# Causes and Effects of Change Orders for Construction Projects in Palestine

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## ABSTRACT

**The construction sector is vital to Palestinian economy, contributing significantly to its growth and development. Its complex nature encompasses human, non-human, and other elements and often necessitates change orders, which are inevitable, regardless of the project size, type, or characteristics. Change orders lead to massive delays and cost overruns impacting project timeline and profitability. The ccurrent study explores and ranks the causes and impacts of change orders in Palestinian construction projects from contractors' and consultants' perspectives. The findings revealed that internal factors related to the owner were the primary source of change orders. The major five causes were ranked based on the Relative Importance Index as follows: "use of duplicated documents from previous projects," "change in plan and scope by owner," "owner's financial difficulties," "poor site investigation before the design stage," and "errors and omissions in design." Similarly, the study presents the top five impacts of change orders as follows: "time overruns," "cost overruns," "rework and demolition," "delay in payment by the owner," and "disputes between contract parties." This study holds particular importance for the construction sector, offering valuable insights into managing the change orders to meet the projects objectives in terms of schedule, budget, and quality.**

***Keywords-change orders; complex nature; inevitable; rank causes and impacts; constractor and consultant perspectives; schedule***

## I. 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. Mainly, owing to the complex nature of the construction process and the multi-involved parties and stakeholders, such as clients, users, designers, regulators, contractors, suppliers, and others, the construction industry is considered highly complex [1]. The construction sector is a backbone sector to the Palestinian economy as it accounts for 4.7% of the GDP through its value-added contribution [2]. 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.

Project change is a common occurrence in the construction industry and presents ongoing challenges for project parties. 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 a primary cause of time overruns and cost overruns, negatively affecting project performance, profitability, safety, and potentially leading to project failure [3]. Additionally, they frequently contribute to disagreements between owners and contractors, often resulting in disputes or claims [4]. While there are cases where project change can be beneficial, hidden or poorly managed changes often harm project stakeholders.

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 [5]. Changes are practically unavoidable throughout the execution of a project because of the uniqueness of each endeavor and the constraints of time, budget, and personnel allocated for the planning process [6, 7]. Regardless of the size, type, or nature of the project, change orders are a practical fact of the construction industry, making the management and governance process more challenging. According to [8], there is a scarcity of data accessible for the examination of change orders, which also exacerbates their management. The impact quantification of change orders on project performance is difficult, partly due to its cumulative effect when multiple changes occur

simultaneously [9]. This study examines the factors leading to change orders in construction projects in Palestine and the effects of these change orders on project performance indicators. The main goals of the study are the identification of the change order causes from contractors' and consultants' perspectives, their ranking based on their importance, the determination of the primary change order initiators, such as owners, contractors, and consultants, the investigation of the relationship between project characteristics, construction firms, and the implementation of change orders, highlighting the impact of change orders on project delivery, and the suggestion of remedies to change order management procedures to mitigate their adverse impact during the execution phase. A change order can be defined as an amendment to construction contract documents that changes the scope of work which 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 [10, 11]. The change order could be implemented by the owner or requested by the contractor and authorized by the owner or the owner's representative, and it must be in written form. It 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" [12]. They also need to fulfill the requirements for legitimate formation (offer and acceptance). Change orders are frequently encountered in the construction industry due to the dynamic nature of complex long-term projects [13, 14]. Furthermore, they make construction parties in projects dissatisfied, leading to an increase in tension between them, and they have a ripple effect on unrelated projects by mobilizing resources that are already allocated elsewhere [15, 16].

Authors in [17] 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 [18], it is also difficult to manage change orders in the construction process since they are an integral part of the contract and must be systematically adhered to. Delivery methods of construction projects also have a significant impact on the change orders. Authors in [19] showed that 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 quantity change. Many studies indicate that change orders add value to the construction projects. They are used to modify contract drawings and specifications, contract unit price adjustments, value engineering method proposals for cost reduction motivations, payment for settled claims, administrative goals, such as creating additional work, and payment adjustments [20].

### *A. Causes of Change Orders*

Categorizing the causes based on the parties involved in the project contract is considered an effective method to understand who is responsible among parties and to address the adaptation practices and avoid disputes and claims, which in most cases lead to arbitration and litigation [21]. Projects in the construction industry issue several change orders, mostly because of inadequate tender contract documents, unclear client needs stated in the contract, and design errors [13, 22]. Authors in [23] found that during the implementation phase of the construction project, 16 factors related to contractual change orders were identified. From the contractors' perspective, it was concluded that the primary causes of these change orders are adverse weather conditions and unfavorable soil conditions. Authors in [20] discovered that most change orders having occurred in construction projects in the Gaza Strip were caused by factors referred to the engineer. 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, and inconsistency between contract documents are considered the most critical causes of change orders. Authors in [24] identified that changes in the scope of work upon owner's requests, mistakes in the design, conflicts between contract documents, absence of coordination between construction parties, preliminary design, and mistakes in the estimation of either time or budget are significant causes triggering change orders leading to an increase in project costs in the Jordanian construction private sector.

