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Causes and Effects of Change Orders for Construction Projects in Palestine

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Thesis Approval

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Declaration

I, the undersigned below, hereby declare that 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.

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Dedication

……To the souls of our noble martyrs who sacrificed their pure souls and blood for the sake of Palestine, and to our heroic wounded and brave prisoners.

…… To the owner of a fragrant biography and an enlightened mind who sacrificed for me and whom I see always giving her dearest and most precious in order to make me happy, to my proud symbol, my dear mother (Fatima), may God prolong your life.

……. To the soul of my dear father, my role model in diligence and study, Professor Mahmoud Abdel-Aal, may God have mercy on him.

……To those who are my refuge and pride, my beloved brother, sisters, brother-in-law, and granddaughter (Amani ... Ayman ... Arwa ... Ahmed ... Elinar), may God protect them.

…….To everyone who stood by my side and was a help and supporter to me. To all my loyal friends.

I dedicate this humble work to you and I ask God that this study may be a help to every researcher or student of knowledge who follows this path.

Ahmed Mahmoud Ahmed Abdelaal

Acknowledgment

"And the favor of Allah upon you has been great." (Quran 12:91)

All praise and thanks be to Allah first and foremost, for without His grace no effort would be completed nor any endeavor concluded. And it is only through His guidance that a servant overcomes obstacles and difficulties. Praise be to Allah in word and deed, praise be to Allah in gratitude and appreciation, praise be to Allah for His favor and kindness with which He has blessed me and enabled me to complete this work to be added to the fields of scientific research.

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Abstract

The construction sector plays a crucial role in the Palestinian economy with a complex nature, which encompasses a mix of various human, non-human, and other elements that necessitate change orders. Change orders are an inevitable aspect of construction projects, regardless of their size, type, or characteristics, and are often cited as the main source of disputes within the industry. Furthermore, change orders serve as the official process for initiating changes in the design and contract documents during the construction phase. Changes frequently lead to delays in schedules and cost overruns, which create a negative impact on project performance and profitability.

The purpose of this project is to investigate and rank the causes and impacts of change orders in construction projects in Palestine from contractors' and consultants' perspectives. It is crucial to understand these aspects to reduce potential changes in the future. To achieve the study objectives, a literature review was conducted to explore the causes and impacts of change orders as secondary data. Subsequently, a pilot study was conducted to assess the questionnaire's validity. Primary data for the study was collected through a structured survey distributed among professionals in the construction industry.

The study sample was acquired using a method of stratified sampling, where participants were randomly chosen from various groups; contractors, and consultants who are key stakeholders in construction projects. Based on the results from the statistical equation, the minimum sample size required is 49 questionnaires. In order to obtain more accurate results, a total of 75 questionnaires were distributed to potential respondents at all levels in the

construction industry. More specifically, 40 questionnaires were sent to contractors and 35 to consultants. A total of 70 responses were received, with 5 responses being considered invalid, resulting in 65 valid responses. A total of 65 questionnaires representing 93% of the responses, were analyzed using statistical techniques such as the Relative Importance Index to identify the importance and ranking of causes and impacts of change orders. Furthermore, the Standard Deviations technique was used to illustrate the degree of agreement between contractors' and consultants' perspectives. The SPSS software was also used to identify the correlation between the causes of change orders and the general characteristics of respondents representing construction firms.

The findings revealed that internal factors related to the owner were the primary source of change orders, followed by factors related to internal consultants, internal contractors-related causes, and external factors such as political situations and lack of skilled labor, respectively. It also identified the major five causes of change orders with the highest relative importance index were, “using duplicated documents from previous projects”, “change in plan and scope by owner”, “owner's financial difficulties”, “poor site investigation before the design stage”, “errors and omissions in design”. Similarly, the study presented the top five impacts of change orders on construction performance as “ time overruns”, “cost overruns”, “rework and demolition”, “delay in payment by the owner”, and “disputes between contract parties”.

Ultimately, the mitigation of different causes leading to change orders can be achieved by enhancing awareness and ensuring the active involvement of all project parties. It is recommended that professionals remain vigilant of the triggers for change orders in construction projects. Additionally, construction experts should implement effective planning

strategies and establish a robust framework for proactive change management. This study holds particular importance for the construction sector, offering valuable insights to help project management teams meet the objectives of projects in terms of schedule, budget, and quality.

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1 Chapter One: Introduction

The construction industry has consistently been regarded as a crucial sector in the economies of all nations due to its extensive and strong connections with other sectors. These interconnections serve to promote overall economic growth in the country, as it plays a significant role in job creation and contributes significantly to the gross domestic product (GDP). Mainly, due to the complex nature of the construction process and the multi-involved construction parties and stakeholders such as clients, users, designers, regulators, contractors, suppliers, and various others, the construction industry is considered more complex (Alzara, 2022). Furthermore, construction in some form is inherent wherever there is a human settlement. Nevertheless, the prosperity of the industry often experiences variations in the overall state of the economy, displaying a cyclical nature and quick adapting to economic shifts (Olomolaiye et al., 1998).

The Palestinian economy is influenced by the construction sector, which serves as a means for society to attain economic growth and development. A pivotal role has been played by this sector in providing employment opportunities for the Palestinian labor force. The increase in construction activity in both the West Bank and Gaza Strip (WBGS) has resulted in the creation of numerous jobs for construction workers with varying skill levels, including skilled, semiskilled, and unskilled individuals (El-Namrouty, 2012). Construction activity accounts for 4.7% of the GDP through its value-added contribution (Owla. A. PCBS, 2023). As a result of time series data analysis, the performance of the Palestinian construction sector is affected by some independent variables, such as political situation, investment, foreign aid, and other variables.

According to (UNCTAD Team, 2022), public sector debt has pushed the construction industry to its breaking point. The political situation in Palestine creates an unstable environment for the construction industry, limiting its growth and impacting various aspects of its operations. The restricted land use imposed by Israeli settlements and limitations on Palestinian land development significantly reduces the availability of land for new construction projects. This scarcity drives up land prices, hindering the industry's overall growth potential.

Moreover, hurdles in movement such as checkpoints, permits, and heightened security measures create significant obstacles for transporting construction materials and skilled workers within Palestinian territories. Disrupted supply chains lead to project delays and increased costs. The political instability also discourages foreign investment in the Palestinian economy, including the construction sector. This lack of access to funding cripples large and medium-scale projects and infrastructure development, hindering the industry's ability to undertake ambitious ventures. In the same context, the fiscal horizon has become gloomier as the Palestinian government does not have a central bank, does not produce a national currency, has limited entry to international financial markets, and is due to the decline in aid and the depletion of secure local borrowing sources. While the industry demonstrates resilience and has adapted by finding alternative materials and workarounds, a more stable political climate is essential for it to truly flourish and reach its full potential.

1.1 Background

A change order in a construction project refers to the addition or removal of work from the planned scope of the contract, resulting in a change to the contract price or completion date. It is an official document employed to amend the agreed-upon contractual agreement and is subsequently incorporated into the project documents (Keane et al., 2010). The implementation of changes in the project is typically carried out formally, either by the owner or by an authorized owner's representative which grants permission to the contractor to execute specific changes that have been defined for the project.

Project changes are a common occurrence in the construction industry and present ongoing challenges for project parties (Ibbs et al., 2001). These changes typically result in the issuance of change orders, which play a significant role in construction due to their substantial impact. Change orders are considered unavoidable throughout the execution of a project as a result of the uniqueness of each endeavor and the constraints of time, budget, and personnel allocated for the planning process (Desai et al., 2015; Moselhi et al., 1991). Regardless of the size, type, or nature of the project, change orders are a practical fact of the construction industry.

Change orders can also occur when project costs, schedules, and labor productivity exhibit significant deviations from the initial plan, even in scenarios with minimal or no changes to the project scope (Ibbs, 2012). Change orders are a primary cause of time overruns and cost overruns, negatively affecting project performance, profitability, and safety, and potentially leading to project failure (Naji et al., 2022). For instance, Engy S. et al. (2010) revealed that change orders lead to a 5-10% increase in the cost of U.S. roadwork construction projects due to errors, omissions, scope changes, and unforeseen conditions. Meanwhile, a study

conducted by Madhav K. & Roshan S. (2024) in Nepal found that over half of the projects experienced time overruns ranging from 24.4% to 514.71% of the initial schedule.

Additionally, they frequently contribute to disagreements between owners and contractors, often resulting in disputes or claims (Al Maamari & Khan, 2021). While there are cases where project change can be beneficial, hidden or poorly managed changes often cause harm to the project players.

David (2005) emphasized that the selection of the delivery method in construction projects has a significant impact on the frequency and scale of change orders. The delivery method is arguably one of the most crucial decisions an owner will make for a project. It defines the contractual relationship, timing of involvement, and risk allocation among the main construction parties (Beard et al. 2001). The most common delivery method for construction projects is design-bid-build (DBB), which consists of three sequential phases. First, is the design phase in which the owner hires an engineering firm to develop project plans, designs, and specifications. Once the design is finalized, the owner solicits bids from qualified bidders and then evaluates bids to select the winning bidder who offers the best value.

Another delivery method is design-build (DB), which includes only two phases as one entity acts as both designer and builder. This streamlines communication and fosters collaboration, allowing for cost-saving adjustments during the design phase. Additionally, the Architect/Engineering (A/E) delivery system combines expertise when the construction manager advises during design, and then becomes the general contractor. Nevertheless, Hassan & Sedqi (2022) demonstrated that the causes of change orders vary based on delivery systems in construction projects.

The analysis of project change and building reliable change management models are very significant. However, the uncertainty of change orders as construction projects differ in their characteristics is making the management and governance process more challenging. According to Hsieh et al. (2004), there is a scarcity of data accessible for the examination of change which also exacerbates the management.

The quantification of change orders' impacts on project performance is difficult, partly due to its cumulative impact when multiple changes occur simultaneously (M.-J. Lee et al., 2004). Change orders have a wide-ranging impact, affecting not only costs, schedules, and quality, but also team dynamics. This makes it difficult to assess the specific effects of each change accurately. Additionally, there are indirect consequences for change orders, including lower worker morale and decreased productivity, which add another layer of complexity to the situation.

It is noteworthy that the Palestinian construction industry is facing a scarcity of data regarding change orders and their specific effects. This is mainly attributed to the confidential nature of construction projects, which may lead to a lack of readily available detailed records.

1.2 Significance of the Research

The construction sector is a key sector that provides a backbone to the Palestinian economy. However, the Palestinian construction sector operates within a complex political and economic landscape. The restrictions on the movement of materials and labor, coupled with

limited access to resources and scarcity of skilled labor, can significantly disrupt project timelines and budgets. The lack of sufficient knowledge of project management practices led to project delays and exceeding the budget. This issue, combined with inexperienced project owners, resulted in improper designs that needed many changes to project plans, specifications, and contract conditions. Change orders can be a source of conflict between project owners and contractors. Ambiguous or poorly documented change orders can lead to disagreements regarding pricing, scope, and responsibility for delays.

The construction projects have a diverse and dynamic nature, ranging from the construction of power plants to the development of city infrastructure. Consequently, numerous researchers are engaged in conducting investigations to identify the causes and impacts of change orders. The construction sector always needs feedback and learn lessons from previous experiences as changes are inevitable in any construction project.

Ibbs (1997) highlighted the importance of allocating a portion of the annual budget for change orders towards research and development within the construction sector. This would significantly enhance the cost-effectiveness of the industry. Therefore, understanding the causes and impacts of change orders in detail is necessary for an efficient analysis of change orders. It provides the Palestinian market with valuable insights into the frequency and nature of disruptions. Furthermore, it assists the construction management team in developing risk mitigation strategies and preparing clearer contract clauses and standardized change order procedures. This can streamline the change order process, expedite dispute resolution, foster collaboration, and reduce project delays. The research also aims to be a basis for future

studies focusing on resolving issues associated with change orders in a highly competitive market with constrained owner budgets.

1.3 Statement of Problem

Change orders can stem from a wide range of factors, posing challenges for clients in managing these changes. These factors may include the evolution of the owner's requirements, unavailability or delayed delivery of necessary materials, as well as errors and omissions in contract documents. Sometimes, the factors are out of the control of construction parties such as bad weather, exchange rate fluctuations, and nonavailability of materials and equipment. The anticipation of every challenge or variable from the outset is simply not possible. The change orders trigger disputes when there is a disagreement between the contractor and the owner particularly in the necessity of extra compensation.

The planning and well-defined project play a critical role in having little or no change orders. On the contrary, a significant number of change orders may be issued in poorly planned projects, leading to constant modifications in the baseline schedule and cost. These changes have the potential to alter the critical path and shift the focus of effort This situation can prove to negatively affect project management such as resource allocations.

The problem is exacerbated when a substantial amount of change occurs due to a cumulative impact condition. This condition results in the project losing more productivity than what is accounted for by the sum of individual change orders (Ibbs, 2012). Consequently, many

projects experience the 'cost-creep' syndrome, where change orders continuously increase the project budget, surpassing the initial plans of the owner.

Tracking the root causes of change orders is crucial to prevent potential changes in upcoming projects or manage and mitigate their impacts such as cost, time, productivity, quality, and safety. The data analysis involves gathering information from actual change order cases for both contractors and consultants who are experiencing change orders in the Palestinian market. The study aims to investigate the correlation between project features as well as characteristics of construction parties and the occurrence of change orders.

1.4 Research Objectives

The objective of this research is to examine and investigate the different factors leading to change orders in construction projects in Palestine that used the Design-Bid-Build (DBB) as a delivery system (discussed in the next Section 1.5). It also identifies the effects of these change orders on project performance indicators such as time, cost, quality, productivity, and safety.

The goals of the study are listed as follows:

1- Study causes of the change orders in construction projects from contractors' and consultants' perspectives,
2- Identify the importance and the ranking of causes of change order,

3- Specify the primary party involved in initiating a change order within construction projects: including owners, contractors, and consultants,
4- Study and investigate the significance of the relationship between characteristics of projects and construction firms, and the implementation of change orders,
5- Highlight the impacts of change orders on delivering projects within targeted performance,
6- Suggest remedies for change order management procedures to mitigate the adverse impacts of change orders during the execution phase.

1.5 Scope of Research

Construction projects have many delivery systems including Design-Bid-Build (DBB), Design-Build (DB), Architect/Engineering (A/E), etc. As abovementioned in the research objectives, this study focuses on the DBB delivery method, which involves a clear separation of responsibilities between different entities. Other delivery systems are not in the scope of the study due to limitations of the use of such systems in Palestine, along with the scarcity of data. The scope of the project only deals with changes that are noticed by the management team, and fully recognized in the change order. However, the change that is not recognized and missed, is not incorporated.

Modifications that occur within the warranty period or during the project's operations and maintenance post-preliminary take-off are not studied. The study analyzes the roles of various parties such as the owner, designer/consultant, and contractors to identify the

significance of their involvement in the change order management procedure. The contractual agreements between main contractors and their subcontractors are not mentioned to streamline the process and reduce the complexity.

The pre-construction stages, including feasibility studies, design process, and financial assessments carried out before the owner makes a go or no-go decision are excluded. Similarly, the bidding processes involving invitations to bids, bid solicitation, and changes to tender documents before signing the contractual agreements are not taken into account. Therefore, the study concentrates on the construction phase following the finalization of the contract between the owner and the contractor.

The study focused on the perspectives of two key construction parties: contractors and consultants. Change orders have a significant effect on the project delivery process. This process is managed by the consultant (design/supervision) and the contractor (construction). Hence, analyzing their experiences provides valuable insights into the practical challenges and decision-making processes related to change orders. Besides, detailed records of change orders, including reasons, costs, and delays, are often maintained by the consultant and contractor.

1.6 Thesis Structure

This thesis contains six chapters as shown in Figure 1.6.1: The first three chapters explain the background, research objectives, the literature reviewed, and methodology. The next two

chapters present analysis techniques for the data obtained through the survey, and discuss the significant findings. The last chapter concludes major research findings, shows the research constraints, provides recommendations for the construction industry, and outlines areas for future research.

The flow of the research is running as follows:

Chapter 1 already showed a brief introduction to the construction industry and the historical background of change orders in the construction industry, the significance of the study, its scope, problems, and objectives.

Chapter 2 illustrates the literature review of previous studies. It includes concepts, types, and features of change orders, critical causes, the traditional procedure, and impacts on project performance.

Chapter 3 elaborates on the methodology of research highlighting the utilization of positive aspects from previous studies to identify the most common reasons for change orders. This chapter also delves into the design of the survey aimed at gathering data from both construction parties; contractors and consultants with diverse roles within the construction industry, explaining the pilot study to finalize the survey at its final edition, identify the size of samples to be studied, and specific tools used in the analysis.

Chapter 4 shows data analysis and findings obtained from the survey, ranks the causes and impacts of the change order, and critical drivers for change orders.

Chapter 5 presents the results of the ranking process and discusses the results gathered from the analysis, refers to the findings of past research, and gives deductive reasoning created by applying used tools.

Chapter 6 emphasizes the recommendations and conclusions drawn from the project, defines the research limitations, offering suggestions for enhancing the current construction change order management process. The chapter also highlights the prospective future expansions of the research project to offer comprehensive assistance to decision-makers in developing the provisions for change orders. Figure 1.6.1 below demonstrates the structure of the Thesis as follows:

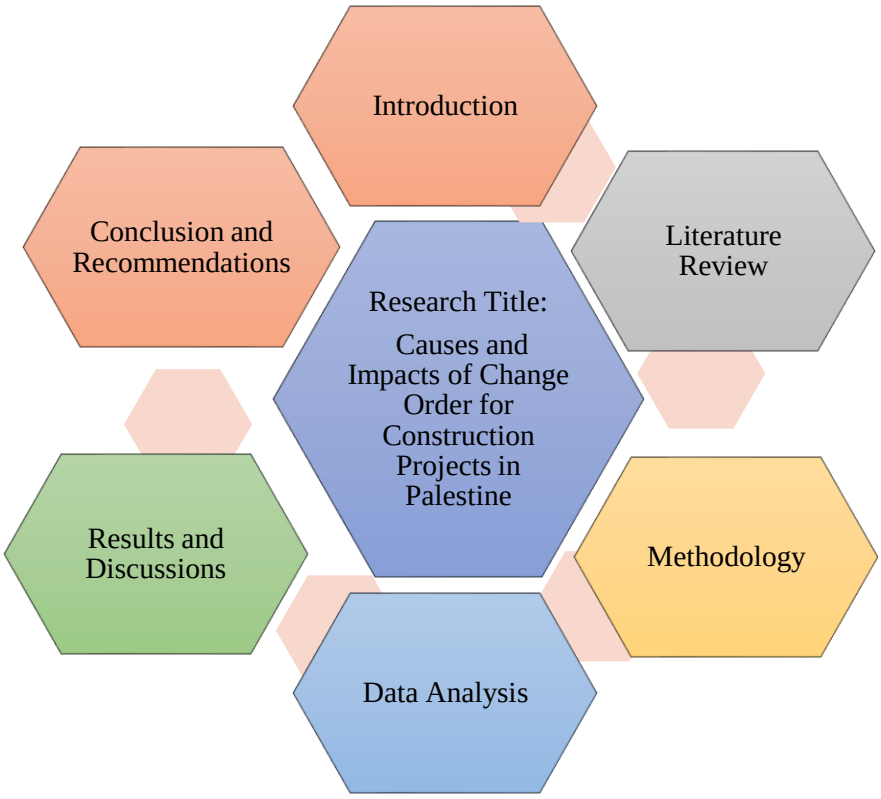

Figure 1.6.1 Flow Chart of Study

2 Chapter Two: Literature Review

Numerous articles have been published on changes, change orders, and change management in construction. Several factors and causes in the construction sector that lead to change orders have also been methodically investigated. These articles discussed how change orders affect the duration, cost, scope, and quality of a project. Although the causes and effects of change orders have been extensively discussed in academic literature, little research has been conducted to examine how a change order may affect several project objectives simultaneously.

2.1 Definitions of Change Orders, their Types, and Features

Change orders are inevitable in the construction industry, despite the adverse associations attached to change orders and the detailed planning that went into the project. However, owners have a bad reputation when it comes to the word "change order." This is because the term "change order" has consequences that disrupt the balance of project objectives including time, cost, and quality (Hussein A.F.F, 2019).

"Change order" can be defined as an amendment to construction contract documents that changes the scope of work that is framed by the legal relationship between construction parties. Many change orders modify the assigned work which, in turn, usually increases the

contract price or adjusts the amount of time needed to complete the work, or both (Mohammed K.H. et. al., 2021; Alsuliman, J.A., 2014).

A change order could be either implemented by the owner or requested by the contractor shall be authorized by the owner or the owner's representative, and it must be in written form. A change order can also be defined as the "written authorization provided to a contractor that approves a change from the original plans, specifications, or other contract documents, as well as a change in the cost" (Hanna et. al., 1999).

Change orders also need to fulfill the requirements for legitimate formation (offer and acceptance). Prieto Robert (2022) stated that every change order needs to specify which part of the contract is being altered and indicate how the work or services have changed. It should also outline the contributions and promises made by each side to the change, and specify the power of authorities for each party to sign the change orders as considered a part of the contract.

Change orders are frequently encountered in the construction industry due to the dynamic nature of complex long-term projects (AIA, 2017; Mahamid, 2017). Construction projects consider the needs of several stakeholders, including geography, site characteristics, communities, physical conditions, and current infrastructure (Construction Extension-PMI Institute, 2021).

Change orders will make construction parties in construction projects dissatisfied, leading to an increase the tension between them. It is having a ripple effect on unrelated projects by mobilizing resources that are already allocated elsewhere (Abdel Rashid et al., 2012; Khalifa

& Mahamid, 2019). Assaf & Al-Hejji (2006) studied the time performance of construction projects in Saudi Arabia. They found 73 causes in 76 projects, and the change order was the most frequent factor for conflicts and project failures. Moreover, El-Sayegh, S. et. al. (2020) revealed that the change orders have a severity index of 55% for the most common cause of claims while delay had an essential importance index of 52.5%. According to Hao et al. (2008), it is also difficult to manage change orders in the construction process well since they are an integral part of the contract and must be systematically adhered to.

Selecting the appropriate delivery method is undeniably a crucial decision that a project owner must make. Beard et al. (2001) outlined that the delivery method is the contractual relationship, risk allocation, and engagement of time between construction parties (the owner, the engineer, and the main contractor) to meet their obligations and responsibilities. Delivery methods for construction projects also have a significant impact on the change orders. Alleman et al. (2020) examined the relationship between delivery method and characteristics and the value of change orders in highway construction projects. The study showed that unforeseen conditions causing change order have the most influence on projects, the second impact was the change of scope issued by the owner, followed by the adjustments of quantity and then errors and omissions. Furthermore, the Design-Build delivery method has a common change order related to the owner-changed scope. On the other hand, the Design-Build-Bid method encounters change orders caused by unforeseen, and quanitty change. The Construction Management method experiences change orders by errors and omissions in tender documents.

According to Ismaeil & Sobaih, (2024), Jaspal Singh Nachatar et. al.(2010), and Naji et al., (2022), the change orders are classified into four categories based on their purposes. The first category involves specific changes requested by the client to the contractor to implement changes or additions to the original scope of work outlined in the contract. The next category involves positive changes made informally to authorize changes and prevent contract failures. The third category entails advantageous change orders aimed at enhancing the standard of quality and managing costs, scheduling delays, and maximizing the client's advantages concerning resources. The fourth category involves compensating for adverse effects caused by global and local crises, to enhance the client's project value, performance, and level of project control complexity.

Many studies investigate that change orders add value to the construction project. They are used to modify contract drawings and specifications, contract unit price adjustments, and value engineering method proposals for cost reduction motivations. It also includes alterations for payment for settled claims, administrative goals such as creating additional work, payment adjustments, and changes to the contract schedule, item quantities, design errors, and unit prices (Enshassi et al., 2010).

The types of change orders may also classified based on their causes into five categories (Alleman et al., 2020). The first one of change orders refers directly to owners that make the change in the work without any change for the general scope of the project which can be added-value variations or adverse results of creeps. The second type is the unexpected circumstances underground, hidden, or material conditions at the location of an extraordinary kind. According to Wentz et al., (2014), this type deviates from the usual ones and is

commonly acknowledged as inherent in the task. He highlighted that this type should be addressed in risk management, especially for large-scale projects.

The next type is changing the estimated quantity when the actual quantity of work performed differs from the original quantity mentioned in the contract documents. It is more frequent in unit-price contracts that quantities are under a unit price. The fourth and last one is the errors in design drawings and omissions. The risk between construction parties for this type relies on the delivery methods (Koch et al., 2010). The fifth type is the change orders that are not included in the previous types which can be contractor value engineering, changes from the beneficiaries and involved stakeholders, and agreements through negotiation of several claims.

In this study, the causes of change orders are classified into two groups according to the level of control of construction parties contributing to the causes (Ming et. al., 2004; Keane et al., 2010). The first group includes the external factors that cause change orders which are located out of the control of the main parties. The second group outlines the causes under the control of construction players. It is divided into three categories based on which construction party is responsible for change orders (Alshdiefat & Aziz, 2018). The first type is caused by the contractor which is performing the construction of projects according to obligations and contracts with owners. The next type is owner-related change orders and includes most causes driven by the owner. The third type is caused by the engineer who is responsible for the design and supervision of the construction projects.

2.2 Causes of Change Orders

Substantial research has been carried out in the field of literature to examine the causes of change orders in construction projects. Categorizing these causes based on the parties involved in the project contract is considered an effective method. This classifying is crucial to understand who is responsible among parties and to address the adaptation practices for the issues generated in the project. It also aims to avoid disputes and claims which are in most cases leading to arbitration and litigation (Koch et al., 2010). Projects in the construction industry issue several change orders, mostly as a result of inadequate tender contract documents, unclear client needs mentioned in the contract, and design errors (Construction Extension-PMI Institute, 2021; AIA, 2017).

