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Assessing the Impact of Change Orders In Construction Engineering Sector In The West Bank

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Dedication

To My Lovely Family

Acknowledgements

First and foremost, I thank my almighty Allah for granting me favors, merci and the power for achieving this research, despite all difficulties. Then, I would like to take this opportunity to express my special thanks to my supervisor Dr. Mohammad Othman for his valuable help, encouragement, professional support and guidance. Furthermore I would like to express my deepest appreciations for Mr. Mohammad Masharqa for his English review.

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الاقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل عنوان:

Assessing the Impact of Change Orders in Construction Engineering Sector in the West Bank

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص ,باستثناء ما تمت الإشارة إليه حيثما ورد ,وأن هذه الرسالة ككل ,أو أي جزء منها لم يقدم من قبل لنيل أية درجة أولقب علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: **اسم الطالب:** مجاهد محمود ستيتي

Signature: **التوقيع:**

Date: **التاريخ:** 26. 11. 2015

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List of Abbreviations

PLO	Palestine Liberation Organization
UN	United Nations
WBGS	West Bank and Gaza Strip
PECDAR	Palestinian Economic Council for Development and Recon struction
GDP	The Gross Domestic Product
PFI	Palestinian Federation of Industries
PCBS	Palestinian Central Bureau of Statistics
PCU	Palestinian Contractors Union
NGOS	A non-Governmental Organization
USAID	United States Agency for International Development
SPSS	Statistical Package for Social Scientist
BIM	Building Information Modeling
CII	Construction Industry Institute

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Abstract

The common practice of construction industry is project-based. The nature of these construction projects is complex where many factors and variables play significant roles. So, when change orders occur, all projects performance is strongly affected. This research aims to investigate the impact of change orders on project performance in West Bank, in order to take proactive measures to minimize changes during construction. The main objectives of the study are to identify the main causes of changes that occur in construction projects in the West Bank and highlight the potential effects of change orders on the Palestinian construction industry and assessing the current practices of change orders management within the construction companies in the West Bank. The researcher used combined methodology: quantitative method represented by questionnaire surveys, and qualitative method represented by interviews of many of construction professionals.

Results from the study show that change orders in construction industry occurred more frequently in adding new works: increasing the quantities of the work by adding new items. Also results show that the main source of changes in construction projects is the owner; it was found that project owners initiated change orders due to financial problems, changing in mind

or non-compliant design with owners' requirements. Consultant initiated change orders due to errors and omissions in designs, specifications or due to conflict in contract documents. Cost and time overrun are the two main effects being noted for change orders; the disputes between parties and degradation of labor productivity are a major concern here. The results also assured that the current situation of change order management in the West Bank needs to be improved; change orders can be minimized if proper planning took place before work starts on site, adequate time and budget allocation, clear scope, close coordination and communication specially in the design stage. A change order management framework was developed by the researcher as the main output of this research. The framework provides processes that enable the different construction participants to manage their change orders effectively.

Chapter One
Introduction

Chapter One

Introduction

Chapter one introduces this research which shows the impact of change orders in construction industry in the West Bank. It provides an overview of Palestine, Palestinian economy. It also presents the problem statement of this study; demonstrates the importance of this research to the construction projects; documents the aim and objectives of the research undertaken along with research questions and describes the structure and outline of this thesis.

1.1 Overview of Palestine

Palestine is yet to find its place on the world's map as an independent state after long years of conflict and military occupation that forced around (60%) of the population to seek refuge in other countries. In 1948, thousands of Palestinians were obliged to leave their homes to neighboring Arab countries following the foundation of Israel and the war that broke out. After the war of 1967, the West Bank and Gaza Strip were occupied by Israel which at the same time annexed Arab Jerusalem to its territories. In 1987 the conflict developed a new dimension upon the outbreak of the first intifada, which paved the way for the 1991 Middle East Peace Conference for both parties to solve the conflict through peaceful negotiations. These sought promises to peace were translated in September 1993 upon the signing of the "Declaration of Principles on Interim Self - Government

Arrangements between Israel and the PLO, representing the Palestinian People" (United Nations, 2001).

The new agreement assured to bring new improvements for the Palestinian areas. Self-ruling was determined as setting free from the harsh conditions of the Israeli occupation, and to bring up new environmental prosperous to the expansion of production and trade. However, 22 years of limited self-rule have not lived up to these high expectations. The reversion to the old habits of daily clashes between the Israeli forces and the Palestinians, protesting the Israeli harsh practices of blockade that have led to the worsening of economic situations and prevented any serious movement toward reconstruction and development of the Palestinian economy. This unjustified situation led to the eruption of Al-Aqsa Intifada on September 2000 with the Israeli army, recapturing most parts of West Bank (MAS, 2008).

The location of Palestine is excellent geographically, forming an economical and cultural platform and point of contact between three continents – Europe, Asia and Africa. The combined area of the West Bank and the Gaza Strip (WBGS) is 6,020 km². The West Bank covers 5,655 km², is 130 km long and ranges between 40 and 65 km in width. The land area of the Gaza Strip is equal to 365 km², and is 40 km long and 5-12 km wide (MAS, 2008)

1.2 Palestinian Economy

The economy of Palestine is dependent on the Israeli economy. This situation was created to serve the occupying power (PECDAR, 1997).

More than 80 percent of our exported products are shipped abroad though Israel (PECDAR, 1997). Thus, Palestinians suffer from a trade deficit due to long years of negligence, restrictions on exports and competitive industrial and agricultural foreign support (PECDAR, 1997).

However, the Palestinian economy came across rapid economic growth between 1994 and 1999, with an increase in the growth rate of the Palestinian gross domestic product (GDP) to more than (10%) yearly. However, the GDP has declined importantly during the peak of the second intifada 2000 – 2002. By contrast, the growth rate resumed again in 2003 to reach its previous levels before the start of the second intifada in September 2000. Consequently, this situation points to having good growth opportunities in Palestine during the stable conditions either economically or politically (PFI, 2009).

In addition, the service sector plays an important role in the economy of Palestine; these services include the following: communication, internet services, education, tourism, information, transportation and insurance, engineering consultants, administration, financial and accounting, real estates, legal consultants, retailer operation and health services (MAS, 2008). During the first period of 2012, this sector contributed to (23.8%) of the Palestinian GDP (PCBS, 2012).

Moreover, the industrial sector contributions to the total of GDP has increased from (8%) in the mid-eighties to (17%) in the late-nineties. But after that, it decreased nearly (16%) during the first years of the second intifada. Furthermore, this sector has employed just during 2007 an average

of (13%) of the total work force; about 81586 workers. The industrial sector includes stone and marble, textiles and garments, food processing, engineering and metallurgical industries, chemical industries, pharmaceuticals and veterinary, construction industries, handicrafts, paper and printing, furniture, leather and shoes, and plastics (PFI, 2009). This sector contribution to the GDP in the fourth quarter of 2011 was amounted to (9.1%). This percentage has decreased later in the first quarter of 2012 to (8.8%) (PCBS, 2012).

1.3 Construction Industry in The Palestinian Economy

The construction industry is considered to be the motive of the national economy. It is a large and mature business. It has also numerous significant links to the rest of the economy. In addition, the Palestinian construction sector is one of the most important economic sectors has the main power that develops the national economy. It also plays an important role in the employment of Palestinian youths. In addition, this sector has implemented significant contracts with other industries like manufactures of construction materials (Abdulhadi, 1994; PCU, 2008).

The importance of the construction industry to the economy can be measured through its contribution to the total GDP which is 33%, such as its contribution to investment and amount of manpower employed. Moreover, the construction industry has a strategic role in Palestinian economy. For example, its great share to the GDP of Palestinian territories which increased from about $165 million in 1980 to about $382 million in 1987 (Abdulhadi, 1994).

As mentioned on page 5, the contribution of this sector to the GDP waves in an upward long-run trend bounded by 9% and 18% from 1972 to 1987 and by 15.3% and 23% from 1989 to 1995 (Abdulhadi, 1994; Enshassi et. al, 2006). On other hand, the sector contribution shows a dramatic decline in 2004 due to the second Intifada outbreak. After that and according to recent reports, the contribution of Palestinian construction industry has increased to 33% in GDP which in turn affected other different sectors (PCU, 2008).

Study for Enshassi and Kaka (1997) confirmed that the construction industry is the biggest industrial employment for the Palestinian economy, so the number of workers in this sector had increased from around 13,000 to about 20,000 between 1970 to 1989 (Abdulhadi, 1994). Moreover, before the breakout of the second Intifada in 2000, the construction industry used to employ an average of 22.3% of Palestinian labor force volume as it is shown in Figure (1.1). The Figure shows the labor forces were employed directly by the Palestinian construction industry.

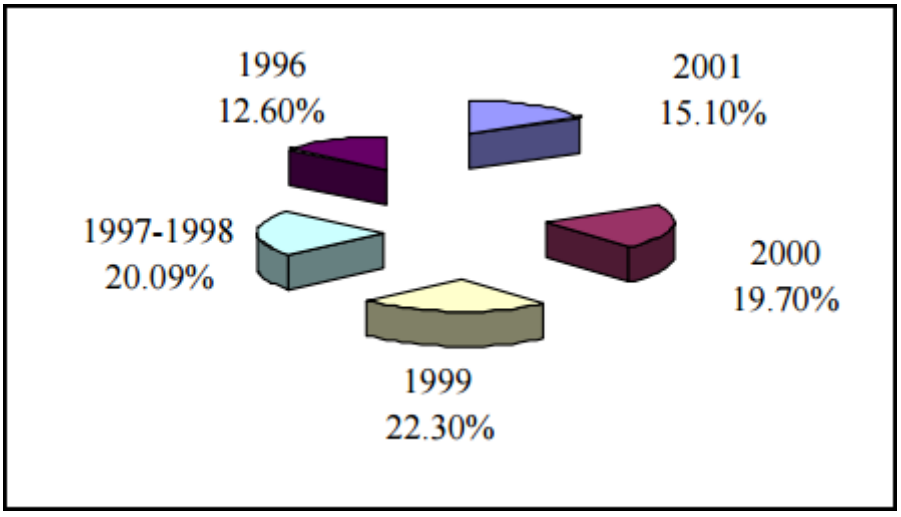

Figure 1.1: Labor forces employed in the construction industry in Palestine for different years.

1.4 Problem Statement

Change order or which is usually called variation requests contains a set of instruction which allows modifications, additions or deletions to be made to the origin contract agreement in terms of volume and scope of work or nature of task to be carried out (Arian and Pheng, 2005).

Change in drawings, designs and contract documents while implementing the construction projects, usually lead to change in projects schedule and have the potential to unnecessarily increase in the cost of projects, which may not add any value to the project in case they may be regarded as "a waste". Waste of time, cost and resources. Conventionally, changes present problems to all participants involved in the construction industry.

Change management is not fully understood and nor well applied in Palestinian construction industry. Also, in order to increase the construction field productivity in the West Bank, there is a need to study the main causes of change orders and identify a clear strategy which illustrates a suggested managerial framework which might lead to their reduction, possible elimination and subsequent improvement in overall projects performance in the West Bank.

1.5 Research Aim and Objectives

The aim of this research is to investigate the impact of change orders on project performance in the West Bank, in order to take proactive measures to eliminate or minimize changes and change orders during construction that will be through the following primary objectives:

- Identify the main causes of change orders in construction sector in the West Bank
- Determine the potential effects of change orders on the Palestinian construction industry.
- Assess the current practices of change orders management in construction companies in the West Bank.
- Develop a change management framework.

1.6 Research Questions

The objectives of the research are formulated in the form of research questions to make research process easier and these questions are:

1. What are the underlying reasons for changes within Construction Industry?
2. To what extent is the construction projects affected by change orders?
3. What are the current practices of change orders management and how they can be made more effective?
4. How can the level of changes be reduced in construction projects?
5. How can owners, contractors and consultants benefit from the result of this research?

1.7 Research Methodology

In this research, mixed approached methodology will be used, which will rely mainly on qualitative and quantitative research tools to identify and interpret the current situation of change management in construction sector:

- Internet research: is largely designed to review existing literatures and publications on the concept of change management and the impact of change orders on construction projects.
- Data collection which will be used for assessing the impact of change orders in construction through a series of semi-structured meetings with project managers' personnel and design survey - questionnaire.
- Analysis of data collected from questionnaire and interviews using different statistical analysis tools.
- Identification of factors that reduce the level of changes in construction.

1.8 Structure and Content of the Research

- **Chapter One - Introduction:** this chapter provides the foundation of this research by presenting an overview of Palestine, Palestinian economy and construction industry in Palestinian economy. Research aim and objectives, and research methodology are discussed. The main objectives of this research is translated into research questions.
- **Chapter Two - Literature Review and Previous Studies :** in this chapter, a comprehensive literature review is presented; it is divided into five parts: The first part provides a general overview of changes that occur in construction, the second part defines the change orders. In the third part, possible causes of such changes are presented, whereas the impact of change orders in construction is determined in the fourth part. Moreover, various types of construction contracts is demonstrated.

- **Chapter Three – Research Methodology:** this chapter presents an overview of methodological approach used in this research. Methods concerned to accomplish the aim and objectives of this study which include review of literatures related to the change orders in construction industry, research design, specifying research location, population and sample size, questionnaire distribution and personal interviews with many of construction professionals.
- **Chapter Four – Data Collection, Discussion and Analysis:** this chapter analyses the results that have been obtained through distributed questionnaires and conducted interviews with professionals working in construction industry. Results is processed using Microsoft Excel and Statistical Package for Social Sciences (SPSS).
- **Chapter Four – Conclusions and Recommendations:** this chapter concludes the research and its main findings and provides recommendations for different parties involved in construction projects.

Chapter Two
Literature Review And Previous Studies

Chapter Two

Literature Review and Previous Studies

2.1 Introduction

In this chapter, a comprehensive literature review is presented; it is divided into five parts. The first part provides general overview of changes in construction. The second part defines change orders. In the third part the possible causes of such changes are presented. While in the fourth part the impact of change orders in construction is determined. Moreover various types of construction contracts is demonstrated in the fifth part.

2.2 Overview of Change Orders

Complex nature of construction projects makes it hard to finish any of construction projects without changing plans or the construction process itself. The common practice of construction industry is project-based. Generally, construction project includes many stages from planning, architectural drawings, engineering designs, cost estimation, bidding, contracting to the actual implementation of the project. During these phases many decisions must be made based on incomplete information, assumptions and personal experience of construction professionals.

Whatever the scope of projects is, the sizes of construction may vary significantly, they tend to have one common element which is "change ". Changes are very common and likely to occur at any stage of construction, this has led many researchers (e.g Revay, 2002; Ssegawa et al., 2002, Hibberd, 1986; Turner, 1990) to assert that for all construction projects

change is a fact of life. Also, Thomas (2008) claimed that “Project changes and/or adjustments are inevitable as they are a fact-of-life at all stages of a project’s life cycle”.

The changes may occur for different reasons such as: the modification of scope, schedule, costs and methods. Change orders are considered as the main reasons leading not meet up with the time specified for the project (Pourrostam and Ismail, 2011). Also, there are some other factors that initiate these change orders such as funding, design, geological, weather conditions (Hanna et al., 2002). A change order should be managed effectively. Otherwise conflicts between all project participants might occur (Charoenngam et al., 2003).

A study in Kuwait for residential building projects declared that variations and modifications during the construction often causes both cost and time overrun. (Koushki et al, 2005).

However, Ndihokubwayo and Haupt (2009) shows that 63% of site instructions for additional works and 14% of these site instructions are considered as a non-value activity "Wastage", especially those involving modifications to the complete works. Then, they recommended that more attention should be devoted to the design stage in order to minimize change orders.

2.3 Definition of Change Order

Although project management has the most advanced techniques and tools, changes should be considered and expected in any project. Many studies

defined, analyzed and recommended appropriate solutions to manage changes in different project environments.