Authors in [16] demonstrated that red flag causes of change orders in the public construction projects in Saudi Arabia are the owner having initiated scaling up of work effort, design mistakes, lack of communication between key players, poor quality of labors, and financial challenge owners facing. Authors in [25] specified the causes of a change order in two different stages, preconstruction and construction. The analysis revealed that the most crucial factors during the preconstruction phase causing change orders are the errors in specifications, the design errors, and the unqualified construction teams appointed by the owner. On the other hand, changes in the design by the owners, late deviations in the scope, and delayed payment by clients are identified as the most critical factors that lead to change orders during the construction phase. Authors in [26] illustrated that owners are responsible for construction change orders in the U.S. followed by consultants and contractors. The study revealed that design or scope modifications by the owner, ambiguous site conditions, design mistakes and omissions, poorly defined drawings, and adjustments of project timeframe by the owner are the main sources of change orders. Moreover, they examined many control measures and they identified that the collaboration of all parties in the preconstruction phase for the contract document in a way that all gray areas are clarified and the use of technologies, such as the Building Information Model (BIM), in all project stages are considered effective practices. Authors in [4] indicated that the main causes of change orders in Oman construction projects are the specification modifications, the changes in design and blueprints, and the time gap in the execution of a project. Authors in [27] also studied the change orders in Oman construction projects and they identified that the contractor was 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 [28, 29].

### *B. Impacts of the Change Orders*

Change orders typically involve alterations to the original project scope and they do not only lead to cost overruns and schedule delays but they also affect the efficiency and effectiveness of project execution [30]. However, cost and time overruns, lower productivity, and disputes leading to arbitration and litigation are considered the main impacts of change orders [22]. Authors in [26] stated that change orders have a significant influence on many aspects of construction projects and are known to be the primary cause of litigation in the construction industry. Authors in [31] conducted a field survey In the Korean context and specified six construction conflicting factors. Among these factors, a change order was found to be the third-factor causing conflict in construction projects. Authors in [32] used the Likert-Scale method and identified the impacts of change orders in construction projects in Yemen, which are the decline in productivity, time overruns, cost overruns, conflict between owner and contractor, poor quality of work, and late payments by owners. Authors in [27] identified schedule delays as the most significant consequence of change orders in construction projects in Oman. Interestingly, authors in [33] found that disputes and claims ranked slightly higher than cost overruns because of change orders. Cost overruns, however, were still a significant concern as changes in the scope of work often lead to increased costs due to contractor markups. They 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. Authors in [34] mentioned that the overall average increase in the total cost of construction projects in Saudi Arabia owing to change orders was found to be 11.3%. Authors in [35] revealed that the five most frequent impacts of change orders on construction projects in Sulaimani Governate were time overruns, exceeding budget, decrease in productivity, disagreements among parties involved in the project, and late payments. In addition, all examined projects experienced cost and time overruns, with an average increase of 20% in project cost and a staggering 65.4% extension in project timelines. Authors in [36] 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. Authors in [37] found that the major impact of change orders in Lagos, Nigeria are the cost overruns. Surprisingly, they were followed by the 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.

## II. METHODOLOGY

The current study is based on a quantitative methodology, which was chosen to specify the perspectives and assessments of contractors and consultants regarding causes that contribute to change orders and the impacts of these orders on construction projects. The study aims to rank these factors based on the Relative Importance Index (RII) method. 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. The questionnaire draft was organized to collect quantitative data into three main parts. The first part was the general and demographic information about the respondents' profile. The second part tabulated the causes of the change order and the participant was requested to state the importance of these causes in the project 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 influence of construction parties. The external factors (A) that cannot be controlled were framed, as shown in Table I. The internal factors (B) fall into the control of key parties and were divided into 3 subcategories according to the responsibility of each party involved in the project; (B1) contractor-related causes, (B2) owner-related causes, and (B3) consultant-related causes, and are presented in Tables II, III, and IV, respectively.

TABLE I. PHYSICAL CHARACTERISTICS OF THE OPC

| Item of Causes | 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 |

TABLE II. CONTRACTOR-RELATED CAUSES OF CHANGE ORDER

| Item of Causes | 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 III. OWNER-RELATED CAUSES OF CHANGE ORDER

| Item of Causes | 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 IV. CONSULTANT-RELATED CAUSES OF CHANGE ORDER

| Item of Causes | 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 and final part concludes the impacts (C) of change orders on the performance of construction projects that originated from the literature review, as shown in Table V. Responses in this part are also provided using a 5-point Likert Scale.