Senouci et al., (2017) studied the main causes of change orders for construction projects in Qatar that lead to cost overrun. The study is based on the analysis of data gathered from more than 20 projects using statistical analysis such as Pearson's correlation (P.C.). Nevertheless, the research identified the prominent causes that had the highest P.C. as follows; design errors (Egan et al., 2012), adjustment in design proposals, substantial adjustments to the quantity of work, owner-changed scope (Pourrostam et al., 2012), changes in the site's conditions, service providers, and mechanical and electrical standards (Al-Nuaimi et al., 2010).

Hanna et al., (2002) found that change orders were issued in 87% after reviewing 865 construction projects. The study revealed the key causes of change from inadequate field examinations, unclear specifications, and plan faults, to consultants' design modifications and errors. Enshassi et al., (2010) found that most change orders occurred in the Gaza Strip

caused by factors referred to the engineer. Followed by the causes sourced from the owner and contractor, respectively. The shortage in construction materials and spare parts for equipment maintenance as a result of the closure and blockade, consultant-modified design, consultants' unfamiliarity with the local market, mistakes and omissions in design, inconsistency between contract documents, and financial deficit of owners are considered the most causes of change orders.

A study by Wu et al., (2004) on highway construction projects implemented by Second National Highway. It analyzed 1038 change orders that were approved and released by the project management. The Grey relation analysis (GRA) was used and identified 34 different causes. They were divided into 4 categories according to their drivers: owner, consultant, general and subcontractors, or external parties. However, the most significant causal change order was unforeseen conditions from the geological perspective. Accordingly, the study recommended applying site investigation tests and designing roads as bridge "viaducts" to reduce the backfilling material in the road. This reduces the likelihood of a change order as a backfilling process requiring additional space and involving more project stakeholders.

The study conducted by Khoso et al., (2019) specifies the causes of a change order in two different stages; preconstruction and construction stage. The expert views on causes of change orders were gathered following an extensive literature review of past research. Then, the questionnaire was developed and distributed to construction parties. The analysis revealed that the most crucial factors during the preconstruction phase causing change orders are; errors in specifications, design errors, and unqualified construction teams pointed out by owners. On the other hand, changes in the design by owners, deviations in the scope later,

and delayed payment by clients are identified as the most critical causes of change orders during the construction phase.

Alshdiefat & Aziz (2018) identified the causes of change orders in the Jordanian construction private sector leading to an increase in projects' cost. The questionnaire was designed based on the output of the interviews with experts. The data were analyzed using content analysis for the qualitative method (interview) and the severity index for the quantitative method (questionnaire). Changes in the scope of work upon owners' request, mistakes in design, the conflict between contract documents, absence of coordination between construction parties, preliminary design, mistakes in the estimation of either time or budget, and the time gap between engineering, procurement, and construction phase are considered the significant causes triggering change orders.

The causes and effects of change orders in the public construction project in Saudi Arabia from the contractors' perspective were studied by Khalifa & Mahamid (2019). The results showed that red flag causes of change orders are scaling up the size of work initiated by the owner, design mistakes and deletion, lack of communication between construction players, poor quality of labor, and the financial challenge facing owners.

Ahmed Redha Gheraba et al., (2023) illustrated that owners are responsible for construction change orders in the U.S. followed by consultants and contractors, respectively. The study revealed that design modification implemented and change of scope by the owner, ambiguous site conditions, mistakes and omissions in design, poor-defined drawings, adjustment of the timeframe of projects by the owner, lack of management practices by contractors, inconsistency between contract documents, and poor estimation of cost and weather

conditions are the main sources of change orders. Moreover, many control measures were examined. The study found that collaboration between construction parties such as checking the contract document in a way that all gray areas should be clarified in the preconstruction phase is considered effective practice. Besides, using technologies such as BIM in all project stages is deemed efficient in managing change orders.

Al Maamari & Khan (2021) indicated in their study of causes of change orders in Oman construction projects that modification in the specification, change in design and blueprints, and time gap in the execution of the project were the main sources of change orders. Al-Nuaimi et al., (2010) also investigated the change order in the Oman construction market. He stated the contractor emerged as the primary beneficiary of the change orders, followed by the consultant and subsequently the client. Furthermore, alterations in regulations are considered external and direct causes of the change orders (Prasad et al., 2019; Sanni-Anibire et al., 2022).

The causes of change orders in the Egyptian construction industry were arranged by El-Sadek (2016). The study showed the added work, unclear and contradictions in contract documents, alterations in the project's schedule, and lack of coordination among construction parties were considered the most critical causes of change orders.

M.karim et al. (2020) studied 36 causes and 10 effects of change orders from the perspective of construction parties in the Sulaimani governorate. A total of 223 sets of completed questionnaires were received, out of the 270 questionnaires that were distributed among the practitioners. Additionally, it investigated 40 projects constructed between 2007 and 2013 by calculating the cost and time overrun caused by change orders. The findings revealed that the

main factors contributing to change orders were the owner's financial difficulties, the need for a standardized design across different districts, errors and omissions in the design, the contractor's desired profitability, and the absence of a suitable site prior the design stage for project construction.

Nurisra et al. (2024) specified the causes of change orders in the construction phase of building projects in Banda Aceh, Indonesia from contractors' review. The study is based on the quantitive method and distributed questionnaires to 36 contractor companies. It reported the five main causes of change orders were; bad weather conditions, soil conditions, fluctuations in prices, considerations for occupational safety measures, and adherence to owner's guidelines.

The conclusion of important causes of change orders in construction projects for different countries is shown in Table 2.2.1 below:

Table 2.2.1 Previous Studies for the Causes of Change Orders for Different Countries

Study Authors	Study Area	Significant Causes of Change Orders
Nurisra et al. (2024)	Banda Aceh, Indonesia	Bad weather conditions, soil conditions, fluctuations in prices, considerations for occupational safety measures, and adherence to owner's guidelines
Ahmed Redha Gheraba et al., (2023)	U.S	Design modification implemented, change of scope by the owner, ambiguous site conditions, mistakes and omissions in design, and poor-defined drawings

Al Maamari & Khan (2021)	Oman	Modification in the specification, change in design and blueprints, and time gap in the execution of the project
M.karim et al. (2020)	Sulaimani Governorate	Owner's financial difficulties, the need for a standardized design, errors and omissions in the design, the contractor's desired profitability, and the absence of a suitable site prior to the design stage
Khalifa & Mahamid (2019)	Saudi Arabia	Scaling up the size of work initiated by the owner, design mistakes and deletion, lack of communication between construction players, poor quality of labor, and the financial challenge facing owners
Khoso et al., (2019)	Pakistan	-Preconstruction phase: causing change orders are; errors in specifications, design errors, and unqualified construction teams pointed out by owners - Construction phase: changes in the design by owners, deviations in the scope later, and delayed payment by clients
Alshdiefat & Aziz (2018)	Jordan	Changes in the scope of work upon owners' request, mistakes in design, the conflict between contract documents, absence of coordination between construction parties, preliminary design
Senouci et al., (2017)	Qatar	Design errors, adjustments in design proposals, substantial adjustments to the quantity of work, owner-changed scope, and changes in the site's conditions

Construction Extension-PMI Institute, (2021) & AIA, (2017)	Institution	Inadequate tender contract documents, unclear client needs mentioned in the contract, and design errors
El-Sadek (2016)	Egypt	Added work, unclear and contradictions in contract documents, alterations in the project's schedule, and lack of coordination among construction parties
Enshassi et al., (2010)	Gaza Strip	The shortage in construction materials and spare, consultant-modified design, consultants' unfamiliarity with the local market, mistakes and omissions in design, inconsistency between contract documents, and financial deficit of owners

2.3 Change Order Procedures

Effective management of change orders requires a comprehensive understanding of contractual terms, approval protocols, and relevant legislation to reduce disputes and facilitate prompt project delivery (Moutez A. et al., 2022). By pinpointing key factors leading to change orders and instituting efficient procedures, construction projects can manage risks, improve project outcomes, and simplify the change order process.

Ammar Y. (2007) stated the lack of knowledge about the procedure of change orders and the continuous disputes within the tender documentation are the most common causes of claims and disputes facing construction parties in the construction phase. SOLIMAN (2017) & Tran, N.N (2020) mentioned that improper analysis and assessment of change orders may result in

project failure, rework, and demolitions. He also addressed the inefficiency in time and cost management, unfunctional projects, and contractual issues arising from claims and disputes as significant impacts of change orders.

Throughout a project's lifecycle, implementing changes is driven by the goal of achieving a future state that surpasses the current one (Ismaeil & Sobaih, 2024). This pursuit of improvement includes optimizing intended benefits and strengthening financial or competitive capabilities. It also includes enhancing the quality of procedures and fulfilling both customer needs and contractual requirements. Even if these changes necessitate increased costs and effort, the ultimate aim is to deliver a more valuable outcome (Ndihokubwayo R., 2008).

The execution of change orders in construction projects follows international procedures outlined in the International Federation of Consulting Engineers (FIDIC) chapter (1/13). According to this chapter, the contractor is required to respond in official writing to any proposal request from the project engineer, providing reasons for their inability to comply. If the engineer issues instructions or agrees to adjustments (7/13) from the FIDIC due to changes in legislation, the contractor must provide specific requirements in accordance with Chapter 12. Additionally, the contractor's proposal is evaluated based on Item 13/2 from the FIDIC, taking into consideration the modified cost increase or decrease. The completion period is also affected by the proposal of the program works under Item 8/1. (International Federation of Consulting Engineers. FIDIC, 2017).

Tran, N.N (2020) described the process as usual of change orders containing three phases as described in (Figure 2.3.1) below. The initial step involves the execution of the input

procedures, which consist of closed rectangular and rhombus shapes. Subsequently, the process flow procedures are carried out, followed by the issuing of the output documents. The input stage, identified by phase 1 (dashed rectangle), contains the forms for change requests and follow-up record forms.

The second phase is the process flow stage, which entails submitting a change request, logging it in, reviewing the request, and identifying the person who will investigate it. It further involves notifying the relevant organizations about the change order, and studying and critically reviewing it. This stage is significant for identifying its impact on the project's schedule and cost, stating the authority's approval or disapproval, recording the final result, and updating the tender documents.

The output stage, referred to as phase 3 (the dotted rectangle), contains a change request, record follow-up, a technical assessment of the change, a cost evaluation, an updated schedule, and an authorized change order (Tran, N.N. et al., 2020). Figure 2.3.1 shows the procedure for initiating the change orders.

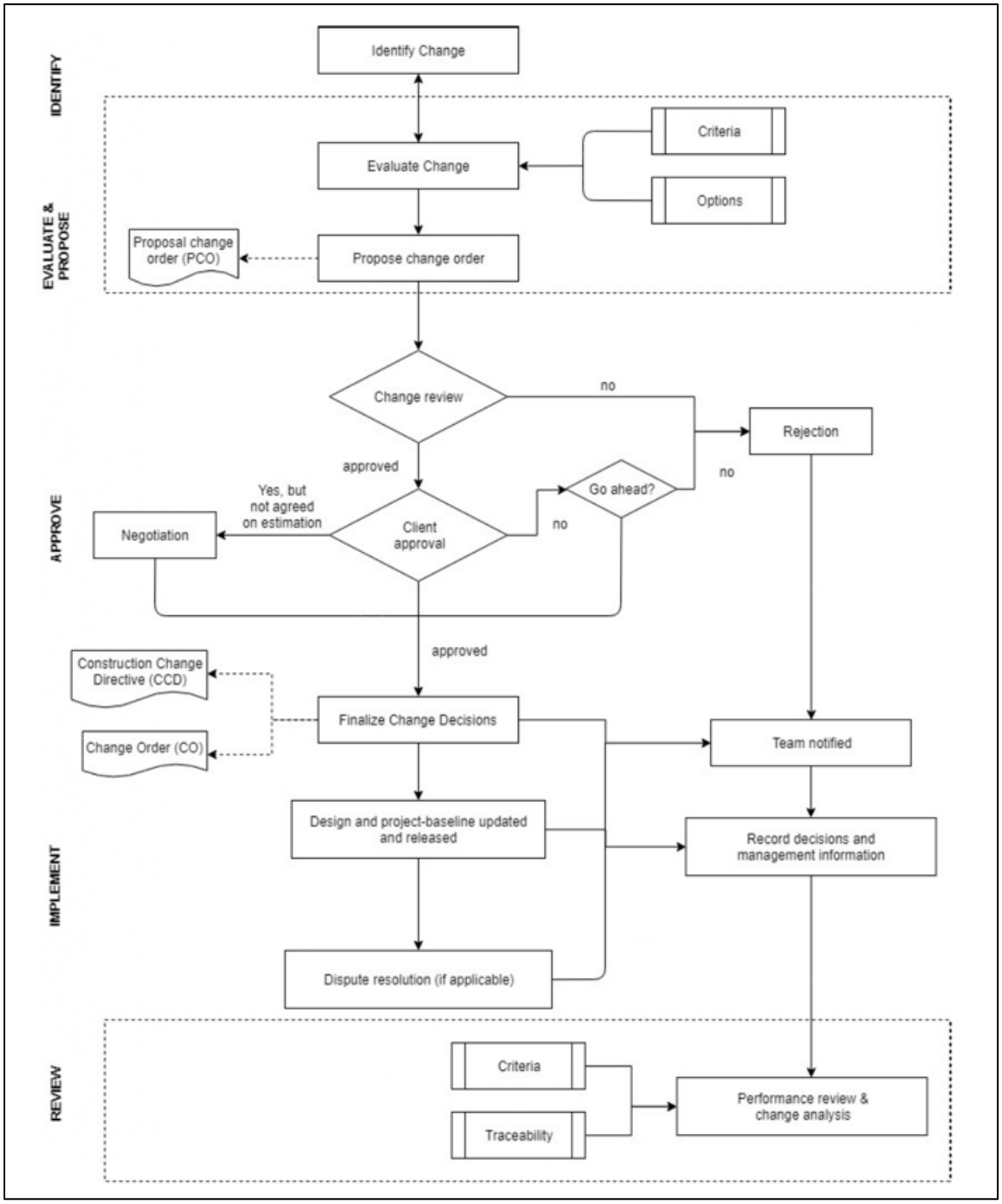

Figure 2.3.1: Change Order's Procedure (Tran, N.N. et al., 2020)

2.4 Impacts of the Change Orders

Change orders in construction projects have significant impacts on various aspects of the project, including cost, time, safety, labor productivity, and work quality. When a change order occurs, which typically involves alterations to the original project scope, it can lead to cost overruns and schedule delays. However, these impacts are not only financial but also affect the efficiency and effectiveness of project execution (Senouci et al., 2017). According to AIA (2017), cost overruns, time overruns, lower productivity, and disputes leading to arbitration and litigation are considered the impacts of change orders. Ahmed Redha Gheraba et al. (2023) stated that change orders have a significant impact on many aspects of construction projects and are known to be the primary cause of litigation in the construction industry.

The impacts of change can be classified into two types: direct effects and indirect effects, downstream impacts. A direct effect of a project change, such as rework, can significantly impact the project's cost, sometimes accounting for 10-15% of the total project cost, as mentioned by EPSRC (Engineering and Physical Sciences Research Council, 2004). On the other hand, an indirect effect also influences the project's cost and schedule based on the changes implemented in the project.

The Construction Industry Institute (CII) has a second type of categorization of the effects of change orders. It divides the effects into two types; direct effects and consequential effects. A direct effect refers to the impact caused by a change within the same project scenario where

the change was implemented, and can also be quantified and clear. On the other hand, a consequential effect occurs when a change has an impact on a different project scenario, rather than the one in which the change was implemented, and this makes it harder to manage.

In the Korean context, Acharya et al. (2006) conducted a field survey and specified six construction conflicting factors. Among these factors, a change order was found to be the third-factor causing conflict in construction projects. Lokhande et al. (2015) studied the impacts of change orders in construction projects in Yemen using the Likert-Scale method. He found that the significant impacts were; the decline in productivity, time overruns, cost overruns, conflict between owner and contractor, poor quality of work, and late payments by owners.

A study by Al-Nuaimi et al., (2010) identified schedule delays as the most significant consequence of change orders in construction projects in Oman. This arises because changes often necessitate revisions to plans, additional work, extended decision-making periods, and material resourcing. Notably, while omissions in the initial contract might not inherently cause delays, cost savings achieved from such omissions can incentivize clients to add new work. This ultimately extends the project timeline and further highlights disputes and claims as the second most impactful effect. The ambiguity surrounding poorly defined change orders can lead to confusion and disruptions, triggering claims and disputes. It particularly happened when introducing new materials or activities not included in the original contract.

Interestingly, the study found that disputes and claims ranked slightly higher than cost overruns as a consequence of change orders (Sherif, W., 2016). Cost overruns, however, were still a significant concern as changes in the scope of work often lead to increased costs due

to contractor markups. It suggested that a decline in work quality is the least prominent effect of change orders as the pressure to complete revised work within the adjusted timeframe can incentivize both parties to prioritize speed over quality.

Ibn-Homaid et al. (2011) mentioned that the overall average increase in the total cost of construction projects in Saudi Arabia due to change orders is found to be 11.3%. They showed that schedule overruns and exceeding the cost are the most critical impacts of change orders. Also, this was followed by disruption of sequences of work packages and activities, the decline in productivity and efficiency of human resources, alteration of subcontractors, wastage of materials in rework, and lack of work teams' ethics. Recently, other studies' results identified that key outcomes of change orders were addressing the requirements of the project, conflicts between project stakeholders, and improving project specifications and drawings (Alzara, 2022b).

M.karim et al., (2020) investigated the impact of change orders on construction projects in Suliamani Governate. Their findings revealed that the five most frequent consequences were time overruns, exceeding budget, decrease in productivity, disagreements among parties involved in the project, and late payments. In addition, all projects examined experienced cost and time overruns, with an average increase of 20% in project cost and a staggering 65.4% extension in project timelines.

Elshaikh et al., (2019) found that the most significant consequences of change orders in the Sudani market were as follows; poor execution and ethics of parties, cost overruns, time overruns, claims and disputes, and adverse quality of work. In another study in the context of the Egyptian market, Sherif, W. (2016) concluded that most impacts of change orders are

delays in projects, followed by claims and disputes, cost variances, bad execution, and defects in work.

In a study by Cheng (2015), the researcher investigated the impact of change orders on project performance through an analysis of 1,071 construction projects. The study population included a mix of residential buildings (17%) and infrastructure projects (83%). His findings revealed a significant influence of change orders on project costs as they increased by 8.45% compared to the original contract price on average, consequently hindering overall project performance.

Oyewobi et al., (2016) concluded the effects of change orders in educational projects on the contract price, schedule, owner discontent, and rework and demolition. Terminations of contracts also occurred in certain instances. Researchers found that the average increase of cost over the original was 33.95%, and the average extension for projects' schedules was 29.45%.

A study conducted by Oladiran et al., (2018) in Lagos, Nigeria found that the most impacts of change orders are cost overruns. Surprisingly, it was followed by a delay in procurement as change orders emerged with associated increased costs or time and needed time for approval by the higher departments, especially when covering the budget gap. The results also specified the other impacts such as time overruns, rise in operating costs, rework and demolition, and late payments by owners.

The summary of the significant impacts of change orders in construction projects for different countries is shown in Table 2.4.1 below:

Table 2.4.1 Previous Studies for the Impacts of Change Orders for Different Countries

Study Authors	Study Area	Significant Impacts of Change Orders
M.karim et al., (2020)	Suliamani Governate	Time overruns, exceeding budget, decrease in productivity, disagreements among parties involved in the project, and late payments
Elshaikh et al., (2019)	Sudan	Poor execution and ethics of parties, cost overruns, time overruns, claims and disputes, and adverse quality of work
Oladiran et al., (2018)	Lagos	Cost overruns, delay in procurement, time overruns, rise in operating costs, rework and demolition, and late payments by owners
AIA (2017)	Institution	Cost overruns, time overruns, lower productivity, and disputes leading to arbitration and litigation
Sherif, W., (2016)	Egypt	Delays in projects, claims and disputes, cost variances, bad execution, and defects in work
Oyewobi et al., (2016)	Nigeria	Increases in contract price, changes in schedule, owner discontent, rework and demolition, and potential of termination of contracts
Lokhande et al. (2015)	Yemen	The decline in productivity, time overruns, cost overruns, conflict between owner and contractor, poor quality of work, and late payments by owners
Cheng (2015)	Taiwan	Increase project costs by 8.45% compared to the original contract price
Al-Nuaimi et al., (2010)	Oman	Delays in schedule and claims and disputes

Ibn-Homaid et al. (2011)	Saudi Arabia	Cost overruns, disruption of sequences of work packages and activities, decline in productivity, alteration of subcontractors, wastage of materials in rework, and lack of work teams' ethics.

The effective management of change orders requires a thorough comprehension of the root causes of changes and their potential consequences downstream. Despite numerous studies delving into the causes and effects of change orders, the circumstances surrounding construction projects vary due to factors such as geography, economy, geopolitical uncertainties, and climate patterns (Al-Nuaimi, S. et al., 2019). In the context of the Palestinian market, there is a lack of studies on the causes and effects of change orders for construction projects. Therefore, this makes the research hold significant value in bridging the knowledge gap by applying theories and findings from previous studies to Palestinian project scenarios. Additionally, the construction industry has a complex communication and dynamic nature because a lot of parties are involved in the business process. It also faces a shortage of up-to-date research. Nevertheless, periodic implementation of studying causes of change orders is beneficial to address issues promptly, improve project efficiency, and enhance change order management practices in building construction projects. (Famadico, J.J.F.& Baccay, M.A., 2019).

By pinpointing the root causes of change orders, the research will pave the way for targeted mitigation and adaptation strategies. This involves improved communication protocols between designers and contractors, more comprehensive project planning that anticipates

potential issues, or standardized processes to streamline decision-making during construction. It will also establish industry benchmarks to serve as a reference point for project managers and stakeholders to assess their own projects and identify areas for improvement.

3 Chapter Three: Methodology

The study is based on a quantitative methodology, which was chosen to specify the perspectives and assessments of contractors and consultants regarding the causes and impacts of change orders in construction projects. Additionally, the study aims to rank these factors based on the Relative Importance Index (RII) method (which will be discussed in Section 4.3). Through an extensive literature review, a total of 38 factors that serve as causes, along with 10 impacts of change orders in the construction phase were identified and tabulated into a structured questionnaire format. Experts in the industry were engaged in meetings to identify the appropriate questions needed and to list them in a concise and unequivocal format. Furthermore, the questions were formulated to be easily comprehensible to the respondents, an Arabic version was also developed and distributed to be able to understand the format clearly.

3.1 The Research Method

The optimal research methodology depends entirely on the nature of the research questions. However, there are two main research methods used in the research study depending on the goals that would achieved (V. Lee & Landers, 2022), which are the qualitative approach, and the quantitative approach. Qualitative research explores the subjective realm of experiences and meanings. Its objective is to gain a deep understanding of a phenomenon by providing detailed descriptions and interpretations. In this approach, interviews, focus groups, and

document analysis serve as valuable tools. Thematic analysis is employed in qualitative research to examine the collected text or observations, aiming to identify recurring ideas, patterns, and insights that arise from the participants' own words and actions.

On the other hand, quantitative research relies heavily on numerical data. It seeks to quantify and measure various phenomena by converting them into numbers for statistical analysis. Common methods used in this type of research include surveys, experiments, and controlled observations. Researchers predefine variables and establish standardized data collection procedures. Following data collection, sophisticated statistical techniques are employed to identify patterns, and relationships between variables, and to test the initial research hypotheses. As a result, the appropriate approach used in this study is quantitative to examine a hypothesis, determine causal relationships, or apply results to a broader population.

3.2 Research Framework

The research framework is designed to be a roadmap to achieve the objectives as shown in the flow chart of Figure 3.2.1. The diagram of the research method effectively outlines a structured sequence of steps and procedures used in the investigative process. It serves as a guide, leading from the initial conception of the research concept and questions to the final analysis and interpretation of the data (Willie Tan, 2017).

The research flowchart commences by establishing the research objective and conducting an extensive literature review to identify the causes and impacts of change orders, utilizing secondary data. Once the data collection process is completed, since the study is based on

quantitative analysis, a well-structured questionnaire is formulated to effectively explore facts, opinions, and perspectives. Subsequently, the questionnaire undergoes a thorough review by experienced experts to assess its validity, making necessary additions or deletions to ensure that it accurately measures what it is intended to measure. Upon completion of this stage, the final version of the survey is prepared for distribution.

The subsequent phase involved identifying the target population, determining the sample size, and sampling method. Surveys were then distributed to a selected group of contractors and consultants through an online form, followed by confirmation via phone calls to encourage more respondents to participate.

The analysis was then conducted by utilizing the Relative Importance Index and the SPSS software to identify significant causes and impacts of change orders. It also examines the relationship between causes and the overall characteristics of respondents and construction projects. Subsequently, the findings were summarized to identify the key causes and impacts of change orders and to propose solutions for managing change orders in projects. Data interpretation was carried out to connect the results with those of previous studies. Lastly, future recommendations were outlined to address the gaps in construction projects.