There is no difference in terms between change orders and variation orders, they are the same; the term change order was coined in the United States and is used over there to deal with change occurring during construction. The term variation order was coined in the United Kingdom to deal also with change occurring during construction and it is used through their various contract forms. FIDIC adopted the term "Variation", which means the same thing (Galloway, 2007).

Generally, change order can be defined as an *"approved change in a specification or project"* (Longman Business Dictionary, 2009). However, a review of the literature declares that change order has been defined in many ways by different researchers. Project management association defines change as "A change in scope or timing of work which a supplier is obliged to do under a contract" (APMP Syllabus, 2000).

Turner (1999) described changes as "*changes within a contract and not changes of the contract*". A another definition presented by Gbeleyi's (2002) is *"to change in specifications, changes in scope, adjustment of PC and provisional sums, errors/omissions in contract documents, discrepancies in contract documents, changes in government policies/legislation, and natural occurrence".*

Moreover, a different definition is provided by Molloy (1999) as: "any alternation of the work whether by way of addition, modification or omission to the work to be done under the contract by the contractor. Such

changes may cover but are not limited to the work required but excluded from the contract, work not required but included in the contract, additional work requested by the client, changes to the written scope requested by the client, changes to the character or quality of materials or construction methods and changes applicable to site conditions, location, etc."

According to Webster's dictionary, change order in construction projects is a transformation or modification, a variation or deviation, the substitution of one thing for another and a replacement or substitution (Galloway, 2007). A change order also can be defined as "an action that specifies and justifies a change to the scope of a construction contract that alters the original time of completion or the project total cost, or both" (Mokbel, 2003).

Another definition of construction change order is provided by Park (2003) who describes changes as 'work state, processes, or methods that deviate from the original construction plan or specification. They usually result from work quality, work conditions or scope changes. A change order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect (Libor et al, 2003).

More straight definition of change orders is a set of instruction which allows modifications, additions or deletions to be made to the origin contract agreement in terms of volume, scope of work or nature of task to be carried out (Arain and Pheng, 2005).

2.4 Causes of Change Orders

Many of literature reviews have indicated that the action of project's stakeholders (e.g. client, architect, and contractor) may be the direct causes of change order in construction (Ssegawa et al., 2002, Hibberd, 1986; Turner, 1990). Several studies have been done by number of researchers using different methodologies to classify the various changes in construction and identify their causes.

Arain (2005) classified the causes of change orders into five major categories, which are:

- Client-related variations.
- Consultant-related variations.
- Contractor-related variations.
- Other variations
- Combinations of causes.

Gbeleyi (2002) prepared a list of common change order causes and their occurrence within the projects of construction. These are shown in Table (2.1):

Table 2.1: Different causes of change orders. (Gbeleyi, 2002)

NO.	Causes of change orders	Client	Consultant	Contractor	Other
1	Change of plans or scopes	○			
2	Change of schedule	○			
3	Client's financial problem	○		○	
4	Inadequate project activities	○			
5	Replacement of material or procedures	○			
6	Impediment in prompt decision making process	○			
7	Obstinate nature of the client	○	○	○	
8	Change in specifications	○	○		
9	Change in design by the consultant		○		
10	Errors and omissions in design		○		
11	Conflicts between contract documents		○		
12	Inadequate scope of work for contractor		○		
13	Technology change		○		
14	Value engineering		○		
15	Lack of coordination		○		
16	Design complexity		○	○	
17	Inadequate working drawing details		○		
18	Inadequate shop drawing details		○		
19	Consultant's lack of judgment and experience		○	○	
20	Lack of consultant's knowledge of available materials and equipment		○		
21	Honest wrong beliefs of consultant		○		
22	Consultant's lack of required data		○		
23	Ambiguous design details		○		
24	Design discrepancies		○		
25	Non-compliant design with government regulations		○		
26	Non-compliant design with owner's requirement		○		
27	Lack of contractor's involvement in design			○	
28	Unavailability of equipment			○	
29	Unavailability of skills			○	
30	Contractor's desired profitability			○	
31	Differing site conditions			○	
32	Defective workmanship			○	
33	Unfamiliarity with local conditions			○	
34	Lack of a specialized construction manager			○	
35	Fast track construction			○	
36	Poor procurement process			○	
37	Lack of communication			○	
38	Long lead procurement			○	
39	Honest wrong beliefs of contractor			○	
40	Lack of strategic planning			○	
41	Contractor's lack of required data			○	

42	Weather conditions				○
43	Health and safety considerations				○
44	Change in government regulations				○
45	Change in economic conditions				○
46	Socio-cultural factors				○
47	Unforeseen problems				○

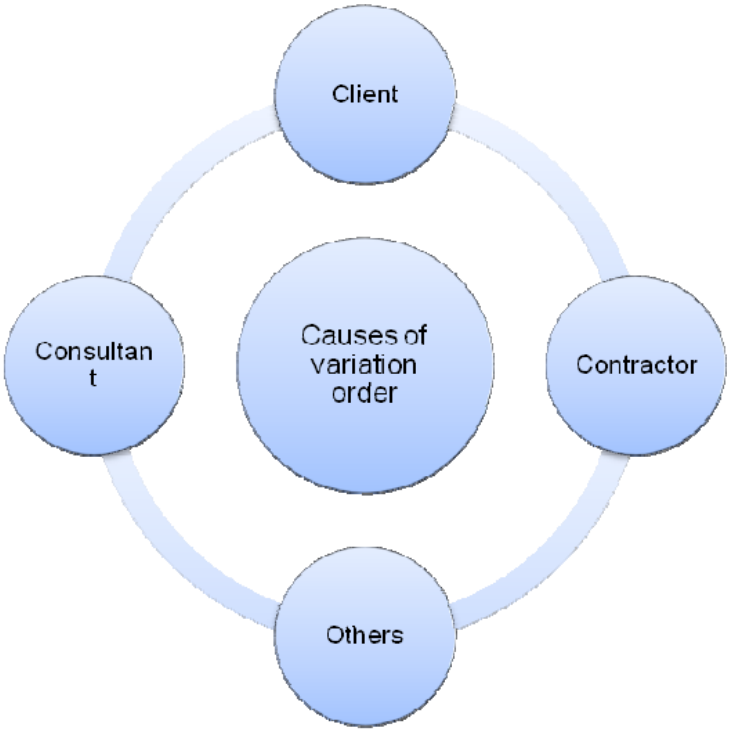

Figure 2.1: Causes of change orders. (Gbeleyi, 2002)

2.5 Possible Impact of Change Orders

Several studies were conducted to demonstrate the impact of change orders and to identify the main cause and effects of changes in construction. The possible impact of change orders is well discussed in the literature (Al-hmas, 2010; Alsuliman, 2012; Arain and Pheng, 2005; CII, 1994a; Clough and Sears, 1994; Fisk, 1997; Ibbs et al., 1998; Thomas and Napolitan, 1995), the overall impact is categorized in the following sections:

1. Impact of Changes on Cost
2. Impact of Changes on Time

3. Quality Degradation
4. Impact of Changes on Productivity
5. Hiring New Professionals
6. Reworks and Demolition
7. Delay in Payment
8. Additional Payment for Contractors
9. Dispute Among Professional
10. Poor Safety Conditions

These are explained in the following sections :

2.5.1 Impact of Changes on Cost

Change orders have often a direct impact on the total project cost. The change in one of project items such as any modification or addition in the design, increases labor costs, equipment and material costs which might increase the overall project costs.(Abdul-Malak, et al, 2002). Because of that for each construction project, a contingency sum is often allocated to attend for any possible changes in the project. (Arain and Pheng, 2005).

Variation in cost is defined as the difference between the cost at the end of the project and the original budget as shown in Equation (2.1) (Ibbs et al, 2003; Oladapo, 2007)

$$Change\ in\ cost(\%) = \frac{\text{final cost} - \text{original budget}}{\text{original budget}} \times 100 \quad \ldots (2.1)$$

According to a study in Taiwan, the cost of change orders in metropolitan public works is about 10-17% ratio to the total project cost (Hsieh et al, 2004). Moreover, Anees (2012) concluded that the cost of the project

increased between 11% and 15% due to change orders. These percentages increase in the few past years due to a lot of conditions, most of which are related to the causes that always lead to changes.

2.5.2 Impact of Changes on Time

Delay of construction projects is a frequent result of changes (Arain and Pheng, 2005). It is defined as the difference between the time consumed to complete all project activities and the estimated time to complete the overall project as shown in the following Equation (2.2) (Ibbs et al, 2003).

$$\text{Change order schedule}(\%) = \frac{\text{total time used} - \text{estimated time}}{\text{estimated time}} \times 100 \quad ..(2.2)$$

Procurement and logistic delays occur due to the changes which may require special kind of skills, new equipment and new materials. (Arain and Pheng, 2005; Al-Dubaisi, 2000; Al-Jishi and Al-Marzoug, 2008).

2.5.3 Quality Degradation

High frequency of change orders in construction project has a significant impact on the quality of work (Fisk, 1997). The quality of construction works are generally getting worse because of frequent of variations. (CII, 1995a; Ndihokubwayo and Haupt, 2009).

In some type of contracts which may have a significant degree of risk for unknown variables such as lump sum, contractors try to cut corners on quality and quantity in many of project items to maximize their own profits. If change orders are frequent, they may potentially affect the quality of work. Quality may be compromised as contractors try to

compensate for losses they are not optimistic about recovering. (Patrick and Toler, 2008).

2.5.4 Impact of Changes on Productivity

Change orders have a direct impact on labor productivity. Changes in construction often lead to disruptions and these disruptions are usually responsible for worker productivity degradation (Thomas and Napolitan, 1995). Productivity is mostly influenced because labor should put more efforts, extra working hours and work overload and that might be translated into labor costs (Hester et al, 1991).

2.5.5 Hiring New Professionals

Change orders may require new manpower with special skills especially in very complex technological projects (CII, 1995).

2.5.6 Rework and Demolition

Rework and demolition are another commonly element that might generate potential impact of change order in construction, which depend on the occurrence and timing of these changes. Reworks are predicted to occur during the construction phase, but they might also happen after the completion of projects. (Arain and Pheng, 2005; Al-Dubaisi, 2000; Al-Jishi and Al-Marzoug, 2008).

2.5.7 Delay in Payment

Delay in payment is another related impact which occurs frequently because of change orders (CII, 1990). Changes often impede the project progress and cause the delays in achieving landmarks targeted during

construction, which leads to delay in the payment of contractor and subcontract (Arain and Pheng, 2005).

2.5.8 Additional Payments for Contractor

Generally the contractors anticipate changes in construction as they often consider them as a customary source of extra works and payments. Any additional payments for a project might enhance the possible impact of change orders in construction projects (O'Brien, 1998).

2.5.9 Disputes Among Professionals

Change orders may affect professional relations, because of frequent changes in construction activities. Change orders lead to dispute and can create a nervous atmosphere among different project participants. These issues have to resolve through negotiation as the first option or litigation (Arain and Pheng, 2005).

2.5.10 Poor Safety Conditions

Health and Safety conditions in construction project can be affected due to changes (O'Brien, 1998; Arain et al., 2004). For example, changes in construction equipment, materials and methods may require additional safety measures during the implementation of construction activities.

2.6 Types of Construction Contracts

Construction contract is defined as a formal agreement between two parties "owner" and "contractor" that outlines the way through which construction projects should be executed based on specific conditions and policies.

There are different types of contracts used in construction, mainly distinguished by the way of determining the contract final price. Whatever the used method, the main goal of any construction project is still, high quality project, completed on time, through the lowest possible price. The construction contracts usually consist of (Ashely and Workman, 1986):

- Bid Form
- Agreement Form
- General Conditions or Standard Specifications
- Special Provisions
- Plans
- Addenda

The more common types of contracts may be classified as the following:

1. Unit Price Contracts
2. Lump Sum Contracts
3. Cost Plus Contracts
4. Target Price Plus a Fee
5. Turnkey Contracts
6. Design – Build Contracts
7. Cost Plus Percentage Contracts
8. Guaranteed Maximum Price Contracts

These are types of construction contracts are detailed as follows:

2.6.1 Unit price contract

This type of contract is based on a list of anticipated work quantities which counted in the project in addition to their unit prices, such as cubic meter of

concrete or excavation or different length of pipe size. The total price of the overall project depends upon these quantities which required to be carried out in the work. In this case the owner may take the risk of variation in quantities (Hendrickson, 2008).

Most government contracts in the West Bank are unit price type. This type of contract allows owners to make changes in the volume of work and permits good control.

2.6.2 Lump sum contract

Based on this type of contract, an engineer or a contractor is required to perform the project according to plans and specifications for a fixed price sum. This type is also known as a "Fixed Price Contract". Fixed Price contract is appropriate where the scope and schedule of the project are well defined which allows the engineer to estimate the total costs of the project (Fisk & Reynolds, 2006).

In the West Bank, lump sum contract for labor work is quite commonly used especially for residential buildings.

2.6.3 Cost plus contract

Under this contract type, a contractor is paid the total cost of materials and labor in addition to a lump sum fee to cover overhead and profit. This type of contract is appropriate when the scope of project is highly undetermined in addition to the types of material, labor, and equipment being similarly uncertain in nature (Fisk and Reynolds, 2006).

2.6.4 Target price plus a Fee

In this contract type, the contract determines specific quality and time criteria. If a contractor has achieved those criteria, he is paid the total costs in addition to a set fee. If the contractor exceeds those criteria, perhaps through completing the work early, the contractor is paid an additional fee. If the contractor does not meet those criteria, the fee is less (Fisk and Reynolds, 2006).

2.6.5 Turnkey Contracts

In a turnkey contract, the design-builder not only designs and constructs the project; it also ensures that the plant is functioning and ready to operate for the owner. The term "turnkey" derives from the concept that the owner may figuratively insert a key into a slot and turn it to begin successful operation of the plant (Fisk and Reynolds, 2006).

2.6.6 Design - Build Contracts

Design-build contract permits an owner to contract with one entity to provide both design and construction services. It involves a single contract for both design and construction services rather than one contract for design and another for construction. It combines into a single role the design responsibility of the project and the building function of the prime contractor (Fisk and Reynolds, 2006).

The design-builder may be a single company, or it may be a joint venture. The design-builder need not have in-house capability to perform both construction and design; a construction contractor may subcontract the

design work, or an engineering firm may subcontract the construction work. Some design-build contracts are “turnkey” contracts (Fisk and Reynolds, 2006).

2.6.7 Cost Plus Percentage Contracts

In this type of contract, a contractor is paid a specified percentage over and above construction costs. This percentage may be pure profit to the contractor, or it may be the contractor's gross compensation from which must be paid general overhead expenses such as clerical help, phone lines, and general business insurance. It is important to determine the difference, because if the contractor expects the percentage to be pure profit, then normal business operating expenses will have to be accounted for somewhere in the construction contract as expenses (Fisk and Reynolds, 2006).

2.6.8 Guaranteed Maximum Price Contracts

Construction contracts which fix the maximum amount of payment for determined scope of job with incentives (Ashly and Workman 1986) for contractor, for cost under run and penalties for cost over runs.

2.7 Change Management Existing Models or Frameworks

Several different modeling techniques exist in the construction industry; each of these existing models has a range of different applications, so it is imperative to choose the correct type of model in order to achieve the best possible outcomes (Fowkes and Mahony, 1994).

This research was concentrated on construction change orders. Change order causes, impact and their current management within the construction industry in the West Bank.

It was noticed from the body of existing literatures that little attention has been paid to the integration models concerning change orders management. A simulation model was built to model change orders occurrences and their impact on cost, time, and productivity for building projects in the Gaza Strip (Al-Hams, 2010).

Another model was developed by Alsuliman (2014); the developed model determines the levels of power and interest, location and position for each stakeholder involved in the process of change order management. As any construction project consists of various complex activities, each stakeholder has different levels of interests and powers in the project they are involved in. Bourne (2005) states that the project's success or failure is strongly affected by both the perceptions and expectations of the project's stakeholders. According to Karlsen (2002) poor management of stakeholders can cause many negative impacts in construction projects, such as "poor scope and work definition, inadequate resources assigned to the project (both in terms of quantity and quality), poor communication, changes in the scope of work and unforeseen regulatory changes".