TABLE V. IMPACTS OF CHANGE ORDERS

| Item of Impacts | Impacts of Change Orders |
|---|---|
| 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 | Damage the company's reputation. |

### *A. 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. They examined the validity of the questionnaire and whether the survey is yielding data that reflect the main objectives of the study. The experts recommended that Environmental and Social Impact (ESI) be included in external factors as many projects face suspension due to ESI. Additionally, they recommended that the questionnaire include the lack of skilled labor due to work outside the country, the incoherent Palestinian labor market, and the documentation misinterpretation during the bid stage. They stated that the contractors will try to issue change orders due to the price underestimation during the bid phase. The experts addressed two causes of change orders originating from the owner that create alternations to project scope; the owner's failure to take decisions on time, and the lack of involvement of stakeholders in projects during the pre-construction phase.

### *B. 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, and 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. This study used Kish's method for calculating the sample size based on a 90% confidence level using (1):

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

Authors in [20] described 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 $S$ represents the variance of the population elements, $V$ is the standard error of the sampling population, and ($N$) represents the total number of populations. 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, 75 questionnaires were distributed to potential respondents across all levels within the construction industry. After collecting the responses from the distributed questionnaires, a total of 70 responses were received. 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 depicted in Table VI.

TABLE VI. IMPACTS OF CHANGE ORDERS

| | 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 |

## III. DATA ANALYSIS AND RESULTS

### *A. Demographic Profile of the Questionnaire Respondents*

An overview of the demographic information gathered from the 69 responses received from the selected sample and the variety of gathered data is provided as follows:

#### *1) The Years of Experience for Respondents*

Figure 1 illustrates the significance of construction project experience in demonstrating the relationship with the causes of change orders. The data indicate 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 subsequently to decreasing the funding from donors. The results also reveal that 2 contractors and 8 consultants have less than 5 years of experience.

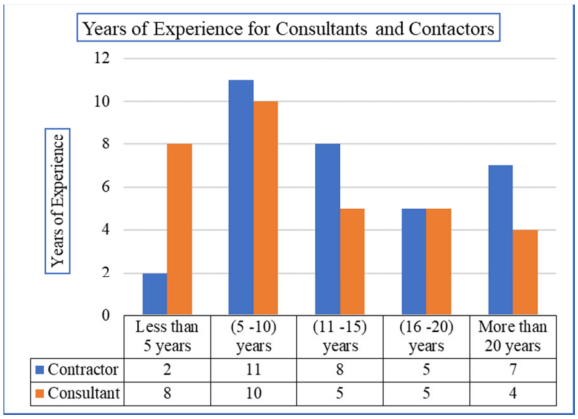


Fig. 1. Years of experience for respondents.

*2) Average Cost of Executed Projects Annually*

Figure 2 depicts the annual turnover of the respondents, which demonstrates their financial capabilities and the complexity of projects. The radar chart exhibits that the contractor, represented by the blue line, undertook a greater number of projects valued between 0.5 to 1 M $ and 1 M$ to 5 M$ compared to those valued less than 0.5 M$ and more than 5 M$. On the other hand, the consultant, represented by the orange line, displayed a relatively normal distribution of constructed projects with average values for both projects, as 7 participants reported, of less than 0.5 M$ and above 5 M$, whereas 10 individuals shared their experiences with projects valued between 0.5 M$ and 1 M$.

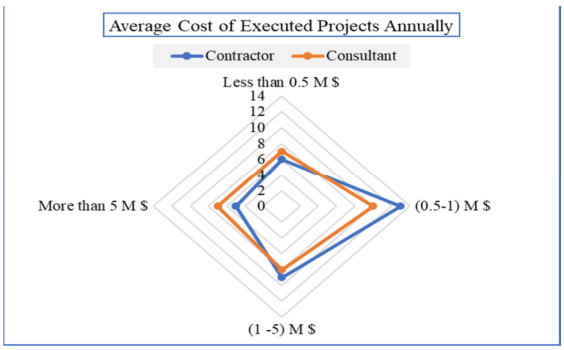


Fig. 2. Average cost of executed projects annually.

## B. Reliability Test

The reliability test was applied to measure the internal consistency between each item in one group and the whole group and between each group and the consistency of the whole questionnaire [38]. The Cronbach's alpha coefficient (α) was calculated for all groups and items and it equals 0.927, which is more than the minimum acceptable value of 0.70.

## C. Ranking the Causes and Impacts of Change Order, and the Degree of Agreement

To assess the relative significance, rank and compare the importance of various causes and impacts of change orders based on participant responses, the RII method was utilized in the current study. Authors in [20, 27] adopted the RII to rank the causes and impacts of change orders from different perspectives. The RII is an average of the values obtained and in this research, it ranges from 1 (being the lowest) to 5 (being the highest), with the score of a certain event being:

$$Score = \frac{\Sigma W}{H \times N} \times 100 \quad (2)$$

where $w$ is the weight assigned to each cause by the respondents, varying 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. The Standard Deviation (SD) was computed for each cause of change orders, as portrayed in Table VII, to assess the spread of relative importance values around the average, illustrating the degree of agreement between contractor and consultant points of view. Table VII outlines the ten most critical causes of the change order based on their RII. The findings indicated that the factors contributing to change orders in the Palestinian context differ from those identified in other studies, primarily due to variations in the economy and distinct circumstances. Additionally, the results underscore the significance of conducting research periodically, as outcomes may vary over time.