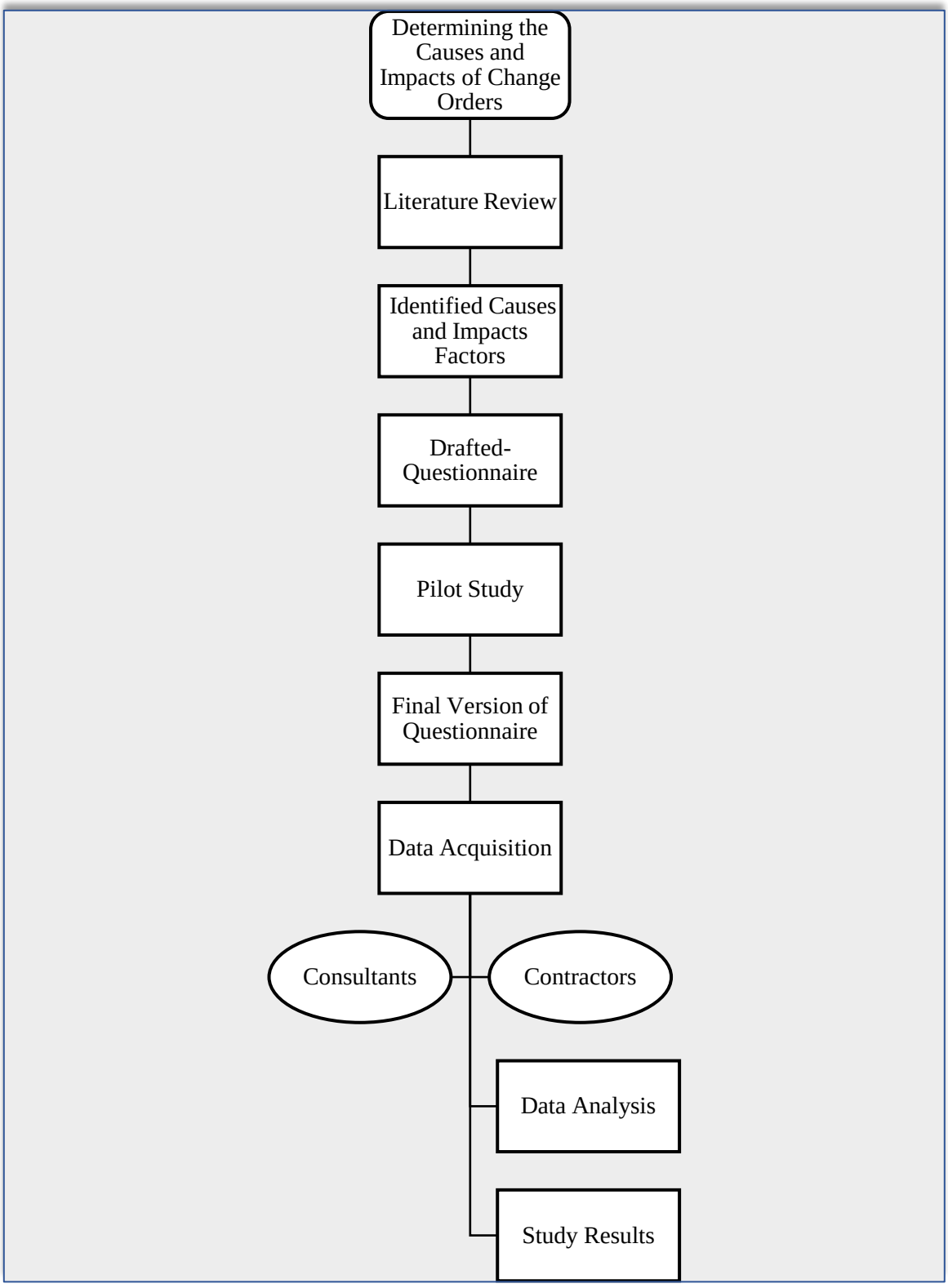

Figure 3.2.1 Flow Chart of Methodology Used in the Study

3.3 Questionnaire Design

After conducting a detailed literature review to achieve the main goals of the study, the questionnaire draft was organized to collect quantitative data. The questionnaire consists of three main parts; the general and demographic information about the respondents' profile, causes of change orders, and impacts of change orders. As shown in Appendix A (Questionnaire Form-Arabic Version); the first part of the questionnaire is composed of 9 questions to elaborate on their background in the construction industry. It includes the type of projects they are involved in, the years of experience, the characteristics of projects facing change order, and the responsible player for causing change order. The questions presented in this section are structured as multiple-choice questions.

The second part tabulated the causes of the change order, the participant was requested to state the importance of these causes in his projects by adopting a five-point Likert scale. Factors deemed most crucial are categorized as "extremely significant", while those considered least significant are classified as 'very low significant', indicating the existence of the factor as a cause. These causes are mainly classified into two categories based on the circle of influence of construction parties as shown in Figure 3.3.1 below.

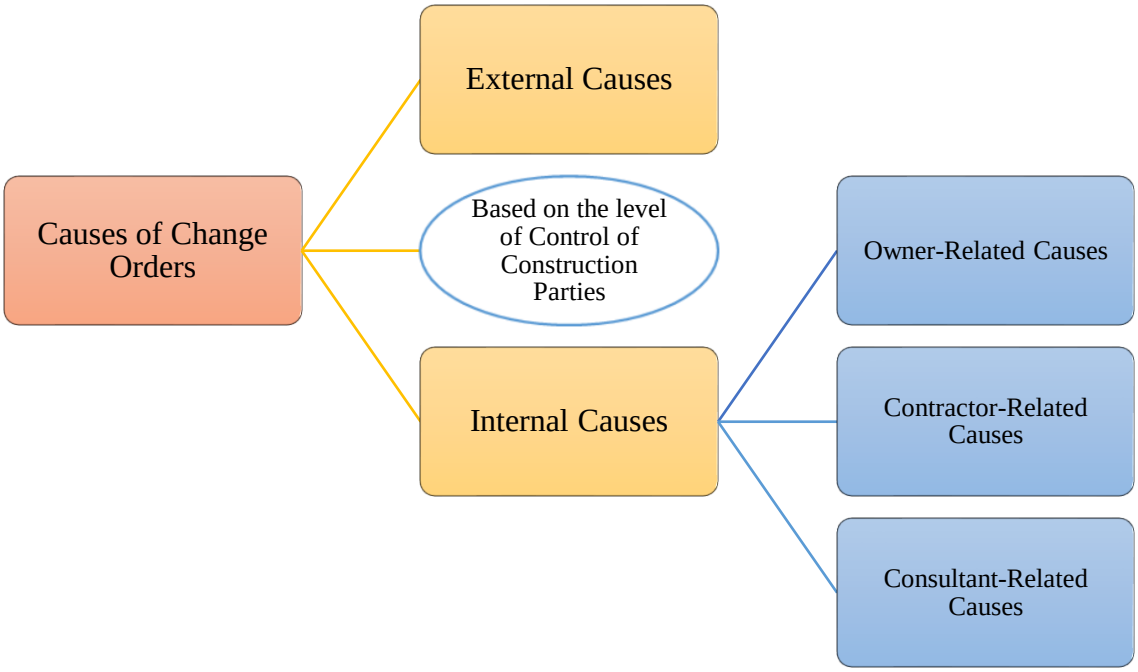

Figure 3.3.1 Categorizing the Causes of Change Orders

The external causes of change orders (A) occurred behind the control of construction parties. It included many common causes in the Palestinian context as shown in Table 3.3.1 below.

Table 3.3.1 External Causes of Change Orders

A1	Political situations and their consequences
A2	Construction material shortage due to blockade and siege
A3	Variation of exchange rate
A4	Fluctuations in construction material price
A5	Unforeseen site conditions
A6	Change in government's regulations, laws, policies
A7	Inflation in the construction industry
A8	Disaster events like pandemics, earthquakes, floods, etc…
A9	Weather conditions
A10	Unfamiliarity of donor instructions to use specific specs
A11	Environmental and social impacts
A12	Lack of qualified labors

The internal factors (B) fall into the control of key construction parties. It is divided into 3 subcategories according to the responsibility of each party involved in the project to cause change orders; (B1) contractor-related causes, (B2) owner-related causes, and (B3) consultant-related causes, and are posed in Table 3.3.2, Table 3.3.3, Table 3.3.4, respectively.

Table 3.3.2 Contractor-related Causes of Change Order

B1-1	Poor experience of the contractor in importing material
B1-2	Lack of contractor's specialty and experienced management team
B1-3	Misunderstanding of contract documents during the cost estimation-bidding stage
B1-4	Lack of contractor involvement in the design and review of contract documents
B1-5	Lack of contractor's knowledge about work scope and site conditions
B1-6	Contractor's intended profitability
B1-7	Poor financial capability of the contractor
B1-8	Safety non-compliance

Table 3.3.3 Owner-related Causes of Change Order

B2-1	The timeline addressed by the owner
B2-2	Change in plan and scope by owner
B2-3	Owner's financial difficulties
B2-4	Change in specification of project and procedure by owner
B2-5	Inadequate experience of owner's staff
B2-6	The owner's failure to make a timely decision
B2-7	Owner-changed design
B2-8	Inadequate stakeholders engagement

Table 3.3.4 Consultant-related Causes of Change Order

B3-1	Change in design during the construction stage by consultant
B3-2	Errors and omissions in design

B3-3	The conflict between contract documents
B3-4	Lack of coordination among project parties
B3-5	Shortage of consultant's knowledge due to the omission in terms of reference of project
B3-6	Project complexity
B3-7	Lack of details in drawings
B3-8	Poor site investigation before the design stage
B3-9	Using duplicated documents from previous projects
B3-10	Value engineering

The third/final part (C) concludes the impacts of change orders on the performance of construction projects that originated from the literature review. Responses in this part are also provided using a 5 - 5-point Likert Scale, starting with the frequency of "extremely significant" and concluding with "very low significant". Table 3.3.5 displays the impacts of change orders to be tested in this study.

Table 3.3.5 The Impacts of Change Order

C1	Time overruns
C2	Cost overruns
C3	Disputes between contract parties
C4	Delay in payment by the owner
C5	Provide additional equipment & staff
C6	Degradation of quality standards
C7	Productivity degradation
C8	Rework and demolition
C9	Logistics delays long lead procurement
C10	Tarnishing the reputation of the institution

3.4 Pilot Study

The draft questionnaire was reviewed by 10 experts in the construction management field with a minimum of 15 years of experience before being distributed. The pilot study offers valuable insights and evaluation of the survey layout and content and conforms to comprehensiveness. It checks the validity of the questionnaire and whether the survey is yielding data that reflects the main objectives of the study.

Consequently, the experts recommended including environmental and social impact (ESI) in external factors, as many projects face suspension due to ESI. Morozov A. et al. (2022) highlighted that environmental impact assessment plays a critical role in construction projects to prevent environmental damage and ensure safety. Moreover, social impact assessment is equally important in assessing community effects. EIS report helps identify potential issues early in the project cycle, leading to incorporating recommendations into the project design to minimize adverse effects.

However, the environmental and social impact reports (ESIs) aren't directly the cause of change orders. The ESI report is considered a proactive approach that can be used not only for the initial project design but also to evaluate potential changes. This helps identify and address environmental and social risks associated with projects before change orders occur. The ESI report process also fosters communication between project stakeholders, including designers, contractors, and the community. This allows for early identification of concerns and collaborative solutions to address them in the preconstruction phase. Additionally, Torelli R. (2023) addressed that ESI reports often have discrepancies between stated commitments

and actual actions, potentially leading to change orders due to the disconnect between reporting and real-world impact.

The lack of skilled labor is also added as an external cause due to work outside the country and the incoherent Palestinian labor market. The experts also added misunderstanding of documents during the bid stage. They stated that the contractor estimated the price of bids incorrectly bid estimation and so he tried to issue change orders to compensate for the misunderstandings.

The experts addressed two causes of change orders originating from the owner. The first cause is the failure of the owner to make the decisions on time. By following the guidelines issued by the Higher Council for Public Procurement Policies, some owner decisions should run into a series of approvals within departments which takes a long time to issue. The next factor is the lack of involvement of stakeholders in projects during the pre-construction phase. This may create opposition to the scope of the project leading to the initiation of change orders.

In the impacts of change orders section, the experts proposed that the firm's reputation be added as an impact of change orders. This is because a project that experiences numerous change orders is often perceived as a failure and source of disputes, as it indicates an inability to deliver the desired outcomes.

The expert recommended omitting the question about the type of contract (lump sum, unit price, etc.). The reason for this is the majority of projects in the Palestinian construction sector are centered around unit-price contracts, with other contract types being less prevalent.

However, the unfamiliarity of local markets by the consultant was considered redundant and removed from the survey such as the unfamiliarity of local markets by the consultant. Moreover, the delayed payment to subcontractors was removed as the survey already included the poor financial capability of contractors.

The final questionnaire was finalized after conducting the improvements suggested by experts as shown in Table 3.4.1 below.

Table 3.4.1 Adjustments Implemented by the Experts-Pilot Study

Items	Item Description	Action by Experts
Lack of skilled labors	External Causes	Added
Environmental and social impact	External Causes	Added
Misunderstanding of documents during the bid stage	Internal Contractor-Related Causes	Added
Delayed payment to subcontractors	Internal Contractor-Related Causes	Omitted (Redundant)
Failure of the owner to make the decisions on time	Internal Owner-Related Causes	Added
Inadequate stakeholders engagement	Internal Owner-Related Causes	Added
The type of contract	The First Part of the Questionnaire	Omitted
Unfamiliarity of local markets by the consultant	Internal Consultant-Related Causes	Omitted (Redundant)

The following sections describe the validity and reliability tests of the questionnaire, and identify the size samples for each party; consultants, and contractors to be distributed to a random sample of working in the Palestinian construction industry.

3.5 Questionnaire Validity and Reliability

The validity test is crucial in determining the accuracy of an instrument tool, whether a measure assesses what it's supposed to measure. The research developed a comprehensive questionnaire to address the research questions. It aimed to answer all relevant aspects of the investigated constructs. The participants were also incapable of detecting the research hypothesis due to the lack of supporting evidence in the survey, while the questionnaire encompassed all parties involved in projects and was responsible for change orders, indicating objectivity.

Experts also reviewed the questionnaire and suggested additions to ensure thorough coverage. This approach aligns with previously published research in peer-reviewed journals that addressed similar topics about the causes and impacts of change orders. All experts in the field confirmed that the survey effectively assesses the intended measurements.

The study was organized to include all design disciplines, performance indicators for the monitoring process, and key stakeholders in construction projects. To achieve this, a stratified random sampling approach was employed, which involved defining the theoretical population as all construction professionals representing consultants and contractors. The accessible population was then determined by selecting the appropriate sampling frame, as discussed in the subsequent section.

The assessment of the internal consistency factors and groups of the questionnaire was carried out by using Cronbach’s alpha as a statistical measurement tool. The reliability test

was used on groups of causes and impacts of change orders to ascertain that all sections and subsections of the questionnaire have the same features.

3.6 Sampling Method and Circulation of Questionnaire

The target population in this research is all contractors who are registered in Palestinian Contractor Unions (PCU) and classified in the Ministry of Public Work and Housing Database. It also targeted consultants registered with the Engineers' Association-Jerusalem Branch. There are 540 contractors, and 380 consultants according to PCU and Engineers' Association- Jerusalem Branch, respectively.

The sample of the study falls within the category of probability sampling approaches. Many approaches were used to determine the sample size. This study used Kish's (1995) method for calculating the sample size based on a 90% confidence level using the following equation:

$$n = \frac{n'}{(1+\left(\frac{n'}{N}\right))} \qquad (1)$$

Enshassi et al., (2010) explained how to calculate the formula as the sample size from a finite population (n) and an infinite population (n') is given by S^2/V^2, where S^2 represents the variance of the population elements and V is the standard error of the sampling population,

and (N) represents the total number of population. Typically, S is assumed to be 0.5 and V is assumed to be 0.1 for a 90% confidence interval.

Based on the results from the previous equation, the minimum sample size required is 49 questionnaires: 25 for contractors and 24 for consultants. To ensure more precise results, a total of seventy-five questionnaires were distributed to potential respondents across all levels within the construction industry. Specifically, 40 questionnaires were sent to contractors and 35 to consultants, and the respondents were selected randomly. After collecting the responses from the distributed questionnaires, a total of 70 responses were received. Out of these, 5 responses were deemed invalid, leaving 65 valid responses. Among the valid responses, 33 were from contractors, resulting in a response rate of 90%, while 32 were from consultants, with a response rate of 97.1% as shown in Table 3.6.1. The respondents were categorized as senior site engineers, project managers, construction managers, and organizational managers, all of whom had over 15 years of experience.

Table 3.6.1 Statistics of Questionnaire

	Contractors	Consultants	Total
Minimum Sample Required	25	24	49
No. of Distributed Questionnaires	40	35	75
No. of Received Questionnaires	36	34	70
Respondent Rate(%)	90%	97.1%	93.55%
No. of Invalid Quesstionnares	3	2	5
No. of Valid Quesstionnares	33	32	65

After the questionnaires were received, the analysis was carried out on gathered data using instruments discussed in the next Chapter.

4 Chapter Four: Data Analysis

The study aimed to identify the most critical causes of change orders and their impacts on delivering construction projects within targeted outcomes. Upon gathering data through questionnaires, an analysis framework was established to address the research objectives. This chapter shows the instruments and methods used in the analysis process, following the structure of the questionnaire. Initially, the analysis focused on assessing the consistency of items within the dataset using the SPSS statistical software. Followed by the use of descriptive tools to present the demographic information of the respondents.

The Relative Importance Index (RII) tool and Standard Deviation were employed to evaluate the significance, ranking, and degree of agreements between contractors and consultants on the causes and impacts of change orders. Subsequently, the overall RII scores for each group were calculated to determine the party most responsible for change orders. Moreover, Hypotheses were formulated and tested to demonstrate the differences and relationship between construction parties' characteristics and the causes of change orders using the One-Way ANOVA test.

4.1 Reliability Test

The credibility of research findings has been a central concern throughout our previous discussion on research design. The validity of the survey was studied to ensure that the data

collected by this frame of the survey will test the addressed objectives of the research. However, to ensure that the research is associated with obtaining consistent outcomes when additional data is gathered through the application of the identical methodology, the reliability test was applied (Willie Tan, 2017). It measures the internal consistency between each item in one group and the whole group and between each group and the consistency of the whole questionnaire.

Cronbach's alpha is a measure used to estimate reliability, ranging from 0% to 100%. Higher values indicate more consistent responses and greater reliability. A minimum acceptable value of 0.70 is typically used to determine if the answers are reliable. In this study, the statistical software SPSS was employed to conduct Cronbach's alpha analysis in order to assess the reliability of the responses across all sections of the questionnaire. The Cronbach's alpha coefficients (α) were calculated both for all groups and items and it equals 0.927 and each group of causes of change orders and impacts, yielding the following results:

Table 4.1.1 Reliability Statistics for Each Group

Reliability- Tested Groups	N of Items	Cronbach's Alpha Value (α)
External Causes	12	0.724
Contractor-related Change Order Causes	8	0.799
Owner-related Change Order Causes	8	0.827
Consultant-related Change Order Causes	10	0.826
Impacts of Change Order	10	0.852

Table 4.1.1 shows that Cronbach's Alpha Values (reliability values) exceed 0.70, illustrating that the obtained results are both reliable and consistent. However, the Cronbach's Alpha

Values for each item within the group are attached in Appendix B: Cronbach's Alpha Values (α).

4.2 Descriptive Analysis

Descriptive analysis is utilized to summarize the general information provided by the respondents in a more manageable and interpretable format (Willie Tan, 2017). The identification of the demographic data of the respondents is crucial to assess the market's awareness of change order events and their consequences. In this study, the frequency of the data was demonstrated, which showcases the diversity of the respondents and helps to study the causes and impacts of change orders. We also provide information on how the data was collected, and the background of the parties involved such as their experience in the construction industry, without specifically targeting a particular age group or party. Therefore, this type of analysis enables us to obtain a clear understanding of the data and enhances our comprehension of its contents. The subsequent chapter will present the results of the respondents' background, utilizing the frequency tool as one of the descriptive analyses.

4.3 RII of Causes and Impacts of Change Order, and the Degree of Agreement

To assess the relative significance, and rank and compare the importance of various causes and impacts of change orders based on participant responses, the relative importance factor method (RII) was utilized in the study. Al-Nuaimi et al., (2010); Enshassi et al., (2010) adopted the RII to rank the causes and impacts that lead to change orders from different perspectives. The RII is an average of the values obtained and in this research, it ranges from 1 (being lowest) to 5 (being highest) where the score of a certain event as seen in equation two is:

$$Score = \frac{\sum W}{H \times N} \times 100 \qquad (2)$$

Where; W is the weight assigned to each cause by the respondents varies from 1 to 5, with 1 representing "Very low importance" and 5 representing "Very strong importance", H is the highest weight, which equals 5 in this case, and N represents the total number of respondents. Table 4.3.1 displays the Relative Importance Index (RII) for every factor contributing to change orders from contractor and consultant perspectives and overall perspectives. It includes the ranking of each factor based on its significance, ranging from strong importance with the highest RII to low importance with the lowest RII. The standard deviation (SD) was computed for each cause of change orders as shown in the table below to assess the spread of relative importance values around the average. This determines the dispersion of their significance and illustrates the degree of agreement between contractor and consultant points of view.

Table 4.3.1 RII of the causes of change orders

	Item code	Causes of change orders	Contractor respondents		Consultant respondents		Overall respondents		SD
			RII	Rank	RII	Rank	RII	Rank	
(A) External Causes	A1	Political situations and their consequences	0.70	10	0.67	14	0.68	12	2.00
	A2	Construction material shortage due to blockade and siege	0.45	34	0.61	25	0.57	28	11.17
	A3	Variation of exchange rate	0.39	38	0.51	35	0.48	36	8.37
	A4	Fluctuations in construction material price	0.47	31	0.59	27	0.54	31	8.99
	A5	Unforeseen site conditions	0.71	9	0.72	5	0.71	7	0.68
	A6	Change in government's regulations, laws, policies	0.45	34	0.47	37	0.46	38	1.00
	A7	Inflation in the construction industry	0.44	36	0.57	28	0.54	32	8.93
	A8	Disaster events like pandemics, earthquakes, floods, etc…	0.62	18	0.62	24	0.62	22	0.39
	A9	Weather conditions	0.65	16	0.54	31	0.62	23	7.41
	A10	Unfamiliarity of donor instructions to use specific specs	0.57	23	0.52	34	0.56	30	3.60
	A11	Environmental and social impacts	0.52	29	0.43	38	0.51	34	5.93
	A12	Lack of qualified labors	0.72	8	0.60	26	0.68	14	8.14
(B1) Contractor-Related	B1-1	Poor experience of the contractor in importing material	0.46	32	0.56	30	0.51	33	6.76
	B1-2	Lack of contractor's specialty and experienced management team	0.55	26	0.67	14	0.63	20	8.29
	B1-3	Misunderstanding of contract documents during the cost estimation-bidding stage	0.68	14	0.65	19	0.67	15	2.46

	B1-4	Lack of contractor involvement in the design and review of contract documents	0.55	27	0.63	23	0.59	26	5.62
	B1-5	Lack of contractor's knowledge about work scope and site conditions	0.58	22	0.67	14	0.63	19	6.15
	B1-6	Contractor's intended profitability	0.51	30	0.64	21	0.59	24	9.08
	B1-7	Poor financial capability of the contractor	0.69	12	0.74	2	0.72	6	3.74
	B1-8	Safety non-compliance	0.46	32	0.53	33	0.49	35	4.55
(B2) Owner-Related Causes	B2-1	The timeline addressed by the owner	0.69	12	0.68	11	0.69	11	0.68
	B2-2	Change in plan and scope by owner	0.73	4	0.78	1	0.76	2	2.95
	B2-3	Owner's financial difficulties	0.75	3	0.74	3	0.74	3	0.56
	B2-4	Change in specification of project and procedure by owner	0.53	28	0.63	22	0.59	25	6.92
	B2-5	Inadequate experience of owner's staff	0.67	15	0.65	19	0.66	17	1.61
	B2-6	The owner's failure to make a timely decision	0.70	10	0.67	14	0.68	13	2.00
	B2-7	Owner-changed design	0.65	16	0.73	4	0.70	10	5.85
	B2-8	Inadequate stakeholders engagement	0.61	19	0.70	8	0.66	16	6.64
(B3) Consultant-Related Causes	B3-1	Change in design during the construction stage by consultant	0.57	23	0.66	18	0.62	21	6.56
	B3-2	Errors and omissions in design	0.73	6	0.72	5	0.72	5	0.60
	B3-3	The conflict between contract documents	0.73	4	0.68	11	0.71	8	3.68
	B3-4	Lack of coordination among project parties	0.59	21	0.69	10	0.65	18	6.62
	B3-5	Shortage of consultant's knowledge due to the omission in terms of reference of project	0.56	25	0.56	29	0.56	29	0.08

	B3-6	Project complexity	0.60	20	0.54	32	0.58	27	4.42
	B3-7	Lack of details in drawings	0.72	7	0.69	9	0.71	9	1.94
	B3-8	Poor site investigation before the design stage	0.79	2	0.68	13	0.74	4	7.98
	B3-9	Using duplicated documents from previous projects	0.82	1	0.71	7	0.77	1	8.34
	B3-10	Value engineering	0.42	37	0.49	36	0.46	37	4.47

The Relative Importance Index method is utilized not only to rank causes but also to assess the individual impact of each cause as well as their combined effect on initiating change orders. Consequently, a comprehensive examination was conducted to compare the outcomes (RII) of each specific group with the overall results to determine the individuals who are more responsible for initiating a change order. Table 4.3.2 shows the RII for the main groups of causes of change orders by main groups as:

Table 4.3.2 RII and Ranking the Causes of Change Order by Group

Item	Groups of the Causes of the Change Order	N of Causes	RII from Contractor Perspective	RII from Consultant Perspective	Overall RII	Ranking
B2	Owner-related Change Order Causes	8	0.68	0.71	0.70	1
B3	Consultant-related Change Order Causes	10	0.71	0.68	0.69	2
B1	Contractor-related Change Order Causes	8	0.60	0.67	0.64	3
A	External Causes	12	0.64	0.63	0.63	4

RII has been emphasized as a tool for assessing the impact of a particular variable on predicting outcomes associated with a criterion variable on its own or in combination (Johnson & Lebreton, 2004). In this framework, RII plays a dual role in ranking the effect of each factor on initiating change orders. The RII and standard deviation of the impacts of the change order and its ranking are illustrated in Table 4.3.3 as follows:

Table 4.3.3 RII of the impacts of change orders

	Item code	Causes of change orders	Contractor respondents		Consultant respondents		Overall respondents		SD
			RII	Rank	RII	Rank	RII	Rank	
(C) Change Orders' Impacts	C1	Time overruns	0.81	1	0.81	1	0.81	1	0.03
	C2	Cost overruns	0.71	2	0.76	2	0.74	2	3.78
	C3	Disputes between contract parties	0.61	4	0.69	5	0.65	5	5.33
	C4	Delay in payment by the owner	0.55	6	0.74	3	0.65	4	13.59
	C5	Provide additional equipment & staff	0.50	7	0.61	9	0.55	8	7.30
	C6	Degradation of quality standards	0.47	10	0.62	7	0.55	9	10.33
	C7	Productivity degradation	0.49	9	0.62	7	0.56	7	9.04
	C8	Rework and demolition	0.63	3	0.73	4	0.68	3	7.14
	C9	Logistics delays long lead procurement	0.56	5	0.68	6	0.62	6	8.30
	C10	Tarnishing the reputation of the institution	0.50	7	0.54	10	0.52	10	2.44

4.4 Statistical Hypotheses

Change is commonly believed to have a detrimental effect on project performance. Nevertheless, each project operates within its distinct environment, and project performance is highly influenced by this environment. Hence, it is wise to examine a variety of projects within the construction sector and analyze the overall impact of change trends in the industry. This can also be utilized as a reference point for industry professionals to review and appraise their projects.

