	134	.000	.155	134	.000
Externality related factors	.140	134	.000	.063	134	.200 [*]
a. Lilliefors Significance Correction						

4.5 Section 1: Respondents Profile

Table C-1 in Appendix (C) shows the responses of participant's (Total = 134) regards sociodemographic characteristics in the studied questionnaire.

4.5.1 A: Education Level

Questionnaire: Question 1: "What is your Education Level?"

Results obtained illustrated that participants who hold bachelor's degree have the highest participations with approximately 80.6 percent, people who possess a master's degree participated with percentage of 14.2, 3 percent own PhD degree and 2.2 percent have a diploma degree while there is no participant have high school. Figure 3 illustrates the level of education of participants in the questionnaire.

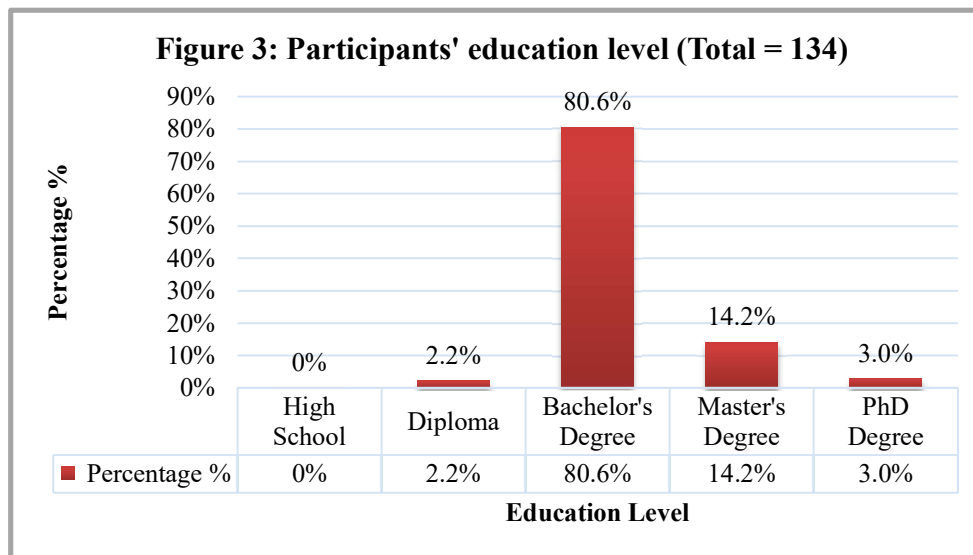


Fig 3: Participant's Education Level

4.4.2 B: Type of Business

Questionnaire: Question 2: “What is your type of business in the current job?”

Figure 4 shows number of respondents that filled the questionnaire. The total number of responses obtained from the questionnaire was 134. Results indicate that contractors have the highest participation compared with other parties, with 53 responders and percentage of 39.6 percent, followed by the consultants, with 47 responders which is 35.1 percent, while clients/owners have the lowest participants with only 34 responders and 25.4 percent.

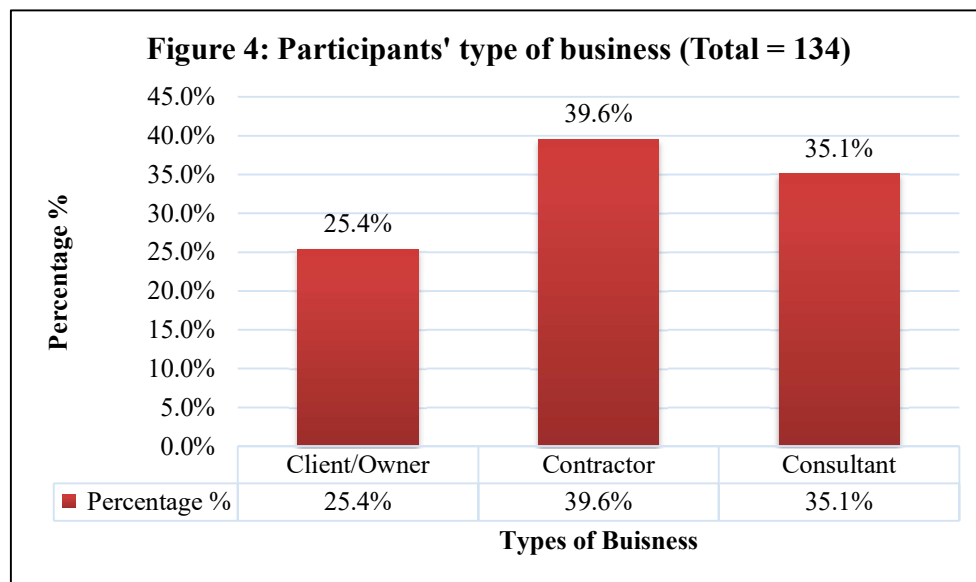


Fig 4: Participant's type of business

4.4.3 C: Duty Position

Questionnaire: Question 3: “What is your duty position?”

The identical participants of this questionnaire were Civil Engineers, Architects, Engineering Managers, or any others who're (were) playing roles in Bahrain building construction projects especially in the private sector.

Participants were asked about their job positions. Figure 5 below turns out the Engineers/Designers represent the vast majority of participants, with 92 responders, with 68.7 %. Project managers and general managers participation is small compared to engineers and designers, project managers participate with 26 (19.4 %) while the general managers have the smallest number of respondents with 16 only, with percentage of 11.9 %.

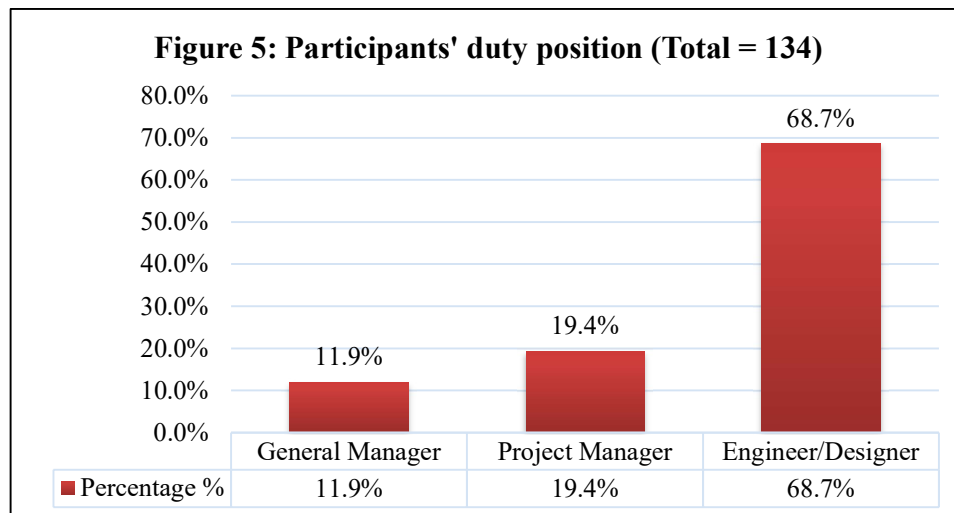


Fig 5: participant's duty position

4.4.4 D: Total Years of Experience

Questionnaire: Question 4: “How many years of experience do you have?”

Table C-1 (Q4) in appendix demonstrates years of experiences of participants, the total number of respondents (contractors, consultants and clients/owners) in the survey is 134. Of these, participants who have six to ten (6 - 10) years and one to five (1 – 5) years of experience making the largest proportion, with 37 respondents at 27.6 percent (contractors: 20, consultants: 10, clients/owners: 7) and 35 respondents at 26.1 percent (contractors: 15, consultants: 15, clients/owners: 5) respectively. Twenty five (25) of participants had an experience between eleven and fifteen (11 – 15) years to indicate 18.7 percent of total respondents (contractors: 10, consultants: 8, clients/owners: 7). Followed by the experts who have been worked for more than twenty (> 20) years, with twenty two (22) participants at 16.4 percent (contractors: 3, consultants: 9, clients/owners: 10). The lowest proportion of participants experienced by sixteen to twenty (16 – 20) years which they are only 15 respondents made up 11.2 percent (contractors: 5, consultants: 5, clients/owners: 5), see Figure 6.

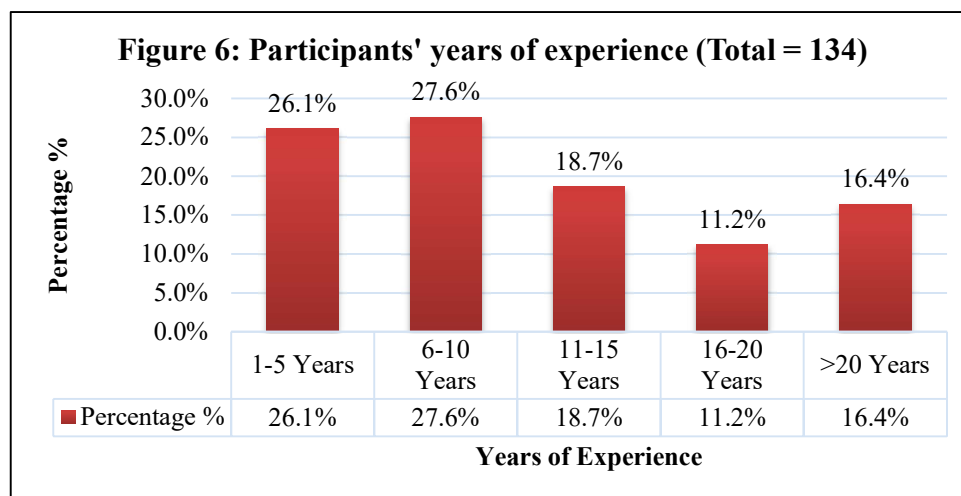


Fig 6: Participant's years of experience

4.4.5 E: Number of Building Projects Worked for

Questionnaire: Question 5: “How many buildings project/s have you worked for in the last 5 years?”

Figure 7 shows number of building projects were participants worked for in the last 5 years. It clarifies that 32.1 percent of respondents (43 participant) had been worked in five to ten (5 - 10) building projects, 29.9 percent (40 respondents) exceeded fifteen building projects (> 1 projects). Respondents who have been worked for less than five projects (< 5 projects) made up 26.9 percent, with 36 participants. Of those remaining, 15 respondents have been worked in projects between eleven to fifteen (11 – 15 projects) at 11.2 percent which is the smallest proportion of the total respondents.

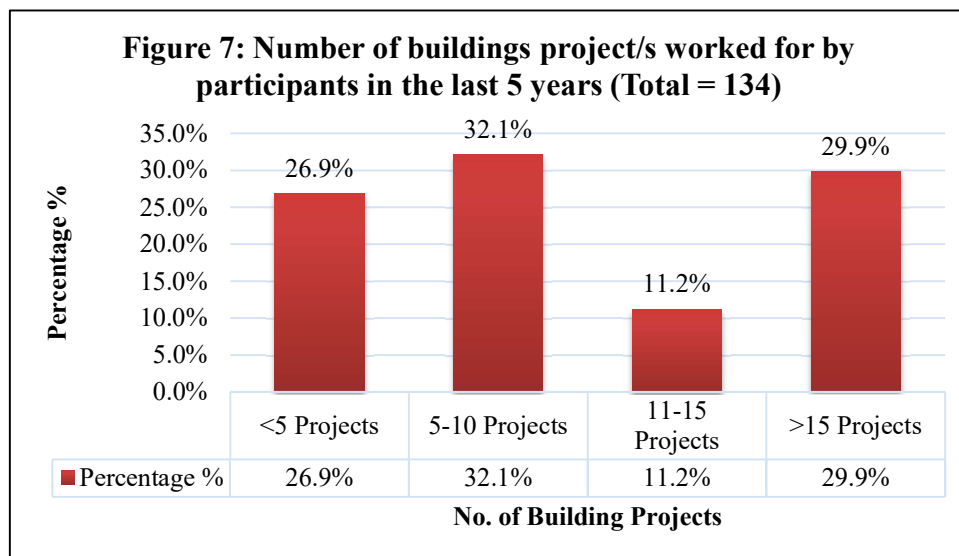


Fig 7: Number of buildings project/s worked for by participants last 5 years

4.4.6 F: Size of Current Project

Questionnaire: Question 6: “What is the size of current project/s you involved in?”

In this survey, respondents were asked to identify the size of current project where they involved in. Size of projects categorized based on Ministry of Works regulation of tender board (MoW, 2023): projects Above BD 2,000,000 considered very large, between BD 1,000,000 - BD 2,000,000 considered large projects. BD 200,000 - BD 1,000,000 bids is to medium projects whereas the small projects which cost between BD 100,000 and BD 200,000.

In response, 34.3 percent of participants (46 participating) were involved in very large projects, 26.9 percent (36 participating) and 26.1 percent (35 participating) were involved in medium projects and large projects respectively. Those who involved in small projects participated with only 12.7 percent, with 17 respondents (see Figure 8).

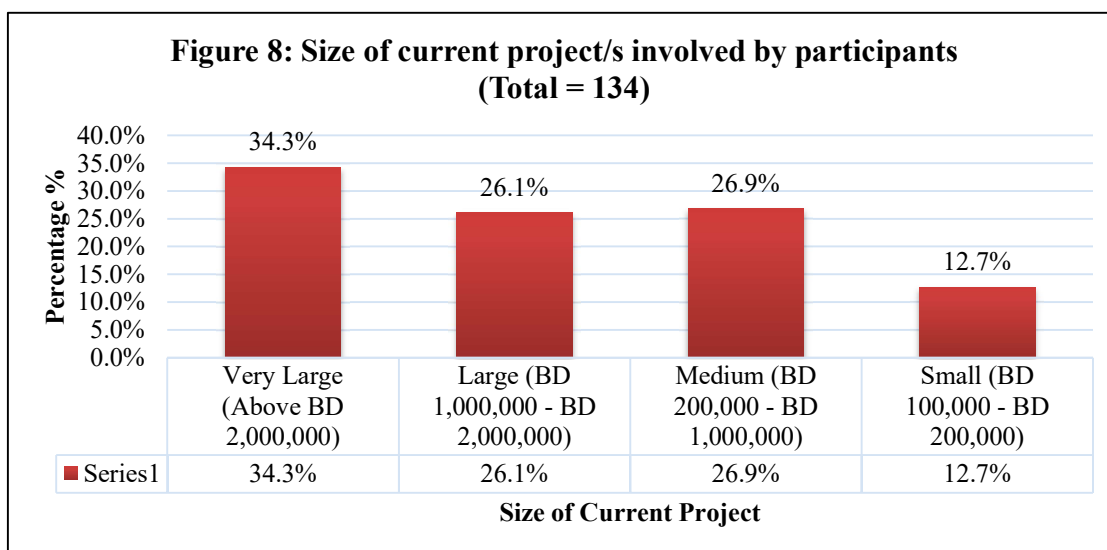


Fig 8: Size of current project/s involved by participants

4.4.7 G: Building Construction Projects Delay

Questionnaire: Question 7: “Do you faced any delayed building construction projects during your work period?”

This research tends to investigate the delays factors that affect building construction projects. Thus, participants (contractors, consultants and clients/owners) were asked from their reality life whether delay exists in building project or not. Based on questionnaire responses, Figure 9 describes that the delayed projects in Bahrain building construction projects especially in private sector were forming 90.3 percent of the total projects were the non-delayed projects indicate (9.7 percent) which is a small proportion.

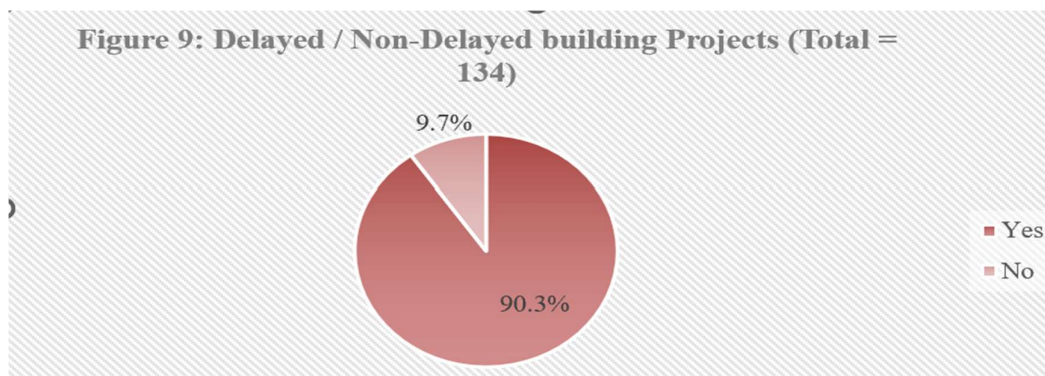


Fig 9: Delayed / Non-Delayed building construction projects

4.6 Delay Factors of Building Construction Projects Analysis

Causes of delays were derived from previous literature reviews as stated in details in chapter 2 of this research. List of delay factors of building construction projects in private sectors shown to building construction experts to be adjusted in order to provide the last version. Frequency of occurrences and degree of severity were assessed for each of listed delay factors.

This section focuses on discussion of the opinion differences of respondents for each group of delay factors individually. Delay factors already categorized to contractor – related (material, equipment, manpower and project management), consultant – related, client/owner – related, governmental regulations/rules – related and factors related to external issues. Moreover, factors of delays will be ranked using relative importance index of frequency of occurrence and degree of severity.

Relative importance outcomes for each group will help in decreasing delay risks in terms of cost, time and quality as private organizational owners will figure out the responsible parties for delay and will manage the procurement and delay analysis properly by considering parties viewpoints.

4.5.1 Delay Factors Related to Contractors

Contractors are the responsible party for supplying the projects with materials, equipment and labours. As well as the management of the projects. Thus, any delay with these factors will enforce the total duration of construction projects to delay either with cost, time and quality effects.

4.5.1.1 Delay factors related to materials

A. Frequency & severity degree from respondents perspectives:

Frequency of occurrence and degree of severity participation for each of delay factors related to materials from perspective of (contractors, consultants and clients) illustrated in Table C-2 in Appendix (C).

1- Lack of materials availability in the local market

Shortage of some materials in the market can subject projects to delays as they will need to import materials from outside sourcing which take longer time to source, procurement and transportation. All participants

(contractors, consultants and clients) agreed that this factor occurs sometimes. The overall results obtained by all participants was 61 of those participants (45.5%) agreed that “Lack of materials availability in the local market” factor have sometimes occurrence. According to severity degree, the total results of participant’s opinions indicated that 60.5 percent agreed on factors to be a fairly severe or severe.

2- Lateness in delivering materials & long lead items

49.1% and 51.1% of contractors and consultants concurred that “Lateness in delivering materials & long lead items” cause has sometimes occurrence while clients/owners participate with 41.2% with rare occurrence for this factor. More than half of total participants agreed that this cause happens sometimes with 47.0%.