TABLE VII. TEN MOST 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 RII 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. It was revealed that the owner-related causes group ranked first with an RII of 0.70, followed by the

consultant-related group (RII = 0.69) and contractor-related group (RII = 0.64). Subsequently, the last and fourth-ranked main group is external, which aligns with the results outlined in [20, 26].

TABLE VIII. RANKING THE CAUSES OF CHANGE ORDER BY GROUP BASED ON RII

| Item | Groups of the Causes of the Change Order | N of Causes | RII for Contractors | RII for Consultants | Overall RII | Rank |
|---|---|---|---|---|---|---|
| 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 |

TABLE IX. RANKING OF THE IMPACTS OF CHANGE ORDERS BASED ON RII

| 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 | Damage to the company's reputation | 0.50 | 7 | 0.54 | 10 | 0.52 | 10 | 2.44 |

### *D. Statestestical Hypotheses*

Change order 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. Several hypotheses were tested in this regard.

#### *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. It was identified that there is a significant difference (sig<0.05, the null hypothesis is rejected) between the expertise of construction firms 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, enabling them to effectively reduce certain causes of change orders, such as design mistakes and incomplete designs [40]. Furthermore, these experienced firms may have solid connections with clients, which leads to improved interaction and comprehension of project needs and may minimize client-initiated changes and delays between the design and construction phases.

#### *2) The Size of the Construction Firms*

The second null hypothesis revealed that there is no statistically significant difference between the size of construction firms and the causes of change orders. The test showed that all significance degrees for most main causes of change orders were no more than 0.05, so the null hypothesis was accepted. Hence, the small, medium, and large construction firms agreed on the same perspective in terms of the causes of change orders. Authors in [41] demonstrated 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 is a notable discrepancy between the scale of construction corporations and a few factors that contribute to change orders, such as 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.

## IV. DISCUSSION

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. 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 alterations to specifications, requirements, and plans during the final stages of design or project construction. The consultant-related causes of change orders follow, being ranked in the second position, with an RII of 0.69. The consultant's role during the preconstruction phase is of utmost importance to mitigate potential causes that could lead to change orders. This underscores the necessity for design consultants to have experienced staff members who can develop constructible designs with minimal conflicts [42]. The group of contractor-related causes is ranked in the third spot. There have been instances where contractors have filed for bankruptcy during an ongoing construction. Therefore, it is crucial to carefully select contractors and their employees based on project-specific requirements. The fourth and last category consisted of external factors leading to change orders as these unexpected events have the potential to significantly impact the project, requiring modifications to the original plans. The most critical five causes of change orders in the Palestinian construction industry, according to contractor and consultant perceptions, based on the RII are listed below:

- Using Duplicated Documents from Previous Projects

The overall ranking exhibits that the primary cause for change orders is the use of copied documents without adjustments to address current conditions, with an RII of 0.77. 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, and water and wastewater facilities. 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 [35].

- Change in Plan and Scope by Owner

The second important cause is a shift in plans or scope initiated by the owner with RII of 0.755. This can occur for various reasons, such as the owner's demand to add new features, modify existing designs, or adapt to new needs. Although 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 that demand the initiation of change orders [5, 24, 27].

- Owner's Financial Difficulties

The owner's financial challenges hold the third position in the causes of 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 [16, 20, 35, 43].

- Poor Site Investigation Before the Design Stage

Poor site investigation, with an RII of 0.740, leading to incorrect site input data during the design phase is identified as the fourth most common cause. 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, which can be further complicated by contractor claims due to inaccuracies in the contract details [16, 24, 43].

- Errors and Omissions in Design

The occurrence of errors and omissions in design has been ranked in the fifth place, with an RII of 0.723. Authors in [44] highlighted that errors and omissions in design contribute significantly to completion delays. A project with insufficiently detailed design, inadequate coverage of all project aspects, or errors in the planning process leads to change orders in construction, impacting both work output and project schedule. It is important to stress that errors in design can result in a shortage or surplus in quantity, especially in the unit-price contract. 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, and request additional time to complete the work, resulting in the issuance of a change order [16].

The most notable five impacts of a change order for construction projects are concluded as follows:

- Time Overrun

The study shows that the time overrun is the most important impact of the change order, with an RII of 0.81. Authors in [45] mentioned that modifications will necessitate a review of the 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 by introducing additional tasks, consequently leading to project completion delays [5, 37, 46, 47, 48].

- Cost Overrun

The second most significant impact of change orders, as determined by construction parties, is the cost overrun, with an RII of 0.74. There is a high level of agreement among these parties, with an SD of 0.74 [4, 36, 49]. Authors in [1] confirmed that change orders frequently increase final project costs due to overhead expenses from delays, additional contractor payments, rework, the costs of added supervision, and the indirect costs encompassing the financial implications arising from a decline in productivity at the workplace.

