
**Arab American University**

**Faculty of Graduate Studies**

# Studying Construction Resource Factors Affecting Cost Overrun in Construction Projects in Palestine

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# Thesis Approval

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## Declaration

This thesis is submitted for the purpose of fulfilment of the requirement of Master's Degree in Construction Management, Arab American University –AAUP,2024, I declare that this research is my own, unaided work. It has not been submitted before for any other degree, part of degree, or examination at this or any other university

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Date: 17 /4 / 2024

**الاهداء**

**الى من سقت ارواحهم الطاهرة تراب الوطن... شهدائنا الابرار**

**الى اساطير الصمود ... اسرانا البواسل**

**الى الشامخة المتفانية في العطاء .. أمي الغالية**

**الى مصدر فخري و اعتزازي ...ابي الغالي , أخواني, أخواتي الاعزاء**

**الى رفيق دربي في الكفاح و مصدر قوتي و الهامي .. زوجي الغالي**

**الى أجمل عطايا الرحمن .. أطفالي فلذات الأكباد**

**الى عائلتي الثانية التي لم تبخل يوما بالعطاء...**

**الى الزملاء و الأصدقاء الأوفياء ...**

**فداء حمدان عبد العزيز أحمد**

**شكر و عرفان**

**يسعدني ان اتقدم بجزيل شكري و عظيم امتناني و تقديري الى كل من قدم جهدا في ابراز هذه الرسالة الى حيز الوجود.**

**الى استاذي الدكتور ابراهيم محاميد , لما بذله من جهد و متابعة في اشرافه على اعداد هذه الرسالة, فقد كان لتوجيهاته عظيم الأثر لاخراج الرسالة بافضل حال.**

**و اتقدم بجزيل الشكر الى كافة الزملاء و الاصدقاء المهندسين و المهندسات الذين كان لهم أثر كبير في الاثراء العلمي للرسالة و وضع بصمة واضحة فيها .**

**الى زملائي و زميلاتي في مرحلة دراسة الماجستير في الجامعة,**

**وأخيرا، أود أن أشكر زوجي على حبه ودعمه و مساندته لي وتحمل الوقت الذي قضيته في العمل على بحثي.**

**فداء حمدان عبد العزيز أحمد**

## Abstract;

The construction industry plays a vital role in driving economic growth by contributing to infrastructure development, generating economic activity, and creating job opportunities. Its influence extends to various related industries, serving as a key indicator of a country's economic health. However, the construction industry faces challenges worldwide, particularly in developing countries. The Palestinian construction industry, like others, grapples with issues such as construction cost overruns, which not only affect the industry itself but also impede progress in other areas. Managing construction resources is identified as a key factor influencing costs.

This research aims to investigate the resource-related factors that contribute to cost overruns in the Palestinian construction industry. The primary objectives include investigating the extent of cost overruns in construction projects, assessing the importance of resource-related factors contributing to these overruns, gauging the significance of each factor from the viewpoint of stakeholders (contractors, consultants, and owners), and determining their effects on the Palestinian construction industry.

A structured questionnaire survey was designed to collect primary data to assess the importance of resource-related factors contributing to these overruns and their effects. The research population were obtained through a stratified sampling method, randomly selecting participants, which includes contractors, consultants, and owners as the primary stakeholders involved in construction projects. The distributed questionnaires were 195, while the total number of completed returned questionnaires were 154 questionnaires, with a response rate of 79 %. The questionnaire was divided into three sections, the first part capturing general information about respondents, the second delved into the resource-related factors affecting the cost overruns, the selection of these factors was based on reviewing of literatures and prior studies focusing on similar subjects, and the third discussed the effects of cost overruns.

Different data analysis techniques were employed, including simple statistical approaches like as correlation coefficients ranks, Spearman's correlation scale, One-Way ANOVA for variance analysis, and Bonferroni analysis for comparing means and identifying significant differences.

The researches findings highlight a dominant presence of small to medium-sized enterprises in the Palestinian construction industry, and highlights the common occurrence of cost overruns in construction projects, with 46.8% of companies experiencing overruns in the 20-40% range and 30.5% facing even higher overruns more than 40%. The top five resource-related factors leading to cost overrun in Palestinian construction projects were: the availability of skilled labors, availability of equipment, labors productivity, financial difficulties of contractor and cash flow, inaccurate cost estimate, respectively. Moreover, results reveal that the top important effects were: losses in contractor and owner profits, delays in construction projects and loss of contractor reputation, respectively. Moreover, the study offers practical implications and essential recommendations for contractors, consultants, and owners aimed at preventing and mitigating cost overruns in construction projects.

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# Chapter One: Introduction

## 1.1. Overview

The construction industry is notorious for facing challenges such as exceeding budgets, timeline extensions, quality deviations, and goal changes, which largely attributed to poor communication within project frameworks (Guérin, 2014). Recognizing construction as a vital sector for a nation's economic development and strategic plan fulfillment (Eleyan, 2018), it is evident that the industry contributes significantly to economic expansion and overall national progress (Lopes, 2011; Ofori, 2012a; Ofori, 2015). Construction's impact on gross domestic product (GDP), especially in developing countries, underscores its pivotal role in shaping a country's economic landscape (Gardezi et al., 2013). Consequently, any changes or challenges affecting the construction sector have a broad impact on the entire economy of a country.

The construction industry is marked by fragmentation and complexity and powered by resources, compared to other industries (Memon et al., 2011; Papadopoulos, 2016). It grapples with challenges like inadequate productivity, poor quality, time and cost overruns, and communication gaps among project participants (El-Sawalhi & Eleyan, 2022). The unique nature of construction projects, involving numerous stakeholders across various sectors, poses a substantial challenge in managing the industry effectively. Given the industry's competitive and complex nature, completing projects within set budgets and timelines is a primary objective (Subramani et al., 2014). The construction industry is currently grappling with significant financial losses attributed to insufficient time and cost management, which has emerged as a critical issue, impacting both developed and developing nations (Gaurang, 2020).

Cost overruns, a common issue in construction projects, are particularly widespread in developing countries (Ahiaga-Dagbui, 2017). There were more cases of cost overruns than time overruns, it should be observed, as a result, the issue of cost overruns becomes extremely significant (Kasimu, 2012). Factors such as the cost of inputs, raw materials, and inflation, both locally and internationally, contribute to cost escalation in construction industry (El-Sawalhi & Eleyan, 2022), and often lead to conflicts among project parties (Creedy, 2010). The significance of adhering to planned budgets is emphasized by the detrimental effects of cost overruns, with instances of projects exceeding initial budgets by substantial percentages which sometimes exceeds more than half of what was originally budgeted for the work (Gaurang, 2020).

Developing countries experience a more pronounced trend of cost overruns, as evidenced by many cases. For instance, as illustrated by Adam et al. (2017), the cost of WB (World Bank)-sponsored projects has increased by 63% over their allocated budget. Moreover, Ahbab (2012) indicated that the cost overrun in Turkey's "state and provincial roads project" was almost 56.4% of the planned budget. It has been discovered that the trend is more severe in these developing countries (Azhar and Farouqui ,2008).

The success of construction projects hinges not only on the quality and quantity of work but also significantly on the effective management and allocation of required resources, failure to complete project activities within the allocated resource and time constraints can significantly impact the project's overall duration and cost (Nagaraju et al., 2012).

The essential means of production, including resource categories of manpower, materials, money, and equipment, are integral to project activities (Nagaraju et al., 2012). Effective management of construction resources, budget allocation, construction methodologies, and communication are crucial factors for achieving success in cost

performance (Othman et al., 2014). Adequate availability and efficient management of resources significantly impact project outcomes, emphasizing the importance of arranging and ensuring provision for resources at each construction stage (Meeampol & Ogunlan, 2006; Rahman et al., 2013).

## 1.2. Risk in construction

Due to the inherent characteristics of the construction industry, encompassing its operations, procedures, environments, and organizational structures, there is a notable association between construction projects and a high level of risk. This heightened risk has been a focal point of concern, particularly in relation to time and cost overruns in construction projects (Kartam & Kartam, 2001). The sources of risk in this context are diverse, ranging from fluctuations in profit margins, competitive bids, and market conditions to site productivity, political and weather variables, inflation, and contractual rights, as outlined by Karimiazari et al. (2011). Various categories of risk are identifiable within construction contracts as highlighted in (Al-Hallaq, 2003), covering aspects such as:

- physical works
- delays and disputes
- direction and supervision
- harm to individuals and property
- external causes, payments
- legal and arbitration considerations.

Construction projects are characterized by a multitude of interconnected and disparate processes, introducing numerous risk factors that can impact the project. To establish an effective risk management plan, the initial step involves identifying the primary risk factors that exert the most significant influence on project objectives (Rezakhani, 2012). This underscores the pivotal role of risk management in determining the success or failure of construction projects. Risk management, as a strategic approach, involves the identification and analysis of potential dangers, responsive handling through appropriate risk-mitigation strategies, and ongoing control and monitoring of risks (Mahendra et al., 2013).

The implementation of risk management practices holds the potential to enhance construction project management by optimizing resource utilization and achieving project objectives in terms of time, cost, and quality (Banaitiene & Banaitis, 2012).The primary challenge facing the construction industry lies in effectively managing the risk of cost overruns and ensuring that projects are completed within the estimated budget, to address this risk, specific project-related considerations demand heightened attention (Jackson, 2002). Construction companies must overcome these risks and uncertainties in order to work on assessing the impact of their sources by identifying which projects are the most dangerous, preparing plans for possible sources of risks that may occur in each project, and managing each of them during construction (Zayed et al., 2008). This strategic approach is crucial for mitigating the adverse effects of cost overruns and enhancing the overall success of construction projects.

## 1.3. Construction industry in Palestine

The construction industry holds a pivotal position in Palestine, being one of the largest and most vital economic sectors that propels the national economy forward. Its significance is underscored by its substantial contributions, encompassing the provision of housing and services, infrastructure development, and the absorption of labor resources (Mahamid & Dmaidi, 2013). As of 2021, the Palestinian Central Bureau of Statistics (PCBS) reported that the construction industry accounted for approximately 8% of the Palestinian GDP. This sector not only plays a crucial role in economic output but has also been instrumental in generating employment opportunities for the Palestinian workforce, as highlighted by Enshassi et al. (2003). Consequently, the construction industry's impact extends beyond economic growth, actively addressing unemployment challenges and fostering overall economic development in the country.

Despite the considerable success of the Palestinian construction sector in terms of contributing to economic growth, GDP, and employment, as well as partially meeting local societal demands, it faces challenges preventing it from playing a more comprehensive role, as is the case in surrounding and developing countries (Enshassi et al., 2006). According to Al-Najjar (2008), these challenges impact the sector's time, cost, and quality performance. Some of these challenges include:

- an excess of labors number
- border closures
- shortages in market materials
- reliance on Israel and other nations for building materials
- rising material prices

- dependence on donor nations for funding
- unstable political and economic situation connected to the Israeli context.

Additionally, local construction projects have faced underperformance due to factors such as material scarcity, insufficient coordination among project partners, excessive design and drawing modifications, ineffective monitoring and feedback, and a lack of project leadership abilities (UNRWA, 2006, cited in Enshassi, 2009). Palestinian construction industry, as in many other developing countries, grapples with numerous factors related to resources that significantly impact the cost of construction projects, often leading to cost overruns. The factors include the supply of raw materials and equipment by contractors, the volatility of material prices, inaccuracies in cost estimation, fluctuations in the costs of building materials, monopolization of project materials by suppliers, currency instability, inflationary pressure, and concerns regarding the availability and adequacy of machinery and equipment crucial for completing project tasks and activities. These factors have been extensively discussed and documented by researchers such as Enshassi et al. (2010), Mahamid & Dmaidi (2013), and El-Sawalhi & Eleyan (2018). Their insights shed light on the multifaceted nature of resource-related challenges within the construction industry in Palestine and underline the importance of addressing these issues for successful project management and cost control.

## 1.4. Statement of the problem

Any project parties' primary goal is to complete the project within the three project criteria of time, cost, and quality. Economic, social, and political obstacles overshadow the construction of complicated projects and civil engineering works, these challenges impact

the cost and aspects that engineers have sometimes less readiness to appreciate it (El-Sawalhi & Eleyan ,2022). Cost overruns are a huge challenge, which hinders project's progress, as they reduce the profit of the contractor and increases the burden on the owner which leads to huge losses and leaving the project in a big problem. In addition, it is considered as a worldwide problem that impacts the relationships between project parties and stockholders involved in the project (owners, project managers, and contractors) (Creedy et al., 2010), and the cost overruns results in many difficulties in finance new investments and developments. Many of previous studies observed that the problem is more sever and more widespread in the developing countries (Azhar et al.,2008; Gaurang, 2020; Al-Momani,1996; Kasimu, 2012; Ahiaga-Dagbui,2017).

The increase of project construction costs in the past few years is considered to have significant financial constraints on the country's construction industry expansion. Also, the uncontrolled growth in these costs has had a severe impact on financial planning of building programs by owners and donors, since complying to the tight standards of financing institutions such as international banks and donors has been difficult (El-Sawalhi & Eleyan ,2022). Thus, failure to manage project costs prudently results in cost overruns and difficulties in making investment decisions. So, defining the actual reasons of cost overruns is critical in order to limit and avoid increasing costs in any construction project, as well as to avoid any other bad consequences.

A few researches have been implemented to study and analyze cost overrun and to determine the factors of cost overrun in construction projects in Palestine, while the general observations show that cost overruns are common in the Palestinian construction sector. As a result, this study is thought to be quite important in identifying the problems in cost estimating and the main factors influencing cost overruns related to construction

resources in order to avoid and control the negative impact of those factors and improve the construction sector performance to support the Palestinian economy.

## 1.5. Significance of the study

As construction projects grow more frequent, the issue of cost overruns becomes a serious concern that requires attention. Palestine experiences issues with cost increases in construction projects for a variety of reasons and factors. Undertaking this research will help identifying the key construction resource-related factors influencing cost overruns of construction projects in Palestine and define the most severe factors leading to it.

So, the findings of the study therefore give construction organizations the ability to prioritize on which factors to focus in order to mitigate the effects of cost overrun, also taking practices concerning in mitigating problems which may arise through the project resources management. It also encourages additional researches on cost overrun issues in Palestine based on the identified factors by other researchers. Finally, the results of this study give various stakeholders working in the Palestinian construction industry and developing nations in general crucial science-based data from the discoveries and recommendations regarding factors that contribute to cost overruns in construction projects that can be used for improving their construction projects.

## 1.6. Objectives of the study

The aim of this research is to identify factors that are related to construction resources which lead to cost overrun in construction projects in Palestine.

**Sub-objectives:**

1. Determine the extent of cost overrun in construction projects in Palestine;
2. Investigate the resource related factors leading to the cost overrun in Palestinian construction industry.
3. Rank resource-related factors leading to cost overrun in construction projects according to project parties' perspectives.
4. Determine the relationship between resource-related factors leading to cost overrun in construction projects.
5. Determine the potential effects of cost overrun on the construction sector in Palestine; and
6. Suggest practical and recommended actions to deal with the issues raised by potential cost overrun in construction projects in Palestine.

## 1.7. Study Hypothesis

The null hypothesis serves as the foundation for hypothesis formulation, encompassing four distinct statements as follows:

**Null Hypothesis #1:**

"There is a low occurrence of cost overruns throughout companies' projects in the construction industry in Palestine".

**Null Hypothesis #2:**

"There is no agreement or consistent pattern in the ranking of the construction resource-related factors contributing to cost overruns across the perspectives of contractors, consultants, and owners in Palestine".

**Null Hypothesis #3:**

"There is no relationship between resource-related factors contributing to the cost overruns in Palestinian construction projects".

**Null Hypothesis #4:**

"Inefficient allocation of resources was the most severe effect of cost overruns in Palestinian construction industry".

## 1.8. Study approach

The descriptive analytical approach was followed to find out and evaluate the causes and factors related to construction resources that affect the cost of construction projects, through a set of data that was collected by designing a questionnaire and distributed to a number of stakeholders in the construction industry, including contractors, consultants and owners. Statistical analysis was used to analyze the data as an introduction to the stage of interpretation and generalization of the results to reach recommendations, Figure 1 describes the study approach.

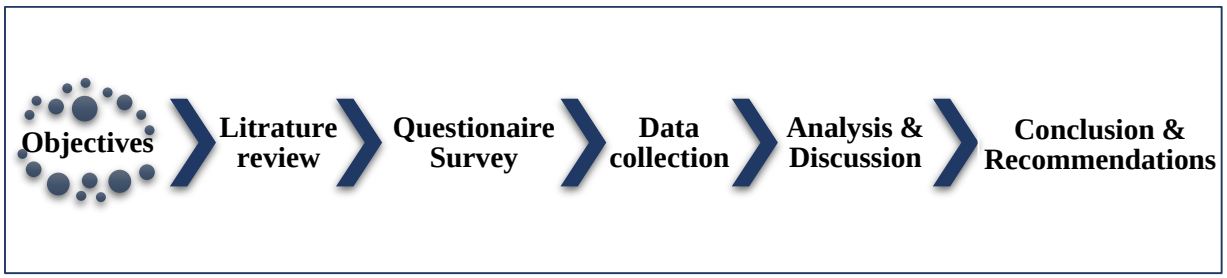


**Figure 1**:The study approach

## 1.9. Thesis organization

This thesis is organized and divided into five chapters as follows:

**Chapter one:** includes introduction and the study background, problem statement, study objectives, hypothesis, significance of the study, study approach and study organization.

**Chapter two:** It is mainly concerned with the literature review of the study, by reviewing of the previous theoretical and empirical literatures, so it includes the parts of: cost overrun definitions, factors and causes of cost overruns, cost overruns effects on construction projects and construction resources.

**Chapter three:** it discusses methodology and approach of the study, the study's structure, data source and collecting method, population and size of sample, sampling method, data analysis process, assessment of reliability and validity for the collected data, and data coding.

**Chapter four:** it covers the discussion of data collected and analyzed. For the study, it includes the findings on resources related factors that causes the problem of cost overrun in construction projects in Palestine, also the results of analysis of these factors, also results of cost overrun effects.

**Chapter five:** it summarizes the conclusion, recommendations of the study, limitations and proposed future studies.

# Chapter Two: Literature Review

## 2.1. General Overview

Cost overrun is a pervasive challenge that strikes a majority of projects within the construction industry, comprising various types such as roads, buildings, sewage, and water infrastructure. This issue has become progressively more severe over time, and the implications of cost overruns extend beyond mere financial concerns, often leading to

delays, compromised quality, and strained resources. studying this problem requires reviewing the past studies about construction cost overrun and its factors.

This chapter provides an overview of previous studies addressing the issue of cost overrun globally. It begins by introducing a general overview of costs in construction projects, classification of construction costs and cost overruns and its definitions. Further, a detailed review is conducted about the common causes of cost overrun in the construction industry and cost overrun factors shows in a table with references to a number of relevant scientific research papers, then construction resources are identified and factors causes cost overrun related to construction resources are explained, the implications and effects of overrun costs in construction projects and impact level are discussed.

## 2.2. Overview on cost overrun

Due to the distinctive characteristics of construction projects, setting them apart from other endeavors, they undergo a series of interrelated and consecutive phases necessitating involvement from various stakeholders. Beyond their inherent uniqueness, complexity, and substantial risk (Aljohani,2017), these projects are further characterized by a specific timeframe and considerably higher costs compared to other types of projects. Moreover, their divergent nature is influenced by varying circumstances. Many projects also encounter a multitude of challenges, with cost overruns emerging as a prominent issue. It is no longer a reasonable expectation for projects to conclude within their initially estimated costs and budgets (Gaurang, 2020). Therefore, achieving the project's anticipated cost is a fundamental benchmark for the accomplishment of any project (Memon et al., 2011).

Cost overruns are a pervasive issue in construction projects worldwide (Bekr, 2015; Rahman,2013; El-Ahwal et al., 2016), causing financial strain and compromising project success. (Creedy et al., 2010) indicated that this global phenomenon impacting the dynamics among project parties including contractors, clients and project managers. According to (Aljohani, 2017), it was observed that the construction sector often struggles with a negative track record in successfully adhering to budgetary constraints when completing projects, furthermore, it is a common occurrence that approximately ninety percent of projects encounter the issue of exceeding projected costs.

Projects have the potential to be finished within its designated budget; however, achieving this necessitates an accurate initial estimation, adherence to disciplined project management practices, and a thorough recognition of elements and factors that could lead to cost overrun (Shane et al., 2009). This requires identifying the notable factors and reasons that result in exceeding the budget and estimated cost in order to avoid the issue of cost overrun in construction projects.

## 2.3. Construction costs classification

Various types of costs exist within construction projects, including costs of labors, materials, plant and machinery, administration, and other miscellaneous expenses (Amser,2020). Construction costs are categorized into two main groups: "Direct costs" and "Indirect costs" (alternatively referred to as "Overhead costs").

The terms direct costs, indirect costs, and overhead costs exhibit variability in interpretation across different construction firms. A brief examination of construction costs literature reveals a range of definitions for these terms. The distinction between

direct and indirect costs is addressed in diverse ways within the literature discussing construction costs. Table 1 outlines three approaches to defining direct and indirect costs, each rooted in specific conceptual frameworks. Ahuja and Campbell (1988) employed the "final placement" approach, while Coombs and Palmer (1989) adopted the "accountability" approach. Additionally, Pratt (1995) utilized the "quantity survey" approach in his research.

**Table 1**:Approaches of defining direct and indirect costs

| Approach | Direct costs | Indirect costs |
|---|---|---|
| **Final placement**<br><br>**(Ahuja and Campbell, 1988)** | Direct costs: expenses that involve manpower, materials, production machines, and supplies that are integral to the creation of a specific component within the finished project. direct costs are those directly associated with the final placement of the project. | Indirect costs encompass various items that do not directly contribute to the completed work, including contractors' overheads, profit margins, contingencies, escalation, and interest incurred during the construction period. |
| **Identification for Accountability**<br><br>**(Coombs and Palmer ,1989)** | The direct construction cost encompasses any expense that can be distinctly attributed to a particular construction project and the specific unit of production within that project. | Indirect construction cost refers to an expense that is associated with a construction project as a whole, rather than a specific unit of production within that project. |
| **Quantity survey**<br><br>**(Pratt ,1995)** | Direct costs are expenses that arise from the procurement of materials, labor, and production equipment specifically for items that are quantitatively assessed during the preparation of the quantity survey. | General expenses within a construction project encompass indirect costs essential for its smooth facilitation. However, this definition inadvertently creates confusion by associating indirect costs with general expenses. |

An overhead cost refers to an expense that cannot be directly attributed or allocated to a specific construction project or a unit of construction production, as articulated by (Coombs and Palmer,1989). Hence, overhead costs are typically classified into two main categories, as outlined by (Peurifoy and Oberlender,1989): general overhead costs and job overhead costs. The distinction between general overhead costs and job overhead costs can sometimes be ambiguous, leading to areas of confusion and overlap in their scope. In their respective studies, (Dagostino, 1993) and (Neil, 1981) explained the distinction between these two categories. This differentiation is summarized in Table 2.