In case of severity degree, 61.2% of respondents (contractors, consultants and clients/owners) were concurred that this factor is fairly severe or severe. In details, 32.1% of contractors and 34% of consultants chose fairly severe and 41.2% of clients/owners participated with severe.

3- Quality of materials used

If the material is not conforming to the standards or have any defects, the project will enforced to delay as materials can’t be used in the site. In some cases, contractors use materials with poor quality so the financing by owners suspended, thus the project suffers of delays.

From Table 20, all participants (contractors, consultants and clients) agreed on occurrence sometimes for “Quality of materials used” factor. Concerning the results in total, 35.1% with 47 participants were agreed that this delay factor occurs sometimes while 25.4% with 34 participants agreed of rarely occurrence.

Severity degree for “Quality of materials used” factor was selected to be severe by both contractors and clients while fairly severe by consultants. Concerning results in total, 61.9% of total respondents agreed that this factor is severe or fairly severe while 19.4% classified it as very severe factor.

4- Prices fluctuation of materials

Prices changes can delay the project if the contractor does not consider such risks and claim for extra bid from owners during construction phase.

Frequency of occurrence for “Prices fluctuation of materials” factor were agreed by contractors and consultants to be sometimes and frequently by the clients/owners at 35.8%, 36.2% and 38.2% respectively. While total results of participant’s opinions showed that 35.1 percent of participants agreed that this factor occurs sometimes, 30.6 percent concurred that this factor occurs frequently and 22.4 percent were agreed with rare occurrence. According to respondents (contractors, consultants and clients/owners), this factor either to be severe with 33.6 percent or fairly severe with 28.4 percent.

5- Materials specifications changes

The vast majority of contractors (32.1%), consultants (36.2%) and clients (44.1%) were selected the frequency of sometimes. But with consideration of results in total, 36.6 percent were agreed on sometimes occurrence while the other 32.1 percent were agreed on rare occurrence.

For degree of severity, more than half of participants 58.3% (contractors, consultants and clients/owners) agreed that “Materials specifications changes” factor is severe or fairly severe while 27.6% of them considered it little or no effect.

B. Kruskal Wallis Test

Mean values of material-related delay factors are described below in Table 23. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 7. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Material-related Delay Factors

Delay Factors (Materials)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Lack of materials availability in the local market	2.89 $\pm$ 0.90	3.38 $\pm$ 1.10
2- Lateness in delivering materials & long lead items	3.09 $\pm$ 0.88	3.55 $\pm$ 1.06
3- Quality of materials used	3.02 $\pm$ 1.13	3.49 $\pm$ 1.07
4- Prices fluctuation of materials	3.14 $\pm$ 1.00	3.39 $\pm$ 1.12
5- Materials specifications changes	2.63 $\pm$ 0.96	3.25 $\pm$ 1.13
P-value	<0.001	0.261

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

It's obvious from Table 20 when Kruskal Wallis test were applied to figure out the significant differences of mean of Delay factors related to materials, P value was identified to be $0.001 < 0.05$ (at 95% level of confidence) which conclude the existence of significant differences in means of delays between the delay factors related to materials for frequency of occurrences, this means that project parties respondents have a disagreement in their perspectives. For instance, means of "Lack of materials availability in the local market" (2.89 ± 0.90) and "Materials specifications changes" (2.63 ± 0.96) which are far away from the means of delay factors 2, 3 and 4 with (3.09 ± 0.88), (3.02 ± 1.13) and (3.14 ± 1.00). Also, fluctuation in prices of materials has the highest mean and records the most frequent factor compared to other from the same group.

P value determined for severity degree of materials related delay factors was $0.261 > 0.05$ (at 95% level of confidence). This indicates that there is no significant differences in means of materials related factors for severity. Thus, there is an agreement between project parties (contractors, consultants and clients/owners) toward delay factor severity. Mean's values of material group factors are closed but "Lateness in delivering materials & long lead items" factor is the most severe with mean of (3.55 ± 1.06) .

Factors 1 & 5 considered as in-frequent and severe factors while factors 2, 3 and 4 considered as frequent and severe factors.

C. Ranking of Delay Factors (R.I.I%)

Table 8. Ranking of Causes of Delay Related to Materials

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
Lateness in delivering materials & long lead items	61.79%	71.04%	43.90%	1
Prices fluctuation of materials	62.84%	67.76%	42.58%	2
Quality of materials used	60.45%	69.70%	42.13%	3
Lack of materials availability in the local market	57.76%	67.61%	39.05%	4
Materials specifications changes	52.54%	64.93%	34.11%	5

Regarding factors related to materials, the highest influencer factor that affect the performance of construction building projects in private sector as results shown in Table 21 is the late of material delivery and long lead items which has a relative importance R.I.I% of 43.90%. Changes of material prices takes the second position regarding the higher influences factor with R.I.I% of 42.58%. Third factor influencing the construction performance is materials quality used in the projects which has (R.I.I% = 42.13%).

4.5.1.2 Delay factors related to equipment

A. Frequency & severity degree from respondents perspectives:

Table C-3 in Appendix (C) describe the frequency of occurrence and the degree of severity of each equipment-related delay factors individually.

1- Equipment Shortage

The highest responses of frequency occurrence of “Equipment Shortage” factor is rarely occurrence with 46 participants (34.3%) and 40 participants (29.9%) were agreed that this factor occurs sometimes collected which represents the vast majority of responses (64.2%). Respondents differed regarding determining the intensity of “Equipment Shortage” factor (severity degree), 33 of total respondents agreed with little effect severity, 36 participants agreed with fairly severe while the highest number of respondents (43) were concurred that shortage in equipment to be severe.

2- Old technological equipment

More than of half of contractor responses (27 contractors) agreed on sometimes occurrence with 50.9 percent, consultants responses for sometimes occurring frequency were 17 consultants with 36.2 percent, while 35.3% of clients agreed that equipment with old technology factor rarely occurs. The total results showed that 39.6 percent were agreed on sometimes while 27.6 percent were concurred on rare occurrence.

Based on severity degree, the results indicated that the highest percentage of all project parties (contractors, consultants and clients/owners) were agreed with fairly severe intense at 41.5% contractors, 38.3% consultants and 38.2% clients. Results in total

determined 39.6% (53 respondents) concurring of fairly severe and 33.6% (45 participants) concurring of little effect severity.

3- Inappropriate equipment used

The agreement of all parties (contractors, consultants and clients) participating in this study toward frequency of “Inappropriate equipment used” factor were rarely occurrence. But in total results, occurrences of this factor were rare at 37.3% (50 respondents) and sometimes occurrence at 32.1% with 43 participants.

Regarding degree of severity responses for this factor were little effect by contractors and fairly severe by both consultants and owners. Concerning results in total, the vast majority agreed on fairly severe severity for “Inappropriate equipment used” factor with 35.8% and 27.6% with little effect severity.

4- Equipment failure

Majority of participants (contractors, consultants and clients) were concurring with rare occurrence frequency at 43.3%, with 58 respondents in total results. In details, contractors participated with 34%, consultants participated with 42.6% and owners participated with 58.8% which more than half of clients (owners) participants for rare frequency.

According to factor intense, contractors participated with severe intense at 35.8%, consultants and clients were participated with little effect intense at 36.2% and 35.3% respectively. It can observed from results in total, 32.1% of all participants agreed with little effect while 44.7% of participants agreed with fairly severe or severe severity.

B. Kruskal Wallis Test

Mean values of equipment-related delay factors are described below in Table 29. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 9. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Equipment-related Delay Factors

Delay Factors (Equipment)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Equipment shortages	2.60 $\pm$ 1.08	3.19 $\pm$ 1.09
2- Old technological equipment	2.67 $\pm$ 1.03	2.72 $\pm$ 0.99
3- Inappropriate equipment used	2.45 $\pm$ 1.04	2.78 $\pm$ 1.10
4- Equipment failure	2.46 $\pm$ 1.00	2.85 $\pm$ 1.20
P-value	0.148	0.002

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Table 22 identified the mean of equipment-related delay factors for both occurrences frequency and severity degree using Kruskal Wallis test. It can be seen that p value calculated to be $0.148 > 0.05$ (at 95% confidence level) which mean the agreement of point view of all project parties towards the frequency of equipment delay factors as illustrated previously in details. Also, it's clear that all Means value are close together regarding the frequency, so there is no Significant differences in frequency of equipment group.

Delay factors related to equipment have a P value = $0.002 < 0.05$ (at 95% confidence level). "Equipment shortage" factor have the highest severity as it has mean = (3.19 ± 1.09) , it's clear that mean value of Equipment shortages is differ than mean values of the rest of equipment-

related delay factors which show the disagreement of parties toward the severity of factors in equipment group (Factor 2: 2.72 ± 0.99), (Factor 3: 2.78 ± 1.10), (Factor 4: 2.85 ± 1.20). To conclude, there is significant differences in severity between the listed factors related to equipment.

Factor 1 considered as in-frequent and severe factor while factors 2, 3 and 4 considered as in-frequent and not severe causes.

C. Ranking of Delay Factors (R.I.I%)

Table 10. Ranking of Causes of Delay Related to Equipment

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
1- Equipment shortages	51.94%	63.88%	33.18%	1
2- Old technological equipment	53.43%	54.48%	29.11%	2
3- Equipment failure	49.25%	57.01%	28.08%	3
4- Inappropriate equipment used	48.96%	55.67%	27.26%	4

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Results of relative importance (R.I.I%) of delay factors are described in Table 23. From equipment-related delay factors, shortage of equipment and equipment with old technology scores the highest importance of (R.I.I% = 33.18%) and (R.I.I% = 29.11%), respectively.

4.5.1.3 Delay factors related to manpower

A. Frequency & severity degree from respondents perspectives:

Table C-4 in Appendix (C) show the occurrences frequency and the severity degree for manpower-related delay factors individually.

1- Lack of skilled manpower

In Bahrain, most labours came from India and Bangladesh. Those labours of fresh workers need training and motivating to increase their productivity.

43.4 percent of contractors with 23 respondents and 47.1 percent of clients/owners with 16 participants were agreed that lack of experienced labours factor frequently occurs, while 40.4 percent with 19 participants were agreed on sometimes frequency for “lack of skilled manpower” factor. From total respondents opinions, 39.6 percent oriented to frequently occurrence while 33.6 percent oriented to sometimes occurrence.

According to degree of severity, 22 of contractors at 41.5 percent and 19 of consultants at 40.4 percent were concurred that this factor is severe on construction projects. But the clients/owners were oriented to fairly severe and very severe with identical percentage of 32.4% with 11 participants. As observed from results in total, the vast majority of respondents agreed on severe severity with 38.1%, 28.4 percent agreed on very severe and 22.4 percent agreed on fairly severe. So 88.9 percent were agreed on fairly severe or severe or very severe which means “lack of skilled manpower” factor have high effects on delays.

2- Delayed mobilization of labour

Responses collected from contractors, consultants and clients/owners in case of frequency of manpower mobilization factor were concurred on

sometimes occurrence (52.8 percent, 36.2 percent and 50 percent respectively). Also, most of respondents chose sometimes frequency with 46.3 percent, with 62 participants and 20.1 percent for frequently occurrence for “Delayed mobilization of labour” factor.

Contractors and clients/owners approved the degree of severe for this delay factor with percentage of 45.3% and 26.5% respectively. On the other hand, consultants and the other portion of clients/owners concurred on fairly severe for “Delayed mobilization of labour” factor with 29.8% and 26.5% respectively. Sixty percent and half (60.5 percent) of participants were agreed that this factor severe or fairly severe.

3- Regulation of recruitments process

As shown in Table 33, thirty nine point six percent (39.6%) from contractors, thirty six point two percent (36.2%) from consultants and half of clients/owners (50%) agreed that process of recruitment process factor sometimes occurs. Considering the total results, 41% agreed with sometimes frequency while 29.9% concurred the rarely frequency.

In order to degree of severity, all project parties (contractors, consultants and clients) have agreement on severity of “Absence and Sickness of Labours” factor to be fairly severe with participation of 39.6% and 34% for contractors and consultants while 47.1% for clients/owners. But results in total tends to assess this factor as 58.3% fairly severe or severe and 22.4% with little effect.

4- Absence and Sickness of Labours

Contractors stated that “Absence and Sickness of Labours” factor is occurring sometimes with 35.8%, while consultants and clients/owners stated that this factor is rarely occurring with 36.2% and 41.2% respectively. Results in total tends to classify this factor to sometimes

occurs or frequently occurs with percentage of 49.2 percent, while 35.1% assessed it as rare frequencies.

In order to degree of severity, all project parties (contractors, consultants and clients) have agreement on severity of "Regulation of recruitments process" factor to be fairly severe with participation of 34% for both contractors and consultants and 41.2% for clients/owners. Results in total tends to assess this factor as 60.4% fairly severe or severe and 16.4% with little effect.

B. Kruskal Wallis Test

Mean values of manpower-related delay factors are described below in Table 24. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 11. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Manpower-related Delay Factors

Delay Factors (Manpower)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Lack of skilled manpower	3.45 $\pm$ 0.97	3.81 $\pm$ 1.04
2- Delayed mobilization of labour	2.96 $\pm$ 1.03	3.38 $\pm$ 1.16
3- Regulation of recruitments process	2.80 $\pm$ 0.98	3.02 $\pm$ 1.09
4- Absence and Sickness of Labours	2.66 $\pm$ 1.03	3.13 $\pm$ 1.15
P-value	<0.001	<0.001

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Table 35 explained the means for both frequency and severity for manpower (labours) related delay factors. It can be shown clearly that there is significance differences in both frequency and severity between the listed factors of delays related to the manpower, so disagreement are exist

between parties opinions. This conclusion derived from results of P-value = 0.001 < 0.005 (at 95% level of confidence).

For frequency of occurrence, “lack of skilled manpower” factor has the highest mean (3.45 ± 0.97) which make it the highest frequent factor comparing to others in the same group, while others approximately has a closer means. For degree of severity, the same “lack of skilled manpower” factor differs in mean value (3.81 ± 1.04). it has the highest mean which means this factor has the highest severe.

Factor 1 considered as frequent and severe factor while factors 2, 3 and 4 considered as in-frequent and severe factors.

C. Ranking of Delay Factors (R.I.I%)

Table 12. Ranking of Causes of Delay Related to Manpower

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
Lack of skilled manpower	68.96%	76.12%	52.49%	1
Delayed mobilization of labor	59.25%	67.61%	40.06%	2
Regulation of recruitments process	55.97%	60.45%	33.83%	3
Absence and Sickness of Labors	53.13%	62.54%	33.23%	4

According to results obtained with regard the relative importance in Table 25, the top ranked manpower-related delay factors were lack of skilled manpower with R.I.I% of 52.49%, as it has high frequency and high severity and delaying of labour mobilization with R.I.I% of 40.06% is the second influencer factor.

4.5.1.4 Delay factors related to project management

A. Frequency & severity degree from respondents perspectives:

Table C-5 in Appendix (C) presented frequency percentages and severity degree percentages for project management-related factors of delays.

1. Poor site management & Ineffective control system

Delays were exist in construction projects with bad management and control. With good project management the project will be delivered successfully within budget, time and conform the quality standards. Planning for costs, monitoring of project schedule and scope and controlling project in accurate way must be conducted by contractors in order to enhance the management of the project. Thus, this factor is integrated with factor of inaccurate planning and scheduling the project.

Contractors and consultants emphasized that poor project management factor occurs sometimes with participation of 47.2% and 34% respectively while clients respondents tends to assess it with frequently occurrence with 41.2% participation. In general, 35.1% agreed with sometimes occurrence while 47% agreed with frequently or always occurrence. On the other hand, severe degree was agreed by 43.4% of contractors and 47.1% of clients/owners while consultants agreed by 36.2% on very severity. In general, 40.3% of respondents concurred that this factor is severe while 35.8% of them concurred the very severe.

2. Rectification Works due to poor PM role

Construction works errors occur due to careless, not adhere to blueprint and procedures exactly by contractors. So contractors should pay

attention to details while working and committed to plan and quality to prevent such re-works activities which increase times and costs delays.

The vast majority of contractors, consultants and clients/owners confirmed that works rectifications factor occurs sometimes by rate of 37.7%, 48.9% and 47.1% respectively. From general results, sometimes frequency has 44% participation while frequent occurrence has participation of 21.6%.

49.1% and 32.4% of contractors and clients stated the severe of this factor while consultants confirmed the fair severe with rate of 38.3%. In general, 60.5% of participants agreed that “Rectification Works due to poor PM role” factor is severe (36.6%) or very severe (23.9%).

3. Lack of contractor’s PM experience

30.2 percent of contractors, 36.2 percent of consultants and 55.9 percent of clients/owners declared that In-experience project managers of contractors factor has sometimes frequency. 59.7 percent of total respondents agreed that this factor occurs sometimes or frequently.

Severity degree of “Lack of contractor’s PM experience” factor agreed by 49.1% of contractors to be severe, 34% of consultants to be very severe and 38.2% of clients to be fairly severe factor. Generally, 62.7 percent of total participants agreed that this factor is severe or very severe while 21.6% confirmed the fairly severe of the factor.

4. Poor communication skills between contractor PM & project parties

Communications within the company is important, the project manager and his teams need to communicate in order to manage project timeframe, schedules and project delays. The successful projects which

include the continuous communications regarding project visions, scope of works and discussing the outcomes.

39.6 percent of contractors, 36.2 percent of consultants and 38.2 percent of clients/owners clarify that “poor communication of contractor’s PM with other project parties” factor has sometimes frequency. 65 percent of total respondents agreed that this factor occurs sometimes or frequently. According to severity, 35.8% of contractors and 38.3% of consultants agreed that this factor is very severe while clients/owners agreed with severe by rate of 38.2%. In general, more of half participants concurred that poor communication factor is severe or very severe which indicate its significance by percentage of 65.7%.

5. Inaccurate project planning & scheduling by contractor

Project management process includes both planning and scheduling the activities of the project, if it is done poorly so the project will have time overrun as well the cost overrun.

64.2% of contractors agreed that ineffective planning and scheduling factor occurs sometimes or frequently while consultants and clients/owners agreed with sometimes occurrence only with percentage of 40.4% and 35.3% successively. At all, 35.8% of total respondents reported the sometimes frequency and 32.8% reported frequently occurrence of this factor.

According to degree of severity for “Inaccurate project planning & scheduling by contractor” factor, more than half of contractors stated that this factor is severe with percentage of 50.9%, consultants and clients stated that is very severe factor by participation rate of 38.3% and 32.4%. Based on total results, the highest participants (35.8%) agreed with severe factor, 27.6% agreed with very severity and 21.6% with fairly severe.

6. Ineffective quality control/Assurance system

It is obvious that there is a disagreement between project parties point-views regard frequency of “Ineffective quality control/assurance” factor. Contractors agreed on frequently occurrence, consultants emphasized the sometimes occurrence while clients stated the rare occurrence with percentages of 35.8%, 34% and 35.3% respectively.