- Rework and Demolition

Authors in [25] stated that 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. Authors in [14] 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 is in line with [37, 47, 50].

- Delay in Payments by the Owner

The delayed payment by the owner is ranked in the fourth place, with an RII of 0.65, as a prominent consequence of change orders [26, 35]. Authors in [25] revealed that the delay in payment can disrupt the project's financial flow, affecting the contractor's cash flow and potentially causing financial strain. Authors in [51] highlighted that in certain projects and programs in Palestine that were funded by donors, the budged was allocated without considering contingency, leading to difficulties in securing funds to address the financial implications of change orders and causing delayed payments.

- Disputes between contract parties

The fifth significant impact identified pertains to disputes between contractual parties, with an RII of 0.648. Authors in [27] explained that this effect is particularly noteworthy in

developing nations, where many changes are inadequately investigated, 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. Failure to resolve these disputes amicably may lead to arbitration or court, potentially suspending the entire project due to legal proceedings [4, 48].

## V. CONCLUSION AND RECOMMENDATIONS

The construction industry holds significant economic importance in Palestine. The understanding of 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. Through data analysis utilizing the weighted mean of the Relative Importance Index (RII) for factors within each group, it was determined that the group of internal owner-related factors plays a crucial role in causing change orders. 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 that the five critical causes of change orders are the "use of duplicated documents from previous projects", with an RII of 0.77, the "changes in plans and scope by the owner", with an RII of 0.755, the "financial challenges faced by the owner", with an RII of 0.741, the "inadequate site investigation prior to the design phase", with an RII of 0.74, and the "errors and omissions in design", with an RII of 0.723. This underscores the critical role of the preconstruction phase managed by only the consultant and the 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. The recommendations derived from the research findings along with the primary conclusion, which are further supported by the insights gained from previous studies' examination discussed in the literature review, are as follows:

### *A. Recommendation to Owner*

- Utilization of a three-dimensional model and 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 [52].
- Involvement of the owner in the recruitment of skilled project management consultants and design/supervision consultants. These consultants serve as the owner's representatives on the construction site, providing valuable insights and observations.
- The owner's decision to proceed with the project within the specified time frame and budget should be carefully considered.
- A Dispute Avoidance Adjudication Board (DAAB) should be appointed at the outset of the projects as a neutral third-party panel.
- It is essential to maintain continuous communication throughout all project phases. Regular meetings and open information exchange allow for early identification and collaborative resolution of any issues that might otherwise necessitate change orders later.

### *B. Recommendations for Consultants*

- All claims and notices submitted by contractors should be evaluated and validated. 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.
- The employment of collaborative and design communication tools, like BIM, enhances the cooperation among all construction parties and pinpoints potential design issues that may lead to change orders in the construction phase.
- Experienced designers should be employed to effectively create a design with minimal conflicts and clashes.
- The designers should be well informed about all the latest specifications and standards set by the local government authorities.
- The consultant should establish periodic checkpoints and deliverables to ensure alignment. These deliverables may include Owner Project Requirements (OPR), Basis of Design (BOD), Schematic Design, Design Development, and Construction Documents.

### *C. Recommendations for Contractors*

- Contractors must maintain a positive cash flow incorporating a contingency fund throughout their projects by securing solid financial planning that involves creating realistic project budgets, maintaining accurate financial records, and implementing cash flow management strategies.
- The use of lean construction methods for waste minimization, the utilization of the latest techniques in project management and communication, and fostering a culture of quality workmanship are expected to minimize rework and delays.
- It is crucial for the contractor to carefully select subcontractors and employees based on the specific project requirements as any shortcomings in the performance of subcontractors directly impact the contractor.
- The contractor must have a comprehensive understanding of all the contractual clauses and specific provisions to execute the work effectively and prevent any discrepancies

between the verbal instructions provided by the consultant and the contractual obligations.

- 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.

## REFERENCES


[1] M. Alzara, "Exploring the Impacts of Change Orders on Performance of Construction Projects in Saudi Arabia," *Advances in Civil Engineering*, vol. 2022, 2022, Art. no. 5775926, https://doi.org/10.1155/2022/5775926.

[2] O. Awad, *Press Report on Economic Forecasts for 2023*, Ramallah, Palestine: Palestinian Central Bureau of Statistics, 2023.

[3] K. K. Naji, M. Gunduz, and A. F. Naser, "The Effect of Change-Order Management Factors on Construction Project Success: A Structural Equation Modeling Approach," *Journal of Construction Engineering and Management*, vol. 148, no. 9, Sep. 2022, Art. no. 04022085, https://doi.org/10.1061/(ASCE)CO.1943-7862.0002350.

