

University of Bahrain

College of Engineering



**Department of
Mechanical Engineering**

**An Investigation into The Delay Factors Affecting
Completion of Private Housing Projects in Bahrain**

**A thesis submitted in partial fulfilment of the requirements for the
Degree of Master of Science in Engineering Management**

Prepared by:

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5th March 2024

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Thesis Discussion Committee Decision

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The student awarded grade B+ In the thesis subject _____

☐ Without making any changes to the thesis

☒ After making the modifications attached with this decision

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بسم الله الرحمن الرحيم

Abstract

Bahrain's construction industry is one of the most significant sectors contributing to GDP. The construction of private housing projects contributes to this economy in a way that is no less important than the rest of the contributions in this sector. Due to various factors, delay in completing these projects is not an exception. The only way to prevent these delay causes is to identify the factors and their sources. The main objective of this study is to identify the main cause factors that result in the delay of the construction of private housing projects in Bahrain, to study the effects of the delay, and to propose methods that would help reduce the delay's impact. A review of the literature, two case studies, confirming the factors with eight experts in the field, and a questionnaire survey served as the basis for this study. The total population found was 604, This was followed by questionnaires distributed to a representative sample of 38 consultants, 54 contractors, and 82 clients. The data was collected from the project's main stakeholders, such as the client, the consultant, and the contractor. Fifty factors were identified as the causes of the project delays and categorized into seven major related groups. In addition, six significant effects of that delay were identified, and 20 methods to reduce the impact were proposed. SPSS was used to analyze and examine the collected data. According to the obtained results, the top ten causes of delays in the construction of private housing projects as per the participants' perspective were as follows: a shortage of labourers, changes in the project's scope, low budget and high expectations, wrong time estimation, labourers' low productivity, unskilled labourers, wrong cost estimation, inflation of the material's price, slow decision making and cash flow shortage. In addition, the impacts of the delays were cost overrun, abandonment, time overturn, dispute, litigation, and arbitration. The participants believed that selecting the right consultants and contractors who have sufficient expertise, ensuring an adequate and available source of finance, and assigning an expert person for the project are the most effective methods to reduce the impact of project delays and will reflect in a significant way on the time, cost, quality, and scope of the project if applied.

Dedications

To those who inspire me ...

My parents who raised me ...

My wife who encouraged me in this journey ...

My beloved family and friends who supported me ...

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First, I would like to express my deepest gratitude to my excellent guide, Assistant Professor Dr. Khaled Alshafiey, for his positive support throughout my research. I also want to extend my deep prayer for his well-being and family.

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List of Abbreviation

BNB	Bahrain News Agency
Benayat	Construction Permit System
CMEC	China Machinery & Engineering Corporation
CRPEP	The Council for Regulating the Practice of Engineering Professions
EOT	Estimated Overall Time
EDB	Economic Development Board - Bahrain
GDP	Gross Domestic Product
GVA	Gross Value Added
MUN	Ministry of Municipalities Affairs and Agriculture
Mofa	Ministry of Foreign Affairs
MOW	Ministry of Works
MOH	Ministry of Housing
SPSS	Statistical Package for the Social Sciences

Chapter 1: Introduction

1.1 Introduction

Any country's development depends mainly on the construction industry. The construction industry usually indicates the wellness or weakness of the country's economic growth. All the construction industry stakeholders aim to have a successful end of the project (within the time and the cost). Both positively and negatively, time and cost are the two key measures of project success as stated by (Johnson et al.,2020).

Generally, the construction process of housing projects can be categorized into two phases: the design phase and the construction or implementation phase.

(Jawad A. Alsulaiman ,2019) Resulted in the main delays in construction projects occurring in the implementation phase due to unexpected circumstances and other factors. Completing the project on time and within the budget is proof of efficient work, but the construction is subjected to various factors that affect the completion of the project.

Cost overruns are usually the most expected result of the delay. This will affect the main project's stakeholders (the client, the consultant, and the contractor), lead to the overrun of the company's budget, and cause a weakness in the relationship between the parties. Additionally, it will cause dissatisfaction of the project's stakeholders and, in some cases, litigation (Ahmed et al., 2002).

Housing projects play an influential role in the country's economic circle. (Anthony, 2023) stated that long considered a social need, initiatives to improve housing affordability may also be economically necessary. The mortgage crisis 2008 shows how housing projects can seriously influence the country's economy. So, the delay in constructing a housing project

will have the same result. (Sambasivan and Soon,2007) have stated that the delay's influence is not exclusively narrowed to construction only, but it exceeds the overall economy of countries. According to (Sameh et al.,2020), Disputes occur frequently in the construction industry, and disputes arise due to disagreements between the contract parties. Disputes devastate construction projects as they can lead to cost overruns, delays, and lost productivity. According to (Matseke et al.,2021), Disputes are a significant cause for delaying project progress since they are represented by complicated legal disagreements that require a significant amount of time and money.

1.2 Bahrain's Construction Industry

The construction sector significantly influences the development of Bahrain's economy. The Kingdom's population growth and economic diversification have aided the industry's rise during the past decade (+24% in sector GVA), which is backed by a boom in investment into infrastructure, manufacturing, and real estate. The sector is the fastest non-oil growing sector. (Mofa,2022).

With 24% of the private sector's workforce employed, the construction industry ranks fourth in Bahrain in employment, behind retail, trade, and manufacturing. With a GVA of 944.3 million BHD, the sector's contribution to the Kingdom's GDP in 2021 was 7.6%. (Bahrain EDB, 2021).

The demand for small housing units for low- and middle-income families has grown significantly in recent years. Over 60,000 Bahraini families are waiting for government-subsidized homes. The government is pursuing an ambitious plan to build 40,000 homes over the next ten years. Around 20,000 housing units are being built. East Hidd City, Diyyar Al Muharraq, Tubli Gardens, Argan, East Sitra, and the Naseej

project in Northern City are the biggest housing developments. MOH has recently started a social housing finance scheme to assist Bahraini citizens in buying homes. (MOH,2020)

Diyar al Muharraq, Dilmunia, and Durrat al Bahrain have seen significant new freehold real estate project launches in the private sector. In Diyar al Muharraq, work has begun on the 3,000-unit Deerat al Oyun project, among other things. The \$650 million Villamar project in the Bahrain Financial Harbour in the heart of Manama is also starting construction again. Government-funded initiatives have greatly influenced the energy, manufacturing, transportation, and construction businesses. (MOH,2020).

The residential construction sector was not confined only to the government side, well-off individuals also have a share in this vital sector, and according to the data of the MUN in Bahrain for the year 2021, nearly 1600 building permits were issued for the residential sector distributed in the governorates of the Kingdom. The engineering permits vary for the residential sector between building modifications and additions or even new construction. The private residential construction sector contributes approximately 100 million Bahraini dinars annually. It contributes to the employment and operation of many small and medium sectors in construction. (BNA,2022).

1.3 Research Problem Statement

MUN in Bahrain has approved new construction of housing project permits in 2022 with a total cost of over 100 million BHD (BNA, 2022). Construction acts as a sensor of the wellness of a country's economy by increasing or decreasing the activities of this industry. The construction of private housing projects plays an essential factor in the entire construction industry.

A delay in the construction of private housing not only affects the direct stakeholders of the project but also slows the economic cycle in the country and increases the losses of the country's resources. This is due to using the resources procured by the government with high expenses and the funders sponsoring the projects, like bank loans and the government's housing sponsorship. Delaying or suspending the private housing projects also influences the small business activity that is supplying the services to the stakeholders.

Delays lead to disputes between the stakeholders. These disputes sometimes reach litigation or arbitration if the parties disagree. As a result, the completion time and the cost of the project increase as well.

The government, the business industry, the clients, the contractors, the consultants, and the funders are all stakeholders affected by and facing the delay problem. Therefore, it is essential to clearly understand the critical factors leading to the project's delay in order to eliminate or mitigate their effects and take earlier action by improving their techniques.

Therefore, several delay factors will be identified and investigated in this research.

1.4 Research Questions

The findings of this research will be used to answer the following questions through the literature, the qualitative and quantitative questionnaires:

- 1- What are the contributing factors that cause the delay in constructing private housing projects?
- 2- What are the effects that can result from the construction projects' delays?

- 3- What are the recommendations that can be used to reduce the effects of the project's delay?

1.5 Research Objectives

This study aims to assist in understanding and identifying the key factors causing the delay in the completion of private housing projects in Bahrain by focusing on the projects' main stakeholders, the client, the contractor, and the consultant throughout the project's life period.

The objectives of the research are the following:

1. Investigate and identify the main delay factors affecting the completion of private housing projects in Bahrain by determining the most influential factors.
2. Identify the effect of construction delay on these projects.
3. Identify methods to reduce the impact of the delay factors.

1.6 Significance of the Study

The results of this study are expected to serve as a baseline for the private housing construction industry stakeholders in Bahrain, such as the government, consultants, contractors, clients, investors, and business industries. They will have a better understanding of the leading causes of delay factors that are affecting their construction industries.

The results from the study will provide the stakeholders with information to avoid delay and reduce the consequences' effects by knowing the main factors. This will increase the cost-effectiveness and timeliness of Bahrain's private housing construction industry stakeholders.

1.7 Literature Gap

Current research on delay factors in private housing projects lacks a specific focus on Bahrain's context. While there are studies on delay factors in construction projects generally out of Bahrain, there is a need for more research that specifically examines the challenges faced by private housing projects in Bahrain. Bridging this literature gap would provide valuable insights tailored to the local context, assisting stakeholders in reducing delays and improving the efficiency of private housing projects in Bahrain.

1.8 Research Framework

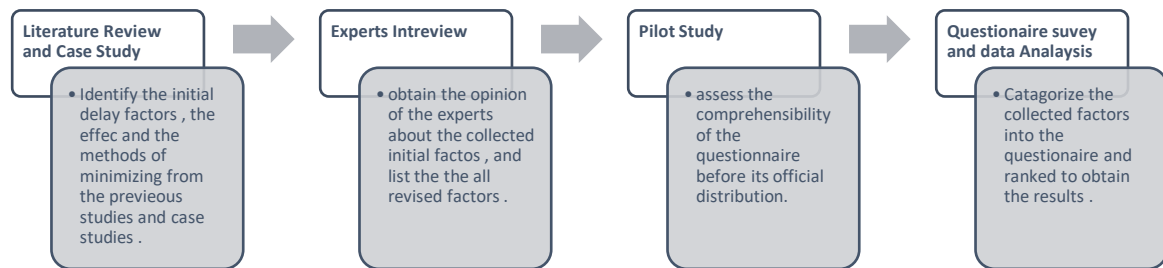


Figure 1: Research Framework

This research adhered to the procedures outlined in the studies conducted by Yang et al. (2009). The methodology employed in this study is founded upon the following principles as shown in Figure 1:

- 1. Literature review and case study:** Previous studies examined delay causes to identify the initial contributing factors, the effects, and the method of minimizing the delay in the construction of private housing projects in Bahrain. In addition, the lessons learned from the case studies for the causes of the delay.

2. **Expert interviews:** To confirm that the first contributing factors were accurate and should be included in the questionnaire survey, expert interviews were carried out to identify and gather expert opinions and interview results. The initial version of the survey questionnaire was created using this information.
3. **Pilot study:** A pilot study was conducted to assess the comprehensibility of the questionnaire before its official distribution. The feedback obtained from the pilot study helped refine and finalize the questionnaire.
4. **Questionnaire survey and data analysis:** The factors causing delays in the construction of private housing projects in Bahrain, effects, and method of minimizing were categorized and grouped based on the questionnaire survey results. These factors were then ranked to determine their significance.

More details regarding the research design, study population, sample selection, instrumentation, data collection procedures, and data analysis methods employed in the study are identified in Chapter 3.

1.9 Structure of the Study

Chapter 1: Introduction

This chapter includes the introduction, research question, research problem statement, research objective, and significance of the study.

Chapter 2: Literature Review

This chapter consists of a literature review highlighting the primary sources of collected data, an analysis of the factors contributing to construction delay, its effects, and the steps that may be taken to mitigate them.

Chapter 3: Research Methodology

Explains the research's methodology in conducting the research by conducting expert opinions, the data collected from the questionnaire, the techniques used for sampling, and the pilot study.

Chapter 4: Data Collection and Analysis

A discussion on the analysed data and the results found from the literature and surveys, by using the proper techniques for data analysis, to identify the factors of delay and their effects.

Chapter 5: Conclusion and Recommendation

A discussion of the findings from the research to prepare a conclusion, recommendations, and suggestions that will support future improvement and will be undertaken to avoid and mitigate the delay causes.

Chapter 2: LITERATURE REVIEW

2.1 Bahrain's Construction Industry

The construction sector significantly influences the development of Bahrain's economy. The Kingdom's population growth and economic diversification have aided the industry's rise during the past decade (+24% in sector GVA), which is backed by a boom in investment into infrastructure, manufacturing, and real estate. The sector is the fastest non-oil growing sector. (Mofa,2022).

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construction again. Government-funded initiatives have greatly influenced the energy, manufacturing, transportation, and construction businesses. (MOH,2020).