On basis of severity, 39.6% of contractors and 31.9% of consultants stated that ”Ineffective quality control/Assurance system” factor is fairly severe while 38.2% of clients/owners agreed that this factor is very severe. From total, 33.6% of participants agreed with fairly severe and 50.8% of these participants emphasized the sever or very severe is this factor.

7. Unrealistic cost estimation (under-priced) & cash flow

There is a disagreement in in frequency of unrealistic cost estimation factor from perspective of project parties. Contractors agreed on frequently occurrence, consultants emphasized that this factor has always occurrence while clients concurred with sometimes occurrence with percentages of 43.4% for contractor, 29.8% for consultants and 32.4% for clients/owners. In general, 77.6% agreed occurrence of sometimes or frequently or always.

On basis of severity, 41.5% of contractors, 38.3% of consultants and 38.2% of clients stated that “Unrealistic cost estimation (under-priced) & cash flow” factor is very severe which indicate project parties agreement regard its severity. In general, 39.6% of participants agreed with very severe and 45.5% of these participants emphasized the fairly severity or severe of this factor.

8. Claims between contractor and subcontractor

Contractors participated with 41.5% to sometimes frequency, consultants and clients/owners participated with 29.8% and 38.2% to frequently occurrence for “Claims between contractor and subcontractor” factor. From results in total, 64.9% agreed that this factor occurs sometimes (34.3%) or frequently (30.6%) while 14.9% concurred with always occurrence.

Regarding severity degree, both contractors and consultants participated with fairly severe of this factor with rate of 35.8% and 42.6% respectively. Clients/Owners participated to very severe intense is this factor with rate of 35.3%. From general results, 32.8% agreed that this factor is fairly severe while 51.5% of respondents concurred that this factor is severe (28.4%) or very severe (23.1%).

9. Claims between client & the main contractors

Claims occurs when contractors increase the budget of the project, use of poor quality materials and not conform to standards in construction works. Contractors must communicate with clients to fully understand client’s need in order to prevent claims issues.

Project parties (contractors, consultants and clients) all agreed that “Claims between client & the main contractors” factor occurs frequently by rate of 47.2%, 34% and 32.4%. In total, approximately 68% of respondents agreed sometimes or frequently occurrences.

According to severity, 32.1% of contractors agreed the fairly severity while 40.4% and 35.3% of consultants and clients agreed the severe intense for this factor. In general, 59.7% said that this factor is fairly severe or severe.

10. Engaging the contractor in other critical projects at the same time

49.1% of contractors agreed that contractor's involvement in multiple projects at the same time factor is frequent while consultants and clients/owners showed the sometimes occurrence with percentage of 55.3% and 41.2% successively. At all, 36.6% of total respondents reported the sometimes frequency and 32.1% reported frequently occurrence of this factor.

According to degree of severity for “Engaging the contractor in other critical projects at the same time” factor, all project parties (contractors, consultants and clients) stated that this factor is fairly severe with percentage of 28.3% for contractors, 46.8% for consultants and 41.2% for clients. Based on total results, the highest participants (38.1%) agreed with fairly severe intense, 20.9% agreed with severe intense and 23.9% with very severity of this factor.

B. Kruskal Wallis Test

Mean values of project management-related delay factors are described below in Table 26. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 13. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Project Management-related Delay Factors

Delay Factors (Project Management)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Poor site management & Ineffective control system	3.41 $\pm$ 1.06	4.03 $\pm$ 0.93
2- Rectification Works due to poor PM role	3.14 $\pm$ 1.00	3.72 $\pm$ 0.99
3- Lack of contractor's PM experience	3.23 $\pm$ 1.08	3.73 $\pm$ 1.06
4- Poor communication skills between contractor PM & project parties	3.23 $\pm$ 1.03	3.87 $\pm$ 1.08
5- Inaccurate project planning & scheduling by contractor	3.29 $\pm$ 0.99	3.75 $\pm$ 1.05
6- Ineffective quality control/Assurance system	3.07 $\pm$ 1.03	3.54 $\pm$ 1.11
7- Unrealistic cost estimation (under-priced) & cash flow	3.46 $\pm$ 1.15	3.86 $\pm$ 1.16
8- Claims between contractor and subcontractor	3.35 $\pm$ 1.07	3.55 $\pm$ 1.09
9- Claims between client & the main contractors	3.38 $\pm$ 1.03	3.65 $\pm$ 1.06
10- Engaging the contractor in other critical projects at the same time	3.22 $\pm$ 0.96	3.47 $\pm$ 1.12
P-value	0.039	<0.001

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Based on results of Kruskal Wallis test for frequency and severity determined in Table 26, both occurrences and degree of severity has P-values of 0.039 and <0.001, respectively which less than 5% (0.05). This summarises that means of frequency have a relative differences and means of severity are significantly different between mentioned delay factors related to project-management.

For example, regarding frequency, mean values of factors (Factor 7: 3.46 ± 1.15) and (Factor 1: 3.41 ± 1.06) is the two most frequent causes and differed with value of (Factor 6: 3.07 ± 1.03) factor.

In case of severity, factor 1 has mean value of 4.03 ± 0.93 which highly differ with mean of factor 10 (3.47 ± 1.12). The most severest cause is poor project management while involvement of contractors in multiple projects at the same time has less severe on building construction delays.

To sum up, there is a disagreement between point-views of project parties regarding frequency and severity between project management-related factors. But respondents agreed that all factors considered frequent and severe which make the group considered highly significant.

C. Ranking of Delay Factors (R.I.I%)

Table 14. Ranking of Causes of Delay Related to Project Management

Causes for delay	Frequency Index%	Severity Index%	Relative Importance index (R.I.I)%	Rank
Poor site management & Ineffective control system	68.21%	80.60%	54.98%	1
Unrealistic cost estimation (underpriced) & cash flow	69.25%	77.16%	53.43%	2
Poor communication skills between contractor PM & project parties	64.63%	77.46%	50.06%	3
Claims between client & the main contractors	67.61%	72.99%	49.35%	4
Inaccurate project planning & scheduling by contractor	65.82%	74.93%	49.32%	5
Lack of contractor's PM experience	64.63%	74.63%	48.23%	6
Claims between contractor and subcontractor	67.01%	71.04%	47.60%	7
Rectification Works due to poor PM role	62.84%	74.33%	46.71%	8
Engaging the contractor in other critical projects at the same time	64.48%	69.40%	44.75%	9
Ineffective quality control/Assurance system	61.34%	70.90%	43.49%	10

Researcher revealed in this study that delay factors related to project management by the contractor have great importance comparing to other factors. The top five factors were poor site management and Ineffective control system (R.I.I% = 54.98%), estimation of unrealistic costs by contractors (R.I.I% = 53.43%), bad communication between the project manager of contractors and other project parties (R.I.I% = 50.06%), claims between the clients and the main contractors is the forth influencer factor

(R.I.I% = 49.35%), last but not least is the inaccurate planning & scheduling by the contractor (R.I.I% = 49.32%) as identified in Table 27.

4.5.2 Delay Factors Related to Consultant

A. Frequency & severity degree from respondents perspectives:

Participants responses about frequency of occurrence and degree of severity of delay factors caused by consultants where detailed in Table C-6 in Appendix (C).

1- Poor design and lack of coordinated drawings

The involved parties convinced with sometimes occurrence toward poor design & drawings factor by approximately 51% of contractors, 36% of consultants and 47% of clients. Total percentage of those choosing sometimes frequency is about 44.8 percent, 20.9 percent for those who persuaded to frequently occurrence while 20.1 percent who agreed that this factor occurs rarely.

Moreover, severity of degree of “Poor design and lack of coordinated drawings” factor were concurred by all parties (contractors, consultants and clients/owners) participated in the study to be severe by 43.4% (contractors), 44.7% (consultants) and 35.3% (clients/owners). Results belonging to total describe that approximately 62% of total proportion tends to severe or very severe, where 41.8% for severe and 20.1% for very severe which represents high participation, while 21.6% agreed with fairly severity.

2- Delaying the approval of project documents

(72.4 percent) of participated parties (contractors, consultants and clients) were selected sometimes occurrence or frequently occurrence,

where in details the highest proportion (47.8%) agreed that this factor occurs sometimes while the other (24.6%) agreed on occurrence of factor “Delaying the approval of project documents” is frequent.

From severity degree aspect, the total poses high percentage of participants who concurred that “Delaying the approval of project documents” factor is severe or very severe with percentage of 35.1 percent for severe and 17.9 percent for very severe to be total of 53%. The others agreed with percentage of 42.6% to fairly severe or little effect of this factor, 28.4 percent for fairly severe participants and 14.2 percent for little effect.

3- Discrepancies between drawings and specifications prepared by consultant

68% participation represented in total results shows that participants agreed that “Discrepancies between drawings and specifications prepared by consultant” occurs either sometimes with 39.6% or rare with 28.4%. Most participants of contractors and consultants agreed with sometimes occurrence while clients concurred with rare occurrence. Degree of severity for this factor assessed by all project parties involved in the study was severe (37.7%, 36.2%, 52.9%). But with total considerations, there is around 65% participants who agreed either with severe or fairly severe (41% or 23.9% respectively).

4- Imprecise time estimation

There is an agreement between contractors and clients participants regards the frequency of time estimation factor with percentage of 35.8% and 44.1% while consultant participants opinions were divided between rare occurrence and sometimes frequency (27.7% for each). But in total, the vast majority represents frequently or sometimes at 33.6% and 29.1%.

Regarding severity participants (consultants and clients/owners) agreed on severe and contractors agreed on fairly severe, while result in total shows percentage of 31.3% for those who agreed that this factor is severe and 49.2% equally for very severe or fairly severe.

5- Unrealistic cost estimation

Contractors respondents inputs were agreed on frequently occurrence of “Unrealistic cost estimation” factor with rate of 39.6 percent. On the other hand, consultants and clients participated at rate of 31.9 percent and 29.4 percent for rare occurrence to this factor. Results in total illustrate that there is an approximately equal participation for each of rare, sometimes and frequently occurrence.

From aspect of severity, total of participants tend to assess this factor as a severe or very severe factor at rate of 28.4 percent or 32.1 percent. contractors agreed on severe with 34% while consultants and clients concurred with very severe at 29.8 percent and 38.2 percent.

6- Slow responses by the consultant towards required design changes/variations

Contractors and consultants convinced that “Slow responses by the consultant towards required design changes/variations” factor has sometimes frequent at rate of 45.3% and 31.9% while 41.2% of clients agreed on rare occurrence of that factor. from total, 36.6% (49 participants) with sometimes occurrence and 29.1% (39 participants) with rare occurs.

From perspective of severity degree, the highest proportion of participants by 34.3% agreed that this factor is severe, 25.4% agreed with fairly severe is this factor.

7- Unqualified/inexperienced consultant's supervision staff

68% of contractors respondents were divided equally with regarding the frequency of "Unqualified/inexperienced consultant's supervision staff" factor to sometimes or frequency occurrence. Consultants agreed that it occurs sometimes while half of the clients (50%) convinced the rare occurrence of that factor. from total, the highest rate is 34.3% (46 respondents) for rare occurrence of this factor.

In case of severity degree, about 56% of total participants agreed that this factor is severe or very severe, 19.4% agreed on fair severity of this factor while the other 24.6% agreed on little effect or no effect.

8- Poor communication skills between consultant and project parties

If there is poor communication exists, each party will have its own understanding of the final goals. So asking clients about their needs is important, because consultant's responsibility is designing his expectations as it is. In some cases, communications done with contractors to deliver client's needs as a representative to the clients.

It is obvious that the vast majority of participants agreed that poor communication between project parties factor has frequency of sometimes at rate of 40.3% and rare frequency at 30.6%. Project parties (consultants and contractors) concurred to sometimes while the clients for rare occurrence.

55.2% of total proportion were agreed that this factor is severe or very severe while 24.6% for fair severity. In this case, there is a disagreement between all parties, contractors agreed for severe, consultants concurred with fairly severe while the clients convinced with very severe.

B. Kruskal Wallis Test

Mean values of consultant-related delay factors are described below in Table 57. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 15. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Consultant-related Delay Factors

Delay Factors (Consultant)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Poor design and lack of coordinated drawings	3.02 $\pm$ 0.99	3.61 $\pm$ 1.08
2- Delaying the approval of project documents	3.15 $\pm$ 0.88	3.48 $\pm$ 1.08
3- Discrepancies between drawings and specifications prepared by consultant	3.01 $\pm$ 0.95	3.43 $\pm$ 1.04
4- Imprecise time estimation	3.35 $\pm$ 1.06	3.59 $\pm$ 1.11
5- Unrealistic cost estimation	3.31 $\pm$ 1.17	3.71 $\pm$ 1.14
6- Slow responses by the consultant towards required design changes/variatio	2.95 $\pm$ 1.02	3.35 $\pm$ 1.09
7- Unqualified/inexperienced consultant's supervision staff	2.77 $\pm$ 0.98	3.46 $\pm$ 1.24
8- Poor communication skills between consultant and project parties	2.93 $\pm$ 0.89	3.57 $\pm$ 1.11
P-value	<0.001	0.166

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Results obtained in Table 28 described that there is a significance differences between factors caused by consultants from frequency of occurrence aspect, this originated from P-value = 0.001 < 0.05 (at 95% confidence level). It is explicit that mean of factor No.7 (2.77 $\pm$ 0.98) is too differ with mean of factor No. 4&5 (3.35 $\pm$ 1.06, 3.31 $\pm$ 1.17). To conclude, existence of no experienced teams with consultants is less frequent while the most frequent factors caused by consultants are Inaccurate estimation of time and cost, then followed with “delays of project documents

approval”. Opinions of project parties (contractors, consultants and clients/owners) regarding the frequency of consultant-related delay factors is differ thus there is a disagreement existence between them.

Regarding degree of severity, $P\text{-value} = 0.166 > 0.05$ (at 95% confidence level) means that there is no significance different in severity between the listed delay factors. It is obvious that all mean values closer together and have high severity which explain the agreement of all parties in their opinions toward the severity of consultant-related delay factors. Based on results, the highest intense factor is “Unrealistic cost estimation” followed with “Poor design and lack of coordinated drawings” and “Imprecise time and poor communication skills”.

Factors 1 to 5 considered as frequent and severe causes while factors 6 to 8 considered as in-frequent and severe factors.

C. Ranking of Delay Factors (R.I.I%)

Table 16. Ranking of Causes of Delay Related to Consultant

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
Unrealistic cost estimation	66.12%	74.18%	49.05%	1
Imprecise time estimation	67.01%	71.79%	48.11%	2
Delaying the approval of project documents	62.99%	69.55%	43.81%	3
Poor design and lack of coordinated drawings	60.45%	72.24%	43.67%	4
Poor communication skills between consultant and project parties	58.66%	71.49%	41.94%	5
Discrepancies between drawings and specifications prepared by consultant	60.30%	68.66%	41.40%	6
Slow responses by the consultant towards required design changes/variatio	58.96%	67.01%	39.51%	7
Unqualified / inexperienced consultant's supervision staff	55.37%	69.25%	38.34%	8

As concluded from results shown in Table 29, the most four important delay factors caused by the consultant are unrealistic cost estimation & imprecise time estimation with R.I.I% of 49.05% and 48.11% successively. Followed with delayed documents approval (R.I.I% = 43.81) and poor design & lack of coordinated drawings (R.I.I% = 43.67%). At all, the frequency and severity of consultant-related delay factors are high.

4.5.3 Delay Factors Related to Client/Owner

A. Frequency and severity degree from respondents perspectives:

Frequency of occurrence and degree of severity percentage of delay factors caused by clients/owners where declared in Table C-7 in Appendix (C).

1- Decision making sluggish by owner

If the clients/owners take decisions very slowly, the project will be delayed by contractors as well due to waiting time consumed with zero works.

Contractor's and consultant's responses varied regarding frequency of occurrence of delaying decisions making factor by the client between occurrence of rare, sometimes or frequently with approximately similar rate (26.4%, 26.4% and 28.3% respectively for participation of contractors) but the highest agreed that this factor happens frequently, while consultants participated with rate of 23.4%, 27.7% and 27.7% respectively. But the client participation in case of frequency of that factor were highly agreed with either sometimes or frequently occurrence by rate of 29.4% and 32.4%, successively. The highest percentage of total participants concurred the frequently occurrence of "Decision making sluggish by owner" factor with 29.1% (39 participants) followed by 27.6% (37 participants) who agreed on sometimes occurrence to same factor.

In case of severity, 47.2% and 41.2% of contractors and clients participants agreed that this factor has severe severity on delay of building construction projects and 31.9% of consultants concurred the very severe intense. From total results, 67.2% (90 participants) agreed either this factor is severe or very severe. Of these, 37.3% for severe intense and 29.9% for very severe intensity. It is clear that this factor has great influence to delay.

2- Continuous changes order by owner during construction

Contractors participation of frequency of “Continuous changes order by owner during construction” factor were distributed equally for frequently or always occurrence with rate of 30.2% (16 participants for each), consultants participated with rate of 38.3% with 18 participants for sometimes frequency while the clients participation were for sometimes or frequently occurrence at successively percentages, 35.3% (12 participants) and 38.2% (13 participants). Concerning results in total, 47.7% of participants agreed that this factor occurs either frequently or always, 28.4% of respondents agreed the sometimes occurrence of this factor.

Severity of this factor were agreed by consultants and clients which participated in this study to be severe factor by 34% and 47.1% respectively. Contractors agreed with very severe intensity of this factor. Thus, the total proportion show that 38.1% (51 respondents) concurred that this factor is severe while 35.1% (47 respondents) concurred the very severe for this factor.

3- Uncooperative owners

“Uncooperative owners” factor frequency percentages collected to be 66% represent contractors participation, 51% represent participation of consultants for sometimes or frequently occurrence. For contractors, 28.3% agreed occurrence of sometimes while 37.7% agreed frequently occurrence. For consultants, 25.5% for each agreed that this factor occurs either sometimes or frequently. Clients/owners have participation at rate 32.4% for sometimes occurrence. Considering total results, the highest percentage (59% - 79 respondents) is for sometimes occur or frequently occurrence. were 30.6% agreed at frequently occurrence while 28.4%

agreed at sometimes occurrence. Only 20.1% of total proportion were concurred that this factor occurs rarely.

Responses of project parties participated regarding this factor severity has discrepancies, 43.4% of contractors agreed that this factor is very severe, 38.3% of consultants agreed the fairly severe intensity while 35.3% of clients agreed with severe of this factor. Based on results in total, 33.6 percent were selected very severe while 53% were selected severe or fairly severe (27.6% or 25.4%, respectively).

4- Lack of owner experience in construction field

37.7% (20 respondents) of contractors and 50% (17 respondents) of clients/owners were concurred that “Lack of owner experience in construction field” factor is occurring frequently while 42.6% (20 respondents) of consultants were concurred that this factor is occurring sometimes. From total respondents, 68.7 percent concurred occurrence of this factor of frequently or sometimes (36.6% or 32.1%, respectively).