**Table 2**:The distinction between general overhead costs and job overhead costs

| Author | General overhead | Job overhead |
|---|---|---|
| **(Dagostino, 1993)** | General overhead costs encompass the essential expenses associated with business operations and are typically viewed as fixed expenditures that contractors must incur. | Job overhead costs pertain to items that can be specifically linked to a particular job, excluding materials, labor, or production equipment. These costs encompass essential expenditures that, while not directly allocable to a specific branch of work, are nonetheless indispensable for the successful execution of the project. |
| **(Neil, 1981)** | Also known as "main-office or home-office expenses", encompass all the expenditures borne by the home office that cannot be directly attributed to a specific project, it includes expenses like home-office building rental, clerical services, and utilities. | Job overhead, also known as project overhead, shares similarities with general overhead. However, job overhead must be apportioned across the associated project as it cannot be directly assigned to specific work packages. |

When striving for the most efficient allocation of resources, the key factor lies in minimizing both the direct and indirect costs associated with an infrastructure network.

Any potential reductions in additional indirect costs can lead to a shift in the optimal allocation of resources (Adey et al.,2004). In essence, alterations in these indirect costs have a significant impact on the overall strategy for resource allocation.

## 2.4. Cost overrun in construction industry

The successful completion of a construction project within its original budget is widely regarded as a noteworthy accomplishment by all project stakeholders, encompassing owners, consultants, contractors, and other affiliated parties (Amser,2020). Hence, the cost factor stands as a crucial determinant for the success of any project. Cost represents the allocated expenses that the client has intended to utilize for obtaining construction project or facility, as outlined by Chitkara (2011).

In public construction projects, it is crucial to assess the performance of every activity over the entire project life cycle to ensure the successful completion of infrastructures (Abdul Rahman et al., 2013). It's important to emphasize that achieving success in construction projects demands a high level of cooperation and coordination among the project team throughout the project life cycle (Mukhtar et al., 2017). As outlined by Adams and Brandt in 1978, the life cycle of construction projects can be broadly categorized into four main phases illustrated in Figure 2 below.

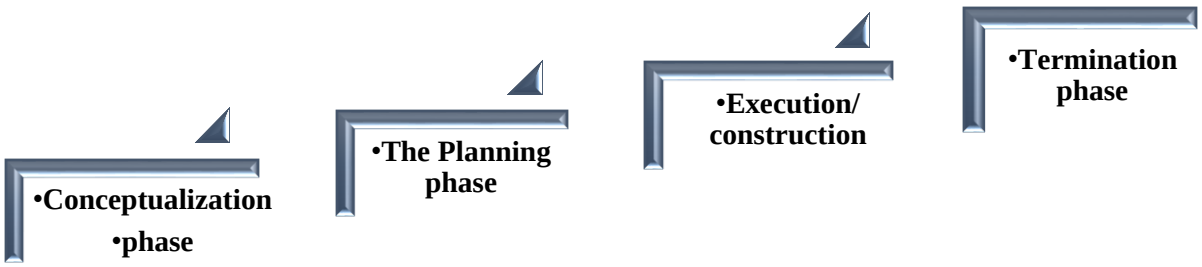


**Figure 2**:Construction project main phases. (Adams & Barndt,1978)

According to Adams and Barndt, (1978), the phase of construction or execution needs the highest level of effort and costs compared to the other phases of construction project, shows in Figure 3. On the other hand, Ghule (2020) explained that the challenge of delays and cost overruns primarily arises during the construction phase of a project. When projects deviate from their original schedule, contractors often try to accelerate the construction process. Unfortunately, this can result in additional expenses due to the implementation of hasty measures, potentially leading to a rise in poor-quality workmanship.

The process of generating cost estimates involves several distinct stages, including project planning, the decision to proceed with construction, the tendering process, contracting, and subsequent renegotiations (Eleyan, 2018). The precision of these estimates at each stage in the construction project is contingent upon the clarity of the proposed ideas and the activities slated for implementation which allows for the identification of finer details, also resulting in more accurate assessments of quantities and pricing information for the project (Flyvbje et al., 2002).

Cost overruns are typically allocated between an owner and a general contractor. The factors that directly impact the estimated cost of a project can be categorized into two groups: those specific to the estimate itself, and those related to the design and particulars of the project (Eleyan, 2018).

Irrespective of the meticulousness in preliminary planning and engineering stages, or final design stages, challenges and cost escalations may still arise right from the start of construction (Eleyan,2018). This underscores the dynamic nature of construction

projects, where unforeseen circumstances or evolving requirements can lead to changes and potentially result in higher project costs.

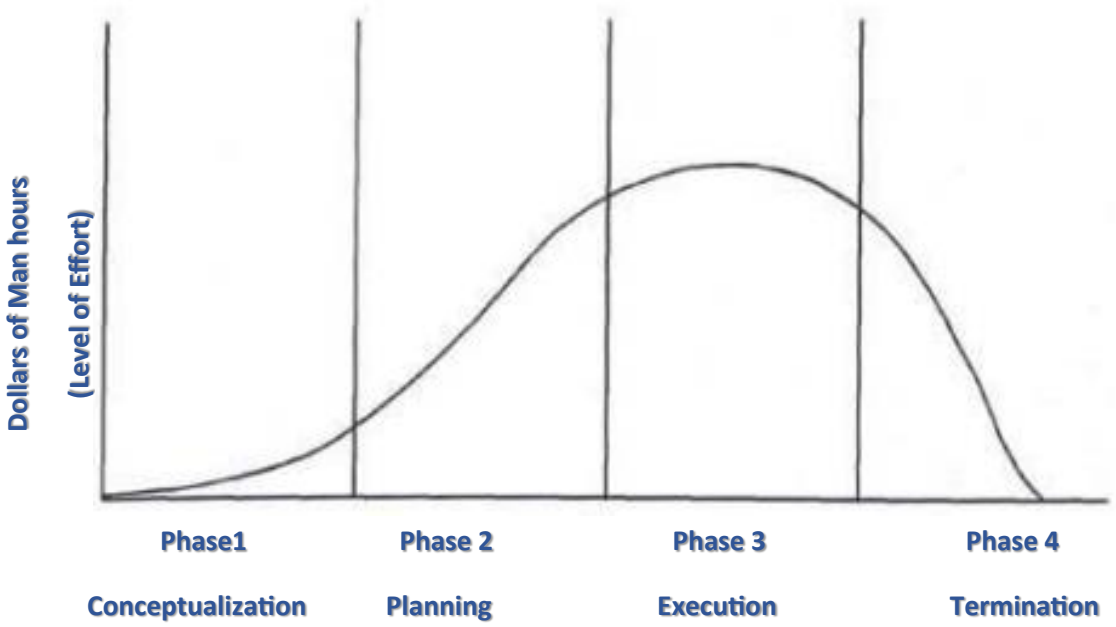


**Figure 3**:Phases of the project life cycle and their level of effort. (Adams & Barndt,1978)

Effective management of construction resources, budget allocation, construction methodologies, and communication stands as crucial factors for achieving success in cost performance, Conversely, hindrances to cost performance lie within the realms of schedule management and human resource oversight, as articulated by (Meeampol & Ogunlan, 2006).

## 2.5. Definition of cost overrun

Ghule (2020) defines cost overruns in the construction industry as increase in the actual cost compared to the initial estimates provided by the quantity surveyor or estimator. Terms like "cost increase" and "budget overrun" are commonly used interchangeably to refer to situations where the actual expenses exceed the initial budgeted amounts

(Vaardini et al., 2016; Ghule,2020). Himansu (2011) provides a definition for cost overrun, stating that it is the extent to which the final cost of a project surpasses the initial 'base' estimate.

Lee (2008) explained that cost overrun refers to the terms of actual and estimated cost. Cost overrun is quantified as the percentage disparity between actual costs and estimated costs, all evaluated in constant prices relative to the initial estimate. Actual costs encompass the verified expenditures actually utilized, determined at the project's conclusion, while estimated costs encompass the budgeted or anticipated expenses at the project's approval stage, usually similar to the financial figures outlined in the project's initial business case (Lee, 2008).

Cost overrun, as articulated by Avots (1983), occurs when the project fails to meet its objectives within the initially estimated budget. It signifies the surplus of actual expenses over the budgeted amount. Another perspective, offered by Jackson (1990), defines cost overrun as the ratio between the contract amount and the completion cost, this ratio can be mathematically represented as:

$$\text{Cost ratio (CR)} = \frac{\text{Completion cost}}{\text{Contract amount}} \qquad \textbf{Eq … (1)}$$

The ideal CR is 1.0, so, any value above this can be considered as a cost overrun.

This calculation can be converted to a percentage for ease of comparison.

According to Ainul et al., (2019) cost overrun is determined by comparing the initial estimated cost with the total expenditure incurred throughout the commissioning of the project, this discrepancy between the estimated and completion costs signifies the extent

of the cost overrun, moreover, cost overrun can be calculated as the favorable variance between the completion cost of a construction project at commissioning and the contract amount initially agreed upon by the key parties during the project's commencement.

Eleyan (2018) and Kavuma et al. (2019) define the term "cost overruns" as the variance between the actual cost required to complete a project and the initially planned or budgeted cost, this computation can be transformed into a percentage for the purpose of comparison. This is achieved by dividing the change in contract amount by the original contract award amount, as expressed in the equation outlined by Kavuma et al., (2019):

$$\text{Cost overrun} = \text{Final} \frac{\text{Contract Amount} - \text{Original Contract Amount}}{\text{Original Contract Amount}} \qquad \boldsymbol{Eq \ldots (2)}$$

"Cost escalation" denotes the anticipated increase in the costs of fundamental inputs in construction projects, including materials, labor, and equipment, alongside market inflation over a specified period. This term is employed in the estimation of project construction costs to adjust current dollar values to their projected future values for budgeting considerations (Raniga, 2015).

## 2.3. Cost overrun causes

Many extensive studies on major projects consistently highlight the common occurrence of cost overruns, which stands as a huge challenge confronting the construction industry in the present days. In construction projects, the reasons behind these overruns are diverse, and some of them not only prove challenging to anticipate but also pose difficulties in effective management (Morris, 1990).

An “out-of-control” in construction cost not only heightens investment stress but also impacts overall construction expenses, influencing investment decisions and straining national finances, therefore it is crucial to pinpoint the factors and causes that lead to cost overruns, aiming to mitigate and prevent such issues (Ali & Kamaruzzaman, 2010). Identifying the underlying causes typically marks the initial phase in resolving any problem, paving the way for subsequent corrective actions (Chang, 2002). Previous studies have provided insight into a range of variables and contributing factors that result in poor cost performances and lead to cost overruns, and covering many aspects of cost overrun in developing as well as developed countries.

Subramani et al. (2014) conducted a comprehensive study on the factors contributing to cost overruns, categorizing them into three main groups: clients, consultants, and contractors. The research involved the identification and assessment of these causes. Respondents were queried about the likelihood of each cause occurring and the level of impact it would have, utilizing a structured questionnaire. The study highlighted several critical factors, among which the most significant included:

1. **Clients** identified "slow decision making" as the foremost cause of cost overrun.
2. **Consultants** pinpointed delays or deficiencies in design provision, ineffective schedule management, and increase in material and machine costs as the most critical factors contributing to cost overrun.
3. According to **contractors**, the primary causes were sub-contractor nonperformance. Also, they agree with consultants about the increase in material and machinery prices

Chitkara's (2011) examination of the primary controllable causes of project cost overruns takes into account their correlation with planning, management, and distinct project phases. These causes encompass various factors, including:

1. Insufficient project formulation: This involves shortcomings in field investigation, insufficient project information, inaccurate cost estimations, limited experience, deficient project formulation and feasibility analysis, and flawed project appraisal, all of which can lead to erroneous investment decisions.
2. Inadequate planning for implementation: This category encompasses deficiencies in time planning, resource allocation and planning, equipment supply planning, and the failure to anticipate inter-linkages. It also involves issues related to poor organization and cost planning.
3. Ineffective contract planning and management: This relates to inappropriate pre-contract actions and insufficient post-award contract management.
4. Inadequate project management during its implementation: This includes factors like inadequate and ineffective work processes, delays, alterations in the scope of work and its location, and disruptions due to law and order issues.

Elayan (2018) highlighted the persistent challenge of elevated construction contract costs, a recurrent issue despite a comprehensive understanding of its underlying causes. The primary contributor to this challenge is often the inaccuracy of initial estimates or an escalation in the actual costs compared to the estimates. According to consensus among professionals in the field, three crucial factors contribute significantly to this issue: a shortage of materials, financial constraints and delayed payments for completed works, and deficiencies in contract management. Addressing these key elements is essential for mitigating the problem of high construction contract costs in various projects.

In a comprehensive study conducted by Aljohani et al. (2017), on 16 previous studies of the factors that lead to cost overruns, the total number of factors identified across these studies reaches 175 factors after removing duplications. Causes of cost overruns are typically categorized as either internal or external to the project, as illustrated in Figure 4 below. Within each class, there are several sub-classifications. For internal causes, sub-classes include project financer, project owner, and project consultants and project contractors.

External causes are further classified into system-related, country-related, economic-related, weather-related, and unclassified factors. Notably, certain factors recur consistently across most of studies, one prominent example being the deficiency in contractor's site management and supervision skills. The most commonly cited causes of cost overruns encompass various factors. These include frequent design changes during the construction phase, issues related to contractors' financing, delays in payments, a lack of experience on the part of contractors, inaccurate cost estimations, deficiencies in tendering documents, and subpar management of materials. These recurring factors underscore their significant impact on project costs and highlight the need for effective management strategies to mitigate potential overruns (Aljohani et al., 2017).

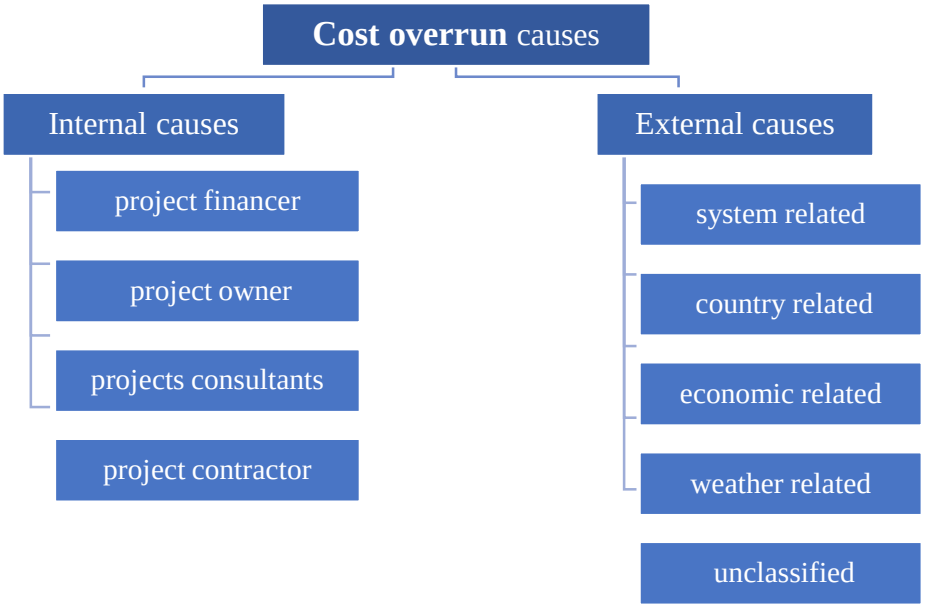


**Figure 4**: cost overrun causes groups according to (Aljohani et al., 2017)

Olawale and Sun (2010) employed a dual approach of questionnaire surveys and in-depth interviews to gather valuable insights into the practical aspects of project control, with a specific focus on cost and time considerations within the UK construction industry. The findings highlighted the top five factors impeding effective cost control in construction practices in the UK, these factors were identified as design changes, risks and uncertainties, inaccurate evaluation of project time/duration, the complexity of works, and non-performance of subcontractors.

Another study conducted by Oluyemi-Ayibiowu et al. (2019), the major causes of cost overruns in the Nigerian building construction industry were investigated through a combination of literature review and a questionnaire survey. The study identified a total of twenty causative factors for cost overruns. The questionnaire survey was distributed to a randomly selected group of respondents, including clients, consultants, contractors, site engineers, project managers, and subcontractors. The collected data revealed six critical factors that were deemed the most severe contributors to construction cost overruns. These factors include issues related to risk and uncertainty, lack of financial power on the

part of clients, weak regulation and control, project fraud and corruption, price variations, and indiscriminate changes in design or works.

In their research, Le-Hoai et al. (2008) delved into the causes of cost overruns in large construction projects in Vietnam through a questionnaire survey. The study identified 21 causative factors associated with delays and cost overruns during the construction phase, ranking them based on diverse perspectives from various involved parties. The five most prevalent, severe, and critical causes were identified as poor site management and supervision, inadequate project management assistance, financial challenges faced by the owner, financial constraints experienced by the contractor, and design changes. This insight into the specific challenges within the Vietnamese construction context contributes to a better understanding of the factors influencing cost overruns in large-scale projects.

The United Kingdom defense industry faces an annual requirement of an extra £200 million to address unexpected challenges and budgetary gaps resulting from rising project costs or the failure to meet equipment in-service deadlines. Significantly, this issue is not exclusive to the defense sector, as many projects within the civil sector encounter similar difficulties and financial constraints (Davey,2000).

Studies conducted in UK have revealed significant challenges within the construction industry explained in Figure 5; Aziz & Hafez (2013) explained that approximately 30% of construction involves rework, also the studies suggest that only 40–60% of the potential labor efficiency is realized. Accidents within the construction sector are identified as a substantial concern, accounting for 3–6% of total costs. Moreover, there is a significant issue of material wastage, with at least 10% of construction materials being squandered. These findings underscore the need for enhanced efficiency, safety measures,

and resource utilization practices within the construction industry in the UK. Whereas, Arcila (2012) highlighted the most prevalent causes of cost overrun in UK projects as: clients altering project specifications mid-course, poor financial performance within job contracts management, and inadequacies in both planning and design quality.

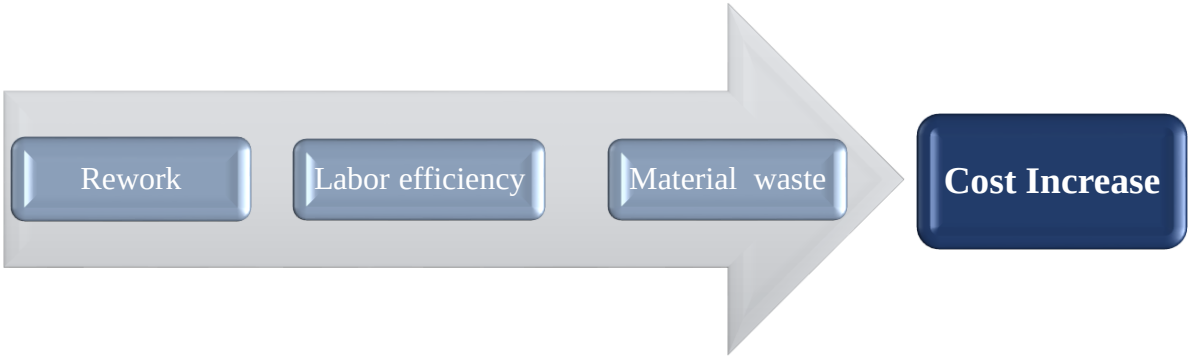


**Figure 5**:Cause of cost increase in construction projects in UK. (Aziz & Hafez, 2013)

In a study focused on the Ethiopian construction industry conducted by Melaku Belay et al. (2021), the investigation revealed noteworthy insights into cost overruns in building construction projects. The study identified a range of cost overruns, with a minimum of 2%, a maximum of 248%, and an average of 35%. Additionally, the research outlined the top ten risk factors contributing to cost overruns in infrastructure projects:

1. Inflation
2. Inaccurate cost estimates
3. Variations
4. Unforeseeable fluctuation in material and labor prices
5. Availability of resources (labor, materials, and equipment)
6. Delay in decision making
7. Market conditions/economic climate
8. Political situation of the country

9. Delay in payment of completed works
10. Poor coordination and communication between project parties

These findings provide valuable insights into the challenges faced by the Ethiopian construction industry and highlight key areas that require attention to mitigate the risk of cost overruns. In addition, Nega (2008) identified crucial causes behind cost overruns in building construction projects within Ethiopia. These included inflation or escalating costs of construction materials, inadequacies in planning and coordination, change orders triggered by client-driven enhancements, and excessive quantities during the construction phase.

In a study conducted by Muhammad et al. (2015), the factors responsible for cost escalation in civil and building engineering projects were meticulously examined. The study identified a total of 14 factors and proceeded to rank them based on their perceived severity, drawing on the opinions of a diverse group of respondents comprising clients, consultants, and contractors. These factors include:

1. Price fluctuations of materials
2. Variations in project specifications
3. Influences of government policies
4. Impact of changes in government and political instability
5. Extended periods between design and tendering phases
6. Inadequate financial control on-site
7. Occurrence of design errors
8. Insufficient supervision and implications of liquidation damages
9. Utilization of incorrect methods of cost estimation

10. Lack of coordination between contractors and consultants
11. Insufficient production of raw materials
12. Influence of weather conditions
13. Past experiences with similar contracts
14. Absence of comprehensive construction cost data

In Malaysia, cost overrun significantly impacts building projects. Ullah (2018) conducted a study highlighting diverse factors contributing to this issue. Through a questionnaire survey aimed at identifying critical cost overrun factors, the research unveiled 31 significant contributors to cost overruns in building projects. The survey outcomes identified the top three critical factors leading to cost overruns: fluctuations in material costs, inadequate planning and scheduling, and underestimation of project duration.

Another study conducted by Ali and Kamaruzzaman (2010) to understand the factors contribute to cost overruns in construction projects within Klang Valley, Malaysia, a questionnaire survey was employed to gather insights from various respondents including project managers, quantity surveyors, M&E engineers, C&S engineers, and related professionals. The results revealed the top five significant factors contributing to cost overruns: inaccurate or poor estimation of the original cost, underestimation of construction costs, inadequate planning, poor project management, and lack of experience. Conversely, the factor that had minimal impact was design errors. The study emphasized that the most effective approach to managing construction costs lies in adopting proper project costing and financing strategies.

Abusafiya and Suliman's (2017) study aimed to pinpoint the primary causes behind cost overruns in Bahrain's construction sector. They curated a list of 45 factors to form the

basis of a questionnaire administered in a survey involving representatives from local contracting, consulting, and client firms within the industry. The survey results underscored frequent design changes, construction errors, and delays in project scheduling as the most prominent factors contributing to cost overruns within Bahrain's construction industry.

The construction industry in China suffers from various problems, prominently among them being project cost overrun, as highlighted in Xie et al.'s 2022 study. Their paper delves into effective measures to counter cost overrun in Chinese construction projects, examining perspectives from both suppliers and owners. By employing structured questionnaires and expert interviews, the study defined 65 critical factors. Among these, market price fluctuations, deficient contract and risk management, shifts in national policies, currency exchange rate volatility, inadequate design, unforeseen events like infectious diseases and natural disasters, subpar drawing designs, constraints posed by project locations, design alterations, fraudulent activities, and rebate issues emerged as the primary influencers on construction costs.