The One-Way ANOVA test was employed to examine the variations between groups in terms of the primary factors contributing to change orders in Palestinian construction projects, as well as the attributes of the respondents and institutions. Several hypotheses were tested in this regard.

4.4.1 The Years of Experience for Construction Firms

The significance of the experience of construction firms and the causes of change orders was evaluated using the One-Way ANOVA method through SPSS Software and the first null hypothesis developed as follows:

H1o: There is no statistically significant difference between the experience of construction firms and the causes of change orders.

Appendix C (The Years of Experience of Construction Firms and the Causes of Change Order) shows the significance degree for the main causes of change orders. It shows that there was a significant difference (sig<0.05, the null hypothesis is rejected) between the

expertise of construction companies and the following causes; political situations and their consequences, unforeseen site conditions, weather and seasonal conditions, lack of qualified labor, errors and omissions, and poor site investigation in the design stage. Construction companies with extensive experience are likely to possess superior project management practices, procedures for communication, and techniques for assessing risks. This enables them to effectively reduce certain causes of change orders such as design mistakes, and incomplete designs (Valeh Moayeri, 2017).

Furthermore, these experienced firms may have solid connections with clients, which leads to improved interaction and comprehension of project needs. Additionally, it may minimize client-initiated changes and delays between the design and construction phases. Conversely, firms with less experience might face challenges related to inadequate information, lack of coordination and connection within construction markets, and challenges with adapting to unforeseen conditions. All of these reasons could lead to more change orders being issued for their projects. However, the respondents agree with other causes that are not dependent on the experience of construction firms.

4.4.2 The Size of the Construction Firms

The second null hypothesis was developed to reveal if there is a positive correlation between the size of construction firms and the causes of change orders using the One-Way ANOVA method through SPSS Software:

H2o: There is no statistically significant difference between the size of construction firms and the causes of change orders.

Appendix D (The Size of Construction Firms and the Causes of Change Order) shows that no significance degree for the most main causes of change orders is more than 0.05, so the null hypothesis is accepted. Hence, the small, medium, and large construction firms did agree on the same perspective in terms of the causes of change orders. Do et al., (2023) displayed that many factors contribute to change orders in the construction industry, regardless of the firm's size. These factors include issues related to the owner, such as design and scope of work, as well as external influences like governmental funding and social interference. Nevertheless, it is important to note that there exists a notable significance between the scale of construction corporations and a few causes that contribute to change orders such as political circumstances and the consultant's limited understanding of the term of reference (TOR) for projects. This discrepancy arises due to the fact that larger consultants possess a greater wealth of expertise, enabling them to precisely formulate comprehensive and well-structured TORs.

4.4.3 The Cost of Construction Projects Implemented Annually by Parties

As the above-mentioned approach, the One-Way ANOVA method through SPSS Software was utilized to formulate the third null hypothesis. It aimed to address whether there is a

dependence between the annual average cost of construction projects executed by construction parties and the factors leading to change orders:

H3o: There is no statistically significant difference between the cost of executed construction projects and the causes of change orders.

Appendix E (The Average Cost of Project Implemented Annually by Construction Firms and the Causes of Change Order) explains that the significance degrees of most causes are more than 0.05. It means that respondents agree that there is no matter the annual value of contracts being conducted, facing the change order is inevitable (Alzara, 2022; Oladiran et al., 2018). This is inconsistent with many researchers arguing that change orders are a common occurrence in construction projects, irrespective of the annual turnover of construction firms. However, respondents with varying scales of projects hold different opinions regarding the factors contributing to change orders, such as the owner's financial capacity and inflation in the construction industry. For instance, when projects entail high costs that reflect financial stability, larger firms are capable of covering their expenses even if their interim payments are delayed.

5 Chapter Five: Results and Discussions

This chapter presents the findings obtained from analyzing all the distributed surveys. A total of 65 valid professional questionnaires were collected, with 33 responses from the contractor's side and 32 from the consultant's side. This chapter comprises three sections; the respondent's background, the primary factors contributing to change orders, and the consequences of such changes. The explanation of the meaning of results in the context of the research questions and existing literature, and explores their significance was included in this Chapter.

5.1 Demographic Profile of the Questionnaire Respondents

This section provides an overview of the demographic information gathered from the 69 responses received from the selected sample and shows the variety of gathered data. The following charts displayed below depict the responses received for the initial section of the questionnaire, which primarily focused on the background details of the respondents.

- *Number of Employees in Construction Firms*

The questionnaire results on the number of employee respondents in the construction industry are illustrated in Figure 5.1.1. It was revealed that 21 respondents had 5 to 50 employees in their respective organizations, whether they were consultants or contractors. Additionally, 11 respondents from the contractor sector and 8 respondents from the consultant sector reported

having fewer than 5 employees. Interestingly, the results also indicated the presence of a small number of large-scale companies with more than 50 employees in the construction sector, with 2 respondents each from the contractor and consultant sides.

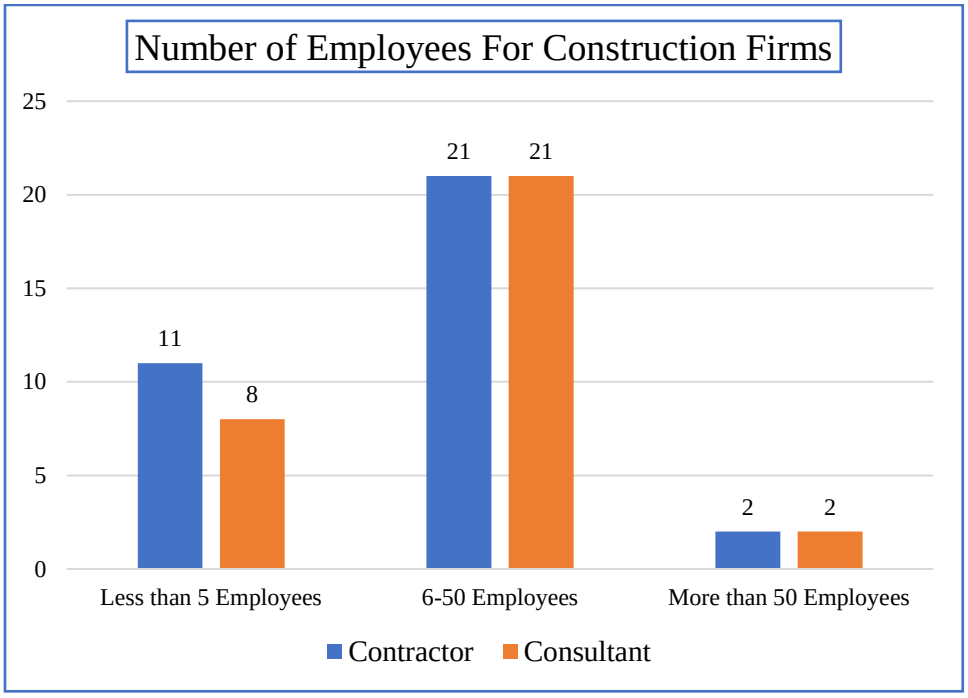

Figure 5.1.1: Number of Employees in Construction Firms of Respondents

- *Types of Construction Projects*

The survey participants in the first part of the questionnaire framed the construction projects sector, as illustrated in Figure 5.1.2. The breakdown of respondents indicates that a significant portion, amounting to 34%, are involved in construction projects, be it residential or commercial. Following closely behind are 32% of respondents engaged in water and

sanitation projects, with 26% focusing on highways and road projects. The data further reveals that 8% of the sample population is involved in electromechanical projects.

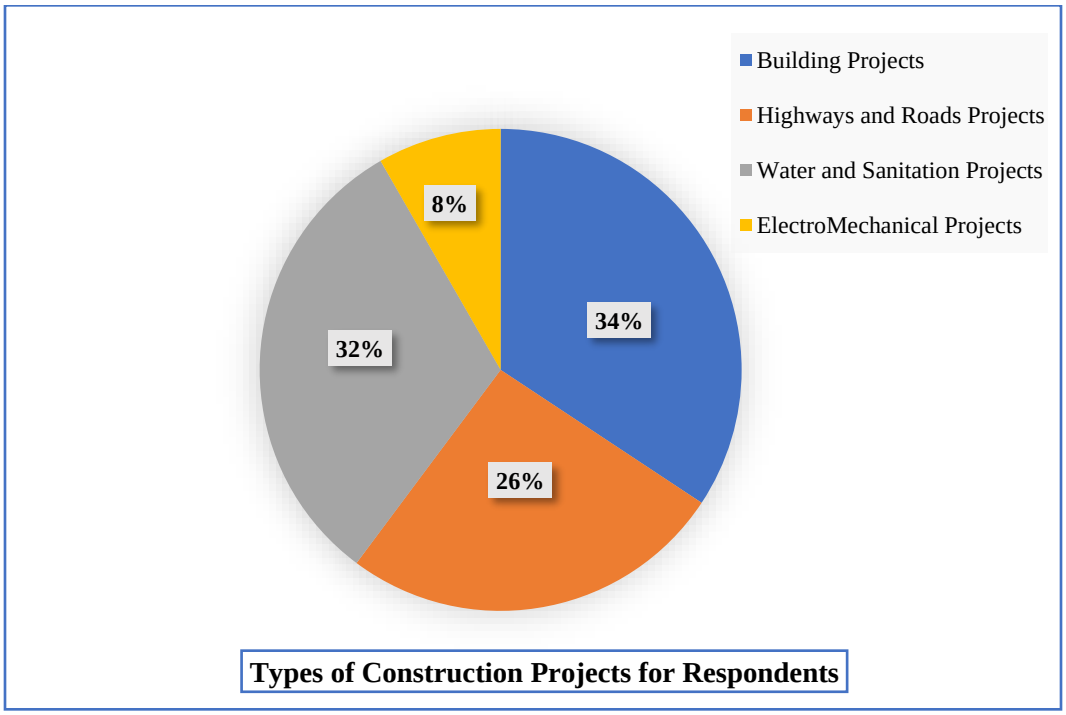

Figure 5.1.2: Types of Construction Projects for Respondents

- *The Years of Experience for Respondents*

Figure 5.1.3 illustrates the significance of construction project experience in demonstrating the relationship with the causes of change orders. The data indicates that there are 7 contractors and 4 consultants with over 20 years of experience, while there are 5 respondents from each category with experience ranging from 15-20 years. Furthermore, there are 8 contractors and 5 consultants with experience ranging from 10 to 15 years. The largest portion of experience falls within the range of 5 to 10 years, with 11 contractors and 10

consultants. This can be attributed to many construction management professionals establishing their own businesses after the recession in the Palestinian construction industry, and decreasing the funding from donors. The results also reveal that 2 contractors and 8 consultants have less than 5 years of experience.

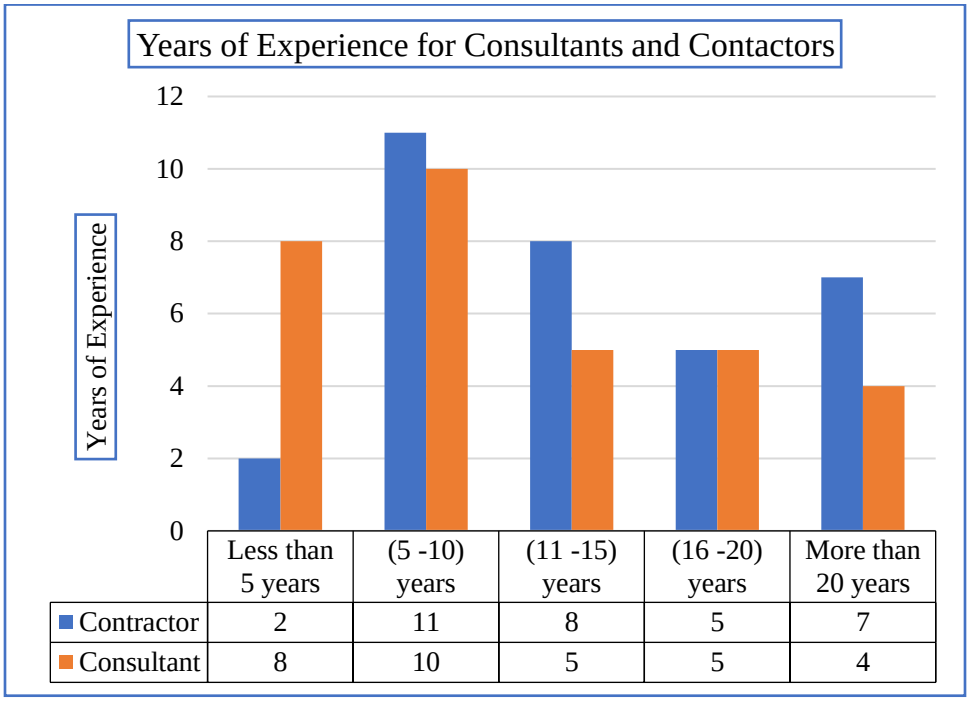

Figure 5.1.3: Years of Experience for Respondents

- *Number of Executed Projects of Respondents for the Last Five Years*

The number of completed projects reflects the level of engagement of respondents in adhering to the updated guidelines and procedures within the construction industry. This aspect is commonly utilized to categorize the respondents based on their technical qualifications when submitting bids. A higher number of projects undertaken in the past five years indicates a greater wealth of experience to learn from. The 5-year timeframe was

specifically chosen due to the impact of COVID-19 on the construction sector in 2020 and 2021, along with the exacerbation of political tensions in Palestine. As shown in Figure 5.1.4, 4 contractors and 6 consultants have completed fewer than 5 projects in recent years. Meanwhile, 15 contractors and 12 consultants have worked on 5 to 10 projects within the specified timeframe, with 5 contractors and 3 consultants handling 11 to 15 projects. Additionally, 2 contractors and 8 consultants have undertaken 16 to 20 projects, while 7 contractors and 3 consultants have executed more than 20 projects during this period.

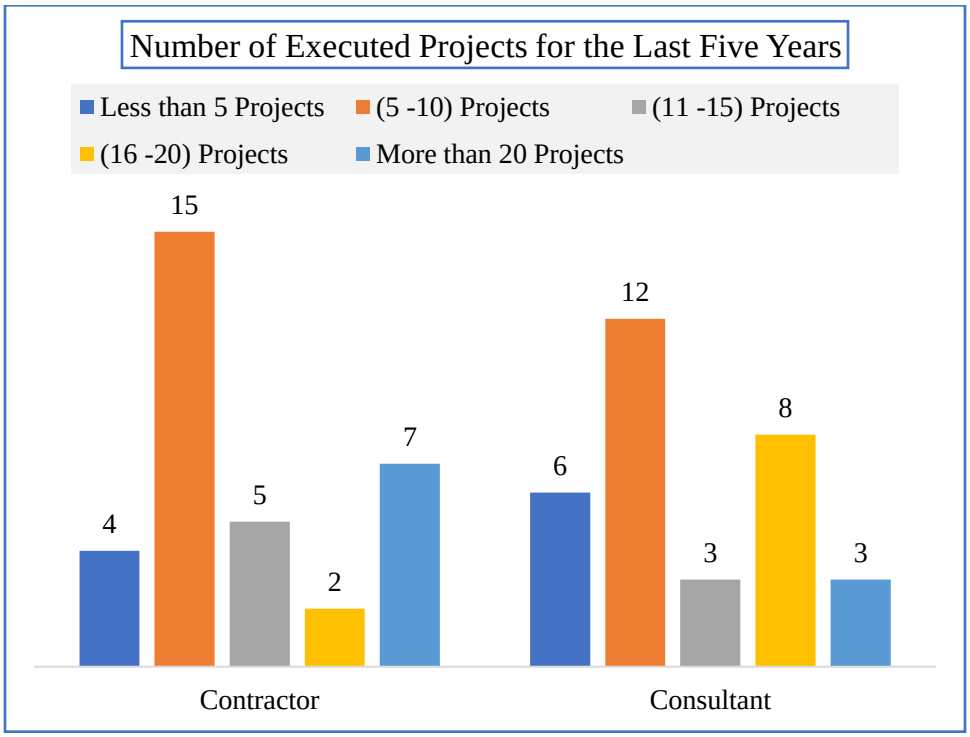

Figure 5.1.4: Number of Executed Projects for the Last Five Years

- *Average Cost of Executed Projects Annually*

In Figure 5.1.5, the annual turnover of the respondents is depicted, which indicates their financial capabilities and the complexity of projects. The bar chart illustrates that the

contractor undertook a greater number of projects valued between 0.5 to 1 M $ and 1 M$ to 5 M$ compared to those valued at less than 0.5 M$ and more than 5 M$. On the other hand, the consultant displayed a relatively normal distribution of constructed projects with average values as 7 participants reported values for both projects with less than 0.5 M$ value and above 5 M$ value. It also showed that 10 individuals shared their experiences with projects valued between 0.5 M$ and 1 M$. Additionally, 8 consultants were involved in the construction of projects valued between 1 M$ and 5 M$.

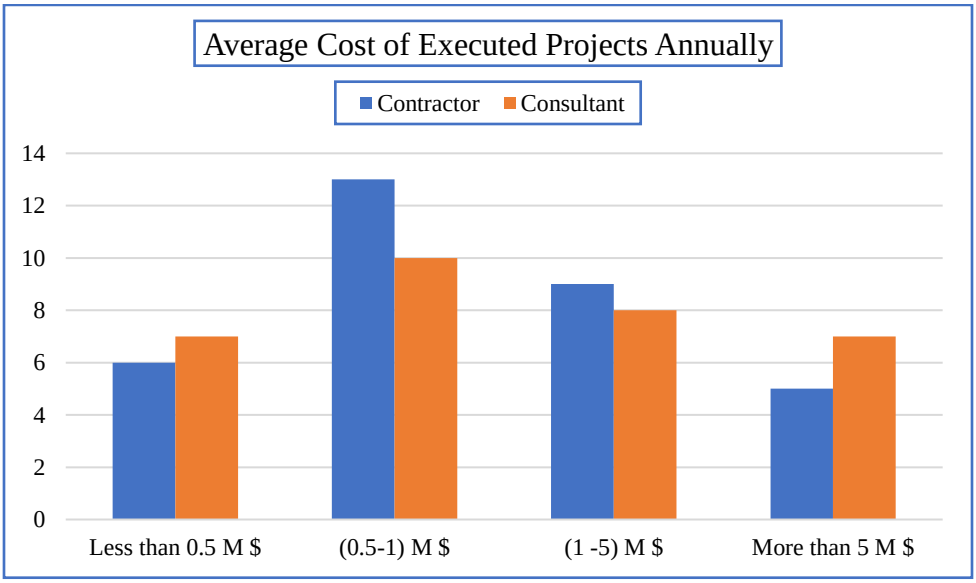

Figure 5.1.5 Average Cost of Executed Projects Annually

- *Type of Projects Based on the Ownership*

The initial findings of the survey also encompassed the ownership of projects that encountered change orders. According to Figure 5.1.6, a total of 25 consultants and 19 contractors are currently engaged in executing change orders for public entities, namely

governments, and municipalities, which constitute the majority. Non-governmental organizations (NGOs) rank second, with 8 contractors and 3 consultants involved in implementing projects with change orders. Additionally, there were 2 respondents each from the contractor and consultant groups who undertook projects for private institutions and initiated change orders. Lastly, there were 4 contractors and 2 consultants who reported projects with individual clients as the owners.

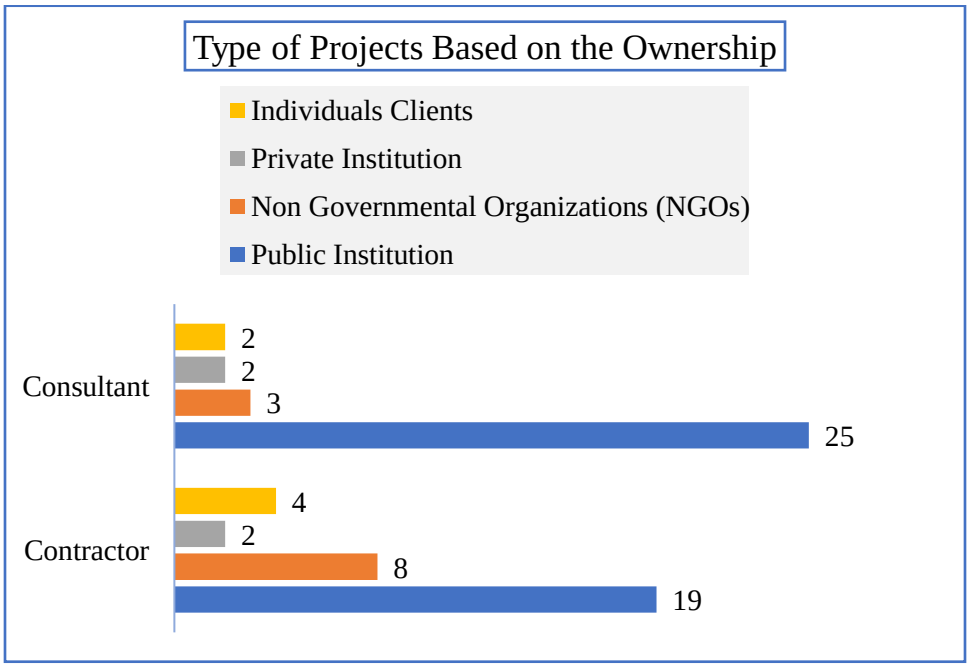

Figure 5.1.6: Type of Projects Based on the Ownership Experiencing Change Orders

5.2 Ranking of the Causes of Change Orders in Construction Projects

The Relative Importance Index (RII) was utilized to assess and prioritize the 38 factors contributing to change orders and their related groups within the construction sector in

Palestine. This section displays the ranking of the main groups of causes of change orders, the drivers of causes of change orders within sub-groups, and the overall ranking for all the causes. Then, the most ten important causes were derived and related to the previous literature review. The comparison between the secondary data and collected data presents the roadmap to adopt and adapt the mitigation plan of change order management within the Palestinian context.

5.2.1 Ranking of the Causes of Change Orders for the Main Groups

The importance of the primary groups of change order causes was established, followed by the utilization of RII to determine the scoring for each category, as illustrated in Figure 5.2.1. It was revealed the owner-related causes group ranked first, followed by the consultant-related group and contractor-related group. Subsequently, the last and fourth-ranked main group is external.

1. *Owner-Related Causes Group*

Upon examination of the outcomes, it was revealed that the group of causes related to the owner held the highest position with an RII of 0.70. This highlights that owner requirements such as "change in plan and scope" and "change in design" have the most detrimental impact on project duration, cost, and quality. Additionally, it is noteworthy that "Owner's financial difficulties," "the timeframe specified by the owner," and "the failure of owners to make decisions" are among the top 15 critical causes of change orders. Given this context, owners

must reconsider their approach to change order management in construction projects. The involvement of owners in the initial stages of design is crucial. Owners must participate in the design phase of the project to prevent any changes to specifications, requirements, and plans during the final stages of design or project construction.

2. Consultant-Related Causes Group

The consultant-related causes of change orders were identified through a thorough literature review and statistical analysis, with the latter ranking in the second position with an RII of 0.69. The consultant's role during the preconstruction phase is of utmost importance in order to mitigate potential causes that could lead to change orders. Causes such as "using duplicated contract documents from other projects," "poor site investigation," "errors and omissions in design," "conflicts between contract documents," and "lack of details in drawings" are among the top 15 critical causes of change orders. This underscores the necessity for design consultants to have experienced staff members who can develop constructible designs with minimal conflicts(Che Ibrahim et al., 2022). Furthermore, design consultants must stay updated on the latest specifications and standards set by local government authorities.

3. Contractor-Related Causes Group

The group of contractor-related causes of change orders, which have an RII of 0.64, is ranked in the third spot. The analysis conducted in Chapter 4 reveals that factors such as "poor financial capabilities of the contractor" and "misunderstanding of contract documents during the cost estimation-bidding stage" are among the 15 major causes that have a negative impact on project success goals. In real-life construction projects, it is not uncommon for owners to

terminate contractors due to significant delays in project progress and subpar work quality. Additionally, there have been instances where contractors have filed for bankruptcy during ongoing construction. Therefore, it is crucial to carefully select contractors and their employees based on project-specific requirements. Moreover, contractors must have a thorough understanding of all contract clauses and special provisions to ensure smooth project execution and prevent any misunderstandings.

4. External Causes Group

The fourth and final category consisted of external factors leading to change orders, which are beyond the control of construction parties, with an RII of 0.63. These external causes were identified as some of the top 15 critical issues contributing to change orders, including "unforeseen site conditions," "political situations and their consequences," and "lack of qualified labor." These unexpected events have the potential to significantly impact the project, requiring modifications to the original plans. Gunduz & Mohammad, 2019 concluded that while predicting these factors may be challenging, assessing their risks and implementing measures to reduce them should be integrated into change order management. This would enhance the resilience of construction projects against such occurrences.