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2.2 Type of Delays

As per (Cambridge Dictionary, 2023), there are many definitions of delay: “to make something happen later than expected; to cause something to be performed later than planned; or not to act timely.” Each of these concepts can be used to explain a delay in a scheduled activity. Delays are common in construction projects and other projects where a schedule is utilized to organize work. What is delayed decides whether a project or another date, such as a milestone, will be finished late. Before discussing delay analysis, it is essential to understand the delay type.

(Assaf, S. A., & Al-Hejji, S. ,2006) In construction, a delay can be characterized as a period that exceeds the deadline for completion stated in a contract or the date that the parties decided to deliver the project. It is a project running behind schedule, a common issue in construction projects. Figure 2 shows a summary of the type of delay.

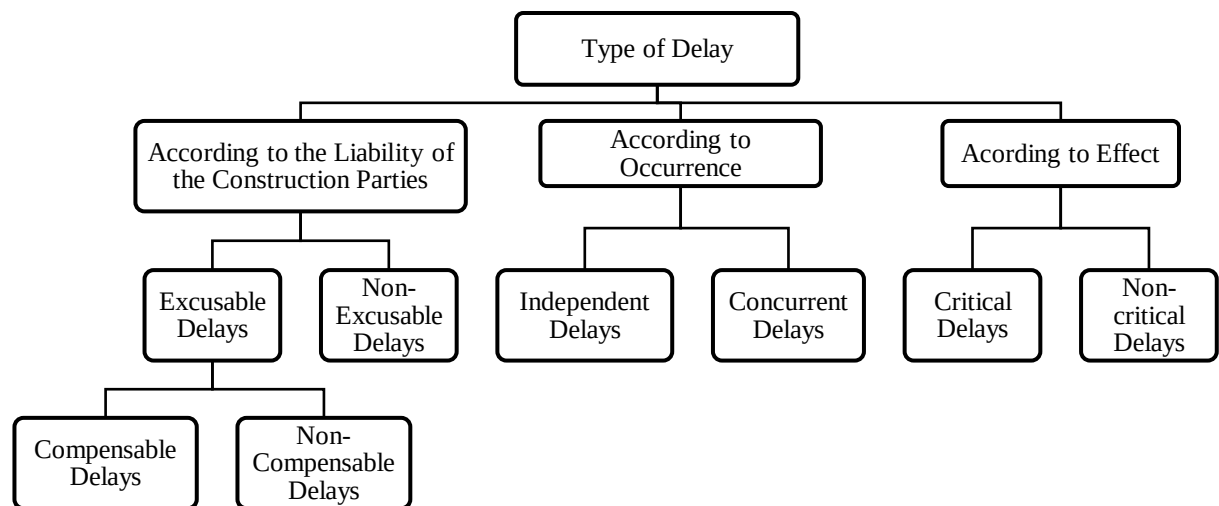


Figure 2 : Type of Delays (Manfinelli & etc., 2009)

The type of delay in the construction of housing projects can be classified as follows:

2.2.1 According to Construction Parties' Liability.

Two main categories can be classified into this type of delay. The first is the excusable, and the second is the non-excusable.

(N. A. Romzi and S. I. Doh 2,022) stated that A delay that can be excused typically results from an unforeseen circumstance beyond the contractor's control. These circumstances might be reasonably unforeseen, beyond the contractor's control, and not their fault or obligation.

It justifies extending time to perform and excuses a contractor from executing within the given contract period. This type of delay can influence a non-critical process. In general, whether delays are excusable is determined by contract stipulations. Acts of God, unforeseen weather, labourer conflicts, changes by the client, and other circumstances may cause excusable delays.

The essential issue to assess is whether the causes exceeded the

contractor's capacity to manage or anticipate. In other words, delays are often excusable when another party causes them but might have been avoided or caused by environmental conditions beyond anyone's control or foresight. Excusable delays are further divided into compensable and non-compensable categories.

Excusable Compensable Delays

Delays that make the contractor eligible for a time extension or additional pay are known as compensable delays. Excusable delays may be compensable in contrast to non-excusable ones (Funke et al.,2020). A compensable delay typically results in a timetable extension, exposing the owner to financial damages claimed by the contractor. According to (Shabbar et al.,2017), some common construction contracts include compensable delays for things like delayed drawing issuance, varying site circumstances, job variations, and delayed site possession.

Excusable non-Compensable Delays

Events or persons outside the contractor's and the client's control bring on excusable non-compensable delays. (Deepa Joy & Sreechithra P,2018) stated that those result from unforeseeable events that are out of the contractor's reasonable control and cannot be linked to the contractor's carelessness or negligence. In this case, the contractor is entitled to an extension of time without having to pay compensation for the costs related to the damage. According to (Jonbi et al.,2020), excusable non-compensable delays are those caused by activities that are beyond the control/responsibility of both the contractor and the owner, For example, Weather conditions, worker strikes, and demonstrations; in this case, the contractor only receives additional time from the owner. Under these circumstances, the contractor may indefinitely extend the estimated overall time (EOT) to liquidate losses.

2.2.2 According to Occurrence

Independent and concurrent delays are two types of delays that can be categorized based on their occurrence: independent and concurrent delays.

Independent Delays

An independent delay is brought on by factors connected to another delay or one of the contractual parties, such as the contractor or the owner. Delays made by the owner due to delays produced by the contractor owing to poor project management are typical examples of independent delays. A construction project stakeholder brings on an independent delay, whether the client or a contractor caused the delay, and whether it may be excused. (Alenezi, T. A. N. , 2020).

Concurrent Delays

It happens when a delay is followed by another, requiring more time and money to complete the project. Usually, either of the contract's sides is to blame for this. (Alenezi, T. A. N. , 2020).

A concurrent delay is a combination of multi-complex situations that happen simultaneously, where all these situations would cost the contractor a claim for an extension of time or losses. A concurrent delay has two or more independent sources of delays that happen simultaneously and have resulted from various causes. The causes of the delays can be classified as excusable and non-excusable, compensable and non-compensable.

2.2.3 According to Effect

Some delays in a specific activity may cause a delay in the overall project's completion, but on the other hand, some delays do not affect the

project's completion. Accordingly, the delay effects can be categorized into two main categories based on the effect on the schedule of the project to critical delays and non-critical delays:

Critical Delays

Delays that lead to an extended submission of the project on time are known as critical delays. (Callahan et al, 1992). Once the delays are an excusable delay type, the contractor has the right to extend the time required to finish the project. For example, the client added one more floor with a ground floor extension. This kind of modification is an example of critical delays that lead to a delay in the overall submission of the project.

Non-critical Delays

Non-critical delays are incurred off the critical path that does not delay ultimate project performance (Leon, 1987). Some excusable delays do not affect the overall time required to submit the project. Changing the type of ceiling lights before starting the fixing activity is an example of no-critical delays. Although the non-critical delays do not affect the completion of the project, they may cause additional costs to the contractor and may ask for a positive variation of cost.

2.3 Success Factors of Construction Projects

The triangle of success for construction projects is cost, time, and quality. According to (Abdul-Rahman et al.,2006), successful management that pays special attention to cost, time, and quality must be administered to ensure a successful project.

1- Cost

One of the most critical scopes for any commercial company is to gain a financial profit by maximizing the profits and minimizing the

costs. It is more important to the managers that the profits earned at the end of the project are equal to or more than the estimated profits at the bidding time. According to (Emmanuel et al.,2019), the reasons for cash flow issues during building projects are inadequate budgetary control, payment delays, and trouble receiving financial aid.

These problems add up to project delays, decreased profit margins, and in the worst cases, project abandonment.

2- Time

The time required to complete a project varies with different types and sizes of construction projects. According to (Aftab et al.,2012), The basic requirements for any project's success are its performance in terms of time and money. The study findings show that only 8% of construction projects were completed on time, and 92% ran over budget. The time required to complete the project should be considered along with the quality and cost, where good quality and lower profits cannot be achieved within a shortened completion time.

3- Quality

The engineers define the quality of construction projects by conforming to specifications and standards. A query like "Does the product satisfy the specified specifications?" is essential to properly assessing quality. Furthermore, "Does the product meet the specified requirements?" According to (H. et al.,2015). Cost, timing, and quality balance are constant expectations for construction projects. Both high quality and low cost can be achieved, but at a loss of time; alternatively, good quality and a quick project can be achieved at a cost. Although a project must be successful, high quality is not usually the client's top priority. The contractor does not exclusively carry the quality but is also carried by the consultant and the client management team as well.

2.4 Identification of Delay Factors

As summarized in the conclusions and findings from the literature review, all potential causes of construction delay that could be faced during construction projects are described in depth. These factors can be categorized into the following main categories. Figure 3:

- Client factors.
- Consultant factors.
- Contractor factors.
- Materials factors.
- Equipment factors.
- Labourer factors.
- External factors.

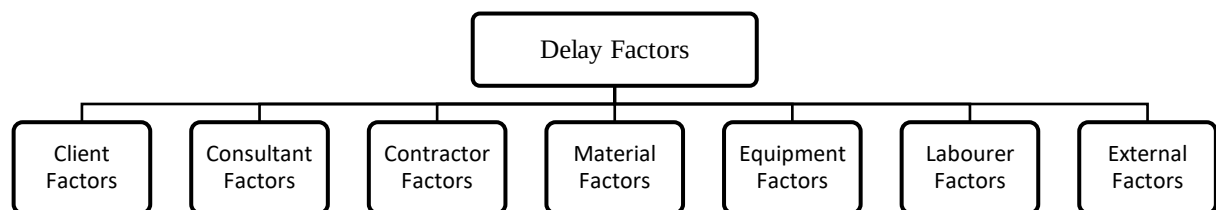


Figure 3 Identification of Delay Factors (Manfinelli & etc., 2009)

2.4.1 Client Factors

The client's duties are challenging, so the clients may need advice from various experienced parties throughout the project's lifecycle. The client loses money when they fail to use the unit at the appointed time. He also has the additional issue of growing interest in nonperforming capital if the funding came from a bank loan. (Ojoko, & etcs,2016).

Some clients establish an internal team for construction management. However, the clients often employed a project management team to support overseas project activity. An essential responsibility of the client is to identify the project's duration, which they usually prefer

the shortest duration. The experts should conduct a technical study throughout the planning phase to decide how long the project needs to be completed.

Delay in submission of the site's location to the contractor, delay of payment as agreed to the contractor, poor communication and cooperation with the main contractor, slow decision making, and repeated suspensions of the project's activities are some of the delaying factors that result from the project's client.

2.4.2 Consultant Factors

The client engages with the consultants to help plan a project. Their primary duties are project management and design. Architectural, structural, electrical, and mechanical consultancy is what they do. These designers create technical paperwork, financial proposals, and details.

In some circumstances, it is recognized that consultants handle planning, quality control, cost management, and activity assessment. Project operations, including drawing creation, testing, and design check and approval, are examples of consultant-related delays. Other causes of delays are inexperienced staff, poor client communication, and the need for operations coordination.

Some delays frequently happen during the project's stages due to weak consultants, including holding up the proposed drawings, approving contractor submissions, and accepting weak design drawings. It is also important to note that similar problems might arise from the consultants' employees due to their limited experience or lack of qualifications.

(Umar, Tariq,2018) stated that the contractor is required to wait until the consultant has finished the inspection before beginning the other activities and that it is necessary to call the consulting staff numerous

times because this sometimes takes longer than usual. It is the same issue during laboratory testing and approval. When a mistake is found, consultants may ask that the work be repeated in some circumstances, even if the contractor may have a better alternative.

Among the factors described by the consultants due to the delay were the consultants' qualifications needing to be better assigned, the late preparation of drawings, the slow approval of the contractor's drawings, poor communication between consultants and other project stakeholders, and inadequate design information. As a result, it is recommended that the consultants meet with the contractors before the construction starts. At the same time, the consultant must take all measures to ensure they can quickly respond to questions from contractors while the construction is in progress.

2.4.5 Contractor Factors

The contractor heavily influences the success of the construction project. As a result, whether directly or indirectly, the contractor is involved in practically all delay reasons. If the job is completed within the planned duration, the client will likely praise the contractor, and in some situations, awards are given. However, when a contract is not completed as planned, there is blame, the budget is strained, and claims are asked in extreme circumstances (such as carelessness).

It takes significant efforts to ensure that the complicated and demanding contracting field is completed on time. Although other parties engaged in the project (such as subcontractors) are essential, If there are multiple subcontractors, it is the main contractor's duty to coordinate with them and ensure that their performance causes no holdups or delays. (Abdullah Rasheed Alhajri and Adel Alshibani,2018).

A contractor's managerial skills and the availability of resources

determine the possibility that the project will be completed within the predetermined project period (e.g., money, materials, equipment, and manpower). The contractor has the option of hiring workers directly or through a subcontractor. Effective selection and monitoring of subcontractors reduces the problem and determines the performance of construction companies. Hire construction subcontractors. Construction projects require a relationship with the main contractor, which will impact the project's success. (Elias Defalgn Debelo, Zerihun Berhane Weldegebriel , 2022).

2.4.5 Material Factors

Based on the literature review, it was found that materials with various uses play a lead factor in the project's delay. The cause of delay due to material is not limited in availability, but it may also be due to its changeable prices and quality.