In Jordan's construction industry, the issue of cost overrun has been notably severe. Bekr's study in 2015 aimed to pinpoint the causes of these overruns in construction projects within the country. The study employed a comprehensive questionnaire survey targeting various aspects related to clients, consultants, contractors, financial management, resources, and external factors. Over 100 respondents participated in the survey, identifying the 10 most significant causes of cost overrun from a list of 49 distinct factors. The primary causes identified explained in Table 3 by ranking them according to their Importance index and their group. The study's overarching finding indicated a shared

responsibility among all involved parties for the cost overruns observed in construction projects across Jordan (Bekr,2015).

**Table 3**: Top 10 Factors Causing Cost Overrun in Jordan (Bekr,2015)

| Cost Overrun Causes | Rank | Group |
|---|---|---|
| schedule delays (time overruns) | 1 | Contractor |
| frequent design alterations | 2 | Consultant |
| additional works due to owner requests | 3 | Client |
| design errors | 4 | Consultant |
| inadequate planning and scheduling | 5 | Contractor |
| inflation and price fluctuations | 6 | Financial |
| changes in the scope of work initiated by the owner | 7 | Client |
| incomplete or lacking detailed drawings during tender stages | 8 | Consultant |
| a scarcity of skilled site workers | 9 | Resource |
| construction errors leading to defective works. | 10 | Financial |

In their study, El-Ahwal et al. (2016) aimed to pinpoint the primary factors responsible for construction cost overrun in both developed and developing countries over the last three decades. Through a comprehensive literature survey spanning various variables, they delineated the key factors causing cost escalation worldwide. These factors were categorized into six main groups: technical, economic and financial, political and regulatory, management, project resources, and environmental factors. These groups encompass roughly 20 categories of elements contributing to cost overrun in construction projects. Despite some disparities in perspectives among scholars, a consensus emerged on certain fronts. All groups concurred that inadequate project cost estimation, deficient planning, additional project scope, unskilled labor, design modifications, project delays, and environmental factors stand as major contributors to cost overrun in construction projects.

Doloi's (2013) underscored several critical factors contributing to cost overrun in Australian construction projects. These include deficiencies in planning and scheduling, shortcomings in construction methodologies, the efficacy of monitoring and feedback processes, complexities inherent in design and construction, inadequate control over site resource allocations, and contractor-related deficiencies during the tender stage. On the other hand, Ropel and Gajewska (2011) highlighted distinct factors affecting construction projects in Sweden, emphasizing delay in decision-making processes, miscalculations, and challenges in securing the right contractor as the primary influencers leading to project delays and subsequent cost overruns.

Besides, Siemiatycki (2015) shed light on international trends indicating that larger projects tend to exceed budgets and timelines more frequently. He specifically discusses how economic and political influences contribute to cost overruns in Canadian construction projects. Also outlines three primary explanations for these overruns: technical complexities, overly optimistic initial assessments, and strategic misrepresentations, underscoring their significant roles in driving cost escalation in construction.

An extensive study includes 72 urban construction projects in Iran conducted by Heravi and Mohammadian (2021), involved an analysis of project documents alongside real assessments of cost and time performance. The study's significant discoveries revealed that: only 7% of the surveyed projects were successfully completed within their allocated budgets. Notably, larger urban construction endeavors experienced more pronounced cost overruns and delays. The study, identified key factors attributing to these challenges. Poor initial planning, financial constraints faced by project owners, and the sluggishness

inherent in decision-making processes emerged as the primary causes contributing to both cost overruns and delays in construction projects.

Cost overruns within construction projects can be attributed to a multitude of factors, these include amplified material costs, economic fluctuations, elevated interest rates set by financial institutions, the mode of financing adopted, bond-related intricacies, payment complexities, and even fraudulent practices, these diverse elements collectively contribute to the escalation of construction project costs (Rahman et al., 2013). Additionally, recurrent factors continuously impacting project costs include project size and location, lack of comprehensive plans, unforeseen utility issues, challenges in obtaining regulatory approvals, varying ground and weather conditions, the quality of supervision, sequencing of project activities, inaccurate estimations, scheduling difficulties, owner's expertise, change work orders, decision-making timelines, crew dynamics, morale, availability of skilled labor, overstaffing, overtime demands, worker absenteeism, material quality, and the timeliness and quality of subcontractors and suppliers, as identified by Knight & Fayek ( 2000).

Recognizing and addressing these multifaceted factors are crucial in effectively curbing cost overruns within construction projects and effectively help in managing and mitigating the impact of cost overruns in construction endeavors.

## 2.6. Cost overrun in construction industry in Palestine

Palestine, much like other countries in the Middle East, contends with substantial challenges related to cost overruns and project timeline extensions. The construction sector in Palestine grapples with a persistent challenge: the continual escalation of raw

material costs and construction inputs, compounded by inflationary pressures in both domestic and international markets (El-Sawalhi & Eleyan, 2018). These escalating costs significantly impact project budgets and pose challenges for construction endeavors. The observations strongly suggest that cost overrun remains a prevalent issue within the Palestinian construction industry (Mahamid & Dmaidi, 2013). Despite its evident significance, the number of studies comprehensively investigating this phenomenon remains notably limited. This scarcity of research dedicated to understanding and addressing cost overrun underscores an unmet need for more in-depth and extensive studies within the Palestinian construction sector. Such studies could provide critical insights and strategies to mitigate this persistent challenge and enhance the efficiency and cost-effectiveness of construction projects in the region.

As highlighted in a report by UNRWA in 2006 explained that most of local construction projects have faced significant challenges, particularly in terms of cost and time performance. These issues stem from various causes, such as:

1. material unavailability
2. frequent alterations in design and drawings
3. inadequate coordination among involved parties
4. ineffective monitoring and feedback mechanisms
5. deficiency in essential project leadership skills.

In addition, Mahamid and Bruland's (2012) study delved into the statistical relationship between the actual and estimated costs of road construction projects in Palestine, utilizing data from projects awarded between 2004 and 2008. This research, centered on a sample of 169 road construction projects in the West Bank. Notably, the findings reveal that

approximately 42.5% of the projects had cost overestimates falling within the range of 10% to 40%. This revealed a considerable disparity between estimated and actual costs.

Enshassi et al. (2010) conducted a study aiming to delineate the factors contributing to cost overruns in construction projects within the Gaza Strip. Their approach involved the development of a comprehensive questionnaire encompassing 42 distinct factors perceived to cause cost overruns, which was then used to gather insights from contractors involved in these projects. The study highlighted several significant causes contributing to cost overruns in the Gaza Strip construction projects. These included:

- the persistent rise in material prices, exacerbated by continuous border closures,
- delays in the construction process,
- challenges in the timely supply of raw materials and equipment by contractors,
- fluctuations in the costs of building materials,
- monopolization of project materials by suppliers,
- the local currency's instability concerning the dollar value,
- limited commitment from donors to compensate for adverse outcomes linked to the region's economic and political instability,
- and donor policies that favor awarding tenders to the lowest bidder.

A comprehensive study conducted by Mahamid ad Dmaidi (2013) focusing on the cost overruns in building construction projects in Palestine, specifically exploring the perspective of consultants through a questionnaire survey. The findings shed light on the severity of cost overruns within these projects, revealing significant insights:

- Firstly, the study highlighted that 100% of the respondents experienced average cost overruns ranging from 10% to 30% of the project's estimated cost, underscoring the prevalent issue of cost discrepancies in building construction projects.
- Moreover, the research identified a risk map encompassing 41 factors contributing to cost overruns, pinpointing 26 of these factors as critical contributors.
- According to the insights of consultants, the top ten factors significantly impacting cost overruns in building construction projects included the political situation, fluctuations in material prices, competitors number and levels, currency exchange rates, instability of the Palestinian economic, Previous experience of contract, Project financing, Inflationary pressure, contract management and Poor planning.

Mahamid's study in 2014 aimed to discern the risk factors influencing cost overruns in building construction projects within the West Bank in Palestine. This time from the perspective of contractors. The research involved 31 contractors engaged in building construction, who completed a comprehensive questionnaire survey encompassing 40 distinct factors. These factors were categorized into five groups: cost estimating, construction items, construction parties, environmental aspects, and financing. The study's outcomes highlighted the top five factors exerting significant influence on cost overruns according to contractors' viewpoints. These included fluctuations in currency exchange rates, aspects related to project financing, effective contract management, the competitive level, and the costs associated with materials (Mahamid ,2014).

The findings from this study align closely with the earlier research conducted by Mahamid and Dmaidi in 2013, which focused on consultants' perspectives. This

congruence indicates a consensus between the viewpoints of consultants and contractors regarding the factors contributing to increased costs within Palestine. The agreement between these two pivotal stakeholders—consultants and contractors—underscores the shared understanding of the reasons behind escalated costs within the region's construction projects.

The rising costs of building materials, challenges associated with acquiring permits and approvals, the necessity for an effective supervisory system, inaccuracies in cost estimation, project changes, considerations regarding work quality, and the availability and adequacy of machinery and equipment essential for completing project tasks and activities were considered as predominant factors driving cost escalation in construction projects within the Gaza Strip, according to El-Sawalhi & Eleyan (2018) , their study identified 36 distinct cost escalation factors linked to various project aspects such as supervision, activities, ownership, labor, equipment, and materials. Employing a structured questionnaire, they collected primary data by distributing 120 questionnaires randomly among owners, consultants, and contractors operating within the Gaza Strip's construction sector.

These findings underscore the multifaceted nature of challenges contributing to cost overruns in Palestinian construction projects and highlight the importance of addressing these critical factors for effective project management and cost control.

The causes of cost overrun, as discussed in the previous literature review encompassing 25 studies across various countries, have been condensed and presented in Table 4.

**Table 4**:The causes of cost overruns in construction projects, though previous studies

| Nu | Cost overrun Factors / Previous studies | Knight & Fayek (2000) | Nega (2008) | Le-Hoai et al. (2008) | Ali & Kamaruzzaman (2010) | Enshassi et al. (2010) | Chitkara's (2011) | Olawale and Sun (2010) | Doloi (2013) | Rahman et al. (2013) | Aziz & Hafez (2013) | Mahamid & Dmaidi (2013) | Subramani et al. (2014) | Siemiatycki (2015) | Muhammad et al. (2015) | (Bekr,2015) | El-Ahwal et al. (2016) | Aljohani et al. (2017) | Abusafiya & Suliman's (2017) | El-Sawalhi & Eleyan (2018) | Ullah (2018) | Elayan (2018) | Oluyemi-Ayibiowu et al. (2019) | Heravi and Mohammadian (2021) | Melaku Belay et al. (2021) | Xie et al. (2022) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | slow decision making | | | | | | | | | | | | * | | | | | | | | | | | * | * | |
| 2 | risk and uncertainty | | | | | | | * | | | | | | | | | | | | | | | * | | | * |
| 3 | inadequacies in planning and coordination | * | * | | * | | * | | * | | | * | | | | * | * | | | | * | | | * | | |
| 4 | complexity of works | | | | | | | * | | | | | | | | | | | | | | | | | | |
| 5 | challenges in obtaining regulatory approvals | * | | | | | | | | | | | | | | | | | | * | | | | | | |
| 6 | mode of financing | | | | | | | | | * | | | | | | | | | | | | | | | | |
| 7 | elevated interest rates by financial institutions | | | | | | | | | * | | | | | | | | | | | | | | | | |
| 8 | currency exchange rate volatility | | | | | * | | | | | | * | | | | | | | | | | | | | | * |
| 9 | project fraud and corruption | | | | | | | | | * | | | | | | | | | | | | | * | | | |
| 10 | fluctuation in prices | | | | | * | | | | * | | * | | | * | * | | | | | * | | * | | * | * |
| 11 | inflation | | * | | | * | | | | * | | * | | | | * | | | | * | | | | | * | |
| 12 | inaccurate cost estimations | * | | | * | | * | | | | | | | | * | | * | * | | * | | | | | * | |
| 13 | financial constraints and delayed | | | | | | | | | * | | * | | | * | | | | | | | * | | | | |
| 14 | financial challenges faced by the owner | | | * | | | | | | | | | | | | | | | | | | | * | * | | |
| 15 | financial constraints faced by contractor | | | * | | | | | * | | | * | | | | | | * | | | | | | | | |
| 16 | delay in payment of completed works | | | | | | | | | * | | | | | | | | | | | | * | | | * | |
| 17 | availability of resources (labor, materials, equipment) | | | | | * | | | | | | | | | | | | | | | | | | | * | |
| 18 | lack of skilled workers | * | | | | | | | | | | | | | | * | * | | | | | | | | | |
| 19 | lack of experience | | | | * | | | | | | | * | | | | | | * | | | | | | | | |
| 20 | labor efficiency | | | | | | | | | | * | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21** | increase machine costs | | | | * | | | | | | * | * | | | | | | | | | | | | | |
| **22** | availability/adequacy of machinery / equipment | | | | | | | | | | | | | | | | | * | | | | | | | |
| **23** | material wastage | | | | | | | | | * | | | | | | | | | | | | | | | |
| **24** | increase in material prices | | * | | | * | | | | * | | * | | | | | | * | | | | | | | |
| **25** | shortage of materials | | | | | | | | | * | | | | | | | * | | | * | | | | | |
| **26** | monopolization of materials by suppliers | | | | | * | | | | | | | | | | | | | | | | | | | |
| **27** | excessive quantities | | * | | | | | | | | | | | | | | | | | | | | | | |
| **28** | rework | | | | | | | | | * | | | | | | | | | | | | | | | |
| **29** | construction shortcomings / errors | | | | | | | | * | | | | | | * | | | * | | | | | | | |
| **30** | inadequate project management | | | * | | | * | | | | | | | | | | | | | | | | | | |
| **31** | poor site management and supervision | * | | * | * | | | | * | | | | | * | | | * | | * | | | * | | | |
| **32** | change orders | | * | | | | | | | | | | | | * | | | | | | | * | | * | |
| **33** | design changes / errors | | | * | | | | * | | | | | | * | * | * | * | * | | | | * | | | * |
| **34** | Changes in project scope / specification | | | | | | * | | | | | | | * | * | * | | | * | * | | | | | |
| **35** | delays or deficiencies in design provision | | | | | | | | * | | | * | | * | * | | | * | | | | | | | |
| **36** | ineffective schedule management | * | | | | | | | | | | * | | | | | | | | | | | | | |
| **37** | deficiencies in contract management/ documents | | | | | | | | | | | | | | | | * | | | * | | | | | * |
| **38** | sub-contractor nonperformance | * | | | | | | * | | | | * | | | | | | | | | | | | | |
| **39** | competitors' number and levels | | | | | | | | | | * | | | | | | | | | | | | | | |
| **40** | inaccurate evaluation of project duration | | | | | | | * | | | | | | | | | | | * | | | | | | |
| **41** | poor coordination between project parties | | | | | | | | | | | | | * | | | | | | | | | | * | |
| **42** | delays | | | | | * | * | | | | | | | | | * | | | | | | | | | |
| **43** | market /economic conditions | | | | | | | | | | * | | | | | | | | | | | | | * | |
| **44** | governmental / national policies | | | | | | | | | | | | | * | | | | | | | | | | | * |
| **45** | political situation of the country | | | | | * | | | | | * | | * | * | | | | | | | | | | * | |
| **46** | constraints posed by project locations | | | | | | | | | | | | | | | | | | | | | | | | * |
| **47** | environmental factors | * | | | | | | | | | | | | | | * | | | | | | | | | |

## 2.7. Effects of cost overrun

Studies within construction domain exhibit a noticeable imbalance, emphasizing the identification of factors leading to cost overruns while affording limited attention to comprehensively analyzing the consequential effects of these cost overruns on the economy as a whole. Cost escalation within construction projects carries adverse implications for both stakeholders and the broader industry (Nasiru et al.,2012). So, cost overruns can significantly impact the project performance, quality, and reputation, accordingly this hinders the situation of the project and Leeds to project failure, as shows in Figure 6 (El-Ahwal et al.,2016). Previous studies have extensively explored the adverse effects of cost overruns in many countries, shedding light on their detrimental impacts across different stakeholders involved in construction projects. These studies have delved into the repercussions experienced by project owners, contractors, and industry practitioners at large (Nega,2008; Muhammad et al,2015; Aljohani et al.,2017; Gbahabo & Samuel ,2017; Melaku Belay et al. ,2021).

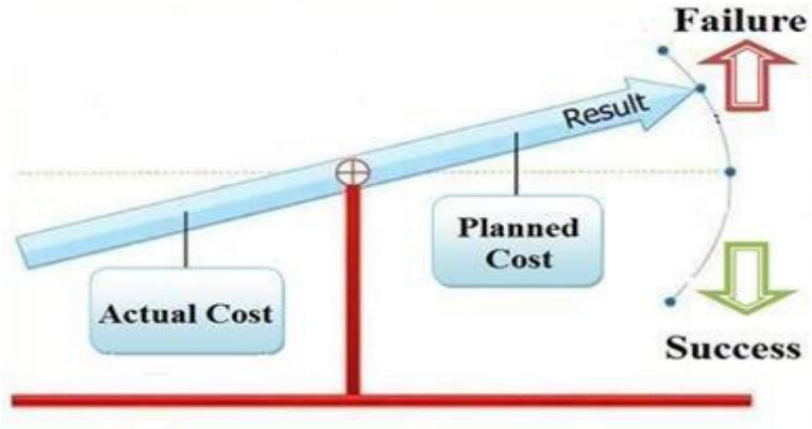


**Figure 6**:The impact of project cost overrun on project situation (El-Ahwal et al.,2016)

Cost overrun stands as a significant flaw within the construction industry, precipitating a range of adverse effects, these repercussions lead to disputes between contractors and clients, a decline in work quality, and an increase in health and safety incidents

(Ahbab,2012). According to (Eleyan ,2018) cost escalation bears immense significance due to the risks it poses across various dimensions:

- Contractor Profitability.
- Owners' Project Funding till the completion.
- Consumer and end users Affordability.

According to Nega, (2008) several prevalent effects of cost overruns were identified, notably encompassing delays in project completion, the emergence of supplementary agreements, strained relations among stakeholders, and budget shortfalls for project owners. Ahmed et al. (2003) assert that cost overruns and delays within construction projects have far-reaching negative implications for clients, contractors, and consultants alike. They contribute to strained relationships, fostering adversarial dynamics, eroding trust, and often leading to legal disputes such as litigation or arbitration. Moreover, these issues result in cash flow constraints and instill a pervasive sense of apprehension and caution among involved parties, impacting the collaborative nature of project engagements within the construction industry.

Construction projects that encounter cost overruns risk transitioning into defaulted projects, exerting substantial impacts on all involved parties. For instance:

1. **For clients**, cost escalation signifies a diminished return on investment, as the project incurs costs beyond the initially agreed-upon sum, based on studies of (Nega, 2008; Muhammad, et al., 2015; Melaku Belay et al. ,2021). Moreover, the completed facility may not be accessible for use, this delay in project completion can result in increased fees for consultations and design modifications (Aljohani et al.,2017). This situation not only impacts the project's financial feasibility but

also extends the timeline for realizing returns, affecting the overall profitability of the investment for the client involved.

2. **For end user,** often shoulders additional expenses in the form of heightened rental or lease charges (Nega, 2008; Muhammad, et al., 2015). These increased costs, stemming from escalations within the project, are transmitted downstream, impacting end users by raising the cost of accessing or purchasing the final products or services.
3. **For consultants,** as indicated by Nega (2008) and Muhammad et al. (2015), these overruns can compromise consultants' ability to deliver the expected value within the allocated budget. Consequently, it could erode the trust and confidence that clients have in their capabilities. This loss of confidence might result in decreased client satisfaction, impacting future opportunities and potentially damaging the consultants' reputation within the industry (Nega, 2008; Muhammad, et al., 2015; Melaku Belay et al. ,2021).
4. **For contractors**, cost escalation translates into various detrimental outcomes. Primarily, it entails a loss of profits due to penalties linked to incomplete or substandard performance (Nega, 2008; Muhammad et al.,2015; Aljohani et al.,2017). Additionally, these escalations may lead to reputational damage and a sense of entrapment within a single project for an extended period, potentially hampering future business prospects. This situation, highlighted by Muhammad et al. (2015), Aljohani et al. (2017), and Melaku Belay et al. (2021), could diminish the confidence of key stakeholders within the construction industry, impacting the contractor's credibility and opportunities for future projects.

Hence, the success or failure of construction projects significantly impacts all stakeholders involved, including the government (Muhammad, et al., 2015). Cost overruns pose dire consequences for the construction industry at large, potentially leading to project abandonment and a decline in building activities. These repercussions include tarnished reputation and challenges in securing project finance, often resulting in higher costs due to increased risks (Mbahu and Nkado, 2004). These combined outcomes significantly hinder the industry's viability and sustainability, eroding its capacity to thrive and maintain stability in the market.

## 2.8. Construction resources

The success of a construction project hinges not only on the quality and quantity of work but also significantly on the availability of required resources. Every project activity demands specific resources allocated within defined budgets and timelines. Failure to complete these activities within the allocated resource and time constraints can significantly impact the project's overall duration and cost (Nagaraju et al., 2012). Therefore, resource availability and efficient allocation are critical for successful project implementation.

Resources involve the essential means of production crucial for project completion (Othman et al., 2014). They include manpower, materials, money, equipment, and space, all contributing to project activities (Nagaraju et al., 2012). Managing these resources is integral to project management, influencing the project's success. Adequate availability and efficient management of resources significantly impact project outcomes. Therefore, arranging and ensuring provision for resources like materials, manpower, machinery, and finance at each construction stage is imperative (Rahman et al., 2013).

In construction projects, resources can be broadly categorized into four key groups. Each category has its unique importance and impact on project execution and success. These four main resource categories include:

1. **Money / Finance Resource**

Money or Financial resources are the cornerstone of any construction project, without adequate financial resources, projects struggle to progress and often face obstacles or remain incomplete. Therefore, the availability of ample funds and proficient financial management stands as pivotal aspects in every project's success (Rahman et al., 2013). Cost, a fundamental parameter in construction project evaluation, signifies the resources consumed in an activity's completion or a product's creation (Callahan et al., 2011). According to (Ioannidou et al., 2018) Construction project costs typically fall into six primary categories: labors, materials, energy, overheads (office and personnel), and taxes.

Cash flow is the balance between the money received and spent during a specific period, affecting the project's progress (Zayed & Liu,2014). Inadequate funds not only impede progress but also render the project's design efforts futile, also wastes time and energy. Hence, cash flow management is pivotal in construction projects (Memon et al., 2011). Effective financial management, encompassing cash flow control and forecasting, is crucial for project completion and success (Zayed & Liu,2014). Financial management has long been recognized as an important management tool. When finances aren't managed properly, it undermines the efficient utilization of other resources. It directly impacts the ability to allocate funds appropriately, diminishing the overall effectiveness of resource management across the project (Memon et al.,

2011).