It is noteworthy to highlight that the prioritization of these key groups in terms of causing changes in orders, with internal owner-related factors, internal consultant-related factors, internal contractor-related factors, and external causes of change orders being ranked first, second, third, and fourth respectively. These results align with the results outlined in (Ahmed Redha Gheraba et al., 2023; Enshassi et al., 2010b).

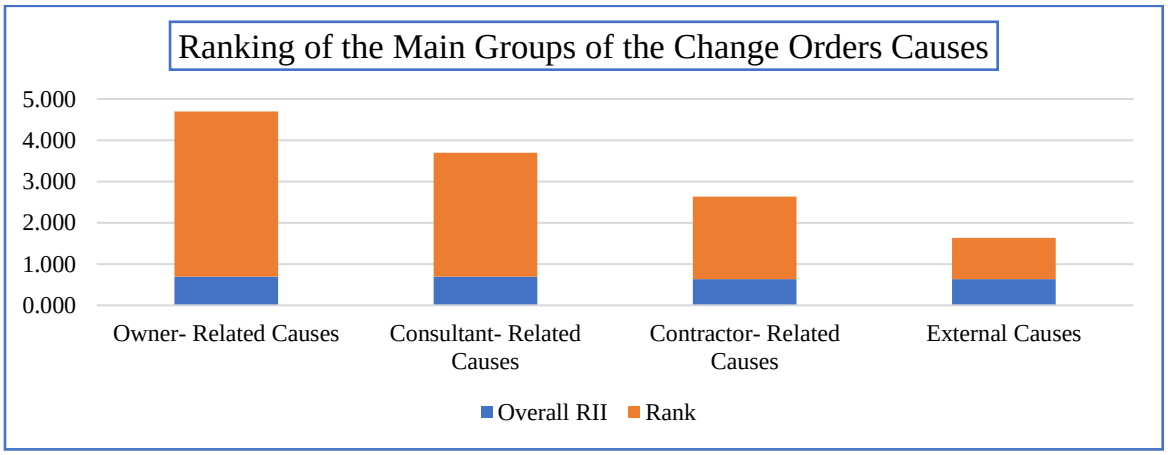

Figure 5.2.1 Ranking of Main Groups of the Causes of Change Orders

5.2.2 Ranking of the Sub-Group Causes of Change Orders

This section presented the results of the ranking of the causes of change orders within subgroups. This step is critical in the assessment of change orders and considering the adaption plan to mitigate the adverse effect of change orders on the targeted goals of construction projects. As mentioned before, the causes of change orders are divided based on the level of control into external causes (A) is discussed in Section 5.2.2.1, and internal causes (B). The internal causes are also divided into three groups based on the relevance to the construction parties; contractor-related causes (B1), owner-related causes (B2), and consultant-related causes (B3) discussed in Section 5.2.2.2, Section 5.2.2.3, and Section 5.2.2.4, respectively.

5.2.2.1 Ranking of the External Causes of Change Orders

Table 5.2.1 presents the hierarchy of external factors contributing to change orders. Unforeseen site conditions emerged as the top-ranked factor, with an RII of 0.71 and a significant SD of 0.68, indicating a strong consensus between contractors and consultants regarding its impact. These unforeseen challenges frequently arise due to changes in the design, resulting in additional work or omissions. Nevertheless, addressing these changes becomes imperative to address the associated implications and proactively mitigate any potential future claims.

The political landscape and its consequences are identified as the second most influential external factors contributing to change orders, with a Relative Importance Index (RII) of 0.68 and a high Standard Deviation (SD) of 2. Razia et al. (2017) concluded that political situations have a significant impact on the construction sector in Palestine, giving rise to a range of obstacles and impediments. These include issues such as border closures, resource scarcity, and inter-departmental conflicts, which pose challenges for project managers and ultimately affect project outcomes. Consequently, these challenges result in project delays, cost escalations, and work stoppages in construction projects. This is primarily due to constraints in building space, water resources, land availability, and fluctuating material costs in conflict-ridden regions like Palestine.

Followed by the lack of qualified labor with an RII of 0.678 and ranking 14 of the significant external causes of change orders. Khoso et al., (2019) identified this issue as one of the key reasons for change orders, leading to conflicts, project delays, and dissatisfaction among

stakeholders. Moreover, the consequences of the shortage of skilled workers are apparent through reduced efficiency, higher expenses, and project setbacks caused by the lower performance of inadequately trained personnel. The adjustment of governmental regulations is considered the least influential external factor contributing to change orders with an RII of 0.46. The reason for this is that changes in policies and laws typically do not have a direct impact on current projects, thus minimizing the occurrence of change orders.

Table 5.2.1 External Causes of Change Orders

Item code	Causes of Change Orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
A5	Unforeseen site conditions	0.71	2	0.72	1	0.71	1	0.68
A1	Political situations and their consequences	0.70	3	0.67	2	0.68	2	2.00
A12	Lack of qualified labors	0.72	1	0.60	5	0.678	3	8.14
A8	Disaster events like pandemics, earthquakes, floods, etc…	0.62	5	0.62	3	0.62	4	0.39
A9	Weather conditions	0.65	4	0.54	8	0.617	5	7.41
A2	Construction material shortage due to blockade and siege	0.45	9	0.61	4	0.57	6	11.17
A10	Unfamiliarity of donor instructions to use specific specs	0.57	6	0.52	9	0.56	7	3.60
A4	Fluctuations in construction material price	0.47	8	0.59	6	0.54	8	8.99
A7	Inflation in the construction industry	0.44	11	0.57	7	0.539	9	8.93
A11	Environmental and social impacts	0.52	7	0.43	12	0.51	10	5.93
A3	Variation of exchange rate	0.39	12	0.51	10	0.48	11	8.37
A6	Change in government's regulations, laws, policies	0.45	9	0.47	11	0.46	12	1.00

5.2.2.2 Ranking of the Internal Contractor-Related Causes of Change Orders

Table 5.2.2 presents the internal causes of change, for which the owner bears responsibility. The table reveals that the primary factor contributing to change is the contractor's poor financial capability, with a Relative Importance Index (RII) of 0.72. Following is the misunderstanding of contract documents during the estimation of costs in the bidding stage, with an RII of 0.67. This misunderstanding often arises due to the lack of experience among contractor staff and the complexity of projects. Such misunderstandings can result in disputes, claims, and reworks, necessitating the implementation of change orders. However, it is crucial for accurate cost estimation to have a thorough understanding of contract documentation.

The lack of knowledge of contractors about site conditions is ranked as the third significant cause of change orders. According to Ahmed et al. (2022), during the implementation stage, the identification of a crucial factor leading to change orders was the absence of contractor experience or technical competence that aligns with the project requirements.

The lack of specialization among contractors was identified as the fourth leading cause (0.628) of change orders, particularly prevalent in complex projects involving procurement and donor requirements. Subsequently, the contractor's primary focus on profitability ranked fifth (0.59), leading to the issuance of change orders to compensate for reduced profitability. In the sixth position (0.587), the absence of contractor involvement in the design process was highlighted, especially in design-bid-build projects where finalized designs are necessary before construction commences. This results in a missed opportunity for contractors with

relevant experience. Lastly, the contractor's inadequate experience in material importation and failure to comply with safety regulations were deemed the least significant internal causes of change orders, with RII values of 0.51 and 0.49, respectively.

Table 5.2.2 Internal Contractor-Related Causes of Change Orders

Item code	Causes of Change Orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
B1-7	Poor financial capability of the contractor	0.69	1	0.74	1	0.72	1	3.74
B1-3	Misunderstanding of contract documents during the cost estimation-bidding stage	0.68	2	0.65	4	0.67	2	2.46
B1-5	Lack of contractor's knowledge about work scope and site conditions	0.58	3	0.67	2	0.63	3	6.15
B1-2	Lack of contractor's specialty and experienced management team	0.55	4	0.67	3	0.628	4	8.29
B1-6	Contractor's intended profitability	0.51	6	0.64	5	0.59	5	9.08
B1-4	Lack of contractor involvement in the design and review of contract documents	0.547	5	0.63	6	0.587	6	5.62
B1-1	Poor experience of the contractor in importing material	0.46	7	0.56	7	0.51	7	6.76
B1-8	Safety non-compliance	0.458	8	0.53	8	0.49	8	4.55

5.2.2.3 Ranking of the Internal Owner-Related Causes of Change Orders

The significance of owner-related factors in change orders has been evaluated based on their importance. It is evident in Table 5.2.3 that the most crucial cause of change orders due to

owner action is the "change in plan and scope," with a high RII (0.76) and SD (2.95). The owner may request a change in the project plan when the scope is not clearly defined and based on their financial stability during project execution. It is essential to avoid scope creep, which refers to a significant change in the project's scope, as it can hinder timely delivery and increase costs (Umuhoza et al., 2023).

Following closely are the financial difficulties faced by the owner (0.74), with a significant agreement between the contractor and consultant, as indicated by an SD of 0.56. This cause is prevalent in the construction industry in Palestine, particularly when the owner is a public organization. The government's financial constraints often fail to meet contractual obligations and make timely interim payments to the contractor. According to FIDIC (2017), this grants the contractor the right to slow down or suspend work, often necessitating the issuance of change orders with cost and schedule implications.

The owner is affected by the third cause of the change order, which is a design change with an RII of 0.70. This modification can take place at different project stages, aiming to enhance construction features, introduce new functionalities, or purely for aesthetic reasons. The owner has identified four (0.69) significant causes within the subgroup that pertain to the specified timeframe. However, it is important to note that in certain instances, this timeframe may not be entirely reliable. The procurement department has asserted the completion time without considering factors such as the execution duration of activities, the sequence of activities, and the management of resource allocation.

The owner's failure to make timely decisions is ranked fifth (0.68). The owner's decisions are transferred through a lengthy approval process, resulting in delays in determining final

decisions. This issue is connected to centralized management in public organizations. Additionally, Azhar 2005 stated that the presence of unstructured data makes timely decisions even more challenging.

The inadequate engagement of stakeholders is ranked as the sixth significant cause. It is crucial to involve stakeholders during the planning stage as their diverse viewpoints can provide valuable insights that lead to better-informed decisions. The experience of the owner's staff and changes in specifications are ranked as the seventh and eighth significant causes within the owner group, with RII scores of 0.662 and 0.59 respectively. To mitigate disputes and ensure clear communication, the owner should assign experienced staff members to represent them in large-scale projects and effectively transfer insights from the site.

Table 5.2.3 Internal Owner-Related Causes of Change Orders

Item code	Causes Of Change Orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
B2-2	Change in plan and scope by owner	0.73	2	0.78	1	0.76	1	2.95
B2-3	Owner's financial difficulties	0.75	1	0.74	2	0.74	2	0.56
B2-7	Owner-changed design	0.65	6	0.73	3	0.70	3	5.85
B2-1	The timeline addressed by the owner	0.69	4	0.68	5	0.69	4	0.68
B2-6	The owner's failure to make a timely decision	0.70	3	0.67	6	0.68	5	2.00
B2-8	Inadequate stakeholders engagement	0.61	7	0.70	4	0.663	6	6.64
B2-5	Inadequate experience of owner's staff	0.67	5	0.65	7	0.662	7	1.61
B2-4	Change in the specification of the project	0.53	8	0.63	8	0.59	8	6.92

	and procedure by the owner							

5.2.2.4 Ranking of the Internal Consultant-Related Causes of Change Orders

The consultant-related causes are ranked as shown in Table 5.2.4. The using duplicated documents from previous projects (0.77), poor site investigation (0.74), errors and omissions (0.72), the conflict between contract documents (0.71), and lack of details in drawings (0.707) are ranked the most five significant causes of change order within the group. They are also considered the most ten critical causes within all groups.

Insufficient coordination among project parties (0.65) is identified as the sixth most significant factor contributing to challenges faced by consultants in ensuring the smooth progress of construction projects. Effective coordination among all stakeholders is crucial for the success of a project. In the absence of clear communication and collaboration, individual parties may prioritize their interests over the project's overall objectives. This can result in change orders, delays, cost overruns, and ultimately, a compromised final product.

The changes in design made by the consultant are the seventh most significant factor (0.62) according to the results presented in the study by Oladiran et al. (2018). This is due to the consultant's original plans being founded on incomplete site investigation. Therefore, it resulted in unforeseen discoveries during the construction phase that required adjustments to the design or enhancements to reduce project costs, ultimately leading to change orders being issued.

The project complexity is rated as the eighth most significant factor with an RII of 0.58. The inherent nature of complex projects can pose challenges in foreseeing every detail in advance, necessitating adjustments during the project and resulting in change orders. The ninth and tenth causes of change orders, which are less significant, are attributed to consultants' lack of knowledge due to omissions in references and value engineering. It should be noted that the utilization of value engineering in the construction industry in Palestine is rare and only occurs in exceptional circumstances.

Table 5.2.4 Internal Consultant-Related Causes of Change Orders

Item code	Causes Of Change Orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
B3-9	Using duplicated documents from previous projects	0.82	1	0.71	2	0.77	1	8.34
B3-8	Poor site investigation before the design stage	0.79	2	0.68	6	0.74	2	7.98
B3-2	Errors and omissions in design	0.73	4	0.72	1	0.72	3	0.60
B3-3	The conflict between contract documents	0.73	3	0.68	5	0.71	4	3.68
B3-7	Lack of details in drawings	0.72	5	0.69	3	0.707	5	1.94
B3-4	Lack of coordination among project parties	0.59	7	0.69	4	0.65	6	6.62
B3-1	Change in design during the construction stage by consultant	0.57	8	0.66	7	0.62	7	6.56
B3-6	Project complexity	0.60	6	0.54	9	0.58	8	4.42
B3-5	Shortage of consultant's knowledge due to the omission in terms of reference of project	0.56	9	0.56	8	0.56	9	0.08
B3-10	Value engineering	0.42	10	0.49	10	0.46	10	4.47

5.2.3 Ranking of the Overall Causes of Change Orders

The Relative Importance Index was used to identify the most significant causes of change orders from contractor and consultant points of view. The analysis revealed that the utilization of duplicated documents from previous projects emerged as the primary cause of change orders, obtaining an RII of 0.77 as shown in Figure 5.2.3.1. Conversely, the RII for the change in government regulations, laws, and policies was the lowest at 0.46, indicating that it has a minimal impact on the frequency of change orders in construction projects. Appendix F: Ranking of the Overall Causes of Change Orders provides a comprehensive overview of the RII values for all the causes of change orders, including their respective rankings.

It also shows that the standard deviation of causes: owner's financial capabilities with SD of 0.56, errors and omissions in design with SD of 0.60, unforeseen site conditions with SD of 0.68, the timeline addressed by owner with SD of 0.68, and shortage of consultants' knowledge due to the omissions in term of references with SD of 0.08, have values of less than 1. This indicates the high significance of the degree of agreement between consultant and contractor perspectives that those factors expose the owner to initiate change orders. These agreements have the potential to enhance decision-making processes and facilitate efficient coordination and communication in order to effectively manage change orders.

However, the shortage of construction materials due to blockade and siege was ranked 34 by contractors and 25 by consultants, indicating a high standard deviation of 11.17, which is larger than 10. The discrepancy regarding this issue can be explained by the consultant's assertion that material allocation should be entirely controlled by contractors and stored on

construction sites for extended periods. Additionally, the material shortage interval is typically no longer than two months in the West Bank Market, resulting in minimal impacts on the progress of construction projects. While contractors believe that material shortages are unpredictable, often stemming from political situations.

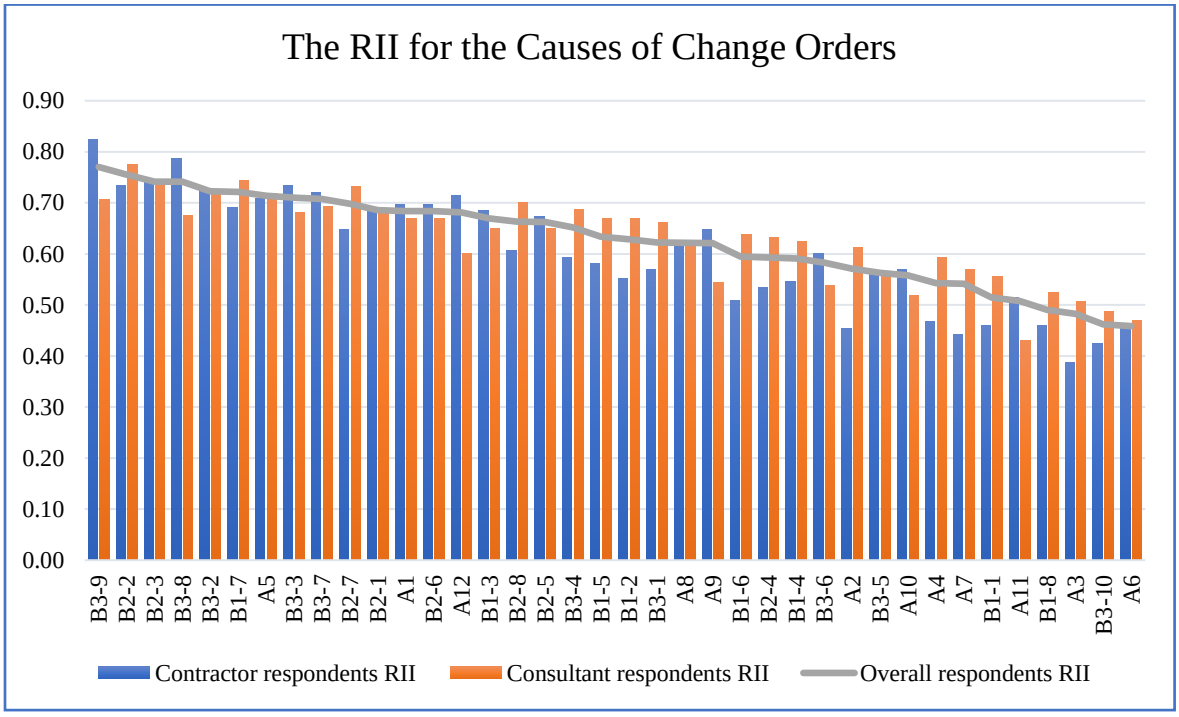

Figure 5.2.2 The RII and Ranking for the Causes of Change Orders

The results show that causes have the least significance in causing change orders in construction projects include “environmental and social impacts”, ‘safety non-compliance”, “variation of exchange rate”, “value engineering”, and “change in government's regulations, laws, policies” with RII values ranging from 0.46 to 0.51. These specific factors are categorized as external causes, indicating their relatively lower impact on the reasons for change orders, as they are typically addressed in the contract provisions to handle these

common issues. The special conditions outlined in construction contracts are typically managed by the Central Tender Department (CTD), which may involve solutions like providing a formula to adjust interim payments based on exchange rate fluctuations, particularly for projects financed in foreign currency by donors. It is important to highlight that the regulations governing the procurement and contract management among construction parties are guided by the directives of the Higher Council for Public Procurement Policies making the change in laws or policies less significant to cause change orders.

5.2.4 Ranking of the Top Ten Causes of Change Orders

The most critical ten causes of change orders in the Palestinian construction industry for each subgroup of participants, based on the RII are listed in Table *5.2.5*. The results illustrate that the top overall ranked cause of change orders is “using duplicated documents from the previous projects” which have an SD of 8.34 with an RII of 0.82 by the contractor and RII of 0.71 by the consultant. This means that there is a level of disagreement on the cause of the change order. The contractor claims that the consultant relied on generic contract documents that didn't adequately address project-specific details. This lack of specificity could lead to ambiguities and omissions that require clarification or correction during construction, resulting in change orders. The SD of the owner's financial difficulties has a value of 0.56 enhancing the high agreement on this factor to implement a change order. This is consistent with data shared by the World Bank about the financial situation of the economy in the Palestinian market.

Table 5.2.5 Most Ten Ranking Critical Causes of Change Order Based on RII

Item code	Causes of change orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
B3-9	Using duplicated documents from previous projects	0.82	1	0.71	7	0.770	1	8.34
B2-2	Change in plan and scope by owner	0.73	4	0.78	1	0.755	2	2.95
B2-3	Owner's financial difficulties	0.75	3	0.74	3	0.741	3	0.56
B3-8	Poor site investigation before the design stage	0.79	2	0.68	13	0.740	4	7.98
B3-2	Errors and omissions in design	0.73	6	0.72	5	0.723	5	0.60
B1-7	Poor financial capability of the contractor	0.69	12	0.74	2	0.721	6	3.74
A5	Unforeseen site conditions	0.71	9	0.72	5	0.714	7	0.68
B3-3	The conflict between contract documents	0.73	4	0.68	11	0.710	8	3.68
B3-7	Lack of details in drawings	0.72	7	0.69	9	0.708	9	1.94
B2-7	Owner-changed design	0.65	16	0.73	4	0.698	10	5.85

The top ten causes of change orders were discussed as follows in connection with the results of past studies:

- *Using Duplicated Documents from Previous Projects*

The overall ranking shows that the primary reason for change orders is the use of copied documents without adjustments to address current conditions, as indicated by an RII of 0.77 and a Standard Deviation (SD) of 8.34. This issue stems from a lack of expertise within consultancy firms and insufficient oversight from the owner or their representative. Over the years of economic growth and infrastructure development, consultants have predominantly

relied on these typical designs and tenders for various sectors such as schools, preschools, police stations, water and wastewater networks, and other types of projects. These typical documents have been imported from international consultants working in the Palestinian construction industry, specifically for those funded by donors.

However, due to the diverse nature of the Palestinian landscape, many projects have encountered difficulties and changes, particularly in underground work such as excavation, grabbing, and grading. These changes have had a significant impact on both the cost and duration of the projects. Similar research conducted in the Sulaimani governorate has also highlighted the use of typical designs for different districts important factor contributing to change orders (M.karim et al., 2020).

- *Change in Plan and Scope by Owner*

The second frequent cause of change orders in construction projects is a shift in plans or scope initiated by the owner with an RII of 0.76. This can occur for various reasons, such as the owner wanting to add new features, modify existing designs, or adapt to changing needs. While these adjustments might improve the final project, they can necessitate alterations to the original construction plan and require additional work or materials outside the initial agreement which requires initiating change orders (Alshdiefat & Aziz, 2018; Lokhande et al., 2015; Al-Nuaimi et al., 2010; Keane et al., 2010).

According to Ahmed Redha Gheraba et al. (2023), the reasons for these requested modifications could be attributed to several factors: the owner's limited ability to visualize and comprehend the design, and changes in personnel responsible for the project during the

design phase or between design and construction. He also includes the owner's exclusion from certain design stages, inadequate communication from the consultant in conveying the design to the owner, and the owner's insufficient knowledge to properly read and interpret the plans are drivers for changes.

- *Owner's Financial Difficulties*

The owner's financial challenges hold the third position in causing change orders, with an RII of 0.741. The agreement among all parties, with an SD of 0.56, highlights the significance of this factor as it directly impacts the project due to the owner's financial problems. Consequently, it may be necessary to implement significant modifications to the project to minimize costs and ensure its feasibility (Enshassi et al., 2010; Lokhande et al., 2015; Khalifa & Mahamid, 2019; M.karim et al., 2020).

The owner's financial challenges encompass a variety of factors such as economic, social, and political influences. Delays in financial matters, particularly for large-scale projects, stem from difficulties in securing funding or accessing government budget allocations. Other contributing factors include unexpected fluctuations in prices, disputed claims, and inaccurate project valuations, all of which can impact the owner's cash flow. Decreased financial resources may necessitate adjustments to project schedules, specs, or project plans to reduce costs and scale back project implementation (Hameed Memon et al., 2014). The owner's careful planning and monitoring of project cash flow play a crucial role in influencing the project's progress, success, and future opportunities for securing additional projects.

- *Poor Site Investigation Before the Design Stage*

Poor site investigation leading to incorrect site input data during the design phase is identified as the fourth most common cause with a Relative Importance Index (RII) of 0.74. Discrepancies between the actual physical conditions and the information provided in the contract documentation, which was inaccurately prepared by consultants, can significantly contribute to project delays. The execution of large-scale construction projects like highways, dams, and canals is influenced by various factors such as soil variations, the presence of rock formations, and other circumstances. This can be further complicated by contractor claims due to inaccuracies in the contract details (Alshdiefat & Aziz, 2018; Khalifa & Mahamid, 2019; Lokhande et al., 2015).

Bamidele T. & Joshua O. (2023) addressed that to effectively manage the impacts of changes in project costs and schedules, it is essential to conduct thorough site evaluations before construction. He also outlined other actions such as addressing any altered conditions promptly for efficient claims resolution and implementing sound financial planning that includes contingency funding for unexpected events.

- *Errors and Omissions in Design*

The occurrence of errors and omissions in design has been identified as one of the primary causes of change orders, with an RII of 0.723. Azar et al. (2018) have highlighted that errors and omissions in design significantly contribute to completion delays. When a project is designed without appropriate coverage of all aspects or contains errors and omissions, it can

negatively impact work productivity and project schedule. It is crucial to address these errors during the design process to prevent their occurrence later on.

This finding aligns with Alshdiefat & Aziz (2018), Khaled El-Sadek & Khaled (2016), Khalifa & Mahamid (2019), Lokhande et al. (2015), M.karim et al. (2020), and SOLIMAN (2017), who also identified this cause as one of the top ten most common occurrences in projects. A project with insufficiently detailed design, inadequate coverage of all project aspects, or errors in the planning process has optional causes of change orders in construction, impacting both work output and project schedule. It is important to highlight that errors in design can result in a shortage or surplus in the quantity addressed in the Bill of Quantities (BOQ) may deviate from the original contract, especially in the unit-price contract which is very common in Palestine. Apart from causing budget overruns, the provisions of the contract, mainly those based on FIDIC, grant contractors the right to claim a new unit price for the increased or decreased quantity. The contractors also could request additional time to complete the work, resulting in the issuance of a change order (Khalifa & Mahamid, 2019).

