

# **Investigation of Delays in Construction Projects: The Case of Jordan-Amman**

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## **ABSTRACT**

Delays in the construction could be defined as a delay in project delivery according to the plan presented during the specified time. The issue of development delays is a worldwide marvel, numerous specialists have led a few investigations to discover the fundamental factors and reasons of postpone causes. It is a standard in the development business that accomplishment of the conveyed venture is estimated by; the timetable season of the specific undertakings inside the cost issues and as per the pre-depicted guidelines of required quality. Consequently, it is imperative to recognize and arrange the potential factors that cause delays during the conveyance of the undertaking. As of recently, numerous investigations are closed and a lot more are as yet under advancement to distinguish the variables causing delay in development extends nonetheless, in handy terms, Jordanian development industry experts despite everything experiences absence of mindfulness on the reasons for venture delays henceforth, no successful insurances are thought of. The postponements in development must be decreased if their sources are known. Thusly, this investigation intends to explain the variables that can bring about development time-expansion and discover arrangements of augmentation time issues in the business of development in Jordan. Inside this unique circumstance, thinking about the social and social habits of the business experts, a framework is proposed with the intention of breaking the squares of traditionally adopted project management principles of Jordanian construction industry professionals. In this research, with the help of conducted questionnaire targeting competent authorities and other stakeholders, project delay factors are identified and grouped based on their roots. This study revealed that, the most critical factors that lead can be resulted in delays in Jordan such as; Delay for

interim budget of the owner/client to contractors and the difficulties of providing funds into projects by the contractors. Client-related delays, in this study was determined as a serious problem that can result in delay such as; designing issue, and labors related delays. In addition, the period of the project and cost overruns are the typical consequences in time extension. In Jordanian construction companies ignore the causes of delays until they actually occur and unavoidably, when this happens, it becomes too costly to reschedule as wasted time can never be recovered. For this reason, a framework will be created, along with proposing appropriate solutions to these delays to contribute to quick decision-making before or after the occurrence of these delays.

**Keywords:** Construction Delay, Project Delivery, Delay Factors, Jordanian Construction Industry

## ÖZ

İnşaat yapımındaki gecikmeler, belirtilen süre boyunca sunulan plana göre proje teslimatındaki gecikme olarak tanımlanabilir. İnşaat gecikmeleri sorunu küresel bir fenomendir ve birçok inşaat yönetimi uzmanı inşaat gecikmelerinin nedenlerini ve etkilerini araştırmaya çalışmıştır. İnşaat sektöründe teslim edilen projenin başarısını; Projelerin bütçe dahilinde ve önceden tanımlanmış kalite standartlarına uygun olarak zamanında teslim edilmesi belirler. Bu nedenle projenin teslimi sırasında gecikmelere neden olan potansiyel faktörlerin belirlenmesi ve sınıflandırılması çok önemlidir. Şimdiye kadar, inşaat projelerinde gecikmeye neden olan faktörleri belirlemek için pek çok çalışma yürütülmüş ve daha pek çoğu henüz devam etmektedir, ancak pratik olarak Ürdünlü inşaat sektörü uzmanları, proje gecikmelerinin nedenleri konusunda hala bilinçsizlikten mustarıdır. İnşaatteki gecikmeler, ancak kaynakları biliniyorsa azaltılabilir. Bu nedenle, bu çalışmanın temel amacı, Ürdün'deki inşaat sektöründe yaşanan gecikmelerin başlıca nedenlerini ve bu gecikmelerin çözümlerini belirlemektir. Bu bağlamda, sektör profesyonellerinin sosyal ve kültürel tavırları dikkate alınarak, Ürdünlü inşaat sektörü öncülerinin geleneksel olarak benimsediği kalıplaşmış proje yönetimi ilkelerini çürütmek amacıyla bir çerçeve önerilmektedir. Bu araştırmada, yetkili makamlara ve diğer paydaşlara yönelik yürütülen anket yardımı ile proje gecikme faktörleri tanımlanmakta ve köklerine göre gruplandırılmaktadır. Bu çalışma, Ürdün'deki proje gecikmelerine yol açan en önemli faktörlerin mal sahibi / işveren tarafından tamamlanan işin yüklenicilere ödenmesindeki gecikmeler ve müteahhitlerin projelere fon sağlamadaki zorluklar gibi finansal sorunlar olduğunu ortaya koymuştur. Müşteriyle yaşanan gecikmeler, gecikmelere neden olan en önemli gruplar olarak sıralanır, ardından tasarımcı ile ilgili

gecikmeler ve işçilikle ilgili gecikmeler gelir. Dahası, zaman ve maliyet aşmaları, inşaat projelerindeki gecikmelerin tipik sonuçlarıdır ve ne yazık ki, çoğu Ürdünlü şirket gecikmelerin nedenlerini gerçekten meydana gelinceye kadar görmezden gelir ve bu olduğunda kaçınılmaz olarak, boşa harcanan zaman asla geri kazanılamayacağından yeniden planlamak sanıldığından çok maliyetli hale alır. Bu nedenle, Ürdün inşaat sektöründeki gecikmelerin en önemli nedenlerini belirlemek için bir çerçeve oluşturulacak ve bu gecikmelerin meydana gelmesinden önce veya sonra hızlı karar alınmasına katkı sağlayacak çözüm önerilerinde bulunulacaktır.

**Anahtar Kelimeler:** İnşaat Gecikmesi, Proje Teslimi, Gecikme Faktörleri, Ürdün İnşaat Sektörü

## **DEDICATION**

**I dedicate this work to all my family**

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# Chapter 1

## INTRODUCTION TO THE RESEARCH

### 1.1 Introduction

Constructions sectors are world's largest if not one of the crucial industries in any country (Duran, Lenihan, & O'Regan, 2006). The project of construction is generally recognized as effective when it finishes within the time on schedule, the exact budget, within the requirements, and to the fulfillment of the stakeholders (Majid, 2006). Jordan's. It contributes to 5.3 percent of the country's Gross Domestic Product (GDP), (Al-Smadi, 2018). The value-added as a result of construction activity was 55.1 percent of the overall added value in 2015 (Alnsour, 2016).

The success of project can be achieved when the objectives and goals.. On the other hand, apart from the parameters that interest the direct stakeholders and commissioning of construction projects with minimum exposure of construction activities related nuisances on to surrounding community (Celik, 2014). According to Ogunlana et. Al (1996), construction industry did not properly plan for subsequent project management issues and many projects suffered delays and thereby surpassed original estimates of time and costs. Since then, not much has changed for the Jordanian construction industry. It is obvious that money is always scarce, replacement of low quality is always very expensive and wasted time can never be recovered. Therefore, strong and effective management of the time, cost and quality is the key to overall success of projects. These three parameters are also highly correlated to each

other, as a deficiency in the management of one will for sure have an adverse impact on the others. Especially snail-like development of developing countries can be chalked up to the fact that poor coordination of construction resources generates delays. At the end of the day, these delays is weakening the state budgets hence productivity decreases as more money is spend for less output. In customer-supplier or owner-contractor relationships, scheduling delays are typically a very sensitive issue which often undermines the commercial outcome of the entire project (Stumpf, 2000).

For instance,in their work, Odeyinka and Yusif (1997) explains that seven out of ten projects in Nigeria have faced delays during the execution phases of the projects and (Ajanlekoko, 1987) noted that the construction industry's performance was poor in terms of time. In Saudi Arabia, it was found that only 30% of construction projects were completed within the scheduled completion dates and that the average length of time overrun was between 10% and 30% (Assaf, Al-Khalil, & Al-Hazmi, 1995).

Another review in Malaysia inferred that 17.3% of 417 open tasks encountered a postponement of roughly three months in 2005 (Sambasivan and Soon, 2007). The business didn't appropriately get ready for resulting venture the executives issues. Numerous activities endured delays and consequently outperformed unique assessments of time and expenses (Ogunlana, Promkuntong, and Jearkjirm, 1996). What's more, one of the analysis coordinated and suggested to Nigerian development industry by the specialists is the increasing pace of undertaking conveyance delays. Deferral is a circumstance wherein the temporary worker and the task proprietor contribute mutually or severally to the undertaking's inability to finish inside the first

or concurred contract period (Aibinu and Jagboro, 2002). Jordan is additionally one of these nations confronting extensive measure of deferrals in the development business.

By reading previous research and articles, we found Malaysia and Nigeria are the closest examples to Jordan in terms of delay in the construction industry. especially in the past decades, several construction projects are to contribute for the development of Jordan's infrastructure facilities. These include bridges, roads, lakes, water and storage facilities, and mass housing project (Ameh & Osegbo, 2011).