Replies of all project parties participated regarding this factor severity has divergences, 32.1% of contractors agreed that this factor is very severe, 34% of consultants agreed the fairly severe intensity while 32.4% of clients agreed with severe of this factor. Depending on results in total, 27.6 percent chose very severe while 49.2 percent chose severe or fairly severe (23.1% or 26.1%, respectively).

5- Late payment by owner (financial difficulties)

Contractors and consultants were participated with sometimes occurrence for frequency of “Late payment by owner (financial difficulties)” factor at percentage of 41.5% and 34%, successively. 52.9% of clients were participated to frequently occurrence of this factor. From

total, 64.2% of total proportion were participated for sometimes or frequently occurrences while only 20.1% participated with rare occurrence.

Project parties replies regarding this factor severity were differed, 37.7% of contractors agreed that this factor is severe, 36.2% of consultants agreed the very severe intensity while 35.3% of clients agreed with fairly severe of this factor. On basis of total results, 89.5 percent of total proportion agreed the severity of this factor is fairly severe or severe or very severe at rate of 24.6%, 34.3% and 30.6% arranged respectively.

6- Un-realistic contract duration

All project parties approved sometimes frequency of “Un-realistic contract duration” factor by 43.4% of contractors, 34% of consultants and 38.2% of clients. The total observed that approximately 65% of respondents agreed that this factor occurs either sometimes or frequently.

Regarding degree of severity, contractors and clients has similar agreement that this factor is very severe with percentage of 35.8% and 38.2%, consecutive. Consultants participated with percentage of 38.3% at severe intensity of this factor. Based on total, 64.2% of total participants agreed that this factor is severe or very severe (32.1% for each) and 23.1% participated to fairly severe is this factor.

7- Shortage of coordination between owner and other project parties

All project parties have similar responses regarding the frequency of this factor by 34% of contractors, 46.8% of consultants and 35.3% of clients/owners. The total results indicate that approximately 38.8% of respondents agreed that this factor occurs sometimes. 23.9% of them agreed with rare occurrence of this factor while 31.3% agreed the frequent or always occurrence of it.

43.4% of participated contractors were agreed to be severe factor, 46.8% of participated consultants were agreed on fairly severe to this factor while half of the clients agreed on fairly severe while the others concurred to severe is this factor (29.4% for each). Total results represent that 36.6% agreed that this factor is fairly severe and 32.8% agreed to be severe factor.

8- Work suspension by owner

Participated parties of this study have an agreement about frequency of this factor to be rare frequency at rate of 30.2% of contractors, 38.3% of consultants and 41.2% of clients/owners. For results of total, 35.8 percent agreed with rare occurrence and 44.7 percent agreed with sometimes occurrence or frequently occurrence of this factor. Of these, 24.6% who concurred that this factor occurs sometimes and 20.1% who concurred frequent occurrence.

Severity of this factor approved by contractors with rate of 35.8% to be very severe. Consultants and clients approved the severity to be fairly severe by percentage of 34% and 29.4%, arranged successfully. From total, 56.8% agreed that this factor is severe or very severe with equal percentage of 28.4%, while 26.1% of total participants agreed that this factor is fairly severe.

9- Settling financial payments of contractor delayed by owner

Contractors agreed that “Settling financial payments of contractor delayed by owner” factor has rare occurrence with rate of 34% while the other parties agreed that this factor occurs sometimes at rate 38.3% for consultants and 29.4% for clients/owners. Considering total results, 32.1% represents the highest proportion which concurred with sometimes occurrence, 27.6% agreed the rare occurrence of this factor while 23.9% agreed the frequently occurrence of it.

This Factor has severity degree of severe by 43.4% of contractors and 34% of consultants, while other 34% of consultants agreed on fairly severe of this factor. From perspective of clients/owners, it is very severe by 38.2%. Results in total represent the highest percentage were agreed at severe by 33.6 percent, 26.9% of total participants agreed on fairly severe is this factor and 22.4% agreed with very severe intensity.

10- Owner interference in construction operations

Parties involved in this study have a concurrence about “Owner interference in construction operations” factor frequency to be sometimes frequency at percentage of 47.2% of contractors, 36.2% of consultants and 52.9% of clients/owners. For results of total, the highest participants (60) agreed that this factor occurs sometimes at rate of 44.8%. 38.8% agreed with frequent occurrence or always occurrence of this factor. Of these, 20.9% who concurred that this factor occurs frequently and 17.9% who concurred that this factor has always occurrence. The other 16.4% agreed that this factor occurs rarely or never occurs.

The collected results regarding degree of severity for this factor have dissimilar opinions from point of view of project parties. Contractors replied with severe by 32.1%, consultants replied to fairly severe with percentage of 34% while clients replied with very severe is this factor at rate of 47.1%. Based on total, the highest results were agreed at very severe by 33.6 percent while severe or fairly severe agreed by 24.6 percent and 29.1% respectively.

11- Lack knowledge of client's own requirements while designing the project

Contractors, consultants and clients/owners agreed that “Lack knowledge of client's own requirements while designing the project” factor has frequency of sometimes at percentage of 45.3%, 38.3% and 38.2% at successively arrangement. There is also 38.2% of clients agreed that this factor occurs rarely. Concerning total, the highest participants (55) agreed that this factor occurs sometimes at rate of 41%. 23.1% agreed with frequent occurrence of this factor while 21.6% agreed that this factor has rarely occurrence.

This factor agreed to be severe by both contractors and consultants with rate of 32.1% and 44.1% respectively while fairly severe by consultants with rate of 36.2%. Basis of total, 59.7% agreed on severe or very severe, 29.9% agreed with fairly severe while only 10.5% agreed that this factor has little or no effect on delay.

B. Kruskal Wallis Test

Mean values of clients/owners-related delay factors are described below in Table 70. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 17. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Client/Owner-related Delay Factors

Delay Factors (Clients/Owners)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Decision making sluggish by owner	3.34 $\pm$ 1.10	3.78 $\pm$ 1.09
2- Continuous changes order by owner during construction	3.57 $\pm$ 1.05	3.93 $\pm$ 1.07
3- Uncooperative owners	3.17 $\pm$ 1.10	3.78 $\pm$ 1.11
4- Lack of owner experience in construction field	3.42 $\pm$ 1.13	3.51 $\pm$ 1.21
5- Late payment by owner (financial difficulties)	3.16 $\pm$ 1.02	3.82 $\pm$ 1.05
6- Un-realistic contract duration	3.34 $\pm$ 1.00	3.80 $\pm$ 1.10
7- Shortage of coordination between owner and other project parties	3.07 $\pm$ 1.07	3.34 $\pm$ 1.01
8- Work suspension by owner	2.72 $\pm$ 1.13	3.58 $\pm$ 1.25
9- Settling financial payments of contractor delayed by owner	2.99 $\pm$ 1.09	3.58 $\pm$ 1.08
10- Owner interference in construction operations	3.37 $\pm$ 1.04	3.78 $\pm$ 1.08
11- Lack knowledge of client's own requirements while designing the project	3.09 $\pm$ 1.01	3.61 $\pm$ 0.96
P-value	<0.001	<0.001

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

Regarding frequency of occurrence shown in Table 30, P-value = less than $0.001 < 0.05$ (at 95% level of confidence) so there is significance differences in frequency between the listed clients/owners – related delay factors, mean values of factors No. 8 & 9 (2.72 ± 1.13) & (2.99 ± 1.09) vary with others mean values of factors which make them the least frequent factors. In contrast, factor No. 2 (has the highest frequency among all factors related to the clients due to the largest mean value (3.57 ± 1.05), followed with factor No. 4 with mean (3.42 ± 1.13).

P-value = less than $0.001 < 0.05$ (at 95% confidence level). Thus, there is also significance difference in severity from perspective of project parties between inserted factors above. The most severe factor is No.2 with mean = (3.93 ± 1.07). Factor No. 5 take the second position of severity with mean = (3.82 ± 1.05) while the third severe factor is No. 6 with mean =

(3.80 ± 1.10). Otherwise, factor No. 5 represent the less severity followed by factor No. 4 which have mean values of (3.34 ± 1.01 & 3.51 ± 1.21).

Factors 1-7 and 10-11 considered as frequent and severe factors while factors 8 & 9 considered as in-frequent and severe factors.

From results obtained in Table 70, it is visible that project parties have different evaluations toward frequency of occurrence as well the degree of severity between clients-related delay factors. Thus, it can be concluded with the disagreement exists between point views of project parties i.e. (contractors, consultants and clients).

C. Ranking of Delay Factors (R.I.I%)

Table 18. Ranking of Causes of Delay Related to Client/Owner

Causes for delay	Frequency Index%	Severity Index%	Relative Importance index (R.I.I)%	Rank
Continuous changes order by owner during construction	71.49%	78.51%	56.13%	1
Owner interference in construction operations	67.31%	75.52%	50.83%	2
Un-realistic contract duration	66.87%	75.97%	50.80%	3
Decision making sluggish by owner	66.87%	75.67%	50.60%	4
Late payment by owner (financial difficulties)	63.28%	76.42%	48.36%	5
Uncooperative owners	63.43%	75.67%	48.00%	6
Lack of owner experience in construction field	68.36%	70.15%	47.95%	7
Lack knowledge of client's own requirements while designing the project	61.79%	72.24%	44.64%	8
Settling financial payments of contractor delayed by owner	59.85%	71.64%	42.88%	9
Shortage of coordination between owner and other project parties	61.49%	66.72%	41.03%	10
Work suspension by owner	54.48%	71.64%	39.03%	11

Results obtained were explained in Table 31, the most six significant delay factors which related to clients/owners were order changes continuously during implementation phase (R.I.I% = 56.13%), owner intervention in construction process (R.I.I% = 50.83%), unrealistic contract duration (R.I.I% = 50.80%), making slow decisions by owner (R.I.I% = 50.60%), existence of financial difficulties (lateness in payment) with

R.I.I% of 48.36% and Un-cooperative owners with relative importance of (R.I.I% = 48%). From here, the key factor related to clients/owners which highly affect the performance of projects were changes orders while work suspension by owner do not affect the performance of building construction projects in private sector.

4.5.4 Delay Factors Related to Governmental Regulations /Rules

A. Frequency and severity degree from respondents perspectives:

Tables C-8 in Appendix (C) illustrate the frequencies and the severity degree for governmental-related delay factors individually.

1- Governmental construction regulations changes

Frequency of “Governmental construction regulations changes” factor agreed to be rare by 35.8 percent (19 participants) of contractors and 47.1 percent (16 participants) of clients/owners. The others 38.3% (18 participants) of consultants agreed with frequency of sometimes. Results in total recorded 38.1% (51 respondents) concurred the rare occurrence while 32.8% (44 respondents) concurred that this factor occurs sometimes.

Opinions collected from project parties about degree of severity of this factor is severe with percentage of 39.6% of contractors and 29.4% of clients while consultants agreed on fairly severe at 38.3%. Based on total results, degree of severity for this factor is either severe or fairly severe as the vast majority with 59 percent of total respondents agreed on.

2- Complexity of obtaining necessary construction building permits

Building permit approval by the government is considered as time consuming due to the long time period and lengthy procedures.

Frequency of occurrence of “Complexity of obtaining necessary construction building permits” factor stated as rare occurs by 37.7 percent (20 participants of contractors) and 27.7 percent (13 participants of consultants), while it stated by 41.2 percent (14 participants of clients/owners) to occur sometimes. Based in total, half of participants (50 percent) agreed with sometimes or frequently occurrence while 32.8 percent concurred rare occurrence for this factor.

Severity of this factor concurred by contractors and clients/owners to be severe with percentage of 32.1% (17 participants) and 29.4% (10 participants) respectively. Thirty one point nine (31.9%) percent with 15 participants agreed that this factor is fairly severe. Results in total shows that opinion of more than half of participants regarding severity of this factor is fairly severe or severe (55.3%) and 20.9% agreed that this factor is very severe.

B. Mann-Whitney Test

Mean values of governmental-related delay factors are described below in Table 74. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 19. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for Governmental-related Delay Factors

Delay Factors (Governmental)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Governmental construction regulations changes	2.61 $\pm$ 1.03	3.37 $\pm$ 1.14
2- Complexity of obtaining necessary construction building permits	3.09 $\pm$ 1.11	3.42 $\pm$ 1.18
P-value	0.001	0.692

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Mann-Whitney test.

With applying Mann-Whitney test in Table 32, P Value = 0.001 < 0.05 (at 95% level of confidence) in case of frequency of delay factors caused by government regulation and rules. Based on P value, opinions of respondents were differed in both factors (1&2), there is a gap between the means of Factor 1 (2.61 $\pm$ 1.03) and Factor 2 (3.09 $\pm$ 1.11) which conclude that there is significant differences in frequency between governmental related factors stated before. Complexity of construction permits factor has highest frequency compared to the other list.

In case of severity degree, P value = 0.692 > 0.05 (at 95% confidence level) which means that there is an agreement exists in opinions of project parties toward severity of factors in governmental group. In other word, there is no significant differences in means of governmental factors from severity perspective. Factor 2 more severe than factor 1. Factor 1 is infrequent and severe factor while factor 2 is frequent and severe factor.

C. Ranking of Delay Factors (R.I.I%)

Table 20. Ranking of Causes of Delay Related to Government

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
Complexity of obtaining necessary construction building permits	61.79%	68.36%	42.24%	1
Governmental construction regulations changes	52.24%	67.31%	35.16%	2

According to this study, there is only two delay factors related to government regulations and rules shown in Table 33. Results revealed that construction permits complexity of obtaining process affect construction performance with R.I.I% of 42.24% while the other factor of changes regulations of construction by the government with R.I.I% of 35.16%.

4.5.5 Delay Factors Related to Externality

A. Frequency and severity degree from respondents perspectives:

Table C-9 in Appendix (C) details respondents for both frequencies and severity degree of external-related delay factors.

1- Inclement weather conditions

Conditions of weather in Bahrain is very hot and sunny which decrease the productivity of labours. Also, supplying materials through importing and delivery will be affected by inclement weather. Thus, the project duration times will be affected also.

The first external factor were stated by all project parties as rare occurs from frequency perspective. Contractors and clients/owner participation more than 50 percent and the consultant participates with 38.3 percent. Frequency of occurrence from total results were rare as the study collected exactly 50 percent (67 participants) and 21.6 percent agreed on sometimes occurrence.

Regarding degree of severity, all participants parties concurred the severity of “Inclement weather conditions” factor as little effect. Concerning the results from total respondents, there is 40.3 percent (54 respondents) agreed that this factor has little effect, this ensure the less significance of this factor on delays of construction projects, while 25.4 percent of total proportion agreed with fairly severe.

2- Traffic flow

Frequency occurrence confirmed by project parties (contractors, consultants and clients/owners to be rarely occurrence frequency for “Traffic flow” factor. Total results indicate that 36.6 percent (49 of total participants) agreed that this factor is rarely occurs while 18.7 percent (25 of total participants) concurred to sometimes frequency.

Severity from perspectives of project parties remarked as little effect as they participate with proportion of 37.7%, 31.9% and 41.2% for contractors, consultants and owners respectively. From total, 36.6 percent (49 of total respondents) agreed that this factor has little effect while 21.6 percent (29 of total respondents) concurred to severe.

3- Accident occurs in construction site (LTI)

The highest number of contractors and consultants were participated with rare occurrence of accident effect factor with 49.1% and 53.2%, while owners were participated to never occurrence with percent of 47.1. Total

refers to 43.3 percent who agreed that this factor occurs rarely, 29.9 percent who concurred to never occurs, 17.2 percent of total proportion were agreed on sometimes occurrence.

This factor has little effect from perspectives of both contractors and consultants which they participated with 16 contractors (30.2%) and 15 consultants (31.9%). 35.3 % of clients (12 participants) were agreed the severity with no effect. 50 percent of participants were agreed that this factor has little effect or no effect (29.1% or 20.9%) while the other 50 percent of participants agreed with fairly severe or severe or very severe (19.4% or 17.9% or 12.7%).

4- Unforeseen conditions of the site (nature & location of the site)

Sometimes there is an overlap exist between lands which can hinder lands division and ownership documents issuance which cause delay to project. In some cases, nature of lands whether rock or sand can also delay the project if it is not figured out at preliminary stages.

About 47.2% of contractors agreed on rarely occurrence to “Unforeseen conditions of site” factor, 53.2% of consultants coincide with contractors opinions with rare occurrence. Clients tend to assess the frequency of this factor to occur sometimes with 38.2% participation. About 46.3% of total respondents coincided about frequency of rare occurrence while 30.6% of them tend to sometimes frequency. In contrary, Project parties opinions were disagreed regarding severity degree of this factor. 41.5% of contractors were involved to this factor as fairly severe, 42.6% of consultants were answered with little effect and 38.2% of clients were chosen fairly severe. From total, 56.7% of total proportion were agreed with fairly severe or severe while 26.1% of participants tend to little effect severity.

5- Crisis & Political issues

In crisis issues, building construction projects enforced to delays. For example, lockdown and the prevention measures were taken during COVID-19 crisis disrupted construction process flow.

Rare occurrence frequency of “Crisis & Political issues” factor had the agreement of all project participants with percentage of 43.4% for contractors, 40.4% for consultants and 41.2% for clients. In total, around 41.8% of total proportion agreed that this factor occurs rarely while 30.6% concurred the never occurrences.

As well as, severity of this factor had the agreement of little effect from all parties too, 28.3% of contractors, 25.5% of consultants and 32.4% of owners. 41 percent of total results were concurred on fairly severe or severe with 20.9% and 20.1% respectively. 28.4% of total respondents were agreed on little effect of this factor.

6- Escalation of claims and disputes to court

Claims and disputes procedures in the court are too lengthy which suspend the projects for long time.

41.5 percent of contractor responses and 44.7 percent of consultant responses satisfied that “Escalation of claims and disputes to court” factor rarely occurs in construction projects. Clients opinions were divided equally with 32.4% between sometimes occurrence and rare occurrence. The vast majority agreed with frequency of rare at 40.3% of total proportion and 26.1% for sometimes occurrence of this factor.

Contractors participated with 32.1% to agree that claims and disputes in the court is very severe factor, 41.2% of clients/owners also participated with the agreement of very severe. But 27.7% of consultants concurred that

“escalation of claims and disputes” factor is severe. Results obtained in total that 32.1% of respondents evaluated that this factor is very severe and 25.4% of respondents assessed it as severe.

B. Kruskal Wallis Test

Mean values of external-related delay factors are described below in Table 82. means of frequency equal to 3 or more (sometimes occurrence or more) will be considered as frequent causes. Also, means of severity degree equal to 3 or more (fairly severe which mean it has an effect) will be considered as severe factors.