Several stakeholder mapping techniques have been established. However, the most common technique of mapping stakeholder impact is the power/interest matrix, which is shown in Figure (2.2). Johnson and Scholes (1999) designed this matrix, which categorizes stakeholders in terms of the

level of power that they have and their level of interest in the project. The type of communication and relationship that the project manager requires to establish and maintain with the different types of stakeholders is illustrated for each type of stakeholder in four zones in the matrix.

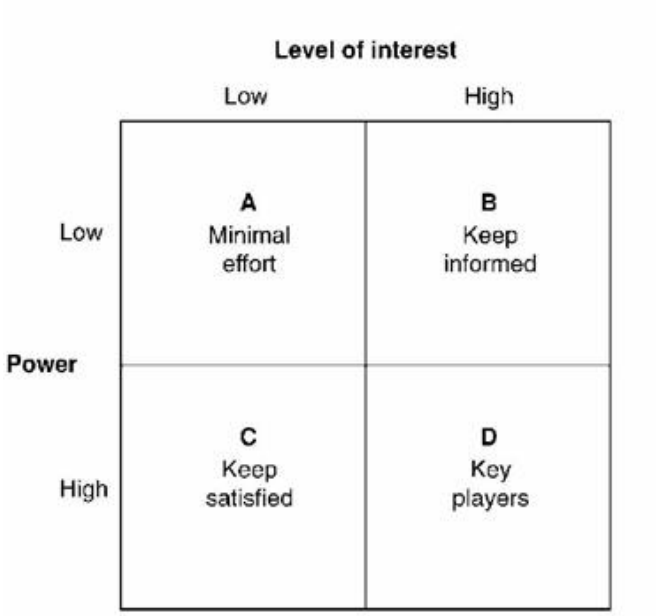

Figure 2.2: Stakeholder mapping, the power-interest matrix (Johnson and Scholes, 1999)

In this matrix, stakeholders with low level of interest in the project activities and low level of power to affect the project activities are in (Zone A), as they just need minimal effort from the project manager. Stakeholders in (Zone B) with a high level of interest in the project activities but low level of power to affect project activities require to be kept fully informed of the major decisions that have been made; hence, good communication with this type of stakeholder is crucial. Those stakeholders in (Zone C) require to be kept satisfied, as they have a high level of power to influence the project activities, but with little interest in the project's activities.

The researcher integrated the power-interest matrix with the basic principles of change order management in construction projects by determining their responsibilities, positions, tasks and the method of engagement and communication to effectively engage stakeholders and better manage change orders. To make the developed model happen in practice, the position and role of the involved stakeholders, notably the public client and design consultant is identified and how their positions will change from step to step which are identifying, analyzing and evaluating the change order, estimation and approval, implementation and documentation.

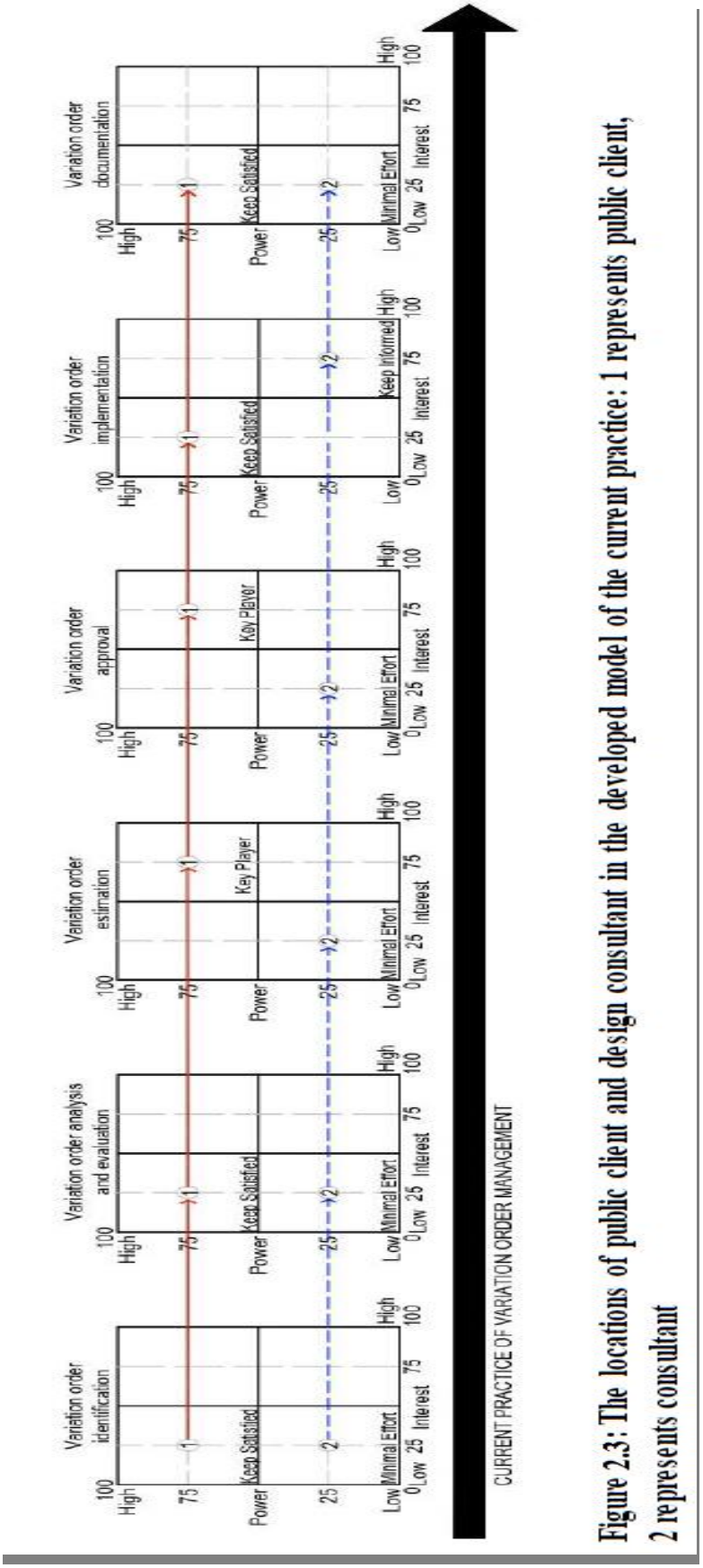

Figure 2.3: The locations of public client and design consultant in the developed model of the current practice: 1 represents public client, 2 represents consultant

Chapter Three
Research Methodology

Chapter Three

Research Methodology

3.1 Introduction

This chapter presents an overview of methodological approach used in studying the impact of change orders in construction industry in the West Bank. Methods concerned to accomplish this study included review of literature related to change orders, personal interviews with construction professionals, research design, specifying research population and sample size, research location, questionnaire design, data analysis and measurement.

3.2 Research Approach and Methodology

Research methodology is defined as "the way through which research aims and objectives can be achieved" (Naoum, 2007).

There are two different methodologies used in most research works, these methodologies are qualitative and quantitative. (Naoum, 2007). This section provides some critical issues regarding the qualitative and quantitative research, their features and the main reasons for the selection of these two methods in this research.

3.2.1 Quantitative Research

Quantitative research is a largely used approach which relies on logical numbers and data and provides a measure of what people think through a statistical point of view. It is used to quantify opinions of research respondents. Quantitative approach uses different methods such as surveys

and questionnaires with predefined questions and selections which can be measured as ‘strongly agree’ ‘disagree’ or scales through which can gather a large amount of data that could be analyzed and reported easily (Naoum, 2007).

3.2.2 Qualitative Research

Qualitative research is ‘subjective’ in nature. It emphasizes meanings, experiences, description and so on (Naoum, 2007). Fellows and Liu (2008) noted that in qualitative research, an exploration of the subject is undertaken without prior formulations, so the object is to gain understanding and collect information and data such that theories will emerge, when comparing quantitative and qualitative research methods.

Hancock (1998), noted that qualitative research is concerned with finding the answers to questions which begin with: Why? How? In what way? Whereas quantitative research is more concerned with questions like: how much? How many? How often? To what extent? .

Combined methodology was used in this analytical research which relied mainly on qualitative and quantitative research tools to identify and interpret the current situation of change management in construction sector.

3.3 Research Design

This research was designed to obtain a full and clear understanding of the study by setting out the various elements of the research in a logical sequence. This research consists of three major stages to achieve the objectives of this study.

First stage includes selecting the research topic, identifying the research problem, defining research aims and objectives, establishing research plan while writing the proposal, developing research methodology and comprehensive review of the relevant literature.

Second Stage includes data collection which is focused on the questionnaire design, in this phase experts should be participated to check whether the questionnaire contents are clear, have a sufficient information are useful to collect the required data. Moreover conducting interviews with some local firm owners, consultants, contractors and construction managers to enrich the results of this study.

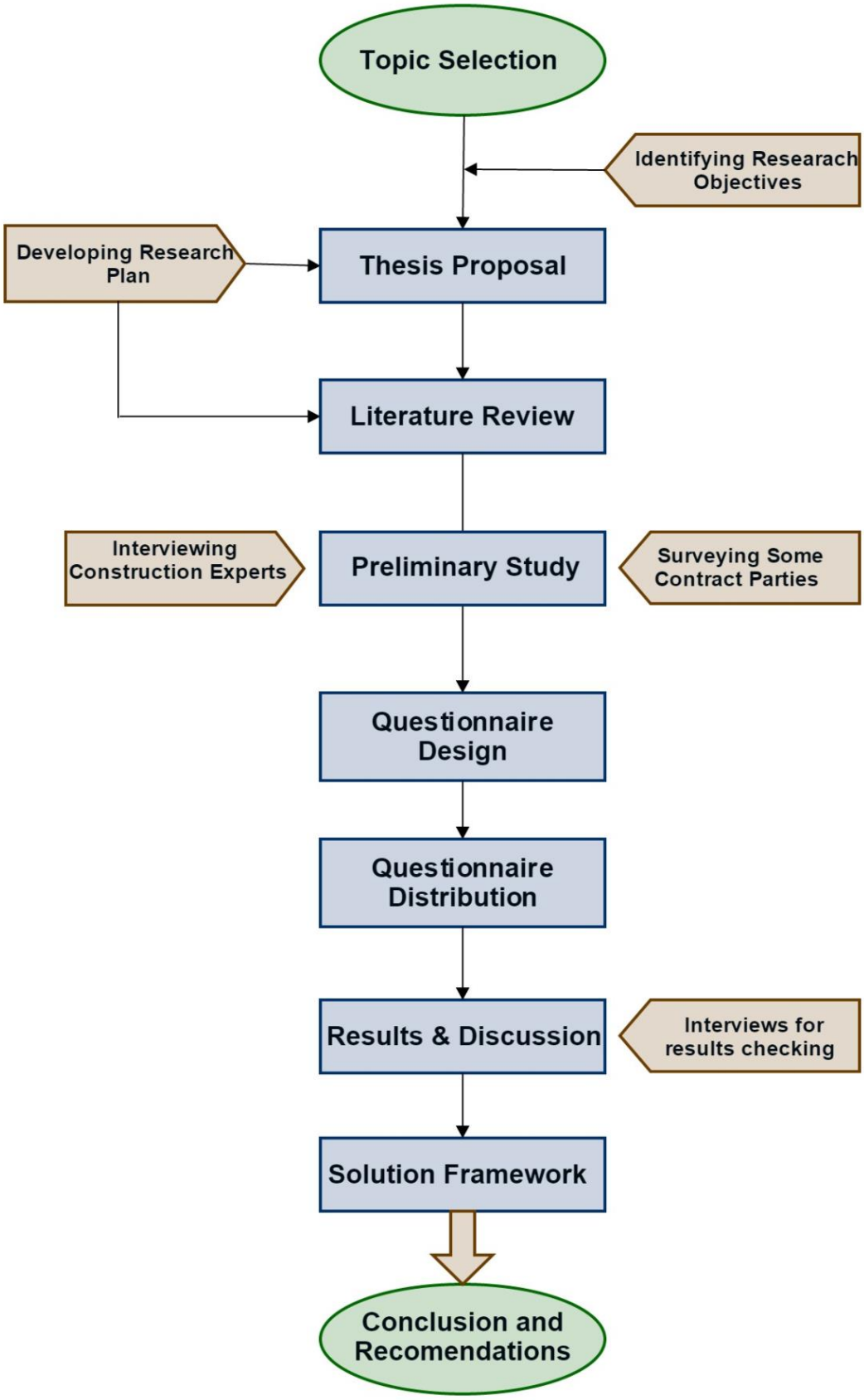

Figure 3.1: Research methodology

Third Stage includes data analysis using Microsoft Excel and the social sciences statistical program "SPSS" to perform the required analysis, discussing the research results and formulating solution framework which could help to reduce the level of changes in construction projects. Finally this stage includes conclusions and recommendations based on the results of this research. Figure 3.1 shows the diagram of the methodology used in this research:

3.4 Research Population and Sampling

Three different populations are targeted in this research, which include different parties involved in construction industry; they are contractors, clients and consultants.

The first population is clients. Unfortunately, there are no official reports specifying the true number of construction projects' owners in the West Bank. To solve this point, large projects owners who have experience in the construction industry were asked to list the names of clients. Those include: governmental ministries, municipalities and non-governmental organizations.

The second population is represented by consultants, according to engineering association the number of consultants who have a valid membership is (477) companies.

The third population is represented by contractor companies who have a valid registration according to the Palestinian Contractors Union (PCU) and have its classification for different types of works. The sample involved only the main three categories first, second and third. These categories

classification is based on the contactors' capital, experience, achieved projects, staff and other issues (Najimi, 2011). The researcher chose to focus on these main degrees first, second and third; because it was found that most projects in the West Bank (about 95%) were accomplished by these three categories. (PCU,2003). Figure (3.2) shows the percentage of the executed projects according to the classification degrees.

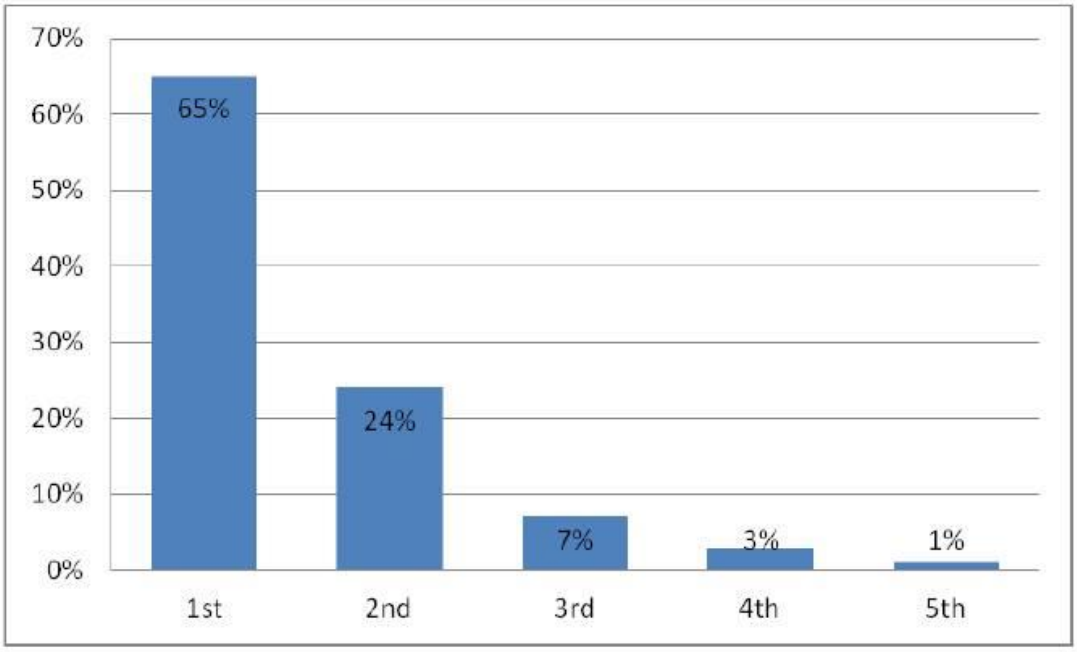

Figure 3.2: The percentage of the executed project according to the classification degrees for the registered classified contracting companies in the West Bank (PCU, 2003).