Unforeseen factors significantly impact cash flow forecasts including: change of progress payment, duration of payment, financial position of the contractor, project delays, and poor planning, underscoring the need for meticulous management to ensure project viability and success (Zayed & Liu,2014).

### 2. Material Resource

Materials considered as the fundamental blocks within the construction industry, representing a significant share of a project's overall value (Rahman et al., 2013). Their utilization intertwines with financial, human, and equipment aspects, emphasizing the importance of their optimal usage, ultimately leading to the conservation of foundational material resources and the facilitation of more cost-effective construction projects (Garba et al., 2016). Constituting a major part of the overall costs of construction projects, materials typically account for approximately (50–60) % of the total cost (Safa et al., 2014). Given their pivotal role and substantial financial influence, effective materials management stands as a critical and indispensable element enhancing productivity within construction projects (Jusoh & Kasim, 2017). Therefore, comprehending the impacts of proficient materials management becomes imperative for construction firms.

A comprehensive material management system includes vital functions crucial for successful construction projects, such as identification, acquisition, storage, distribution, and disposal of materials, whereas material planning can vary significantly, contingent upon factors like project scale, location, cash flow demands, as well as the procurement and inspection procedures (Memon et al., 2011). According to Othman et al., (2014) effective material procurement and on-site storage necessitate careful planning to avert

the adverse effects of shortages or excessive inventory at construction sites. The inefficiencies in material supply and logistics have frequently emerged as primary catalysts for diminished productivity and financial setbacks. Strategic planning of material procurement and on-site storage, however, can yield substantial enhancements in construction productivity and overall project profitability.

Previous studies consistently highlight that material shortage stands as a leading contributor to project delays, cost overruns, and low productivity (Rivas et al., 2011; Safa et al., 2014). This underscores the critical impact of ineffective materials management, directly influencing project performance due to shortages at construction sites (Caldas et al., 2015). Consequently, issues associated with materials significantly contribute to cost overruns within construction projects.

### 3. Manpower Resource (Labors)

The efficient utilization and management of human resources, particularly skilled and unskilled labor, are crucial for the success of any project. The availability of an adequate workforce and its proper allocation and management are fundamental elements contributing to favorable project outcomes, so without skilled and capable manpower, achieving optimal results becomes challenging, making effective human resource management a critical aspect of project success (Rahman et al., 2013).Manpower output denotes the quantity of work accomplished per person per day, factoring in all necessary safety measures and quality standards stipulated by the client (Nagaraju & Reddy, 2012). It represents the productive yield generated by an individual worker within a given timeframe, ensuring adherence to safety protocols and meeting the specified quality benchmarks as mandated by the client or project requirements.

Labors productivity in construction is influenced by several critical factors, including:

improper work planning, materials non-availability, lack of skilled workers (Parthasarathy et al., 2017). According to Othman et al., (2014), embracing modern technology and providing comprehensive training to laborers could increase the productivity within the construction industry. Effective manpower management and enhancing labor productivity stand as critical needs within the construction industry, hence these measures considered as pivotal in curbing labor costs, subsequently bolstering the company's profitability (Rahman et al., 2013). Efficiently managing manpower ensures optimal resource utilization and streamlined operations, ultimately contributing to improved project outcomes and financial gains for the project.

**4. Machines or Equipment Resources**

Construction projects rely on diverse equipment and machinery, each tailored to specific level of applications. The modern construction projects increasingly embrace mechanization, with onsite equipment playing a pivotal role in enhancing productivity and efficiency (Waris et al., 2014). Machinery possesses distinct advantages over manpower, capable of continuous operation in adverse conditions and demanding less manpower and fewer facilities (Rahman et al., 2013). According to Waris et al. (2014), the selection of suitable equipment stands as a critical factor in project success, the study conducted that top five essential criteria for equipment selection include productivity, safety features, ownership and operational costs, and efficiency. Whereas, the nature of a project dictates the type and quantity of equipment needed (Rahman et al., 2013).

Equipment productivity in construction hinges on several crucial factors, the three key elements influencing equipment productivity encompass: improper work planning, operator skill deficiency, equipment breakdowns as highlighted by (Parthasarathy et al.,2017).

Particularly in civil construction projects, a substantial portion of overall expenses is allocated to various heavy equipment costs, significantly impacting construction expenditures due to the considerable expenses associated with renting, owning, leasing, and maintaining this machinery (Cheng et al., 2017). Therefore, these equipment-related costs significantly influence the overall construction costs.

## 2.9. Resource-related factors causing cost overrun

Indeed, the availability of resources significantly impacts construction costs. There exists a direct correlation between the resources allocated to a construction project and the overall incurred costs (Subramanian et al., 2014). The effectiveness of resource combinations in construction activities relies heavily on the contractor's capacity to comprehend the interconnections among diverse resources (Nagaraju et al., 2012). Conversely, by addressing issues like inefficient utilization, inadequate construction equipment, and a dearth of quality materials, contractors can effectively curtail the construction budget (Meeampol & Ogunlana, 2006).

Efficient resource management often translates into better cost control and optimization within construction projects. Previous studies (Meeampol & Ogunlana, 2006; Ahbab, 2012; Nagaraju et al., 2012; Gaurang, 2020) underscore the criticality of proper management of construction resources flow for project success. Consequently, effective construction resource management stands as the foremost determinant of cost achievement in projects.

In other hand, Challenges faced by management encompass execution methods, labor oversight, equipment management, scheduling, and financial allocations (Ahbab, 2012). Many studies indicate that various resource-related factors significantly impact cost management, often leading to substantial cost overruns. However, limited

investigations have been conducted in Palestine regarding the effects of resources within the construction industry. This gap warrants further exploration into the effects of resources on construction practices within the region.

In Palestine, the existing body of literature on cost overrun factors is relatively limited, with a notable gap in studies specifically addressing resource-related factors contributing to cost overruns in construction projects. This research endeavor gains significance as it fills a critical void, marking the inaugural study to concentrate on identifying construction resource-related factors. To achieve this, the study draws upon insights derived from prior researches on cost overruns and taps into the expertise of industry professionals. The outcome of this comprehensive approach is the formulation of 33 factors, categorized into four distinct groups based on their respective relationships to construction resources. By addressing this research gap, the study aims to contribute valuable insights to the understanding of resource related factors leading to cost overruns in construction projects within the Palestinian context.

# Chapter Three: Research Methodology

## 3.1. Overview

The preceding chapter delved into an extensive review of literature addressing cost overruns in global construction projects, with a specific focus on Palestine. This chapter, however, pivots towards a detailed discussion of the research methodology employed in identifying resource-related factors contributing to cost overruns and their effects within Palestinian construction projects.

The methodology consists of a comprehensive outline of the study's approach, including the selection of research methods and strategies, the research design, target locations, population demographics, sample size determination, participant selection for questionnaire surveys, questionnaire design with a focus on expanding statistical factors, considerations of validity and reliability, as well as the methodologies employed in data collection, coding, data entry, and subsequent data analysis.

## 3.2. The research method & strategy

The research strategy refers to the methodology employed to investigate research objectives. According to Naoum (2012) two primary research strategies prevail: 'quantitative research' and 'qualitative research'.

- Quantitative research deals with numerical, quantified data (Polit, 2010), emphasizing objectivity. This approach is suitable for exploring factual information, establishing relationships between these facts to test theories or hypotheses (Naoum, 2012).
- On the other hand, qualitative research is subjective, focusing on meanings, experiences, and descriptive accounts and preferred when the knowledge about a topic is limited (Naoum, 2012). It involves detailed descriptions of people, events, situations, or observed behaviors (Polit, 2010).

In this thesis, the chosen strategy is **quantitative research** due to its well-established advantages, including formality, descriptiveness, exploratory capacity, and its ability to establish correlations.

## 3.3. The research design

A research design serves as a master plan, outlining the specific methodologies and approaches required to gather and analyze essential information within a research project, so it is considered as a comprehensive blueprint or a framework which guide the actions of the research project (Amser, 2020). Essentially, the design constructed by the researcher embodies this framework. Its primary objective is to furnish a structured plan that effectively addresses and answers the research problem (Wood & Haber, 1998).

Selecting the right research design encompasses a series of steps, starting with identifying the issue, defining the study's purpose, and conducting a thorough literature review (Amser, 2020). Meanwhile, Wood and Haber (1998) have illustrated the interplay and dependencies among a group of key elements which offer a visual roadmap for researchers for research design, these elements include: the problem statement, study purpose, literature review, theoretical framework, and hypothesis, shown in Figure 7.

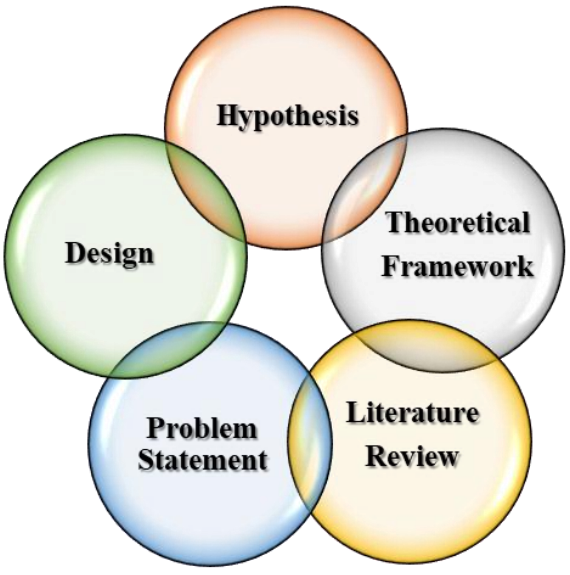


**Figure 7**: The connection among research components (design, problem statement, literature review, theoretical framework, and hypotheses) as outlined by (wood and Haber, 1998)

In social sciences and management, a significant portion of research revolves around seeking answers through surveys involving people, which commonly employ tools like

questionnaires, interviews, and case studies (Fellows and Liu, 2021). Among these methods, the structured questionnaire stands out as one of the most prevalent techniques for gathering information, enabling researchers to delve into facts, opinions, and perspectives (Naoum, 2012).

The survey approach, as highlighted by Saunders et al. (2009), had a strength advantage of gathering diverse data on people's beliefs and perceptions related to a research hypothesis. Ensuring reliability and validity tests stands as paramount for a questionnaire's credibility. Saunders et al. (2009) emphasize the significance of pilot testing before widespread distribution to validate the survey's accuracy.

Following a comprehensive review of the literature, the author determined that employing a survey method would be most effective in capturing the necessary data related to the research problem and substantiating the research objectives. Consequently, the study utilizes a questionnaire survey as its primary data collection tool. A structured questionnaire is used in this research for its advantages. A research questionnaire designed to investigate the resource related factors that lead to cost overrun in construction project in Palestine and to assess their effects on the industry, which is conducted from the results of the studied literature review. The approach used in the questionnaire survey is descriptive statistics.

The research methodology is visually articulated as a **flowchart** as shown in Figure 8. This diagram likely encapsulates a structured sequence of steps and procedures employed in the investigative process, offering a navigational path from the inception of the research concept and questions to the eventual analysis and conclusion. The flow chart illustrates

three main stages, each comprising a series of steps that highlight the key methodologies employed:

1. **Structured literature review stage**: encompassing steps such as concept and problem identification, defining objectives and research questions, conducting a literature review, and defining resource related-factors causing cost overrun and their effects.
2. **Data collection and analysis stage:** involving activities such as questionnaire design, piloting, validity and reliability studies, conducting field surveys, and employing SPSS for data analysis.
3. **Results and interpretation stage:** primarily covering results and discussion, top resource related-factors leading to cost overrun in Palestine, top Severe effects of cost overrun in Palestine, and concluding with the study's recommendations and future studies.

This **flowchart** serves as a valuable guide, facilitating researchers' understanding of the systematic approach employed throughout the study's execution, offering clarity in navigating the various stages from inception to conclusion.

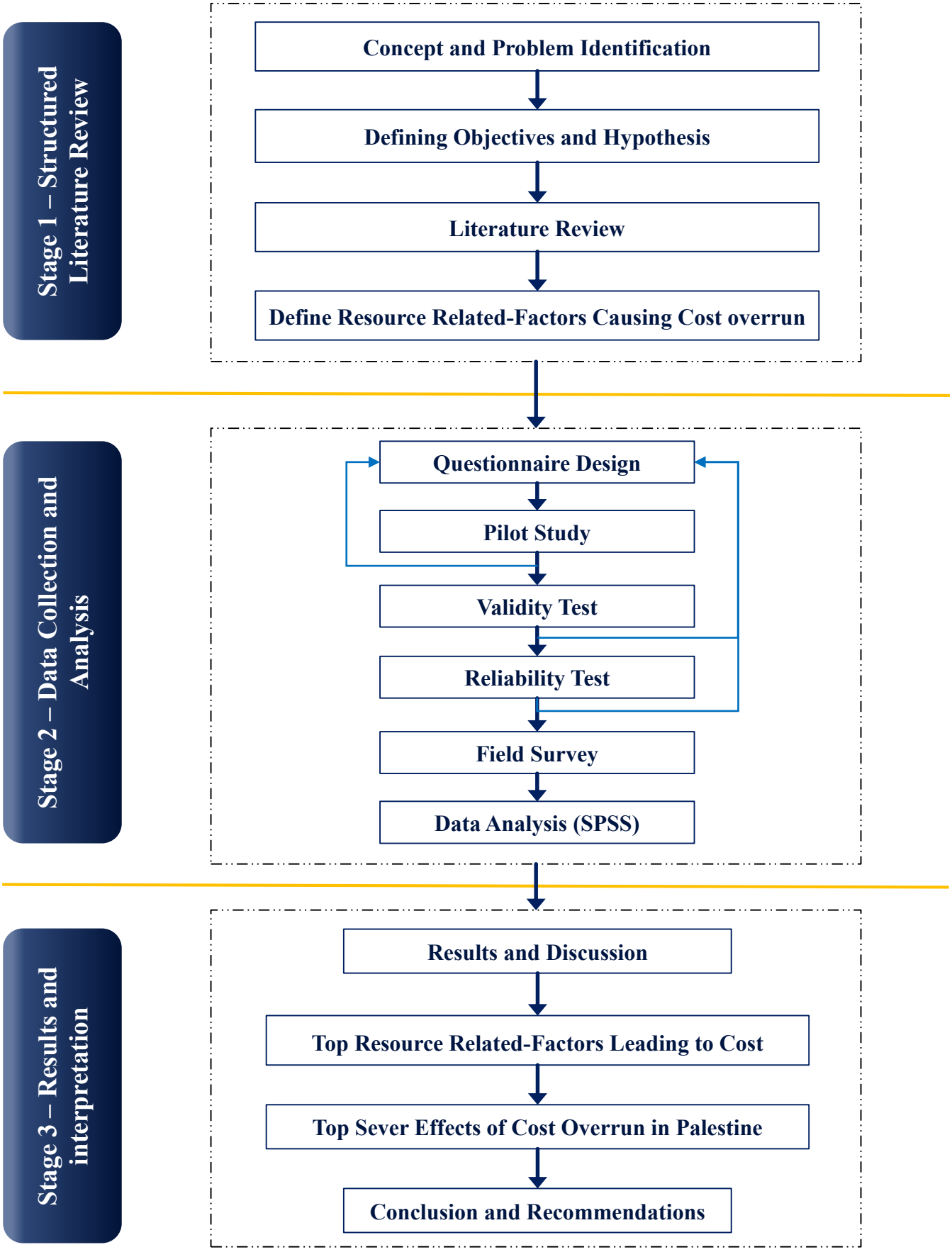


**Figure 8**:The research methodology flow chart

## 3.4. Study population

The research population included construction project parties who directly involved in West Bank's construction industry, consisting of **contractors**, **consultants**, and **owners**. Specifically:

- Contractors: those registered within the Palestinian Contractors Union.
- Consultants: who registered within the Palestinian Engineers Association.
- Owners: this group included large local municipalities which classified as “A” according to Municipal Development and Lending Fund (2019), as well as construction companies or non-governmental organizations (NGOs) engaged in construction activities as per The Ministry of Public Works and Housing criteria.

## 3.5. The questionnaire design

The questionnaire has been built using the factors extracted from literature review. The resource related factors that lead to cost overrun in construction projects were defined through a detailed literature review. These factors were translated into questions of straightforward, uncomplicated, and unambiguous questions. Questions addressing similar topics were clustered together, forming the core sections of the initial questionnaire draft. A closed-ended questionnaire was selected due to its inherent advantages, including ease of posing questions and swift responses. Notably, these questionnaires necessitate no writing from either the respondent or the interviewer and facilitate straightforward analysis, as highlighted by Naoum (2012).

The preliminary draft of the questionnaire underwent a thorough evaluation process to refine its content and structure. Initially reviewed by the supervisor, whose insights and

feedback proved invaluable, the draft questionnaire received crucial input. Subsequently, the questionnaire was further scrutinized by four experienced construction managers, eliciting their perspectives on its content. Their collective input and assessments prompted modifications and adjustments to the questionnaire. A pivotal pilot study was conducted, revealing essential insights that led to significant enhancements in the questionnaire. This study not only introduced crucial new questions but also served to clarify existing queries and refine the contents of certain sections.

The questionnaire was divided into three main areas to accomplish the aim of the research:

I. **The first area**, includes the company profile and general information about projects and cost overrun in the company, Table 5 illustrates the fields used in this area.

**Table 5**:Number General information about all respondents and company profile

| No. | General information about respondents and company profile |
|---|---|
| **1** | Relevancy to the construction project |
| **2** | Company filed of work |
| **3** | Job of the person who fills out the questionnaire |
| **4** | Number of years of experience for those who fill out the questionnaire |
| **5** | The number of permanent employees in the company |
| **6** | Number of projects executed in the last 5 years |
| **7** | Volume of construction work in the last 5 years |
| **8** | Percentage of the company's projects whose cost exceeds the pre-calculated cost |
| **9** | Percentage of cost overrun in the whole company's projects |
| **10** | If the company apply any software to plan, monitor, and control cost |

**II.** **The second area**, covers 33 resource related factors that lead to cost overrun in construction projects which extracted from the previous studies and the expert's expertise. Factors classified into four categories depending in their relationship to the project resources, a list of the categories shown in Table 6 below. The categories include:

1. Materials
2. Manpower (Labors)
3. Machines and Equipment's
4. Money.

**Table 6**: Resource-related factors causing construction cost overrun

| No. | Category | Code | Resources-related factor |
|---|---|---|---|
| 1 | Materials | A1 | Fluctuation of prices of materials |
| | | A2 | Availability of materials |
| | | A3 | Changes in material specification and type |
| | | A4 | Delay in delivery of materials |
| | | A5 | Bad materials quality |
| | | A6 | Amount of materials waste |
| | | A7 | Poor storage of materials |
| | Manpower | B1 | Availability of skilled labor |
| | | B2 | Overmanning and crowding |
| | | B3 | Turnover and absenteeism |
| | | B4 | Amount of work/workload |
| | | B5 | Labors productivity |
| | | B6 | High cost of labors |

| | | | |
|---|---|---|---|
| **2** | | B7 | Low wages of labors |
| | | B8 | Morale/motivation of crew |
| | | B9 | loyalty and ethics of labors |
| | | B10 | Number of change/extra work orders |
| | | B11 | Amount of rework |
| | | B12 | Relationship between labors |
| | | B13 | Relationship between labors and management |
| **3** | **Money** | C1 | Financial difficulties of owner |
| | | C2 | Financial difficulties of contractor and cash flow |
| | | C3 | Financing methods, bonds and payments |
| | | C4 | Inflation of prices |
| | | C5 | Change in currency exchange rate |
| | | C6 | Poor financial control on site |
| | | C7 | Inaccurate cost estimate |
| **4** | **Machines** | D1 | Availability of Equipment |
| | | D2 | Efficiency of Equipment |
| | | D3 | Suitability of Equipment |
| | | D4 | Insufficient number of equipment's |
| | | D5 | Easy access to equipment on site |
| | | D6 | High cost of machines and their maintenance |

**III.** **The third area** include the effects of cost overrun in construction industry. Table 7 shows eight effects of cost overrun conducted from literature review and experts experience. Participants asked to rate the importance of these effects according to their experience in construction works.

**Table 7**:effects of cost overrun in construction industry used in questionnaire

| No. | Code | Effects of cost overrun in construction projects |
|---|---|---|
| **1** | E1 | A damaging to the whole economy of the country and loss of job and income |
| **2** | E2 | Inefficient allocation of resources |
| **3** | E3 | Delays in construction projects |
| **4** | E4 | Contractual disputes, claims and litigation between parties |
| **5** | E5 | Project failure and total abandonment |
| **6** | E6 | Loss of contractor reputation |
| **7** | E7 | Loss of consultant reputation |
| **8** | E8 | Losses in contractor and owner profits |

In the second and third areas of the questionnaire, aimed at identifying resource factors contributing to cost overruns and assessing the impacts of these overruns in construction projects, respondent's perspectives are measured using a 5-point Likert scale. This scale provides five distinct options: '5' = 'very high', '4' = 'high', '3' = 'medium', '2' = 'low', and '1' = to 'very low'. By utilizing this scale, respondents can effectively express the intensity or degree of their views regarding the significance of these resource factors and the resulting effects of cost overruns in construction projects.

## 3.6. Sampling Technique

According to Wood and Haber (1998), sampling refers to the selection process of representative units from a population to be studied within research investigations. Sampling involves researchers analyzing a portion or studying a subset of sample from a

larger group of potential participants and leveraging the findings to make broader statements applicable to the larger population or group (Amser, 2020).

The research adopted a **stratified sample** depending on the classification of population into three parties (owners, consultants and contractors) as a non-homogenous stratum. The participants were selected using **random samples from the three stratums**.

## 3.7. Sample Size

A statistical calculation is used to ensure that the selected sample in this research fairly represents the population of the three parties. The size of the sample required from each population was determined on the basis of statistical principles. There are several approaches to determine the sample size, in this research, sample size was calculated from following formula equation (Kish,1965):

$$SS = n'/ (1+ (n' / N)). \qquad Eq \ldots (3)$$

Where:

SS: the sample size from infinite population, which can be calculated from this formula.

N: total population number.

n' = sample size from infinite population

where, $[n' = (S^2/ V^2)]$.