Table 21. Means and Standard Deviations of Frequency of Occurrence and Severity Degree for External-related Delay Factors

Delay Factors (External)	Frequency of occurrence Mean $\pm$ SD¹	Severity degree Mean $\pm$ SD¹
1- Inclement weather conditions	2.34 $\pm$ 0.96	2.73 $\pm$ 1.06
2- Traffic flow	2.40 $\pm$ 1.21	2.54 $\pm$ 1.14
3- Accident occurs in construction site (LTI)	2.10 $\pm$ 1.00	2.72 $\pm$ 1.32
4- Unforeseen conditions of the site (nature & location of the site)	2.50 $\pm$ 0.95	2.82 $\pm$ 1.07
5- Crisis & Political issues	2.09 $\pm$ 0.98	2.75 $\pm$ 1.29
6- Escalation of claims and disputes to court	2.47 $\pm$ 1.07	3.56 $\pm$ 1.31
P-value	<0.001	<0.001

1. Mean $\pm$ SD was computed out of 5; Note: P-values were computed by using Kruskal Wallis test.

From Table 34, P values for both frequency and severity were obtained using Kruskal Wallis test at 95% level of confidence. P values for both are = 0.001 < 0.05 which means that there is significant differences in frequency and severity between external related factors where listed previously. So it is definite that there is a disagreement between the opinions of the project parties towards frequency and severity degree of factors related to external group.

From frequency perspective, mean of (Factor 3: 2.10 ± 1.00) and (Factor 5: 2.09 ± 0.98) varied with Factor 1, Factor 2, Factor 4 and Factor 6 mean values. It is evident that Factor 4 is the most frequent factor amongst the other factors within the same group, while Factor 5 is the least frequent factor.

From severity perspective, mean of (Factor 6: 3.56 ± 1.31) is much more others mean values which implies the highest severity or it has more severe on construction project delays.

Factors 1 to 5 are in-frequent and not severe factors while only factor 6 is in-frequent and severe cause.

C. Ranking of Delay Factors (R.I.I%)

Table 22. Ranking of Causes of Delay Related to External

Causes for delay	Frequency Index%	Severity Index%	Relative Importance Index (R.I.I)%	Rank
Escalation of claims and disputes to court	49.40%	71.19%	35.17%	1
Unforeseen conditions of the site (nature & location of the site)	50.00%	56.42%	28.21%	2
Inclement weather conditions	46.87%	54.63%	25.61%	3
Traffic flow	48.06%	50.75%	24.39%	4
Crisis & Political issues	41.79%	55.07%	23.01%	5
Accident occurs in construction site (LTI)	41.94%	54.48%	22.85%	6

Results obtained from the questionnaire were illustrated in Table 35, belonging external-related delay factors which highly affecting building construction projects in Bahrain in the private sector summarized that the highest influencer factor is the escalation of claims and disputes to the court with (R.I.I% = 35.17%). Followed by unforeseen conditions of the site regarding its nature and situations with R.I.I% of 28.21% while the third factors affecting the project performance is the inclement conditions of weather with (R.I.I% = 25.61%). While accident occurrences in the site is the least influencer factor as it had the least value of importance R.I.I% = 22.85%.

4.7 Ranking of Top Ten Delay Factors

Table 84 indicates the relative importance indices and ranks the overall delay factors (materials, equipment, manpower, project management, consultant, client, government and external) to the top ten.

Table 23. The Most Ten (10) Significant Delay Factors which Affect Construction Building Projects

Causes for delay	Frequency Index%	Severity Index%	Relative Importance index (R.I.I)%	Rank
Continuous changes order by owner during construction	71.49%	78.51%	56.13%	1
Poor site management & Ineffective control system	68.21%	80.60%	54.98%	2
Unrealistic cost estimation (underpriced) & cash flow	69.25%	77.16%	53.43%	3
Lack of skilled manpower	68.96%	76.12%	52.49%	4
Owner interference in construction operations	67.31%	75.52%	50.83%	5
Un-realistic contract duration	66.87%	75.97%	50.80%	6
Decision making sluggish by owner	66.87%	75.67%	50.60%	7
Poor communication skills between contractor PM & project parties	64.63%	77.46%	50.06%	8
Claims between client & the main contractors	67.61%	72.99%	49.35%	9
Inaccurate project planning & scheduling by contractor	65.82%	74.93%	49.32%	10

As summarized in Table 36, factor of continuous changes order by owner during construction is extreme critical of client-related delay factors as it (R.I.I% = 56.13%). Overall, it is the highest delay factor according to this study which affect building construction projects. Poor site

management & Ineffective control system is the extreme critical while unrealistic cost estimation (underpriced) & cash flow of project management-related delay factors is critical with (R.I.I% = 54.98%) and (R.I.I% = 53.43%) respectively which they ranked as the second and third influencer factors. Moreover, the fourth affecting factor is related to manpower “lack of skilled manpower” with (R.I.I% = 52.49%). From fifth to seven ranks factors related to clients with R.I.I% of 50.83% (“Owner interference in construction operations”), 50.80% (“Un-realistic contract duration”) and 50.60% (“Decision making sluggish by owner”). From rank eight to ten, factors related to project management with R.I.I% of 50.06%, 49.35%, 49.32% respectively for “Poor communication skills between contractor PM & project parties”, “Claims between client & the main contractors” and “Inaccurate project planning & scheduling by contractor”.

It is visible that most of top ranked influencing factors were from contractor’s responsibility under project management and manpower categories, the other factors were from client’s responsibility. From here, it can be concluded that the contractors and clients are the most responsible parties for delay based on the relative importance indices obtained in the analysis of survey data.

4.8 Parties Responsibility for Construction Delays

Respondents percentage regarding the most responsible stakeholder (contractors, consultants, clients, government and external) obtained from the questionnaire of this study as shown in Table 8.

Table 24. The Most Responsible Stakeholder in Causes of Project Delays

Responsible stakeholder	First	Second	Third	Fourth	Fifth
	n (%)	n (%)	n (%)	n (%)	n (%)
1- Contractor Related Delay Factors	78 (58.2)	14 (10.4)	13 (9.7)	7 (5.2)	22 (16.4)
2- Consultant Related Delay Factors	16 (11.9)	59 (44)	40 (29.9)	15 (11.2)	4 (3)
3- Client/Owner Related Delay Factors	11 (8.2)	35 (26.1)	63 (47)	16 (11.9)	9 (6.7)
4- Delay Factors Related to Governmental Rules	13 (9.7)	15 (11.2)	14 (10.4)	78 (58.2)	14 (10.4)
5- External Delay Factors	16 (11.9)	11 (8.2)	4 (3)	18 (13.4)	85 (63.4)

As explained in Table 37, most of respondents agreed that contractor is the first responsible party for delay by rate of 58.2% (78 participants), the second responsible party is the consultant with participation of 59 (44%). Client is the third party responsible for delay as respondents participate with rate of 47% (63 participants). Fourth responsible party is the government as agreed by 78 of respondents with rate of (58.2%). 58 participants with percentage of 63.4% agreed that the last responsible party is the external.

4.9 Discussion

This section interprets the results obtained through the questionnaire. It explains the most frequent and severest causes for each category individually. As well as it compares results obtained with previous literatures.

4.9.1 Factors with most frequent and severest

Table 38 indicated the two most important delay factors based on their relative importance indices for each category individually.

Table 25. Extremely Critical and Very Critical Causes for Each Group

Delay group	Causes for delay	RII index	Criticalness
Materials	Lateness in delivering materials & long lead items	43.90%	Extremely critical
	Prices fluctuation of materials	42.58%	Very critical
Equipment	Equipment shortages	33.18%	Extremely critical
	Old technological equipment	29.11%	Non-critical
Manpower	Lack of skilled manpower	52.49%	Extremely critical
	Delayed mobilization of labor	40.06%	Very critical
Project management	Poor site management & Ineffective control system	54.98%	Extremely critical
	Unrealistic cost estimation (underpriced) & cash flow	53.43%	Very critical
Consultants	Unrealistic cost estimation	49.05%	Extremely critical
	Imprecise time estimation	48.11%	Very critical
Clients (Owners)	Continuous changes order by owner during construction	56.13%	Extremely critical
	Owner interference in construction operations	50.83%	Very critical

Government regulations & rules	Complexity of obtaining necessary construction building permits	42.24%	Extremely critical
	Governmental construction regulations changes	35.16%	Very critical
Externality	Escalation of claims and disputes to court	35.17%	Extremely critical
	Unforeseen conditions of the site (nature & location of the site)	28.21%	Non-critical

A. Contractor's Related Delay Factors:-

➤ Material

Results depicted that three of delay factors under material group are frequent and severe which are: lateness of material delivery, materials quality and fluctuation of materials prices. Late material delivery was ranked the first severest factor and second most frequent related to materials. While prices fluctuations was ranked as first frequent cause.

Contractor's depends on outside resourcing of construction materials which considers as a loss of time due to long time of sourcing, procurement and transportation processes. Quality of materials may delays time of the project if there is existence of defects or it's not conforming to the standards.

In order to prevent occurrence of these factors, contractors may during contract preparation increase payment by a percentage of 10% of total contract value to protect himself against prices fluctuations, apply early planning, good procurement management to determine the required and sufficient materials at the right time to prevent construction delays.

➤ ***Equipment***

It is obvious from results that there is only one factor from equipment category is severe and infrequent which is Equipment shortages. It was ranked as the first severest cause. When the equipment is unavailable, project work process could obstructed and postpone projects completion. Contractors in order to solve shortage of equipment, equipment rent is the best solution rather than waiting for long time. Also, doing proper planning to arrange equipment delivery with schedule of project prepared to supplement the deficiency.

➤ ***Manpower (Workforce)***

Results clarified that there is one frequent and severe factor related to manpower which is lack of skilled manpower. It ranked as the first most frequent and first severest factor. As mentioned before, most of workforce are Indian or Pakistani so they weren't have the required skills or qualifications. To increase productivity of labours and decrease un-skilled labours, contractors may provide training and programs to develop their labours. Also, attractive job environment is the key to attracting talented employees i.e. (competitive salaries, benefits packages and development opportunities).

➤ ***Project Management***

Results revealed that all delay factors related to project management are frequent and severe which conclude that this group is significant to delay of construction projects. First severest ranked factor and second most frequent is poor site management & ineffective control followed by poor communication skills between PM and project parties in the second position of severity. Unrealistic cost estimation (under-priced) & cash flow was ranked as first most frequent.

This problem integrated with planning and scheduling. To overcome with problems related to project management, contractor's project managers should plan a certain schedule for project and use technology (construction management software).

B. Consultants-Related Delay Factors:-

Results indicated that there is five frequent and sever factors under consultants-related group which clarify its significance. Imprecise estimation of time and un-realistic cost estimation were ranked to be most frequent factors. While unrealistic estimation of costs is the first severest factor followed by poor design and drawing coordination. These factors indicate that consultants have no enough experiences which may force projects to time and cost delay.

Problems related to time and cost can be reduced through doing accurate planning for estimations and schedules with account for unexpected issues. Also, poor designs provided can be solved by communications with clients to understand their needs as well the contractor to involve him in design phase to overcome with initial delays.

C. Clients-Related Delay Factors:-

Results pointed out that most of clients-related delay factors were frequent and severe causes. Thus, this group is very important. Of these factors, orders changes continuously by owner is the first most frequent and highest severe cause. In-experienced clients factor is the second most frequent while difficulties of finance by clients ranked as the second severest cause. Financing issues could impede progress of work by contractors as owner will be unable to fund the project. Also, slow make decisions, un-cooperative owners and interference of owners in

construction were from severe factors and could hamper contractor's work and delay project.

To overcome with order changes problems, clients should always be communicated about delay caused by their changes to reduce unnecessary changes and help them in making right decisions. Clients should also pay a great attention to design phase as all their needs correctly transferred to the consultants to be a client's representative in order to meet their expectations.

D. Government-Related Delay Factors:-

Government related delay factors ranked complexity of providing building permits cause as the most frequent and highest severe. While the other factor of changes in government rules and regulations were clarified to be the second severe cause with little frequency.

To overcome with delay related to government regulations is engaging with regulatory authorities requirement and navigate building permits in details with high diligence.

E. External-Related Delay Factors:-

Results showed that only one factor related to external is most frequent and severest cause which is the claims and disputes escalations to the court while all others are in-frequent and have no severe on construction projects performance which means that this group is in-significant to delays. Claims and disputes are lengthy procedures which delay projects times so project parties should try to solve their claims together internally and negotiate amicably without escalated to the court. Other factors with little frequency and no severe will not have much effect on delay of the project as they are not critical factors.

4.9.2 Results Comparison with related literatures

This research illustrated that the construction performance indicators as cost, time and quality effects which proved by Aziz (2013) and Shebob et al. (2011). This study revealed that *Continuous changes order by owner during construction* and Unskilled manpower were ranked as the most frequent and severest causes related to consultants and manpower, respectively. This is compatible with Al-Hammadi (2016), Abusafiya & Suliman (2017) and Yap et al. (2021).

Furthermore, this study intended to prove results obtained by [Aziz (2013); Abusafiya & Suliman (2017); Alaghbari¹² et al. (2018); Mahdi and Soliman (2021); Yap et al. (2021)] that *Poor site management & Ineffective control system* is one of major causes for building construction delays. Confirmation by considering this factor as the first most frequent and severest contractor's related factors under project management category. Overall, it was ranked as the second influencer cause (RII% = 54.98%).

Aziz (2013) and Yap et al. (2021) found that *Inaccurate project planning & scheduling by contractor* listed as one of the critical causes for delays in building construction projects performance. This study agreed with their results as this factor listed among the top ten delay factors based on their relative importance.

Culfik et al (2014), Al-hammadi (2016) and Yap's researches agreed that slow decisions making by the clients is very important factor in building construction delays. This research also agreed with them as it ranked as the severest factor amongst clients-related delay factors.

This study determined the major delay factors were order changes by owners (RII% = 56.13%), bad project management (RII% = 54.98%), unskilled labors (RII% = 52.49%), slowness in making decisions by clients (RII% = 50.60%), bad communication skills between project parties and contractors (RII% = 50.06%) and lastly the in-effective planning and scheduling by contractors (RII% = 49.32%). All these factors listed among the top factors which affect the project performance which totally match Yap's research. Moreover, poor communication factor was agreed as major cause to delay by Khan & Gul (2017) research.

Factors with RII% equal or less than 29.11% considered in this research as factors with less impact on building construction delays in Bahrain (private sector). In this research, there is eight causes do not have an effect belonging equipment-materials and external-related groups.

This research emphasized that conditions of weathers, claims and disputes escalation and accident occurs in the site (LTI) have least frequent and less severe which supported by Kasimu & Isah (2012) and Khan & Gul (2017). In addition, traffic flow, unforeseen site conditions, obsolete technology, old technology of equipment and improper equipment used also have no effect on delay which this results were confirmed by several studies such as, Kasimu & Isah (2012), Aziz (2013) and Yap et al. (2021).

4.10 Summary

This chapter provided outcomes to conclude with by doing the investigation and analysis. The main research questions and objectives were met through conducting the results and discussion. The delay factors with their impact on building construction projects were determined and analyzed in order to rank their significance using Kruskal Wallis/Mann-Whitney and RIIs.

First of all, the most important factors related to materials are lateness in delivering materials & long lead items and prices fluctuation of materials. For equipment-related factors the only crucial factor is equipment shortages. For the manpower-related factors, lack of skilled manpower and delayed mobilization of labor were paramount. Finally, the significant factors related to project management are poor site management & ineffective control system, unrealistic cost estimation (underpriced) & cash flow, poor communication skills between contractor PM & project parties, claims between client & the main contractors and inaccurate project planning & scheduling by contractor.

For consultants-related delay factors, the top important factors for delaying construction projects are unrealistic cost estimation, imprecise time estimation, delaying the approval of project documents, and poor design and lack of coordinated drawings.

For clients-related delay factors, continuous changes order by owner during construction, owner interference in construction operations, unrealistic contract duration and decision making sluggish by owner are the most significant factors for delay in building construction projects.

Regarding governmental regulations related factors, factors that are of vital importance are the complexity of obtaining necessary construction

building permits and governmental construction regulations changes. Regarding externality-related delay factors, there is only one critical factor, which is the escalation of claims and disputes in court.

Findings of this study demonstrated that contractors are the most responsible party for construction delays as the projects greatly affected by delays in manufacturing or delivery process of materials and equipment, since the contractors require extra time to install equipment, re-arrange schedules and re-allocate manpower in order to provide successful project management. Consultants and clients are the second and third responsible for construction delays. Whereas government and external factors have less responsibility in construction delays.

Chapter 5: Conclusion and Recommendations

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5.1 Introduction

This chapter summarizes all research findings. It presents summary of findings, conclusion and recommendations to be considered by all project groups (contractors, consultants, clients, governments and external factors) as well as the future studies.

5.2 Conclusion

This research investigated causes of delays and their impact on building construction projects. This study illustrates lists of causes of delays (delay factors) which affect the performance of building construction projects and their types in chapter two. Delay factors were assessed in this study based on their frequency occurrence (how often they occur) and severity degree (how they impact delays) on a 5 point-Likert scale. Moreover, relative importance index (RII) measurement was used to rank these delay factors based on their importance.

Design of this research was conducted to include quantitative descriptive research (survey research). Questionnaire developed in this study was distributed to contractors, consultants, and clients in the private sector with non-random sampling method. The targeted population of this study is 52 contractors, 45 consultants and 34 clients/owners. SPSS software used in the analysis of research's collected data.

This study determined 50 delay factors which were categorized into eight groups: material-related delay factors, equipment-related delay factors, manpower (workforce)-related delay factors, project management-related delay factors, consultant-related delay factors, client-related delay factors, government regulations/rules-related delay factors and external-related delay factors. Reliability and Validity of research instrument were conducted and checked by Cronbach's alpha reliability test and Bivariate

test. Also, delay factors were ranked based upon their RIIs which indicate the quality and significance of each category.

Analysis of collected data showed that Forty-two (42) factors with $RII\% > 29.11\%$ were considered crucial whereas factors with $RII\% < 29.11\%$ which are eight (8) factors were considered un-important. The overall top ten (10) ranked delay factors which highly impact building construction projects in Bahrain were (1) continuous changes ordered by owners during construction, (2) poor site management & Ineffective control system, (3) unrealistic cost estimation (underpriced) & cash flow, (4) lack of skilled manpower, (5) owner interference in construction operations, (6) un-realistic contract duration, (7) decision making sluggish by owner, (8) poor communication skills between contractor PM & project parties, (9) claims between client & the main contractors and (10) inaccurate project planning & scheduling by contractor.

This conclusion summarises that from the top significant ten delay factors, there is 5 factors belonging under project management-related, 4 factors under client-related group and 1 factor belong manpower-related group which proved the responsibility of contractors in delaying construction projects, it showed from results obtained through survey that the first responsible stakeholder is the contractors, consultants, clients, government while the external factors have the least responsibility toward delays in construction projects. This is categorization were proved by many previous researches, thus the results of this study is reasonable.