The number of contracting companies which were classified as first, second and third in the West Bank are (253) companies (PCU, 2011). A according to previously mentioned restrictions, specifying the sample size of this study was not so easy. The required sample size for this research was determined by using the basic of statistical principles as follows (Farooq, 1997):

$$n_0 = (p \times q) \times Z^2 / V^2 \quad \text{..... (3.1)}$$

$$n = n_0 / [1 + ((n_0 - 1)/N)] \quad \text{..... (3.2)}$$

Where:

n_0 : First estimate of sample size

p: The proportion of the characteristic being measured in the target population

q: Complement of 'p' or 1-p

V: The maximum standard error allowed

N: The population size

n: The sample size

z: z value (e.g. 1.645 for 90% confidence level)

The total targeted populations N is 730, p is chosen at 0.5. Maximum standard error V is set at 10%; to account qualitative questionnaire answers error. Substituting in Equations 1 and 2 above, the minimum required sample size was calculated to be 62.23; which means that the sample size according to that population should be at least 63. The researcher decided to take 50 contracting companies and another 50 of clients and consultants. The contractors' sample; the sample represented (20%) of the whole contractor population of 253 contractors.

3.5 Research Location

This study was carried out in the West Bank; which consists of 11 governorates; they are Bethlehem, Hebron, Jenin, Jerusalem, Jericho,

Nablus, Qalqilya, Ramallah & Al-Bireh, Salfit, Tubas and Tulkarm,. Gaza strip was not included in this research due to access difficulties to this location.

3.6 Questionnaire Design

The research questionnaire was designed to meet the aims and objectives of this study. Closed ended questions were selected because they are easy and quick to answer, they don't require any writing issues, they only require a short response in form of Agree or Disagree, Yes or No, Always, Often or Seldom... etc. (Naoum, 2007).

The questionnaire was also built and distributed in Arabic Language to make it clearer and easier understood by all participants, especially for those not familiar with English language, see Appendix (1). The questionnaire was divided into three sections:

Section One – Questions related to the respondents' profile; this contains general information about the professions, period of experience, sectors and types of most accomplished projects**.**

Section Two – Questions related to the prevalence and effects of change orders on project performance.

Section Three – Questions related to the factors influencing the occurrence of changes and the main causes of change orders in construction industry.

3.7 Interviews

Two types of interviews were conducted in this research; the first type was a group of unstructured interviews; and open conservations with some of

professions who are involved in construction industry. Many of project managers, consultants and contractors were asked about the main causes of change orders, the prevalence of changes and the effect of change orders in the performance of construction projects to have a general preliminary study from their experiences and their own point of view, which were used in formulating the questionnaire to assess their occurrences in construction. A list of research interviewers' is attached in appendix (3) on page 114.

3.8 Data Analysis and Measurement

The researcher used two formats in the questionnaire, the first one was the Likert scale and the second was the checklist. The Likert scale is a very useful question type when you want to measure or determine respondents' opinions, attitude and experience for a particular topic and also to collect specific data regarding that topic. (Burns & Grove, 1997). The check list format is basically used to mark a list of items or special events offered to research respondents. The check list questions are particularly designed for specialized respondents who have the sufficient knowledge which could help them to answer the questions with certainty. It is a straightforward method of collecting and analyzing data (Naoum, 2007).

Microsoft Office Excel and Statistical Package for Social Sciences (SPSS) were used in this research to analyze data. The following statistics were used: means, frequencies, percentages, standard deviations and Chi Square Test.

3.9 Research Validity and Reliability

3.9.1 Research Validity

Test validity relies on what it was purported to measure and how properly test measures (Majumdar, 2011). The researcher carried out many of steps to accomplish the research validity.

1. Many of arbitrators who are specialist in construction and project management were asked to review the research tools to assure that they could achieve the research objectives.
2. Palestinian Contractor Union were asked to assess the questionnaire and its components. They assured that the questionnaire was comprehensive and covers all aspects of change orders as shown in Appendix (4).
3. The researcher has chosen combined research methods in data collection, including quantitative approach represented by questionnaire and qualitative approach represented by professional interviews.

The researcher developed a change order framework and validated it by taking construction managers and experts' opinions and suggestions.

3.9.2 Research Reliability

The significant aspects of research reliability are usually their objectivity and consistency (Majumdar, 2011).

The reliability of this research was analyzed through estimating the average internal consistency of all questionnaire items by using Cronbach's alpha

coefficient test; reliability varies from 0 to 1; the closer coefficient to 1, the more reliable. The Cronbach's test is calculated as follows:

$$ra = \frac{n}{n-1}(1 - \frac{\sum \sigma^2}{\sigma^2}) \quad \text{(3.3)}$$

Where: ra = sum of the item variance

σ^2= variance of the total score of the scale

n = number of items

By using SPSS software, it was found that the reliability of all items combined 90% which indicates good consistency.

Chapter Four
Data Collection, Analysis and Discussion

Chapter Four

Data Collection, Analysis and Discussion

4.1 Introduction

This chapter aims to describe and analyze the results that have been obtained through distributed questionnaires and conducted interviews. Results were processed using Microsoft Excel and Statistical Package for Social Sciences (SPSS). This chapter is divided into five major sections as follows:

4.2 Profile of Respondents

4.2.1 Location of Sample Companies

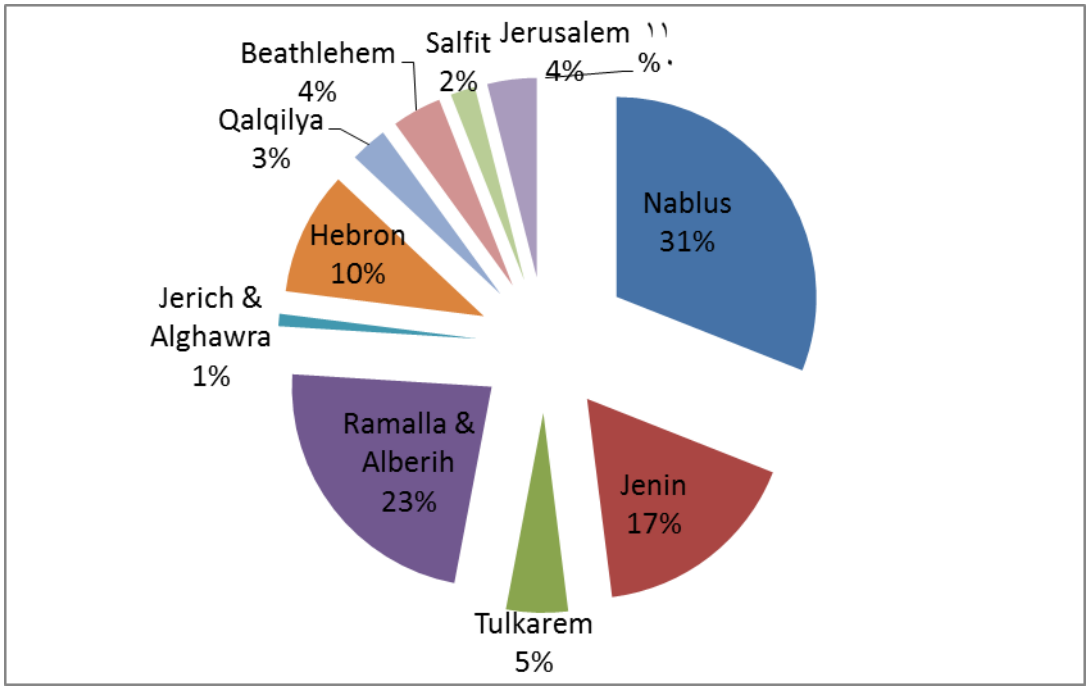

Figure 4.1: Location of companies

Figure (4.1) shows the location of companies who participated in this research survey, since it indicates that the most of respondents

were concentrated mainly in Nablus (31%), Ramallah (23%) , Jenin (17%) and Hebron (10%)which they contain the wide range of construction companies as well as the biggest numbers and the most important projects in the West Bank.

4.2.2 Respondents Types of Works

The total number of respondents was (80); (65) out of 100 surveying questionnaires in addition to (15) personal interviews. Contractors were registered the first with (58.5%) of the total participants. Consultants were in the second position with (24.5%) of the total participants and the lowest frequency was for Clients (17%) with (11) participants. As shown in Table (4.1) and Figure (4.2).

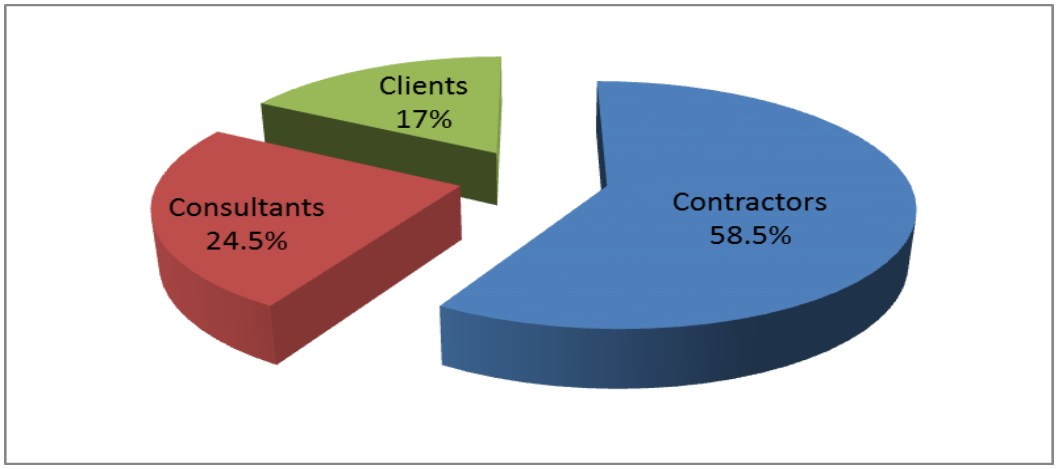

Figure 4.2: Type of work

Table 4.1: Frequency of participants

Work type	Frequency
Contractors	38
Consultants	16
Clients \ Owners	11
Total	65

4.2.3 Sector Types

Table (4.2) shows that the research sample for both contractors and consultants work for both public and private sectors (54) out of (65). While the owner only work for public sector under the ownership of government projects (11) out of (65) such as ministries, municipalities and USAID.

Table 4.2: Sector type

Category	**Sector Type**			
	Public	Private	Both	Total
Client	11			11
Consultant			16	16
Contractor			38	38
				65
Total	11		54	65

4.2.4 Respondents Position

It can be seen from Figure (4.3) that nearly three - fourth (72.9%) of research respondents were either project managers or company directors, which in turn increase the reliability and accuracy of this research results. Moreover (25.1%) of respondents were office and site engineers and (2%) mentioned other.

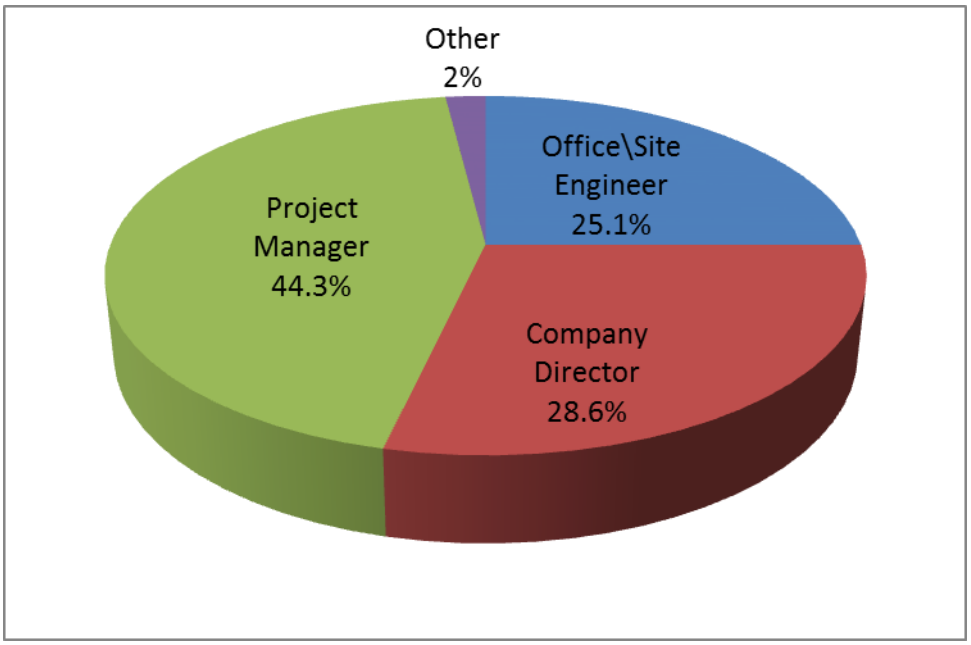

Figure 4.3: Respondent position

4.2.5 Participants Years of Experience

The results in Table (4.3) indicates that most of participants in this research survey have more than (10) years of experiences, which increases the reliability of data.

Table 4.3: Participants years of experience

Category	**Years of experience**				
	<5	5-10	10-15	>15	Total
Client	1	2	5	3	11
Consultant	2	2	8	4	16
Contractor	5	13	12	8	38
Total	8	17	25	15	65

4.2.6 Types of Most Accomplished Projects

Both of Table (4.4) and Figure (4.4) shows that most of the participated companies accomplished (80%) " Building " projects which was ranked as the first type. " Road " projects were in the second position with (9%), followed by " Electro-Mechanical " projects in the third position with

(6%), " Water & sewage" projects came in the fourth rank with (3%) and " General works " projects ranked fifth with (2%).

Table 4.4: Types of most accomplished projects

No	Type	Frequency
1	Buildings	52
2	Roads	6
3	Electro-Mechanical	4
4	Water and Sewage	2
5	General Works	1
Total		65

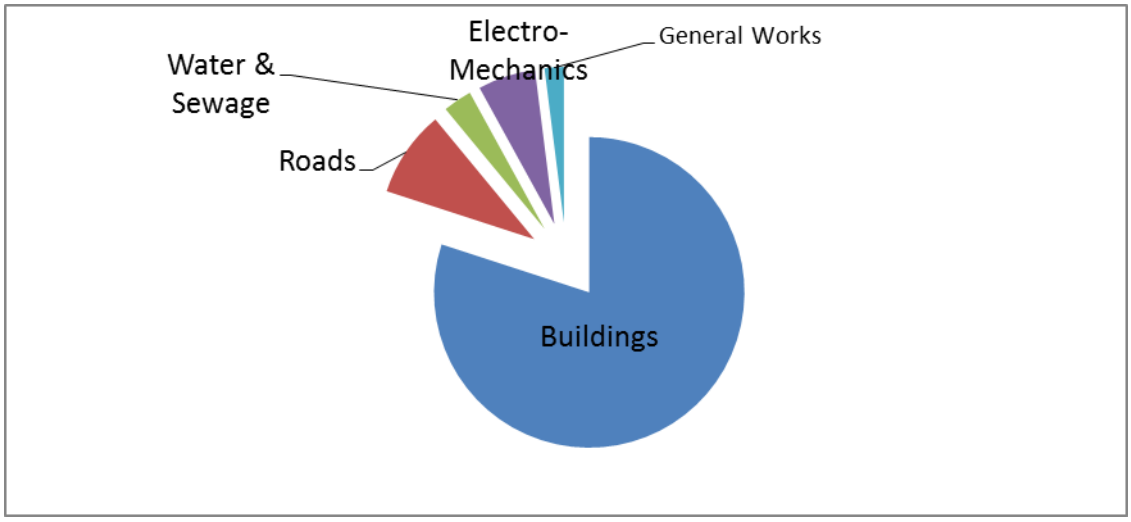

Figure 4.4: Types of most accomplished projects

4.2.7 Types of Construction Contracts Preferred

Table (4.5) indicates that most of companies preferred “unit price contracts “as appropriate contract type to be applied in construction industry with (61.5%) coming in the first rank. “ Cost plus contracts " were given the second position with (16.9%), whereas “Turnkey contracts “ were ranked the third with (9.2%). ” Lump-sum contracts “ were ranked the fourth with (7.8%) and “ Design-Build contract “ were given fifth with (4.6%).