Where $\mathbf{S^2}$ is the standard error variance of population and **V** is a standard error of sample population; usually S = 0.5 and V = 0.05 for the confidence level 95 %**.**

According to the Palestinian Contractors Union (2023), there are (454) contractor companies that classified and working in the field of construction. The size of the sample of contractors was calculated by using the equation (3.1),

SS = n'/ (1+ (n' / N))

$n'$ = (0.5) ² / (0.05) ² = 0.25/0.0025= 100

SS = 100/ (1+ (100 / 454))

SS = 81.9, so **contractors sample size = 82**

According to the Palestinian Engineers Association (PEA) in 2023, the number of engineering offices which classified in the association and working as consultants were (306) offices. The size of the consultant's sample was calculated as follows:

$n'$ = (0.5) ² / (0.05) ² = 0.25/0.0025= 100

SS = 100/ (1+ (100 / 306))

SS = 75.3, so **consultants sample size = 75**

The total target sample of clients (project owners) consisted of government institutions (large local municipalities which has construction department and government ministries which working in construction) and NGO'S associations which operating in the field of construction according to The Ministry of Public Works and Housing, the population of owners were **= 60**

$n'$ = (0.5) ² / (0.05) ² = 0.25/0.0025= 100

SS = 100/ (1+ (100 / 60))

SS = 37.5, so **owners sample size = 38**

In Figure 9, the distribution of the sample size across project parties is shown, revealing that contractors accounted for the largest proportion at 42% of the total sample size. This notably highlights the substantial representation of contractors within the sampled population, signifying a notably higher number of contractors compared to other entities, particularly owners.

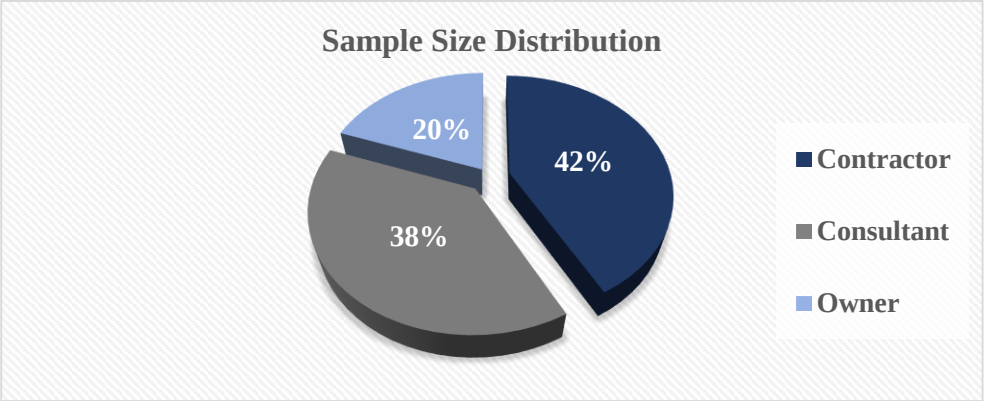


**Figure 9**:Sample size distribution for Construction parties

## 3.8. Validity of research

Scientific research Validity shows the precision of measurement aligned with the intended research objectives (Eleyan, 2018). This concept of validity refers to the instrument's ability to measure what it's intended to measure, as outlined by Pilot and Hungler (1985). Essentially, when an instrument demonstrates validity, it truly reflects the concept it's designed to assess (Wood and Haber, 1998). Assessing validity encompasses diverse approaches, including content validity, criterion-related validity, and construct validity, as detailed by Polit and Hungler (1985).

A group of experts were reviewed the questionnaire, focusing on several crucial aspects. They were requested to evaluate whether the questions aligned with the scope of the items and accurately captured the essence of the research problem. Additionally, they assessed the questionnaire's ability to effectively establish relationships and conduct variable tests. Overall, their collective opinion was affirmative: the questionnaire was deemed valid and sufficiently aligned with the intended concept of interest. However, they suggested some amendments to further refine its precision and effectiveness.

## 3.9. Questionnaire distribution and collection

The total number of questionnaires distributed to contractors, consultants and owners was 195 questionnaires. The total number of completed returned questionnaires was 154 questionnaires, 4 losses and unqualified questionnaires and 37 questionnaires were in completed. According to Mellahi and Harris, (2016), a return rate ranging from 50% to 80% is deemed necessary to maintain the validity of research, with 55% being the average considered reasonably acceptable. The return rate received during the survey was found to be **81 %**, divided as (68) for contractors, (59) for consultants and (31) for owners as shown in Table 8, and having a **response rate of 79 %**, which is considered as a high response rate and accepted in respect to the unstable construction industry conditions and unstable political situation in the West Bank.

**Table 8** : The population and sample size for the study

| Construction parties | Population size | Sample size | Return size | Return rate |
|---|---|---|---|---|
| Contractors | 454 | 82 | 68 | 82% |
| Consultants | 308 | 75 | 59 | 79% |
| Owners | 60 | 38 | 31 | 82% |

The questionnaire was the chosen method for data collection in this research due to its widespread utilization as a primary tool for conducting surveys. Data collection for study was based on distribution of questionnaire on construction parties, also personal short interviews used for filing questions of the questionnaire with project parties or their representative, in which the respondents have questions about the questionnaire, the researcher provides a brief explanation for the ideas and contents of questionnaire. Also,

google forms used to fill the questionnaire by respondents who can't reached by the researcher due to the tough political conditions in West Bank.

## 3.10. Reliability of the research

Instrument reliability related to the consistency exhibited in measuring the intended attribute (Polit & Hunger, 1985). The lesser the variability in repeated measurements of an attribute, the higher the reliability of the instrument. This consistency not only signifies reliability but also stability, evaluating reliability often involves conducting the test with the same group on two separate occasions and then analyzing the obtained scores to compute a reliability coefficient (Polit & Hunger, 1985). As a general guideline, reliability coefficients surpassing 0.7 are typically considered satisfactory for most purposes, indicating a commendable level of consistency in measurement.

In this study, the Cronbach Alpha coefficient was computed for each field of the questionnaire to assess their reliability. Table 9 presents the Alpha values, indicating the reliability of individual questionnaire fields as well as the entire questionnaire. These Alpha values signify the extent of consistency within each field. The Cronbach Alpha values fall between **0.715 and 0.822,** as depicted in Table 10, indicating a high level of reliability for each field of the questionnaire. Notably, the Alpha Cronbach coefficient for the entire questionnaire stands **at 0.893** for all variables of the questionnaire as shown in Table 6, reinforcing the high level of reliability across the entirety of the questionnaire and a commendable degree of consistency across all its components.

**Table 9**:SPSS results for reliability test for every field of the questionnaire

| No. | Field | Cronbach's Alpha Coefficient | N of Items |
|---|---|---|---|
| 1 | Material-related factors | 0.715 | 154 |
| 2 | Manpower-related factors | 0.822 | 154 |
| 3 | Money-related factors | 0.764 | 154 |
| 4 | Machinery-related factors | 0.777 | 154 |
| 5 | Cost overrun effects | 0.732 | 154 |

**Table 10**:SPSS results for reliability test for all variables

| | | N | % |
|---|---|---|---|
| Cases | Valid | 154 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 154 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .893 | 46 |

## 3.11. Coding and data entry

Utilizing computers for data analysis necessitates translating respondent's answers into numerical values through a coding process. Specifically, closed-ended questions involve assigning a numerical value to each response provided by an individual. Before initiating any data analysis, a data summary sheet becomes imperative. This sheet serves as the foundational tool for organizing collected data. The process of transferring the amassed data from questionnaires or collection forms into this summary sheet, after data collection, is termed the 'recording scheme' or 'production coding', as detailed by Naoum (2012). This crucial step lays the groundwork for subsequent analysis by ensuring the data are organized and ready for statistical evaluation or other analytical techniques.

# Chapter Four: Analysis and Discussion

## 4.1. Overview

Analysis should be done for the study to determine if the obtained results align with the specific goals or intentions linked to each objectives posed. This chapter delves into the analysis derived from the collected survey data and presenting the findings and results. The data obtained from the questionnaire survey was meticulously analyzed utilizing the widely used Statistical Package for Social Science (SPSS), specifically version 25, as the primary statistical analysis tool for this study.

Primarily, this chapter encompasses several key components. It includes the analysis of the population characteristics, examines the ranking of resource-related factors influencing cost overruns, presents the ranking of resource-related factors based on project parties' perspectives , identify the top ten resource-related factors that significantly contribute to cost overrun in the Palestinian construction industry, taking into account previous studies that have addressed these factors, studying the relationship between resource- related factors causing cost overrun , explores the connections between the population characteristics and resource related factors through statistical tests and finally, discusses the effects of cost overruns and their mean ranks ,and their ranks according to parties perspective and correlations within studied effects.

For this purpose, a **group of sequential steps** taken in the statistical analysis, including:

- Defining and coding each variable.
- Organizing the data collected in a systematic and structured manner.
- Transferring the collected data into excel worksheet.

- Cleaning the data to ensure accuracy and consistency.
- Transferring data set into SPSS data sheet and defining all variables.
- Calculating the frequency and percentages of population characteristics variables.
- Calculating the mean values and ranking of all of the sub-factors.
- Ranking of the sub-factors within each category of factors.
- Ranking of all resource- related factors causing cost overrun according to project parties.
- Studying the mean values across the four categories and their sub-factors.
- Studying the relationship between resource- related factors using spearman's correlation.
- Conducting an ANOVA test to assess differences in respondents' answers of main groups and their relationship with population characteristics variables.
- Employing a multiple-comparison test (Post-Hoc test - Bonferroni test) to evaluate significant differences, if present.
- Ranking the effects of cost overrun depending on their mean scores.
- Ranking the effects of cost overrun according to project parties.
- Studying the relationship between effects of cost overrun using spearman's correlation.

These steps demonstrate a comprehensive approach to analyzing the data collected, utilizing various statistical techniques to explore relationships and differences within the dataset.

## 4.2. Population characteristics

This section includes all data and information collected from questioners about respondents. Data include respondents type according to construction projects, company's field of work, respondents' position, respondents experience, volume of company's staff, volume(number) and value of construction projects, distribution of company's projects whose cost exceeds the pre-calculated cost, cost overrun in the whole company's projects and cost overrun extent and finally the distribution of companies which applying any software to plan, monitor, and control cost.

### 4.2.1. Type of respondents

The distribution of respondents was revealed as follows: 42.9% were contractors, 37.7% were consultants, and 19.5% were owners. Notably, the highest proportion of respondents was represented by contractors and consultants, collectively constituting the largest segment among the surveyed groups, refers to their large population size, (Table 11 and Figure 10).

**Table 11**:Types of respondents

| Respondents | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **Contractor** | 66 | 42.9 | 42.9 |
| **Consultant** | 58 | 37.7 | 80.5 |
| **Owner** | 30 | 19.5 | 100.0 |
| **Total** | 154 | 100.0 | |

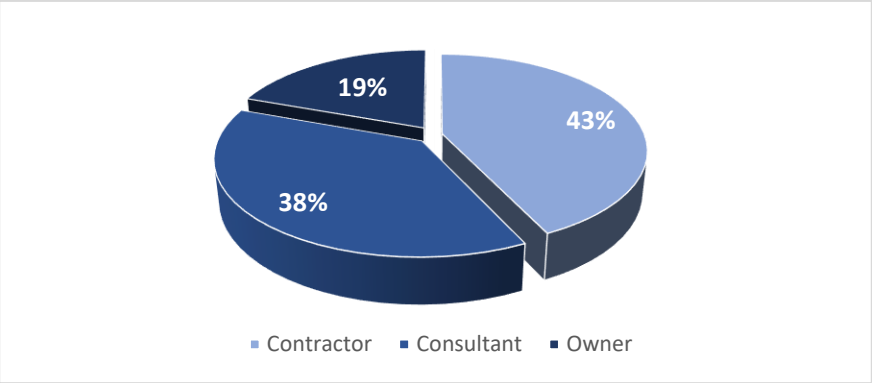


**Figure 10**:Distribution of respondent's type

### 4.2.2. Distribution of company's field of work

When considering the nature of projects, Table 12 and Figure 12 illustrate the distribution among respondents based on their primary work types: 62.3% were involved in building construction, 10.4% in roads & transportation, and a notably smaller fraction of 1.9% comprised individuals engaged in water and sewerage-related projects, accounting for only three participants. Moreover, a significant 25.3% of respondents reported involvement in multiple fields of work, showcasing a diverse spectrum of professional engagements among the surveyed population.

**Table 12**:Distribution of company's field of work (frequency and percentage)

| Field of work | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **Building Construction** | 96 | 62.3 | 62.3 |
| **Roads & transportation** | 16 | 10.4 | 72.7 |
| **Water and sewage** | 3 | 1.9 | 74.7 |
| **Multiple fields** | 39 | 25.3 | 100.0 |
| **Total** | 154 | 100.0 | |

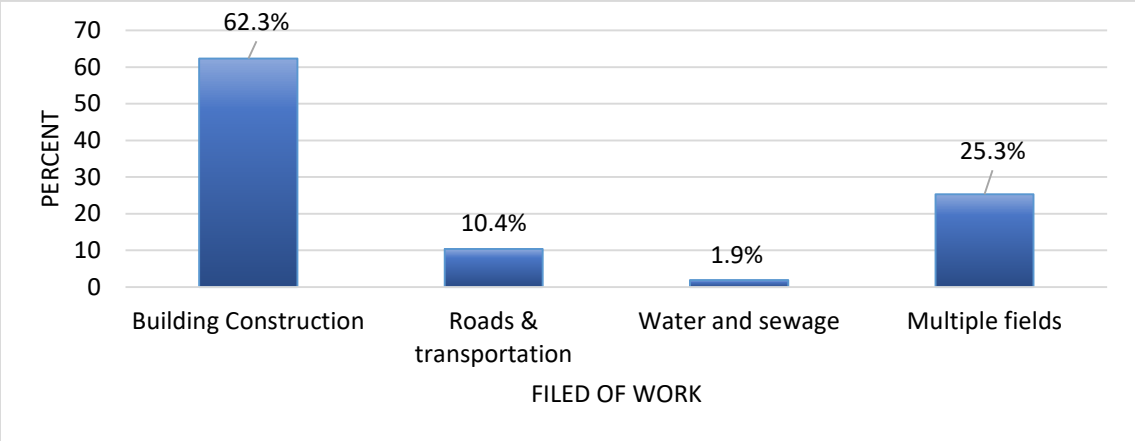


**Figure 11**:Distribution of company's field of work

### 4.2.3. Distribution of respondent's position in construction companies

Table 13 and Figure 13 visually represent the distribution of respondents' contributions to the questionnaire categorized by their roles and position within their respective organizations or companies. Notably, 59.1% of respondents held positions as engineers, encompassing site, office, or design engineers. Additionally, 29.2% were identified as project and construction managers, indicating a strong level of interest among these professionals and suggesting a reliable confidence level in their provided responses. Moreover, out of the total 154 respondents, only 18 individuals identified themselves as quantity surveyors, delineating a smaller representation within the surveyed population.

**Table 13**:Distribution of respondent's position in construction companies

| Respondent's position | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **project manager** | 36 | 23.4 | 23.4 |
| **construction manager** | 9 | 5.8 | 29.2 |
| **quantity surveyor** | 18 | 11.7 | 40.9 |
| **design engineer** | 20 | 13.0 | 53.9 |
| **office engineer** | 38 | 24.7 | 78.6 |
| **site engineer** | 33 | 21.4 | 100.0 |
| **Total** | 154 | 100.0 | |

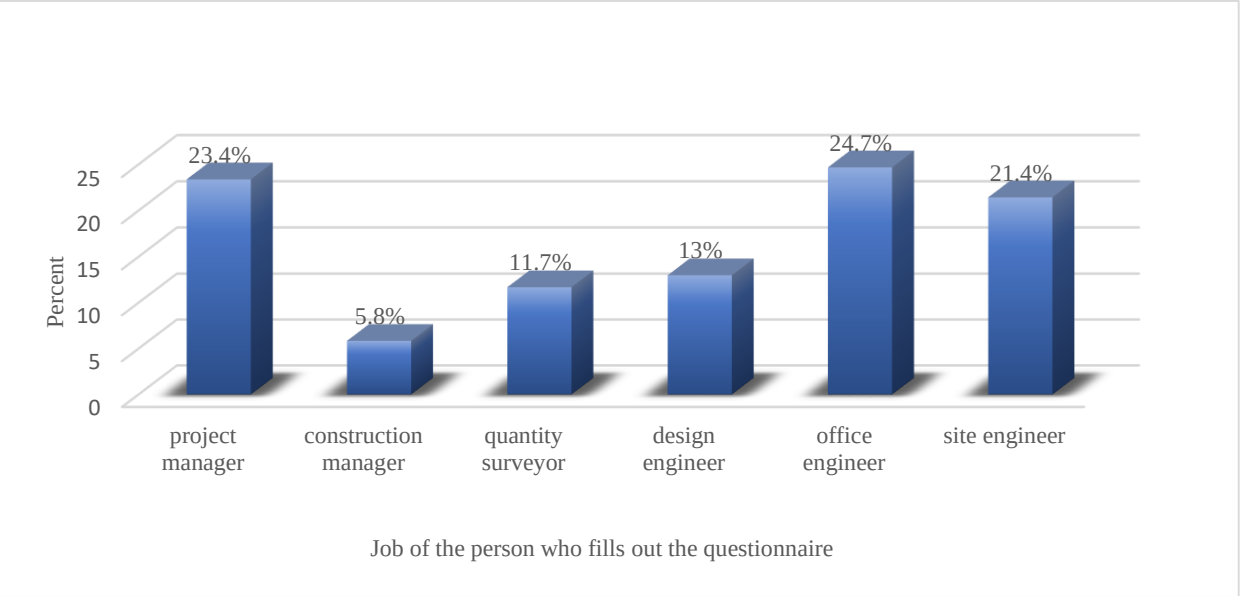


**Figure 12**:Distribution of respondent's position in construction companies

### 4.2.4. Distribution of respondent's years of experience

The majority of respondents have more than 5 years of experience in construction projects, which are 42.2% of them have experience from 6-10 years and 22.7% have experience more than 10 years, this gives a higher confidence in the quality of answers of the questionnaire. Only 5.8% of respondents have experience less than 3 years, as shown in Figure 13 and Table 14.

**Table 14**:Distribution of respondent's years of experience

| years of experience | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **less than 3 years** | 9 | 5.8 | 5.8 |
| **3-5 year** | 45 | 29.2 | 35.1 |
| **from 6-10 years** | 65 | 42.2 | 77.3 |
| **more than 10 years** | 35 | 22.7 | 100.0 |
| **Total** | 154 | 100.0 | |

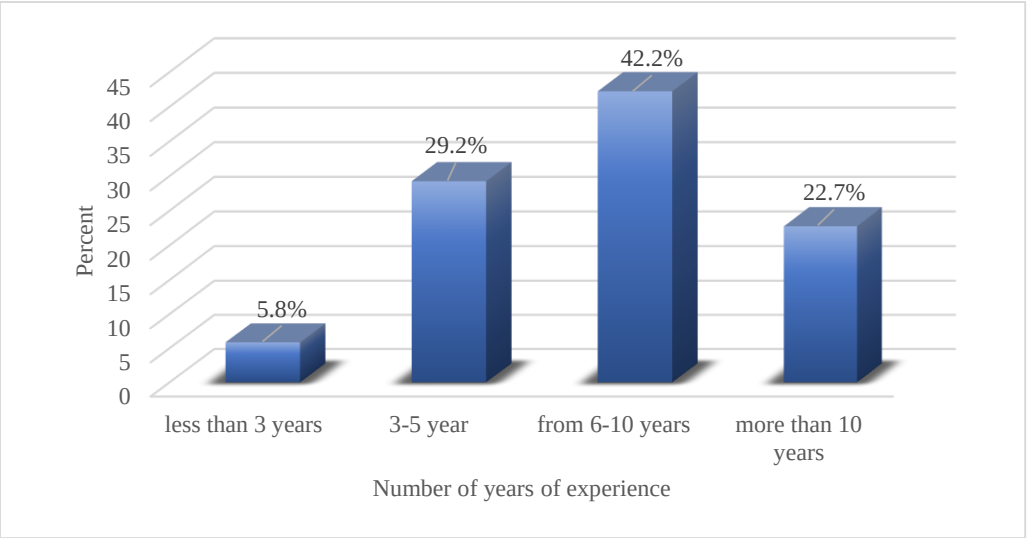


**Figure 13**:Distribution of respondent's years of experience

### 4.2.5. Experience versus type of respondents

Table 15 shows the distribution of work experience according to relevancy to construction projects within project parties (contractor, consultant, and owner) is depicted. The data indicates that the largest proportion of respondents falls within the contractor category, also the majority of respondents possessing experience ranging between 6 to 10 years. Additionally, among those with over 10 years of experience, the highest percentage originates from the contractor group, accounting for 11.04% of the total respondents and comprising 26% of the contractor subset. This distribution underscores a significant level of experienced professionals within the contractor segment compared to consultants and owners.

**Table 15**: Experience versus type of respondents

| years of experience/ project parties | less than 3 years | 3-5 year | from 6-10 years | more than 10 years | Total |
|---|---|---|---|---|---|
| **Contractor** | 2.60 % | 12.34 % | 16.88 % | 11.04 % | 42.86 % |
| **Consultant** | 2.60 % | 14.29 % | 16.23 % | 4.55 % | 37.66 % |
| **Owner** | 0.65 % | 2.60 % | 9.09 % | 7.14 % | 19.48 % |
| **Total** | 5.84 % | 29.22 % | 42.21 % | 22.73 % | 100 % |

### 4.2.6. Distribution of number of company staff

Based on Table 16 and Figure 14, the survey indicates that over half of the companies represented (54.5%) maintain a staff of 11 to 15 permanent employees. A significant portion, about 34.4% of the respondents' companies, have fewer than 10 permanent employees, while a mere 11% have a workforce exceeding 15 permanent employees. Absolutely, the data seems to highlight that either the majority of construction companies surveyed fall within the bracket of small to medium-sized enterprises based on their employee count or this trend suggests a reliance on recurrent project-based employment.

**Table 16**:Distribution of number of company staff

| Number of company's staff | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **less than 10 workers** | 53 | 34.4 | 34.4 |
| **11-15 workers** | 84 | 54.5 | 89.0 |
| **16-20 workers** | 9 | 5.8 | 94.8 |
| **more than 20 workers** | 8 | 5.2 | 100.0 |
| **Total** | 154 | 100.0 | |

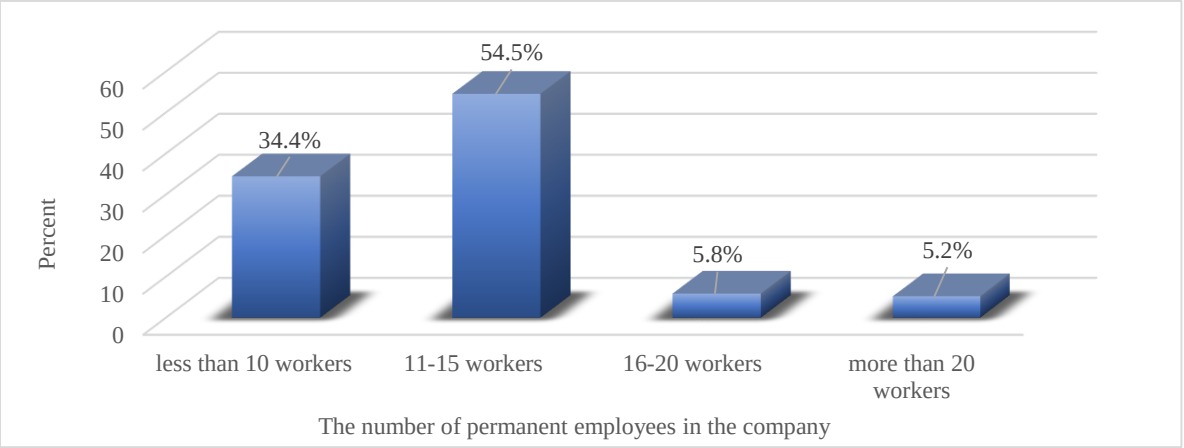


**Figure 14**:Distribution of number of company staff

### 4.2.7. Distribution of volume(number) and value of construction projects

In Table 17 and Figure 15, it's evident that a substantial portion, about 55.8%, of construction companies undertook less than 20 projects in the past five years. Conversely, a smaller 9.1% of these companies engaged in over 30 projects during the same period, showcasing a varied distribution in project volume. Meanwhile, Table 18 and Figure 16 depict that a significant majority, 86.4% of these companies, completed projects valued at less than 20 million dollars. Conversely, a smaller but noticeable 13.6% handled projects exceeding the 20 million dollars. This pattern might align with the notion of smaller-sized organizations within the construction sector and could also reflect economic constraints or limitations within certain segments of the industry.