Furthermore, there is some agreement between the results of this study compared to others, but its necessary that there are discrepancies due to population size, sampling method and participant's experiences.

5.3 Research Limitations

There are significant limitations in this research. For instance, study is limited to construction of buildings projects in the private sector only. In addition, data gathered from the questionnaire which distributed to civil experts only without investigating realistic construction projects in Bahrain. This process impede the written of the final conclusion, so multiple analysis of real projects will be needed in such cases to conclude with reasonable inference.

5.4 Recommendations

Recommendations will be stated here in this section to suggest ways to reduce delays and to control the impact of listed delay factors on building construction projects in Bahrain, as well as providing suggestions for future works.

5.4.1 Recommendations to be considered by contractors

- Contractors should provide excellent site management and work supervision to control essential activities, decrease costs by focusing on eliminating unnecessary processes, and complete projects on schedule, under budget and conform to quality.
- Contractors obligated to prepare an accurate cash flow for projects and develop financial resources to prevent finance problems occurring during construction phase.
- Materials and equipment delivery should be managed effectively by contractors to prevent long lead items delays.

- Contractors have to assign sufficient number of skilled workforce and motivate them in order to deliver projects with less or without delays.
- Contractors should properly plan and schedule the projects in order to prevent delays and enhance work development.
- Rectification works should be minimized by contractors.

5.4.2 Recommendations to be considered by consultants

- Consultants should provide precise estimation of cost and time to complete the project successfully without any delays.
- Consultants should develop checking, reviewing, and approving of project documents processes to minimize delays of time and quality during construction phase.
- Consultants should create engineering drawings with highly precision scale as well as doing the right inspection for drawing's discrepancies.
- Communications skills must be evolved between consultants and other projects parties to avoid delays.

5.4.3 Recommendations to be considered by clients

- Clients should decrease order changes during construction to minimize time, costs and quality issues.
- Clients have to do periodical payment to facilitate project's funding by contractors to prevent delays of time, costs, and quality.
- Decision making by owners should be done quickly and the design documents approvals should be finalized as timely as possible to minimize time delay of projects' completion.

- Interferences of owners must be minimized in construction phase to ensure the flow of work by contractors in order to deliver the building projects within its schedule, timeline and quality.

5.4.4 Recommendations to be considered by governments

- To have construction permits, there is list of approvals needed from multiple governmental authorities like Municipality, Ministry of Water and Electricity and Civil Defence certificate. To minimize time delays, government should modify and accelerate documentation cycle for receiving approval and modification for new projects to expedite the process of authority approval.

5.4.5 Recommendations to be followed in managing external factors

- Claims should be settled internally between project parties and decrease number of disputes referred to court which may take very long time to settle.
- Manpower and equipment productivity should be scheduled either through night shifts or overtime; and working hours in harsh weather conditions especially in Bahrain's summer should be considered.
- It is important to register all project resources (materials, labours and equipment) under credible insurance company in order to decrease losses occurring due to global crises, political issues and on-site labours accidents (LTI).

5.4.6 Recommendations for future studies

This is a list of recommendations for future works in relative field of this research:

- 1- Carry out research to investigate and analyze delay factors in Bahrain building construction projects in the private sector according to real-life case studies via Monte Carlo Simulation to minimize delays and manage risks as it predicts possible outcomes and provide approximate solution for construction delays.
- 2- It recommended to investigate delay factors and their effect in various type of building construction projects such as (residential projects, commercial projects, mixed projects and industrial projects).
- 3- Study causes and effects of delay on building construction projects (such as cost overrun, time overrun and disputes) to draw suitable final conclusion.
- 4- Similar research can be carried out for road and other infrastructures projects.
- 5- Doing an analysis research to delay factors in GCC countries with doing the comparison between those causes of delays.
- 6- Conduct a research to compare effects of delay factors between developing countries and developed countries.

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7.0 APPENDICES

7.1 Appendix (A): Responses Samples of Pilot Study

7.2 Appendix (B): Research Questionnaire

7.3 Appendix (C): Tables of Analysis

**7.4 Appendix (D): Overall Relative Importance Index
(R.I.I%) Of Delay Factors**

Appendix (A1): Responses Sample of Pilot Study

Dear Dalal Alwedaei,

Your questionnaire overall is excellent and covered almost all possibilities, but I may add some of “suggestions” to unclear points and questionnaire structure.

According to posting, Google Forms questionnaire (online) is better because it has more organized questions and easier in publish.

Part 1:

Q2) According to type of business: Client/Owner - Other, specify_____.

Q3) According to duty position: Other, specify_____ as you will get responses from many other positions.

Part 2:

- Please add Reference Letter for each item to ease reading and report writing.

Materials related delay factors:

- Point 1 is not clear, better write lack of material availability in the local market.
- You can add point 5 “Long lead items”

Manpower related delay factors:

- Add point 3 “Absence and Sickness of Labours”.

Project Management related delay factors:

- Point 12: Rewording “Rectification Works due to poor PM role”.
- Point 16: Be specific (Unrealistic under-priced cost estimation).

Consultant related delay factors:

- Suggested Re-wording:

Point 1: “Poor design and lack of coordinated drawings”

Point 7: “Unqualified/inexperienced consultant’s supervision staff”

- According to Point 2: (consultants can’t prepare and approve the same document), I guess you mean “Delays in the approval of shop drawings” or “Delays in the preparation of required construction drawings”.

Owner related delay factors:

- Better to remove point 6 as it not applicable, you already added the scheduling factor under consultant and consultant.
- You can add point 11) “Lack knowledge of client’s own requirements while designing the project”

Externality related delay factors:

- Point 7 is already mentioned above several times.

Wish you all the best in your thesis

Best Regards,

Mariam Jawad Al-Markhi

Project Manager

Prime Minister’s Office (PMO)

Contact No. (+973) 39931125

Email: mariamalmarkhi@gmail.com

Appendix (A2): Responses Sample of Pilot Study

Dear Dalal Alwedaei,

The questionnaire developed is very organized and clear, but there are some suggestions from my perspective as an assistant project manager.

For Page 2, Responses of frequency and severity: Better to be presented as a list in order to be clear.

For Section 1:

Q5) The minimum project value under this study is BHD 100,000, you may specify the nature of projects you are counting here.

For Section 2:

➤ Rank can be measured by the student using the frequency and severity degree, so if it can be eliminated better or ask the reader to pick the top 1 only.

Material: you could add 5) “Quality of materials used” [example: if contractor used low quality washed sand it will cause cracks in concrete plaster layer which will result in re-doing the works and consume more time.

Project Management:

Re-word suggests: 13) “Lack of contractor’s PM experiences”

14) “Poor communication skills between contractor’s PM and project parties”

Consultant: Re-word suggests, 2) “delays in preparation of project documents”, 9) “poor communication skills between consultant and project parties”

Client/Owner: Re-word suggests 9) “Settling contractor financial payment delayed by client/owner”. Also, you could add 11) “Contractor claims/issues with client”

Governmental Regulations & Rules:

Re-word suggests, 2) “Prolonged tendering procedures instead of slow”

4) what do you mean? Not clear.

Optional notes: You can add area for participants to write any “other” reasons of delay from their perspective, but keep in mind that it will take you longer time and effort in analysis and writing the thesis reports

Wishing you the all best and happy Eid.

Kind regards,

Mohamed Maki
Assistant Project Manager
Sayed Khadem Al-Durazi Group (SKD)
Contact No. (+973)
Email:

Appendix (B)
Research Questionnaire

**M.Sc. Thesis on Investigating and Analysing Delays Factors and its Impact on
Private Building Construction Projects in Bahrain**

Questionnaire Survey

Dear Sir/Madam:-

I am preparing a research project aims to investigate and analyse delays factors and its effects on building construction projects in Bahrain especially in private sector using statistical software package (SPSS). That is to fulfil the requirements of Master's degree in Engineering Management at University of Bahrain.

The objective of this questionnaire is to identify the most responsible factors of delay and solutions for causes of delay in Bahrain construction industry. You are kindly requested to spare part of your valuable time to answer all attached questions carefully and substantively.

Please note that all data will be remain confidential when analysing the questionnaire. Also, no personal information will be shared.

Your collaboration will be highly appreciated. For more information or clarifications please contact me through my email d.alwedaei98@gmail.com.

Thank you,

Researcher: Dalal A. Razaq Alwedaei

(+973) 34403416

Please read these notes before filling the questionnaire:

- **Ideal participants in this questionnaire:**

Engineers, Architects, Engineering Managers, Academics, or any others who're (were) playing roles in the constructing process in Bahrain building construction projects.

- **Introduction:**

questionnaire of this research developed to identify the frequency of occurrence and degree of severity of delay factors in building construction projects in the private sector in Bahrain. Questionnaire includes two parts (1) & (2). Part (1) focuses on the demographic information (experiences and education levels) while part (2) includes list of delay factors which you are requested to choose the frequency of occurrence and degree of severity and specify the top five significant delay factors which mostly affect building construction projects from your perspective.

- **Definition:**

“Frequency”: refers to the likelihood of delay occurrence by factors listed and how it impact the building construction projects in Bahrain.

“Severity”: refers to the severity of delay on building construction projects and the severity of impact on the completion of the project.

- **Responses:**

- ✓ **Frequency of occurrence:**

- 1- Never: (Never occur).
- 2- Rare: (Rarely occur).
- 3- Sometimes: (occur from time to time).
- 4- Frequently: (mostly occur).
- 5- Always: (occur all the time).

- ✓ **Degree of Severity:**

- 1- No effect: (negligible factors or without effect).
- 2- Little effect: (little effect on completion time).
- 3- Fairly severe: (some effect on completion time).
- 4- Severe: (factors has appreciable effect on completion time).
- 5- Very Severe: (factors with great effect on completion time).

Section 1: Respondent's Experiences

1. What is your Education Level?

- ☐ High school
- ☐ Diploma
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ PhD degree

2. What is your type of business in the current job?

- ☐ Client/Owner
- ☐ Contractor
- ☐ Consultant
- ☐ Other, Specify.....

3. What is your duty position?

- ☐ General Manager
- ☐ Project Manager
- ☐ Engineer/Designer
- ☐ Other, Specify.....

4. How many years of experience do you have?

- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ >20 years

5. How many buildings project/s have you worked for in the last 5 years?

- ☐ <5 Projects
- ☐ 5-10 Projects
- ☐ 11-15 Projects
- ☐ >16 Projects

6. What is the size of current project/s you involved in?

- ☐ Very Large (Above BD 2,000,000)
- ☐ Large (BD 1,000,000 – BD 2,000,000)
- ☐ Medium (BD 200,000 – BD 1,000,000)
- ☐ Small (BD 100,000 – BD 200,000)

7. Do you faced any delayed building construction projects during your work period?

- ☐Yes ☐No

Section 2: Delay Factors in building construction project

1- Please mark[☒] delay factors in the table to their frequency occurrence and

severity degree and rack them based on their importance. Whereas,

Frequency: 1- Never, 2- Rare, 3- Sometimes, 4- Frequently, 5- Always

Severity degree: 1- No effect, 2- Little effect, 3- Fairly severe, 4- Severe, 5- Very Severe

➤ 1.1 Contractor-Related Delay Factors

[illegible]

➤ **1.4 Governmental Regulations & Rules-Related Factors**

	Delay Factors	Frequency of occurrence					Severity Degree				
		1	2	3	4	5	1	2	3	4	5
1	Governmental construction regulations changes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	Complexity of obtaining necessary construction building permits	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

➤ **1.5 Externality-Related Delay Factors**

	Delay Factors	Frequency of occurrence					Severity Degree				
		1	2	3	4	5	1	2	3	4	5
1	Inclement weather conditions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	Traffic flow	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	Accident occurs in construction site (LTI)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	Unforeseen conditions of the site (nature & location of the site)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5	Crisis & Political issues	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6	Escalation of claims and disputes to court	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2- Who is the most responsible stakeholder in causes of project delays? Please rank the following stakeholders. [(1 - the most) to (5 - the least)]

Main Categories of Delay Factors	1	2	3	4	5
1. Contractor Related Delay Factors	☐	☐	☐	☐	☐
2. Consultant Related Delay Factors	☐	☐	☐	☐	☐
3. Client/Owner Related Delay Factors	☐	☐	☐	☐	☐
4. Delay Factors Related to Governmental Rules	☐	☐	☐	☐	☐
5. External Delay Factors	☐	☐	☐	☐	☐

APPENDIX (C)
(ANALYSIS TABLES)

Table C-1: Frequency and percentage distribution of sociodemographic characteristics (Total = 134)

Characteristics	n (%)
Education Level	
Diploma	3 (2.2)
Bachelor's Degree	108 (80.6)
Master's Degree	19 (14.2)
PhD Degree	4 (3)
Type of business	
Client/Owner	34 (25.4)
Contractor	53 (39.6)
Consultant	47 (35.1)
Duty position	
General Manager	16 (11.9)
Project Manager	26 (19.4)
Engineer/Designer	92 (68.7)
Years of experience	
1-5 Years	35 (26.1)
6-10 Years	37 (27.6)
11-15 Years	25 (18.7)
16-20 Years	15 (11.2)
>20 Years	22 (16.4)
Number of buildings project/s you worked for in the last 5 years	
<5 Projects	36 (26.9)
5-10 Projects	43 (32.1)
11-15 Projects	15 (11.2)
>15 Projects	40 (29.9)
Size of current project/s you involved	
Very Large (Above BD 2,000,000)	46 (34.3)
Large (BD 1,000,000 - BD 2,000,000)	35 (26.1)
Medium (BD 200,000 - BD 1,000,000)	36 (26.9)
Small (BD 100,000 - BD 200,000)	17 (12.7)
Facing any delayed building construction projects during your work period	
Yes	121 (90.3)
No	13 (9.7)

**Table C-2 : [Participants Respondents toward Material-Related
Delay Factors]**

C/M1	Frequency of occurrence scale	Participants		Total	Degree of Severity	Participants		Total
		Contractor	Consultant			Client/Owner	Contractor	
Never		2	2	6	No effect	2	4	6
		3.8%	4.3%	5.9%		4.5%	3.8%	8.5%
Rare		14	11	38	Little effect	9	6	23
		26.4%	23.4%	38.2%		28.4%	17.0%	12.8%
Sometimes		24	22	61	Fairly Severe	22	12	43
		45.3%	46.8%	44.1%		45.5%	41.5%	25.5%
Frequently		12	8	23	Severe	11	14	38
		22.6%	17.0%	8.8%		17.2%	20.8%	29.8%
Always		1	4	6	Very Severe	9	11	24
		1.9%	8.5%	2.9%		4.5%	17.0%	23.4%
C/M2	Frequency of occurrence scale	Participants		Total	Degree of Severity	Participants		Total
		Contractor	Consultant			Client/Owner	Contractor	
Never		1	1	2	No effect	1	2	3
		1.9%	2.1%	0.0%		1.5%	1.9%	4.3%
Rare		8	9	31	Little effect	7	7	19
		15.1%	19.1%	41.2%		23.1%	13.2%	14.9%
Sometimes		26	24	63	Fairly Severe	17	16	43
		49.1%	51.1%	38.2%		47.0%	32.1%	34.0%
Frequently		15	8	29	Severe	16	9	39
		28.3%	17.0%	17.6%		21.6%	30.2%	19.1%
Always		3	5	9	Very Severe	12	13	30
		5.7%	10.6%	2.9%		6.7%	22.6%	27.7%
C/M3	Frequency of occurrence scale	Participants		Total	Degree of Severity	Participants		Total
		Contractor	Consultant			Client/Owner	Contractor	
Never		3	1	11	No effect	2	0	4
		5.7%	2.1%	20.6%		8.2%	3.8%	4.3%
Rare		13	13	34	Little effect	6	5	21
		24.5%	27.7%	23.5%		25.4%	11.3%	10.6%
Sometimes		19	18	47	Fairly Severe	15	18	41
		35.8%	38.3%	29.4%		35.1%	28.3%	38.3%
Frequently		10	9	25	Severe	20	11	42
		18.9%	19.1%	17.6%		18.7%	37.7%	23.4%
Always		8	6	17	Very Severe	10	11	26
		15.1%	12.8%	8.8%		12.7%	18.9%	23.4%

C/M4									
Frequency of occurrence scale	Participants			Total	Degree of Severity	Participants			Total
	Contractor	Consultant	Client/Owner			Contractor	Consultant	Client/Owner	
Never	3	2	1	6	No effect	3	2	3	8
	5.7%	4.3%	2.9%	4.5%		5.7%	4.3%	8.8%	6.0%
	8	13	9	30		7	8	6	21
Rare	15.1%	27.7%	26.5%	22.4%	Little effect	13.2%	17.0%	17.6%	15.7%
	19	17	11	47		14	19	5	38
Sometimes	35.8%	36.2%	32.4%	35.1%	Fairly Severe	26.4%	40.4%	14.7%	28.4%
	15	13	13	41		21	10	14	45
Frequently	28.3%	27.7%	38.2%	30.6%	Severe	39.6%	21.3%	41.2%	33.6%
	8	2	0	10		8	8	6	22
Always	15.1%	4.3%	0.0%	7.5%	Very Severe	15.1%	17.0%	17.6%	16.4%
C/M5									
Frequency of occurrence scale	Participants			Total	Degree of Severity	Participants			Total
	Contractor	Consultant	Client/Owner			Contractor	Consultant	Client/Owner	
Never	5	7	5	17	No effect	3	4	1	8
	9.4%	14.9%	14.7%	12.7%		5.7%	8.5%	2.9%	6.0%
	14	15	14	43		7	11	11	29
Rare	26.4%	31.9%	41.2%	32.1%	Little effect	13.2%	23.4%	32.4%	21.6%
	17	17	15	49		17	14	7	38
Sometimes	32.1%	36.2%	44.1%	36.6%	Fairly Severe	32.1%	29.8%	20.6%	28.4%
	16	7	0	23		16	12	12	40
Frequently	30.2%	14.9%	0.0%	17.2%	Severe	30.2%	25.5%	35.3%	29.9%
	1	1	0	2		10	6	3	19
Always	1.9%	2.1%	0.0%	1.5%	Very Severe	18.9%	12.8%	8.8%	14.2%