Table 4.5: Types of construction contracts preferred

No	Type	Frequency
1	Unit price contracts	40
2	Cost plus contracts	11
3	Turnkey contracts	6
4	Lump-sum contracts	5
5	Design-build contracts	3
Total		**65**

4.3 Possible Causes of Change Orders in Construction

4.3.1 Responsibility Changes

Table (4.6) indicates that the first cause of change orders in construction is the clients “projects’ owner" which was given the first rank with (1.6) mean score, followed by consultants which was ranked the second with a mean score (2.1). Through experts interviews, they assured that consultants also caused many of changes in construction projects because they were involved earlier in the design stage and aware more according to projects specifications. Then contractors came in the third position with (3.2) a mean score, contractors contribute less changes because they carry out works according to the design and contract agreement.

Table 4.6: Changes responsibility

No	Responsible	N	Mean Score	St. deviation
1	Client	64	1.6	0.8
2	Consultant	62	2.1	0.8
3	Contractor	62	3.2	0.8

4.3.2 Construction Participants Versus Causes

Table (4.7) shows the contribution of each construction parties versus a given list of causes of the change orders. Each party was given a number as

following Clients = 1; Consultants = 2; Contractors =3; others = 4. The main results for each party were classified and highlighted in grey color. It was found that project owners initiated change orders due to financial problems (82.5 %), inability to make quick decisions (76.5%) and changing in the overall project scope which rarely occur as mentioned in experts' interviews. Consultant causes changes and initiated change orders due to errors and omissions in designs (95.5%), change in project specifications (90%), inadequate working drawings details (87.1%), Ambiguous and discrepancies in design details (85%).

Table 4.7: the contribution of each construction parties versus a given list of causes of the change orders

Causes of change orders	N	1	2	3	4
		%	%	%	%
Financial problems	65	82.5	5.0	12.5	0.0
Impediment in prompt decision making process	63	76.5	23.5	0.0	0.0
Change in project scope	62	66.4	20.5	13.1	0.0
Errors and omissions in design	65	0.0	95.5	0.0	4.5
Change in specifications	64	10	90	0.0	0.0
Inadequate working drawing details	63	0.0	87.1	12.9	0.0
Ambiguous design details	65	5	85	10	0.0
Design discrepancies	63	5	85	10	0.0
Non-compliant design with owner's requirements	63	2	85.7	12.3	0.0
Non-compliant design with government regulations	61	15	76.5	8.5	0.0
Design complexity	64	10.9	74.1	15	0.0
Lack involvement in design of one or more parties	61	25.5	68.3	4	2.2
Lack of coordination	62	0.0	60.0	35	5
Changes in design	58	41.5	58.5	0.0	0.0
Conflicts between contract documents	58	9.8	55.6	34.6	0.0
Change of schedule	62	15	55	25	5
Lack of communication	59	18	52.1	26.9	3
Lack of required data	59	10	50	25	5
lack of judgment and experience	62	0.0	5	90	5
Lack of strategic planning	60	0.0	0.0	88.9	11.1
Delay in material delivery	60	0.0	0.0	80	20
Lack of a specialized construction management	63	0.0	5	78.5	16.5
Shortage of required materials	62	0.0	10	75.2	14.8
Failure of equipments	61	0.0	5	72.6	12.8
Shortage of required equipments	65	0.0	15	70	15
Inadequate equipment used for the works	65	0.0	19.5	65.5	15
Shortage of manpower	64	20	15	60	5
Low skill of manpower	62	5.6	0.0	52.4	42
Inadequate shop drawing details	62	20	25	50	5
Health and safety considerations	60	0.0	35	49.5	15.5
Differing site conditions	64	0.0	25	40	35
Extreme weather conditions	62	0.0	15	20	65
Change in economic conditions	63	26.5	5	10.5	58
Change in governmental regulations	63	20	15	10	55

Moreover respondents thought that contractor initiated change orders mainly due to lack of judgment and experience (90%), lack of strategic planning (88.9%), delay of material delivery (80%) which occur in several projects due to lack of a specialized construction management (78.5%). It was also found that many external factors initiated change orders due to: extreme weather conditions (65%), change in economic conditions (58%) and change in governmental regulations (55%).

4.3.3 Frequency Occurrence of the Causes of Change Orders

The occurrence of change orders causes was determined by using also a 5 likert scale, the top (10) of mean scores generated from SPSS were ranked and highlighted in grey color as the most critical factors that having the major possibilities of causing changes and change orders in construction industry in the West Bank. Their score ranges from (4.0 – 3.5) as the following: change in schedule origin duration of construction projects (4.0) mean score, financial problems (4.0) mean score, delay in material delivery and change in project specifications (3.9) mean score, change in project designs (3.8), conflicts between contract documents (3.7), non-compliant design with owner's requirements, errors and omissions in design and ambiguous design details (3.6) and lack of coordination among construction project participants (3.5). As shown below in Table (4.8).

Table 4.8: Frequency of change orders causes

No	Causes of change orders	N	Mean	SD
1	Change of schedule	65	4.0	0.7
2	Financial problems	65	4.0	0.9
3	Delay in material delivery	65	3.9	0.8
4	Change in specifications	64	3.9	0.8
5	Change in design	64	3.8	0.8
6	Conflicts between contract documents	64	3.7	0.7
7	Non-compliant design with owner's requirements	64	3.6	0.9
8	Errors and omissions in design	64	3.6	0.9
9	Ambiguous design details	64	3.6	0.7
10	Lack of coordination	64	3.5	0.8
11	Inadequate working drawing details	63	3.5	0.9
12	Lack of communication	63	3.5	0.8
13	Impediment in prompt decision making process	62	3.4	0.7
14	Inadequate shop drawing details	62	3.4	1.0
15	Design discrepancies	63	3.4	0.9
16	Shortage of required materials	62	3.3	0.7
17	Lack involvement in design of one or more parties	64	3.3	0.6
18	Design complexity	64	3.2	0.9
19	Consultant's lack of judgment and experience	64	3.2	0.8
20	Lack of strategic planning	62	3.2	0.6
21	Lack of required data	63	3.1	0.9
22	Lack of a specialized construction management	63	3.0	0.7
23	Non-compliant design with government regulations	63	2.9	0.9
24	Failure of equipment	62	2.8	0.6
25	Shortage of required equipment	63	2.7	0.8
26	Inadequate equipment used for the works	62	2.6	0.7
27	Differing site conditions	62	2.6	0.7
28	Technology change	62	2.6	0.9
29	Low skill of manpower	62	2.5	0.8
30	Shortage of manpower	63	2.5	0.9
31	Health and safety considerations	63	2.4	0.9
32	Change in project scope	62	2.3	0.8
33	Change in economic conditions	63	2.2	0.7
34	Change in government regulations	63	2.1	0.7
35	Extreme Weather conditions	63	2.0	0.7

As also shown in Table (4.8) the bottom (10) mean score ranges in between (2.7 – 2.0), which have the lowest possibilities of causing change orders, many of them are related to materials and equipments. As respondents reported in Table (4.8) they are as the following: shortage of required equipments (2.7) a mean score , inadequate equipments used for the works, differing site conditions, technology change (2.6) mean score , low skill of manpower and shortage of manpower (2.5) mean score , health and safety considerations (2.4) mean score, change in the overall project scope (2.3) for example change of hospital project to school project; according to professions interviews that's rarely occur, change in economic conditions (2.2) mean score, change in government regulations (2.1) mean score; experts assured that changes in laws and regulations is one of main causes of change orders in construction industry in the West Bank; changes in the relevant law can affect the way work is performed under a contract. Contractors will generally be obliged to complete the work in accordance with local building regulations and other laws. If the law changes during the term of a construction project, this can cause cost and time implications on the projects .

However, extreme weather conditions (2.0) mean score, for the most times of year the climate of Palestine and the West Bank remains moderate in nature and enjoyable as Mediterranean Sea countries, which usually doesn't interrupt the construction work progresses.

During interviews, professionals also assured that in some cases change orders initiate due to any number of unforeseen circumstances.

Unfortunitly, the West Bank still under Israeli occupation; millions of Palestinians live in hard political and economic conditions. Israel controls all Palestinian borders; all imports and exports, and all movement between towns and cities. This situation increases the possibilities of construction changes to meet the requirements of projects and at the same time to meet those unforeseen circumstances.

4.4 Impact of Change Orders on Construction

4.4.1 Types of Change Orders According to Construction Works

Change orders in construction projects may involve additional, substitution or omission works. Their types frequency on construction work were ranked as 1st for (most frequent) to 3rd for (least frequent). As can be seen in Table (4.9) additional works were ranked to be the first as the most frequent with a mean score (1.4). Substitution works came in the second rank with a mean score (2.0) and omission works were reported as the third with a mean score (2.6).

Table 4.9: Frequency of consequence

No	Work impact	N	Mean Score	Std. deviation
1	Additional works	65	1.4	0.5
2	Substitution works	63	2.0	0.6
3	Omission works	63	2.6	0.8

4.4.2 Awareness of Change Orders Outcomes

Changes are expected to occur in any of construction projects. To determine to what extent participants agreed with the given sentences , the researcher used A 5 point Likert scale.

Table 4.10: Outcomes of change orders

Statement	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean
A clause permitting of change orders is a major feature for any of construction contract	65	2.2	15.0	2.2	51.6	29.0	3.9
A change order clause is provided because The complexity of construction operations which cannot be accurately determined in advance	65	2.2	32.5	4.0	38.7	22.6	3.5
The existence of a change order clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract	65	12.9	18.6	4.0	54.8	9.7	3.3
The excessive occurrence of change orders increases the possibility of unethical practices	65	12.9	22.6	0.0	54.8	9.7	3.2
All clients are fully aware that there could be unnecessary costs that accrue due to a change order	65	12.9	46.2	0.0	38.7	2.2	2.7
Most of change orders can be avoided	65	22.5	41.9	2.2	29.0	4.4	2.5

Table (4.10) shows that most of participants (80.6%) reported that a clause permitting of change orders is a major feature for any of construction contract. Moreover, (61.3%) of participants agreed that the complexity of construction operations provides change orders. Many of respondents (64.5%) mentioned that the existence of change orders encourage projects' owner and\or consultants to change some of contract items and change their minds and also they agreed that the excessive occurrence of change orders increases the possibility of unethical practices. Whereas more than

the half of participants (59.1%) disagreed with the statement of all owners know and fully aware that there could be unnecessary costs that occur due to change orders. (64.4%) of respondents indicated that change orders in most of construction projects cannot be avoided.

4.4.3 Cost Impact of Change Orders

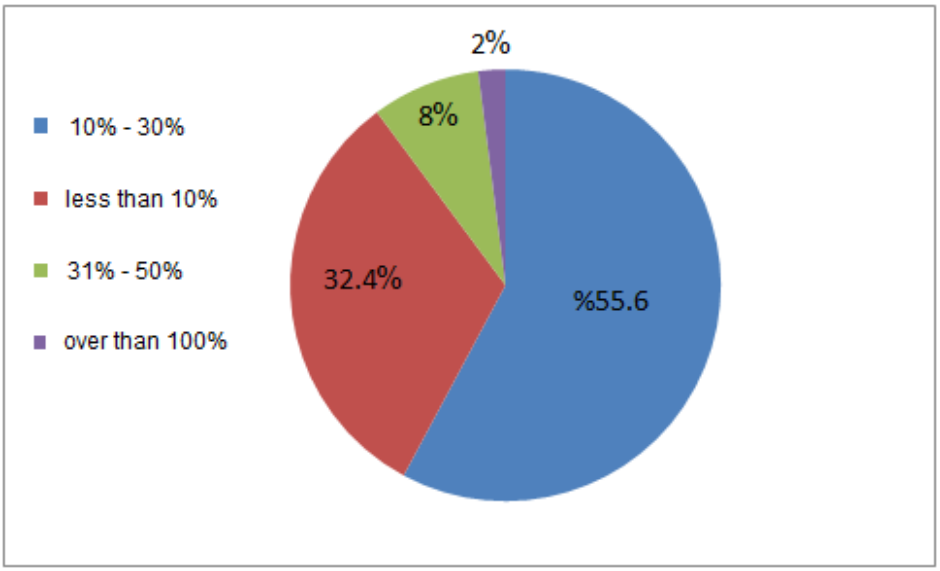

Figure 4.5: Average change in terms of cost

Figure (4.5) shows that (55.6%) of respondents indicated that the average construction changes are usually in between (10% - 30%) of total cost of the origin contract, whereas (32.4%) mentioned that the changes are less than (10%) of contract value, however (8%) mentioned that the changes are between (31%-50%) and (2%) only mentioned that the changes are over than (100%); that occurs due to the overall change in project scope.

Table 4.11: Cost Impact of change orders

Statement	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean
The reduction of the occurrence of change orders can optimally lower construction delivery costs	65	0.0	4.0	4.0	59.5	32.5	4.3
No matter how carefully a change order is administrated, indirect costs accrue on it	65	0.0	4.0	2.2	68.0	25.8	4.2
The occurrence of change orders is the major factor of delay in delivery of construction projects	65	0.0	22.6	2.2	32.5	42.7	3.8
The reduction of variability in construction operations can contribute to significant reduction of unnecessary costs	65	2.2	12.9	4.0	68.0	12.9	3.7
Excessive change orders result in incurring unnecessary costs	65	4.0	25.8	2.2	58.3	9.7	3.5
Time compression in construction operations can contribute to significant reduction of unnecessary costs	65	9.7	22.6	0.0	45.1	22.6	3.4

As can be noticed from Table (4.11), the majority of participants (92%) assured that the reduction of change orders can lower the total delivery costs of construction projects. Many of respondents (68%) agreed that the excessive change orders result in incurring unnecessary costs. Slightly less participants (67.7%) agreed that the time compression in construction operations can contribute to significant reduction of unnecessary costs. Moreover, (75.2%) of respondents assured that change orders are the major causes of delay in construction projects in the West Bank.

4.4.4 Frequency Impact of Change Orders on Project Performance

The frequency of change orders impacts on project performance were ranked by using a 5 point Likert scale as the following: Never = 1;

Seldom = 2; Sometimes = 3;Often = 4; and Always = 5. According to research respondents" time overrun" was ranked as the first outcome of change orders with a mean score(4.2). Followed directly with "cost overrun" which also was given a mean score (4.0). Dispute between parties of construction contract was ranked 3rd with a mean (3.7). Delay in payment for contractors came in the fourth rank. Complaints of one or more of construction parties was ranked 5th with a mean score (3.5), as can be shown in Table (4.12).