During the implementation of these projects, extreme delays for which the Jordanian construction industry is not well prepared occurred. Unfortunately and Jordan's construction industry is not surprised to facing.

Litigation and loss of opportunity because resources are tied up in delayed projects necessitates the importance of understanding the underlying causes of project delivery delays. Need for appropriate response plans to delays becomes inevitable (Aibinu & Jagboro, 2002).

Many of the conducted studies discuss different delay analysis techniques and propose recommendations to improve project time performance. For construction projects in general, remains poor and project delays seem unavoidable (Mittal, Paul, Rostami, Riley, & Sawhney, 2020).

This study puts forward a reason for abovementioned construction delays and suggests that the first step to correct this delay anomaly should be to identify the root causes of the delays to develop specific corrective measures. Therefore, in this study, the root



causes of construction delays and their impact on the Jordanian construction industry will be examined in depth and root-wise mitigation strategies will be developed through a proposed checklist approach to mitigate if cannot eliminate the construction delays.

## **1.2 Problem Statement**

Jordan's industrial sector is the country's backbone, and plays a major role in providing jobs. (Sweis, 2013). Construction has grown rapidly as specifically this sector contributed to Jordan's GDP growth by 6.5 percent between 2000 and 2009 whereas the real growth was just 2.5 percent between 2010 and 2016. In addition, Jordan's overall public debt has risen at a pace that is beyond economic development. At the end of 2016, this resulted in a debt-to - GDP ratio of 95% compared to roughly 61% in 2010.

The funds invested in Jordan for public and infrastructure projects is increased from JD 2.5 trillion (2003) to JD 6.5 trillion in 2006. Nominal GDP in 2006 was JD 14.3 trillion, with an annual real growth of 6.4 percent, of which 11.6 percent was in the construction sector but this growth has accompanied many problems (Hammad, Ali, Sweis, & Bashir, 2008).

In Jordan most infrastructure projects are marked by cost and time overruns which leads to many disputes and financial losses (Tarawneh, Sarireh, & Tarawneh, 2020). Delay problem is critical and there are several explanations why there are delays. These may be due to strikes, rework, bad management, short-lived supplies, equipment breakdown, Variation Orders, (VOs) and type of contract where construction contracts allow the owner to modify, add and delete work items through a VO at any time, delay

problem is critical, and needs to be researched (Gharaibeh, Matarneh, Arafeh, & Sweis, 2020). In Jordan, these changes are dealt agreed among the parties to deliver the project.

The project delivery system is the mechanism by which a project is planned and implemented comprehensively for a proprietor. As the definition of the and closure and start-up are the stages of probable delays and requires a comprehensive Project delivery and tracking system (Demetracopoulou, O'Brien, & Khwaja, 2020).

There are different types of (D-B-B) and design-build (D-B), (BOT), but the most famous project delivery method in Jordan is the design bid build (DBB)/ New findings have uncovered substantial delays in Jordan's public programs, which warrant further investigation. It is imperative for any corrective steps to consider the root causes of these delays (Odeh & Battaineh, 2002).

Unfortunately, until now, there is no standardised recipe which exists to identify the root problem of Jordan's construction delays occurring as a result of poor project management. Considering the industry's boom and the growing complexity of projects it must be investigated and somehow resolved.

### **1.3 Aim and Objectives of the Study**

This study is aiming to suggest a comprehensive and a generic framework to avoid experiences, views and opinions of the Jordanian construction industry's professionals. Comprehensive literature review, a questionnaire survey targeting the professionals in Jordanian construction industry, and pre-pilot study are the methods adopted through the below identified sequentially listed objectives for meeting the targeted aim:

1. To prepare a categorization of the root delay factors identified in the previous step.
2. To rank each identified factor based on their hierarchical significance.
3. To develop a conceptually generic framework to eliminate the time overrun in civil engineering projects in Jordan with the incorporation of project stakeholders' contributions.

## **1.4 Methodology**

The research design or pattern of this present in this study is quantitative methods have been used (interviews and surveys respectively) to collect the data. A number of research articles and books and a pilot study in the area of construction management structured the questionnaire

## **1.5 Guides to Thesis**

In part 2 the attempted past examination occurred. Writing survey section. underlines titles applicable to this thesis point, Sort of Defers, for example, Basic or non-basic and Forgivable or non-passable likewise Compensable or non-compensable and Simultaneous or non-simultaneous. What's more, it will speak commonly about the plan delays in the tasks of development in various nations followed by ID of Timetable Postpone Components and Classes which impact on the time and cost overwhelm in the undertakings moreover, section 2 discussions about constructability and the relief technique to make sense of the method of the answer for the subject issue in the following parts. The procedure for this examination is expressed in section 3. Section 3 talks about the substance, nature, and technique of the survey embraced for this examination, the poll audit and results and the synopsis of the outcomes got. In the fourth part, the outcomes will be introduced and examined in detail and in the fifth section, an illustrative system will be introduced to the most significant reasons that

cause delay in the Jordanian development industry, with proper arrangements appeared. Follow by section 6 which will show the finish of this investigation.

## **Chapter 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Construction is a wide, competitive and compound sector adapting procedures for the construction of new renovation processes that include additions, modifications or maintenance and rehabilitation of old structures (Behm, 2008).

In order to successfully completion a construction project , it is important that the structure is carried in a specific time (schedule), and the quality expected is achieved (Ergonul & Yilmaz, 2011). All members in completing the project, and their actions can have causes and effect on time project delivered.

The word ' delay ' means either execution a job slower than expected or performing a n act that was originally planned to be done at a later date than previously.(Fugar & Agyakwah-Baah, 2010) define delay as an event that causes extended time to complete all or part of a project. Delay can be expressed as a time overrun, either behind time of finishing by contracts or behind the prolonged contract time when this time is granted. Delays in construction have always been a topic of concern for construction management researchers, identify delay as the most common, complex and universal phenomenon in construction (Ahmed, 2003).

Regardless of the construction process can be awarded with a construction project are direct negotiation and competitive bidding in the construction sector(Ergonul & Yilmaz, 2011). However, the actions taken by the contractor when implementing projects differ depending on the type of project delivery method. Therefore, when knowing the appropriate project delivery method for project implementation, this will increase of successful project delivery on time (Ghasemzadeh, 2014).

delays in the construction industry, causes that lead to delays depending on the participants in the project, and the effect of these delays on the construction industry are discussed. In the second part, the definition of the project delivery method, its types compatible with the study, and the way to avoid the causes of delay are discussed in detail.

## **2.2 Type of Delay**

Many factors and reason could be behind the delay .(Ahmed, 2003) gathered factors causing delays into two classes: internal external reasons. Internal reasons emerging from different parties such as; contractor, client, and consultant). external reasons, emerge from occasions outside the ability to control of the gatherings, government activity, and material providers. There are four basic ways to categorize delays classified by (Fugar & Agyakwah-Baah, 2010):

- 1) C or – non-C
- 2) Ex or- non-Ex
- 3) Com or non-Com
- 4) Con or non-Con.

### **2.2.1 Critical and Non-Critical Delays**

Dangerous delays are those common delays that affect the development of the project in such a method that result in a forecast delay to the project accomplishment time. However, many delays happen that do not delay the project accomplishment time. Delays that disturb the project accomplishment are reflected dangerous delays, and delays that do not disturb the project accomplishment are considered noncritical delays (Trauner, Lowe, Nagata, & Manginelli, 2017). The concept of “critical” delays emanates from Critical Path Method (CPM) scheduling.

(Trauner et al., 2017) have Determined which actions really control the project accomplishment date depends on the following:

- 1) The project
- 2) The plans and schedule of contractor
- 3) The requirements of the agreement for arrangement
- 4) The physical constraints of the project.

### **2.2.2 Ex or Non-Ex Type**

All delays are sorted in many types. Excusable-delays are unforeseeable-delays that are beyond the their influence. Non-excusable delays are predictable delays or under the control of the contractor. These are some examples of excusable delays:

- Owner-directed changes
- Unusually severe weather
- Errors and omissions in the plans and specifications
- Acts of God
- Constructive changes
- freight embargoes
- Fires.

Non-Ex type deferments are delays, which the all the responsible also reasons or accepts the risk for. These deferrals might be the results of miscalculates of efficiency, construction botches, inadequate arrangement or botch, issues, or negligible misfortune. Such deferrals are innately the contractor's duty and no help is permitted. These deferrals are within the contractor are expected; however, it isn't important that they are both.