[4] A. A. Maamari and F. Khan, "Evaluating the Causes and Impact of Change Orders on Construction Projects Performance in Oman," *International Journal of Research in Entrepreneurship & Business Studies*, vol. 2, no. 1, pp. 41–50, Jan. 2021, https://doi.org/10.47259/ijrebs.215.

[5] P. Keane, B. Sertyesilisik, and A. D. Ross, "Variations and Change Orders on Construction Projects," *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, vol. 2, no. 2, pp. 89–96, May 2010, https://doi.org/10.1061/(ASCE)LA.1943-4170.0000016.

[6] J. N. Desai J. Pitroda, and J. J. Bhavsar, "A Review On Change Order And Assessing Causes Affecting Change Order In Construction," *Journal of International Academic Research For Multidisciplinary*, vol. 2, no. 12, pp. 152–162, 2015.

[7] O. İlter and T. Çelik, "Investigation of Organizational and Regional Perceptions on the Changes in Construction Projects," *Teknik Dergi*, vol. 32, no. 6, pp. 11257–11286, Nov. 2021, https://doi.org/10.18400/tekderg.595995.

[8] T. Hsieh, S. Lu, and C. Wu, "Statistical analysis of Causes for Change Orders in Metropolitan Public Works," *International Journal of Project Management*, vol. 22, no. 8, pp. 679–686, Nov. 2004, https://doi.org/10.1016/j.ijproman.2004.03.005.

[9] M.-J. Lee, A. S. Hanna, and W.-Y. Loh, "Decision Tree Approach to Classify and Quantify Cumulative Impact of Change Orders on Productivity," *Journal of Computing in Civil Engineering*, vol. 18, no. 2, pp. 132–144, Apr. 2004, https://doi.org/10.1061/(ASCE)0887-3801(2004)18:2(132).

[10] K. H. Mohammad, N. S. Ali, and B. M. Najm, "Assessment of the Cost and Time Impact of Variation Orders on Construction Projects in Sulaimani Governorate," *Journal of Engineering*, vol. 27, no. 2, pp. 106–125, Feb. 2021, https://doi.org/10.31026/j.eng.2021.02.08.

[11] J. A. Alsuliman, "Effective Stakeholder Engagement in Variation Order Management at the Design Stage of Public Sector Construction Projects in Saudi Arabia," Ph.D. dissertation, Institute for Infrastructure & Environment, Heriot-Watt University, Edinburgh, UK, 2014.

[12] T. D. Laksono and D. S. Wiyanti, "Analysis of the Cause and Effect of Contract Change Order on Construction Projects in Banyumas Regency," *International Journal of Engineering Technologies and Management Research*, vol. 11, no. 7, pp. 14–25, Jul. 2024, https://doi.org/10.29121/ijetmr.v11.i7.2024.1476.

[13] *General Conditions of the Contract for Construction*, Washington, DC, USA: American Institute of Architects, 2017.

[14] I. Mahamid, "Effect of Change Orders on Rework in Highway Projects in Palestine," *Journal of Financial Management of Property and Construction*, vol. 22, no. 1, pp. 62–76, Apr. 2017, https://doi.org/10.1108/JFMPC-03-2016-0015.

[15] I. A. Rashid, M. A. El-Mikawi, and M. E. Abdel-Hamid Saleh, "The Impact of Change Orders on Construction Projects Sports Facilities Case Study". *Journal of American Science*", Vol. 8, no. 8, 2012.

[16] W. M. A. Khalifa and I. Mahamid, "Causes of Change Orders in Construction Projects," *Engineering, Technology & Applied Science Research*, vol. 9, no. 6, pp. 4956–4961, Dec. 2019, https://doi.org/10.48084/etasr.3168.

[17] S. El-Sayegh, I. Ahmad, M. Aljanabi, R. Herzallah, S. Metry, and O. El-Ashwal, "Construction Disputes in the UAE: Causes and Resolution Methods," *Buildings*, vol. 10, no. 10, Oct. 2020, Art. no. 171, https://doi.org/10.3390/buildings10100171.

[18] Q. Hao, W. Shen, J. Neelamkavil, and R. Thomas, "Change Management in Construction Projects," in *Proceedings of the 25th W78 International Conference on Information Technology:Improving the Management of Construction Projects through IT Adopation*, Santiago, Chile, 2008, pp. 387–396.

[19] D. Alleman, A. L. C. Antoine, M. S. Stanford, and K. R. Molenaar, "Project Delivery Methods' Change-Order Types and Magnitudes Experienced in Highway Construction," *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, vol. 12, no. 2, May 2020, Art. no. 04520006, https://doi.org/10.1061/(ASCE)LA.1943-4170.0000380.

[20] A. Enshassi, F. Arain, and S. Al-Raee, "Causes of Variation Orders in Construction Projects in the Gaza Strip," *Journal of Civil Engineering and Management*, vol. 16, no. 4, pp. 540–551, Dec. 2010, https://doi.org/10.3846/jcem.2010.60.