Table 4.12: Frequency impacts of change orders

No	Impacts	N	Mean	SD
1	Time overrun	65	4.2	0.7
2	Cost overrun	65	4.0	0.5
3	Disputes between parties to the contract	65	3.7	0.8
4	Delay in payment	65	3.6	0.9
5	Complaints of one or more of the parties to the contact	64	3.5	1.0
6	Additional specialist equipment	63	3.1	0.5
7	Professional reputation of one or more parties adversely affected	64	2.9	0.9
8	Additional health & safety equipment/measure	65	2.5	0.8
9	Degradation of quality standards	65	2.4	0.6
10	Degradation of health& safety	63	2.4	0.9
11	Additional specialist personnel	62	2.0	0.7

4.4.5 Impact of Change Orders

The impacts of change orders on construction industry were ranked by using a 3 points scale: as the following Major impact = 1; Slight impact = 2; and No impact = 3. As can be seen in Table (4.13) Cost overrun came in the first position with a mean score(1.1), followed by time overrun which was given a mean score (1.2) and took the second. Whereas dispute

between construction parties was ranked the third with a mean score (1.4). Moreover, many of change orders adverse impacts were ranked according to their mean scores as shown in Table (4.13)

Table 4.13: Impacts of change orders on the following

No	Impacts	N	Mean	SD
1	Cost overrun	65	1.1	0.3
2	Time overrun	65	1.2	0.5
3	Disputes between parties to the contract	64	1.4	0.6
4	Delay in payment	65	1.5	0.7
5	Complaints of one or more of the parties to the contact	64	1.6	0.5
6	Professional reputation of one or more parties adversely affected	63	1.8	0.6
7	Additional specialist equipment	62	2.0	0.5
8	Additional health & safety equipment/measure	64	2.1	0.6
9	Degradation of quality standards	62	2.2	0.6
10	Degradation of health& safety	63	2.3	0.8
11	Additional specialist personnel	62	2.4	0.7

4.4.6 Change Orders Administration

Many of research respondents mentioned that there were no standard methods for managing and recording change orders in construction. In practice changes are typically recorded as they occur. As can be seen in Figure (4.6) all participants (100%) indicate that their companies records change orders in their construction projects. All participants (100%) also indicates that they calculate the direct cost of change orders whereas only (42.6%) of them reported that they calculate the indirect costs. Moreover According to all respondents, construction companies in

the West Bank often don't employ a specific person to manage changes and change orders in construction.

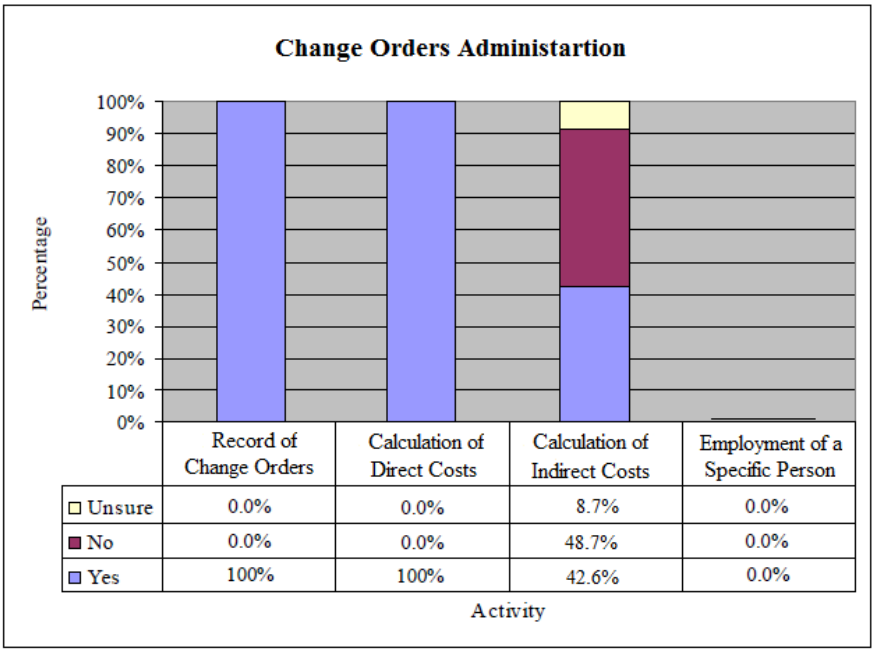

Figure 4.6: Change orders administration

4.5 Reduction of Change Orders in Construction Industry

Table 4.14: How to minimize the change orders in construction industry (N= 60).

Suggestions	Percentage (N=60)
Planning	25%
Design completeness	17.5%
Pre-contract time allocation	15.5%
Budget consideration	12.5%
Clear scope	10%
Coordination	5%
Communication	5%
Experience	5%
Quality of information	2.5%
Forecast and value engineering	2.5%

Through the research survey and interviews conducted with construction professionals, most of participants assured that the

occurrence of changes in construction projects could be reduced, since many of opinions were collected and reported as shown in Table (4.14).

According to respondents change orders can be minimized if proper planning took place by involving all construction parties before start works on site, proper planning took (25%). Consultants should prepare a complete designs and specifications of project at the tender stage (17.5%). Adequate time allocation for all project activities to be able to determine the actual project duration (15.5%). Adequate budget allocation to whole project phases in order to determine total project costs (12.5%). Moreover the clients should have a clear scope and final decisions concerning their projects on pre-contract stage (10%). Close coordination and well communication are required at all times especially in the design stage (5%). Experience (5%); construction works should be controlled with a well - experienced supervisor. Quality of information (2.5%); accurate information should be provided regarded to procurement processes, equipment, materials, skills and manpower. Forecast (2.5%); All construction participants must forecast to predict unforeseen problems or situations.

4.6 Framework Development

In this research, the methods used to develop a framework included taking some ideas from the existing body of literature review in addition to empirical data collection through experts ‘interviews and the questionnaire.

The data gathering from the qualitative and quantitative methods was designed in the way to gather the information required for the framework development.

The findings of the research indicates that the current situation of change order management needs to be improved, since this research aims to improve the methodology in which change orders are managed. During interviews, construction experts assured that the current practices of managing change order in the West Bank occur orally for the basic changes or by using an official change order forms, as seen in Appendix (5).

The significance of this framework comes that the model applies the most basic principles of change management system which help to study and identify the different change aspects; including change sources, types, needs, causes, possible impacts. All through defined sequence stages. The development of the framework went through two stages:

A. Developing the framework based on the insights and results from the questionnaire survey and experts suggestions.
B. Validating the proposed framework by experts in the Palestinian construction industry to confirm the clarity, applicability and effectiveness of the model.

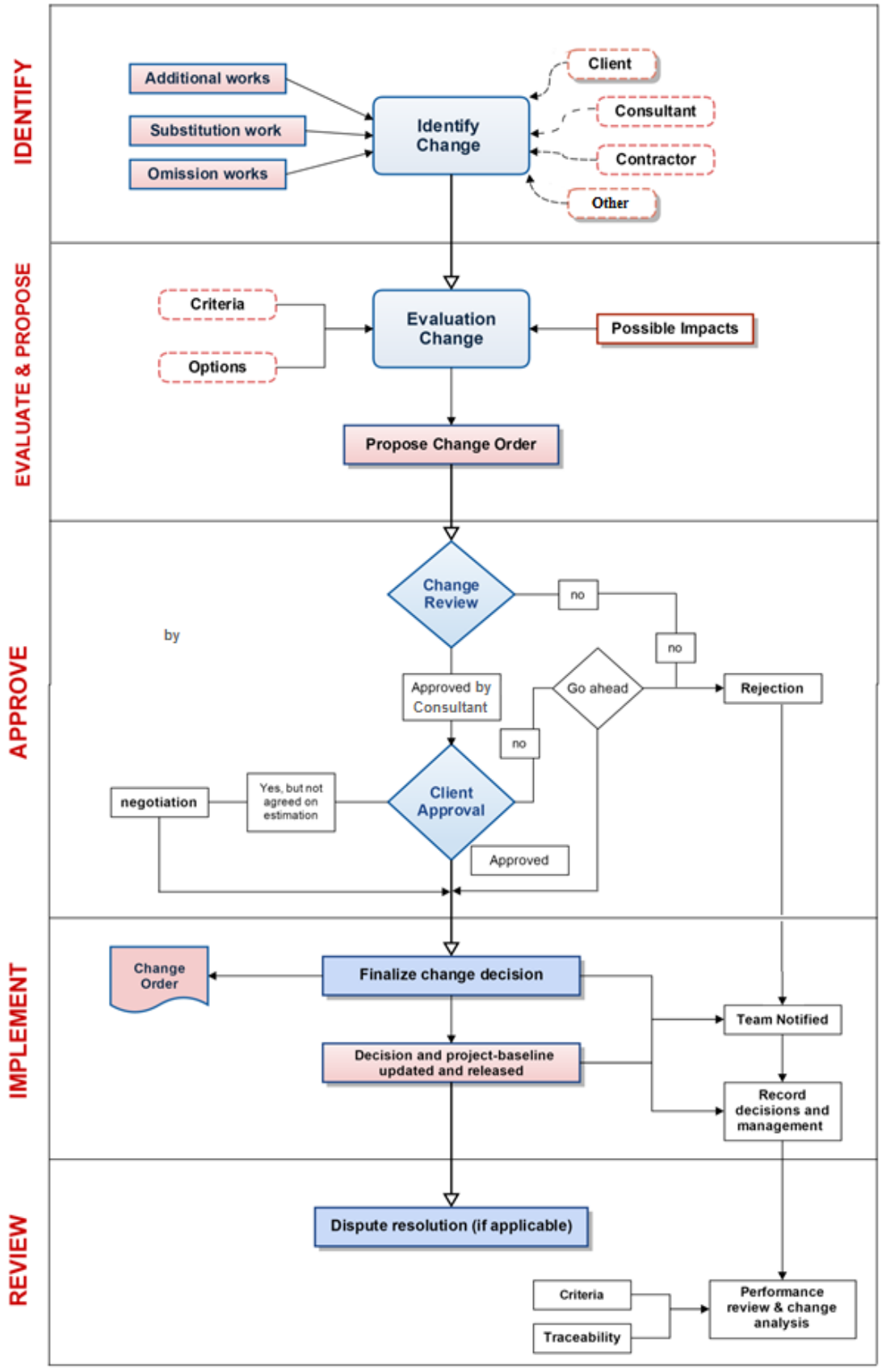

Figure 4.7: Change order management framework

The framework consists from a sequence of a five major stages starting from identifying changes, evaluate changes and propose change order, approve change order, implement and review as shown in Figure (4.7): Change order management framework

4.6.1 Identify Changes

The first stage in this framework has a set of proactive procedures determined to identify changes which occur in construction projects. These rules including clear identification to the major source of changes and their justified causes, whether these changes caused by client, consultant, and contractor or other. Identifying the type of changes; whether they are additional works to origin contract agreement, substitution or omissions works. This builds up the relationships of various aspects of changes properly.

4.6.2 Evaluate Changes

This stage is based on project criteria, items, designs and specification and its relationship with the possible options and needs for change. Evaluation includes comparing requested changes according to project - contract criteria, analyzing change options and calculating all possible impacts in terms of cost and time that an identified change could have whether on project progress or team members. Evaluation can be used to filtrate the change that have already occurred or about to occur. The outcome of this stage is a proposed change order; a new updated an action plan, budget, schedule, etc.

4.6.3 Approve Changes

According to the third phase in this framework, proposed change orders should go through a formal process, since there are a set of formal approval progress for each type of change in the construction sector. Consultants and clients must involve and make decisions according to the whole changes which described in the proposed change orders. Give their acceptance, suggest any improvements through negotiation or reject those changes that makes through a change review and client approval process. Even so rejected changes should record on management system to be able to re-evaluate again when they are ready, and team members should be notified with that.

4.6.4 Implement Changes

Final decision of changes is taken in the previous stage. Operational processes are expected during the stage of implementation just to make sure that the official change order are considered, all parties are notified, all activities are coordinated properly and all aspects are updated.

4.6.5 Review and Analysis

At this stage all disputes outcome due to change orders should be resolution, through justifying and analyzing whole direct and indirect causes of change and reviewing the performance which bases mainly on the data collected during the change implementation phase.

4.7 Validation

In order to explore if this framework is applicable or not, this model was discussed through interviews which were conducted with many of construction professionals, their own opinions according to this framework were as the following:

The first opinion came from number of consultants who found that the framework is clear, easily understood, excellent and should be applied in all projects in construction industry. Applying this framework will organize the occurrence of changes in construction works and managing the sequence of change orders effectively. But maybe some of construction teams who are not familiar with such a model need to rehabilitate their knowledge, information and to train them.

The second opinion was from client, engineers working in Palestinian Ministry of Housing and Public Works who studied the framework properly and they assured that the model is comprehensive, applicable and many of its items are already implemented in their projects but they are not organized as presented in the proposed framework. Starting from sufficient change identification, following with accurate evaluation of proposed change orders and their possible impacts on project, accept or reject propose changes and then initiate the final decisions.

The third opinion came from number of contractors who were not engineers, they indicated that they were satisfied with their methods of managing change orders in their projects and they don't have the ability to learn new methods which might consume more time, effort and cost. According to their point of view, applying such a framework require to learn new things they are not familiar with it.

Chapter Five
Conclusions and Recommendations

Chapter Five

Conclusions and Recommendations

5.1 Introduction

This chapter summaries the outcomes of the research and presents many of notable findings, conclusions, and recommendations which could help all parties involved in construction projects in the West Bank to improve and develop their own practices of managing change orders. Some of the recommendations for other further studies are presented.

Generally speaking, the objectives have been achieved, some results were concluded, and many actions have been recommended. These conclusions and recommendations are hoped to improve the capability of Palestinian construction parties in change orders practices, one hand, and to add a value for construction industry researches in Palestine, in the other hand.

5.2 Conclusions

The causes of change orders, and their effects on project performance are complex and influenced by several interrelated factors. The risk and uncertainties associated with project changes make predictions and planning for changes a difficult task. Based on the field survey conducted and the results presented in chapter four, the following can be concluded:

1. This research adds contribution to the Palestinian construction studies as the first research enlightening the main important issues related to change orders and their management within construction industry in the West Bank. The research provided an extensive review of

construction change orders in terms of change current practices, the responsibilities of changes occur in projects, the main causes of change orders, their impact on construction projects and management.

2. The main source of changes in construction is the owner. It was found that project owners initiated change orders due to financial problems, changing in project plan or scope, changing in mind and non-compliant design with owners' requirements. There are three explanations for this: first, the owner was not involved in the design development. Secondly, the owner didn’t understand or visualize the design. The designer may not have made the design clear or the owner just lack of ability to read the drawings. Thirdly, it is merely a change of mind while at the same time not appreciating the negative impacts of changes. The result showed that changes can have a huge financial impact to the owner due to the huge value of the project which means (10% - 30%) increase in cost.
3. The second major source of change orders in construction is the consultant. Consultant causes changes and initiates change orders due to errors and omissions in designs, change in project specifications, and conflicts in the contract documents after award.
4. The consultant and owner also generating change orders for substituting some of works, material or procedures. This may occur due to new materials becoming available in the market, or due to changes in specifications, and also due to delivery challenges.

5. It was concluded that the change orders in construction industry occurred more frequently for adding new works: increasing the quantities of the works by adding new items that did not exist in the original contract, which consequently increase the contract value.
6. Cost and time overrun are the two main effects being noted for change orders; increase in project duration and additional payments for contractors are considered an outcome of changes. The disputes between parties to the contract and degradation of labor productivity are a major concern here. Quality of work mostly is not affected by changes.
7. The current situation of change order management in the West Bank needs to be improved. Change orders can be minimized if proper planning took place by involving all construction parties before the works start on site, adequate time allocation, adequate budget allocation, clear scope, close coordination and well communication are required at all times, specially in the design stage.
8. The main contribution of the research is the development of a change order management framework to better manage change orders in the Palestinian construction industry. However, it was noticed that no attention has been paid to the integration models, frameworks or change order management systems.

5.3 Recommendations

Based on the results of this research which were discussed in Chapter 4, together with the main conclusions listed above, and referring to findings

of previous studies discussed in the literature review, the following recommendations are made :

A) Recommendations for Owners

In order to reduce change orders, cost and time overruns, owners are recommended to do the following:

- Provide a clear brief of the scope of works.
- Get involved in the design at an early stage to make sure it meets all his requirements.
- Make adequate financial planning during planning stage to avoid changing plans later, or during construction.
- Hire experienced consultants, contractors, and construction managers to avoid work repetition.
- Meet with the contractor regularly to avoid any deviations from the agreed up-on work scope.

B) Recommendations for Contractors

In order to reduce change orders, cost and time overruns contractors are recommended to do the following:

- Follow the owner’s instructions and scope of work as much as possible.
- Check the project site before starting the project to estimate the work correctly and to avoid future change orders.
- Hire experienced workers, engineers, and construction managers to avoid work repetition.