### **2.2.3 Compensable and Non-Compensable Delays**

Excusable Compensable (EC) delays are delays that are caused by, are within the control of or are due to the negligence of the owner, who is contractually responsible. These are the delays that typically entitle the contractor to both a time extension and delay damages. Examples include a failure to grant site access, rough drawings and specifications, and the late arrival of owner-furnished material (Student). While non-compensable delays are affected by third parties. These delays are usually named "acts of God" because they are not the concern (W. e. Alaghbari, Kadir, & Salim, 2007).

There is a strong relationship between the delay and the type of contract. In normal contract it should be a well definition of the type of delay that could be happen during the project implementation, this contract can give the contractor a right to the time extension.

### **2.2.4 Delay of Concurrent or Non-Concurrent**

The concurrent delay type gives a good example of nowadays delay problems. The concurrency it is not just used for determining the delay problems, but it also can determine the serious problems that can be resulted from delay and drag the project into wrong way. Usually the contractors prefer to claim the owner as the reason of delay. Unlikely, a few types of contracts discuss the this kind of delay and how it could be affected on the contractors when they apply for time extension.



To clarify the concurrent delays issue, each delay has to be defined its impacts on the other tasks. A guideline for this type of delay should be written. If the types of Ex and non-Ex delays have happened, a time postponement should be provided to the contractor. In contrast, if excusable type of delay with/without recompense has happened, time extension should be allowed to contractors but without damage. In case of other form of delay happens, it is allowed to contractor to take time extension and damage responsibility.

### **2.3 Causes of Time-Schedule Delays in Projects**

The life cycle of the project is facing difficulty by the grouping of different parties , and There are many steps of work until the end of the project ,(Puspasari, 2005) Many factors relate to the reason of timeline delays in the projects , Different people have investigated and identified the causes of timetable delays in projects. These were some of the preceding articles.

(Frimpong, Oluwoye, & Crawford, 2003) have conducted a research in the reasons for the causes of delay and cost overrun in groundwater drilling projects between 1970 and 1999 in Ghana, They cited twenty six (26) delay factors under three categories (owners of the groundwater projects, consulting offices, and contractors working in the groundwater works).

Mansfield, Ugwu, and Doran (1994) Examined the causes of scheduling delays and cost overruns in Nigerian construction projects, the study include sixteen(16) major factors, the most important factors were financing and payment for completed works, poor contract management, changes in site conditions, shortage of materials, and improper planning.

The causes of timetable delays in major building projects in Saudi Arabia were examined. (Assaf & Al-Hejji, 2006) one cause of delay is common between all parties, which is “change orders by owner during construction”, There are many common factors between two parties, such as delays in the payment of results, inadequate preparation and scheduling by the contractor, bad management of the site and monitoring by the contractor, lack of work and difficulties in financing by the contractor.

(Ubaid, 1991) They discussed contractors' performance as one of the main causes of timetable delays. They considered thirteen (13) significant factors. Those factors (contractor resources and capabilities) were related.

Toor and Ogunlana (2008) They concluded that the building industry 's problems in developing economies can be nested in three layers: problem of shortages in industry infrastructure and problems produced by clients and contractors problems, the studies include 75 reasons categorized under 10 groups was used to examine the most significant factors causing delays in the Thailand construction industry, that most significant factors related to designers, clients, contractors and finance; whereas a multi-cultural and multilingual environment were perceived as not very significant factors.

Wiguna and Scott (2005) The investigation on the 22 development ventures indicated that the most basic danger factors influencing both the time and cost of the undertaking were comparable, They were: high swelling/expanded value, structure change by proprietor, faulty plan, postponed installments on contract, climate condition and blemished development work.

(Mezher & Tawil, 1998) Directed an overview of the reasons for plan delays in the Lebanon development division. The review included (64) postpone causes, gathered into ten ( 10) huge gatherings. Contractors looked at contractual relationships according to their results, financial problems, and project management issues were the most critical causes of schedule delays.

(Al-Momani, 2000) Led a quantitative examination of the development plan delays in a single hundred and thirty (130) open development ventures worked in Jordan. The researcher found that planners, user changes, environment, site conditions, late deliveries, economic factors and increase in quantities are the key causes of schedule delays in construction projects.

## **2.4 Identification of Schedule Delay Factors and Categories**

(Ahmed, Azhar, Kappagantula, & Gollapudi, 2003) assembled delays into two classes – inner causes and outer causes. Interior causes emerge from the gatherings to the agreement (for example contractual worker, customer, and specialist). Outside causes, then again, emerge from occasions outside the ability to control of the gatherings. The following tables and figures will show components and classes which gathered By means of books, designing articles, meeting papers, ace postulations, the web and master interviews in the companies of Jordan.

### **2.4.1 Owner Related Delay Factors**

Several studies identified owner related delay factors which trigger delays in the schedule, Assaf et al. (1995) considered the most basic factor of postpone identified with the proprietor, Late in inspecting and supporting structure archives by proprietor, Change orders by proprietor during development that cause a defer issues, and another study by Odeh and Battaineh (2002) show that Money and

installments of finished work .Proprietor interference, Slow dynamic by proprietors, Unreasonable forced agreement span have high effect to the reasons for delays, Based on this previous literature review by (Assaf & Al-Hejji, 2006), the author identified twelve (12) factors of owner related delays as shown in Table 2.1.

Table 2. 1: Owner related delay factors (Assaf & Al-Hejji, 2006)

<b>Number</b>	<b>Factors</b>
1	Slowness of the owner's decision-making process
2	Delay in appointment of consultant
3	Increase in quantity of work (Additional works)
4	Finance and payment of complete work
6	Suspension of work by owner

#### **2.4.2 Consultant Related Delay Factors**

Category of specialist based postpone factors has been accounted for as one of the reasons for plan delays in development extends, A few examinations distinguished expert related variables that cause delays. (Long, Ogunlana, Quang, & Lam, 2004) distinguished the components of Deficient experience ,Absence of normalization in configuration, Absence of duty, Unrealistic design,Inadequate venture the executives help, Slow reaction ,Absence of association through task life.

Table 2.2: Consultant related delay factors (Ozdemir, 2010)

<b>Number</b>	<b>Factors</b>
1	Agreement on the major changes in the project
2	Errors in designing documents
3	Inadequate experience of consultant
4	Uniting time for approval of tests and inspections

### 2.4.3 Contractor Related Delay Factors

Contractor is a important part in delay factor of the reasons of scheduling delays in building projects. Many studies conducted on which trigger delays in the schedule.(Chan & Kumaraswamy, 1997) identified the factors of that contribute to causes of delays. Recognized the contractor related delay reasons as show in table 2.3.

Table 2.3: Contractor related delay factors (Chan & Kumaraswamy, 1997)

<b>Number</b>	<b>Factors</b>
1	Delay in mobilization by contractor
2	Poor performance of contractor
3	Site management
4	Mistakes during construction and make rework due to specific errors
5	Difficulties in financing project by contractor
6	Quitting the work by contractor
7	Delays in subcontractor's work
8	Inadequate front-end planning of project

### 2.4.4 Designer Related Delay Factors

The category of reasons related to the delay was recognized as one of the causes of timetable (Abd El-Razek, Bassioni, & Mobarak, 2008) Established the reasons of project changes made by the mistakes by designers who have a strong impact on the causes of the delays. Related to these factors there are some factors discussed by (Ozdemir, 2010)described delay factors as shown in Table 2.4.

Table 2.4: Design related delay factors (Ozdemir, 2010)

<b>Number</b>	<b>Factors</b>
1	Unpredictability of venture plan
2	Postponements in delivering configuration archives
3	Inadequate design team experience
4	Design errors made by designers

#### 2.4.5 Supplier Delay Related Factors

Many investigations have recognized design related delay reasons which cause delays in the schedule (A. A. Aibinu & Odeyinka, 2006), which is the late to deliver the equipment and tools to the sit project on the write time in have big effect on the project process,(Salunkhe & Patil, 2014) has identifay the factors related to the supplier as it shows in the table 2.5.

Table 2.5: Supplier related delay factors (Salunkhe & Patil, 2014)

Number	Factors
1	Unavailability or shortage of required materials from supplier
2	Change and acceleration in provider costs (materials)
3	Slow or Postponed material or hardware conveyance to extend site

#### 2.4.6 Public Authorities Related Delay Factors

The category of public authorities related delay reasons was documented as one of the causes of timetable delay. (Acharya, Lee, & Im, 2006),below table 2.6 shows factor related to public authorities.