[21] J. E. Koch,, D. D. Gransberg, and K. R. Molenaar, *Project Administration for Design-Build Contracts: A Primer for Owners, Engineers, and Contractors*, Reston, Virginia, USA: American Society of Civil Engineers, 2010, https://doi.org/10.1061/9780784410752.

[22] *Construction Extension to the PMBOK® Guide*, Newtown Square, Pennsylvania, USA: Project Management Institute, 2016.

[23] N. Nurisra, M. Mubarak, M. Mahmuddin, and M. R. Hariska, "The Potential Causes of Contractual Change Orders Sourced from the Construction Phase of the Building Project," in *E3S Web of Conferences*, vol. 476, 2024, Art. no. 01055, https://doi.org/10.1051/e3sconf/202447601055.

[24] A. Alshdiefat and Z. Aziz, "Causes of Change Orders in the Jordanian Construction Industry," *Journal of Building Construction and Planning Research*, vol. 6, no. 4, pp. 234–250, 2018, https://doi.org/10.4236/jbcpr.2018.64016.

[25] A. R. Khoso, J. S. Khan, R. U. Faiz, and M. A. Akhund, "Assessment of Change Orders Attributes in Preconstruction and Construction Phase," *Civil Engineering Journal*, vol. 5, no. 3, pp. 616–623, Mar. 2019, https://doi.org/10.28991/cej-2019-03091273.

[26] A. R. Gheraba, C. B. Fedler, D. Pati, M. Schmidt, M. Darwish, A. Nejat, and B. Wade, "Causes, Effects, and Control Measures of Construction Change Orders in the U.S.," *Journal of Civil Engineering and Architecture*, vol. 17, no. 2, pp. 57-72, Feb. 2023, https://doi.org/10.17265/1934-7359/2023.02.001.

[27] A. S. Alnuaimi, R. A. Taha, M. Al Mohsin, and A. S. Al-Harthi, "Causes, Effects, Benefits, and Remedies of Change Orders on Public Construction Projects in Oman," *Journal of Construction Engineering and Management*, vol. 136, no. 5, pp. 615–622, May 2010, https://doi.org/10.1061/(ASCE)CO.1943-7862.0000154.

[28] K. V. Prasad, V. Vasugi, R. Venkatesan, and N. S. Bhat, "Critical Causes of Time Overrun in Indian Construction Projects and Mitigation Measures," *International Journal of Construction Education and Research*, vol. 15, no. 3, pp. 216–238, Jul. 2019, https://doi.org/10.1080/15578771.2018.1499569.

[29] M. O. Sanni-Anibire, R. Mohamad Zin, and S. O. Olatunji, "Causes of Delay in the Global Construction Industry: A Meta Analytical Review," *International Journal of Construction Management*, vol. 22, no. 8, pp. 1395–1407, May 2022, https://doi.org/10.1080/15623599.2020.1716132.

[30] A. Senouci, A. Alsarraj, M. Gunduz, and N. Eldin, "Analysis of Change Orders in Qatari Construction Projects," *International Journal of Construction Management*, vol. 17, no. 4, pp. 280–292, Oct. 2017, https://doi.org/10.1080/15623599.2016.1211973.

[31] N. K. Acharya, Y. Dai Lee, and H. Man Im, "Conflicting Factors in Construction Projects: Korean Perspective," *Engineering, Construction and Architectural Management*, vol. 13, no. 6, pp. 543–566, Jan. 2006, https://doi.org/10.1108/09699980610712364.

[32] M. A. Lokhande and F. S. Y. Ahmed, "Assessing Consequences of Change Request Impact in Construction Industry of Yemen: An Explorative Likert-Scale Based Survey Design," *Management*, vol. 5, no. 5, pp. 141–147, 2015.

[33] W. Sherif, "Impact of Variation Orders on Performance of Repetitive Residential Projects in Egypt," M. S. Theses, Dept. of Construction and Architectural Engineering, American University in Cairo, Egypt, 2016.

[34] N. T. I. Homaid, A. I. Eldosouky, M. A. Al-Ghamdi, "Change Orders in Saudi Linear Construction Projects," *Emirates Journal for Engineering Research*, vol. 16, no. 1, pp. 33-42, 2011.

[35] K. H. M.karim, N. Ali, and B. Majeed, "The Causes of Variation Orders and their Effects on Cost and Time of Projects in Sulaimani Governorate," *Kurdistan Journal of Applied Research*, vol. 5, no. 1, pp. 218–235, Jun. 2020, https://doi.org/10.24017/science.2020.1.16.

[36] L. O. Oyewobi, R. Jimoh, B. O. Ganiyu, and A. A. Shittu, "Analysis of Causes and Impact of Variation Order on Educational Building Projects," *Journal of Facilities Management*, vol. 14, no. 2, pp. 139–164, May 2016, https://doi.org/10.1108/JFM-01-2015-0001.