- Stop using change orders as a way to make more profit from the project. It is recommended to educate contractors on the negative effects of change orders. Contractors should consider direct and indirect impact of changes to check their feasibility.
- Avoid increasing working hours and overtime to complete the work.
- Be up to date with all government regulations.

C) Recommendations for Consultants

In order to reduce change orders, cost and time overruns consultants are recommended to do the following:

- Understand the owner's scope of work thoroughly to avoid design changes.
- Use updated lists of materials to avoid erroneous material specifications.
- Avoid miscommunications between the design team members (Architects, Structural, Mechanical engineers) to reduce change orders and cost overruns.

5. 4 Recommendations for Further Studies

This research included all parties in construction industry the contractor, consultant and the owner. As mentioned in the conclusion, project owners received most of the blame for generating changes. More studies should be concentrate on the participation of the project owners in the design stage to improve their understanding of the design drawings, and show them a model of their project before construction by considering the benefits of a

BIM environment to efficiently implement change orders. It is also recommended to conduct in each sector separately so that building, infrastructure, roads and mechanical projects to satisfy the specialty of each of them.

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Appendices

Appendix 1: Questionnaire in Arabic Language.

Appendix 2: Questionnaire in English Language.

Appendix 3: Research Interviewers' List.

Appendix 4: Questionnaire Review – PCU.

Appendix 5: Construction Change Order Form.

Appendix (1)

استبانه حول

تقييم أثر الأوامر التغييرية في قطاع هندسة المشاريع الإنشائية بالضفة الغربية

السادة الكرام / تحية طيبة وبعد ،،،

يهدف هذا الاستبيان إلى دراسة وتقييم أثر الأوامر التغييرية في قطاع هندسة المشاريع الإنشائية في الضفة الغربية /فلسطين، وذلك من حيث الأسباب والعوامل الرئيسية الكامنة وراء حصول تلك التغييرات وأثارها المتوقعة على أداء المشاريع. يعتبر هذا الاستبيان جزءاً من البحث التكميلي لنيل درجة الماجستير في تخصص الإدارة الهندسية/ جامعة النجاح الوطنية . آملين أن يتمخض عن هذا البحث إيجاد حلول واقعية للمشكلات الناتجة عن الأوامر التغييرية والتي تواجه كافة الإطراف المشاركة بقطاع المقاولات، وخفض مستوى التغيير قبل وأثناء تنفيذ المشروع الإنشائي، والذي بدوره يقلل النزاعات والمعيقات التي تواجه تلك الأطراف، وتعزيز الثقة والاحترام المتبادل بينهم وذلك من أجل النهوض بقطاع الإنشاءات في فلسطين .

المساهمة في تعبئة هذا الاستبيان سيؤدي إلى تقييم و دراسة معظم المشكلات الناتجة عن الأوامر التغييرية وذلك لتحقيق أفضل النتائج لخدمة مجتمعنا الفلسطيني. جميع المعلومات الواردة في هذا الاستبيان سوف تستخدم فقط لأغراض هذا البحث .أي نتائج سوف يتم نشرها على شكل نتائج إحصائية لمجموع شركات عينة البحث.

شاكرين لك حسن تعاونك ،،،

القسم الأول: معلومات عامة عن الشركة ومعبئ الاستبيان.

الباحث : المهندس مجاهد ستيتي . **ايميل : Mojespal@yahoo.com**

إشراف : الدكتور محمد عزام عثمان

الرجاء اختيار الإجابة الأنسب من وجهة نظرك بوضع إشارة (√) بجانب الإجابة المناسبة.

1. **المحافظة التي يوجد فيها المقر الرئيسي للشركة : .....**

2. **طبيعة عمل الشركة \ المؤسسة :**

☐ جهة مالكه ☐ استشاري ☐ مقاول ☐ غير ذلك \ حدد

3. **القطاع التي تعمل فيه الشركة \ المؤسسة :**

☐ قطاع عام ☐ قطاع خاص ☐ كلاهما

4. **الموقع الوظيفي لمعبئ الاستبيان :**

☐ مدير الشركة ☐ مدير المشروع ☐ مهندس موقع \ مكتب ☐ غير ذلك

5. **عدد سنوات الخبرة في المشاريع الإنشائية لمعبئ الاستبيان :**

☐ اقل من 5 سنوات ☐ (5- 10) سنوات ☐ (11- 15) سنة ☐ أكثر من 15 سنة

6. **أكثر أنواع المشاريع التي تعمل فيها الشركة و تنفذها :**

☐ أبنية ☐ طرق ☐ مياه ومجاري ☐ كهروميكانيك ☐ أشغال عامة

7. أنواع العقود الهندسية التي تفضل شركتكم التعاقد بها :

☐ عقود المبلغ المقطوع (Lump Sum) ☐ عقود السعر الموحد (Unit Price)

☐ عقود الكلفة الزائدة (Cost Plus) ☐ عقود تسليم المفتاح (Turnkey)

☐ عقود تصميم وتنفيذ (Design Build) ☐ غير ذلك\حدد

8. من خلال خبرتك الخاصة في المشاريع الإنشائية، من فضلك يرجى ترتيب \ تصنيف أثر الأوامر التغييرية التالية على الأعمال و الأنشطة الإنشائية، من (1st للأكثر تكراراً) حتى (3rd للأقل تكراراً) :

الرقم	التأثير	1st	2nd	3rd
8.1	أوامر لأعمال أضافية			
8.2	أوامر لتبديل الأعمال المطلوبة			
8.3	أوامر للامتناع عن تنفيذ أعمال محدده			

9. برأيك كم متوسط النسبة المئوية لجميع التغييرات التي قد تحصل في المشروع الواحد وذلك من خلال تجربتك مع الأوامر التغييرية ؟

☐ أقل من 10 % ☐ 10 % - 30 % ☐ 31 % - 50 % ☐ أكثر من 100 %

10. <u>من حيث التكلفة</u> ما هو متوسط النسبة المئوية لجميع تغييرات في المشاريع التي شاركت فيها ؟

☐ أقل من 10 % ☐ 10 % - 30 % ☐ 31 % - 50 % ☐ أكثر من 100 %

11. إلى أي مدى تتفق مع العبارات التالية فيما يخص انتشار الأوامر التغييرية وأثرها ، وفقا للتالي : لا أوافق بشدة =1 ، لا أوافق = 2 ، لا أدري = 3 ، أوافق = 4 ، أوافق بشدة = 5 ؟

الرقم	العبارة	لا أوافق بشدة	لا أوافق	لا أدري	أوافق	أوافق بشدة
11.1	شرط السماح للأوامر تغييرية هي سمة أساسية من سمات أي عقد بناء.					
11.2	يمكن تجنب معظم الأوامر التغييرية.					
11.3	وجود الأوامر التغييرية بسبب التعقيد في الأعمال الإنشائية التي لا يمكن التنبؤ بها وتحديدها مسبقاً					
11.4	وجود الأوامر التغييرية هو عامل مشجع لملاك المشاريع والاستشاريين إلى كثرة التغيير في المشاريع و أذواقهم.					
11.5	جميع ملاك المشاريع يدركون جيدا انه قد تكون هناك تكاليف غير ضرورية بسبب الأوامر التغييرية.					
11.6	كثرة الأوامر التغييرية تزيد من الممارسات غير الأخلاقية والمصداقية في أداء المشاريع.					
11.7	كثرة الأوامر التغييرية تؤدي إلى تكبد تكاليف غير ضرورية.					
11.8	الحد من وقوع الأوامر التغييرية يمكن أن يقلل من التكلفة الإجمالية عند تسليم المشروع.					
11.9	ضغط وتحديد الوقت لجميع عمليات البناء يساهم بدرجة كبيرة في التقليل من التكاليف غير الضرورية.					
11.10	الحد من التباين والاختلاف في أنشطة وعمليات البناء يمكن أن يسهم في الحد بدرجة كبيرة من التكاليف غير الضرورية.					
11.11	بغض النظر عن الطريقة التي تدار فيها الأوامر التغييرية ، لا بد من وجود تكاليف غير مباشرة بسبب تلك الأوامر.					
11.12	حدوث الأوامر التغييرية هو عامل رئيسي للتأخير في أنجاز وتسليم المشاريع الإنشائية.					

12. من خلال خبرتك السابقة في المشاريع الإنشائية، من فضلك حدد مدى تكرار حدوث الآثار المتوقعة التالية للأوامر التغييرية في المشاريع الإنشائية.

الرقم	الآثار المتوقعة	دائماً	غالباً	أحياناً	نادراً	أبداً
12.1	زيادة وقت المشروع.					
12.2	زيادة تكلفة المشروع.					
12.3	الحاجة إلى معدات متخصصة إضافية.					
12.4	الحاجة إلى موظفين متخصصين إضافيين.					
12.5	سوء وتدهور معايير السلامة في المشروع.					
12.6	الحاجة إلى معدات سلامة إضافية في المشروع.					
12.7	خلافات و مشاكل بين الإطراف المتعاقدة.					
12.8	تضرر سمعة احد أطراف المشروع.					
12.9	شكوى وتذمر أحد الإطراف أو أكثر في المشروع.					
12.10	سوء معايير جودة المشروع.					
12.11	تأخر في الدفعات.					
12.12	دفعات إضافية للمقاول					

13.من خلال خبرتك السابقة في المشاريع الإنشائية، من فضلك حدد مدى تأثر المشاريع الإنشائية بالنتائج المتوقعة التالية للأوامر التغييرية.

الرقم	الآثار المتوقعة	تأثير رئيسي	تأثير طفيف	لا تأثير
13.1	زيادة وقت المشروع.			
13.2	زيادة تكلفة المشروع.			
13.3	الحاجة إلى معدات متخصصة إضافية.			
13.4	الحاجة إلى موظفين متخصصين إضافيين.			
13.5	سوء وتدهور معايير السلامة في المشروع.			
13.6	الحاجة إلى معدات سلامة إضافية في المشروع.			
13.7	خلافات و مشاكل بين الإطراف المتعاقدة.			
13.8	تضرر سمعة احد أطراف المشروع.			
13.9	شكوى وتذمر أحد الإطراف أو أكثر في المشروع.			
13.10	سوء معايير جودة المشروع.			
13.11	تأخر في الدفعات.			
13.12	دفعات إضافية للمقاول			

14.من فضلك حدد أي من الممارسات التالية صحيحة في شركتك \ مؤسستك ؟

الرقم	النشاط	نعم	لا	غير متأكد
14.1	يتم تسجيل جميع الأوامر التغييرية ومتابعتها .			
14.2	يتم جمع وتحديد الزيادة في التكلفة المباشرة للأوامر التغييرية.			
14.3	يتم جمع وتحديد الزيادة في التكلفة الغير المباشرة للأوامر التغييرية.			
14.4	يتم تعيين موظف خاص لإدارة الأوامر التغييرية في مشاريعنا.			

القسم الثالث: أسئلة تتعلق بالعوامل والأسباب الرئيسة للأوامر التغييرية

15. من فضلك يرجى تحديد من هو المسؤول الأول عن تكرار حدوث الأوامر التغييرية في المشاريع الإنشائية باستخدام الترتيب التالي : 1st للأكثر تكراراً حتى 3rd للأقل تكراراً.

الرقم	أطراف العقد	1st	2nd	3rd
15.1	المالك			
15.2	الاستشاري			
15.3	المقاول			

16. الجدول التالي يوضح بعض الأمثلة على الأسباب الرئيسية للأوامر التغييرية ، من وجهة نظرك يرجى تحديد مدى تكرار حدوث كل منهما في المشاريع الإنشائية.

الرقم	أسباب الأوامر التغييرية	دائماً	غالباً	أحياناً	نادراً	أبداً
	التخطيط والتصميم					
17.1	تغيير في هدف المشروع.					
17.2	تغيير في المدة الزمنية للمشروع.					
17.3	تغيير في تصميم المشروع.					
17.4	حدوث أخطاء في التصميم.					
17.5	تعقيدات في التصميم.					
17.6	تناقضات في التصميم.					

17.7	عدم توافق التصميم مع متطلبات ورؤية الجهة المالكة للمشروع.					
17.8	عدم توافق التصميم مع المحددات والقوانين الحكومية.					
17.9	عدم الوضوح في المخططات التفصيلية.					
17.10	عدم الوضوح في المخططات التنفيذية.					
17.11	عدم مشاركة احد أطراف العقد في تصميم المشروع.					
17.12	غموض في تفاصيل التصميم.					
	المعدات المستخدمة	دائما	غالبا	أحياناً	نادراً	أبداً
17.13	تغييرات في التكنولوجيا المستخدمة.					
17.14	نقص في المعدات المطلوبة.					
17.15	تعطل المعدات المستخدمة.					
17.16	عدم ملائمة\ توافق المعدات المستخدمة مع الأعمال المطلوبة انجازها.					
	المواد الإنشائية					
17.17	نقص في المواد المطلوبة					
17.18	تغيير في مواصفات المواد المطلوبة					
17.19	تأخر في توريد المواد المطلوبة					
17.20	ضعف عمليات الشراء والتوريد					
	القوى البشرية العاملة					
17.21	نقص في القوى العاملة					
17.22	عدم توفر المهارات المطلوبة					
	إدارة المشاريع	دائما	غالبا	أحياناً	نادراً	أبداً

17.23	غياب التنسيق بين أطراف العقد.					
17.24	ضعف قنوات التواصل بين أطراف العقد.					
17.25	تناقضات في وثائق العطاء.					
17.26	غياب السرعة في اتخاذ القرارات.					
17.27	غياب التخطيط الاستراتيجي.					
17.28	نقص البيانات والمعلومات المتعلقة في المشروع					
17.29	قلة الخبرة لدى الاستشاري وغياب القدرة على الحكم					
17.30	اعتبارات الصحة والسلامة العامة.					
	عوامل أخرى	دائما	غالبا	أحياناً	نادراً	أبداً
17.31	صعوبة الظروف المناخية .					
17.32	اختلاف ظروف الموقع.					
17.33	تغيير في القوانين والمحددات الحكومية.					
17.34	تغيير في الظروف الاقتصادية.					
17.35	مشاكل مالية.					

18. برأيك كيف يمكن التقليل من التغيير والأوامر التغييرية في المشاريع الإنشائية ؟

.....

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19. هل لديك أي اقتراحات ، تعليقات أو مشاركات أخرى تتعلق بالأوامر التغييرية ؟

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.....

.....

Appendix (2)

Questioner for surveying the Impact of Change Orders in Engineering Construction Sector in the West Bank

Dear Sir\Madam:

I am currently preparing my thesis which aims to study and assess the impact of change orders in engineering construction sector in the West Bank. Hopping the result of this study will reduce the level of changes in construction projects and find a rational solution for change orders problems which face all construction participants. Where this questionnaire considered as a part of the supplementary research to achieve my master's degree in Engineering Management /An-Najah National University –Nablus and based on your experience as a professional in construction industry, I kindly request you to take a little of your valuable time to fill this questionnaire. Your contribution in filling this questioner leads to detecting and resolving this sector problems to achieve the best outcomes for the benefit of the Palestinian society.

Section One *: Questions related respondents' Profile:*

Please note that your company name and your name will remain confidential as far as the results are concerned. The collected data will be statistically analyzed, and a conclusion will be finalized.

Thanks for your assistant and cooperation

The researcher: Mujahed M. Staiti Email: Mojespal@yahoo.com

The Supervisors: Dr. Muhammad Othman

Please choose the best answer from your point of view, make (√) to the best answers:

1. Company Location in the West Bank : _____.

2. Which of the following best describes your company work?

☐ Client (owner) ☐ Consultant ☐ Contractor ☐ Other. Specify

3. What sector do you work in ?

☐ Public ☐ Private ☐ Both

4. Position of the respondent :

☐ Company Director ☐ Project Manager ☐ Site\office Engineer

☐ Other. Specify_____

5. How long have you been dealing with construction projects ?

☐ <5 years ☐ 5-10 years ☐ 11-15 years ☐ >15 years.