Table 2.6: Supplier related delay factors (Acharya et al., 2006)

Number	Factors
1	Complicated administrative and governmental procedures (institutional problems)
2	Political Issues-Changes
3	Changes in law rules

#### 2.4.7 Labor Related Delay Factor

The category of public authorities related delay reasons was recognized as one of the causes of timetable delay (Acharya et al., 2006).

## **2.5 Effect of Delay**

There are many factor effects the delay in the construction industry, a few selected related articles on the causes and effects of delay on construction works were presented in this section, Mansfield et al. (1994) examined in Nigerian in many projects. The findings showed that funding and payment are the most significant factors

(Owolabi et al., 2014) reasoned that the fundamental driver of deferrals in development ventures are fashioners, client changes, climate, area conditions, late conveyances, financial conditions and amounts increment.(A. Aibinu & Jagboro, 2002).

Main causes and factor of delay of construction projects:

## **2.6 Project Delivery Methods**

Project delivery play to delivered the project on-time (Ghasemzadeh, 2014) .With a framework utilized by an organization or proprietor for arranging and financing plan, development, activities, and support administrations for a structure or office by going into lawful concurrences with at least one substances or gatherings to deliver design and construction services.

### **2.6.1 Types of the Project Delivery Methods**

For each method of delivery usually they have advantages and disadvantages and should be applied where the advantages exceed the cost. In general sector, this customarily involves the practically utilization of system framework, including the partition of plan and development administrations and the successive execution of plan and development. Lately, in any case, the general sector has started testing elective strategies and proficiency of forms. These elective frameworks have been closed to the incorporated administration's. No single undertaking conveyance framework is

generally proper for any sort of venture. Rather, blends of various procedures are utilized for various conditions (Gordon, 1994).

Involving the construction sector in Jordan, the most famous project delivery systems are sorted below with (\*):

1. D-B method.
2. D-B-B method (\*).
3. B-O-T method (\*).
4. C-M Agency.

### **Design Build (DB)**

Design/build is the most common approach that is regarded as a new and alternative delivery method in the manufacturing industry (Ibbs, Kwak, Ng, & Odabasi, 2003) . This strategy for venture conveyance incorporates one substance (plan manufacturer) and a solitary agreement with the proprietor to give both building/designing structure administrations and development. This entity may be a designer who has hired a construction firm or a designer who self-performs construction. It can also be a construction firm that acquires or enters into a joint venture with a design firm for the same purpose (Thomas & Lester, 2015).

### **Design Bid Build**

The conventional U.S. venture conveyance technique, which normally includes three successive task stages: The plan stage, which requires the administrations of a fashioner who will structure the undertaking; the offer stage, when a temporary worker is obtained; and a form or development stage, when the task is worked by the temporary worker. This grouping for the most part prompts the fixed offer, fixed value



contract.

(D-B-B) method is the most famous project delivery method in the industrial sector its contain Two separate contracts: owner to designer and owner to contractor. The Owner is responsible for any “gaps” between the plans and specs and the owner’s requirements for performance as well as functions as for all project parties such as; project manager and architects, experts, and temporary workers until presenting the undertaking. The contractual worker is mindful to assemble the venture as structure inside details and norms.

### **Build Operate Transfer (BOT)**

The B-O-T method is considered as strong method in the infrastructural facilities. the first BOT venture authoritatively actualized in quite a while was during the 1980s, as a major aspect of a transition to privatize framework activities and huge force plants in Turkey (Algarni, Arditi, & Polat, 2007).

## **2.7 Constructability**

During the 1980s the idea of buildability was brought into the development business. From that point forward, an assortment of studies have been completed investigating how standards of constructability can be adequately applied practically speaking. The accompanying segments present a survey of existing endeavors and commitments in the field of development, from its definition and credits to the turn of events and misuse of PC based apparatuses.

### **2.7.1 Definition**

An assortment of constructability definitions have emerged dependent on venture needs and necessities. Now and again alluded as "buildability, "generally in Joined

Realm .As characterized by (Low, 2001) the degree to which the structure of the structure encourages simplicity of development, subject to the general prerequisites for the finished structure". (Fischer and Tatum, 1997) Altered the buildability definition to address the Plan Development interface legitimately "Constructability is the degree to which the structure of the structure encourages simplicity of development, subject to the prerequisites of development techniques.". constructability characterized by the Development Business Organization (CII) Endeavoring to utilize building information and involvement with arranging, plan, acquisition and field tasks to accomplish by and large venture targets (Institute, 1986). As the definitions demonstrate, however fluctuated, the ideas of constructability center around encouraging the usage of undertaking plan through the contribution of building information and experience.

### **2.7.2 Benefits of Constructability Beyond Cost Savings**

Benefits accrued by implementing constructability are often hard to quantify. Typically, they are measured by documented benefits from realized constructability ideas. The cost of design, construction labor, and materials used to complete a given alternative design is relatively easy to track. Nevertheless, buildability requires creating ideas that optimize the construction process (Russell, Swiggum, Shapiro, & Alaydrus, 1994).

Constructability benefits include reduced labor costs in the field, reduced waste materials, improved safety and streamlined construction. Several practices have been developed to formally manage the buildability knowledge during project design, Benefits can be either quantitative or qualitative as shows in Table 2.7 which done by (Pulaski, Horman, & Riley, 2006).

Each of these quantitative types of benefits contribute to a decrease in infrastructure, building costs, and scheduling times. Nevertheless, the size of the benefits calculated in saved dollars varies; strategic decisions have the greatest effect on the design and development costs and on the timetable of projects.

Table 2.7: Framework for Determining Constructability Benefits

Constructability benefits	
Quantitative	Qualitative
Lessen building cost	Increased problems avoidance
Lessen plan term	Improved site accessibility
Lessen development cost	Reduce disruption to current production
	Reduce amount of rework
	Increased focus on a common goal
	Increased communication

## 2.8 Mitigation Strategy

Mitigation means reducing the risk of losses arising from any unwanted event (Chai, Yusof, & Habil, 2015). Despite various project management strategies and the availability of project control tools, project teams are still struggling to meet their goals for time and expense. Project delays in infrastructure are still possible, though various mitigation measures are taken into account, Efforts to reduce losses are necessary to minimize, and this can be accomplished by forecasting and detecting issues in earlier stages and thereby diagnosing the causes of delays in finding and implementing the most suitable economic solutions, building ventures are sectioned and confused and include more factors and vulnerabilities due to overbuilding exercises. This improves the probability of postpone which makes compelling task the board critical to keep the arranged timetable from being redirected (Chai et al., 2015). The following table 2.8 tabulates the mitigation measures suggested by the researchers.

Table 2.8: Mitigation measures (Chai et al., 2015)

No.	Mitigation Measures	Sources
1	Comprehensive contract documentation	Abdul Rahman et al. (2006); Olawale and Sun (2010); Kasimu and Abubakar (2012)
2	Hire an independent supervising engineer to monitor the project	Abdul Rahman et al. (2006)
3	Multidisciplinary/competent project	Abdul Rahman et al. (2006); Olawale and Sun (2010); Smart Market Report (2011)
4	Accurate initial time estimates	Ng (2007); Abdul Rahman et al. (2006); Love et al. (2000)
5	Use up to date technology	Abdul Rahman et al. (2006); Olawale and Sun (2010)
6	Accurate initial cost estimates	Abdul Rahman et al. (2006); Olawale and Sun (2010); Kasimu and Abubakar (2012); Love et al. (2000); Smart Market Report (2011)
7	Perform a preconstruction planning of project tasks and resource needs	Ng (2007); Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010)

This research will come up with mitigation strategy for each factors to solve the delay problems by create a check list templet before construction management do start this check list have to be filled and review by contractor forms in a way it converted to constructability review report which is targeting the time overrun in civil engineering project based on these factor that identified and mitigation suggested.

## **Chapter 3**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter shows in detail how the research is conducted. The chapter contains the following subsections: Questionnaire; Design of questionnaire; Questionnaire procedure and Questionnaire analysis.

#### **3.2 Questionnaire**

A questionnaire was prepared to identify and classify the causes of the delay in construction project in Jordan-Amman. It was believed that preparing a questionnaire would be the most suitable method to gather information from the stockholders. The causes of delay are many. Therefore, the target of this questionnaire is to determine the most important of these causes to be tested in this study to classify these causes according to their degree of danger on the delay in construction in Jordan and try to find solutions to them.