(Nehal Elshaboury, Hassan Alaa and etcs,2021) identified the main reasons for the materials: ' Late delivery of material and shortage of materials. '

2.4.5 Equipment Factors

Equipment may be categorized as either a hauler or an operator depending on whether it is employed to carry out repeated operations and activities throughout the construction phases of a project. Transporters like trucks and other equipment, such as skips, are included in the category of hauliers since they are utilized for various tasks on the property. Operators like cranes and graders are only permitted on the construction site and inside its bounds.

The primary factor to consider when deciding whether to lease or buy this equipment for the project is its frequency of usage (Kikwasi,

2012). Therefore, some of the contractor's duties are obtaining these essential equipment, managing their upkeep, and guarding them against theft and destruction. Equipment-related delays could be from improper equipment use, equipment breakdown, high equipment cost, and slow mobilization of equipment.

2.4.7 Labourer Factors

When it comes to construction projects, the labourer is a crucial factor. Teams of managers, engineers, technicians, and other professionals make up the workforce. The success of the project depends on every group within the workforce. Labourers can be classified into three skill levels: skilled, intermediate, and unskilled.

The issue of labourer productivity concerns both the construction industry and academia because it affects the project's time, cost, and quality (Kiyanoosh et al., 2018).

Most construction workers in Bahrain are foreigners. Effective communication in the construction industry is an essential skill for project success. However, ensuring effective communication is always tricky because the field is fragmented, dynamic, and composed of many parties (customers, consultants, contractors, and authorities), leading to poor communication (Ismail et al.,2019). An unskilled labourer, absenteeism, and low productivity are a few workforce-related concerns that might cause a deadline to be missed. As a result, it is critical to start planning the project as soon as possible. Establishing control mechanisms is also vital to ensure employees function as planned and carry out the required activities as the project progresses.

2.4.7 External Factors

These factors in this section are beyond the client's, contractor's, etc. control. For instance, the site's temperature could not be appropriate for operations to start any day, which would impede the project's development (Ameh & Osegbo, 2011). According to (Ahmed Senouci and others, 2018), Qatar's construction projects often encounter significant delays. One of the leading causes of this delay is the lack of understanding of Qatar's harsh weather conditions on labour productivity. The project's total cost will rise because of the change in the initial construction timetable, which could impact how quickly the project's phases are finished and how sustainability is implemented.

As was already said, changes in material prices significantly influence the various stages of construction. Unexpected weather conditions, rising material costs, adverse traffic conditions, and site access limitations are additional external issues that can affect a project.

An overview of earlier research on construction delays in various countries and the feedback can be found in Table 1.

The literature cannot agree on the elements that influence construction delay. This is due, in part, to the fact that researchers have approached the topic from a variety of angles. Diverse opinions on what might be considered a primary source of delay in building projects characterize even the most recent studies on construction delays. This study aims to benefit from the different delay factors and present them to the main stakeholders of the private housing projects industry (The client, the contractor, and the consultant).

Table 1 A Comparative analysis for major top three causes of delay factors across different countries

Country	Researchers	Top Three Factors
Saudi Arabia	(Assaf SA, Al-Khalil M, Al-Hazmi M. ,1995)	- Slow preparation and approval of shop drawings - Delays in payments to contractors - Changes in design/design error
Kuwait	(Koushki PA, Al-Rashid K, Kartam N.,2005)	- Changing orders - Owners' financial constraints - Owners' lack of experience in the construction business
Egypt	(Abd El-Razek,M.E; Bassioni, H.A; Mobarak, M.A ,2008)	- Financing by contractor during construction - Delay in contractor payment by the owner - Uncooperative owners
Nigeria	(Aibinu, A. A., & Odeyinka, H. A. ,2006)	- Contractors' Financial Difficulties - Clients' cash flow problem - Architects' incomplete drawing
Ghana	(Frimpong, Oluwoye, J., & Crawford, L.,2003)	- Monthly payment difficulties - Poor contractor management - Material procurement
Algeria	(ZEMRA, R.,2021)	- Delay in payment of performed work - Shortage of skilled workers - Bureaucracy in public administrations
Tanzania	(Kikwasi, G.,2012)	- Design changes - Delays in payment to contractors - Information delays
Turkey	(Kazaz, A., Ulubeyli, S., &Tuncbilekli,2012)	- design and material changes - delay of payments - cash flow problems

2.5 Effects and Methods of Minimizing Delays

2.5.1 Introduction

One of the main criteria for the construction project's success is to complete the project on planned time. Project delays can result in cost overruns and late completions by increasing the time and cost allotted for the various project operations. Time delays and cost overruns can occur at any stage of a project. However, the most significant causes frequently arise during the construction stage.

The effect will be felt only when the program's critical path is

delayed. The results from the literature review continue in this chapter. It concentrates on analyzing the effects of delays that earlier researchers have found. Additionally, it thoroughly investigated the methods for reducing delays that several researchers had suggested.

2.5.2 Effects of the Delay in the Construction of Private Housing Projects

There are always issues with the completion of construction projects. When a project is behind schedule, it either accelerates or extends the time duration of the completion of a project.

Cost overruns are usually a natural result of the delay, as per the researchers' investigation results.

Additional costs and low quality of the work and rework are the results found by (Li et al.,2000). (Aibinu and Jagboro ,2001) found that delays in construction projects led to the abandonment of a project. It was discovered by (Abdul-Rahman H. et al.,2006) that the delay affects the termination of contracts, disputes, and time and cost overrun.

Although the contract's parties agree on the project duration and the additional cost as a penalty, the delay generates tension and distrust between the client and the contractor (Aibinu,2009). This tension in the environment and the relationship between all parties reduces the ability to create a confident relationship and leads to arbitration and problems in cash flow. (Ahmed, et al., 2002).

In a summary by the researchers for the most repeated effects of the delay of the construction of housing projects, it was found that the delay affects the following. Figure 4:

- 1- Time overturn
- 2- Cost overrun
- 3- Dispute

- 4- Arbitration
- 5- Litigation
- 6- Abandonment

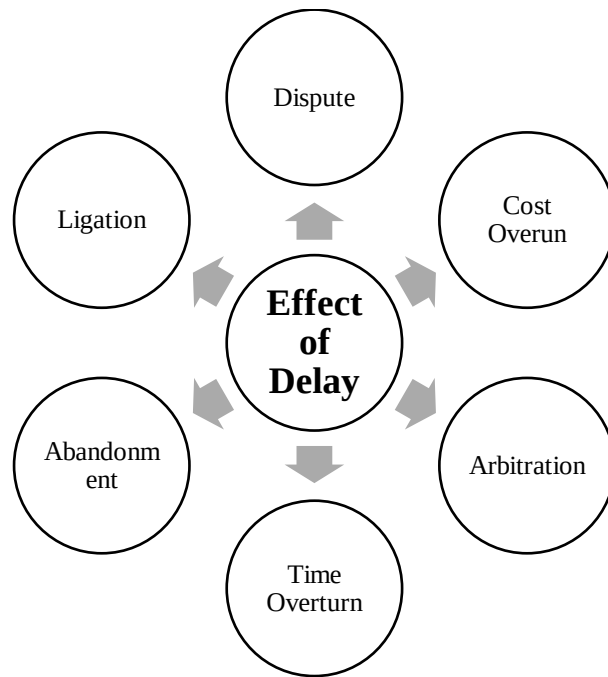


Figure 4 Effects of the Delay in the Construction of Private Housing Projects

2.5.3 Methods to Minimize the Delay in Construction of Housing Projects.

Delays can only be minimized if the cause is identified. Knowing the causes of specific delays in construction projects can help you avoid delays. (T. Sathish Kumar, K. Ajith Kumar, etc.,2022)

Many techniques are used to minimize the delay of construction projects, as suggested by (Abdul-Rahman H. et al.,2006). They proposed that the contractor work overtime to increase productivity. They suggested outsourcing laborers and subcontractors if the problem is the resource shortage. In addition, they agreed on the importance of regular site meetings to solve all the conditions they might face.

(Chan and Kumarasamy,1997) Improving the communication between the team would contribute to reducing the delay. In addition, the availability of solid management will reduce the time overrun.

Sixteen methods in total have been identified to minimize construction delays from the literature review and the feedback from the structured interview, as listed below, based on different studies of project success factors.

1. Assign delayed activities to the subcontractors.
2. Ensure the availability of resources along the project.
3. Assign overtime for more productivity.
4. Assign an expert for the project.
5. Component project manager.
6. Realistic activity planning.
7. Accurate initial time estimate.
8. Comprehensive contract documentation.
9. Proper communication between the stakeholders parties.
10. Proper material procurement.
11. Ensure adequate and available source of finance.
12. Periodic progress meeting.
13. Site management and supervision.
14. Proper planning of the project.
15. Accurate cost estimation.
16. Select the right expert/consultant and contractor.

Chapter 3: RESEARCH METHODOLOGY

3.1 Introduction

This study was carried out to identify the main factors causing the delay in completing private housing projects in Bahrain. The objective was to gather comprehensive data on the causes, the effects, and the methods to mitigate project delays. Review the literature using a quantitative method through a questionnaire survey and a qualitative method by asking experts. These methods are tools to achieve the target by discussing the results, recommendations, and conclusions.

3.2 Research Design

Given the previous recognition of the research problem and the restriction of access to government authorities, the most appropriate approach for this study is "Descriptive Research". Descriptive studies frequently serve as the initial exploratory steps into novel realms of scientific inquiry as stated by (Grimes, D. A . et al.,2002). This approach will allow the researcher to investigate the delays in the construction of private housing projects in Bahrain.

The initial phase involves identifying the factors that contribute factors to enhance the primary objective of this research. The second phase is to confirm the collected data by the experts and the stakeholders of the research. The third phase is to identify the survey population and select the sample size for the survey population. After that, the instruments are to be used based on the identified population and distribution of the survey as per the minimum sample size. Then, to examine the comprehensibility and feasibility of the study, a pilot study is to be applied. Last, is to conduct the survey after ensuring the suitability of the survey and extracting the results and conclusion from

the collected data. A summary of the research design methodology can be summarized in Figure No.5.

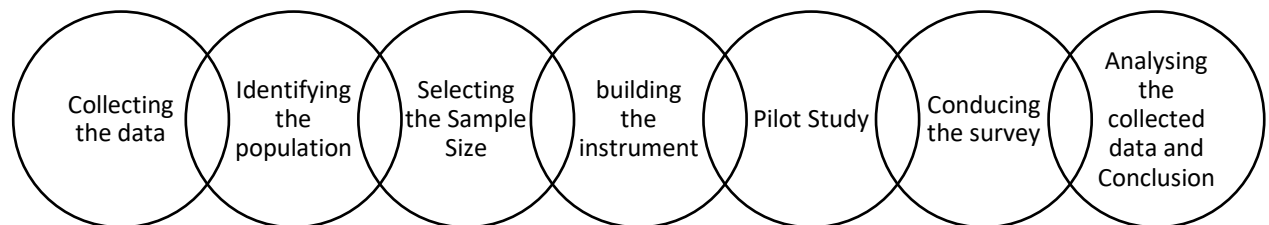


Figure 5 Research Design Methodology

3.3 Data Collection

3.3.1 Literature Review

A literature review was used to gather all the data related to the causes of the delay. The purpose of the literature review was to improve the comprehension of the theory behind the research's topics.

Books, articles, published papers, journals, documents, and other people's research papers were some of the sources for the literature review.

These readings served as a reliable primary source for the study. The pertinent information was compared to primary data gathered to support the research as a benchmark.

3.3.2 Expert Interview

Asking experts through interviews is a technique used to confirm the collected list of the causes of delay, which will be more adequate for constructing private housing projects in Bahrain.

Six structured interviews with specialists were undertaken to

evaluate the list of delay causes and any additional suggested factors. Real-world experience and reliable research methodologies must be balanced. The scientific method, however, offers the framework for determining if the program is operating efficiently and according to plan. The scientific method can help distinguish between a program's potential effectiveness and its potential underperformance. (Ahlin,2019). Accordingly, two extra interviews that corroborated the findings of the previous five interviews and demonstrated saturation were used to achieve this. A diverse sample was collected, including expert clients, contractors, and consultants with at least ten years of knowledge and experience in housing construction and management, as shown in Table 2.

Table 2 Interview with Experts Sample

No.	Field of Experience	Years of Experience	Position
1	Client	More than 15 Years	Housing Projects Developer
2	Client	More than 20 Years	Housing Projects Developer
3	Consultant	More than 10 Years	Senior Engineer
4	Consultant	More than 10 Years	Senior Civil Engineer
5	Consultant	More than 20 Years	Project Manager
6	Contractor	More than 10 Years	Quality Manager
7	Contractor	More than 10 Years	Project Manager
8	Contractor	More than 15 Years	Senior Civil Engineer

The structure of the interviews was designed to show the main factors causing delays in the construction of private housing projects in Bahrain, the impacts of that delay, and the proposed solutions to reduce the effects of the delay. It has been derivative of four main questions adapted from (Shahsavand et al.,2018) related to the factors found in the literature review, which were:

- From your experience, do you think these are the main factors

that cause the delay in constructing private housing projects in Bahrain?

- Do you think that these are the effects of the delay?
- Do you think these are suitable solutions to reduce the delay in constructing private housing projects in Bahrain?
- Would you like to add any further causes, effects, or proposals?