- *Poor Financial Capability of the Contractor*

The financial problems of the contractor have important change order causes in a project with an RII of 0.721, impacting the schedule and quality of the construction. The primary concern lies in ensuring that the workers receive their payment on time as the contractor's financial capacity is impacted by payment delays (Keane et al., 2010; Lokhande et al., 2015; Wu et al., 2004). A contractor's financial health can indirectly contribute to a rise in change orders. Facing financial constraints, contractors might use lower-quality materials or resort to shortcuts to meet the agreed-upon budget, leading to issues and rework later.

Furthermore, cash flow problems can also cause delays in material procurement or subcontractor payments. This disrupts the schedule and potentially necessitates change orders to cover additional delay costs. While not the sole culprit, a contractor's financial capability deserves consideration during the selection process to minimize the risk of change orders stemming from financial instability.

- *Unforeseen Site Conditions*

The unexpected site conditions have an RII of 0.71, placing it in the seventh position. Despite meticulous planning, unforeseen site conditions can disrupt even the most accurate plans. This finding contradicts the research by Ahmed Redha Gheraba et al. (2023), Keane et al. (2010), and Wilberg et al. (2015), which identified unforeseen problems as one of the most significant contributors to change orders.

During excavation, construction crews might encounter unexpected challenges like unstable soil, hidden underground utilities, or previously unknown contaminants. These surprises can necessitate significant deviations from the original design plan. To address these discrepancies, change orders become essential, outlining the additional work required, the impact on costs, and potential adjustments to the schedule (Kim et al., 2020). According to (Alleman et al., 2020) unforeseen changes in conditions have the most significant effect on the overall increase in costs.

- *The Conflict Between Contract Documents*

The conflict found in contract documents is recognized as one of the top ten significant factors leading to change orders(Elbeltagi et al., 2014; Elshaikh et al., 2019; Enshassi et al.,

2010b; Keane et al., 2010; Pourrostam et al., 2012). Contract document conflicts may occur as a result of ambiguities, discrepancies, and lack of synchronization. These conflicts have the potential to adversely affect project cost, schedule, and the relationships between parties involved in the contract, and also lead to misunderstandings regarding the true project requirements (Babaeian Jelodar et al., 2022).

Amoah & Nkosazana, (2023) illustrated that clarity and precision in contract documents are crucial to avoid potential delays in project completion or unexpected cost variations. The contract documentation should communicate the objectives and connections with other contracts within the project to ensure a smooth project execution with no room for potential future liabilities.

- *Lack of Details in Drawings*

The lack of details was defined as the ninth of the most significant causes of change orders. One crucial element for avoiding change orders is having detailed and comprehensive drawings. When these drawings lack specifics, it can trigger a cascade of problems. Ambiguous details or missing information can be misinterpreted by contractors, leading to work that deviates from the owner's vision (Elshaboury et al., 2021; Msallam et al., 2015).

To prevent such costly surprises and delays, clear and detailed drawings are essential. These should address various aspects like dimensions, materials, and construction methods (Moazemi Goudarzi & Seles, 2022). This meticulous approach minimizes misunderstandings and ensures everyone involved is working from the same blueprint, ultimately reducing the need for disruptive and expensive change orders.

- *Owner-Changed Design*

The design change by the owner is considered within the tenth spot of critical causes of change orders in construction projects in Palestine with an RII of 0.69 (Alshdiefat & Aziz, 2018; Elbeltagi et al., 2014). A frequent cause of change orders in construction is modifications to the design initiated by the owner. This can happen for various reasons, such as the owner wanting to upgrade features, add entirely new functionalities, or simply change their mind about certain aesthetic elements. These formal documents detail the design changes requested by the owner, the associated cost implications due to additional materials or labor, and potential adjustments to the project timeline.

5.2.5 Degree of Agreements on Causes of Change Order among Consultants and Contractors

The results indicated that the category of external factors accounts for 4 out of 10 high values in terms of consensus on causes of change orders among contractors and consultants. These factors have a standard deviation ranging from 0.39 to 2 as shown in Figure 5.2.5.1. Even though the lowest standard deviation does not fall within the external factors category, it is noteworthy that a significant number of causes within this category exhibit the lowest standard deviation. This suggests that construction parties generally concur on the external factors influencing change orders, given that these external forces are beyond the direct influence of the project team. While well-detailed planning can help mitigate certain external risks, their inherent nature makes complete elimination challenging. This highlights the

importance of flexibility and a well-defined change order process to ensure a project's smooth adaptation to these external causes leading to successful completion.

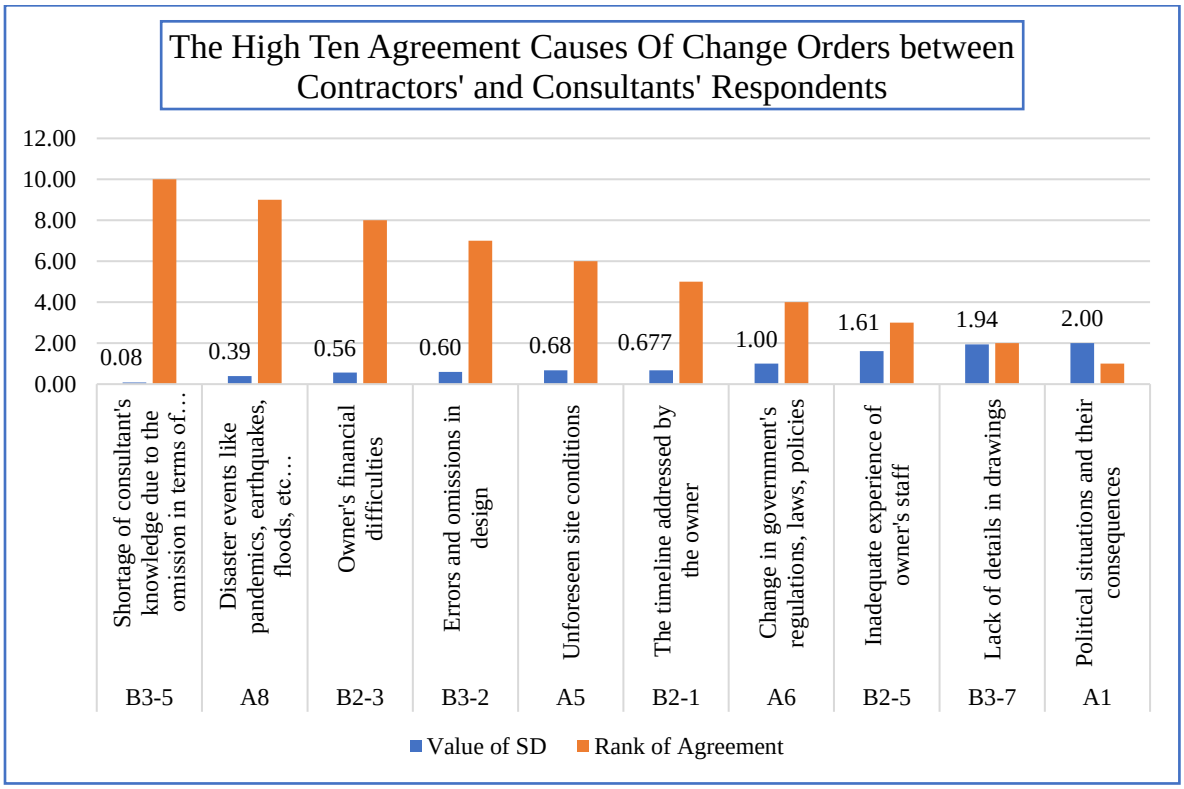

Figure 5.2.3 The High Ten Agreement Causes of Change Orders between Contractors and Consultants

5.3 Ranking of the Impacts of Change Orders in Construction Projects

There are various consequences resulting from modifications and change orders in the construction industry. This section delves into some of these effects that are frequently encountered. The Relative Importance Index (RII) was utilized to pinpoint the most significant impacts of change orders from the perspectives of both contractors and

consultants. The findings displayed in Table 5.3.1 reveal the scoring for the impacts, it highlights that the most notable effect of the change order is delayed in project timelines, with an RII of 0.81.

Subsequently, the effects on project costs due to change orders are significant, with an RII of 0.74 and second rank. This is because change orders often result from new additional work, or adjustments in the scope of the project which are implicated in the total cost of projects. Ranked third with an RII of 0.68 is "rework and demolition," followed by "delay in payment by the owner" in fourth place with an RII of 0.65, and "disputes between contract parties" in fifth place with the same RII of 0.65.

Table 5.3.1 Ranking of the Impacts of Change Orders

Item code	Impacts of change orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
C1	Time overruns	0.81	1	0.81	1	0.81	1	0.03
C2	Cost overruns	0.71	2	0.76	2	0.74	2	3.78
C8	Rework and demolition	0.63	3	0.73	4	0.68	3	7.14
C4	Delay in payment by the owner	0.55	6	0.74	3	0.65	4	13.59
C3	Disputes between contract parties	0.61	4	0.69	5	0.648	5	5.33
C9	Logistics delays long-lead procurement	0.56	5	0.68	6	0.62	6	8.30
C7	Productivity degradation	0.49	9	0.62	7	0.56	7	9.04
C5	Provide additional equipment & staff	0.50	7	0.61	9	0.55	8	7.30
C6	Degradation of quality standards	0.47	10	0.62	7	0.548	9	10.33
C10	Tarnishing the reputation of the institution	0.50	7	0.54	10	0.52	10	2.44

Here is the discussion of the most five significant impacts of change orders and their relevance to previous studies.

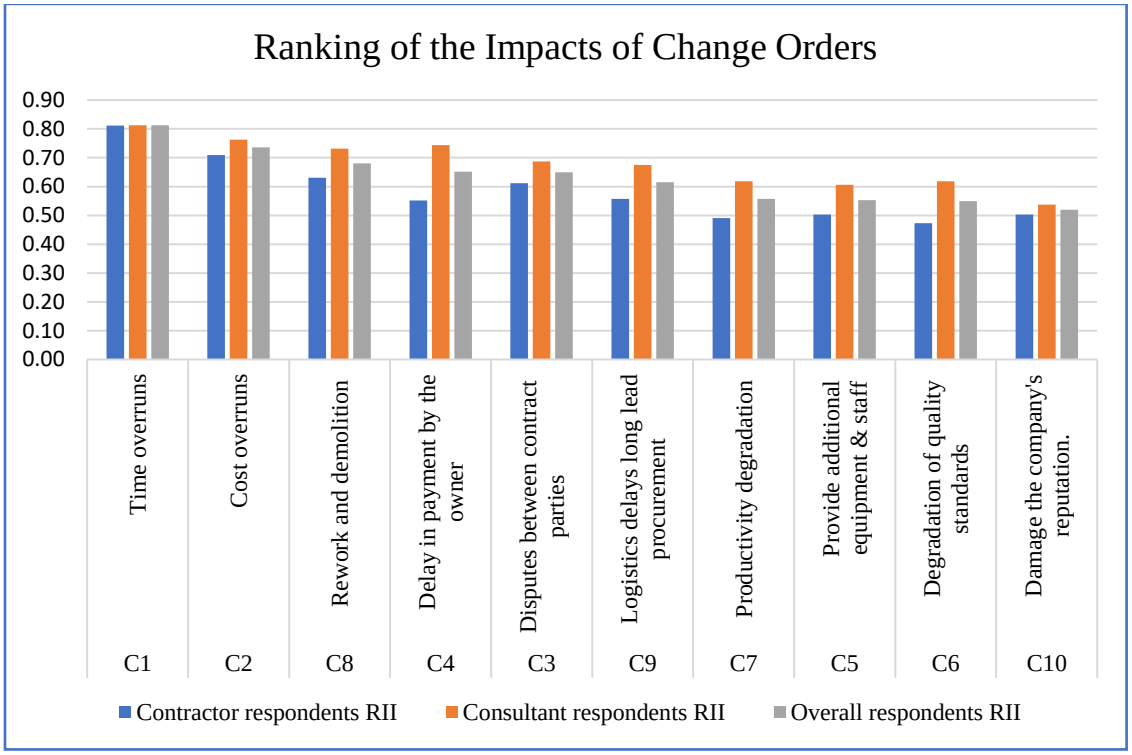

Figure 5.3.1 Ranking of the Impacts of Change Orders

1. *Time Overrun*

Figure 5.3.1, shows that the time overrun is the most important impact of change order as it ranked in the first spot. The level of agreement among construction parties regarding the change order's implications on project timelines is substantial, with a standard deviation of 0.03. Kontogiannis, (2010) mentioned that modifications will necessitate a review of existing plans, incorporation of additional tasks, extended time for decision-making, sourcing of

materials, and other related adjustments. In instances where certain elements are omitted, no significant delays are foreseen; however, clients may opt to utilize cost savings. Accordingly, the usage of surplus on the budget is carried out by introducing additional tasks, consequently leading to project completion delays.

In alternative scenarios, the owner might seek to remunerate the contractor for expediting the work to adhere to the base schedule. In every situation, more time equates to more expenses, and setbacks in finishing the project can result in significant financial losses. The owner or owner's representatives authorizing the modification request should be aware of the expenses incurred due to delays before approving a time extension. However, this result is aligned with many types of research considering the completion time of the project is highly affected by change orders (Al Maamari & Khan, 2021; Elbeltagi et al., 2014; Elshaikh et al., 2019; Msallam et al., 2015; Oladiran et al., 2018).

2. *Cost Overrun*

The second most significant impact of change orders, as determined by construction parties, is the cost overrun. There is a high level of agreement among these parties, with a standard deviation of 0.74 (Ahmed Redha Gheraba et al., 2023; Al Maamari & Khan, 2021; Elshaboury et al., 2021; Oyewobi et al., 2016).

Alzara (2022) confirmed that change orders frequently increase final project costs due to overhead expenses from delays, additional contractor payments, rework, and the costs of added supervision. Moreover, it covered the indirect costs encompassing the financial implications arising from a decline in productivity at your workplace. To mitigate cost

impacts, experts recommended all parties thoroughly study the project and coordinate before starting. They also suggested conducting periodic reviews to identify needed changes early, using specialized consultants experienced with the project type, and minimizing reliance on specifications from similar projects. Senouci et al. (2017) suggested the approach using regression analysis to forecast the cost overruns depending on the magnitude of the project or the value of the contract.

3. Rework and Demolition

The study highlighted that the rework and demolition process is ranked third in terms of importance among the impacts of change orders in construction projects. According to Khoso et al. (2019), the modifications made after the completion of the project may necessitate the demolition and reconstruction of certain sections of the work. This phase is regarded as the most unfavorable for making changes, as the expenses incurred during this period are at their highest on the project time curve.

Furthermore, rework frequently occurs as a result of changes in existing conditions or specifications. This resulted in miscommunications between parties involved in the contract, fluctuations in expenses, and setbacks in the finalization of the project. Mahamid (2017) studied the influence of change orders on rework, uncovering a noteworthy correlation characterized by a direct proportionality between the number of change orders and the associated cost of rework. This result goes in line with Elbeltagi et al. (2014), Hameed Memon et al. (2014), and Oladiran et al., (2018).

4. Delay in Payments by the Owner

The delayed payment by the owner is ranked in the fourth spot as a prominent consequence of change orders (Ahmed Redha Gheraba et al., 2023; M.karim et al., 2020). Khoso et al. (2019) revealed that change orders often lead to alterations in project scope or requirements, which can result in delays in payment processing for the contractor involved. This delay in payment can disrupt the project's financial flow, affecting the contractor's cash flow and potentially causing financial strain.

Morrar & Sultan (2020) highlighted that certain projects and programs in Palestine funded by donors are allocated the budget of projects without considering contingency. This oversight often leads to leading to difficulties in securing additional funds to address the financial implications of change orders and causes the delayed payment issue.

5. *Disputes between contract parties*

The fifth significant impact identified pertains to disputes between contractual parties. Al-Nuaimi et al., (2010) explained that this effect is particularly noteworthy in developing nations, where many changes are inadequately investigated. It is causing uncertainty and disturbances that give rise to claims and disputes, especially when new materials or work activities are introduced that were not initially outlined in the contract.

Nevertheless, changes must undergo assessment, estimation, and negotiation, resulting in tension and strain in the relationship between the parties. Failure to resolve these disputes amicably through direct talks may lead to arbitration or court, potentially suspending the entire project due to legal proceedings. This impact has been found in numerous previous

studies, including Al Maamari & Khan (2021), Elbeltagi et al. (2014), and Elshaikh et al. (2019).

Adverse Quality of Work

Surprisingly, the adverse quality of work is ranked ninth in impacts with an RII of 0.55. This result is in line with (Al-Nuaimi et al., 2010). This insight is exacerbated by the fact that rework is frequently associated with change orders, adding additional pressure on construction parties and ultimately leading to decreased performance.

The contractor encounters challenges in their forthcoming work, which may result in their inability to participate in bidding for new projects. Additionally, they might be compelled to postpone ongoing projects due to insufficient manpower and delayed equipment in the current project. Consequently, this condition leads to a fast execution of the work, particularly during the final phase, resulting in lower quality. Nevertheless, only a minority would acknowledge this issue, and adherence to quality control measures is typically not achieved.

Contrarily, the impact of change orders that ranked the lowest in the overall response was " Tarnishing the reputation of the institution," exhibiting a significant disparity compared to the highest-ranked impact (with a difference in RII equivalent to 0.29). This discrepancy can be attributed to the fact that a tarnished reputation arises from a consistent pattern of poorly managed change orders over a prolonged period, rather than a singular occurrence. When a company consistently demonstrates its ability to handle change orders efficiently and transparently, even in unforeseen circumstances, its reputation as a dependable contractor becomes firmly established. Furthermore, the severity of the reputation impact depends on

the cause of the change order. If it's due to factors outside the firm's control and they manage it effectively, the client might be understanding.

6 Chapter Six: Conclusion and Recommendations

This chapter encompasses the study's conclusions, which provide a concise overview of the significant findings and results derived from the study which is structured by an extensive review of academic literature. It presents recommendations for construction parties (contractors, consultants, and owners), aiming to reduce the occurrence of change orders and the consequences of issued change orders and to enhance the construction sector in Palestine. Furthermore, it examines constraints and identifies areas for future research to boost the robustness of the change orders concept by opening doors for future exploration and contributing to a more comprehensive understanding. This demonstrates the potential and significance of the study concept, providing a springboard for further development. These aspects will be addressed individually in the subsequent three sections.

6.1 The Summary

The study contributed to identifying the most critical causes of change orders as well as the impact of implementation of the changes in construction projects in Palestine. The results of the study would contribute as an additional input to the existing knowledge to improve the proactive change order management model. Industry professionals use this model to predict potential changes in projects and compare the change performance to a large dataset of projects. As a result, the construction industry's cost-effectiveness is improved.

It was divided into six chapters, each addressing different aspects of the research topic. Chapter One serves as an introduction, emphasizing the importance of investigating change orders, and outlines the objectives of the study, as well as its scope and limitations. Chapter Two focuses on reviewing existing literature on change orders. This comprehensive review encompasses four main sections: definitions, types, and characteristics of change orders; significant causes of change orders; change orders procedures; and the impacts of changes. The review incorporates various sources such as articles, research studies, master's and Ph.D. dissertations, as well as books. Moving on to Chapter Three, this section defines the parameters that will be measured and studied in the field survey component of the research. It provides clear definitions for 38 potential causes of change orders and 10 potential effects of these change orders.

Chapter Four delves into the process of developing the survey questionnaire. It also discusses the approach taken to determine the appropriate sample size. Additionally, this chapter outlines the procedures used to collect field data and test hypotheses regarding the agreement between consultants and contractors on the causes and effects of change orders. The chapter also explains the scoring system employed to generate different indexes and ranks.

Chapter Five presents the results and findings of the study, organized into three sections. The first section provides general industry information, while the second section focuses on the causes of change orders. The third section examines the effects of change orders. The results are presented using the scoring system previously mentioned. The data collected from 65 consultants and contractors are analyzed, and the Relative Importance Index (RII) of causes and effects is tabulated. Furthermore, each cause and effect is ranked for both consultants

and contractors, and these rankings are compared to previous studies. Overall, the study is structured in a systematic manner, with each chapter addressing specific aspects of change orders. The inclusion of literature reviews, field surveys, and data analysis ensures a comprehensive examination of the topic.

6.2 The Conclusion

The construction industry holds significant economic importance in Palestine. This study delves into the significance of examining the construction sector by identifying discrepancies between theoretical knowledge and practical application concerning the causes of change orders and their repercussions on the successful completion of construction projects. Nevertheless, understanding the causes of change orders and their impact on project cost and schedule is intricate, as they are influenced by a multitude of interconnected factors. The presence of risks and uncertainties associated with project changes further complicates the prediction and planning process for these changes.

The data gathered on the industry provides general information and describes the respondents. The results indicated that construction companies are involved in various sectors of construction projects, with 34% focusing on residential or commercial buildings. The second most popular sector is water and sanitation projects, accounting for 32%, followed by highways and road projects at 26%. It is evident that the electromechanical field has the lowest percentage (8%) of involvement among construction firms, particularly in

developing countries such as Palestine. This is due to financial limitations hindering investments in costly technologies and infrastructure necessary for extensive electromechanical projects.

The results presented a significant part of construction companies in Palestine can be classified as small and medium-sized enterprises, employing less than 50 individuals (Dwikat et al., 2023). The data reveals that medium-sized firms, employing between 6 and 50 employees, constitute 65% of the construction firms in the region. In contrast, firms with less than 5 employees make up 29% of the construction industry. However, large-scale companies are relatively rare, accounting for only 6% of the construction firms, as the Palestinian Economy is characterized by a modest level of gross domestic production.

Moreover, the data reveals that 83% of construction companies have less than 20 years of experience, while 69.2% of them have undertaken fewer than 15 projects in the last five years. This trend suggests the predominance of small and medium-sized businesses in the construction field, which frequently encounter challenges in securing essential financial resources. These difficulties can be attributed to various factors, including the presence of weak representative organizations and the absence of supportive legal frameworks and incentives that make construction firms less resilient and more vulnerable to affect by external and internal changes during the construction stage.

As change orders are authorized by the owner or owner's representatives, the need to show the nature of the owner of construction parties is so critical. Research data indicates that over 67% of projects that encounter change orders are owned by public organizations such as ministries, municipalities, and national councils. The prevalence of change orders in

construction projects in Palestine is significant, with over 90% of construction companies experiencing projects that require change orders. Furthermore, more than 75% of construction companies face change orders in contracts valued at over $0.5 million, indicating that large-scale projects are more likely to change due to their complexity, as highlighted in previous studies. This emphasizes the importance of change order management to address the adverse effects of change orders on key project success factors such as quality, cost, time, owner satisfaction, the satisfaction of other construction parties, and the reduction of disputes and claims within construction projects.

The primary aim of this research is to evaluate the significance of 38 factors leading to change orders in construction projects in the Palestinian market, as well as the 10 effects of change orders on project performance. These factors were identified through a comprehensive review of literature and previous research. They were categorized into four groups based on their causal responsibility: external factors, internal contractor-related factors, internal owner-related factors, and internal consultant-related factors. The responses of professionals regarding the causes and effects of change orders were assessed through the administration of a quantitative questionnaire. Analytical data was collected using this method, which involved parties such as consultants and contractors.

Through data analysis utilizing the weighted mean of the Relative Importance Index for factors within each group, it was determined that the group of internal owner-related factors plays a crucial role in causing change orders, with an RII of 0.70. This underscores the importance of establishing a clearly defined scope of work at the outset to delineate project

deliverables and constraints, thereby aiding in managing expectations and reducing the necessity for owner-initiated changes.

The research findings revealed the primary factors contributing to change orders in construction projects in Palestine from contractors' and consultants' perceptions. These factors encompass a variety of issues such as "using duplicated documents from previous projects," "changes in plans and scope by the owner," "financial challenges faced by the owner," "owner's financial difficulties ", "inadequate site investigation prior to the design phase," "errors and omissions in the design," "limited financial capacity of the contractor," "unforeseen site conditions," "discrepancies between contract documents," "insufficient details in drawings," and "changes in design by the owner." The Relative Importance Index (RII) for these factors ranged from 0.698 to 0.77. Notably, these causes were categorized into three groups: owners with 3 causes, consultants with 5 causes, and contractors and external entities with 1 cause each. This underscores the critical role of the preconstruction phase managed by only the consultant and owner in mitigating the occurrence of change orders.

The study also revealed that the top five critical impacts of the change orders on the performance of construction projects are; “time overruns”, “cost overruns”, “rework and demolition”, “delay in payment by the owner”, and “disputes between contract parties”. Cost and time are fundamental aspects of project performance. Introducing modifications can interrupt the existing construction flow, leading to schedule modifications and possible delays in subsequent activities. This ripple effect has the potential to postpone the project's finalization. The financial consequences are closely linked to change orders, which can either incur direct expenses for extra work or overhead costs related to project extensions. It is

important to highlight that contractors may utilize change orders as a means to address underpriced projects, taking advantage of the situation by proposing increased unit prices for items specified in the change orders.

The results revealed a significant distinction between the proficiency of construction firms and various causes of change orders. This finding aligns with the practical observation that ‘’more experience means more lessons learned’’. In most cases, construction firms with greater experience possess enhanced capability and resilience to effectively navigate challenging situations such as weather conditions and political events. The reason for that is they have encountered and learned from these issues throughout their lifespan.

Furthermore, the data analysis revealed that the primary factors contributing to change orders did not exhibit any statistically significant differences among construction companies of varying sizes. The size of a company doesn't necessarily guarantee immunity to change orders in construction projects. While larger firms might have more resources to handle unexpected situations or absorb cost increases, change orders can still significantly impact them. The findings of the study also showed that there is no significant relationship between project size, measured by cost, and the factors contributing to change orders. While large-scale projects might seem inherently more prone to change orders due to their complexity, smaller projects can also encounter them. Change orders arise from various factors like unforeseen site conditions, design modifications, or regulation updates which can impact projects of any size.

6.3 Recommendations

This section presents the recommendations that are derived from the research findings presented in Chapter Five, along with the primary conclusion highlighted earlier. These recommendations are further supported by the insights gained from the examination of previous studies discussed in the literature review.