##### **3.2.1 Design of Questionnaire**

The questionnaire was designed to gather information from the contractor firms. To ensure the questionnaire design worked well with the targeted contractor companies, a pilot study was conducted within the contractor firms, engineers, and architects, as a result of this pilot study, small changes made to the questionnaire according to the suggestions of the experts. \*Questionnaires prepared before and after pilot study are given in Appendix A.

for our research, the survey was conceived using Google Forms and circulated online via e-mails sent to construction industries throughout the country in addition to video interviews and also delivered by hand to locations. And this questionnaire was established to examine and evaluate owners, consultants, designer, contractors and supplier ' responsiveness to the importance of factors causing construction project delays. And these survey get the ethical poured approval from the graduate institute before send it to the company's.

The survey included a brief introduction to the intent of this research to help professionals understand the purpose of the questionnaire and answer the severity impact, for each factor.

The first part incorporated the demographic and operational qualities for the respondents, the second section contains 37 delay factors obtain from literature review and previous articles which classified under 7 groups to test the delay impact of these factors on the capital of Jordan, these factor determined by using a pilot study by talking to the expert engineering to ensure that these factors are good for doing analysis on them, in addition, some previous article and research were taken to determine these factors.

by using the a five-point scale of 1 to 5 (Likert)was considered. Following values of numerical effect are assigned to the ranking of the respondents:

The answer from the respondents will depend on the factor, if the respondent sees that factor, not an effective factor, they will give this factor answer 1 or 2 but if they see that his factor in the middle as normal they will give it 3, and the effective answer will start from 3 and above, if the answer was 4 that means the factor is a very significant

factor, in the other hand, if the respondent gives this factor 5 that means this factor is extremely important and important (Joshi et al., 2015).

### **3.2.2 Questionnaire Procedure**

A list of contractor companies in Jordan was obtained from the Jordan Contractors Association (JCA), There are about 3,251 contracting companies in Jordan, 1,200 of them are in the capital, Amman. The top 100 active contractor firms who are specialized in building construction were selected to participate in this research.

Every company in Jordan has a rank, there is a first rank, a second and a third and a fourth rank, the higher ranks were chosen from the first and second rank so that the results are stronger, out of 100 companies there are 50 companies who agreed to conduct the interview to take information from them about the questionnaire, appointments were arranged With them and make video calls to get their answers and include them in the survey All of the interviews were completed in Jan-Feb 2010.

The mother tongue spoken in Jordan is Arabic and the piloted questionnaire was therefore translated into Arabic for a better understanding of the participants. Every query and its answers and comments were read out to the participants. It took about 30 minutes to complete every interview based questionnaire.

### **3.3 Area/Location of the Study**

The location of the research is in Jordan focusing on the capital city Amman because of the number of population and the projects which is stationed in the capital, Jordan is an Arab nation on the East Bank of the Jordan River, in Western Asia. Saudi Arabia borders Jordan to the south and east, Iraq to the north-east, Syria to the north and Palestine to the west, The Dead Sea is situated along its western boundaries, and in its

extreme southwest, the nation has a 26-kilometer (16 mi) coastline on the Red Sea. Jordan is strategically located at the Asia, Africa and Europe crossroads, Amman, the capital, is the most populous city in Jordan, and the economic, political, and cultural hub of the country.

### **3.4 Questionnaire Analysis**

In this research, the Excel and Social Sciences Statistical System (SPSS) has been used.

The questionnaire findings are presented using bar charts, pie charts and tables of analyzed results using simple statistical methods and (SPSS) programs to make it very clear and simple SPSS is one of the most commonly used predictive analytics systems in the social sciences. It could be used in analysts of markets, health analysts, researchers, marketing administrations, government (Argyrous, 2009).

All raw data were obtained from the respondents in this Statistical section. The calculation is made easier and faster with the SPSS software than in other ways. Firstly, the parameters and rating system were entered in different views of SPSS software. After that the raw data in the View tab should be put in the correct order. In this research session, we had to measure the mean in addition to the relative important index.

The "mean" is the "average" in which all the numbers are combined and then divide by the number of numbers while the "median" in the list of numbers is the "middle" value. To find the median, it is necessary to list the numbers from the smallest to the largest in numerical order and in the end the "mode" is the most commonly occurring value. If no number is repeated in the list, the list does not have a mode.



RII which can be calculated using the following equation:

towards the survey materials. The data were coded in order to quickly collect the questions into various classifications, after which the data was grouped for quick results interpretation.

The details of the analysis of the response and the result analysis of the questioners will be discussed and explained in the next chapter.

## **Chapter 4**

### **DATA ANALYSIS AND DISCUSSION**

#### **4.1 Introduction**

This chapter presents and discusses the results of the survey data collected and its analysis. It consists of description of the respondents, descriptive statistics of the data, the results concerning delay in Jordanian projects and causes of delay. The main objective the questionnaire review is to identify all thirty-seven factors within the groups identified. The ranking system was organized according to the degree of importance of each parameter. The selected factors are divided into group and each group was evaluated separately to achieve a better result. With this approach, the most powerful factor in each group could easily be identified.

#### **4.2 Parts of Questionnaire**

Cronbach Alpha measurements were utilized to test the dependability of the scale. In this structure, Cronbach Alpha qualities were determined for each factor independently. Moreover, the commitment of the inquiries of the scale to the components to which they have a place and the dependability of the entire scale was inspected with the assistance of Cronbach Alpha insights when the thing was erased. After the analysis, all items contributed positively to the reliability of the scale, and alpha values of 0.70 and above (Hair & Tripp, 1995) were determined as the minimum criteria to confirm the reliability of the scale. Cronbach's alpha is one of those measures most widely used to determine the accuracy of science.

One of the most important aspects that any researcher should take into consideration is the dependability of the data collected. Since the data is undependable, the main research process could fail, and the final response to the main objective will be improper. Whenever a study involves model estimation, it is critical to check the dependability of the scale, especially when Likert questions are included. It is an Alpha Cronbach test that tests the inner consistency or dependability of an informational collection, Testing the appropriateness of an informational index for measurable examination is among the methodologies, the rule for Cronbach Alpha's proper range is if the number is among 0.7 and up, as 0.8 (Cortina, 1993).

Table 4.1: Reliability Statistics

<b>Cronbach's Alpha</b>	<b>Cronbach's Alpha Based on Standardized Delays</b>	<b>Number of Delay</b>
0.808	0.856	50

### **4.3 Descriptive Statistics**

The engaging measurements are done in classes that incorporate; graphic segment insights of the respondents, including age, sex, organization names inspected, staff positions and years of experience. The below tables show these descriptive statistics.

### Working Positions

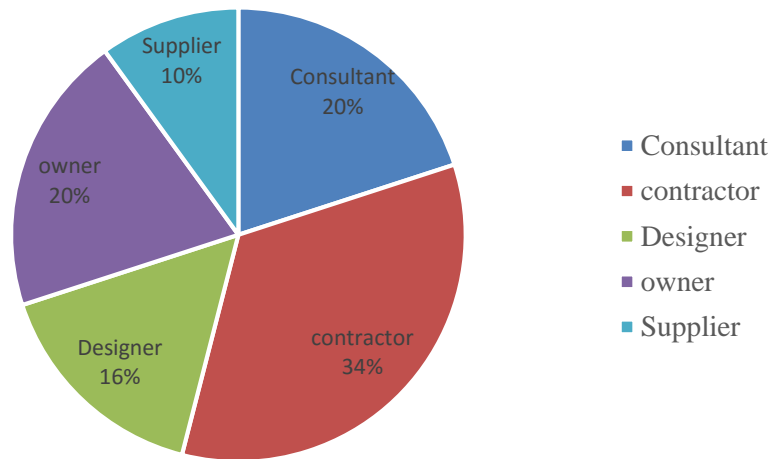


Figure 4.1: Respondents' working positions

From figure 4.1 it can be seen that the highest respondents are the contractor with percentage 34%, while 20% of respondents are designer, followed owners and consultant with 20% for each of them, then with lowest rates supplier with 10 %.