All the experts agreed that these delay factors identified in the literature review were applicable in Bahrain. Some of them added new factors that caused delays and proposed new methods to reduce the impact of the delay, as shown in Table 3 and Table 4.

Table 3 Additional Delay Factors Proposed by the Experts

	Delay Related to	No.	The delay factor
1	The Contractor	1	Improper construction method
		2	Over projects capacity
2	The Client	1	Low budget and high expectations
		2	Dispute with other stakeholders
3	The Consultant	1	Conflict of interest
4	The Labors	1	Language barriers
5	The External Factors	1	Delays in utility connections

Table 4 Additional Methods to Reduce the Delay Impact Proposed by the Experts

No	Proposed Methods to Reduce Delay
1	Avoid bureaucracy.
2	Ask for an extension of time.
3	Do not award the contract based on the cheapest price.
4	Obtain the permits from the authority at an early stage.

The experts commented on the effects of the delay: These results have more effects in large-scale projects, like arbitration and dispute, but should be addressed in small-scale projects like housing projects.

Some experts shared a valuable comment regarding the recommendations for future studies. For example, study the financial

impact of the delay in constructing private housing projects in Bahrain to measure the impact on the stakeholders' decisions.

After consulting these experts and benefiting from the lessons learned from the two cases in the Appendix to match the different factors and obtain their opinions, the factors were determined as outlined in the questionnaire specific to this research.

3.4 Population and Sample Size

3.4.1 Population

To count the population for the study, it focused on the stakeholders (Clients, Contractors, Consultants) of private housing projects in Bahrain to achieve the purpose of this study.

The population at this research stage included qualified contractors listed under the Ministry of Works in Bahrain (MOW,2023) Who can work on the construction of small projects, like private villas, and stay within the maximum cost cap of 500,000 BHD in 2023. However, the research population in Bahrain were consultants registered at CRPEP and working in both architectural and civil engineering supervision in the year 2023. Clients included all the new residential villa permits exported through the Benayat system in 2022 (BNA,2022).

The following targeted populations are the findings from the literature review; the populations of the study were categorized into three groups as follows:

1. The Clients:

Whether private organizations or people, clients are the main decision-makers in the initiatives (Frimpong et al., 2003). According to the (BNA,2022), approximately 1,600 engineering building permits

were issued in 2022. The construction permits varied in terms of purpose, as shown in the following Table 5:

Table 5 Total Construction Permits in 2022 as per Benayat system

Total Construction Permits in 2022	1565 Permits
Number of new housing permits	428 Permits
Number of additions, modifications, fencing, and maintenance permits for housing projects	447 Permits
Number of investment permits	378 Permits
Other construction permits	312 Permits

The new permits for housing construction represented the size of the client's population, which equals 428 Permits.

2. The Contractors

The MOW 2023 has listed a total of 200 qualified building contractors. These contractors are eligible to work in the construction of building projects according to their abilities and capacity, as shown below in Table 6 (MOW,2023) :

Table 6 List of Valid Prequalified Contractors By MOW

Prequalified Contractors list		
Company Category	Total number	Project Size
Construction Projects - GRADE A	28	Up to BHD 6,000,000
Construction Projects - GRADE AA	51	Over BHD 6,000,000
Construction Projects - GRADE B	31	Up to BHD 2,000,000
Construction Projects - GRADE C	17	Up to BHD 1,000,000
Construction Projects - GRADE D	40	Up to BHD 500,000
Construction Projects - GRADE E	37	Up to BHD 200,000
Construction Projects - GRADE F	40	Up to BHD 100,000

As per the research goal, the contractors of grades A, AA, B, and C were excluded from the target population since the size of the companies is much bigger than the cost of private housing projects. Accordingly, the population size of the research for the contractors was 117 contractors.

3. The Consultants

As per (CRPEP 2023), 111 consultant offices are working in Bahrain, and they have permits to practice engineering consultancy. The table below shows the details of the consultant's category and their professions as shown in Table 7.

Table 7 List of Valid Numbers of Engineering Consultants By CRPEP

Company Category	Practice Field Permit		
	Architecture only	Architecture & Civil Engineering	Others Field
Construction Projects - Category A	4	23	11
Construction Projects - Category B	9	23	11
Construction Projects - Category C	9	13	0
Construction Projects - Category D	0	0	3
Construction Projects - Category E	0	0	2
Construction Projects - Category K	1	0	2
Total	23	59	29

As shown in the table, 59 consultant offices have a permit to practice consultancy in both architectural and civil engineering, representing the total population of the consultants. Meanwhile, the other

consultants are excluded due to needing to be fit for the research requirements.

3.4.2 The Representative's Sample

Finding a selection that represents the population was the aim of the sampling. Finding the 'representative' of the given population was essential to sum up the findings to achieve the research goal.

The sample is generally a small portion of the target population and is randomly chosen (Groves et al., 2009). (Baker,1997) found that a minimum of 20 samples can give a reliable picture and a reflection of the targeted population.

(Singh, et al., 2014) proposed various approaches for determining the sample size, which are outlined below:

- 1- Using a census for small populations
- 2- Using a sample size of a similar study
- 3- Using published tables
- 4- Using formulas to calculate a sample size

For this study, a strategy involving the use of a formula was employed to calculate the appropriate sample size.

To calculate the minimum sample size, the formula that (Kisg,1965) presented is considered.

The minimum sample size equals:

$$n = \frac{n'}{(1+\frac{n'}{N})} \rightarrow \text{Eq.1}$$

$$n' = \frac{S^2}{(V^2)} \rightarrow \text{Eq.2}$$

$$S^2 = (P)(1-P) \rightarrow \text{Eq.3}$$

Where,

n = Sample size for the finite population

N = Total population

n' = Sample size

V = acceptable margin of error (Considered as 5%)

S = Maximum standard deviation

P = portion of population elements (maximum possible portion considered as 0.5)

Accordingly, the sample size of the main stakeholders of the delay can be found in the following:

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

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

1. Minimum sample size for the clients:

$$n = \frac{100}{(1 + \frac{100}{428})} = 81.06 = 82 \text{ Clients}$$

2. Minimum sample size for the contractors:

$$n = \frac{100}{(1 + \frac{100}{117})} = 53.92 = 54 \text{ Contractors}$$

3. Minimum sample size for the consultants:

$$n = \frac{100}{(1 + \frac{100}{59})} = 37.10 = 38 \text{ Consultants}$$

3.5 Instrumentations

The survey questionnaire was designed based on the research objectives, which are the causes of delay in the completion of private housing projects, the effects of delay in the construction progress, and the methods to reduce the impact of this delay. A questionnaire survey

was designed to collect opinions and the experienced respondents' understanding of construction delays. Respondents found it more straightforward to express their opinion using the Likert scale (John F., 2001). So, the questionnaire was based on a Likert scale, with five ordinal scales from 1 to 5 depending on the contributing factor's influence. The survey questionnaire was divided into four sections:

SECTION 1: Respondent's background

This section focused on the respondent's backgrounds to obtain information about them and their experience. Frequently asked questions included:

- Companies represented by respondents.
- Respondent's position in the company.
- Respondent's experience in the construction of private housing projects.
- Company experience in the construction of the private housing industry.

SECTION 2: The causes of the delays in the completion of private housing projects

This section is intended to contain information on the causes of construction delays in private housing projects from the perspective of clients, contractors, and consultants. This structured questionnaire identified seven groups of the delay sources (Contractor, Client, Consultant, Material, Equipment, Labourers, and External Factors) with 50 contributors to the causes of delay factors. The questionnaire depended on a Likert scale to measure the level of factor Causes

SECTION 3: The effects of delays

It was expected that the respondents in this section would share their opinions and experiences about the effects of delay. The questionnaire depended on a Likert scale to measure the level of factor effect.

SECTION 4: The methods to minimize the impact of delay

The purpose of this section was to outline the most efficient ways to minimize the delay of the completion of private housing projects. Many methods were found to have achieved the purpose from the literature reviews, and they were listed as 20 methods throughout the structured questions. A Likert's scale measured these methods to identify the effectiveness of the proposed solution on a 5-scale level.

3.6 Pilot Study

According to (Malmqvist et al.,2019), methodological texts advise conducting pilot studies in qualitative research. The findings raise awareness of the crucial role that a pilot study plays in large-scale qualitative research projects. This argument is predicated on the idea that after conducting a pilot study, the un expert researchers or even sometimes the expert researchers will be better predicted to handle the challenges that may arise during the qualitative study and have more confidence about the gathered data to use. Additionally, the pilot study will identify the weaknesses facilitating the results gained and increase the quality of the research outcomes.

This pilot study aimed to determine whether the questionnaire was sufficiently concise and understandable and whether there were any problems with how it was written or how long it took to complete. The client, contractors, and consultants with experience in private housing

projects were sent an electronic pilot survey.

In addition, the literature review carried out in the first stage of the research served as the basis for the survey presented in the pilot test. Eight stakeholders (Client, Contractor, and Consultant) were chosen randomly to make up the sample. This sample size was selected because it appeared appropriate for the ongoing development of the final questionnaire. It was discovered that no significant changes to the questions were required after the results of the eight questionnaires had been compiled.

3.7 Conducting the Survey

To expedite the data collection process, the survey was systematically administered to three distinct groups of respondents: clients, contractors, and consultants. The data collection method used was as follows:

- A shortlist of the organizations for (Client, Contractor, and Consultant) was created.
- Contact lists were created to facilitate data collection and enhance communication with the respondents.
- A Google Forms questionnaire link was generated to provide an electronic option for those who preferred to answer the questionnaire online, and distributed to the respondents either through WhatsApp.
- Each group (clients, contractors, and consultants) was given a maximum of seven days to complete the questionnaire. Weekly follow-up reminders were sent via WhatsApp and SMS to ensure timely responses.
- The data collection process was allocated a maximum of three weeks to conclude.

3.8 Collected Data Analysis

The analysis of the questionnaire was divided into two main parts. Initially, descriptive statistics were used to provide an overview of the study's sample. These statistics included frequency counts and measures of central tendency (such as mean and standard deviation) for the variables examined in the study.

Next, to validate the research instrumentation, Reliability, Bivariate, and Normality test were applied. This involved calculating correlation coefficients based on the stakeholder of the project.

3.9 Summary of the Delay Factors, Effects and Methods

List of the delay factors:

To sum up, the following are the main factors that caused the delay in the construction of private housing projects during the research work, which can be summarized as the following in Table 8:

Table 8 Delay Factors for construction of Private Housing Projects

	Delay Related to	No.	The delay factor
1	The Contractor	1	Inadequate contractor experience
		2	Improper construction method
		3	Weak site management
		4	Inaccurate cost estimation of the project
		5	Inaccurate time estimation of the project
		6	Unskilled subcontractors
		7	Financial and cash flow issues
		8	Re-working to correct unsatisfactory work
		9	Over projects capacity
2	The Client	1	Poor communication
		2	Slow decision making
		3	Changes in project scope
		4	Delay in payments
		5	Suspension of work
		6	Unrealistic expected timeframe
		7	Low budget and high expectations

		8	Lack of knowledge
		9	Dispute with other stakeholders
3	The Consultant	1	Inadequate technical expertise
		2	Poor design and documentation
		3	Inadequate coordination with other stakeholders
		4	Poor and late inspection
		5	Slow response
		6	Poor site management
		7	Late approval of completed work
		8	Low quality and services due to less amount paid
		9	Conflict of interest
4	The Material	1	Poor quality of construction materials
		2	Delay in the delivery of materials
		3	Inflation in the material's price
		4	Shortage of material in market
		5	Inadequate storage and handling of materials
5	The Equipment	1	Shortage of equipment on site
		2	Inadequate equipment used
		3	High cost of equipment
		4	Slow mobilization of equipment
6	The Labors	1	Unskilled labors
		2	Shortage of labors
		3	Low productivity of labors
		4	Absenteeism and labor disputes
		5	Weak Motivation
		6	Language barriers
		7	Poor working Condition
7	The External Factors	1	Weather condition
		2	Changes in laws and regulations
		3	Unexpected nature of conditions on site
		4	Poor communications between the parties
		5	Effect of social and cultural factors
		6	Delay in obtaining permits from the Authorities
		7	Delays in utility connections

List of the delay effects:

In a summary by the researchers for the most repeated effects of the delay of the construction of housing projects, it was found that the delay affects the following :

- 1- Time overturn
- 2- Cost overrun

- 3- Dispute
- 4- Arbitration
- 5- Litigation
- 6- Abandonment

List of methods to reduce the delay:

Twenty methods in total have been identified to minimize construction delays from the literature review and the feedback from the structured interview, as listed below, based on different studies of project success factors.

1. Assign delayed activities to the subcontractors.
2. Ensure the availability of resources along the project.
3. Avoid bureaucracy.
4. Ask for an extension of time.
5. Assign overtime for more productivity.
6. Do not award the contract based on the cheapest price.
7. Assign an expert for the project.
8. Component project manager.
9. Realistic activity planning.
10. Accurate initial time estimate.
11. Comprehensive contract documentation.
12. Proper communication between the stakeholders parties.
13. Proper material procurement.
14. Ensure adequate and available source of finance.
15. Periodic progress meeting.
16. Site management and supervision.
17. Proper planning of the project.
18. Obtain the permits from the authority at an early stage.
19. Accurate cost estimation.
20. Select the right expert/consultant and contractor.