**Table C-3: [Participants Respondents toward Equipment-
Related Delay Factors]**

C/E1	Frequency of occurrence scale	Participants				Degree of Severity	Total	Participants				Total
		Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner			
Never		6	7	8	21	No effect	21	4	3	0	7	
		11.3%	14.9%	23.5%	15.7%		7.5%	6.4%	0.0%	5.2%		
		16	16	14	46		6	16	11	33		
		30.2%	34.0%	41.2%	34.3%		11.3%	34.0%	32.4%	24.6%		
		19	17	4	40		19	11	6	36		
Sometimes		35.8%	36.2%	11.8%	29.9%	Fairly Severe	29.9%	35.8%	23.4%	17.6%	26.9%	
		10	4	6	20		20	11	12	43		
Frequently		18.9%	8.5%	17.6%	14.9%	Severe	14.9%	37.7%	23.4%	35.3%	32.1%	
		2	3	2	7		4	6	5	15		
Always		3.8%	6.4%	5.9%	5.2%	Very Severe	5.2%	7.5%	12.8%	14.7%	11.2%	
C/E2	Frequency of occurrence scale	Participants				Degree of Severity	Total	Participants				Total
		Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner			
Never		6	5	8	19	No effect	19	3	4	5	12	
		11.3%	10.6%	23.5%	14.2%		5.7%	8.5%	14.7%	9.0%		
		9	16	12	37		18	16	11	45		
		17.0%	34.0%	35.3%	27.6%		34.0%	34.0%	32.4%	33.6%		
		27	17	9	53		22	18	13	53		
Sometimes		50.9%	36.2%	26.5%	39.6%	Fairly Severe	39.6%	41.5%	38.3%	38.2%	39.6%	
		10	6	3	19		6	5	5	16		
Frequently		18.9%	12.8%	8.8%	14.2%	Severe	14.2%	11.3%	10.6%	14.7%	11.9%	
		1	3	2	6		4	4	0	8		
Always		1.9%	6.4%	5.9%	4.5%	Very Severe	4.5%	7.5%	8.5%	0.0%	6.0%	
C/E3	Frequency of occurrence scale	Participants				Degree of Severity	Total	Participants				Total
		Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner			
Never		8	8	8	24	No effect	24	6	4	7	17	
		15.1%	17.0%	23.5%	17.9%		11.3%	8.5%	20.6%	12.7%		
		20	17	13	50		19	12	6	37		
		37.7%	36.2%	38.2%	37.3%		35.8%	25.5%	17.6%	27.6%		
		17	16	10	43		18	19	11	48		
Sometimes		32.1%	34.0%	29.4%	32.1%	Fairly Severe	32.1%	34.0%	40.4%	32.4%	35.8%	
		7	1	2	10		7	7	8	22		
Frequently		13.2%	2.1%	5.9%	7.5%	Severe	7.5%	13.2%	14.9%	23.5%	16.4%	
		1	5	1	7		3	5	2	10		
Always		1.9%	10.6%	2.9%	5.2%	Very Severe	5.2%	5.7%	10.6%	5.9%	7.5%	
C/E4	Frequency of occurrence scale	Participants				Degree of Severity	Total	Participants				Total
		Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner			
Never		6	8	6	20	No effect	20	5	7	5	17	
		11.3%	17.0%	17.6%	14.9%		9.4%	14.9%	14.7%	12.7%		
		18	20	20	58		14	17	12	43		
		34.0%	42.6%	58.8%	43.3%		26.4%	36.2%	35.3%	32.1%		
		15	12	7	34		11	9	11	31		
Sometimes		28.3%	25.5%	20.6%	25.4%	Fairly Severe	25.4%	20.8%	19.1%	32.4%	23.1%	
		12	5	1	18		19	6	4	29		
Frequently		22.6%	10.6%	2.9%	13.4%	Severe	13.4%	35.8%	12.8%	11.8%	21.6%	
		2	2	0	4		4	8	2	14		
Always		3.8%	4.3%	0.0%	3.0%	Very Severe	3.0%	7.5%	17.0%	5.9%	10.4%	

Table C-4 : [Participants Respondents toward Manpower (labour) Related Delay Factors]

C/Labor1	Frequency of occurrence scale		Participants		Total	Degree of Severity	Participants		Total
	Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner	
Never	2	2	1	5	No effect	1	2	1	4
	3.8%	4.3%	2.9%	3.7%		1.9%	4.3%	2.9%	3.0%
	4	6	5	15		6	4	1	11
	7.5%	12.8%	14.7%	11.2%		11.3%	8.5%	2.9%	8.2%
	18	19	8	45		7	12	11	30
Sometimes	34.0%	40.4%	23.5%	33.6%	Fairly Severe	13.2%	25.5%	32.4%	22.4%
	23	14	16	53		22	19	10	51
Frequently	43.4%	29.8%	47.1%	39.6%	Severe	41.5%	40.4%	29.4%	38.1%
	6	6	4	16		17	10	11	38
Always	11.3%	12.8%	11.8%	11.9%	Very Severe	32.1%	21.3%	32.4%	28.4%
C/Labor2	Frequency of occurrence scale		Participants		Total	Degree of Severity	Participants		Total
	Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner	
Never	1	6	7	14	No effect	1	5	4	10
	1.9%	12.8%	20.6%	10.4%		1.9%	10.6%	11.8%	7.5%
	5	7	10	22		7	9	4	20
	9.4%	14.9%	29.4%	16.4%		13.2%	19.1%	11.8%	14.9%
	28	17	17	62		13	14	9	36
Sometimes	52.8%	36.2%	50.0%	46.3%	Fairly Severe	24.5%	29.8%	26.5%	26.9%
	17	10	0	27		24	12	9	45
Frequently	32.1%	21.3%	0.0%	20.1%	Severe	45.3%	25.5%	26.5%	33.6%
	2	7	0	9		8	7	8	23
Always	3.8%	14.9%	0.0%	6.7%	Very Severe	15.1%	14.9%	23.5%	17.2%
C/Labor3	Frequency of occurrence scale		Participants		Total	Degree of Severity	Participants		Total
	Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner	
Never	1	5	5	11	No effect	4	5	2	11
	1.9%	10.6%	14.7%	8.2%		7.5%	10.6%	5.9%	8.2%
	17	12	11	40		10	9	11	30
	32.1%	25.5%	32.4%	29.9%		18.9%	19.1%	32.4%	22.4%
	21	17	17	55		21	16	16	53
Sometimes	39.6%	36.2%	50.0%	41.0%	Fairly Severe	39.6%	34.0%	47.1%	39.6%
	10	10	1	21		10	10	5	25
Frequently	18.9%	21.3%	2.9%	15.7%	Severe	18.9%	21.3%	14.7%	18.7%
	4	3	0	7		8	7	0	15
Always	7.5%	6.4%	0.0%	5.2%	Very Severe	15.1%	14.9%	0.0%	11.2%
C/Labor4	Frequency of occurrence scale		Participants		Total	Degree of Severity	Participants		Total
	Contractor	Consultant	Client/Owner	Contractor			Consultant	Client/Owner	
Never	6	5	6	17	No effect	7	4	3	14
	11.3%	10.6%	17.6%	12.7%		13.2%	8.5%	8.8%	10.4%
	16	17	14	47		6	12	4	22
	30.2%	36.2%	41.2%	35.1%		11.3%	25.5%	11.8%	16.4%
	19	12	8	39		18	16	14	48
Sometimes	35.8%	25.5%	23.5%	29.1%	Fairly Severe	34.0%	34.0%	41.2%	35.8%
	10	11	6	27		17	8	8	33
Frequently	18.9%	23.4%	17.6%	20.1%	Severe	32.1%	17.0%	23.5%	24.6%
	2	2	0	4		5	7	5	17
Always	3.8%	4.3%	0.0%	3.0%	Very Severe	9.4%	14.9%	14.7%	12.7%

**Table C-5 : [Participants Respondents toward Project
Management Related Delay Factors]**

C/PN1 Frequency of occurrence scale	Contractor	Participants Consultant	Client/Owner	Total	Degree of Severity	Contractor	Participants Consultant	Client/Owner	Total
	1	3	2	6	No effect	0	0	0	0
	1.9%	6.4%	5.9%	4.5%		0.0%	0.0%	0.0%	0.0%
	4	9	5	18	Little effect	3	7	2	12
	7.5%	19.1%	14.7%	13.4%		5.7%	14.9%	5.9%	9.0%
	25	16	6	47	Fairly Severe	7	8	5	20
	47.2%	34.0%	17.6%	35.1%		13.2%	17.0%	14.7%	14.9%
C/PN2 Frequency of occurrence scale	15	12	14	41	Severe	23	15	16	54
	28.3%	25.5%	41.2%	30.6%		43.4%	31.9%	47.1%	40.3%
	8	7	7	22	Very Severe	20	17	11	48
	15.1%	14.9%	20.6%	16.4%		37.7%	36.2%	32.4%	35.8%
	Contractor	Participants Consultant	Client/Owner	Total	Degree of Severity	Contractor	Participants Consultant	Client/Owner	Total
	0	4	2	6	No effect	0	1	1	2
	0.0%	8.5%	5.9%	4.5%		0.0%	2.1%	2.9%	1.5%
C/PN3 Frequency of occurrence scale	11	7	8	26	Little effect	4	5	4	13
	20.8%	14.9%	23.5%	19.4%		7.5%	10.6%	11.8%	9.7%
	20	23	16	59	Fairly Severe	12	18	8	38
	37.7%	48.9%	47.1%	44.0%		22.6%	38.3%	23.5%	28.4%
	16	8	5	29	Severe	26	12	11	49
	30.2%	17.0%	14.7%	21.6%		49.1%	25.5%	32.4%	36.6%
	6	5	3	14	Very Severe	11	11	10	32
	11.3%	10.6%	8.8%	10.4%		20.8%	23.4%	29.4%	23.9%
C/PN4 Frequency of occurrence scale	Contractor	Participants Consultant	Client/Owner	Total	Degree of Severity	Contractor	Participants Consultant	Client/Owner	Total
	0	4	2	6	No effect	0	2	0	2
	0.0%	8.5%	5.9%	4.5%		0.0%	4.3%	0.0%	1.5%
	15	7	5	27	Little effect	7	6	6	19
	28.3%	14.9%	14.7%	20.1%		13.2%	12.8%	17.6%	14.2%
	16	17	19	52	Fairly Severe	8	8	13	29
	30.2%	36.2%	55.9%	38.8%		15.1%	17.0%	38.2%	21.6%
C/PN5 Frequency of occurrence scale	12	10	6	28	Severe	26	15	6	47
	22.6%	21.3%	17.6%	20.9%		49.1%	31.9%	17.6%	35.1%
	10	9	2	21	Very Severe	12	16	9	37
	18.9%	19.1%	5.9%	15.7%		22.6%	34.0%	26.5%	27.6%
	Contractor	Participants Consultant	Client/Owner	Total	Degree of Severity	Contractor	Participants Consultant	Client/Owner	Total
	1	2	3	6	No effect	2	0	1	3
	1.9%	4.3%	8.8%	4.5%		3.8%	0.0%	2.9%	2.2%
C/PN6 Frequency of occurrence scale	6	7	12	25	Little effect	6	3	4	13
	11.3%	14.9%	35.3%	18.7%		11.3%	6.4%	11.8%	9.7%
	21	17	13	51	Fairly Severe	10	15	5	30
	39.6%	36.2%	38.2%	38.1%		18.9%	31.9%	14.7%	22.4%
	18	14	4	36	Severe	16	11	13	40
	34.0%	29.8%	11.8%	26.9%		30.2%	23.4%	38.2%	29.9%
	7	7	2	16	Very Severe	19	18	11	48
	13.2%	14.9%	5.9%	11.9%		35.8%	38.3%	32.4%	35.8%
C/PN7 Frequency of occurrence scale	Contractor	Participants Consultant	Client/Owner	Total	Degree of Severity	Contractor	Participants Consultant	Client/Owner	Total
	2	1	2	5	No effect	2	0	0	2
	3.8%	2.1%	5.9%	3.7%		3.8%	0.0%	0.0%	1.5%
	13	5	5	23	Little effect	8	3	7	18
	24.5%	10.6%	14.7%	17.2%		15.1%	6.4%	20.6%	13.4%
	17	19	12	48	Fairly Severe	8	15	6	29
	32.1%	40.4%	35.3%	35.8%		15.1%	31.9%	17.6%	21.6%
C/PN8 Frequency of occurrence scale	17	16	11	44	Severe	27	11	10	48
	32.1%	34.0%	32.4%	32.8%		50.9%	23.4%	29.4%	35.8%
	4	6	4	14	Very Severe	8	18	11	37
	7.5%	12.8%	11.8%	10.4%		15.1%	38.3%	32.4%	27.6%

**Table C-6: [Participants Respondents of Consultant
Related Delay Factors]**

Cons1	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Client/Owner	Contractor	Participants		Client/Owner	Total
		2	4	3					3	0		
		3.8%	8.5%	8.8%					5.7%	0.0%		
		10	13	4					5	6		
		18.9%	27.7%	11.8%					9.4%	17.6%		
		27	17	16					10	8		
		50.9%	36.2%	47.1%					18.9%	23.4%		
		12	8	8					23	12		
		22.6%	17.0%	23.5%					43.4%	35.3%		
		2	5	3					12	8		
Cons2	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Client/Owner	Contractor	Participants		Client/Owner	Total
		1	2	0					1	3		
		1.9%	4.3%	0.0%					1.9%	4.3%		
		12	7	6					8	7		
		22.6%	14.9%	17.6%					15.1%	20.6%		
		21	23	20					15	16		
		39.6%	48.9%	58.8%					28.3%	34.0%		
		17	10	6					21	8		
		32.1%	21.3%	17.6%					39.6%	23.5%		
		2	5	2					8	9		
Cons3	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Client/Owner	Contractor	Participants		Client/Owner	Total
		1	2	1					2	0		
		1.9%	4.3%	2.9%					1.9%	4.3%		
		12	11	15					8	6		
		22.6%	23.4%	44.1%					20.8%	17.0%		
		27	17	9					12	5		
		50.9%	36.2%	26.5%					22.6%	31.9%		
		12	11	7					20	18		
		22.6%	23.4%	20.6%					37.7%	52.9%		
		1	6	2					8	5		
Cons4	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Client/Owner	Contractor	Participants		Client/Owner	Total
		0	1	4					0	2		
		0.0%	2.1%	11.8%					0.0%	5.9%		
		9	13	4					4	8		
		17.0%	27.7%	11.8%					7.5%	23.4%		
		16	13	10					18	4		
		30.2%	27.7%	29.4%					34.0%	11.8%		
		19	11	15					17	12		
		35.8%	23.4%	44.1%					32.1%	35.3%		
		9	9	1					14	8		

Cons5	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		1	1	4		0	0	1	
		1.9%	2.1%	11.8%		0.0%	0.0%	2.9%	
		9	15	10		7	12	8	
		17.0%	31.9%	29.4%		13.2%	25.5%	23.5%	
		14	13	5		12	11	2	
		26.4%	27.7%	14.7%		22.6%	23.4%	5.9%	
Cons6	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		21	7	9		18	10	10	
		39.6%	14.9%	26.5%		34.0%	21.3%	29.4%	
		8	11	6		16	14	13	
		15.1%	23.4%	17.6%		30.2%	29.8%	38.2%	
Cons7	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		3	3	2		3	1	1	
		5.7%	6.4%	5.9%		5.7%	2.1%	2.9%	
		12	13	14		9	11	9	
		22.6%	27.7%	41.2%		17.0%	23.4%	26.5%	
		24	15	10		13	17	4	
		45.3%	31.9%	29.4%		24.5%	36.2%	11.8%	
Cons8	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		4	3	4		7	2	2	
		7.5%	6.4%	11.8%		13.2%	4.3%	5.9%	
		13	16	17		6	8	8	
		24.5%	34.0%	50.0%		11.3%	17.0%	23.5%	
		18	19	7		5	17	4	
		34.0%	40.4%	20.6%		9.4%	36.2%	11.8%	
Cons8	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		18	6	5		23	10	11	
		34.0%	12.8%	14.7%		43.4%	21.3%	32.4%	
		0	3	1		12	10	9	
		0.0%	6.4%	2.9%		22.6%	21.3%	26.5%	
Cons8	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		1	2	1		3	0	0	
		1.9%	4.3%	2.9%		5.7%	0.0%	0.0%	
		11	14	16		8	10	6	
		20.8%	29.8%	47.1%		15.1%	21.3%	17.6%	
		23	20	11		13	16	4	
		43.4%	42.6%	32.4%		24.5%	34.0%	11.8%	
Cons8	Frequency of occurrence scale	Participants			Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner		Contractor	Consultant	Client/Owner	
		16	9	5		16	14	11	
		30.2%	19.1%	14.7%		30.2%	29.8%	32.4%	
		2	2	1		13	7	13	
		3.8%	4.3%	2.9%		24.5%	14.9%	38.2%	

**Table C-7 : [Participants Respondents of Client/Owner
Related Delay Factors]**

Own1	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Participants		Total
		2	Contractor	Consultant			Contractor	Consultant	
		3.8%	1	1			1	0	
		14	2.1%	2.9%			2.9%	0.0%	
		26.4%	11	6			6	7	
		14	23.4%	17.6%			17.6%	14.9%	
		26.4%	13	10			4	14	
		15	27.7%	29.4%			11.8%	29.8%	
		28.3%	13	11			14	11	
		8	27.7%	32.4%			41.2%	23.4%	
Own2	Frequency of occurrence scale	15.1%	9	6	Very Severe	23	Participants		29.9%
		30.2%	19.1%	17.6%			31.9%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
		30.2%	17.6%	17.6%			26.5%	15	
Own3	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Participants		Total
		1	Contractor	Consultant			Contractor	Consultant	
		1.9%	3	1			2	1	
		12	6.4%	2.9%			3.8%	2.1%	
		22.6%	11	4			5	5	
		8	23.4%	11.8%			10.6%	10.6%	
		15.1%	18	12			14.7%	10	
		38.3%	38.3%	35.3%			21.3%	21.3%	
		16	8	13			16	16	
		30.2%	17.0%	38.2%			34.0%	34.0%	
Own4	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Participants		Total
		2	Contractor	Consultant			Contractor	Consultant	
		3.8%	3	4			4	0	
		8	6.4%	11.8%			7.5%	0.0%	
		15.1%	10	9			3	4	
		28.3%	21.3%	26.5%			5.7%	8.5%	
		37.7%	12	11			10	18	
		8	25.5%	32.4%			18.9%	38.3%	
		15.1%	12	9			13	12	
		37.7%	25.5%	26.5%			24.5%	25.5%	
Own4	Frequency of occurrence scale	Contractor	Participants		Degree of Severity	Total	Participants		Total
		4	Contractor	Consultant			Contractor	Consultant	
		7.5%	5	2			3	1	
		9.4%	10.6%	5.9%			5.7%	2.1%	
		15	4	4			8	5	
		28.3%	8.5%	11.8%			15.1%	25.5%	
		37.7%	20	8			11	16	
		8	42.6%	23.5%			20.8%	34.0%	
		15.1%	12	17			14	6	
		37.7%	25.5%	50.0%			26.4%	12.8%	