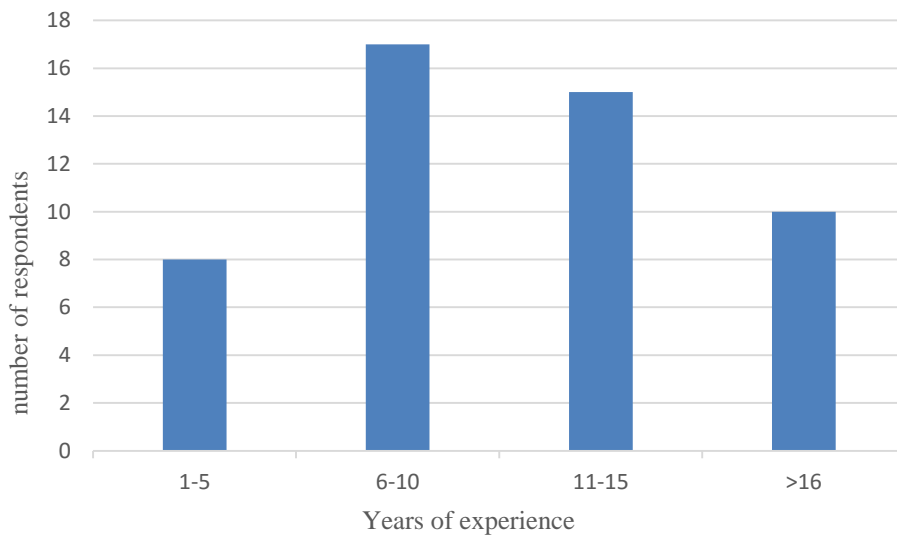


Figure 4.2: Respondents years of experience

## 4.4 Analysis of Responses

The files were then evaluated, as appeared in Table 1. The high 20 positioning from all the components will think about them for the structure arrangement. The mean records and the positioning of all gatherings are appeared in Table 4.2.

Table 4.2: Relative important index and ranking of delays factors

Categories	Factors	Mean	RII	Rank
Client	Decision of owner with low process time	3.22	0.644	7
	Delay in appointment of consultant	2.66	0.532	29
	Changes in quantities of work	3.18	0.636	8
	Delay for interim payments	3.80	0.76	1
	lack of motivation for the contractor	3.14	0.628	10
	Suspension of work by owner	2.72	0.544	27
	Increase or change in scope of the Project	3.00	0.6	16
Contractor	Delay in mobilization by contractor	2.44	0.488	32
	Poor performance of contractor	2.58	0.516	31
	Site management	3.16	0.632	9
	Reworks	3.36	0.672	4
	Difficulties in financing project by contractor	3.38	0.676	3
	Quitting the work by contractor	2.28	0.652	36
	Delays in subcontractor's work	3.3	0.66	5
	Inadequate front-end planning of project	2.3	0.46	35
Consultant	Delays in approving change order	3.1	0.62	12
	Conflicts between consultant and other contractor	3.52	0.704	2
	Absence of consultant's staff on the project site	2.98	0.596	18
	Inadequate experience of consultant	1.98	0.396	37
	Uniting time for approval of tests and inspections	2.68	0.536	28
Public authorities	Complicated administrative and governmental procedures (institutional problems)	2.36	0.472	33
	Political Issues-Changes	2.74	0.548	26
	Changes in government regulations and laws	2.36	0.472	34
Designer	Complexity of project design	2.88	0.576	23
	Delays in producing design documents	2.96	0.592	20
	lack of experience in design	3.04	0.608	15
	Design errors	3.06	0.612	14
Supplier	Unavailability or shortage of required materials from supplier	3.08	0.616	13
	Fluctuation and escalation in supplier prices (materials, machinery. Equipment)	2.6	0.52	30
	Slow or Delayed material or equipment delivery to project site	2.94	0.588	21
Labors	Absenteeism	3.00	0.6	17
	Ineffective mobilization among construction sites	2.74	0.548	25
	Personal conflicts among labor	2.8	0.56	24

	Shortage of labor	2.96	0.592	19
	Slow mobilization of labor	3.12	0.624	11
	Unqualified / inadequate experienced labor	3.26	0.652	6
	Low productivity of labor	2.9	0.58	22

## 4.5 Discussion of result

The ranking of the relative important index of the delay factors, table 4.1 shows that, differences between consultant and design engineer, Difficulties in financing project by contractor through the construction implementation due to specific errors and delays in subcontractor's work made the top five significant factors which had the highest ranking between all the factors, on the other hand, the quitting the work by contractor and Inadequate experience of consultant was the lowest rank between all factors. as the rank shows in table 4.2.

### 1. Delay for interim payments

The result shows that most respondents agree that this factor is the most important factor among the other factors having a 0.76 important index. The factor is considered under client items. An observation was conducted on the engineers in the construction site, it was concluded that the client has the weak process of payment for the contractors in the Jordanian construction industry, and after talking to different owners about this problem the reason of this late from owner viewpoint, shows that most of the answers were to take more control of the contractor.

To find out the solution for this factor, different engineering experts include previous research (Lopez, Love, Edwards, & Davis, 2010) suggest to application of interest for delayed interim payments.

## **2. Conflicts between consultant and contractor**

The second rank between all factors with 3.52 mean, that means 0.704 of respondents consider the importance of this factor, the main problem of this factor that the consultant plays the main part for many parts in the construction process which effect on the project process for example, the factor Uniting time for approval of tests and inspections has rank 28 with 2.68 mean which happens because of the consultant which affects the continuity of contractor work in the project which will lead to Delays in the project. And this late of approval has an effect on the other processes which lead to conflicts between consultants and contractors.

To find out the solution for this factor, different engineering experts include previous research (Barnea & Rubin, 2010) suggest that Authorities and responsibilities of the owner, contractor, and the Engineer (consultant) should be strictly specified under conditions of the contract. If the conflict cannot be negotiated, take the case to Arbitrator, otherwise, Jordanian courts will give the final decision.

## **3. Difficulties in financing project by contractor**

The third highest rank with mean 3.38 from respondent consider this factor between moderate and major with 0.676 important indexes, and by doing an interview with a different contractor to find out the main root of this difficulty to financing the projects, the conclusion for the answers revolves around that the contractors fall in many construction projects until they are unable to finance the projects.

To find out the solution for this factor, different engineering experts include previous research (Romeli, Halil, Ismail, & Shukor, 2016) suggest the Risk management

application for project budgeting , witch means to let the contractor to show which processes of what will happen under the risk management for project budget.

#### **4. Rework**

This factor leads to the loss of millions of dollars according to previous studies, a mean 3.36 of respondents are near to totally agree on effect this factor and the importance of this factor with 0.672 important indexes. The contractors are the most responsible part of the constriction work in the site position, these mistakes could happen because of the poor performance of contractor as respondent consider the importance of this factor is 0.516 or could happen because of weak Site management from the contractor .and the errors could be because of the different party like a designer, the design errors made by designers could lead the contractor to fall in mistakes during carrying out project plans and as mentioned above the weak performance of contractor it caused by the error not being detected before it occurs.

To find out the solution for this factor, different engineering experts include previous research (Love et al., 2018) suggest to design techniques (use of BIM) for clash detection. Experienced engineers should be hired by the contractor for intense progress monitoring.

#### **5. Delays in subcontractor's work**

The fifth rank between all factors is under the contractor items, which have 3.3 mean and 0.66 important indexes, which means the respondent considers this factor as a major factor.



The subcontractor takes the job from the main contractor, and the reason for delays in work could be related with other factors such as the first rank of the factors (Delay for interim payments) so it will effect on the contractor performance to the subcontractor performance and could be related to Low productivity of labor as respondent give this factor 0.58 important index which will lead to delay in subcontractor work.

To find out the solution for this factor, different engineering experts include previous research (Ramachandra & Rotimi, 2015) suggest to Application of proper procurement management. Apply liquidated damages.

#### **6. Unqualified / inadequate experienced labor**

Consultant were good in construction, the inadequate experience of labor will create different types of mistakes which will lead to many delays in the construction industry, for this reason, the responses agreed with 0.652 as the importance of this factor.

By taking many expert engineering opinions for the reasons of this inadequate experienced labor, most was agreeing that the Changes in government regulations and laws make it lead to imposes strict laws on the worker, which mean the government push on the labors by laws, and this lead to reduce the arrival of the skilled worker to Jordan.

To find out the solution for this factor, different engineering experts include previous research (Sepasgozar, Razkenari, & Barati, 2015) suggested to preferably certified workers should be hired and written in the contract documents.

## **7. Decision making of owner with less in time period**

The slowness of taking the decision to agree about the ideas or the way that the construction will be on by the owner its effect on all the parties of stockholders which lead to delays in many process of the construction, 65% of the respondents consider this factor as a moderate to major factors.