4. CHAPTER 4: Data Collection and Analysis

4.1 Introduction:

The data was gathered, and the analysis was done using the proper methodology described and presented in detail in the previous chapter. The information collected from the questionnaire survey was used in the analysis. The data and information acquired will be analysed based on the aim of achieving the predetermined study objectives.

Two levels of analysis were done. Descriptive statistics were used at the first level, including frequency tables, graphical representation and visualization of certain variables, and mean and standard deviation calculations for variables assessed on a 5-point scale. The second level of analysis, known as inferential statistics, used correlation analysis and Kruskal-Wallis significance tests to determine the study hypothesis.

The statistical analysis was carried out with SPSS. The example replies were gathered digitally and saved in an Excel file. Subsequently, the suitable and applicable replies were coded using numerical values corresponding to the survey variable groupings.

4.2 Data Collection:

As explained in the previous chapter, the questionnaire consisted of four sections. Section 1 asked the respondents about their background, and Section 2 asked about their perspectives on the causes of the delays in completing private housing projects through 50 factors. Section 3 asked about the effects of those delays on their housing project, and the last section, section 4, asked about the effective methods to mitigate the impact of the delay.

4.3 Findings & Analysis

4.3.1 Part 1: Descriptive Findings

4.3.1.1 Section 1: Respondent's Background

A. Respondents By Gender:

The gender distribution of the sampled respondents (Table 9) revealed that, in comparison to female respondents (16.9%), men made up the majority of respondents (83.1%) represented in the sample.

Table 9 Sampled respondents by gender

		Fr.	%
State your Gender	Male	162	83.1%
	Female	33	16.9%
	Total	195	100.0%

B. Respondents By Age:

As shown in Table 10, most respondents were between 31 and 60 years old (83% of the respondents), while 17% were between 20 to 30 years old and over 60 years old.

Table 10 Sampled respondents by age

		Fr.	%
State your age	20 to 30	26	13.3%
	31 to 40	77	39.5%
	41 to 50	50	25.6%
	51 to 60	35	17.9%
	> 60	7	3.6%
	Total	195	100.0%

C. Respondents by Employment Classification:

The respondents' breakdown by their kind of job categorization is seen in Table 11. The project contractors comprised 30.8% of the respondents, followed by the consultants (21.5%) and the clients/client representatives (46.7%). Therefore, those who answered were qualified to provide data for this research.

Table 11 Sampled respondents by employment classification

	Fr.	%
State the employment Client/Client Representative	93	47.7%
classification Contractor	60	30.8%
Consultant	42	21.5%
Total	195	100.0%

D. Respondents By Years of Experience in the Construction of Private Housing Projects & Numbers of Projects Involved:

Regarding years spent working in the construction industry, 39.5% of the respondents have less than five years of experience, 23.6% have between six and ten years of experience, 18.5% have between eleven and fifteen years of experience, and 18.5% have fifteen years or more.

The respondents' experiences may aid in better comprehending this issue and placing them in a better position to provide more exact answers needed on the questionnaire form.

It would be preferable, though, if a higher proportion of respondents—18.5% of the sample—had experience of at least 15 years. These ratios, which show that 52.8% of the sample is between the ages of 20 and 40, reflect the current occurrence in the local industry, which is the enormous number of young practitioners who have graduated in recent years to fulfill the great market need.

In addition, the highest percentage of respondents were clients who built one housing unit in their life. As per local industry, they represent the 39.5% involved in less than five projects. Table 12 shows the results of the working experience of respondents involved in this study, and Table 13 shows the number of projects that involved the respondents.

Table 12 Sampled respondents by years of experience in construction of private housing projects

	Fr.	%
State the number of years of experience in the construction of private housing projects		
< 5	77	39.5%
6 - 10	46	23.6%
11-15	36	18.5%
>15	36	18.5%
Total	195	100.0%

Table 13 Sampled respondents by total number of projects

	Fr.	%
State the total number of projects you were involved in		
< 5	77	39.5%
6 - 10	18	9.2%
11-15	19	9.7%
>15	81	41.5%
Total	195	100.0%

4.3.1.2 Section 2: Delay Factors Associated with Private Housing Projects

This section aims to identify the reasons behind the delays in terms of their frequency and impact on the construction project. The literature reviews, the case studies, and the qualitative method of asking the experts identified 50 causes of why the construction of private housing projects in Bahrain takes longer than expected.

Seven primary categories were used to group the 50 delay causes as stated. These reasons will be classified according to the relative relevance index within their respective causes.

The primary variables under study were examined using a 5-point agreement scale from strongly disagree to agree strongly. The mean values that show the sample responses' central tendency will be computed to explain this 5-point rating. The 5-point agreement scale interpretation of the mean results is presented in Table 14.

Table 14 Interpretation of the agreement level on the 5-point level based on mean values

Mean range	5-point scale rating level
1.00 - 1.79	Strongly disagree / lowest level
1.80 - 2.59	Disagree / low level
2.60 - 3.39	Neutral / moderate level
3.40 - 4.19	Agree / high level
4.20 – 5.00	Strongly

1. Delay Related to the Contractor

According to the respondents, nine factors of delays related to the contractor have been identified and ranked. The findings of a survey analysis on the reasons behind delays related to contractors are displayed in Table 15, based on the frequency and the percentage of each agreement level on the 5-point scale.

Table 15 Distribution of the sample responses toward Delay Related to the Contractor items

Delay Related to the Contractor	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Inadequate contractor experience	8	4.1%	35	17.9%	28	14.4%	77	39.5%	47	24.1%	195	100.0%
Improper construction method	3	1.5%	40	20.5%	56	28.7%	73	37.4%	23	11.8%	195	100.0%
Weak site management	4	2.1%	15	7.7%	27	13.8%	73	37.4%	76	39.0%	195	100.0%
Wrong cost estimation	3	1.5%	14	7.2%	31	15.9%	81	41.5%	66	33.8%	195	100.0%
Wrong time estimation	0	0.0%	13	6.7%	29	14.9%	89	45.6%	64	32.8%	195	100.0%
Unskilled subcontractors	1	0.5%	17	8.7%	50	25.6%	73	37.4%	54	27.7%	195	100.0%
Cash flow shortage	4	2.1%	13	6.7%	36	18.5%	77	39.5%	65	33.3%	195	100.0%
Re-working to correct unsatisfactory work	2	1.0%	13	6.7%	54	27.7%	95	48.7%	31	15.9%	195	100.0%
Over projects capacity	4	2.1%	19	9.7%	43	22.1%	60	30.8%	69	35.4%	195	100.0%

Table 16 shows that the delay related to the contractor mean values ranged from 3.37 to 4.05. The 5-point agreement scale, which goes from moderate level to high level, was used to understand this mean range. With a mean value of 3.37, "Improper construction method" got the lowest level of agreement out of all the items. In contrast, "Wrong time estimation" had the highest relative percentage of agreement.

Table 16 Mean and Standard Deviation of Delay Related to the Contractor

Delay Related to the Contractor	Mean	SD*	Mean value interpretation on the 5-point scale
Inadequate contractor experience	3.62	1.154	Agree / high level
Improper construction method	3.37	.989	Neutral = moderate level
Weak site management	4.04	1.012	Agree / high level
Wrong cost estimation	3.99	.963	Agree / high level
Wrong time estimation	4.05	.863	Agree / high level
Unskilled subcontractors	3.83	.951	Agree / high level
Cash flow shortage	3.95	.986	Agree / high level
Re-working to correct unsatisfactory work	3.72	.848	Agree / high level
Over projects capacity	3.88	1.067	Agree / high level

* SD: standard deviation value

2. Delay Related to the Client

The findings of the survey analysis on the causes of the delays related to the clients are shown in Tables 17 and 18. It was found that the factors of “Changes in the project’s scope” and “Low budget and high expectations” have the highest mean value of the delay (Mean 4.07). At the same time, the lowest was found with the factor “Poor Communication” with a 3.46 delay mean. However, all the factors are under with Agree/high level of mean value interpretation on the 5-point scale, which shows how the respondents agreed with the causes of delay factors related to the client.

Table 17 Distribution of the sample responses toward Delay Related to the Client items

Delay Related to the Client	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Poor communication	5	2.6%	41	21.0%	35	17.9%	87	44.6%	27	13.8%	195	100.0%
Slow decision making	1	0.5%	18	9.2%	30	15.4%	87	44.6%	59	30.3%	195	100.0%
Changes in project scope	3	1.5%	10	5.1%	21	10.8%	97	49.7%	64	32.8%	195	100.0%
Delay in payments	7	3.6%	19	9.7%	44	22.6%	73	37.4%	52	26.7%	195	100.0%
Suspension of work	6	3.1%	23	11.8%	53	27.2%	77	39.5%	36	18.5%	195	100.0%
Unrealistic expected timeframe	3	1.5%	14	7.2%	41	21.0%	101	51.8%	36	18.5%	195	100.0%
Low budget and high expectations	4	2.1%	17	8.7%	24	12.3%	67	34.4%	83	42.6%	195	100.0%
Lack of knowledge	4	2.1%	21	10.8%	32	16.4%	79	40.5%	59	30.3%	195	100.0%
Dispute with other stakeholders	1	0.5%	23	11.8%	67	34.4%	65	33.3%	39	20.0%	195	100.0%

Table 18 Mean and Standard Deviation of Delay Related to the Client

Delay Related to the Client	Mean	SD	Mean value interpretation on the 5-point scale
Poor communication	3.46	1.051	Agree / high level
Slow decision making	3.95	.935	Agree / high level
Changes in project scope	4.07	.882	Agree / high level
Delay in payments	3.74	1.069	Agree / high level
Suspension of work	3.58	1.019	Agree / high level
Unrealistic expected timeframe	3.78	.882	Agree / high level
Low budget and high expectations	4.07	1.041	Agree / high level
Lack of knowledge	3.86	1.034	Agree / high level
Dispute with other stakeholders	3.61	.954	Agree / high level

3. Delay Related to the Consultant

There were nine causes of delay related to the consultant identified and assessed by the respondents in this study, as shown in Table 19 and Table 20. As per the respondents' perspectives, "Inadequate coordination with other stakeholders" is the delay factor most related to the consultant, while "Low quality and services due to less amount paid" is the lowest factor that causes the delay in the project and they were neutral in this factor.

Table 19 Distribution of the sample responses toward Delay Related to the Consultant items

Delay Related to the Consultant	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Inadequate consultant experience	5	2.6%	32	16.4%	57	29.2%	75	38.5%	26	13.3%	195	100.0%
Poor design and documentation	2	1.0%	30	15.4%	49	25.1%	80	41.0%	34	17.4%	195	100.0%
Inadequate coordination with other stakeholders	3	1.5%	15	7.7%	35	17.9%	110	56.4%	32	16.4%	195	100.0%
Poor and late inspection	4	2.1%	20	10.3%	43	22.1%	92	47.2%	36	18.5%	195	100.0%
Slow response	4	2.1%	21	10.8%	49	25.1%	84	43.1%	37	19.0%	195	100.0%
Poor site management	3	1.5%	18	9.2%	50	25.6%	90	46.2%	34	17.4%	195	100.0%
Late approval of completed work	3	1.5%	21	10.8%	59	30.3%	85	43.6%	27	13.8%	195	100.0%
Low quality and services due to less amount paid	13	6.7%	39	20.0%	55	28.2%	48	24.6%	40	20.5%	195	100.0%
Conflict of interest	8	4.1%	24	12.3%	77	39.5%	59	30.3%	27	13.8%	195	100.0%

Table 20 Mean and Standard Deviation of Delay Related to the Consultant

Delay Related to the Consultant	Mean	SD	Mean value interpretation on the 5-point scale
Inadequate consultant experience	3.44	1.000	Agree / high level
Poor design and documentation	3.58	.983	Agree / high level
Inadequate coordination with other stakeholders	3.78	.864	Agree / high level
Poor and late inspection	3.70	.956	Agree / high level
Slow response	3.66	.973	Agree / high level
Poor site management	3.69	.919	Agree / high level
Late approval of completed work	3.57	.913	Agree / high level
Low quality and services due to less amount paid	3.32	1.198	Neutral = moderate level
Conflict of interest	3.37	1.004	Neutral = moderate level

4. Delay Related to the Material

Table 21 and Table 22 show the results of the causes of delay related to the material. As shown in the tables, it was found that the respondents agreed that “Inflation in the material’s price” is the most recurring delay factor in the materials, followed by “Shortage of material in the market.” The respondents were neutral in their opinions regarding all other factors.