6.3.1 Recommendation to Owner

As concluded earlier, the research findings indicate that the primary source of change orders in construction projects in Palestine is the owner. While many studies have demonstrated that owners tend to become involved during the design phase of the project, this level of involvement alone is insufficient in mitigating the problems associated with changes and cost overruns. Through discussions with experts conducted to carry out the pilot study, it was revealed that owners cannot often comprehend the design documents prepared by the engineer. Consequently, owners frequently find themselves surprised when the constructed project does not align with their initial expectations or visions.

The research further reveals that the majority of changes derived from deficits during the preconstruction phase of the project life cycle, particularly in the design stages. To address this issue, the utilization of a three-dimensional model and Building Information Model (BIM) proves to be highly beneficial. Implementing these tools would enable owners to

visualize their projects before the commencement of construction, thereby minimizing the changes initiated by the owner (Abuaddous et al., 2020).

In addition, the involvement of the owner in the recruitment of skilled project management consultants and design/supervision consultants is crucial for the effective implementation of the change order management process. These consultants serve as the owner's representatives on the construction site, providing valuable insights and observations. When evaluating potential consultants for a construction project, it is essential to thoroughly examine their experience in similar assignments and selection of consultant is quality-cost based selection. The terms of reference (TOR) associated with the request of the proposal (RFP) or expression of interest (EOI) should list the required key staff and their experiences. The owners can reach out to the contractor's previous clients to gather feedback on their performance.

The owner's decision to proceed with the project within the specified time frame and budget should be carefully considered. Abrupt changes in requirements by the owner to accelerate the project schedule can lead to a decrease in project quality and significant cost overruns. These circumstances can be prevented through the owner's unwavering commitment to adhere to the initial cost and schedule parameters. The consultant plays a crucial role in this situation by emphasizing and illustrating the potential consequences of expediting the project schedule to the owner. A strong foundation for the project is crucial which starts with a clearly defined scope of work. This document should explicitly detail what's included and excluded from the project, leaving no room for ambiguity.

According to Clause 21 of FIDIC (2017), there is a sub-clause to appoint a Dispute Avoidance Adjudication Board (DAAB) at the outset of projects as a neutral third-party panel. When a

change order arises, the contractor can present their case to the DAAB, outlining the proposed change, its necessity, and associated costs. The DAAB then reviews the case, considering both the owner's perspective and the contract terms. This prompt resolution through a neutral party helps avoid lengthy and expensive legal battles (El-Sewafy et al., 2022). Furthermore, knowing that a DAAB is present often encourages earlier communication and collaborative problem-solving between the owner and contractor. The potential for a quick, expert decision incentivizes both parties to present reasonable arguments and negotiate in good faith, ultimately minimizing the need for disruptive and costly change orders.

Finally, maintaining continuous communication throughout all project phases is essential. Regular meetings and open information exchange allow for early identification and collaborative resolution of any issues that might otherwise necessitate change orders later on. By implementing these recommendations, owners can proactively manage expectations, mitigate risks, and ensure a smoother construction process with fewer surprises.

6.3.2 Recommendations for Consultants

The consultant plays a crucial role in the change order management process by evaluating and validating all claims and notices submitted by contractors. Consultants are involved from the beginning of a project and must have a thorough understanding of the client's requirements to ensure that the project design aligns with the owner's vision. This proactive approach helps prevent unnecessary late design changes that may arise from misunderstandings or misinterpretations of the owner's needs.

The design consultant must also take into account the crucial aspect of ensuring effective coordination among team members. It is a common occurrence in construction projects that various disciplines within the team are not adequately synchronized in the design drawings. For example, conflicts between electrical and mechanical networks are often left unresolved until the issuance of construction drawings to the contractor. These situations lead to frequent change order requests from contractors to the client. Employing collaborative and design communication tools like Building Information Modeling (BIM) can enhance cooperation among all construction parties and pinpoint potential design issues that could lead to change orders in the construction phase.

Experienced employees are required by the design consultants to effectively create a design that can be constructed with minimal conflicts and clashes. Additionally, the design consultants must stay updated on all the latest specifications and standards set by the local government authorities. This aspect is also identified as a significant factor contributing to change orders in construction projects within this area, as the design consultants often produce design drawings based on outdated standards. It is crucial to strictly prevent such situations as they can potentially subject the client to change orders.

The consultant must also establish periodic checkpoints and deliverables to ensure alignment. These deliverables may include a Feasibility Study, Owner's Project Requirements (OPR), Basis of Design (BOD), Schematic Design, Design Development, and Construction Documents. This stage can be administered during the negotiation stage after reviewing both the technical and financial offers of the consultants and selecting the most qualified offer. The deliverables should be linked to a specific time frame. Additionally, the interim payments

should be connected to these deliverables to ensure that the consultants submit the required reports within the designated time.

6.3.3 Recommendations for Contractors

The contractor plays a crucial role in the change order management process, as their involvement is unparalleled. Contractors must maintain a positive cash flow throughout their projects. This could be achieved by securing solid financial planning. It involves creating realistic project budgets, maintaining accurate financial records, and implementing cash flow management strategies to ensure timely payments to suppliers and workers. Furthermore, diversifying revenue streams can provide stability, and focusing on operational efficiency helps maximize profitability. This involves implementing lean construction methods to minimize waste, investing in technology to improve project management and communication, and fostering a culture of quality workmanship to minimize rework and delays.

In the initial phases of the project, the contractors must offer their expertise in terms of constructability, cost, and schedule. Furthermore, entails incorporating contingency funds into the overall project cost to account for any unforeseen circumstances. It is also recommended that the contractors establish effective coordination and communication with both the consultants and the owner. This ensures that they are fulfilling their obligations as

outlined in the contractual scope of work. Failure to properly interpret the scope of work can often lead to legal disputes between the contractor and the client.

It is crucial for the contractor to carefully select subcontractors and employees based on the specific project requirements. When hiring subcontractors, their financial stability and necessary experience should be thoroughly evaluated. This is essential because any shortcomings in the performance of subcontractors directly impact the contractor. Moreover, the main contractor faces additional pressure when subcontractors lack sufficient funds, equipment, and labor resources.

Moreover, it is crucial for both the subcontractors and the contractor to possess adequate expertise for the project they have undertaken. Additionally, the contractor must have a comprehensive understanding of all the contractual clauses and specific provisions. This will aim to execute the work effectively and prevent any discrepancies between the verbal instructions provided by the consultant and the contractual obligations. The proactive involvement of the contractor is also significant in identifying and resolving any conflicts that may arise among the contract documents.

It is pivotal for contractors to conduct a thorough investigation of the construction site prior to commencing onsite construction to mitigate the potential risks associated with unforeseen conditions. Contractors should consider using a Work Breakdown Structure or alternative tracking mechanism with greater frequency than presently observed. A significant number of contractors have expressed that they do not employ any form of organizational system for their construction activities, potentially resulting in an inability to monitor the consequences of change orders on the overall project. Lastly, the ultimate cost outlined in the project

contract should be determined by accurate estimates. These precise estimations are provided by subcontractors or by referencing comparable projects executed considering the spatial and timely execution.

6.4 Further Studies Recommendations

The construction management research community has dedicated significant resources to investigating the causes and consequences of change orders within the construction industry. However, a gap exists between the academic literature and the practical data within the construction sector. The insights gained from past construction projects have not been adequately documented in the educational sector to be utilized in future projects. The information presented in this study opens up space for further exploration in various interconnected fields as follows:

- The research involved two primary parties in the construction phase, specifically the contractor and consultant. The third key player is the owner. As highlighted in the findings, the owner was predominantly held responsible for instigating modifications. Future research endeavors could delve into exploring the reasons behind change orders from the owner's point of view.
- Future studies ought to focus on diminishing the number of change orders in construction endeavors by integrating information technology like Building Information Modeling (BIM).

- Conducting regular research periodically to observe emerging trends among key project parties, including contractors, consultants, and owners.
- Studies can be conducted on the identification of disputes that may arise among the participants in the construction industry as a result of a change order.
- Develop a proactive change management model to improve proactive change management ability. By utilizing this model, project teams can effectively anticipate the magnitude of change or compare their projects with industry standards. Consequently, project stakeholders are empowered to make informed decisions to enhance project change management and maintain control over the project (Chao Chen, 2015).
- Future studies can use a combination of qualitative and quantitative methods. By conducting Field interviews to comprehensively examine the factors behind change orders that result in delays and increased costs.
- A research investigation can be conducted to identify the causes and impacts of change orders, with a particular emphasis on the type of construction projects such as infrastructure projects. Alternatively, the study may choose to examine projects owned by public organizations.

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Appendices

Appendix A: Questionnaire Form-Arabic Version

السيد/ة_____المحترم/ة

الموضوع: جمع بيانات لغرض البحث العلمي

تحية وبعد

يقوم الباحثون بدراسة حول **أسباب وأثر أوامر التغيير في مشاريع التشييد في فلسطين وتقييم حدتها**، والإستبانة التي بين يديك هي أداة جمع البيانات في هذه الدراسة، إن تعاونكم مشكورين بتعبئة هذه الإستبانة بموضوعية سينعكس ايجابا على صدقية النتائج ومدى قبول توصيات الباحثين بهدف تطبيقها.

نحن نؤمن أن الوقت الذي ستستثمره في تعبئة هذه الإستبانة سيحقق مردودا على المدى الطويل على شكل قرارت وسياسات أكثر رشدا، ما يعني مستقبل أفضل لنا ولأبنائنا جميعا، لقد حاولنا في هذه الإستبانة تجنب اية أسئلة إعتقدنا ان لها حساسية خاصة، ومع ذلك نعدكم أن كافة البيانات ستستخدم لغرض البحث العلمي فقط ولن يطلع عليها غير الباحثين.

وتفضلوا بقبول فائق الإحترام

الطالب: أحمد عبد العال

المشرف :د.إبراهيم محاميد

القسم الأول: المعلومات العامة عن شركة المقاولات او المكتب الهندسي والاستشاري

1. تتعلق بالدور الذي تلعبه في منظومة العمل الانشائية

☐ مقاول

☐ مكتب هندسي أو استشاري

2. المعلومات العامة عن الشركة او المكتب الهندسي والاستشاري

اسم الشركة أو المكتب(اختياري): .....

المسمى الوظيفي في الشركة أو المكتب الهندسي: .....

يهدف هذا القسم الى معرفة حجم المؤسسة ومدى خبرتها وحجم الموارد ومدى توفر الاستراتيجيات والخبراء في ادارة المخاطر للمشاريع الانشائية.
الرجاء الإجابة على الأسئلة التالية بوضع إشارة (✓) في مربع الإجابة التي تناسبك:

1. عدد الموظفين الثابتين العاملين في المؤسسة:

☐	أقل من 5 موظفين	☐	6-50 موظف	☐	50 موظف فأكثر

2. أي من القطاعات الانشائية المختلفة التي تعمل فيها :

☐	مشاريع الأبنية	☐	مشاريع الطرق والجسور والأنفاق	☐	مشاريع المياه والصرف الصحي	☐	المشاريع الكهربائية والألكتروميكانيكية

3. عدد سنوات الخبرة في المشاريع الانشائية:

☐	أقل من 5 سنوات	☐	5-10 سنوات	☐	11-15 سنة	☐	16-20 سنة
☐	أكثر من 20 سنة						

4. عدد المشاريع السنوية المنفذة من قبل الشركة خلال الخمس سنوات الماضية:

☐	أقل من 5 مشاريع	☐	5-10 مشاريع	☐	11-15 مشروع	☐	16-20 مشروع
☐	أكثر من 20 مشروع						

5. معدل قيمة المشاريع التي يتم تنفيذها بشكل سنوي (دولار) :

☐	أقل من نصف مليون دولار	☐	نصف مليون- 1 مليون دولار	☐	1 مليون -5 مليون دولار	☐	أكثر من 5 مليون دولار

6. هل تم إعداد أو إصدار أوامر تغيرية عند تنفيذك المشاريع الانشائية:

☐	نعم	☐	لا

7. قيمة المشاريع المنفذة التي صدرت فيها الأوامر التغيرية بشكل عام (دولار):

☐	أقل من نصف مليون دولار	☐	نصف مليون- 1 مليون دولار	☐	1 مليون -5 مليون دولار	☐	أكثر من 5 مليون دولار

8. من هو المالك للمشاريع الانشائية التي يتم فيها حدوث الأوامر التغيرية :

☐	المؤسسات الحكومية	☐	المؤسسات الغير حكومية (NGO's)	☐	الشركات الخاصة	☐	أفراد

9. من هو الطرف المسؤول عند حدوث الأوامر التغيرية:

☐	المقاول	☐	المهندس المصمم أو المهندس المشرف	☐	المالك للمشروع	☐	الجهة المستفيدة للمشروع

القسم الثاني: تحديد أسباب الأوامر التغيرية في مشاريع الأنشاءات في فلسطين:

يهدف هذا القسم الى تحديد درجة الأهمية للعوامل التي تسهم في حدوث الأوامر التغيرية في مشاريع الأنشاءات في فلسطين حيث تم تقسيم العوامل المسببة لحدوث الأوامر التغيرية إلى محورين: العوامل الخارجية والتي تكون خارج تحكم الأطراف الإنشائية والمحور الثاني: والذي يقع ضمن تحكم الأطراف الإنشائية وتنقسم حسب الجهة المسببة لها: المالك أو المكتب الاستشاري أو المقاول وحيث تم تقسيم المقياس من (1-5) كالتالي:

- درجة الحدة للأسباب المؤدية الأوامر التغيرية:

(1) : **دور قليل جدا** في حدوث الأوامر التغيرية
(2): **دور قليل** في حدوث الأوامر التغيرية
(3): **دور متوسط** في حدوث الأوامر التغيرية
(4): **دور قوي** في حدوث الأوامر التغيرية
(5): **دور قوي جدا** في حدوث الأوامر التغيرية

الرجاء الإجابة على الأسئلة التالية بوضع إشارة (✓) في مربع الإجابة التي تناسبك:

(A) المحور الأول: يهدف هذا الجزء إلى تحديد درجة الحدة للعوامل المسببة لحدوث الأوامر التغيرية والتي تقع خارج سيطرة وتحكم الأطراف الإنشائية						
عوامل خارجية لحدوث الأوامر التغيرية		**درجة الحدة**				
		1	**2**	**3**	**4**	**5**
A1	المعيقات السياسية والاثار المرتبة منها					
A2	قلة توفر المواد الإنشائية من الاغلاقات والحصار المفروض على الحدود					
A3	التغير في أسعار صرف العملات					
(A)المحور الأول		**1**	**2**	**3**	**4**	**5**
A4	التذبذب في اسعار مدخلات المواد الانشائية					

A5	ظروف الموقع المختلفة والغير متوقعة					
A6	اصدار سياسات وتنظيمات جديدة او تطوير الحالية منها من قبل الحكومات					
A7	ارتفاع معدل التضخم في سوق الانشاءات					
A8	الكوارث الطبيعية والقوة القاهرة(جائحة , زلازل, فيضانات ....الخ)					
A9	الظروف الجوية السائدة					
A10	تعليمات المانحين لأستخدام مواصفات معينة للمواد الإنشائية غير متوافقة مع السوق المحلي					
A11	الأثار الجانبية الإجتماعية والبيئية					
A12	قلة توفر العمال المهرة المرتبط بالوضع الإقتصادي					

(B) المحور الثاني: يهدف هذا الجزء إلى تحديد درجة الحدة للعوامل المسببة لحدوث الأوامر التغيرية والتي تقع ضمن سيطرة وتحكم الاطراف المختلفة في المشاريع الانشائية (المالك، المهندس، المقاول) وسوف يتم تقسيمها حسب علاقتها بالاطراف الى 3 أجزاء						
الجزء الأول(B1) : أسباب الأوامر التغيرية من طرف المقاول		**درجة الحدة**				
		1	**2**	**3**	**4**	**5**
B1-1	قلة خبرة المقاول في توريد المواد الانشائية من الخارج					
B1-2	قلة الخبرة والتخصص لطاقم المقاول في إدارة المشروع					
B1-3	سوء فهم المقاول لوثائق العقد في مرحلة التسعير للعطاء					
B1-4	قلة معرفة المقاول في التصميم وقراءة المخططات					
B1-5	ضعف اطلاع المقاول على بيانات و ظروف العمل					
B1-6	نسبة الربح المرصودة من قبل المقاول					
B1-7	القدرة المالية للمقاول					
B1-8	عدم الالتزام بتعليمات وتدابير السلامة العامة والخطة المرورية للعمل					

الجزء الثاني(B2) : أسباب الأوامر التغيرية من طرف المالك		درجة الحدة				
		1	2	3	4	5
B2-1	الإطار الزمني المحدد من المالك غير منطقي في مرحلتي التصميم والتنفيذ					
B2-2	تعديل المالك في طبيعة ومفهوم المشروع					
B2-3	الصعوبات المالية للمالك					
B2-4	تغيير الإجراءات والمواصفات للمواد الإنشائية من طرف المالك					
B2-5	قلة الخبرة اللازمة في طواقم المالك					
B2-6	عدم قدرة المالك على اتخاذ في الوقت المناسب					
B2-7	تعليمات المالك في تعديل التصميم					
B2-8	قلة اشراك الأصحاب ذات العلاقة في مراحل المشروع					
الجزء الثالث(B3) : أسباب الأوامر التغيرية من طرف المهندس المصمم والاستشاري		**درجة الحدة**				
		1	**2**	**3**	**4**	**5**
B3-1	تغيير في التصميم أثناء مرحلة التنفيذ من قبل المصمم					
B3-2	حدوث أخطاء أو حذف في التصميم					
B3-3	حدوث تعارض في وثائق العقد					
B3-4	ضعف التنسيق بين الأطراف المشتركة في مرحلة التصميم					
B3-5	ضعف خبرة المصمم أو المكتب الإستشاري من تعديلات وحذف في مرجعيات المشروع					
B3-6	تعقيد وضخامة المشروع					
B3-7	قلة الوضوح في الرسومات والمخططات					
B3-8	ضعف اطلاع الإستشاري على ظروف وبيانات الموقع					
B3-9	استخدام تصميمات متشابهة مع اختلاف مناطق وظروف المشاريع					
B3-10	استخدام تقنيات ومفاهيم هندسة القيمة					

القسم الثالث: تحديد تأثيرات الأوامر التغيرية في مشاريع الإنشاءات في فلسطين:

يهدف هذا القسم الى تحديد درجة الأهمية للاثار الناجمة عن حدوث الأوامر التغيرية في مشاريع الأنشاءات في فلسطين وحيث تم تقسيم المقياس من (1-5) كالتالي:

- درجة الأهمية للأثار المؤدية الأوامر التغيرية:

(1) : **دور قليل جدا** عند حدوث الأوامر التغيرية
(2): **دور قليل** عند حدوث الأوامر التغيرية
(3): **دور متوسط** عند حدوث الأوامر التغيرية
(4): **دور قوي** عند حدوث الأوامر التغيرية
(5): **دور قوي جدا** عند حدوث الأوامر التغيرية

الرجاء الإجابة على الأسئلة التالية بوضع إشارة (✓) في مربع الإجابة التي تناسبك:

(C) المحور الثالث: يهدف هذا الجزء إلى تحديد مجالات التأثير على المشروع عند حدوث الأوامر التغيرية						
مجالات تأثير الأوامر التغيرية على المشروع		**درجة التأثير**				
		1	**2**	**3**	**4**	**5**
C1	التغيير في مدة إنجاز المشروع					
C2	التغير في قيمة العقد (ميزانية المشروع)					
C3	حدوث خلافات بين أطراف العقد					
C4	تأخر الدفعات المرحلية					
C5	توفير مصادر إضافية من معدات وعمال مهرة إضافيين					
C6	تدهور في معايير الجودة					
C7	قلة الإنتاجية					
C8	إعادة تنفيذ جزء من الأعمال أو هدمها					
C9	تأخيرات لوجستية (تأخيرات عمليات الشراء) خاصة في بنود التوريد للمواد طويلة الأمد					
C10	تشويه سمعة المؤسسة					

Appendix B: Cronbach's Alpha Values (α)

Reliability Test-Cronbach's Alpha Values (α) for each cause and impact of change orders

	Item-Total Statistics	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha
(A) External Causes	Political situations and their consequences	30.420	38.684	0.404	0.525	0.699
	Construction material shortage due to blockade and siege	31.170	41.674	0.276	0.518	0.716
	Variation of exchange rate	31.600	44.369	0.067	0.370	0.741
	Fluctuations in construction material price	31.180	39.997	0.377	0.609	0.703
	Unforeseen site conditions	30.260	37.290	0.585	0.513	0.675
	Change in government's regulations, laws, policies	31.520	41.410	0.312	0.357	0.712
	Inflation in the construction industry	31.310	40.841	0.328	0.583	0.710
	Disaster events like pandemics, earthquakes, floods, etc…	30.720	39.360	0.335	0.340	0.710
	Weather conditions	30.850	37.413	0.446	0.655	0.693
	Unfamiliarity of donor instructions to use specific specs	31.110	40.316	0.405	0.462	0.701
	Environmental and social impacts	31.460	41.127	0.362	0.375	0.706
	Lack of qualified labors	30.540	38.346	0.399	0.560	0.700
(B1) Contractor-Related Causes	Poor experience of the contractor in importing material	21.340	28.290	0.302	0.290	0.805
	Lack of contractor's specialty and experienced management team	20.830	24.330	0.672	0.543	0.752
	Misunderstanding of contract documents during the cost estimation-bidding stage	20.540	23.784	0.654	0.481	0.753
	Lack of contractor involvement in the design and review of contract documents	20.950	25.076	0.629	0.527	0.759
	Lack of contractor's knowledge about work scope and site conditions	20.750	25.157	0.584	0.450	0.765

	Contractor's intended profitability	21.020	26.828	0.398	0.233	0.794
	Poor financial capability of the contractor	20.290	25.273	0.445	0.385	0.789
	Safety non-compliance	21.420	27.122	0.417	0.258	0.790
(B2) Owner-Related Causes	The timeline addressed by the owner	23.820	32.934	0.442	0.347	0.820
	Change in plan and scope by owner	23.480	29.316	0.647	0.461	0.793
	Owner's financial difficulties	23.540	32.784	0.390	0.323	0.827
	Change in specification of project and procedure by owner	24.340	31.696	0.386	0.281	0.831
	Inadequate experience of owner's staff	23.940	30.340	0.646	0.493	0.795
	The owner's failure to make a timely decision	23.830	29.049	0.690	0.570	0.787
	Owner-changed design	23.800	29.569	0.613	0.558	0.798
	Inadequate stakeholders engagement	23.980	29.109	0.615	0.488	0.797
(B3) Consultant-Related Causes	Change in design during the construction stage by consultant	29.370	44.205	0.536	0.423	0.809
	Errors and omissions in design	28.830	40.268	0.716	0.622	0.788
	The conflict between contract documents	28.910	38.398	0.809	0.788	0.776
	Lack of coordination among project parties	29.250	45.001	0.522	0.468	0.811
	Shortage of consultant's knowledge due to the omission in terms of reference of project	29.630	41.455	0.693	0.561	0.792
	Project complexity	29.600	48.369	0.243	0.113	0.838
	Lack of details in drawings	28.910	40.804	0.668	0.653	0.794
	Poor site investigation before the design stage	28.780	42.203	0.663	0.496	0.796
	Using duplicated documents from previous projects	28.620	50.522	0.148	0.187	0.843
	Value engineering	30.120	52.266	0.056	0.087	0.846
(C) Change Orders'	Time overruns	27.490	42.660	0.463	0.613	0.846
	Cost overruns	27.880	39.610	0.651	0.745	0.830
	Disputes between contract parties	28.310	41.279	0.634	0.521	0.833
	Delay in payment by the owner	28.320	43.285	0.329	0.285	0.859
	Provide additional equipment & staff	28.780	41.297	0.473	0.328	0.846

	Degradation of quality standards	28.830	40.080	0.618	0.506	0.833
	Productivity degradation	28.780	41.078	0.589	0.518	0.836
	Rework and demolition	28.150	40.413	0.599	0.595	0.835
	Logistics delays long lead procurement	28.480	37.503	0.675	0.515	0.826
	Tarnishing the reputation of the institution	28.950	39.826	0.558	0.401	0.838

Appendix C: The Years of Experience of Construction Firms and the Causes of Change Order

The significant degree between causes of change order and years of experience of construction firms using the One-way ANOVA test.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Political situations and their consequences	Between Groups	19.499	4	4.875	3.643	.010
	Within Groups	80.286	60	1.338		
	Total	99.785	64			
Construction material shortage due to blockade and siege	Between Groups	7.109	4	1.777	1.681	.166
	Within Groups	63.445	60	1.057		
	Total	70.554	64			
Variation of exchange rate	Between Groups	5.250	4	1.313	1.120	.355
	Within Groups	70.288	60	1.171		
	Total	75.538	64			
Fluctuations in construction material price	Between Groups	2.340	4	.585	.459	.766
	Within Groups	76.521	60	1.275		
	Total	78.862	64			
Unforeseen site conditions	Between Groups	22.108	4	5.527	5.734	<.001
	Within Groups	57.830	60	.964		
	Total	79.938	64			

Change in government's regulations, laws, policies	Between Groups	7.075	4	1.769	1.806	.140
	Within Groups	58.772	60	.980		
	Total	65.846	64			
Inflation in the construction industry	Between Groups	1.782	4	.445	.369	.830
	Within Groups	72.434	60	1.207		
	Total	74.215	64			
Disaster events like pandemics, earthquakes, floods, etc…	Between Groups	11.549	4	2.887	1.791	.142
	Within Groups	96.698	60	1.612		
	Total	108.246	64			
Weather conditions	Between Groups	19.868	4	4.967	3.133	.021
	Within Groups	95.117	60	1.585		
	Total	114.985	64			
Unfamiliarity of donor instructions to use specific specs	Between Groups	5.231	4	1.308	1.312	.276
	Within Groups	59.785	60	.996		
	Total	65.015	64			
Environmental and social impacts	Between Groups	1.356	4	.339	.352	.842
	Within Groups	57.782	60	.963		
	Total	59.138	64			
Lack of qualified labors	Between Groups	33.624	4	8.406	6.652	<.001
	Within Groups	75.822	60	1.264		
	Total	109.446	64			
	Between Groups	1.219	4	.305	.273	.894