6. Types of most accomplished projects:

☐ Building ☐ Roads ☐ Water and Sewage ☐ General Works

7. Types of construction contracts that your company prefers to contract with:

☐ Lump-Sum ☐ Unit Price ☐ Cost Plus ☐ Turnkey Contracts

☐ Design-Build Contracts

8. From your own experience, from the 1st (most frequent) to the 3rd (least frequent) **rank** the following impacts of change orders on construction work.

No	Impact	1st	2nd	3rd
8.1	Additional works			
8.2	Omissions from works			
8.3	Substitution of works			

9. What percentage of your project had changes?

☐ Less than 10% ☐ 10 to 30 % ☐ 31 to 50 %

☐ 51 to 100% ☐ Over 100 %. Please specify……

10. What are the average changes in your project/s in terms of cost?

☐ Less than 10% ☐ 10 to 30 % ☐ 31 to 50 %

☐ 51 to 100% ☐ Over 100 %. Please specify……

11. To what extent do you agree with the following statements where strongly Disagree=1, Disagree=2, Neutral=3, Agree=4, Strongly agree=5?

No	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
11.1	A clause permitting change orders is an essential feature of any construction contract					
11.2	Most change orders can be avoided					
11.3	A change order clause is provided because construction projects involve complex operations which cannot be accurately determined in advance					
11.4	The existence of a change order clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract					
11.5	All clients are fully aware that there could be unnecessary costs that accrue due to a change order					
11.6	The excessive occurrence of change orders increases the possibility of unethical practices					
11.7	Excessive change orders result in incurring unnecessary costs					
11.8	The reduction of the occurrence of change orders can optimally lower construction delivery costs					
11.9	Time compression in construction operations can contribute to significant reduction of unnecessary costs					
11.10	The reduction of variability in construction operations can contribute to significant reduction of unnecessary costs					
11.11	No matter how carefully a change order is administrated, indirect costs accrue on it					
11.12	The occurrence of change orders is the major factor of delay in delivery of construction projects					

12. From your experience with change orders, indicate how **frequently change orders** resulted in the following:

No	Outcome	Never	Seldom	Sometim	Often	Always
12.1	Time overrun					
12.2	Cost overrun					
12.3	Additional specialist equipment					
12.4	Additional specialist personnel					
12.5	Degradation of heath & safety					
12.6	Additional health & safety equipment/measure					
12.7	Disputes between parties to the contract					
12.8	Professional reputation of one or more parties adversely affected					
12.9	Complaints of one or more of the parties to the contact					
12.10	Degradation of quality standards					
12.11	Delay in payment					

13. From your experience, what was the impact of change orders on construction projects?

No	Outcome	Major Impact	Slight Impact	No Impact
13.1	Time overrun			
13.2	Cost overrun			
13.3	Additional specialist personnel			
13.4	Additional specialist equipment			
13.5	Degradation of health & safety			
13.6	Additional health & safety equipment/measure			
13.7	Disputes between parties to the contract			
13.8	Professional reputation of one or more parties adversely affected			
13.9	Complaints of one or more of the parties to the contact			
13.10	Degradation of quality standards			
13.11	Delay in payment			

Section Three: Questions Related the Causes of Change Orders

14. Indicate which of the following is true of your organization.

No	Activity	Yes	NO	Unsure
14.1	We record all change orders			
14.2	We calculate the direct costs of change orders			
14.3	We calculate indirect costs of change orders			
14.4	We employ a specific person with relevant skills to manage change orders			

15. Please indicate the frequency of each as an origin agent by ranking from 1st (most frequent) to 3rd (least frequent).

No	Agent	1st	2nd	3rd
15.1	Client			
15.2	Consultant			
15.3	Contractor			

16. Following are the examples of **causes of change orders**, indicate **how frequently** each of them occur on construction projects.

No.	Causes of change orders	Client	Consultant	Contractor	Other
	Early Planning and Design				
16.1	Change in the scope of project				
16.2	Change of schedule, origin time of the project.				
16.3	Change in design				
16.4	Errors and omissions in design				
16.5	Design complexity				
16.6	Ambiguous design details				
16.7	Design discrepancies				
16.8	Non-compliant design with government regulations				
16.9	Non-compliant design with owner's requirement				
16.10	Lack involvement in design of one or more parties to the contract				
16.11	Inadequate working drawing details				
16.12	Inadequate shop drawing details				
	Equipment				
16.13	Technology change				
16.14	Shortage of required equipment				
16.15	Failure of equipment				
16.16	Inadequate equipment used for the works				
	Material				
16.17	Shortage of required materials				
16.18	Delay in material delivery				
16.19	Change in materials specifications				
16.20	Poor procurement process				
	Manpower				
16.21	Shortage of manpower (skilled, semi-skilled, unskilled labour)				
16.22	Low skill of manpower				
	Project Management				

16.23	Lack of coordination				
16.24	Lack of communication				
16.25	Conflicts between contract documents				
16.26	Impediment in prompt decision making process				
16.27	Consultant's lack of judgment and experience				
16.28	Lack of required data				
16.29	Lack of strategic planning				
16.30	Health and safety considerations				
	External Factor				
16.31	Extreme Weather conditions				
16.32	Differing site conditions				
16.33	Financial problem				
16.34	Change in government regulations				
16.35	Change in economic conditions				

17. Following are the examples of **causes of change orders**; indicate **how frequently** each of them occurs on construction projects.

No.	Causes of change orders	Never	Seldom	Sometimes	Often	Always
	Early Planning and Design					
17.1	Change in the scope of project					
17.2	Change of schedule, origin time of the project.					
17.3	Change in design					
17.4	Errors and omissions in design					
17.5	Design complexity					
17.6	Ambiguous design details					
17.7	Design discrepancies					
17.8	Non-compliant design with government regulations					
17.9	Non-compliant design with owner's requirement					
17.10	Lack involvement in design of one or more parties to the contract					
17.11	Inadequate working drawing details					
17.12	Inadequate shop drawing details					
	Equipment					
17.13	Technology change					
17.14	Shortage of required equipment					
17.15	Failure of equipment					
17.16	Inadequate equipment used for the works					
	Material					
17.17	Shortage of required materials					
17.18	Delay in material delivery					
17.19	Change in materials specifications					
17.20						
	Manpower					
17.21	Shortage of manpower (skilled, semi-skilled, unskilled labour)					
17.22	Low skill of manpower					
	Project Management					
17.23	Lack of coordination					
17.24	Lack of communication					

17.25	Conflicts between contract documents					
17.26	Impediment in prompt decision making process					
17.27	Consultant's lack of judgment and experience					
17.28	Lack of required data					
17.29	Lack of strategic planning					
	Lack of a specialized construction management					
17.30	Health considerations					
	External Factor					
17.31	Extreme Weather conditions					
17.32	Differing site conditions					
17.33	Change in government regulations					
17.34	Change in economic conditions					
17.35	Financial problem					

18. How can the occurrence of change orders be reduced?

……

……

……

……

……

……

19. Do you have any further comment, suggestion or contribution relative to change orders?

……

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……

……

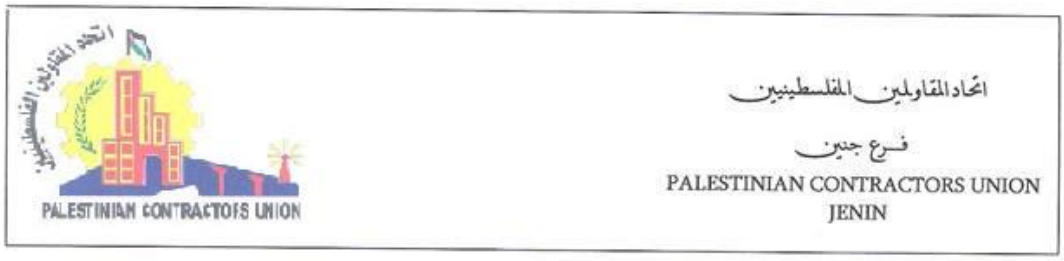
Thank you.

Appendix (3)

Research Interviewers' List

PCU secretary	PCU – Jenin Branch
Eng. Ziyad Rabaia’	Head Of Engineering Association - Jenin
Eng. Sulaiman Foqha	Head of Engineering and Maintenance Department – Arab American University
Dr. Yahya Saleh	Assistant Professor Industrial Engineering Department – An- Najah National Univer.
Eng. Nezar Mughrabi	Al Moghrabi Engineering Company
Eng. Faisal Zakarni	Al-Buroj Engineering Company
Eng. Yaqub Arqawi	Darco Engineering and Consulting
Eng. Muhammad Ghazawni	First Option Engineering Company
Eng. Muhammad Alraji	Al-aqsa & Alshamal Company
Eng. Osama Hamadan	Ramallah Municipality
Eng. Noor Eddine Jaradat	Engineers Consultant & Project Manager
Eng. Lama Qassrawi	Municipal Development & Lending Fund
Eng. Ehab Hamaeyel	Amjad Shuaibi Architects
Mr. Rida Eleswed	Elesewed Contracting Company
Mr. Mustafa Qineery	Al-Nakheel Contracting Company

Appendix (4)



REF..... : الرقم

DATE : ..... 2015/6/25..... : التاريخ

الاخ المهندس مجاهد محمود استيتي المحترم،

تحية طيبة وبعد

بعد مراجعة بنود الاستبيان الذي وصلنا من قبلك فاننا في اتحاد المقاولين نرى أن كافة البنود والمواد المطلوب الاستفسار عنها والاجابة عليها كافية و مستوفيه معظم الأسباب والقضايا والعراقيل التي يواجهها قطاع المقاولات في الضفة الغربية بسبب التغيير والاوامر التغييرية في المشاريع الانشائية.

شاكرين لكم حسن تعاونكم .

وتفضلوا بقبول فائق الاحترام

اتحاد المقاولين الفلسطينيين

25/6/2015

Appendix (5)

CONSTRUCTION CHANGE ORDER REQUEST FORM

Change Order No.:_____ Contract No._____

To: _____ Date:_____

_____

_____

Project Name_____

Under our AGREEMENT dated _____, _____(Year)

****

You hereby are authorized and directed to make the following change(s) in accordance with terms and conditions of the Agreement:

(DESCRIPTION OF THE CHANGE)

FOR THE Additive (Deductive) Sum of: _____($ _____).

Original Agreement Amount	$_____
Sum of Previous Changes	$_____
This Change Order Add (Deduct)	$_____
Present Agreement Amount	$_____

The time for completion shall be (increased/decreased) by _____(____) calendar days due to this Change Order. Accordingly, the Contract Time is now _____(____) calendar days and the substantial completion date is _____. Your acceptance of this Change Order shall constitute a modification to our Agreement and will be performed subject to all the same terms and conditions in our Agreement indicated above, as fully as if the same were repeated in this acceptance.

The adjustment, if any, to this Agreement shall constitute a full and final settlement of any and all claims arising out of or related to the change set forth herein, including claims for impact and delay costs.

The Contract Administrator has directed the Contractor to increase the penal sum of the existing Performance and Payment Bonds or to obtain additional bonds on the basis of a $25,000.00 or greater value change order.

• Check if applicable and provide written confirmation from the bonding company/agent (attorney-in-fact) that the amount of the Performance and Payment Bonds have been adjusted to 100% of the new contract amount.

Accepted _____, _____(Year)

By:_____ By:_____

Contractor Architect/Engineer

By:_____

Owner

جامعة النجاح الوطنية
كلية الدراسات العليا

تقييم أثر الأوامر التغييرية في قطاع هندسة المشاريع الانشائية في الضفة الغربية

إعداد
مجاهد محمود استيتي

إشراف
د. محمد عزام عثمان

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في الادارة الهندسية بكلية الدراسات العليا في دامعة النجاح الوطنية في نابلس ، فلسطين.
2015

تقييم أثر الأوامر التغييرية في قطاع هندسة المشاريع الانشائية في الضفة الغربية

إعداد

مجاهد محمود استيتي

إشراف

د. محمد عزام عثمان

الملخص

تعتبر صناعة البناء والتشييد صناعة معقدة ومتباينة بدرجة عالية، كما ان العديد من العوامل تؤثر على اداء ونتائج مشاريعها. وحيث أن مشاريع البناء في عصرنا الحالي أصبحت أكثر حجما وتعقيداً، لذلك حدوث أي تغيير قبل أو أثناء تنفيذ هذه المشاريع يمكن أن يؤثر بقوة على أداء ونتائج تلك المشروعات.

يهدف هذا البحث لدراسة وتقييم أثر الأوامر التغييرية على أداء المشاريع الانشائية في الضفة الغربية، من أجل اتخاذ تدابير استباقية للحد من الأوامر التغييرية أثناء تنفيذ وهندسة تلك المشاريع. تتمثل الأهداف الرئيسية لهذه الدراسة في تحديد الأسباب الرئيسية الكامنة لطلبات التغيير التي تحدث في مشاريع البناء في الضفة الغربية، تسليط الضوء على الآثار المحتملة لتلك التغييرات في قطاع المقاولات الفلسطينية بالإضافة إلى تقييم الممارسات الحالية لإدارة أوامر التغيير داخل شركات البناء في الضفة الغربية وتقديم بعض الحلول والمقترحات للحد أو التقليل من حدوث التغييرات والمساعدة في اخراج هذا القطاع من بعض مشاكله وتحسين أداءه.

لتحقيق الأهداف المذكورة، تم اجراء مقابلات مع مختلف الأطراف المتعاقدة و العاملة في قطاع الانشاءات وكذلك تم تصميم استبيان وتوزيعه على عينة البحث من أجل عمل مسح وتحديد كافة الأسباب و المشكلات التي تواجههم وتعيق عملهم في ذلك القطاع الهام جراء حدوث التغيير قبل أو أثناء تنفيذ تلك المشاريع.

أظهرت نتائج هذه الدراسة أن أكثر الاوامر التغييرية حدوثاً في الضفة الغربية هو لإضافة أعمال وكميات و بنود جديدة للعطاء وكذلك بينت الدراسة ان المصدر الأول للأوامر التغييرية في قطاع البناء هم ملاك المشاريع وذلك لأسباب مختلفة منها مشاكل مالية ، عدم توافق التصميم مع

متطلبات أصحاب المشاريع، تغيير في هدف أو فكرة المشروع أو تغيير في أذواقهم واختياراتهم لبعض التفاصيل. أشارت الدراسة ان الاستشاري هو المسبب الثاني للأوامر التغييرية وذلك لأسباب مختلفة أهمها غموض او تناقضات في تصميم المشروع، وقوع أخطاء في التصميم أو في المواصفات المختلفة لعناصر المشروع أو حدوث تضارب بين وثائق العقد و العطاء والمخططات. وأشارت الدراسة ايضا الى الاثار المحتملة والناتجة عن الاوامر التغييرية والتي تمثلت في زيادة الميزانية المخصصة والوقت المحدد للمشروع، دفعات اضافية للمقاول ، تأخر في الدفعات، تذمر طرف او اكثر من اطراف العقد، مشاكل ومشاحنات بين اطراف العقد.

أكدت نتائج هذا البحث ان الوضع الحالي لإدارة الاوامر التغييرية في الضفة الغربية يحتاج الى تحسين، حيث يمكن الحد او التقليل من حدوث التغيير و الاوامر التغييرية في قطاع البناء من خلال التخطيط الشامل والسليم لجميع تفاصيل المشروع قبل البدء في العمل، إقرار وتحديد الهدف الاساسي للمشروع، تخصيص الميزانيات وتحديد وقت المشاريع بدقه، التواصل والتنسيق الوثيق مع جميع اطراف العمل وخصوصا في مرحلة تصميم المشروع. في نهاية الدراسة اقترح الباحث عدد من التوصيات الهامة بالإضافة الى اطار عمل يمكن جميع الاطراف المتعاقدة لإدارة الاوامر التغييرية في قطاع الانشاءات بشكل متسلسل وعلى نحو فعال.