Table 21 Distribution of the sample responses toward Delay Related to the Material items

Delay Related to the Material	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Poor quality of construction materials	8	4.1%	71	36.4%	51	26.2%	56	28.7%	9	4.6%	195	100.0%
Delay in the delivery of materials	5	2.6%	43	22.1%	45	23.1%	72	36.9%	30	15.4%	195	100.0%
Inflation in the material's price	2	1.0%	17	8.7%	25	12.8%	92	47.2%	59	30.3%	195	100.0%
Shortage of material in market	12	6.2%	45	23.1%	41	21.0%	69	35.4%	28	14.4%	195	100.0%
Inadequate storage and handling of materials	7	3.6%	40	20.5%	72	36.9%	60	30.8%	16	8.2%	195	100.0%

Table 22 Mean and Standard Deviation of Delay Related to the Material

Delay Related to the Material	Mean	SD	Mean value interpretation on the 5-point scale
Poor quality of construction materials	2.93	1.000	Neutral = moderate level
Delay in the delivery of materials	3.41	1.072	Agree / high level
Inflation in the material's price	3.97	.936	Agree / high level
Shortage of material in market	3.29	1.153	Neutral = moderate level
Inadequate storage and handling of materials	3.19	.975	Neutral = moderate level

5. Delay Related to the Equipment

The mean value of the delay factors related to the equipment was found to be almost close to each other. The “High cost of equipment” factor is considered the highest cause of the delay factor related to the equipment. The respondents agreed that the “Inadequate equipment used” and “Shortage of equipment on-site” factors followed most of the delay factors, respectively. In contrast, the “Slow mobilization of equipment” delay factor came at the tail of the list, as shown in Tables 23 and 24 below.

Table 23 Distribution of the sample responses toward Delay Related to the Equipment items

Delay Related to the Equipment	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Shortage of equipment on site	7	3.6%	33	16.9%	49	25.1%	78	40.0%	28	14.4%	195	100.0%
Inadequate equipment used	5	2.6%	32	16.4%	52	26.7%	80	41.0%	26	13.3%	195	100.0%
High cost of equipment	3	1.5%	29	14.9%	43	22.1%	91	46.7%	29	14.9%	195	100.0%
Slow mobilization of equipment	3	1.5%	51	26.2%	55	28.2%	68	34.9%	18	9.2%	195	100.0%

Table 24 Mean and Standard Deviation of Delay Related to the Equipment

Delay Related to the Equipment	Mean	SD	Mean value interpretation on the 5-point scale
Shortage of equipment on site	3.45	1.046	Agree / high level
Inadequate equipment used	3.46	1.001	Agree / high level
High cost of equipment	3.58	.967	Agree / high level
Slow mobilization of equipment	3.24	.994	Neutral = moderate level

6. Delay Related to the Labourers

Table 25 and Table 26 show the results of the delay factors related to the labourers. It can be seen that the top rankings are “Shortage of labourers,” followed by “Low productivity of labourers,” and “Unskilled labourers.” The “Language barrier” is considered the lowest factor that causes delays in housing projects as per the respondents’ perspective.

Table 25 Distribution of the sample responses toward Delay Related to the Labourers items

Delay Related to the Labors	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Unskilled labourers	1	0.5%	23	11.8%	23	11.8%	77	39.5%	71	36.4%	195	100.0%
Shortage of labourers	0	0.0%	18	9.2%	20	10.3%	86	44.1%	71	36.4%	195	100.0%
Low productivity of labourers	0	0.0%	10	5.1%	32	16.4%	100	51.3%	53	27.2%	195	100.0%
Absenteeism and labourers disputes	3	1.5%	29	14.9%	77	39.5%	54	27.7%	32	16.4%	195	100.0%
Weak Motivation	3	1.5%	26	13.3%	58	29.7%	76	39.0%	32	16.4%	195	100.0%
Language barriers	13	6.7%	46	23.6%	60	30.8%	53	27.2%	23	11.8%	195	100.0%
Poor working Condition	3	1.5%	31	15.9%	54	27.7%	72	36.9%	35	17.9%	195	100.0%

Table 26 Mean and Standard Deviation of Delay Related to the labourers

Delay Related to the Labors	Mean	SD	Mean value interpretation on the 5-point scale
Unskilled labourers	3.99	1.003	Agree / high level
Shortage of labourers	4.08	.913	Agree / high level
Low productivity of labourers	4.01	.803	Agree / high level
Absenteeism and labourers disputes	3.43	.984	Agree / high level
Weak Motivation	3.55	.969	Agree / high level
Language barriers	3.14	1.111	Neutral = moderate level
Poor working Condition	3.54	1.011	Agree / high level

7. Delay related to the External Factors

As shown in Tables 27 and 28, seven external delay factors contribute to the construction of private housing project delays as ranked by the respondents. The respondents considered the "Weather conditions," "Delays in utility connections," and "Delays in obtaining permits from the Authorities" to be the three most recurring causes of the delay with the external factors. The "Effect of social and cultural factors" delay factor is the last of their considerations.

Table 27 Distribution of the sample responses toward Delay Related to the external factors items

Delays related to external factors	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%	Fr.	%
Weather conditions	2	1.0%	21	10.8%	45	23.1%	76	39.0%	51	26.2%	195	100.0%
Changes in laws and regulations	4	2.1%	24	12.3%	59	30.3%	70	35.9%	38	19.5%	195	100.0%
Unexpected nature of conditions on site	5	2.6%	29	14.9%	55	28.2%	81	41.5%	25	12.8%	195	100.0%
Poor communications between the parties	4	2.1%	13	6.7%	61	31.3%	89	45.6%	28	14.4%	195	100.0%
Effect of social and cultural factors	21	10.8%	37	19.0%	79	40.5%	39	20.0%	19	9.7%	195	100.0%
Delays in obtaining permits from the Authorities	6	3.1%	17	8.7%	48	24.6%	77	39.5%	47	24.1%	195	100.0%
Delays in utility connections	5	2.6%	16	8.2%	46	23.6%	80	41.0%	48	24.6%	195	100.0%

Table 28 Mean and Standard Deviation of Delay Related to the External Factors

Delays related to the external factors	Mean	SD	Mean value interpretation on the 5-point scale
Weather conditions	3.78	.987	Agree / high level
Changes in laws and regulations	3.58	1.003	Agree / high level
Unexpected nature of conditions on site	3.47	.981	Agree / high level
Poor communications between the parties	3.64	.883	Agree / high level
Effect of social and cultural factors	2.99	1.103	Neutral = moderate level
Delays in obtaining permits from the Authorities	3.73	1.022	Agree / high level
Delays in utility connections	3.77	.996	Agree / high level

Top 10 Factors Causing Delays in the Construction of Private Housing Projects in Bahrain

The results in Table 29 show that the shortage of labourers during construction is the main concern, according to the respondents in this study. The shortage of labourers will result directly in the project's completion period and will cause more delays to the completion of the project, precisely the construction period.

The delays related to the labourers are not narrowed to this point, but it included the low productivity and the lack of skills concerning the labourers from the respondents' perspective.

The delays related to the labourers are not narrowed to this point,

but it included the low productivity and the lack of skills concerning the labourers from the respondents' perspective.

The respondents see that the client must control changes in scope of work during the design/implementation period. In addition, the client should be more reliable and well-managed with his financial budgets and his needs to complete his house without delay. Also, the slow decision-making by the client is an essential factor contributing to the delay.

Regarding the delay, the project contractor's factor was not far from the construction. Instead, according to the respondents' opinions, it was one of the ten factors that caused the most delays in the completion of private housing projects in Bahrain. The respondents found that the wrong estimation of both periods and the project cost contributed to this delay and the cash flow factor, which utterly affected the contractor's progress in completing the project during the construction phase.

Additionally, inflation in the price of materials is considered an obstacle that causes a delay in the project.

The top ten factors that cause delays in the construction of private housing projects in Bahrain are devoid of factors related to the consultant, the equipment, and external factors, as per the respondents' perspectives.

Table 29 summary of top delay factors in construction of private housing projects in Bahrain

c	Causes	Delay related to	Mean	SD
1	Shortage of Labourers	Labor	4.08	0.913
2	Changes in project scope	Client	4.07	0.882
3	Low budget and high expectations	Client	4.07	1.041
4	Wrong time estimation	Contractor	4.05	0.863
5	Low productivity of Labourers	Labor	4.01	0.803
6	Unskilled Labourers	Labor	3.99	1.003
7	Wrong cost estimation	Contractor	3.99	0.963
8	Inflation in the material's price	Material	3.97	0.936
9	Slow decision making	Client	3.95	0.935
10	Cash flow shortage	Contractor	3.95	0.986

4.3.1.3 Section 3: The Effect of Delays

This section will show the effects of the delay based on the fifty overall causes.

A 5-point scale that goes from no effects to very great effects is used to measure the effect level of the delay. This 5-point scale will be displayed by the computation of mean values, which show the central tendency of the respondents. Table 30 shows a 5-point range system for the average values.

Table 30 Interpretation of the affect level on the 5-point level based on mean values

Mean range	5-point scale rating level
1.00 - 1.79	No affects
1.80 - 2.59	Slightly affect
2.60 - 3.39	Moderate affect
3.40 - 4.19	Great affect
4.20 – 5.00	Very great affect

As shown in Table 31, the respondents agreed that overturning the cost is the most effective result for their projects, and the abandonment effect came second. It also had a great effect on the time of the project, which is a concern to them.

Overall, the delay effect has a great effect on time overturn, cost overrun, and abandonment. It has a moderate effect on disputes, arbitration, and litigation.

Table 31 Mean and Standard Deviation of Delay effect

Delay effect	Mean	SD	Mean value interpretation on the 5-point scale
Time overturn	3.41	1.133	Great affect
Cost overrun	3.65	1.253	Great affect
Dispute	3.31	1.193	Moderate affect
Arbitration	2.85	1.207	Moderate affect
Litigation	3.22	1.391	Moderate affect
Abandonment	3.49	1.352	Great affect

4.3.1.4 Section 4: Methods to Minimize the Impact of the Delay

One of the biggest concerns that face the construction industry for private housing projects in Bahrain is the delay. Delays can be controlled and mitigated only when the causes are identified. Knowing what are the factors that are contributing to the delay of the construction helps reduce the effects. This study has proposed twenty methods to minimize the delay as the respondents have evaluated the proposed solutions based on their effectiveness in reducing the delay as per their perspectives. Tables 32 show the sample distribution and the alternatives' mean values. The methods used were based on a 5-point scale, as explained earlier.

The respondents believed that selecting the right consultant and contractor with the most expertise at an early stage is the most effective method in eliminating and reducing the delays in their housing projects, as per their perspective, with a mean of 3.99.

In addition to that, they believe that “Ensure adequate and available source of finance”, “Assign an expert person for the project,” and “Proper planning of project” have a great effect on reducing the delay issue. The survey participants' opinions regarding these points were close, and their average answers were 3.77, 3.74, and 3.71.

The opinions of the survey respondents differed in terms of the extent of the effect of other proposed solutions to reduce the effects of the delay between the strong effect and the moderate effect, but they agreed that “Contractor/Consultant to be followed by the government to avoid any violations along the construction period” has fewer effects to reduce the delay with the lowest effect mean equalling 3.09. Tables 28 and 29 show more details for the respondents' answers.

Table 32 Mean and Standard Deviation of Delay Minimizing Method

Delay Minimizing Method	Mean	SD	Mean value interpretation on the 5-point scale
Assign delayed activities to the subcontractors	3.36	1.053	Moderate affect
Ensure availability of the resources along the project	3.46	1.168	Great affect
Avoid bureaucracy	3.05	1.116	Moderate affect
Ask for time extension	3.19	1.127	Moderate affect
Assign overtime for more productivity	3.32	1.109	Moderate affect
Not awarding the contract based on the cheapest price	3.49	1.224	Great affect
Assign an expert person for the project	3.74	1.143	Great affect
Contractor / Consultant to be followed by the government to avoid any violations along the construction period.	3.09	1.209	Moderate affect
Realistic activity planning	3.46	1.099	Great affect
Accurate initial time estimate	3.45	1.140	Great affect
Comprehensive contract documentation	3.34	1.197	Moderate affect
Proper communication between the stakeholders parties	3.52	1.090	Great affect
Proper material procurement	3.48	1.172	Great affect
Ensure adequate and available source of finance	3.77	1.227	Great affect
Periodic progress meeting	3.41	1.133	Great affect
Site management and supervision	3.54	1.136	Great affect
Proper planning of project	3.71	1.118	Great affect
Obtain the permits from the authority at early stage	3.50	1.266	Great affect
Accurate cost estimation	3.54	1.202	Great affect
Select the right/expert consultant and contractor	3.99	1.206	Great affect

In addition, the effectiveness of the proposed method in minimizing the delay was measured. If applied, it will reflect on the project through the following factors: the time, the cost, the quality, and the scope as shown in Table 33.

It was found that the respondents all agreed that the proposed methods had a great effect on their project, especially the time to complete the project, with a mean of 3.91.

The proposed methods were satisfying to the respondents and scaled with a great effect on the other factors like cost, quality, and scope.

Table 33 Mean and Standard Deviation of Impact of proposed solution

Impact of proposed solution	Mean	SD	Mean value interpretation on the 5-point scale
Time period of the project	3.91	.924	Great affect
Cost of the project	3.81	1.027	Great affect
Quality of the work	3.74	1.087	Great affect
Scope of the work	3.69	1.029	Great affect

4.3.2 Part 2: Inferential Findings

4.3.2.1 Relationship Between the Studied Variables

This part focuses validity test of the research instrumentation. The first step is assessing the reliability, and testing the normality assumption. Finally, the appropriate bivariate inferential analysis will be performed to find any statistically significant difference due to the demographic variables.