[37] O. J. Oladiran, C. N. Umeadi, and D. A. Onatayo, "Evaluating Change Orders and their Impacts on Construction Project Performance in Lagos, Nigeria," *FUTY Journal of the Environment*, vol. 12, no. 2, pp. 81–89, Dec. 2018.

[38] W. Tan, *Research Methods: A Practical Guide For Students And Researchers*, 1st ed. Singapore: World Scientific Publishing Company, 2017.

[39] J. W. Johnson and J. M. Lebreton, "History and Use of Relative Importance Indices in Organizational Research," *Organizational Research Methods*, vol. 7, no. 3, pp. 238–257, 2004, https://doi.org/ 10.1177/1094428104266 510.

[40] V. Moayeri, "Design Change Management in Construction Projects Using Building Information Modeling (BIM)," Ph.D. dissertation, Building, Civil and Environmental Engineering Dept., Concordia University, Montreal, Canada, 2017.

[41] S. T. Do, V. T. Nguyen, and N. H. Nguyen, "Relationship Networks Between Variation Orders and Claims/Disputes Causes on Construction Project Performance and Stakeholder Performance," *Engineering, Construction and Architectural Management*, vol. 30, no. 9, pp. 3817–3839, Jun. 2022, https://doi.org/10.1108/ECAM-01-2022-0066.

[42] C. K. I. Che Ibrahim, S. Belayutham, M. Z. Mohammad, and S. Ismail, "Development of a Conceptual Designer's Knowledge, Skills, and Experience Index for Prevention through Design Practice in Construction," *Journal of Construction Engineering and Management*, vol. 148, no. 2, Feb. 2022, Art. no. 04021199, https://doi.org/10.1061/(ASCE)CO.1943-7862.0002234.

[43] M. A. Lokhande, M., F. Saif, and Y. Ahmed, "Assessing Consequences of Change Request Impact in Construction Industry of Yemen: An Explorative Likert-Scale Based Survey Design," *Management*, vol. 5, no. 5, pp. 141-147, 2015, https://doi.org/10.5923/j.mm.20150505.01.

[44] A. D. Azar, C. Militaru, and C. P. Mattar, "Construction Design-Phase Errors and their Impacts on Project Performance Case Study of Lebanese Local Applications," *International Journal of Engineering and Information Systems*, vol. 2, no. 7, pp. 42–46, Jul. 2018.

[45] T. Kontogiannis, "Adapting Plans in Progress in Distributed Supervisory Work: Aspects of Complexity, Coupling, and Control," *Cognition, Technology & Work*, vol. 12, no. 2, pp. 103–118, Jun. 2010, https://doi.org/10.1007/s10111-010-0150-7.

[46] A. Alaryan, E. Elbeltagi, A. Elshahat and M. Dawood,"Causes and Effects of Change Orders on Construction Projects in Kuwait," *Journal of Engineering Research and Applications"*, vol. 4, no. 7, pp. 1-8, Jul. 2014.

[47] S. Y. M. Mahmoud and E. A. E. M. Elshaikh, "The Potential Effects of Variation Orders on Building Projects in Khartoum State-Sudan," *International Journal of Construction Engineering and Management*, vol. 8, no. 2, pp. 70–79, 2019.

[48] M. Msallam, M. Abojaradeh, B. Jrew, and I. Zaki, "Controlling Of Variation Orders in Highway Projects in Jordan," *Journal of Engineering and Architecture*, vol. 3, no. 2, pp. 95-104, Jan. 2015, https://doi.org/10.15640/jea.v3n2a11.

[49] N. Elshaboury, Y. Mohamed, and A. Elsaid, "Overall Ranking of the Most Influential Causes and Impacts of Variation Orders in Arab Construction Projects," in *Proceedings of the 2nd International Conference on Applied Economics and Social Science*, Batam, Indonesia, 2020, pp. 331–339, https://doi.org/10.5220/ 0010358003310339.

[50] A. H. Memon, I. A. Rahman, and M. F. A. Hasan, "Significant Causes and Effects of Variation Orders in Construction Projects," *Research Journal of Applied Sciences, Engineering and Technology*, vol. 7, no. 21, pp. 4494–4502, Jun. 2014, https://doi.org/10.19026/rjaset.7.826.

[51] R. Morrar and S. Sultan, "The Donor-Driven Model and Financial Sustainability: A Case Study from Palestinian Non-Government Organizations," *Cosmopolitan Civil Societies: An Interdisciplinary Journal*, vol. 12, no. 2–3, Nov. 2020, https://doi.org/10.5130/ccs.v12.i2-3.6771.

[52] M. Abuaddous, J. A. A. Al-Btoosh, M. A. K. Al-Btoush, and A. J. Alkherret, "Building Information Modeling Strategy in Mitigating Variation Orders in Roads Projects," *Civil Engineering Journal*, vol. 6, no. 10, pp. 1974–1982, Oct. 2020, https://doi.org/10.28991/cej-2020-03091596.