Own5

Frequency of occurrence scale	Contractor		Participants		Degree of Severity	Total	Participants		Contractor	Participants		Total																										
	2	3.8%	13	24.5%			22	16		41.5%	12		22.6%	4	7.5%																							
																2	4.3%	11	23.4%	34.0%	8	17.0%	10	52.9%	0	21.3%												
																											3	8.8%	3	8.8%	29.4%	18	52.9%	0	0.0%			
																																				3	8.8%	3
Never	3	5.7%	6	11.3%	10	18.9%	20	37.7%	14	26.4%	3	5.7%																										
													0	0.0%	3	6.4%	11	23.4%	35.3%	29.4%	10	36.2%																
																							1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%								
																															1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%
Rare	3	5.7%	6	11.3%	10	18.9%	20	37.7%	14	26.4%	3	5.7%																										
													0	0.0%	3	6.4%	11	23.4%	35.3%	29.4%	10	36.2%																
																							1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%								
																															1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%
Sometimes	3	5.7%	6	11.3%	10	18.9%	20	37.7%	14	26.4%	3	5.7%																										
													0	0.0%	3	6.4%	11	23.4%	35.3%	29.4%	10	36.2%																
																							1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%								
																															1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%
Frequently	3	5.7%	6	11.3%	10	18.9%	20	37.7%	14	26.4%	3	5.7%																										
													0	0.0%	3	6.4%	11	23.4%	35.3%	29.4%	10	36.2%																
																							1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%								
																															1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%
Always	3	5.7%	6	11.3%	10	18.9%	20	37.7%	14	26.4%	3	5.7%																										
													0	0.0%	3	6.4%	11	23.4%	35.3%	29.4%	10	36.2%																
																							1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%								
																															1	2.9%	1	2.9%	35.3%	29.4%	10	36.2%

Own6

Frequency of occurrence scale	Contractor		Participants		Degree of Severity	Total	Participants		Contractor	Participants		Total																										
	0	0.0%	6	11.3%			23	16		43.4%	16		30.2%	8	15.1%																							
																2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%														
																									0	0.0%	8	23.5%	38.2%	11	32.4%	2	5.9%					
																																		0	0.0%	8	23.5%	38.2%
Never	0	0.0%	6	11.3%	23	16	43.4%	16	30.2%	8	15.1%																											
												2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%																		
																					1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%									
																														1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%
Rare	0	0.0%	6	11.3%	23	16	43.4%	16	30.2%	8	15.1%																											
												2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%																		
																					1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%									
																														1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%
Sometimes	0	0.0%	6	11.3%	23	16	43.4%	16	30.2%	8	15.1%																											
												2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%																		
																					1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%									
																														1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%
Frequently	0	0.0%	6	11.3%	23	16	43.4%	16	30.2%	8	15.1%																											
												2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%																		
																					1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%									
																														1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%
Always	0	0.0%	6	11.3%	23	16	43.4%	16	30.2%	8	15.1%																											
												2	4.3%	11	23.4%	34.0%	8	17.0%	10	21.3%																		
																					1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%									
																														1	2.1%	3	6.4%	29.8%	18	38.3%	11	23.4%

Own7

Frequency of occurrence scale	Contractor		Participants		Degree of Severity	Total	Participants		Contractor	Participants		Total																													
	4	7.5%	11	20.8%			18	22		34.0%	14		26.4%	6	11.3%																										
																3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																
																										1	2.9%	10	29.4%	12	35.3%	5	14.7%	6	17.6%						
																																				1	2.9%	10	29.4%	12	35.3%
Never	4	7.5%	11	20.8%	18	22	34.0%	14	26.4%	6	11.3%																														
												3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																				
																						0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16										
																																0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16
Rare	4	7.5%	11	20.8%	18	22	34.0%	14	26.4%	6	11.3%																														
												3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																				
																						0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16										
																																0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16
Sometimes	4	7.5%	11	20.8%	18	22	34.0%	14	26.4%	6	11.3%																														
												3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																				
																						0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16										
																																0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16
Frequently	4	7.5%	11	20.8%	18	22	34.0%	14	26.4%	6	11.3%																														
												3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																				
																						0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16										
																																0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16
Always	4	7.5%	11	20.8%	18	22	34.0%	14	26.4%	6	11.3%																														
												3	6.4%	11	23.4%	22	46.8%	7	14.9%	4	8.5%																				
																						0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16										
																																0	0.0%	8	29.4%	10	29.4%	10	20.6%	7	16

Own8

Frequency of occurrence scale	Contractor		Participants		Degree of Severity	Total	Participants		Contractor	Participants		Total																													
	8	15.1%	16	30.2%			12	14		22.6%	15		28.3%	2	3.8%																										
																7	14.9%	18	38.3%	14	29.8%	2	4.3%	6	12.8%																
																										2	5.9%	14	41.2%	7	20.6%	10	29.4%	1	2.9%						
																																				2	5.9%	14	41.2%	7	20.6%
Never	8	15.1%	16	30.2%	12	14	22.6%	15	28.3%	2	3.8%																														
												7	14.9%	18	38.3%	14	29.8%	2	4.3%	6	12.8%																				
																						5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%										
																																5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%
Rare	8	15.1%	16	30.2%	12	14	22.6%	15	28.3%	2	3.8%																														
												7	14.9%	18	38.3%	14	29.8%	2	4.3%	6	12.8%																				
																						5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%										
																																5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%
Sometimes	8	15.1%	16	30.2%	12	14	22.6%	15	28.3%	2	3.8%																														
												7	14.9%	18	38.3%	14	29.8%	2	4.3%	6	12.8%																				
																						5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%										
																																5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%
Frequently	8	15.1%	16	30.2%	12	14	22.6%	15	28.3%	2	3.8%																														
												7	14.9%	18	38.3%	14	29.8%	2	4.3%	6	12.8%																				
																						5	10.6%	3	6.4%	16	34.0%	13	30.2%	10	21.3%										
																																5	10.6%	3	6.4%	16	34.0%				

**Table C-8 : [Participants Respondents of Governmental
Related Delay Factors]**

Gov1	Frequency of occurrence scale	Participants			Total	Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner			Contractor	Consultant	Client/Owner	
Never		6	4	6	16	No effect	3	3	2	8
		11.3%	8.5%	17.6%	11.9%		5.7%	6.4%	5.9%	6.0%
		19	16	16	51		8	8	8	24
		35.8%	34.0%	47.1%	38.1%		15.1%	17.0%	23.5%	17.9%
Sometimes		18	18	8	44	Fairly Severe	12	18	6	36
		34.0%	38.3%	23.5%	32.8%		22.6%	38.3%	17.6%	26.9%
Frequently		6	6	3	15	Severe	21	12	10	43
		11.3%	12.8%	8.8%	11.2%		39.6%	25.5%	29.4%	32.1%
Always		4	3	1	8	Very Severe	9	6	8	23
		7.5%	6.4%	2.9%	6.0%		17.0%	12.8%	23.5%	17.2%
Gov2										
Gov2	Frequency of occurrence scale	Participants			Total	Degree of Severity	Participants			Total
		Contractor	Consultant	Client/Owner			Contractor	Consultant	Client/Owner	
Never		1	2	2	5	No effect	3	4	1	8
		1.9%	4.3%	5.9%	3.7%		5.7%	8.5%	2.9%	6.0%
Rare		20	13	11	44	Little effect	9	6	9	24
		37.7%	27.7%	32.4%	32.8%		17.0%	12.8%	26.5%	17.9%
Sometimes		11	12	14	37	Fairly Severe	11	15	8	34
		20.8%	25.5%	41.2%	27.6%		20.8%	31.9%	23.5%	25.4%
Frequently		15	10	5	30	Severe	17	13	10	40
		28.3%	21.3%	14.7%	22.4%		32.1%	27.7%	29.4%	29.9%
Always		6	10	2	18	Very Severe	13	9	6	28
		11.3%	21.3%	5.9%	13.4%		24.5%	19.1%	17.6%	20.9%

**Table C-9 : [Participants Respondents of External
Related Delay Factors]**

Ext 1	Frequency of occurrence scale	Contractor		Participants		Total	Degree of Severity	Participants		Total						
				Consultant	Client/Owner			Consultant	Client/Owner							
Never		7	13.2%	12	2	21	No effect	3	5.7%	6	12.8%	3	8.8%	12	9.0%	
				25.5%	5.9%	15.7%										
	Rare	29	54.7%	18	20	67		Little effect	22	41.5%	17	36.2%	15	44.1%	54	40.3%
					38.3%	58.8%			50.0%							
Sometimes		9	17.0%	11	9	29	Fairly Severe	14	26.4%	13	27.7%	7	20.6%	34	25.4%	
				23.4%	26.5%	21.6%										
	Frequently	8	15.1%	4	1	13		Severe	14	26.4%	7	14.9%	5	14.7%	26	19.4%
				8.5%	2.9%	9.7%										
Always		0	0.0%	2	2	4	Very Severe	0	0.0%	4	8.5%	4	11.8%	8	6.0%	
				4.3%	5.9%	3.0%										
	Ext 2															
Ext 1	Frequency of occurrence scale	Contractor		Participants		Total	Degree of Severity	Participants		Total						
				Consultant	Client/Owner			Consultant	Client/Owner							
Never		14	26.4%	13	7	34	No effect	9	17.0%	11	23.4%	6	17.6%	26	19.4%	
				27.7%	20.6%	25.4%										
	Rare	21	39.6%	15	13	49		Little effect	20	37.7%	15	31.9%	14	41.2%	49	36.6%
					31.9%	38.2%			36.6%							
Sometimes		7	13.2%	9	9	25	Fairly Severe	7	13.2%	11	23.4%	7	20.6%	25	18.7%	
				19.1%	26.5%	18.7%										
	Frequently	8	15.1%	5	2	15		Severe	16	30.2%	7	14.9%	6	17.6%	29	21.6%
				10.6%	5.9%	11.2%										
Always+A+A243		3	5.7%	5	3	11	Very Severe	1	1.9%	3	6.4%	1	2.9%	5	3.7%	
				10.6%	8.8%	8.2%										
	Ext 3															
Ext 1	Frequency of occurrence scale	Contractor		Participants		Total	Degree of Severity	Participants		Total						
				Consultant	Client/Owner			Consultant	Client/Owner							
Never		15	28.3%	9	16	40	No effect	8	15.1%	8	17.0%	12	35.3%	28	20.9%	
				19.1%	47.1%	29.9%										
	Rare	26	49.1%	25	7	58		Little effect	16	30.2%	15	31.9%	8	23.5%	39	29.1%
				53.2%	20.6%	43.3%										
Sometimes		5	9.4%	10	8	23	Fairly Severe	14	26.4%	10	21.3%	2	5.9%	26	19.4%	
				21.3%	23.5%	17.2%										
	Frequently	6	11.3%	2	1	9		Severe	12	22.6%	5	10.6%	7	20.6%	24	17.9%
				4.3%	2.9%	6.7%										
Always		1	1.9%	1	2	4	Very Severe	3	5.7%	9	19.1%	5	14.7%	17	12.7%	
				2.1%	5.9%	3.0%										

Ext 4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												</
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Appendix (D)
[Overall Relative Importance Index (R.I.I%)
Of Delay Factors]

Causes for delay	Code	Frequency Index%	Severity Index%	Relative Importance index (R.I.I)%	Rank
1- Continuous changes order by owner during construction	CLN	71.49%	78.51%	56.13%	1
2- Poor site management & Ineffective control system	C/PM	68.21%	80.60%	54.98%	2
3- Unrealistic cost estimation (underpriced) & cash flow	C/PM	69.25%	77.16%	53.43%	3
4- Lack of skilled manpower	C/MP	68.96%	76.12%	52.49%	4
5- Owner interference in construction operations	CLN	67.31%	75.52%	50.83%	5
6- Un-realistic contract duration	CLN	66.87%	75.97%	50.80%	6
7- Decision making sluggish by owner	CLN	66.87%	75.67%	50.60%	7
8- Poor communication skills between contractor PM & project parties	C/PM	64.63%	77.46%	50.06%	8
9- Claims between client & the main contractors	C/PM	67.61%	72.99%	49.35%	9
10- Inaccurate project planning & scheduling by contractor	C/PM	65.82%	74.93%	49.32%	10
11- Unrealistic cost estimation	CONS	66.12%	74.18%	49.05%	11
12- Late payment by owner (financial difficulties)	CLN	63.28%	76.42%	48.36%	12
13- Lack of contractor's PM experience	C/PM	64.63%	74.63%	48.23%	13
14- Imprecise time estimation	CONS	67.01%	71.79%	48.11%	14
15- Uncooperative owners	CLN	63.43%	75.67%	48.00%	15
16- Lack of owner experience in construction field	CLN	68.36%	70.15%	47.95%	16

17- Claims between contractor and subcontractor	C/PM	67.01%	71.04%	47.60%	17
18- Rectification Works due to poor PM role	C/PM	62.84%	74.33%	46.71%	18
19- Engaging the contractor in other critical projects at the same time	C/PM	64.48%	69.40%	44.75%	19
20- Lack knowledge of client's own requirements while designing the project	CLN	61.79%	72.24%	44.64%	20
21- Lateness in delivering materials & long lead items	C/M	61.79%	71.04%	43.90%	21
22- Delaying the approval of project documents	CONS	62.99%	69.55%	43.81%	22
23- Poor design and lack of coordinated drawings	CONS	60.45%	72.24%	43.67%	23
24- Ineffective quality control/Assurance system	C/PM	61.34%	70.90%	43.49%	24
25- Settling financial payments of contractor delayed by owner	CLN	59.85%	71.64%	42.88%	25
26- Prices fluctuation of materials	C/M	62.84%	67.76%	42.58%	26
27- Complexity of obtaining necessary construction building permits	GOV	61.79%	68.36%	42.24%	27
28- Quality of materials used	C/M	60.45%	69.70%	42.13%	28
29- Poor communication skills between consultant and project parties	CONS	58.66%	71.49%	41.94%	29
30- Discrepancies between drawings and specifications prepared by consultant	CONS	60.30%	68.66%	41.40%	30
31- Shortage of coordination between owner and other project parties	CLN	61.49%	66.72%	41.03%	31

32- Delayed mobilization of labor	C/MP	59.25%	67.61%	40.06%	32
33- Slow responses by the consultant towards required design changes/variatio	CONS	58.96%	67.01%	39.51%	33
34- Lack of materials availability in the local market	C/M	57.76%	67.61%	39.05%	34
35- Work suspension by owner	CLN	54.48%	71.64%	39.03%	35
36- Unqualified / inexperienced consultant's supervision staff	CONS	55.37%	69.25%	38.34%	36
37- Escalation of claims and disputes to court	EXT	49.40%	71.19%	35.17%	37
38- Governmental construction regulations changes	GOV	52.24%	67.31%	35.16%	38
39- Materials specifications changes	C/M	52.54%	64.93%	34.11%	39
40- Regulation of recruitments process	C/MP	55.97%	60.45%	33.83%	40
41- Absence and Sickness of Labours	C/MP	53.13%	62.54%	33.23%	41
42- Equipment shortages	C/E	51.94%	63.88%	33.18%	42
43- Old technological equipment	C/E	53.43%	54.48%	29.11%	43
44- Unforeseen conditions of the site (nature & location of the site)	EXT	50.00%	56.42%	28.21%	44
45- Equipment failure	C/E	49.25%	57.01%	28.08%	45
46- Inappropriate equipment used	C/E	48.96%	55.67%	27.26%	46
47- Inclement weather conditions	EXT	46.87%	54.63%	25.61%	47
48- Traffic flow	EXT	48.06%	50.75%	24.39%	48
49- Crisis & Political issues	EXT	41.79%	55.07%	23.01%	49
50- Accident occurs in construction site (LTI)	EXT	41.94%	54.48%	22.85%	50

الخلاصة

شهدت صناعة البناء والتشييد في البحرين نموًا ملحوظًا في الآونة الأخيرة. ومع ذلك، لا تزال مشكلة التأخير في إنجاز المشاريع تُشكل تحديًا كبيرًا، حيث تؤثر بشكل جوهري على مواعيد التسليم، التكاليف، ومعايير الجودة المقررة. لذا، فإن هذه الدراسة تسعى إلى تحليل العوامل المسببة للتأخير في مشاريع البناء في البحرين، وتركز بشكل خاص على القطاع الخاص.

استنادًا إلى تحليل شامل للأدبيات السابقة، تم تحديد خمسين (50) عاملاً يؤدي إلى تأخير المشاريع. اعتمد البحث على منهجية أخذ العينات غير العشوائي، حيث تم توزيع استبيانات على الأطراف الرئيسية في المشروع (المقاولون، الاستشاريون، العملاء/المالكون) لجمع آرائهم حول هذه العوامل. تم توزيع الاستبيانات عبر الإنترنت وكذلك عبر لقاءات مباشرة، وشمل حجم العينة $N = 5902$ ، بينما تم الحصول على 134 استجابة في المجمل.

تم تصنيف عوامل التأخير إلى ثماني فئات رئيسية: العوامل المرتبطة بالمواد، المعدات، القوى العاملة، إدارة المشاريع، الاستشاريين، العميل/المالك، العوامل الحكومية، والعوامل الخارجية. لتحليل هذه العوامل، تم استخدام منهجية "كروسكال واليس/مان ويتني" ومؤشر الأهمية النسبية (RII) لقياس تواتر وشدة العوامل المؤثرة في التأخير.

أظهرت النتائج أن العوامل الأكثر تأثيرًا في تأخير المشاريع هي: "التغييرات المستمرة في أوامر المالك"، "سوء إدارة الموقع ونظام التحكم غير الفعال"، "التقديرات غير الواقعية للتكاليف والتدفقات النقدية"، "نقص القوى العاملة الماهرة"، "تدخل المالك في عمليات البناء"، "فترات العقود غير الواقعية"، "بطء اتخاذ القرار من قبل المالك"، "ضعف التواصل بين مدير المشروع وأطراف المشروع"، "المطالبات بين العميل والمقاولين"، و"تخطيط غير دقيق للمشروع من قبل المقاول". وبالتالي، الدراسة تشير إلى أن المقاولين والمالكين هم الأطراف الأكثر مسؤولية عن تأخيرات البناء. بالرغم من أن هذه الدراسة أجريت في البحرين، إلا أن نتائجها قابلة للتطبيق على دول أخرى مع إمكانية إجراء المزيد من البحوث.

جامعة البحرين
كلية الهندسة
قسم الهندسة الميكانيكية



دراسة و تحليل عوامل التأخير و تأثيرها على مشاريع تشبيد المباني الخاصة في البحرين

أطروحة مقدمة كجزء من متطلبات الحصول على درجة الماجستير
في الإدارة الهندسية

إعداد

دلال عبد الرزاق السيد محمد الوداعي

الرقم الجامعي: 20163145

إشراف د. يوسف المالكي

أستاذ مساعد

جامعة البحرين

مملكة البحرين

سبتمبر، 2024