4.3.2.2 Reliability of the Studied Variables

Each studied variable was designed to be measured by a set of variables. This is called the composite variable. For the composite variables, assessing the reliability or the internal consistency level is required. Table 34 shows the reliability results using the common method usually used by research, Cronbach's Alpha Coefficient. For a composite measure to be reliable, Cronbach's Alpha Coefficient should be equal to or greater than 0.7. The range of Cronbach's Alpha Coefficient was from 0.725 to 0.946. Thus, all composite variables studied had an acceptable reliability level.

Table 34 Reliability level based on Cronbach's Alpha Coefficient method

Composite variable studied	Total number of items	Items excluded (to increase reliability, if any)	Cronbach's alpha coefficient	Reliability level
Delay Related to the Contractor	9	-	.817	Reliable
Delay Related to the Client	9	-	.825	Reliable
Delay Related to the Consultant	9	-	.859	Reliable
Delay Related to the Material	5	-	.754	Reliable
Delay Related to the Equipment	4	-	.811	Reliable
Delay Related to the Labourers	7	-	.796	Reliable
Delay Related to the external factors	7	-	.725	Reliable
Delay effect	6	-	.883	Reliable
Delay Minimizing Method	20	-	.964	Reliable
Impact of proposed solution	4	-	.879	Reliable

4.3.2.3 Bivariate Analysis

In order to validate the survey responses from participants, a correlation analysis using Spearman's rho was performed. This involved calculating the correlation coefficient between the main stakeholders, specifically focusing on their work field (clients, contractors, and consultants).

Based on Table 35, it is clear that there is a good correlation among the responses from each field. This indicates a significant correlation at the 0.01 level (2-tailed).

Table 35 Spearman's rho correlation analysis between the Work Field

Correlations				
		Clients	Contractors	Consultants
Clients	Correlation Coefficient	1.000	.631**	.585**
	Sig. (2-tailed)	.	.000	.000
Contractors	Correlation Coefficient	.631**	1.000	.613**
	Sig. (2-tailed)	.000	.	.000
Consultants	Correlation Coefficient	.585**	.613**	1.000
	Sig. (2-tailed)	.000	.000	.
**. Correlation is significant at the 0.01 level (2-tailed).				

4.3.2.4 Normality Test

Testing for normality assumption is required, as it will inform which inferential analysis method shall be performed to test the research hypothesis.

Normality was tested using the Kolmogorov-Smirnov test of normality. Table 36. This test of normality tests the null hypothesis, which states that the variable follows a normal distribution, versus the alternative hypothesis, which states that the variable does not follow a normal distribution. It was found that all composite variables studied were statistically significant at a 1% significance level since the p-values were less than 0.01. So, the null hypothesis is rejected, and the alternative hypothesis is concluded, except for the Delay Related to the external factors, which was not found to have a statistically significance level at a 5% significance level.

Accordingly, when testing the research hypothesis, the inferential methods to be performed should be the ones that do not assume normal distribution. These types of inferential analysis methods are called non-parametric tests.

Table 36 Testing normality using Kolmogorov-Smirnov test of normality

Composite variable	Kolmogorov-Smirnov ^a Test of Normality		
	Statistic	df	p-value
Delay Related to the Contractor	.097**	195	.000
Delay Related to the Client	.110**	195	.000
Delay Related to the Consultant	.078**	195	.006
Delay Related to the Material	.087**	195	.001
Delay Related to the Equipment	.092**	195	.000
Delay Related to the Equipment	.092**	195	.000
Delay Related to the external factors	.062	195	.063
Delay effect	.138**	195	.000
Delay Minimizing Method	.105**	195	.000
Impact of proposed solution	.139**	195	.000

a. Lilliefors Significance Correction

* significant at 5% (p-value < 0.05); ** significant at 1% (p-value < 0.01)

4.4 Analysis of Case Studies:

Based on the lessons learned from the case studies (Appendix A) provided in the attachments, the results and impacts can be summarized as follows:

Case No.1 :

1- Causes of the delay :

- Low Budget and high expectations.
- Wrong cost estimation
- Suspension of work
- Slow decision making
- Delay in payments
- Unskilled Subcontractor
- Wrong time estimation
- Poor site management
- Poor and late inspection

2- Effects of the Delay :

- Time overturn
- Cost overrun
- Litigation

Case No.2 :

1- Causes of the delay :

- Unexpected nature of conditions on-site.
- Inadequate storage and handling of materials
- Weak site management
- Wrong cost estimation
- Cash flow shortage
- Poor communication
- Unskilled Subcontractor

- Delays in utility Connection

2- Effects of the Delay :

- Time overturn
- Cost overrun

4.5 Results and Discussion:

This study identifies the ten most recurring causes of delays in constructing private housing projects in Bahrain. The delays related to the labourers included the shortage of labourers, unskilled labourers, wrong time estimation, and low productivity of labourers. The delays related to the client were changes in the project's scope, low budget, high expectations, and slow decision-making. The delays related to the contractor were wrong cost estimation, wrong time estimation, and cash flow shortage. In addition, the delay found concerning the materials was caused by inflation in the prices of the materials.

The list of the top ten causes for delays did not contain any causes related to the consultant, equipment, or external factors.

An overview of earlier research on construction delays in various countries and the feedback from the structured interview with experts as discussed in the literature (Table No.1) show disagreement on the elements that influence construction delay and the results obtained.

This is due, in part, to several reasons such as different sampling techniques, data collection methods, sample size, geographical location, and cultural background. In addition, the researchers have approached the topic from a variety of angles. Diverse opinions on what might be considered a primary source of delay in building projects characterize even the most recent studies on construction delays.

Regarding the effects of delays on the construction of private

housing projects in Bahrain, they are on par with the findings of previous studies conducted in other nations. The topmost effects outcomes were cost overrun, abandonment, time overturn, dispute, litigation, and arbitration at the end of the list. These elements are global as they appeared to be the most recurring effects of the delays in other countries.

After that, many methods were proposed to reduce the effects of these delays. Twenty methods were proposed based on the literature review and presented to those with experience and following the regulations in Bahrain.

It is concluded that selecting the right/expert consultant and contractor are the main factors required to control and reduce delay causes as per the perspective of the respondents, while the contractor/consultant is to be monitored by the government to avoid any violations that might be made along the construction period was at the bottom of this list according to their point of view.

The participants in this study emphasized the importance of the proposed solutions by measuring the extent of their impact on the project's success factors, which are quality, time, cost, and scope. The participants confirmed that if the previous solutions are implemented, their impact will significantly and positively affect the time, cost, quality, and, finally, the project's scope.

4.6 Summary

In this chapter, several conclusions and outcomes were reached via an investigation and an analysis. The pre-established objectives were met by providing a solution to the research question during the analysis and discussion. The main factors that cause delays in constructing private housing projects in Bahrain have been identified. The effects of those

delays and their results were studied. The methods for reducing project delays were also established.

This means that the conclusion, and recommendations for more research on this subject will all be included in the next chapter, which is the final chapter. The next chapter will also describe the limitations throughout the study.

5 CHAPTER 5: Conclusion & Recommendations

5.1 Introduction:

This chapter includes the methodology applied to achieve this study's objective and the outcome interpretation of the research. In addition, the limitations of the main study's findings will be explained, and recommendations will be given to improve the performance of the construction of private housing projects industry in Bahrain.

5.2 Conclusion:

This research investigated the causes, the effects, and the methods required to reduce the impact of delays in the construction of private housing projects in Bahrain. A questionnaire was conducted from the literature reviewed and the case studies and was presented to six experts in the construction industry of private housing in Bahrain to measure how the factors fit the regulations in Bahrain. The survey was designed to obtain the perspective of the three main stakeholders – clients, contractors, and consultants.

The survey identified fifty causes of delays according to their related causes. Additionally, the effects of that delay on the project have been studied. Twenty different methods have been proposed to prevent, treat, and reduce the impact of delays in project delivery, and the positive effectiveness of these methods if they were to be implemented, has been studied. In addition, the impact of these solutions, if implemented, on the four elements of the project, time, cost, quality, and scope, has been measured.

In this survey, 195 participants (93 of the Clients, 60 of them Contractors, and 42 Consultants) participated and gave their

perspectives, representing the population sample. The data collected has been analysed using SPSS.

The analysis's findings confirm the validity of the data collected, as proven by the results of Cronbach's alpha reliability test, normality test, and Bivariate test.

After analyzing the collected data, it was found that many factors are causing the delays. The top ten factors include Shortage of labourers, Changes in the project's scope, Low budget and high expectations, Wrong time estimation, Low productivity of labourers, Unskilled labourers, Wrong cost estimation, Inflation in the material's prices, Slow decision making, and Cash flow shortage. All the factors causing the delays are related to the Labourers, the client, the contractor, and the material. At the same time, the list excluded the delays related to the consultant, the equipment, and external factors.

The collected results can indeed show variations compared to the outcomes of other researchers, and this can be attributed to various factors such as sample size, sampling method, and the social and cultural backgrounds of the respondents.

Furthermore, the effect of that delay on the project has been measured. It found that most of the participants see that delay has a great effect on their project by cost overrun, abandonment effect, and last, time overturn, while the other effects were moderate.

In addition to the delay effect, twenty methods to minimize the delay have been proposed. The participants agreed that most of the proposed methods have a great effect on reducing the delay. However, the three most effective methods are to select the right/expert consultant and contractor, Ensure adequate and available source of finance, and Assign an expert person for the project. The respondents believe that if the proposed methods are implemented, they will have a great effect on

the duration of the project.

The objectives of this study have been accomplished. This study identifies the main factors affecting the completion of private housing projects in Bahrain. Additionally, the effects of the delay on the stakeholder's projects have been found. Finally, the practical methods to control and reduce these delays have been proposed and identified.

5.3 Limitations:

The study aimed to collect viewpoints from experts representing different construction industry stakeholders, including clients, contractors, and consultants. The study included the opinions of a few of the experts in the construction field, and it did not include the opinions of all the experts and stakeholders in the construction industry in Bahrain.

Furthermore, this study has several limitations. First, I needed some support throughout this investigation, especially when collecting data. For example, MUN and MOW do not have information about the delay of private housing projects. Also, they were reserved in providing more information about the current projects due to their privacy policy.

Also, the assembly of the conceptual structure of the survey is limited to the findings found in the literature and the experts' observations only and did not include the local information obtained from the responsible authorities for the reasons explained above.

5.4 Recommendations for Future Research

- Reviewing government laws and regulations related directly or indirectly to the construction process, such as the ease of providing labours, will result in assisting in reducing the impact of the construction delay. This field may require assistance from some

specialists, such as lawyers, arbitrators, or even engineers with a long history in construction projects with their experience.

- Study the financial impact of the delay in the construction of private housing projects in Bahrain on the stakeholders (The client, The consultant, and the contractor) and the extent of their impact on the decisions taken in the event of a delay in construction.
- It is recommended to include additional factors that have been suggested by the reviewers and respondents, such as currency fluctuations, design deficiencies, political crises, and other relevant factors that may contribute to project delays.

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Appendices

Appendix A

Case Study

Case No.1

A project to build a private villa consisting of a basement, ground floor, first floor, and rooftop services in Al-Malikiyah area – the Kingdom of Bahrain.

In this case, the parties involved in this project have been referred to by their initials, based on the request of the parties to the dispute, to preserve privacy and to preserve the procedures of the case currently pending in court:

- **Project details:**

Project description: Building a villa consisting of a basement, two-story “ground and first,” and services on the roof.

Area: Al-Malikiyah

The client: K.A

The consultant: Y. Engineering Consultancy

The contractor: N. E for Construction & Maintenance

- **Construction contract details:**

Beginning of the work period: June 23, 2015

Original contract period: 16 months

Original contract expiration date: October 16, 2016

Actual project completion date: not completed “last update, July 25, 2023”

Initial project cost: BHD 135,000

Construction cost to date: BHD 167,000

Contract type: Lump sum

- Project background:

The client applied to the consultant to design and submit drawings for house construction in the Al-Malikiyah area, consisting of a basement, two-story “ground and first,” and services on the roof. The consultant completed the engineering drawings and obtained the related permits to start the work in a period not exceeding four months from the first meeting (a reasonable period), which is based on the client’s request and his consultation with the consultant regarding the estimated costs of the construction process based on his needs. The consultant estimated the construction cost at BHD 120,000 (BHD 15,000 less than the lowest offer the client received from the construction contractors), as per the client’s budget.

After receiving the construction drawings and related permits from the client, he got different quotes from different contractors. However, the lowest offer he received was BHD 135,000, Which exceeded his budget by BHD 15,000. The client agreed with the contractor to carry out the construction of his house project and with the consultant to partially supervise the construction, covering some construction stages to save money, and he hoped that the amount would be available during the following periods.

The construction of the house had already begun on the date mentioned above, and the project’s stages were proceeding smoothly at the beginning of the project. In contrast, the structural items of the project were completed. Then, the contractor began to falter financially due to a miscalculation of the correct construction costs and because the client partially faltered financially because he used part of the project’s budget

for other matters. The two parties agreed to extend the project's period for an additional year so that each party could provide the necessary financial resources. However, the construction period has been extended for more than four years, and the project has yet to be completed.