Poor experience of the contractor in importing material	Within Groups	66.935	60	1.116		
	Total	68.154	64			
Lack of contractor's specialty and experienced management team	Between Groups	13.750	4	3.438	3.375	.015
	Within Groups	61.111	60	1.019		
	Total	74.862	64			
Misunderstanding of contract documents during the cost estimation-bidding stage	Between Groups	3.934	4	.984	.697	.597
	Within Groups	84.620	60	1.410		
	Total	88.554	64			
Lack of contractor involvement in the design and review of contract documents	Between Groups	8.080	4	2.020	2.002	.106
	Within Groups	60.535	60	1.009		
	Total	68.615	64			
Lack of contractor's knowledge about work scope and site conditions	Between Groups	5.637	4	1.409	1.219	.312
	Within Groups	69.378	60	1.156		
	Total	75.015	64			
Contractor's intended profitability	Between Groups	1.608	4	.402	.309	.871
	Within Groups	78.146	60	1.302		
	Total	79.754	64			
Poor financial capability of the contractor	Between Groups	13.568	4	3.392	2.207	.079
	Within Groups	92.216	60	1.537		
	Total	105.785	64			
Safety non-compliance	Between Groups	1.876	4	.469	.425	.790
	Within Groups	66.278	60	1.105		

	Total	68.154	64			
The timeline addressed by the owner	Between Groups	5.933	4	1.483	1.534	.204
	Within Groups	58.006	60	.967		
	Total	63.938	64			
Change in plan and scope by owner	Between Groups	6.512	4	1.628	1.177	.330
	Within Groups	83.026	60	1.384		
	Total	89.538	64			
Owner's financial difficulties	Between Groups	2.726	4	.682	.533	.712
	Within Groups	76.720	60	1.279		
	Total	79.446	64			
Change in specification of project and procedure by owner	Between Groups	3.481	4	.870	.502	.734
	Within Groups	103.965	60	1.733		
	Total	107.446	64			
Inadequate experience of owner's staff	Between Groups	9.255	4	2.314	2.218	.078
	Within Groups	62.591	60	1.043		
	Total	71.846	64			
The owner's failure to make a timely decision	Between Groups	7.386	4	1.846	1.413	.241
	Within Groups	78.399	60	1.307		
	Total	85.785	64			
Owner-changed design	Between Groups	5.135	4	1.284	.886	.478
	Within Groups	86.926	60	1.449		
	Total	92.062	64			

Inadequate stakeholders engagement	Between Groups	2.734	4	.683	.419	.794
	Within Groups	97.820	60	1.630		
	Total	100.554	64			
Change in design during the construction stage by consultant	Between Groups	2.128	4	.532	.387	.817
	Within Groups	82.488	60	1.375		
	Total	84.615	64			
Errors and omissions in design	Between Groups	17.994	4	4.499	3.019	.025
	Within Groups	89.391	60	1.490		
	Total	107.385	64			
The conflict between contract documents	Between Groups	16.463	4	4.116	2.477	.054
	Within Groups	99.691	60	1.662		
	Total	116.154	64			
Lack of coordination among project parties	Between Groups	2.840	4	.710	.595	.667
	Within Groups	71.560	60	1.193		
	Total	74.400	64			
Shortage of consultant's knowledge due to the omission in terms of reference of project	Between Groups	8.168	4	2.042	1.431	.235
	Within Groups	85.617	60	1.427		
	Total	93.785	64			
Project complexity	Between Groups	11.499	4	2.875	2.241	.075
	Within Groups	76.962	60	1.283		
	Total	88.462	64			
Lack of details in drawings	Between Groups	15.536	4	3.884	2.463	.055

	Within Groups	94.618	60	1.577		
	Total	110.154	64			
Poor site investigation before the design stage	Between Groups	17.173	4	4.293	3.609	.011
	Within Groups	71.381	60	1.190		
	Total	88.554	64			
Using duplicated documents from previous projects	Between Groups	4.868	4	1.217	1.173	.332
	Within Groups	62.270	60	1.038		
	Total	67.138	64			
Value engineering	Between Groups	.893	4	.223	.283	.888
	Within Groups	47.322	60	.789		
	Total	48.215	64			

Appendix D: The Size of Construction Firms and the Causes of Change Order

The significant degree between causes of change order and size of construction firms using the One-way ANOVA test.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Political situations and their consequences	Between Groups	10.901	2	5.451	3.802	.028
	Within Groups	88.884	62	1.434		
	Total	99.785	64			
Construction material shortage due to blockade and siege	Between Groups	1.174	2	.587	.524	.595
	Within Groups	69.380	62	1.119		
	Total	70.554	64			
Variation of exchange rate	Between Groups	2.838	2	1.419	1.210	.305
	Within Groups	72.701	62	1.173		
	Total	75.538	64			
Fluctuations in construction material price	Between Groups	7.148	2	3.574	3.090	.053
	Within Groups	71.714	62	1.157		
	Total	78.862	64			
Unforeseen site conditions	Between Groups	3.853	2	1.926	1.570	.216
	Within Groups	76.085	62	1.227		
	Total	79.938	64			
Change in government's regulations, laws, policies	Between Groups	.604	2	.302	.287	.752
	Within Groups	65.243	62	1.052		
	Total	65.846	64			
Inflation in the construction industry	Between Groups	5.861	2	2.930	2.658	.078
	Within Groups	68.355	62	1.102		
	Total	74.215	64			

Disaster events like pandemics, earthquakes, floods, etc…	Between Groups	3.887	2	1.944	1.155	.322
	Within Groups	104.359	62	1.683		
	Total	108.246	64			
Weather conditions	Between Groups	8.687	2	4.343	2.533	.088
	Within Groups	106.298	62	1.714		
	Total	114.985	64			
Unfamiliarity of donor instructions to use specific specs	Between Groups	3.208	2	1.604	1.609	.208
	Within Groups	61.808	62	.997		
	Total	65.015	64			
Environmental and social impacts	Between Groups	2.831	2	1.415	1.558	.219
	Within Groups	56.308	62	.908		
	Total	59.138	64			
Lack of qualified labors	Between Groups	2.024	2	1.012	.584	.561
	Within Groups	107.422	62	1.733		
	Total	109.446	64			
Poor experience of the contractor in importing material	Between Groups	.410	2	.205	.188	.829
	Within Groups	67.744	62	1.093		
	Total	68.154	64			
Lack of contractor's specialty and experienced management team	Between Groups	3.910	2	1.955	1.708	.190
	Within Groups	70.952	62	1.144		
	Total	74.862	64			
Misunderstanding of contract documents during the cost estimation-bidding stage	Between Groups	1.635	2	.818	.583	.561
	Within Groups	86.919	62	1.402		
	Total	88.554	64			
Lack of contractor involvement in the design and review of contract documents	Between Groups	2.040	2	1.020	.950	.392
	Within Groups	66.576	62	1.074		
	Total	68.615	64			
Lack of contractor's knowledge about work scope and site conditions	Between Groups	.051	2	.025	.021	.979
	Within Groups	74.965	62	1.209		
	Total	75.015	64			
	Between Groups	.284	2	.142	.111	.895

Contractor's intended profitability	Within Groups	79.470	62	1.282		
	Total	79.754	64			
Poor financial capability of the contractor	Between Groups	6.708	2	3.354	2.099	.131
	Within Groups	99.077	62	1.598		
	Total	105.785	64			
Safety non-compliance	Between Groups	.786	2	.393	.362	.698
	Within Groups	67.368	62	1.087		
	Total	68.154	64			
The timeline addressed by the owner	Between Groups	1.811	2	.906	.904	.410
	Within Groups	62.127	62	1.002		
	Total	63.938	64			
Change in plan and scope by owner	Between Groups	2.261	2	1.130	.803	.453
	Within Groups	87.278	62	1.408		
	Total	89.538	64			
Owner's financial difficulties	Between Groups	3.138	2	1.569	1.275	.287
	Within Groups	76.308	62	1.231		
	Total	79.446	64			
Change in specification of project and procedure by owner	Between Groups	3.502	2	1.751	1.044	.358
	Within Groups	103.944	62	1.677		
	Total	107.446	64			
Inadequate experience of owner's staff	Between Groups	2.735	2	1.368	1.227	.300
	Within Groups	69.111	62	1.115		
	Total	71.846	64			
The owner's failure to make a timely decision	Between Groups	1.935	2	.968	.715	.493
	Within Groups	83.849	62	1.352		
	Total	85.785	64			
Owner-changed design	Between Groups	3.011	2	1.506	1.048	.357
	Within Groups	89.050	62	1.436		
	Total	92.062	64			
Inadequate stakeholders engagement	Between Groups	2.464	2	1.232	.779	.463
	Within Groups	98.090	62	1.582		

	Total	100.554	64			
Change in design during the construction stage by consultant	Between Groups	6.732	2	3.366	2.679	.077
	Within Groups	77.884	62	1.256		
	Total	84.615	64			
Errors and omissions in design	Between Groups	6.112	2	3.056	1.871	.163
	Within Groups	101.272	62	1.633		
	Total	107.385	64			
The conflict between contract documents	Between Groups	6.587	2	3.293	1.864	.164
	Within Groups	109.567	62	1.767		
	Total	116.154	64			
Lack of coordination among project parties	Between Groups	2.763	2	1.382	1.196	.309
	Within Groups	71.637	62	1.155		
	Total	74.400	64			
Shortage of consultant's knowledge due to the omission in terms of reference of project	Between Groups	10.243	2	5.121	3.801	.028
	Within Groups	83.542	62	1.347		
	Total	93.785	64			
Project complexity	Between Groups	3.692	2	1.846	1.350	.267
	Within Groups	84.769	62	1.367		
	Total	88.462	64			
Lack of details in drawings	Between Groups	3.399	2	1.699	.987	.379
	Within Groups	106.755	62	1.722		
	Total	110.154	64			
Poor site investigation before the design stage	Between Groups	4.746	2	2.373	1.756	.181
	Within Groups	83.808	62	1.352		
	Total	88.554	64			
Using duplicated documents from previous projects	Between Groups	.335	2	.168	.155	.856
	Within Groups	66.803	62	1.077		
	Total	67.138	64			
Value engineering	Between Groups	1.140	2	.570	.750	.476
	Within Groups	47.076	62	.759		
	Total	48.215	64			

Appendix E: The Average Cost of Project Implemented Annually by Construction Firms and the Causes of Change Order

The significant degree between causes of the change order and the average cost of their implemented projects using the One-way ANOVA test.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Political situations and their consequences	Between Groups	3.098	3	1.033	.652	.585
	Within Groups	96.686	61	1.585		
	Total	99.785	64			
Construction material shortage due to blockade and siege	Between Groups	2.402	3	.801	.717	.546
	Within Groups	68.152	61	1.117		
	Total	70.554	64			
Variation of exchange rate	Between Groups	2.238	3	.746	.621	.604
	Within Groups	73.300	61	1.202		
	Total	75.538	64			
Fluctuations in construction material price	Between Groups	6.200	3	2.067	1.735	.169
	Within Groups	72.662	61	1.191		
	Total	78.862	64			
Unforeseen site conditions	Between Groups	1.941	3	.647	.506	.680
	Within Groups	77.997	61	1.279		
	Total	79.938	64			
Change in government's regulations, laws, policies	Between Groups	6.061	3	2.020	2.061	.115
	Within Groups	59.785	61	.980		
	Total	65.846	64			
Inflation in the construction industry	Between Groups	9.188	3	3.063	2.873	.043
	Within Groups	65.027	61	1.066		
	Total	74.215	64			

Disaster events like pandemics, earthquakes, floods, etc…	Between Groups	4.855	3	1.618	.955	.420
	Within Groups	103.391	61	1.695		
	Total	108.246	64			
Weather conditions	Between Groups	1.963	3	.654	.353	.787
	Within Groups	113.022	61	1.853		
	Total	114.985	64			
Unfamiliarity of donor instructions to use specific specs	Between Groups	3.691	3	1.230	1.224	.309
	Within Groups	61.325	61	1.005		
	Total	65.015	64			
Environmental and social impacts	Between Groups	2.765	3	.922	.997	.400
	Within Groups	56.373	61	.924		
	Total	59.138	64			
Lack of qualified labors	Between Groups	.778	3	.259	.146	.932
	Within Groups	108.668	61	1.781		
	Total	109.446	64			
Poor experience of the contractor in importing material	Between Groups	2.997	3	.999	.935	.429
	Within Groups	65.157	61	1.068		
	Total	68.154	64			
Lack of contractor's specialty and experienced management team	Between Groups	1.392	3	.464	.385	.764
	Within Groups	73.470	61	1.204		
	Total	74.862	64			
Misunderstanding of contract documents during the cost estimation-bidding stage	Between Groups	2.845	3	.948	.675	.571
	Within Groups	85.709	61	1.405		
	Total	88.554	64			
Lack of contractor involvement in the design and review of contract documents	Between Groups	.314	3	.105	.094	.963
	Within Groups	68.301	61	1.120		
	Total	68.615	64			
Lack of contractor's knowledge about work scope and site conditions	Between Groups	2.074	3	.691	.578	.632
	Within Groups	72.941	61	1.196		
	Total	75.015	64			
	Between Groups	.942	3	.314	.243	.866

Contractor's intended profitability	Within Groups	78.812	61	1.292		
	Total	79.754	64			
Poor financial capability of the contractor	Between Groups	2.054	3	.685	.403	.752
	Within Groups	103.731	61	1.701		
	Total	105.785	64			
Safety non-compliance	Between Groups	3.225	3	1.075	1.010	.395
	Within Groups	64.929	61	1.064		
	Total	68.154	64			
The timeline addressed by the owner	Between Groups	2.831	3	.944	.942	.426
	Within Groups	61.108	61	1.002		
	Total	63.938	64			
Change in plan and scope by owner	Between Groups	1.264	3	.421	.291	.832
	Within Groups	88.275	61	1.447		
	Total	89.538	64			
Owner's financial difficulties	Between Groups	11.156	3	3.719	3.322	.026
	Within Groups	68.290	61	1.120		
	Total	79.446	64			
Change in specification of project and procedure by owner	Between Groups	5.863	3	1.954	1.173	.327
	Within Groups	101.584	61	1.665		
	Total	107.446	64			
Inadequate experience of owner's staff	Between Groups	2.636	3	.879	.775	.513
	Within Groups	69.210	61	1.135		
	Total	71.846	64			
The owner's failure to make a timely decision	Between Groups	4.783	3	1.594	1.201	.317
	Within Groups	81.002	61	1.328		
	Total	85.785	64			
Owner-changed design	Between Groups	1.430	3	.477	.321	.810
	Within Groups	90.631	61	1.486		
	Total	92.062	64			
Inadequate stakeholders engagement	Between Groups	1.662	3	.554	.342	.795
	Within Groups	98.892	61	1.621		

	Total	100.554	64			
Change in design during the construction stage by consultant	Between Groups	2.557	3	.852	.634	.596
	Within Groups	82.058	61	1.345		
	Total	84.615	64			
Errors and omissions in design	Between Groups	5.937	3	1.979	1.190	.321
	Within Groups	101.448	61	1.663		
	Total	107.385	64			
The conflict between contract documents	Between Groups	2.446	3	.815	.437	.727
	Within Groups	113.708	61	1.864		
	Total	116.154	64			
Lack of coordination among project parties	Between Groups	1.795	3	.598	.503	.682
	Within Groups	72.605	61	1.190		
	Total	74.400	64			
Shortage of consultant's knowledge due to the omission in terms of reference of project	Between Groups	8.521	3	2.840	2.032	.119
	Within Groups	85.264	61	1.398		
	Total	93.785	64			
Project complexity	Between Groups	7.060	3	2.353	1.764	.164
	Within Groups	81.401	61	1.334		
	Total	88.462	64			
Lack of details in drawings	Between Groups	1.096	3	.365	.204	.893
	Within Groups	109.057	61	1.788		
	Total	110.154	64			
Poor site investigation before the design stage	Between Groups	3.419	3	1.140	.817	.490
	Within Groups	85.135	61	1.396		
	Total	88.554	64			
Using duplicated documents from previous projects	Between Groups	1.053	3	.351	.324	.808
	Within Groups	66.085	61	1.083		
	Total	67.138	64			
Value engineering	Between Groups	2.416	3	.805	1.073	.367
	Within Groups	45.800	61	.751		
	Total	48.215	64			

Appendix F: Ranking of the Overall Causes of Change Orders

The causes of change orders have been ranked by the Relative Importance Index (RII) as shown in the table below.

Item code	Causes of change orders	Contractor respondents		Consultant respondents		Overall respondents		SD
		RII	Rank	RII	Rank	RII	Rank	
B3-9	Using duplicated documents from previous projects	0.82	1	0.71	7	**0.77**	**1**	8.34
B2-2	Change in plan and scope by owner	0.73	4	0.78	1	**0.76**	**2**	2.95
B2-3	Owner's financial difficulties	0.75	3	0.74	3	**0.74**	**3**	0.56
B3-8	Poor site investigation before the design stage	0.79	2	0.68	13	**0.739**	**4**	7.98
B3-2	Errors and omissions in design	0.73	6	0.72	5	**0.72**	**5**	0.60
B1-7	Poor financial capability of the contractor	0.69	12	0.74	2	**0.718**	**6**	3.74
A5	Unforeseen site conditions	0.71	9	0.72	5	**0.71**	**7**	0.68
B3-3	The conflict between contract documents	0.73	4	0.68	11	**0.708**	**8**	3.68
B3-7	Lack of details in drawings	0.72	7	0.69	9	**0.706**	**9**	1.94
B2-7	Owner-changed design	0.65	16	0.73	4	**0.70**	**10**	5.85
B2-1	The timeline addressed by the owner	0.69	12	0.68	11	**0.69**	**11**	0.68
A1	Political situations and their consequences	0.70	10	0.67	14	**0.68**	**12**	2.00
B2-6	The owner's failure to make a timely decision	0.70	10	0.67	14	**0.678**	**13**	2.00
A12	Lack of qualified labors	0.72	8	0.60	26	**0.677**	**14**	8.14
B1-3	Misunderstanding of contract documents during the cost estimation-bidding stage	0.68	14	0.65	19	**0.67**	**15**	2.46
B2-8	Inadequate stakeholders engagement	0.61	19	0.70	8	**0.66**	**16**	6.64
B2-5	Inadequate experience of owner's staff	0.67	15	0.65	19	**0.659**	**17**	1.61
B3-4	Lack of coordination among project parties	0.59	21	0.69	10	**0.65**	**18**	6.62

B1-5	Lack of contractor's knowledge about work scope and site conditions	0.58	22	0.67	14	**0.63**	**19**	6.15
B1-2	Lack of contractor's specialty and experienced management team	0.55	26	0.67	14	**0.628**	**20**	8.29
B3-1	Change in design during the construction stage by consultant	0.57	23	0.66	18	**0.62**	**21**	6.56
A8	Disaster events like pandemics, earthquakes, floods, etc…	0.62	18	0.62	24	**0.619**	**22**	0.39
A9	Weather conditions	0.65	16	0.54	31	**0.617**	**23**	7.41
B1-6	Contractor's intended profitability	0.51	30	0.64	21	**0.59**	**24**	9.08
B2-4	Change in specification of project and procedure by owner	0.53	28	0.63	22	**0.589**	**25**	6.92
B1-4	Lack of contractor involvement in the design and review of contract documents	0.55	27	0.63	23	**0.587**	**26**	5.62
B3-6	Project complexity	0.60	20	0.54	32	**0.58**	**27**	4.42
A2	Construction material shortage due to blockade and siege	0.45	34	0.61	25	**0.57**	**28**	11.17
B3-5	Shortage of consultant's knowledge due to the omission in terms of reference of project	0.56	25	0.56	29	**0.56**	**29**	0.08
A10	Unfamiliarity of donor instructions to use specific specs	0.57	23	0.52	34	**0.558**	**30**	3.60
A4	Fluctuations in construction material price	0.47	31	0.59	27	**0.54**	**31**	8.99
A7	Inflation in the construction industry	0.44	36	0.57	28	**0.539**	**32**	8.93
B1-1	Poor experience of the contractor in importing material	0.46	32	0.56	30	**0.51**	**33**	6.76
A11	Environmental and social impacts	0.52	29	0.43	38	**0.507**	**34**	5.93
B1-8	Safety non-compliance	0.46	32	0.53	33	**0.49**	**35**	4.55
A3	Variation of exchange rate	0.39	38	0.51	35	**0.48**	**36**	8.37

B3-10	Value engineering	0.42	37	0.49	36	**0.46**	**37**	4.47
A6	Change in government's regulations, laws, policies	0.45	34	0.47	37	**0.456**	**38**	1.00

الملخص

يلعب قطاع الإنشاءات دورًا محوريًا في الاقتصاد الفلسطيني بطبيعته المعقدة ، حيث يشتمل على مزيج من عناصر بشرية وغير بشرية وغيرها تستلزم حدوث الأوامر التغيرية .تعد أوامر التغيير جانبًا لا مفر منه من مشاريع التشييد ، بغض النظر عن حجمها أو نوعها أو خصائصها ، وغالبًا ما يتم الاستشهاد بها كمصدر رئيسي للنزاعات داخل القطاع .علاوة على ذلك ، تعتبر الأوامر التغيرية الإجراء الرسمي لإجراء تغييرات في التصميم ووثائق العقد خلال مرحلة التنفيذ .غالبًا ما تؤدي التغييرات إلى تأخير في الجداول الزمنية وتجاوزات في التكاليف ، مما يؤثر سلبًا على أداء المشروع وتحقيق الربح.

تهدف هذه الرسالة إلى دراسة وتصنيف أسباب وآثار الأوامر التغييرية في مشاريع التشييد في فلسطين من وجهة نظر المقاولين والاستشاريين. يعتبر فهم هذه الجوانب ضروريا للمساهمة في تقليل حدوث تغييرات محتملة في المستقبل. لتحقيق أهداف الدراسة ، تم تنفيذ مراجعة أدبية لإستكشاف أسباب وتأثيرات أوامر التغيير كبيانات ثانوية ومن ثم إجراء دراسة تجريبية لتقييم صحة الاستبيان. اعتمدت الدراسة لجمع البيانات الأولية من خلال توزيع الاستبيانات المنظمة مسبقًا على العاملين في قطاع التشييد حيث تم الحصول على عينة الدراسة باستخدام طريقة العينة الطبقية علما بأنه تم اختيار المشاركين بشكل عشوائي من مجموعات مختلفة؛ شملت هذه المجموعات المقاولين والاستشاريين الذين يعتبرون أصحاب المصلحة الرئيسيين في مشاريع التشييد.

بناءً على نتائج المعادلة الإحصائية، فإن الحد الأدنى لحجم العينة المطلوبة هو 49 استبيانًا .لضمان نتائج أكثر دقة، تم توزيع ما مجموعه 75 استبيانًا على المستجيبين المحتملين عبر جميع المستويات في قطاع البناء .على وجه التحديد، تم إرسال 40 استبيانًا إلى المقاولين و 35 إلى الاستشاريين .تم استلام ما مجموعه 70 ردًا بما في ذلك 5 ردود اعتبرت غير صالحة، و 65 ردًا صالحًا. كخطوة لاحقة في هذه الرسالة نفذت عملية التحليل لخمس وستين استبيانا بنسبة استجابة 93٪ باستخدام تقنيات إحصائية مثل معامل الارتباط الداخلي لتحديد أهمية وتصنيف أسباب وتأثيرات أوامر التغيير .علاوة على ذلك، تم استخدام أسلوب الانحرافات المعيارية لتوضيح درجة الاتفاق بين وجهات نظر المقاولين

والاستشاريين. بالإضافة إلى ذلك، تم استخدام برنامج SPSS لتحديد الارتباط بين أسباب أوامر التغيير والمعلومات والصفات العامة للمستجيبين.

وكشفت النتائج أن العوامل الداخلية المتعلقة بالمالك كانت المصدر الرئيسي لأوامر التغيير ، يليها عوامل متعلقة بالاستشاريين الداخليين ، والمقاولين الداخليين ، والعوامل الخارجية مثل الأوضاع السياسية وقلة توافر العمال المهرة، على التوالي. كما حددت الرسالة أيضًا أهم خمسة أسباب لأوامر التغيير ذات أعلى مؤشر للأهمية النسبية، وهي: "استخدام وثائق مكررة من مشاريع سابقة" ، "تغيير المخطط ونطاق المشروع من قبل المالك"، "صعوبات مالية لدى المالك" ، "ضعف دراسة الموقع قبل مرحلة التصميم" ، "أخطاء وحذف في التصميم". وبالمثل ، قدمت الدراسة خمسة تأثيرات رئيسية لأوامر التغيير على أداء المشروع على أنها "تجاوزات زمنية"، "تجاوزات التكاليف" ، "إعادة العمل والهدم"، "تأخير الدفع من قبل المالك" ، "خلافات بين أطراف العقد".

في نهاية المطاف ، يمكن تحقيق الحد من العوامل المختلفة التي تؤدي إلى الأوامر التغييرية من خلال تعزيز الوعي وضمان المشاركة الفاعلة لجميع أطراف المشروع. توصي الرسالة بأن يبقى الخبراء والعاملين في قطاع التشييد على دراية بشكل مستمر بعوامل تحفيز أوامر التغيير. بالإضافة إلى ذلك ، يجب على خبراء التنفيذ تبني استراتيجيات تخطيط فعالة وإنشاء إطار قوي لإدارة الأوامر التغيرية الوقائية. تكتسب هذه الرسالة أهمية خاصة بالنسبة لقطاع التشييد، حيث تقدم رؤية قيمة للمساعدة في ضمان تحقيق فرق إدارة المشاريع لأهدافهم من إنجاز المشاريع ضمن الفترة الزمنية والتكلفة والجودة المطلوبة المخطط لها.