**Table 17**:Distribution of volume(number) in the last 5 years

| Number of construction projects (in last 5 years) | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **less than 10 projects** | 17 | 11.0 | 11.0 |
| **11-20 projects** | 69 | 44.8 | 55.8 |
| **21-30 projects** | 54 | 35.1 | 90.9 |
| **more than 30 projects** | 14 | 9.1 | 100.0 |
| **Total** | 154 | 100.0 | |

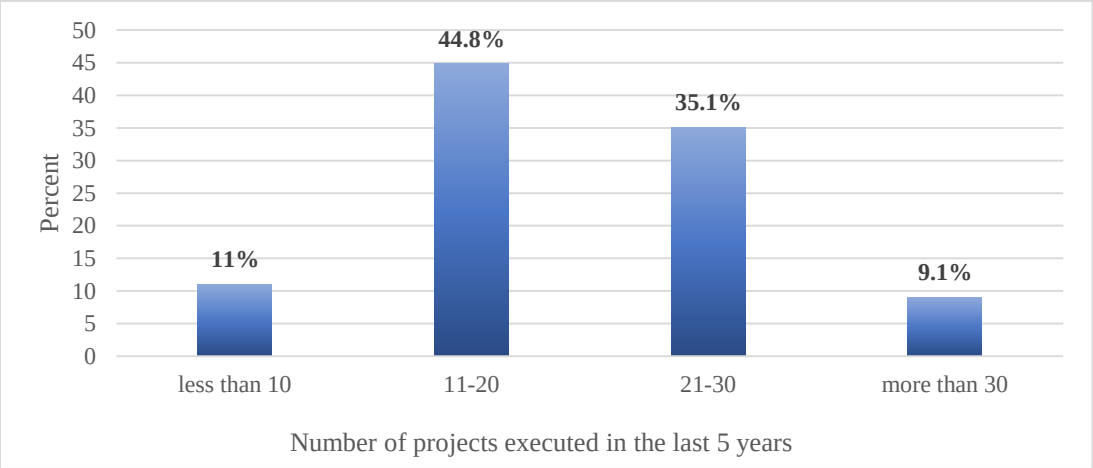


**Figure 15**:Distribution of volume(number) in the last 5 years

**Table 18**:Distribution of value of construction projects in the last 5 years

| Value of construction projects (in last 5 years) | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **less than 5 million $** | 22 | 14.3 | 14.3 |
| **5-10 million $** | 53 | 34.4 | 48.7 |
| **10-20 million $** | 58 | 37.7 | 86.4 |
| **more than 20 million $** | 21 | 13.6 | 100.0 |
| **Total** | 154 | 100.0 | |

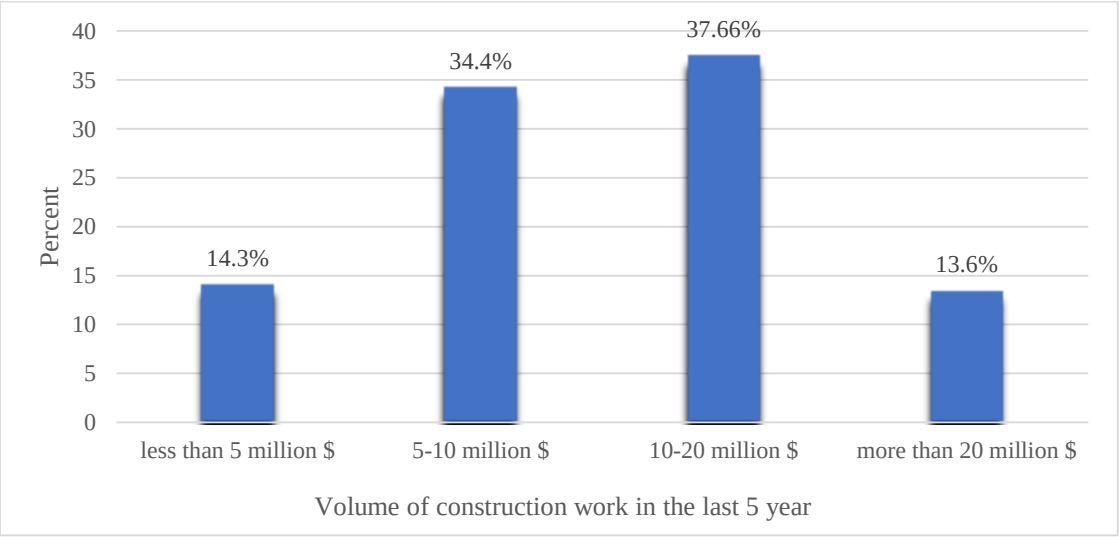


**Figure 16**:Distribution of value of construction projects in the last 5 years

### 4.2.8. Distribution of company's projects whose cost exceeds the estimated cost

Table 19 and Figure 17 indicate that 53.2% of construction companies faced a scenario where 21-40% of their projects exceeds the initially calculated costs. Moreover, within this group, 9.1% of companies experienced an even higher rate, with 41-60% of their projects exceeding the anticipated costs. These findings underline a significant occurrence of projects overshooting their planned costs within a considerable segment of the construction industry.

**Table 19**:Distribution of company's projects whose cost exceeds the pre-calculated cost

| Percentage of projects whose cost exceeds the pre-calculated cost | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **0%-20** | 57 | 37.0% | 37.0% |
| **21%-40** | 82 | 53.2% | 90.3% |
| **41%-60** | 14 | 9.1% | 99.4% |
| **81%-100** | 1 | 0.6% | 100% |
| **Total** | 154 | 100% | |

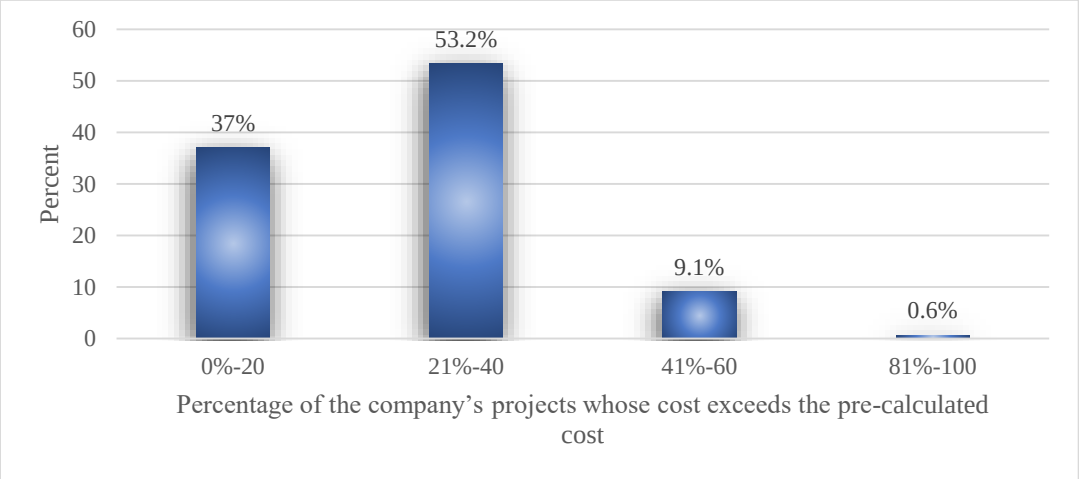


**Figure 17**:Percentage of the company's projects whose cost exceeds the pre-calculated cost

### 4.2.9. Distribution of cost overrun in the whole company's projects

Figure 18 and Table 20 illustrate the prevalence of cost overruns across the entirety of companies' projects within the construction sector. The breakdown of the percentage of cost overruns in these projects reveals a significant distribution: 22.7% of companies experienced a cost overrun ranging from 0-20%, while a larger proportion, 46.8% of companies, faced cost overruns between 21-40%. Furthermore, 29.2% of these companies encountered an even higher range of cost overruns, falling within the 41-60% margin. Remarkably, only a minimal 1.3% of companies contended with cost overruns ranging from 61-80%.

This distribution emphasizes the widespread occurrence of cost overruns in varying degrees across construction projects, with a substantial portion facing considerable overages in their projected cost.

**According to the results, the null Hypothesis #1: "There is a low occurrence of cost overruns throughout companies' projects in the construction industry in Palestine" is rejected**, because this data strongly emphasizes the acute and pervasive issue of cost overruns within the construction industry in Palestine. The prevalence and varying degrees of cost overruns across numerous projects underscore the gravity of this challenge, indicating a critical issue that requires attention and strategic intervention within the construction sector to ensure more accurate budgeting and cost control measures.

**Table 20**: Distribution of cost overrun in the whole company's projects

| cost overrun in the whole company's projects | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| **0%-20** | 35 | 22.7 | 22.7 |
| **21%-40** | 72 | 46.8 | 69.5 |
| **41%-60** | 45 | 29.2 | 98.7 |
| **61%-80** | 2 | 1.3 | 100.0 |
| **Total** | 154 | 100.0 | |

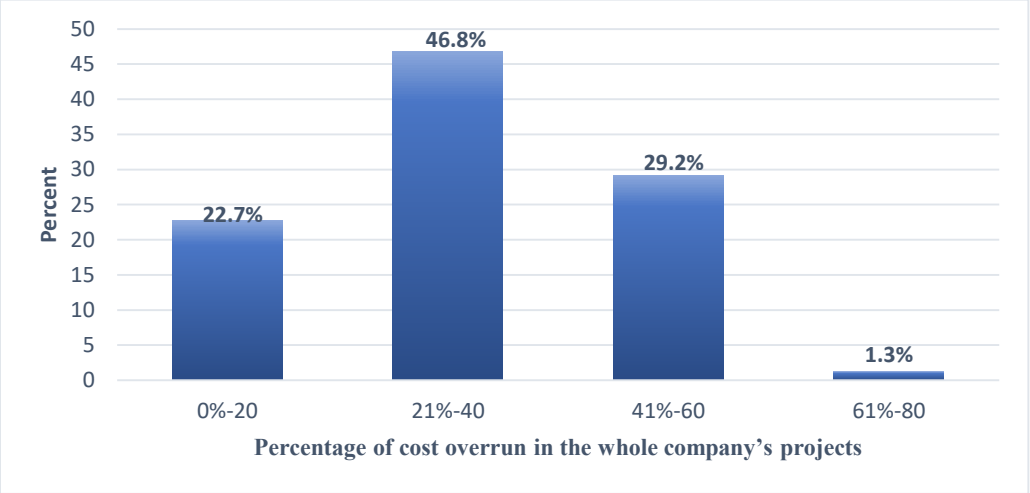


**Figure 18**:Percentage of cost overrun in the whole company's projects

### 4.2.10.Distribution of companies who make plans for control cost

When survey participants were questioned about their companies' proactive measures to address costs before exceeds calculated estimates—such as implementing programs for cost planning, monitoring, and control—only 19.5% confirmed such practices. Alarmingly, a significant 40.9% admitted to not implementing any specific procedures, indicating a substantial portion of companies lacking formal cost management protocols. Additionally, 39.6% acknowledged sporadic application, mentioning that certain cost-related procedures are sometimes utilized in selected projects, as shown in Figure 19. This

distribution highlights a concerning lack of consistent and comprehensive cost management strategies across a considerable segment of the surveyed construction companies.

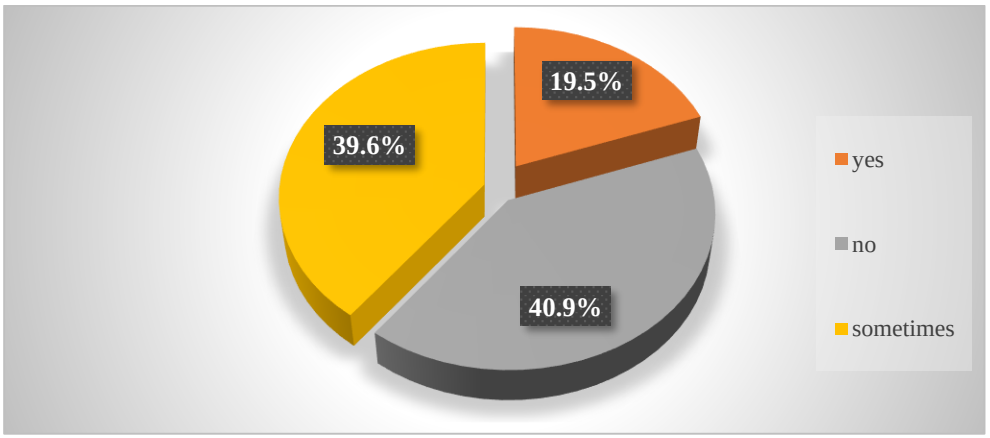


**Figure 19:**Distipution of companies which apply any software to plan, monitor, and control cost

## 4.3. Resource related factors causing cost overrun

This section delves into the analysis and results concerning the four categories of resource-related factors: material, manpower, monetary, and equipment, which significantly impact cost overruns within construction projects and are thoroughly examined to highlight their implications.

### 4.3.1. Main categories

Table 21 presents the mean and ranks assigned to each category of resource-related factors. Notably, the group exerting the most substantial impact on cost overrun was the money-related factors group, scoring a mean of 3.9 which is considered a high mean value compared to the average mean score for all sub-factors (**3.59**), this observation aligns with the findings reported in the study by Memon et al. (2013). This underscores the critical significance of financial elements and their direct correlation with project cost escalation.

Conversely, the manpower-related factors group registered the lowest mean of 3.4, signifying comparatively lesser influence, despite the presence of diverse sub-factors and differing counts within each group.

**Table 21**:Mean and ranking of main resource factors categories

| Factor Categories | Mean score | Mean ranking | Number of sub-factors |
|---|---|---|---|
| Money related factors | 3.8980 | 1 | 7 |
| Equipment related factors | 3.7879 | 2 | 6 |
| Material related factors | 3.4750 | 3 | 7 |
| Manpower related factors | 3.4036 | 4 | 13 |
| All factors | 3.59 | - | 33 |

### 4.3.2. Mean and ranking of sub-factors for each category

#### 4.3.2.1. Material Related Factors category

In this category, seven factors were identified. The mean for this group was 3.475, slightly lower than the overall sub-factors average mean of 3.59. In Table 22, the mean values of individual sub-factors within the material-related factors category are showcased in descending order, accompanied by their respective ranks according to project parties. Among the material-related factors, those with means exceeding the overall sub-factors average, which ranging from 3.65 to 4.21, included:

- Availability of materials
- Fluctuation of prices of materials
- Changes in material specification and type
- Delay in delivery of materials

The results indicate that two material-related factors, namely "Poor storage of materials" and "Amount of materials waste," received the lowest mean score, both registering a value of 2.81, they shared the same lowest rank within the group, indicating their comparatively lower impact or influence on cost overrun among the factors examined within this category.

**Table 22**:Means and ranking of material related factors group according to the project party: contractor, owner, consultant and overall

| Material- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Availability of materials | 4.32 | 1 | 4.19 | 1 | 4.03 | 1 | 4.21 | 1 |
| Fluctuation of prices of materials | 4.02 | 2 | 3.91 | 2 | 3.87 | 2 | 3.95 | 2 |
| Changes in material specification and type | 3.70 | 4 | 3.72 | 3 | 3.70 | 3 | 3.71 | 3 |
| Delay in delivery of materials | 3.77 | 3 | 3.50 | 4 | 3.67 | 4 | 3.65 | 4 |
| Bad materials quality | 3.09 | 5 | 3.28 | 5 | 3.20 | 5 | 3.18 | 5 |
| Amount of materials waste | 2.94 | 6 | 2.64 | 6 | 2.87 | 7 | 2.81 | 6 |
| Poor storage of materials | 2.92 | 7 | 2.62 | 7 | 2.93 | 6 | 2.81 | 7 |

#### 4.3.2.2. Manpower Related Factors category

The manpower-related factors group registered the lowest mean of 3.4036, compared to the overall sub-factors mean (3.59), signifying comparatively lesser influence. The 13 sub-factors of this category were listed in this category related to labors issues. The mean of each sub-factor of manpower-related factors is detailed in Table 23, organized in descending order, the rank of each factor is also provided according to project parties. Three from them have mean values more the overall sub-factors mean, include:

- Availability of skilled labors, with mean score 4.43, ranked the first significant factor from the over-all factors.
- Labors productivity, with mean score 4.36, ranked the third significant factor from the over-all factors.
- High cost of labors, with mean score 4.27, ranked the fifth significant factor from the over-all factors.

On other side, the lowest factors influencing cost overrun were identified as "Loyalty and ethics of labors," "Relationship between labors," and "Overmanning and crowding," each receiving mean scores ranging from 2.81 to 2.86. this underscoring their comparatively lower influence on cost escalation within the surveyed context.

**Table 23**:Means and ranking of Manpower related factors group according to the project party: contractor, owner, consultant and overall

| Manpower- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Availability of skilled labor | 4.53 | 2 | 4.48 | 1 | 4.10 | 1 | 4.43 | 1 |
| Labors productivity | 4.56 | 1 | 4.38 | 2 | 3.90 | 2 | 4.36 | 2 |
| High cost of labors | 4.39 | 3 | 4.22 | 3 | 4.10 | 1 | 4.27 | 3 |
| Amount of work/workload | 3.62 | 4 | 3.52 | 4 | 3.30 | 4 | 3.52 | 4 |
| Low wages of labors | 3.52 | 5 | 3.33 | 5 | 3.20 | 6 | 3.38 | 5 |
| Number of change/extra work orders | 3.29 | 8 | 3.29 | 6 | 3.40 | 3 | 3.31 | 6 |
| Turnover and absenteeism | 3.26 | 7 | 3.17 | 7 | 3.07 | 7 | 3.19 | 7 |
| Amount of rework | 3.15 | 9 | 3.14 | 8 | 3.23 | 5 | 3.16 | 8 |
| Relationship between labors and management | 3.38 | 6 | 2.98 | 9 | 2.83 | 9 | 3.12 | 9 |
| Morale/motivation of crew | 3.06 | 10 | 2.90 | 10 | 2.90 | 8 | 2.97 | 10 |
| loyalty and ethics of labors | 2.97 | 11 | 2.78 | 11 | 2.80 | 10 | 2.86 | 11 |
| Relationship between labors | 3.05 | 12 | 2.72 | 12 | 2.70 | 11 | 2.86 | 11 |
| Overmanning and crowding | 2.83 | 13 | 2.72 | 12 | 2.90 | 8 | 2.81 | 12 |

#### 4.3.2.3. Money Related Factors category

This group exerting the most substantial impact on cost overrun, scoring a mean of 3.9. This underscores the critical significance of financial elements and their direct correlation with project cost escalation. This category includes 7 sub-factors, according to Table 24, six from them have mean values -ranging from 3.62 to 4.36- more than the overall mean, as follows:

- Financial difficulties of contractor and cash flow
- Inaccurate cost estimate
- Financial difficulties of owner
- Inflation of prices
- Change in currency exchange rate
- Poor financial control on site

The seventh factor 'Financing methods, bonds, and payments' secured the lowest rank among the sub-factors, with a mean score of 3.38, suggesting a comparatively lesser influence on the examined aspects related to financial factors in cost overrun.

**Table 24**:Means and ranking of Money related factors group according to the project party: contractor, owner, consultant and overall

| Money- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Financial difficulties of contractor and cash flow | 4.41 | 1 | 4.38 | 1 | 4.23 | 1 | 4.36 | 1 |
| Inaccurate cost estimate | 4.38 | 2 | 4.22 | 3 | 4.20 | 2 | 4.29 | 2 |
| Financial difficulties of owner | 4.23 | 3 | 4.31 | 2 | 4.23 | 1 | 4.26 | 3 |
| Inflation of prices | 3.77 | 5 | 3.71 | 5 | 3.73 | 3 | 3.74 | 4 |
| Change in currency exchange rate | 3.64 | 6 | 3.74 | 4 | 3.43 | 6 | 3.64 | 5 |
| Poor financial control on site | 3.83 | 4 | 3.40 | 6 | 3.60 | 4 | 3.62 | 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Financing methods, bonds and payments | 3.52 | 7 | 3.17 | 7 | 3.47 | 5 | 3.38 | 7 |

#### 4.3.2.4. Equipment Related Factors category

This category registered mean score of 3.7879, which is more than the overall mean (3.59) Among the equipment-related factors outlined in Table 25, there are six listed sub-factors, four from them have high mean scores and more the overall mean, include:

- Availability of Equipment
- High cost of machines and their maintenance
- Insufficient number of equipment's
- Efficiency of Equipment

In contrast," Suitability of Equipment" and "Easy access to equipment on site" registered the lowest mean values of 3.29, indicating a comparatively lesser impact on the examined aspects related to equipment in the context of cost overrun.

**Table 25**:Means and ranking of Equipment related factors group according to the project party: contractor, owner, consultant and overall

| Equipment- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Availability of Equipment | 4.56 | 1 | 4.41 | 1 | 4.10 | 2 | 4.42 | 1 |
| High cost of machines and their maintenance | 4.21 | 2 | 4.26 | 2 | 4.17 | 1 | 4.22 | 2 |
| Insufficient number of equipment's | 3.88 | 3 | 3.48 | 4 | 3.67 | 3 | 3.69 | 3 |
| Efficiency of Equipment | 3.76 | 4 | 3.66 | 3 | 3.57 | 4 | 3.68 | 4 |
| Suitability of Equipment | 3.53 | 5 | 3.33 | 5 | 3.43 | 5 | 3.44 | 5 |
| Easy access to equipment on site | 3.44 | 6 | 3.07 | 6 | 3.37 | 6 | 3.29 | 6 |

### 4.3.3. Over-all ranks of all resource- related factors causing cost overrun

In Table 26, the comprehensive resource-related factors contributing to cost overrun in the Palestinian construction industry are detailed in descending order. Notably, the most severe factors identified are "Availability of skilled labor," "Availability of Equipment," "Labor productivity," "Financial difficulties of contractor and cash flow," and "Inaccurate cost estimate," with mean scores ranging from 4.29 to 4.43. These factors predominantly fall within the categories of Manpower, Equipment, or Money, indicating their substantial impact on cost escalation.