At the beginning of 2021, due to periodic heavy rains, water leak marks appeared in the basement, in addition to other problems due to the low quality of the construction. The client, the contractor, and the consultant met to find solutions to address the existing situation, but the solutions developed were either expensive or ineffective for the existing situation.

The client sued a case in the Bahraini court against the contractor and the consultant, accusing them of negligence in the implementation process and the supervision of the project and of being the reason for the delay in the project's implementation. The court appointed a construction expert to submit his report, verify the existing problems, determine the responsibilities of each party, and suggest ways to treat existing construction problems and the necessary costs for the repair and delay process.

The expert's report and the court's ruling reached a preliminary conclusion that there were actual problems during the construction process as a result of intentional mistakes or mistakes made out of ignorance by all construction parties (the client, the contractor, and the consultant). The costs of correcting the existing problems were estimated at approximately BHD 18,000; the cost to be borne by the three parties was equal, and the court explained its ruling in its initial report on the

reasons for the problems in implementing the construction and the delay in implementation as follows:

Reasons belonging to the owner:

- Incorrect estimation of the construction project's budget
- Choosing a consultancy package based on the lowest cost, not the project's actual needs.
- Delay in making the necessary decisions during the construction process
- Irregularity in the payment of financial dues to the contractor
- Canceling the waterproofing protection layer in the basement and not implementing it by agreement with the contractor and without referring to the consultant out of ignorance of the consequences.
- Choosing a contractor based on the cheapest cost, not on efficiency

Reasons belonging to the contractor:

- Lack of correct estimation of the project's cost
- Failure to correctly estimate the actual time required to build the project
- Inefficiency of labourers during the implementation of the construction phases of the project
- Not referring to the consultant when canceling the waterproofing of the basement
- Lack of quality of work and sufficient trained labourers to implement the project

Reasons belonging to the consultant:

- Incompetence of the engineer supervising the site
- Weak proper control of engineering supervision on the site
- Mistakes in designing engineering drawings
- Mistakes in project supervision.

Case No. 2

A project to build a private residential villa Consisting of a Ground and First Floor in the Bani Jamra area - Kingdom of Bahrain

In this case, the parties involved in this project are indicated with initials based on the request of the client and the contractor:

- Project details:

Project description: Construction of a two-story villa consisting of ground and first floors.

Area: Bani Jamra

The client: A.M.F

The consultant: R. For engineering

The contractor: J.C.L Building Contracting and Maintenance

- Construction contract details:

Beginning of the work period: December 1, 2020

Original contract period: 10 months

Original contract expiration date: October 1, 2021

Actual project completion date: November 5, 2022

Initial project cost: BHD 37,000

Actual construction cost: BHD 42,000

Contract type: Lump sum

- Project background:

The client agreed with the contractor to build a two-story residential villa in the Bani Jamra area on land that was recently planned and sold, where none of the residential services provided by the authorities (electricity lines, roads, water, sewage, and other services)

were available. The role of the consultant was secondary, as the client has an extensive engineering background in the construction field. The construction process took ten months, i.e., an additional 13-month delay over the estimated construction time.

The client replaced the building contractor after a friendly agreement between him and the contractor eight months after the start of construction because the contractor was no longer able to complete the project due to the increase in various costs and his inability to bear them, provided that each party bears the amount of the resulting loss with a pledge from both parties, not to complain or file counter-cases in court.

The client agreed with another contractor to complete the construction with a loss of 3 months from the first contractor leaving the project. The client paid an additional fee to the original contract, around BHD 5000, to the new contractor to complete the construction work.

The reasons for the delay in building the housing unit can be summarized as follows:

- Trucks were unable to enter the project for approximately three weeks because the area's soil was clay and caused danger to the vehicles used to carry out excavation and soil replacement work until a temporary road was made for the vehicles, which caused additional costs and a loss in the time period to the contractor.
- Lack of protection and control for the equipment and tools used in construction exposed the site to theft more than once, increasing costs for the contractor.
- The construction contractor uses subcontract labour (Same nationality as the contractor) whose cost is more than one and a half times the usual market cost and with lower productivity in comparison.
- Problems in the construction contractor's financial flow are caused by incorrect estimation of the cost and its increase due to the previous

reasons.

- The construction contractor needs more administrative experience to do the required work.
- Misdistribution of the financial flow in the contract for the completed works based on a request and pressure from the client.
- Poor communication between the client and the new contractor.
- Lack of good coordination between the subcontractors and the client during the finishing stage of the building.
- Work being stopped intermittently due to the main building contractor's failure to pay the subcontractors' dues.
- The competent government authorities delayed the delivery of the electricity and water services to the house after completing the required work.

Appendix B

Research Questionnaire

Research Questionnaire



UNIVERSITY OF BAHRAIN
College of Engineering

Research title: **An Investigation Into The Delay Factors Affecting the Completion of Private Housing Projects in Bahrain**

To: Participants

This study investigates the causes and factors of delay in constructing private housing projects in Bahrain. It is expected to offer some empirical information and approaches to reduce the delay in the construction of private houses. In addition, it aims to propose to the construction stakeholders (clients, contractors, and consultants) a method to mitigate the effects of the delay to deliver the projects on time, within the budget, and satisfy the stakeholders.

Objectives of the study:

1. Investigate and identify the main delay factors affecting the completion of private housing projects in Bahrain by determining the most influential factors.
2. Identify the effect of construction delay on these projects.
3. Identify methods to reduce the impact of the delay factors.

Notes:

Your reply will be kept strictly confidential. The results will be used for academic purposes only. Your participation will be greatly appreciated.

Yours faithfully,

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SECTION 1: Respondent's Background

Please tick (✓) and fill in the blanks:

1. State your Gender.

☐ Male

☐ Female

2. State your age.

☐ 20 to 30

☐ 31 to 40

☐ 41 to 50

☐ 50 to 60

☐ > 60

3. State your professional background.

☐ Client/Client Representative

☐ Contractor

☐ Consultant

4. State the number of years of experience in the construction of private housing projects.

☐ < 5

☐ 6 - 10

☐ 11-15

☐ >15

5. State the total number of projects you were involved in.

☐ 1-5

☐ 6-10

☐ 11-15

☐ >15

SECTION 2: The causes of the delays in the completion of private housing projects

Please tick (✓) the selected rated scale and fill in the blanks based on your experience for the following related causes of delays in the construction of private housing projects.

No.	Delay Factor	1. Strongly Agree	2. Agree	3. Neutral	4. Disagree	5. Strongly Disagree
Delay Related to the Contractor						
1	Inadequate contractor experience					
2	Improper construction method					
3	Weak site management					
4	Wrong cost estimation					
5	Wrong time estimation					
6	Unskilled subcontractors					
7	Cash flow shortage					
8	Re-working to correct unsatisfactory work					
9.	Over projects capacity					
Delay Related to the Client						
1	Poor communication					
2	Slow decision making					
3	Changes in project scope					
4	Delay in payments					
5	Suspension of work					
6	Unrealistic expected timeframe					
7	Low budget and high expectations					
8.	Lack of knowledge					
9.	Dispute with other stakeholders					
Delay Related to the Consultant						
1	Inadequate consultant experience					
2	Poor design and documentation					
3	Inadequate coordination with other stakeholders					
4	Poor and late inspection					

5	Slow response					
6	Poor site management					
7	Late approval of completed work					
8	Low quality and services due to less amount paid					
9	Conflict of interest					
Delay Related to the Material						
1	Poor quality of construction materials					
2	Delay in the delivery of materials					
3	Inflation in the material's price					
4	Shortage of material in market					
5	Inadequate storage and handling of materials					
Delay Related to the Equipment						
1	Shortage of equipment on site					
2	Inadequate equipment used					
3	High cost of equipment					
4	Slow mobilization of equipment					
Delay Related to the Labors						
1	Unskilled labors					
2	Shortage of labors					
3	Low productivity of labors					
4	Absenteeism and labor disputes					
5	Weak Motivation					
6	Language barriers					
7	Poor working Condition					
Delay Related to the external factors						
1	Weather condition					
2	Changes in laws and regulations					
3	Unexpected nature of conditions on site					
4	Poor communications between the parties					
5	Effect of social and cultural factors					
6	Delay in obtaining permits from the Authorities					
7	Delays in utility connections					

SECTION 3: The effects of delays

Please tick (✓) the selected rated scale and fill in the blanks based on your experience for the following related effects of construction delays on private housing projects.

No.	Delay effect	1. No affects	2. Slightly affect	3. Moderate affect	4. Great affect	5. Very great affect
1	Time overturn					
2	Cost overrun					
3	Dispute					
4	Arbitration					
5	Litigation					
6	Abandonment					

SECTION 4: Methods to minimize the impact of the delay.

Please tick (✓) the selected rated scale and fill in the blanks based on your experience to measure the effectiveness of the proposed solution to mitigate the effects of construction delays on private housing projects.

No.	Delay Minimizing Method	1. No affects	2. Slightly affect	3. Moderate affect	4. Great affect	5. Very great affect
1	Assign delayed activities to the subcontractors.					
2	Ensure availability of the resources along the project.					
3	Avoid bureaucracy					
4	Ask for a time extension.					
5	Assign overtime for more productivity.					
6	Not awarding the contract based on the cheapest price.					
7	Assign an expert person for the project.					
8	Realistic activity planning					
9	Accurate initial time estimate					
10	Comprehensive contract documentation					
11	Proper communication between the stakeholders parties					
12	Proper material procurement					
13	Ensure adequate and available source of finance					
14	Periodic progress meeting					
15	Site management and supervision					
16	Proper planning of project					
17	Obtain the permits from the authority at early stage.					
18	Accurate cost estimation					
19	Select the right/expert consultant and contractor.					
20	Contact or / Consultant to be followed by the government to avoid any violations along the construction period.					

SECTION 5: Measure the impact of proposed solutions to minimize the effects of the delay and methods to minimize the impact of the delay.

Please tick (✓) the selected rated scale and fill in the blanks based on your experience to measure the effectiveness of the proposed solution to mitigate the effects of construction delays on private housing projects.

No.	Measure the impact of proposed solution	1. No affects	2. Slightly affect	3. Moderate affect	4. Great affect	5. Very great affect
1	Time period of the project					
2	Cost of the project					
3	Quality of the work					
4	Scope of the work					

Thank you for participating in this survey. Your valuable insights will help us better understand the factors affecting the completion of private housing projects in Bahrain and propose practical solutions to stakeholders.

الملخص

تعتبر صناعة البناء والتشييد في البحرين من القطاعات الحيوية التي تسهم بشكل كبير في الناتج المحلي الإجمالي. وتعمل المشاريع السكنية الخاصة على دعم الاقتصاد بشكل مهم ولها أثر كبير في هذا القطاع. التأخير إنجاز هذه المشاريع يحدث بشكل شائع في هذه الصناعة نظرا للظروف المتنوعة. والسبيل الوحيد لمنع هذا التأخير هو تحديد عوامل التأخير المؤثرة ومصادرها. يهدف هذا البحث بشكل أساسي إلى تحديد العوامل الرئيسية التي تؤدي إلى تأخير بناء مشاريع الإسكان الخاصة في البحرين، ودراسة تأثير هذا التأخير، واقتراح الأساليب التي يمكن أن تساعد في تقليل تأثيره. تم جمع البيانات من المشاركين الرئيسيين في هذه المشاريع، مثل الملاك والاستشاريين والمقاولين، من خلال استعراض الأدبيات ودراسة الحالة والاستبيان واستشارة الخبراء. بلغ إجمالي عينة السكان 604 شخص، و تلا ذلك توزيع عينة تمثيلية مكونة من 38 يمثلون الاستشاري، و 54 يمثلون المقاول و 82 يمثلون الملاك. خلال البحث فإنه تم تحديد 50 عاملاً كأسباب لتأخير المشروع، وقد تم تصنيفها إلى سبعة مجموعات رئيسية ذات صلة. بالإضافة إلى ذلك، تم تحديد ستة آثار رئيسية لهذا التأخير، واقتراح 20 طريقة لتقليل تأثيره. لتحليل و فحص البيانات المجمعة فقد تم استخدام برنامج SPSS. ووفقاً للنتائج، فإن نقص العمالة والتغيرات في نطاق المشروع وانخفاض الميزانية وارتفاع التوقعات والتقدير الزمني الخاطئ وانخفاض إنتاجية العمال والعمال غير المهرة والتقدير الخاطئ للتكلفة وتضخم أسعار المواد وبطء اتخاذ القرار ونقص التدفق النقدي كأهم العوامل المؤدية لتأخير بناء مشاريع الإسكان الخاصة. وتشمل آثار التأخير زيادة التكاليف والتخلي عن المشروع وانقضاء الوقت وحدوث نزاعات وتحكيم. يعتقد المشاركون أن اختيار الاستشاريين والمقاولين المناسبين وضمان توفر مصدر تمويل كافٍ وتعيين شخص متخصص للمشروع هي أكثر الأساليب فعالية للحد من تأثير تأخير المشروع، وسيكون لها تأثير كبير على الوقت والتكلفة والجودة.

جامعة البحرين
كلية الهندسة
قسم الهندسة الميكانيكية



تحقيق في العوامل المؤثرة في تأخر إنجاز مشاريع الإسكان الخاصة في البحرين

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

إعداد

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