To find out the solution for this factor, different engineering experts include previous research (Sepasgozar et al., 2015) suggested to establishing a new, neutral position for all parties to take the final decision to solve problems between the opposing parties. Which is the same solution for the rank 2.

## **8. Change in the quantities of work**

This factor related strongly with the previous factor, which increases of the quantity work and slowness of taking a final decision of these additional work will affect directly on the time overrun, the answers of this factor by the respondent get the mean 3.18 which mean its important factor to consider it and take the solutions to not fall in this factor.

To find out the solution for this factor, different engineering experts include previous research (Tang & Tomlin, 2008) suggest a precise bill of quantities should be prepared. Put a clause in the conditions of the contract that change order cannot exceed 20% of the total cost.

## **9. Site management**

The main part which plays a strong part to manage the site is the contractor, the poor performance of the contractor as mentioned above will lead to weak site management

and it will affect the other project process. The defendants agree for the importance of this factor with 63 percent of the important indexes.

To find out the solution for this factor, different engineering experts include previous research (Schwartz, Taff, Lawhon, & VanderWoude, 2018) suggest considering the Background and experience-wise selection of the site engineers. for example: If experienced in Road contractor construction, put him to road construction. solid control of work activities for the engineer's work description

#### **10. Lack of motivation for the contractor**

To finish the project on the schedule it needs good stockholder group, specifically the contractor team, but it needs a high level of strategy to create an all the necessary procedure to finish the project before the time, which will give the benefit for all stockholder's party, but unfortunately, there is low motivation to support the contractor to finish the project before the time, and this factor got a 0.628 important index.

To find out the solution for this factor, different engineering experts include previous research (Herbsman, Tong Chen, & Epstein, 1995) suggest motivating the contractor with Early handover of work bonus.

#### **11. Ineffective mobilization among construction sites**

This factor could happen because of inadequate experienced labor as it mentions above, the need for skilled labor may delay the recruitment process, or the poor performance of the contractor will lead to delay in the mobilization of labor by a contractor but also low motivation and morale of labor from the company's will effect on the behavior of the labor to accept the job.

the respondents consider this an important factor with 3.12 mean with mean its consider between moderate to major factor.

To find out the solution for this factor, different engineering experts include previous research (Cummings & Boutcher, 2009) suggest to Inclusion of the mobilization activity into the project schedule and approval of it by the consultant.

### **12. Delays in approving change order**

As it mentions above that the conflicts between consultant and other stockholders will create different of factors which will lead to create delays in construction industry, for example when the owner increase or change in lead to create a problem between consultant and contractor because of owner changes and for this reason the approving of changes by consultant will take time, the respondent consider the important of this factor with 3.1 mean which mean 0.62 important index .

To find out the solution for this factor, different engineering experts include previous research (Doloi, Sawhney, Iyer, & Rentala, 2012) suggest to write in the conditions of the contract change order duration limitation.

### **13. Unavailability or shortage of required materials from supplier**

The project will not continue without the material required to finish the project, this factor has 3.08 mean from respondents, so it's more close to be a major factor, to solve this delay in reach the material on time without shortage, the expert engineering experts include previous research (Musazzi, Di Giorgio, & Minghetti, 2020) suggests to Application of proper procurement management. Apply liquidated damage to suppliers for the delay. Alternatively, if a unique and locally not available material is

selected in the design, change the design with locally available materials. Otherwise, include order date for special materials, or locally not available materials in the project schedule.

#### **14. Design errors**

This factor will affect the contractor's work and it will lead to creating mistakes during the construction which will be the reason for an inadequate design team experience, the respondents consider the important and they agree by giving this mean 3.06 among all factors. (Lopez et al., 2010)

To find out the solution for this factor, different engineering experts include previous research (Avirneni & Somani, 2011) suggest to Comprehensive briefing and design stage should be carried out. For some cases, owner can hire a consultant/owner's representative/consultant.

#### **15. lack of experience in design**

As mentions above it will lead to errors in the design and it will affect other processes in the project plan which will lead to many project, the mean of this rank is 3.04 which is near to the previous factor which has 3.06. that means all factors are connected to each other and one issue could effect to create more factors which all will lead to delays and lose time and money.

To find out the solution for this factor, different engineering experts include previous research (Slimani, Da Silva, Médini, & Ghodous, 2006) suggested to proper selection of designer team which mean design team could be selected through a designer tender.

## **16. Increase or change in scope of the Project**

The kind of these changes affect directly on all stockholder parties, it will need to review the design on the project., the mean for this factor is 3.00 which mean is a moderate factor because it's unique to happen.

To find out the solution for this factor, different engineering experts include previous research (Lyneis, Cooper, & Els, 2001) suggest to proper scope management should be applied by the project manager. The robust project charter should be prepared.

## **17. Absenteeism**

Absence affects the daily workflow, especially if there is no alternative to the absent elements, and the absence of workers has a significant impact, as we explained earlier, there is a lack of skilled workers in Jordan, and the absence of this skilled labor leads to delays in the work of the contractor and consequently the delay in delivering the project in the specified time. The mean of this factor is 3.00 and it's the last factor that has this rank among all factors. The stockholders mention that most laborers in Jordan work with daily salary because companies do not employ workers officially because of government decisions so this reason the laborer's absenteeism on the work if they found a better chance in another site. To find out the solution for this factor, different engineering experts experts include previous research (W. Alaghbari, Al-Sakkaf, & Sultan, 2019) suggest that the Contractors should implement proper procurement management with their work force. The highest 17 factor which they got mean from 3.00 and more was discused them in priveous paragraphs and find out the soluotion for them acorrding to previous articals and expert engineering opinions are shows in Taple 4.3 .

Table 4.3: The highest 17 factors effect on the construction delay in the Amman

Mean	Factors
3.8	Delay for interim payments
3.52	Conflicts between consultant and other contractor
3.38	Problems in budget of the project by contractor
3.36	Reworks
3.3	Delays in subcontractor's work
3.26	Unqualified / inadequate experienced labor
3.22	Decision making of owner with less time process
3.18	Changes in quantities of work
3.16	Site management
3.14	lack of motivation for the contractor
3.12	Slow mobilization of labor
3.1	Delays in approving change order
3.08	Unavailability or shortage of required materials from supplier
3.06	Design errors
3.04	lack of experience in design
3	Increase or change in scope of the Project
3	Absenteeism

The other 20 factors got mean less than 3.00 which mean they are less important from the respondent's view, but all factors still related and effective with each other, its like network connected as a big frame, for example, Inadequate front-end planning of project which got 35 rank among all factors considered as a low factor effect on the delay by respondents viewpoint but most of factor-related directly with this factor and most of them are happened because of weak front-end planning of the project such as, Poor performance of the contractor, Site management, Mistakes through construction due to specific errors, Design errors, Shortage of labor, all of these factors got high ranks and its connected directly with planning factor .in addition, other factor got ranks near to the moderate such as Delays in producing design documents.

The mean and rank of most categories effective among all categories with the most effective factor for each category are shown in table 4.4.

Table 4.4: Important index and ranking of major delay categories

Categories	Most effect factor	Mean of effective factor	Mean of each group	RII of group	Rank of category
Client	Delay for interim payments	3.80	3.10	0.62	1
Designer	Design errors	3.06	2.985	0.60	2
Labors	Unqualified / inadequate experienced labor	3.26	2.97	0.594	3
Supplier	Unavailability or shortage of required materials from supplier	3.08	2.87	0.574	4
Consultant	Conflicts between consultant and contractor	3.52	2.85	0.57	5
Contractor	Problems in budget of project by contractor	3.38	2.85	0.57	6
Public authorities	Political Issues-Changes	2.74	2.49	0.50	7

Table 4.3 shows the main effective factors that can be resulted in delay in construction projects, the main factors obtained in the present study from the view of (client, contractor, consultant, public authorities, designer, supplier and labors), have considered as the most effective factors among the other factors. Regarding the client's view, the Delay for interim payments can be resulted in time extension in the construction projects, this type of problems is very common in Jordan because it depends on the amount of work that have achieved from the contractor and on the payments come from client, this factor was in agreement with a study conducted by (Amoatey & Ankrah, 2017). On the other hand, the contractor is considered that difficulties in financing project can challenge the operation process and can affect the required time of work, difficulties in financing project can be found in my projects as stated by (Hussain, Zhu, Ali, Aslam, & Hussain, 2018). From the consultant's view it was found that conflicts in the relationship between consultant and the contractor can be a serious factor for delay. The Public authorities has provided that political issues



can change the consequence of the tasks during the implementation of the projects as stated in (Yang, Yang, & Kao, 2010). The designer have noticed the frequently changes in design stage delays the process of framework of the project, a plan was designed to manage the decision in dealing with design changes by (Hui, Abdul-Rahman, & Chen, 2017). It was good mentioned that Unavailability or shortage of required materials from supplier has important issue as responder agree with. While the labors heightened that the experience and the skills are very important for achieving the required task and duties at the specific times as stated by (Assbeihat, 2016).