Conversely, the least impactful factors influencing cost overrun include "Loyalty and ethics of labors," "Relationship between labors," "Poor storage of materials," "Amount of materials waste," and "Overmanning and crowding," with mean scores ranging from 2.81 to 2.86. These factors are primarily associated with the categories of manpower or material-related factors, highlighting their relatively lower influence on cost escalation within the surveyed context.

**Table 26**: Means and ranks of all resource related factors causing cost overrun

| Resource- related factors causing cost overrun | Rank | Mean score | Category |
|---|---|---|---|
| Availability of skilled labors | 1 | 4.43 | Manpower related factors |
| Availability of Equipment | 2 | 4.42 | Equipment related factors |
| Labors productivity | 3 | 4.36 | Manpower related factors |
| Financial difficulties of contractor & cash flow | 3 | 4.36 | Money related factors |
| Inaccurate cost estimate | 4 | 4.29 | Money related factors |
| High cost of labors | 5 | 4.27 | Manpower related factors |
| Financial difficulties of owner | 6 | 4.26 | Money related factors |

| | | | |
|---|---|---|---|
| High cost of machines and their maintenance | 7 | 4.22 | Equipment related factors |
| Availability of materials | 8 | 4.21 | Materials related factors |
| Fluctuation of prices of materials | 9 | 3.95 | Materials related factors |
| Inflation of prices | 10 | 3.74 | Money related factors |
| Changes in material specification and type | 11 | 3.71 | Materials related factors |
| Insufficient number of equipment's | 12 | 3.69 | Equipment related factors |
| Efficiency of Equipment | 13 | 3.68 | Equipment related factors |
| Delay in delivery of materials | 14 | 3.65 | Materials related factors |
| Change in currency exchange rate | 15 | 3.64 | Money related factors |
| Poor financial control on site | 16 | 3.62 | Money related factors |
| Amount of work/workload | 17 | 3.52 | Manpower related factors |
| Suitability of Equipment | 18 | 3.44 | Equipment related factors |
| Low wages of labors | 19 | 3.38 | Manpower related factors |
| Financing methods, bonds and payments | 19 | 3.38 | Money related factors |
| Number of change/extra work orders | 20 | 3.31 | Manpower related factors |
| Easy access to equipment on site | 21 | 3.29 | Equipment related factors |
| Turnover and absenteeism | 22 | 3.19 | Manpower related factors |
| Bad materials quality | 23 | 3.18 | Materials related factors |
| Amount of rework | 24 | 3.16 | Manpower related factors |
| Relationship between labors and management | 25 | 3.12 | Manpower related factors |
| Morale/motivation of crew | 26 | 2.97 | Manpower related factors |
| loyalty and ethics of labors | 27 | 2.86 | Manpower related factors |
| Relationship between labors | 27 | 2.86 | Manpower related factors |
| Poor storage of materials | 28 | 2.81 | Materials related factors |
| Amount of materials waste | 28 | 2.81 | Materials related factors |
| Overmanning and crowding | 28 | 2.81 | Manpower related factors |

### 4.3.4. Ranks of all resource- related factors according to project parties' perspective

This study utilized Mean Score ranking techniques to identify primary resource related factors contributing to cost overruns in the Palestinian construction sector, as perceived by project parties. Table 27 outlines the summary of the Mean Score analysis and ranks of these factors, from the perspective of contractors, consultants and owners.

**Table 27**: Means and ranks of all resource related factors causing cost overrun according to project parties' view

| Resource- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Availability of skilled labor | 4.53 | 2 | 4.48 | 1 | 4.10 | 4 | 4.43 | 1 |
| Availability of Equipment | 4.56 | 1 | 4.41 | 2 | 4.10 | 4 | 4.42 | 2 |
| Labors productivity | 4.56 | 1 | 4.38 | 3 | 3.90 | 6 | 4.36 | 3 |
| Financial difficulties of contractor and cash flow | 4.41 | 3 | 4.38 | 3 | 4.23 | 1 | 4.36 | 3 |
| Inaccurate cost estimate | 4.38 | 5 | 4.22 | 6 | 4.20 | 2 | 4.29 | 4 |
| High cost of labors | 4.39 | 4 | 4.22 | 6 | 4.10 | 4 | 4.27 | 5 |
| Financial difficulties of owner | 4.23 | 7 | 4.31 | 4 | 4.23 | 1 | 4.26 | 6 |
| High cost of machines and their maintenance | 4.21 | 8 | 4.26 | 5 | 4.17 | 3 | 4.22 | 7 |
| Availability of materials | 4.32 | 6 | 4.19 | 7 | 4.03 | 5 | 4.21 | 8 |
| Fluctuation of prices of materials | 4.02 | 9 | 3.91 | 8 | 3.87 | 7 | 3.95 | 9 |
| Inflation of prices | 3.77 | 12 | 3.71 | 11 | 3.73 | 8 | 3.74 | 10 |
| Changes in material specification and type | 3.70 | 14 | 3.72 | 10 | 3.70 | 9 | 3.71 | 11 |
| Insufficient number of equipment's | 3.88 | 10 | 3.48 | 15 | 3.67 | 10 | 3.69 | 12 |
| Efficiency of Equipment | 3.76 | 13 | 3.66 | 12 | 3.57 | 12 | 3.68 | 13 |
| Delay in delivery of materials | 3.77 | 12 | 3.50 | 14 | 3.67 | 10 | 3.65 | 14 |
| Change in currency exchange rate | 3.64 | 15 | 3.74 | 9 | 3.43 | 14 | 3.64 | 15 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Poor financial control on site | 3.83 | 11 | 3.40 | 16 | 3.60 | 11 | 3.62 | 16 |
| Amount of work/workload | 3.62 | 16 | 3.52 | 13 | 3.30 | 17 | 3.52 | 17 |
| Suitability of Equipment | 3.53 | 17 | 3.33 | 17 | 3.43 | 14 | 3.44 | 18 |
| Low wages of labors | 3.52 | 18 | 3.33 | 17 | 3.20 | 19 | 3.38 | 19 |
| Financing methods, bonds and payments | 3.52 | 18 | 3.17 | 20 | 3.47 | 13 | 3.38 | 19 |
| Number of change/extra work orders | 3.29 | 21 | 3.29 | 18 | 3.40 | 15 | 3.31 | 20 |
| Easy access to equipment on site | 3.44 | 19 | 3.07 | 22 | 3.37 | 16 | 3.29 | 21 |
| Turnover and absenteeism | 3.26 | 22 | 3.17 | 20 | 3.07 | 20 | 3.19 | 22 |
| Bad materials quality | 3.09 | 24 | 3.28 | 19 | 3.20 | 19 | 3.18 | 23 |
| Amount of rework | 3.15 | 23 | 3.14 | 21 | 3.23 | 18 | 3.16 | 24 |
| Relationship between labors and management | 3.38 | 20 | 2.98 | 23 | 2.83 | 24 | 3.12 | 25 |
| Morale/motivation of crew | 3.06 | 25 | 2.90 | 24 | 2.90 | 22 | 2.97 | 26 |
| loyalty and ethics of labors | 2.97 | 27 | 2.78 | 25 | 2.80 | 25 | 2.86 | 27 |
| Relationship between labors | 3.05 | 26 | 2.72 | 26 | 2.70 | 26 | 2.86 | 27 |
| Amount of materials waste | 2.94 | 28 | 2.64 | 27 | 2.87 | 23 | 2.81 | 28 |
| Poor storage of materials | 2.92 | 29 | 2.62 | 28 | 2.93 | 21 | 2.81 | 28 |
| Overmanning and crowding | 2.83 | 30 | 2.72 | 26 | 2.90 | 22 | 2.81 | 28 |

- **Contractor's perspective:** the findings highlight the resource related factors identified by contractors, including availability of equipment, labors productivity, availability of skilled labor, financial difficulties of contractor and cash flow and high cost of labors, as the top 5 significant factors contributors to cost overruns, respectively. Notably, what stands out is that these top five factors hold greater significance, as indicated by their higher mean scores from the contractors' perspective compared to those from the viewpoints of consultants and owners. This disparity in mean scores elucidates the elevated importance contractors attribute to

these factors, underlining their substantial impact on cost overruns within construction projects.

- **Consultant's perspective:** the results of mean score in Table 27 shows that consultant's perspective mostly agreed with the over-all ranking of factors which include: "availability of skilled labor", "availability of equipment", "labors productivity", "financial difficulties of contractor and cash flow" and "financial difficulties of owner", respectively. it shows that the first four factors matching with the overall ranking, but the 5$^{th}$ factor in consultant's perspective were the 7$^{th}$ in the over-all ranking of factors.
- **Owner's perspective:** The perspective of the owners is clearly reflected in Table 27, where respondents ranked "financial difficulties of the contractor and cash flow" as the first factor. Interestingly, the factor of "financial difficulties of the owner" holds a secondary position in their ranking, despite being placed seventh in the overall sub-factor ranking Additionally, "inaccurate cost estimates," "high cost of machines and their maintenance," and "availability of skilled labor" were respectively positioned as the third, fourth, and fifth factors, elucidating their significance from the owner's viewpoint. The first three factors belong to the category of money related factors, which emphasizes the owner's predominant concern for financial aspects as a primary consideration.

It's important to note that across contractors, consultants, and owners, the resource-related factors contributing to cost overruns exhibit a relatively stable pattern. While there might be variations in their specific rankings, the top factors largely remain consistent among all project parties. These factors consistently hold their positions within the top ten significant contributors to cost overruns in the Palestinian construction industry. This

consensus emphasizes a shared agreement among these stakeholders regarding the criticality of these factors and their undeniable impact on cost overruns.

Depending on this result, we **reject the null Hypothesis #2 : "There is no agreement or consistent pattern in the ranking of the construction resource-related factors contributing to cost overruns across the perspectives of contractors, consultants, and owners in Palestine",** because results show a high agreement among project parties on the studied resource related factors.

Moreover, a chart was generated to depict the significance plotted against the comprehensive ranking of variables, considering the magnitudes of importance for contractors, consultants, owners, and the overall perspective. The objective was to provide a visual representation of the consensus level among these respondents (project parties). Refer to Figure 20 for details.

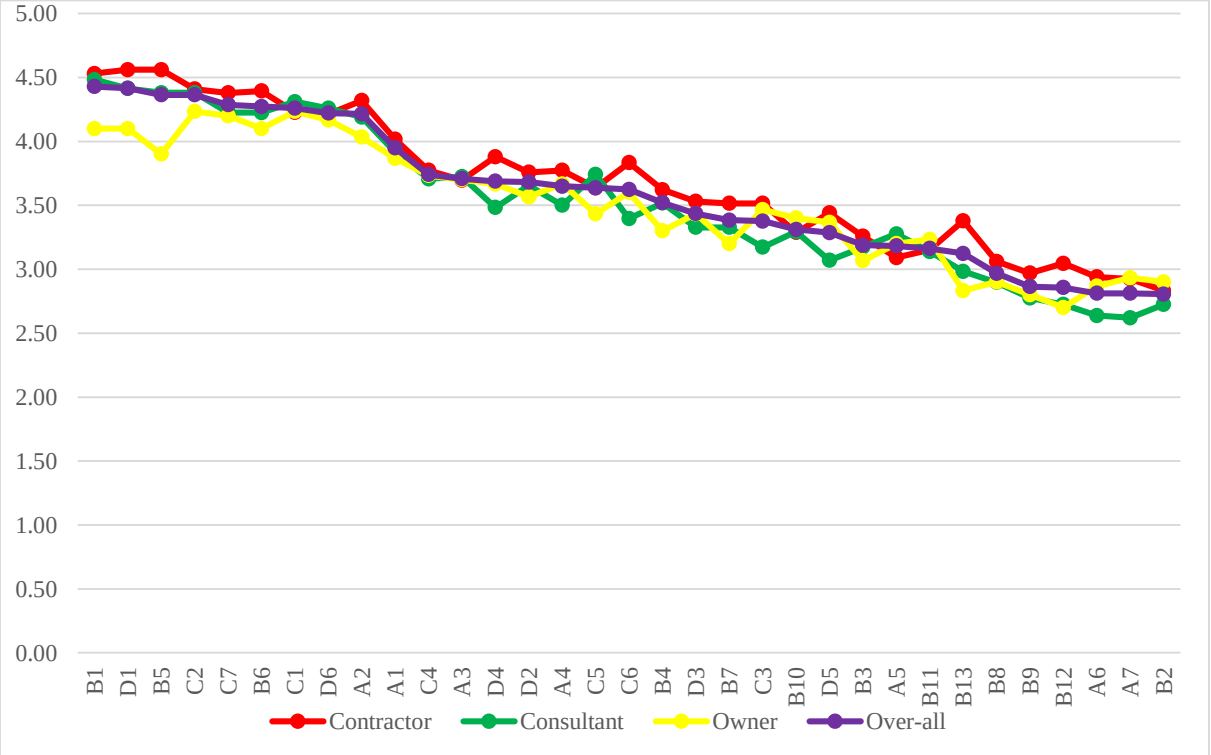


**Figure 20**:The importance magnitudes against the overall ranking of resource related factors of cost overrun

### 4.3.5. Top ten resource- related factors causing cost overrun

In Table 28, the top 10 resource-related factors contributing to cost overrun in Palestinian construction projects are highlighted. The table provides mean values for these factors, ranging from 3.95 to 4.43, showcasing their varying degrees of influence on cost escalation. Also it shows the studies that support these findings according to previous studies which were discussed before Additionally, it categorizes each factor according to its relevant resource category, offering insights into whether these influential aspects predominantly fall within the realms of material, manpower, money, or equipment categories.

**Table 28**: Top ten resource related factor causing cost overrun and the supporting previous studies

| Resource- related factors | Rank | Mean Score | previous supported studies |
|---|---|---|---|
| Availability of skilled labors | **1** | 4.43 | (Knight & Fayek, 2000; Bekr,2015 and El-Ahwal et al.,2016). |
| Availability of Equipment | **2** | 4.42 | (El-Sawalhi & Eleyan, 2018; Enshassi et al., 2010 and Melaku Belay et al., 2021). |
| labors productivity | **3** | 4.36 | (Aziz & Hafez, 2013) and (Almamlook, 2020) |
| Financial difficulties of contractor and cash flow | **3** | 4.36 | (Le-Hoai et al., 2008; Doloi's, 2013; Mahamid & Dmaidi, 2013 and Aljohani et al., 2017). |
| Inaccurate cost estimate | **4** | 4.29 | (Knight & Fayek, 2000; Ali & Kamaruzzaman, 2010; Chitkara's, 2011; Muhammad et al., 2015; El-Ahwal et al., 2016; Aljohani et al., 2017; El-Sawalhi & Eleyan, 2018 and Melaku Belay et al., 2021) |
| High cost of labors | **5** | 4.27 | (Kaming et al., 1997; Forth & O'Mahony, 2003 and Musarat et al.,2022) |

| | | | |
|---|---|---|---|
| Financial difficulties of owner | **6** | 4.26 | (Le-Hoai et al., 2008; Oluyemi-Ayibiowu et al., 2019 and Heravi and Mohammadian, 2021) |
| High cost of machines and their maintenance | **7** | 4.22 | (Azhar et al. ,2008; Ali & Kamaruzzaman,2010; Mahamid & Dmaidi ,2013 and Subramani et al. ,2014). |
| Availability of materials | **8** | 4.21 | (Rahman et al., 2013; Aljohani et al., 2017; Elayan, 2018; Enshassi et al., 2010 and Melaku Belay et al., 2021) |
| Fluctuation of prices of materials | **9** | 3.95 | (Enshassi et al. ,2010; Rahman et al.,2013; Mahamid & Dmaidi,2013; Muhammad et al. ,2015; Bekr,2015; Ullah, 2018; Oluyemi-Ayibiowu et al., 2019; Melaku Belay et al., 2021 and Xie et al., 2022). |

Moreover, top ten resource-related factors were studied and ensuing discussion provides an in-depth exploration of these critical factors, including comparisons between the results obtained in this study and previous studies discussed in the literature review. These factors are illustrated below:

1. **Availability of skilled labors:**

The issue of skilled labor availability in construction projects, as shown in the results, is the critical top factor that can significantly impact the cost overrun of construction projects, and hinders the execution and success of construction projects. This problem is multifaceted, involving both labor quality and quantity issues (Karimi et al.,2017). Proactive planning, strategic partnerships, and investment in workforce development are crucial for mitigating these challenges and ensuring the success of construction projects. This issue has been reported and discussed frequently by numerous past studies in the context of construction industry as highlighted by (Knight & Fayek, 2000; Bekr,2015 and El-Ahwal et al.,2016).

**2. Availability of Equipment**

The availability of Equipment Resources significantly influences construction costs and stands as the second most impactful factor contributing to the cost overrun of construction projects, as the study results reveal. Equipment Resources have a distinct advantage over manpower resources, as they can operate continuously under adverse conditions, requiring fewer personnel and additional facilities (Rahman etal.,2013). Therefore, the specific type and quantity of equipment required for any project are contingent upon the nature of that project. This issue has garnered attention in numerous past studies within the construction industry, with notable discussions and reports as highlighted (El-Sawalhi & Eleyan, 2018; Enshassi et al., 2010 and Melaku Belay et al., 2021).

**3. labors productivity**

The results of the study emphasize that labor productivity is a critical factor influencing project cost overruns in construction projects, marking it as the third most significant factor according to the survey findings. Previous studies, like (Aziz & Hafez, 2013) and (Almamlook, 2020), have underscored that poor labor productivity is a major challenge within the construction industry. Consequently, productivity remains an intriguing and dominant issue in the sector.

Despite the substantial contribution of the construction industry to the economic growth of both developed and developing nations, labor productivity within this sector remains comparatively low. This factor has notable repercussions on construction project delivery and client satisfaction, as pointed out by (Adebowale & Ayodeji, 2015). Several key factors contribute to the decline in labor productivity, such as the quality of site management, labor experience, and misunderstandings between labor and supervisors,

as highlighted by (Dharani, 2015). The collective impact of these factors underscores the importance of addressing labor productivity challenges to enhance overall project performance and client satisfaction in the construction industry.

**4. Financial difficulties of contractor and cash flow**

Financial difficulties of a contractor and challenges related to cash flow have been consistently identified as significant contributors to cost overruns in construction projects, as evidenced by study results and the consensus among prior research studies, including (Le-Hoai et al., 2008; Doloi's, 2013; Mahamid & Dmaidi, 2013 and Aljohani et al., 2017).According to (Seo et al., 2018), maintaining a stable financial performance, facilitated by effective cash flow analysis, enables construction organizations to leverage investment opportunities. The financial health of a contractor's is contingent on having sufficient capital to meet obligations such as payments to creditors, suppliers, subcontractors, and employees. Additionally, reliance on client payments to cover these expenditures adds another layer of complexity to the financial dynamics of construction projects.

In a study conducted by (Omopariola et al., 2020), it was found that cash flow problems during construction projects can stem from various factors. Delayed payments, difficulty in securing financial aid, and inadequate budgetary control were identified as causes of cash flow challenges. So, a contractor's financial stability and effective cash flow management are pivotal in preventing cost overruns.

**5. Inaccurate cost estimate**

The accuracy of project estimates plays a pivotal role, often serving as a key metric for assessing the project team's performance and the overall success of the project, as

highlighted by previous studies. According to Peeters and Madauss (2008), one of the primary contributors to budget overruns is the inaccurate estimation of the original or initial cost of a project. This is often attributed to technical challenges in estimating project costs and insufficient project information in the early stages, as noted by (Ali & Kamaruzzaman, 2010).

The determination of pricing and the required profit for a construction project occurs during the bidding process and bid acceptance. This underscores the importance for construction managers to comprehend the various factors influencing the accuracy of project cost estimates, as emphasized by (Arif et al., 2015). Numerous studies highlight the criticality of accurate cost estimates for construction projects, including (Knight & Fayek, 2000; Ali & Kamaruzzaman, 2010; Chitkara's, 2011; Muhammad et al., 2015; El-Ahwal et al., 2016; Aljohani et al., 2017; El-Sawalhi & Eleyan, 2018 and Melaku Belay et al., 2021).

**6. High cost of labors**

The results indicate that the high cost of labor was identified as the sixth factor contributing to cost overruns in construction projects in Palestine. The impact of high labor costs on cost overruns can be understood through various mechanisms. As noted by (McTague and Jergeas, 2002), labor costs typically account for a substantial portion, ranging between 30 and 50%, of a construction project's total cost. Consequently, when labor costs exceed the initial estimates, it places a strain on the overall financial viability of the project.

The significance of high labor costs and their implications for cost overruns in construction has been highlighted by several studies, studies that support this result include (Kaming et al., 1997; Forth & O'Mahony, 2003 and Musarat et al.,2022).

**7. Financial difficulties of owner**

The financial difficulties of an owner play a significant role in contributing to cost overruns in construction projects as study results show, this stemming from the owner's challenges in meeting financial obligations and commitments. To mitigate the risk of cost overruns, owners are advised to proactively prepare available funds for the project and develop a comprehensive financial plan aligned with the contract agreement, as recommended by (Le-Hoai et al., 2008).

According to (Kaliba et al., 2009), delays in payments resulting from complex financial processes within client firms can lead to financial difficulties for contractors, it can subsequently disrupt the project schedule, causing delays in completing on-site activities. Additionally, interest charges may be incurred on delayed payments, further contributing to cost overruns in the project. Multiple previous studies such as (Le-Hoai et al., 2008; Oluyemi-Ayibiowu et al., 2019 and Heravi and Mohammadian, 2021) consistently confirms that the financial challenges faced by owners are a pivotal factor in the occurrence of cost overruns in construction projects.

**8. High cost of machines and their maintenance**

The elevated expenses related to machinery and their maintenance in construction projects considered one of the most important issues that contribute significantly to cost overrun, as results show. Estimates suggest that equipment costs in the construction

industry typically range from 25% to 40 % of the total project cost (Iseley & Gokhale, 2003), which considered high-cost level referring to project costs.

This issue arises when the substantial costs associated with acquiring and maintaining construction machinery exceed the initial project estimates, impacting the overall budget and potentially leading to financial challenges in project execution. Addressing and managing the high costs of machines and their maintenance is crucial to mitigating the risk of cost overruns in construction endeavors. This finding is supported by various studies, including (Azhar et al. ,2008; Ali & Kamaruzzaman,2010; Mahamid & Dmaidi ,2013 and Subramani et al. ,2014).

**9. Availability of materials**

Materials are integral to the construction industry, representing a substantial proportion of the total project value, as noted by (Memon et al., 2013). The availability of materials on construction sites is crucial as it has significant implications for the productivity of construction labor, thereby impacting both project cost and performance, as highlighted by (Jusoh & Kasim, 2017). Several factors contribute to the lack of materials on construction sites, each with potential repercussions. These factors include a shortage of funds, inadequate planning, excessive paperwork, improper materials usage in relation to specifications, fluctuations in materials, waste due to negligence, improper materials storage, poor delivery of materials to the site, on-site transportation difficulties, and poor materials handling on-site, as identified by (Hughes & Thorpe, 2014).