The most effective category among all categories shows in table 4.3, the client got the first category with 3.1 mean as a category the second category is designer with 3.985 followed directly with labor category related factor with 3.97 mean of labor factors, as shows the labor and designer are equal categories with their effectiveness, the contractor, and the consultant category got the same important rank from the respondents according to their answer on the factors that are related to these categories with 2.85 mean which is 0.57 important index. the supplier category has a 0.574 important index as a 2.87 mean, the last category is public authority's category which got the lowest rank among all categories with 2.9 means. The following figure will summery these categories as a bar chart in Figure 4.3.

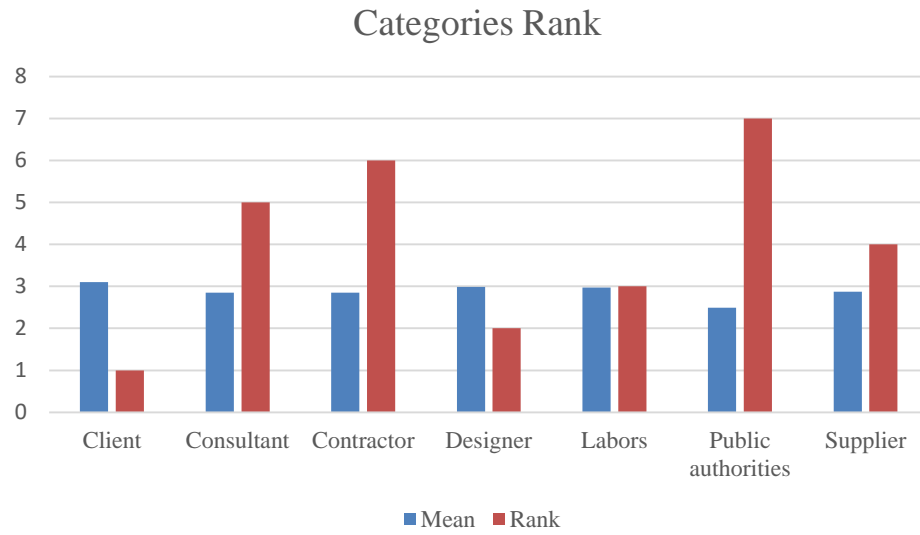


Figure 4.3: Ranking and mean of major delay categories.

## **Chapter 5**

### **DEVELOPING CONCEPTUAL FRAMEWORK**

#### **5.1 Introduction**

This chapter illustrates conceptual framework to the main factors and solutions which related to delay in the Jordanian construction industry, it's important to know these factor and their solutions to not fall in losing of schedule, especially the effect directly to the government budget, building contracts awarded in 1998 amount to 944 million Jordanian dinars and its increases every year (Odeh & Battaineh, 2002), so by this framework which is cover some of all factors will help to save time and cost overrun.

In the questionnaire survey, there was 37 factors which affects the delay in Jordanian construction industry according to the previous researcher and pilot study, after the analysis, it finds out that there is 17 factor among 37 factors has the highest effective by the responded answers, this framework will create by theses 17 factors with their solutions in three faces, face one will include the design stage

Which include 2 factors from the 17 factors with their solutions, stage 2 will have the operation factors and its include 11 factors with their solutions, and the last stage is the common stage wich have factors connected with all stages, the next table will show all of these stages together as a framework.

Table 5.1: Framework for the main effective factor with their solutions

<b>Stage 1 Design</b>	<b>Solution</b>	<b>Stage2 Operation</b>	<b>solution</b>	<b>Stage3 Common</b>	<b>Solution</b>
<i>Design errors</i>	Comprehensive briefing and design stage should be carried out. For some cases, owner can hire a consultant/owner's representative/consultant	Delay for interim payments	Application of interest for delayed interim payments.	Slowness of the owner's decision-making process  (conflict management)	Establishing a new, neutral position for all parties to take the final decision
<i>lack of experience in design</i>	Proper selection of designer team. Design team could be selected through a designer tender.	Conflicts between consultant and contractor	Authorities and responsibilities of owner, contractor and the Engineer (consultant) should be strictly specified under conditions of the contract. If conflict cannot be negotiated, take the case to Arbitrator, otherwise, Jordanian courts will give the final decision.	changes in quantities of work <b>(scope creep control) Change</b>	Precise bill of quantities should be prepared. Put a clause in the conditions of the contract that change order cannot exceed 20% of the total cost.
		Difficulties in financing project by contractor	Risk management application for project budgeting	Increase or change in scope of the Project	Proper scope management should be applied by the project manager. Robust project charter should be prepared.

Reworks	Adoption of sophisticated design techniques (use of BIM) for clash detection. Experienced engineers should be hired by the contractor for intense progress monitoring.	Absenteeism	Contractors should implement proper procurement management with their work force.
Delays in subcontractor's work	Application of proper procurement management. Apply liquidated damages.		
Unqualified / inadequate experienced labor	preferably certified workers should be hired and written in the contract documents.		
Site management	Background and experience-wise selection of the site engineers.		

lack of motivation for the contractor	Early handover of work bonus. check internet to see how to motivate contractors
Ineffective mobilization among construction sites	Inclusion of the mobilization activity into the project schedule and approval of it by the consultant.
delays in approving change order	Write in the conditions of the contract change order duration limitation
Unavailability or shortage of required materials from supplier	Application of proper procurement management. Apply liquidated damage to suppliers for delay

In Table 5.1 as it clears the common stages of the construction buildings, under the design stage the Design errors made and lack of experience in design was the factor which is related to the design, as it shows the solutions for each factor of them.

The next stage is the operation stage which include 11 factor with there solutions, and these factor are Difficulties in Delay for interim payments, Conflicts between consultant and contractor, Difficulties in financing project by contractor, rework due to specific errors, Delays in subcontractor's work, Unqualified / inadequate experienced labor, Site management, Lack of motivation for the contractor, Slow mobilization of labor, Ineffective mobilization among construction sites, delays in approving change order and Unavailability or shortage of required materials from supplier. The sequentially solutions for these factors are shows in the table 5.1 one by one.

The last stage is the common stage, which has the factors are related with all stages and can affect in any time to the projects, and these factors, Change in quantity of work , , all of these factor play in all stages, for example, the slowness of the owner decision making could be in the design stage when the owner takes time to accept the design charts or could be in the operation stage when the owner takes time to make his decision for the changes in the works. The sequential solutions for these factors are shows in the table 5.12

The benefit of know these factors and apply their solutions will help out the construction industry in Jordan to reduce schedule among the stages mentions above, these factors are some of many factors which happened during the project construction, and if create a type of contract which include all main factors in the Jordanian

construction industry will help out all the company's to save time and cost in a high level of strategy.



## Chapter 6

### CONCLUSIONS AND RECOMMENDATIONS

This instruction examined the factors which related to the delay in the construction industry in Jordan, these factor have effect on time and cost which is very important in the economics of the contries, Identifying these factors are important. Prviouse study and pilot study was collected in order to identify these factors.

A questionnaire survey used to examine these factors and categories them in groups to be ready for analysis, the analysis done by the SPSS by using mean and relative important index, the asalysis shows that there are 17 factors among the 37 factors are main and most effective factors .

The principle opjective of this examination which was resolved to start with was to recognize the postpone factors in development ventures in Amman-Jordan and to arrange the defer factors in Jordan construction projects and to rank each identified factor based on their hierarchical significance and to design a conceptual framework to eliminate time overrun in civil engineering project based on the stakeholder's perspective and mitigation methods suggestion and all of them are done in this study.

The ranks show the main factors which have most effective influence on delay in Jordan construction industry, these ranks, can be used usefully in order to avoid facing time extension and delay proplems.

This study recommended the future studies to:

- This study can help the researchers who are interested in the delay problems that can face the stockholders of the project and it can be used usefully for coming researches and comparison to include the other categories to create a full overview of the causes that effect on the delay on the construction industry.
- It would be good to include as many reasons of postponement in the building industry as possible, to include them under all major categories of the project, and to produce a complete framework that contains these factors with appropriate solutions.

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