Many studies such as (Rahman et al., 2013; Aljohani et al., 2017; Elayan, 2018; Enshassi et al., 2010 and Melaku Belay et al., 2021) have consistently highlighted the significance

of material availability as a crucial factor contributing to cost overrun in construction projects.

**10. Fluctuation of prices of materials**

Results reveals that material price fluctuation is a crucial issue leads to cost overrun in construction project. The alarming rate of material price fluctuation is a significant concern, giving rise to disputes in numerous construction projects. These fluctuations not only impact costs but also have implications for project timelines and overall quality performance. According to Omede (2021) , Several key factors contribute to material price fluctuations, including the exchange rate of the national currency, transportation costs, inflation in building materials prices, and the cost of energy .This issue were addressed and supported by numerous studies, among them (Enshassi et al. ,2010 ; Rahman et al.,2013; Mahamid & Dmaidi,2013; Muhammad et al. ,2015; Bekr,2015;Ullah , 2018 ; Oluyemi-Ayibiowu et al., 2019 ; Melaku Belay et al. , 2021 and Xie et al. , 2022).

## 4.3.6. Relationship between resource- related factors causing cost overrun

### I. Correlation:

In assessing the strength of associations among the studied resource related factors, correlation relationships were employed. Three common methods used to determine the degree of association between pairs of variables include the Pearson correlation, the Spearman correlation, and the Chi-square test of independence. Given that the data collected and used in analysis for this study involves non-parametric and ordinal variables, Spearman’s rank order correlation emerges as the more powerful method for

examining the relationships between every 2 factors. This method's strength lies in its suitability for non-parametric data, allowing for a comprehensive evaluation of associations among variables in this particular dataset. According to (Bryman and Cramer ,2002), Spearman's correlation formula is given as:

$$\rho = 1 - \frac{6\sum d^2}{n(n^2 - 1)} \qquad \textbf{Eq ... (4)}$$

Where, $d$ difference between ranks, $n$ is the highest weight and $\rho$ (rho) represents the Spearman's correlation coefficient.

The correlation coefficient $\rho$ have values ranging from -1.0 to +1.0, serving as a measure of the relationship between two variables. As $\rho$ approaches +1 or -1, it indicates a stronger association between factors. A value close to +1 signifies a strong positive linear relationship, while a value near -1 denotes a strong negative linear relationship (Daud et al., 2009).

A correlation coefficient of ±1 is considered a perfect correlation, indicating a complete linear relationship between factors. When $\rho$ value falls between ±0.5 and ±1, it signifies a high degree of correlation. For values between ±0.3 and ±0.5, the correlation degree is moderate. A low correlation occurs when $\rho$ value ranges between ± 0.1 and ± 0.3. A $\rho$ value of zero signifies no correlation between the factors at all (Cohen,1988). These ranges provide insights into the strength and nature of the relationship between factors based on the calculated correlation coefficient.

## II. Relationship Between Resource Related Factors leading to cost overrun

The relationship between pairs of factors was investigated using Spearman's rank order correlation, a method outlined by Bryman and Cramer (2002). Table 29 presents the correlation analysis of the resource-related factors contributing to cost overrun. This analysis likely assesses the strength and direction of associations between different factors, shedding light on their interrelatedness and potential impact on cost escalation in the studied context.

- The correlation analysis highlights a notable relationship between the two factors "Relationship between labors and management" and "Relationship between labors," despite their rankings being 25th and 27th among the resource-related factors. Their correlation value of 0.704 signifies a strong positive association between these factors. This suggests that despite their relatively lower individual rankings among the studied factors, these aspects concerning labor relationships hold a pronounced interconnection, implying a shared influence on certain aspects, possibly impacting project outcomes.
- The analysis reveals a substantial correlation (0.690) between "Financial difficulties of contractor and cash flow" and "Financial difficulties of owner", these two factors ranked as 3$^{rd}$ and 6$^{th}$ among the resource-related factors, respectively. This correlation underscores a significant association, suggesting that financial challenges experienced by owners and contractors, particularly concerning cash flow, tend to align or coincide within the cost overrun in construction projects, Figure 21.

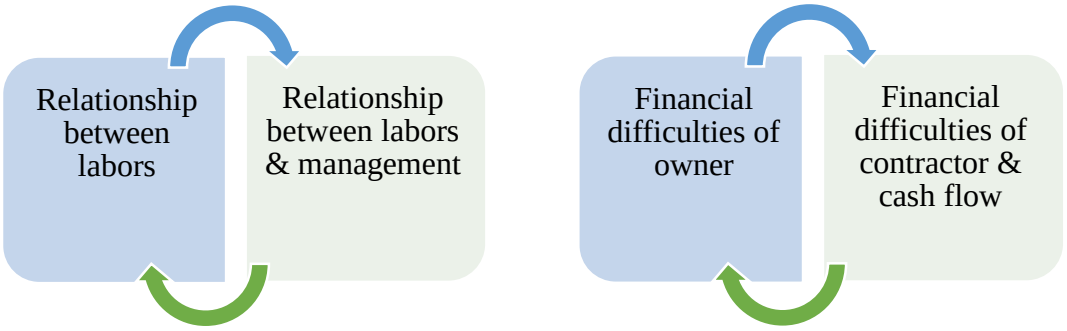


**Figure 21**:Relationship between resource related factors leading to cost overrun-1

- The correlation analysis reveals significant associations between "Labors productivity" and three distinct factors: "Availability of Equipment," "High cost of labors," and "Availability of skilled labor." With correlation values of 0.583, 0.516, and 0.567 respectively (as depicted in Figure 22). These factors, known for their high mean scores and rankings (3rd, 2nd, 5th, and 1st ranks respectively among the top ten resource-related factors), demonstrate a noteworthy relationship. This correlation emphasizes on the strong interdependence among these factors and underscores their collective impact on project cost overrun in Palestinian construction industry.

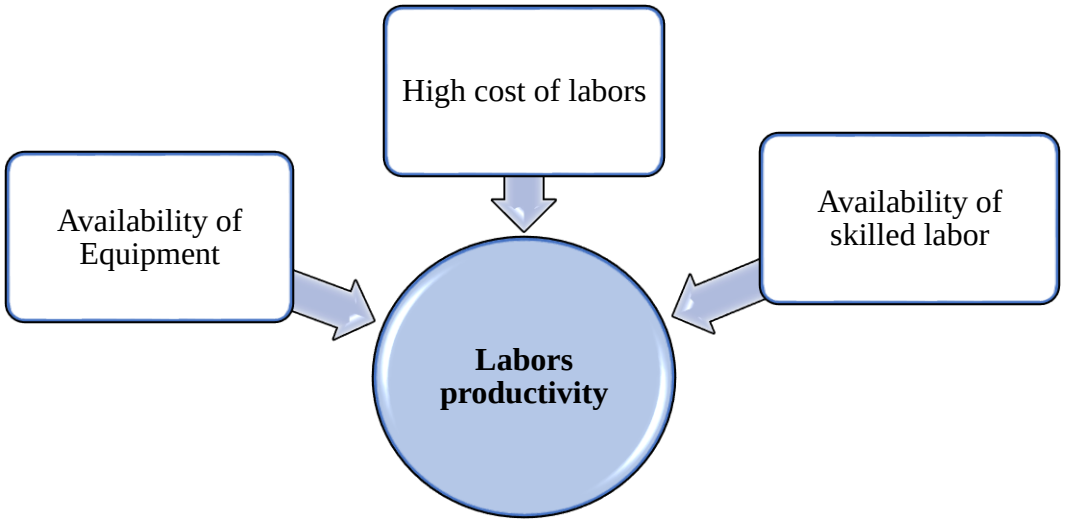


**Figure 22**:Relationship between resource related factors leading to cost overrun-2

- Figure 23 shows significant connections among various equipment-related factors. Notably, "Efficiency of Equipment" and "Suitability of Equipment" show a substantial

correlation of 0.667. Additionally, "Suitability of Equipment" demonstrates a notable correlation of 0.565 with "Easy access to equipment on site." These factors, characterized by high mean scores, with high correlation among equipment-related factors. This emphasizes the strong interrelation between these factors and underscores their substantial impact on cost overrun within the construction industry.

- Interestingly, "Amount of materials waste" and "Poor storage of materials" exhibit a correlation value of 0.604. It's noteworthy that these two factors, despite having the lowest mean values (2.81) and ranking lowest among the factors studied, demonstrate a strong positive correlation. This correlation suggests that despite their lower individual impact, there's a tendency for these factors to co-occur or influence each other within the context of the studied dataset
- The variables "Turnover and absenteeism" demonstrate a notable correlation with both "Overmanning and crowding" (0.529) and "Amount of work/workload" (0.527). Despite having mean scores of 3.19, 2.81, and 3.52 respectively, these factors exhibit a moderate strong positive relationship, indicating that higher instances of turnover and absenteeism tend to align or co-occur with increased overmanning, crowding, and workload within the studied dataset.
- The variable "Morale/motivation of crew" demonstrates correlations of 0.507 with "Low wages of labors" and 0.647 with "Loyalty and ethics of labors" (as depicted in Figure 23). These correlation values indicate strong positive relationships. This suggests that within the study, the morale or motivation of the crew tends to align notably with both the issue of low wages among the labor force and the perceived loyalty and ethical conduct of the workforce.

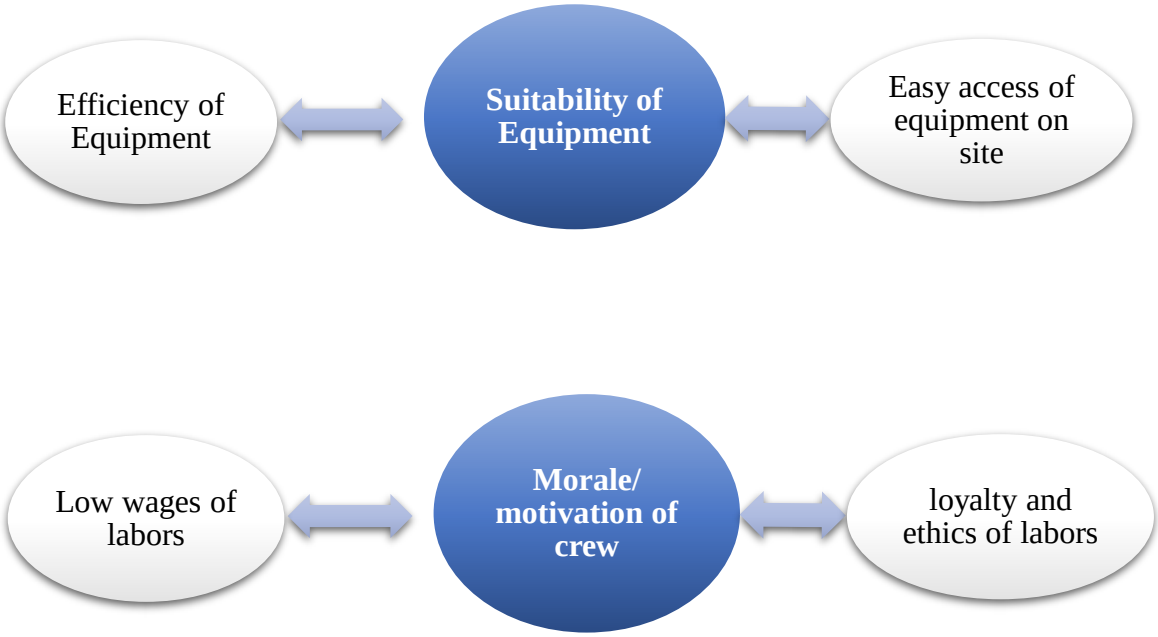


**Figure 23**:Relationship between resource related factors leading to cost overrun-3

- There is a notable association between "Delay in delivery of materials" and both "Changes in material specification and type" (0.537) and "Bad materials quality" (0.526). These significant correlation values underscore strong positive relationships among these material-related factors.

All the results of relationships between resource-related factors and their high correlations, this emphasizes that **we must reject the null Hypothesis #3: "There is no relationship between resource-related factors contributing to the cost overruns in Palestinian construction projects".**

Summary of correlation for resource-related factors causing cost overrun is shown in Table 29.

**Table 29**: Correlation (Spearman's Correlation) between construction resources related factors leading to cost overrun

| | A1 | A2 | A3 | A4 | A5 | A6 | A7 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | D1 | D2 | D3 | D4 | D5 | D6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A1** | 1.000 | .397** | 0.055 | -0.017 | 0.087 | 0.116 | 0.096 | 0.142 | 0.142 | 0.064 | .229** | .184* | .210** | .321** | .201* | .162* | .189* | 0.098 | 0.094 | -0.015 | 0.078 | 0.082 | 0.028 | .183* | 0.086 | -0.075 | 0.056 | .203* | .361** | .200* | 0.073 | 0.028 | 0.049 |
| **A2** | .397** | 1.000 | .317** | .208** | 0.114 | .210** | 0.088 | .334** | 0.112 | 0.038 | .299** | .332** | .289** | .187* | 0.128 | -0.001 | .218** | 0.081 | 0.097 | 0.086 | 0.083 | 0.108 | -0.067 | 0.002 | 0.023 | -0.016 | 0.063 | .374** | .165* | 0.018 | .199* | 0.011 | .208** |
| **A3** | 0.055 | .317** | 1.000 | .537** | .323** | .178* | 0.141 | 0.027 | 0.002 | -0.039 | 0.075 | 0.052 | .241** | 0.055 | 0.125 | -0.024 | .261** | 0.117 | 0.140 | 0.092 | -0.131 | -0.104 | 0.029 | -0.090 | -0.099 | 0.080 | -0.004 | 0.042 | -0.090 | -0.100 | .194* | 0.112 | .238** |
| **A4** | -0.017 | .208** | .537** | 1.000 | .526** | .258** | .222** | 0.040 | 0.009 | 0.136 | -0.028 | -0.044 | 0.046 | -0.038 | 0.117 | 0.088 | .214** | 0.080 | 0.146 | 0.118 | -.171* | -0.142 | 0.148 | -.162* | -.192* | 0.107 | -0.098 | -0.074 | -.227** | -0.109 | 0.113 | .204* | 0.039 |
| **A5** | 0.087 | 0.114 | .323** | .526** | 1.000 | .361** | .291** | -.162* | 0.123 | .272** | 0.150 | -0.146 | -0.008 | 0.079 | 0.127 | 0.110 | 0.139 | 0.158 | 0.154 | 0.110 | -.178* | -0.156 | 0.026 | -0.131 | -0.079 | 0.042 | -.173* | -.242** | -0.123 | -0.070 | -0.057 | 0.119 | -0.054 |
| **A6** | 0.116 | .210** | .178* | .258** | .361** | 1.000 | .604** | 0.035 | .274** | .267** | .267** | 0.145 | 0.121 | 0.150 | .192* | .291** | .199* | .281** | .306** | .238** | -0.045 | 0.006 | 0.143 | -0.012 | -.168* | 0.119 | 0.024 | 0.042 | 0.076 | .243** | .174* | .293** | .221** |
| **A7** | 0.096 | 0.088 | 0.141 | .222** | .291** | .604** | 1.000 | -0.104 | .335** | .257** | 0.139 | 0.055 | 0.012 | 0.146 | .352** | .383** | .224** | .213** | .370** | .329** | -0.074 | 0.024 | 0.038 | 0.014 | -0.107 | .185* | -0.046 | 0.002 | 0.080 | .331** | 0.132 | .376** | -0.004 |
| **B1** | 0.142 | .334** | 0.027 | 0.040 | -.162* | 0.035 | -0.104 | 1.000 | 0.123 | 0.136 | .272** | .567** | .357** | 0.068 | 0.002 | -0.008 | 0.066 | 0.058 | 0.094 | 0.033 | .185* | .252** | 0.003 | 0.113 | 0.007 | -0.037 | 0.153 | .483** | .198* | 0.108 | 0.141 | -0.080 | .185* |
| **B2** | 0.142 | 0.112 | 0.002 | 0.009 | 0.123 | .274** | .335** | 0.123 | 1.000 | .529** | .432** | .222** | 0.128 | .230** | .310** | .272** | 0.138 | 0.149 | .232** | .254** | 0.053 | 0.071 | -0.138 | 0.128 | 0.103 | 0.009 | .184* | 0.107 | .283** | .462** | .241** | .339** | 0.005 |
| **B3** | 0.064 | 0.038 | -0.039 | 0.136 | .272** | .267** | .257** | 0.136 | .529** | 1.000 | .527** | .260** | 0.035 | .400** | .299** | .210** | 0.100 | .165* | .255** | .389** | -0.007 | -0.024 | 0.057 | 0.115 | 0.014 | 0.121 | 0.076 | 0.081 | .207* | .292** | 0.078 | .371** | -0.107 |
| **B4** | .229** | .299** | 0.075 | -0.028 | 0.150 | .267** | 0.139 | .272** | .432** | .527** | 1.000 | .488** | .337** | .332** | .250** | 0.149 | .255** | .307** | .259** | .255** | .201* | 0.157 | 0.038 | .240** | .171* | 0.082 | 0.122 | .262** | .354** | .296** | .291** | .216** | 0.144 |
| **B5** | .184* | .332** | 0.052 | -0.044 | -0.146 | 0.145 | 0.055 | .567** | .222** | .260** | .488** | 1.000 | .516** | .245** | 0.114 | 0.021 | 0.057 | 0.024 | 0.154 | 0.139 | 0.037 | 0.154 | -0.044 | 0.154 | 0.057 | 0.021 | .177* | .583** | .330** | .193* | .233** | 0.033 | .301** |
| **B6** | .210** | .289** | .241** | 0.046 | -0.008 | 0.121 | 0.012 | .357** | 0.128 | 0.035 | .337** | .516** | 1.000 | .242** | 0.049 | -0.042 | 0.099 | 0.141 | 0.064 | -0.066 | 0.114 | .255** | -0.113 | 0.083 | 0.117 | -0.136 | 0.153 | .311** | 0.143 | 0.063 | 0.105 | 0.011 | .301** |
| **B7** | .321** | .187* | 0.055 | -0.038 | 0.079 | 0.150 | 0.146 | 0.068 | .230** | .400** | .332** | .245** | .242** | 1.000 | .507** | .303** | 0.092 | 0.109 | 0.138 | 0.148 | 0.089 | 0.079 | -0.034 | 0.025 | 0.100 | 0.076 | 0.121 | 0.087 | .274** | .182* | 0.035 | 0.102 | 0.032 |
| **B8** | .201* | 0.128 | 0.125 | 0.117 | 0.127 | .192* | .352** | 0.002 | .310** | .299** | .250** | 0.114 | 0.049 | .507** | 1.000 | .647** | .234** | .267** | .444** | .341** | 0.008 | 0.026 | -0.044 | -0.011 | 0.022 | 0.040 | 0.097 | 0.010 | .160* | .247** | .201* | .256** | 0.050 |
| **B9** | .162* | -0.001 | -0.024 | 0.088 | 0.110 | .291** | .383** | -0.008 | .272** | .210** | 0.149 | 0.021 | -0.042 | .303** | .647** | 1.000 | .340** | .225** | .408** | .424** | -0.030 | 0.050 | 0.071 | 0.072 | 0.086 | 0.086 | -0.015 | -0.040 | 0.040 | .199* | 0.084 | .228** | -0.014 |
| **B10** | .189* | .218** | .261** | .214** | 0.139 | .199* | .224** | 0.066 | 0.138 | 0.100 | .255** | 0.057 | 0.099 | 0.092 | .234** | .340** | 1.000 | .491** | .292** | .276** | 0.110 | .168* | 0.151 | 0.081 | 0.070 | -0.038 | 0.002 | 0.010 | -0.018 | -0.022 | 0.100 | 0.034 | 0.025 |
| **B11** | 0.098 | 0.081 | 0.117 | 0.080 | 0.158 | .281** | .213** | 0.058 | 0.149 | .165* | .307** | 0.024 | 0.141 | 0.109 | .267** | .225** | .491** | 1.000 | .434** | .277** | 0.124 | .180* | 0.128 | 0.041 | 0.000 | 0.087 | 0.066 | 0.068 | 0.105 | 0.093 | 0.114 | .202* | -0.028 |
| **B12** | 0.094 | 0.097 | 0.140 | 0.146 | 0.154 | .306** | .370** | 0.094 | .232** | .255** | .259** | 0.154 | 0.064 | 0.138 | .444** | .408** | .292** | .434** | 1.000 | .704** | 0.041 | 0.065 | 0.029 | 0.061 | 0.023 | 0.120 | -0.002 | 0.058 | .176* | .240** | 0.136 | .210** | -0.079 |
| **B13** | -0.015 | 0.086 | 0.092 | 0.118 | 0.110 | .238** | .329** | 0.033 | .254** | .389** | .255** | 0.139 | -0.066 | 0.148 | .341** | .424** | .276** | .277** | .704** | 1.000 | -0.042 | 0.037 | 0.086 | 0.106 | 0.069 | 0.093 | -0.023 | 0.070 | 0.094 | .213** | 0.134 | .219** | -0.136 |
| **C1** | 0.078 | 0.083 | -0.131 | -.171* | -.178* | -0.045 | -0.074 | .185* | 0.053 | -0.007 | .201* | 0.037 | 0.114 | 0.089 | 0.008 | -0.030 | 0.110 | 0.124 | 0.041 | -0.042 | 1.000 | .690** | 0.036 | .285** | .402** | .194* | .335** | .212** | .302** | .164* | 0.078 | 0.047 | 0.121 |
| **C2** | 0.082 | 0.108 | -0.104 | -0.142 | -0.156 | 0.006 | 0.024 | .252** | 0.071 | -0.024 | 0.157 | 0.154 | .255** | 0.079 | 0.026 | 0.050 | .168* | .180* | 0.065 | 0.037 | .690** | 1.000 | 0.124 | .221** | .310** | 0.092 | .302** | .312** | .253** | 0.142 | 0.135 | -0.012 | 0.135 |
| **C3** | 0.028 | -0.067 | 0.029 | 0.148 | 0.026 | 0.143 | 0.038 | 0.003 | -0.138 | 0.057 | 0.038 | -0.044 | -0.113 | -0.034 | -0.044 | 0.071 | 0.151 | 0.128 | 0.029 | 0.086 | 0.036 | 0.124 | 1.000 | .358** | -0.001 | .263** | -0.016 | -0.068 | -0.120 | -0.009 | 0.102 | 0.051 | 0.030 |
| **C4** | .183* | 0.002 | -0.090 | -.162* | -0.131 | -0.012 | 0.014 | 0.113 | 0.128 | 0.115 | .240** | 0.154 | 0.083 | 0.025 | -0.011 | 0.072 | 0.081 | 0.041 | 0.061 | 0.106 | .285** | .221** | .358** | 1.000 | .334** | .261** | .166* | 0.117 | .300** | .345** | .181* | 0.143 | 0.054 |
| **C5** | 0.086 | 0.023 | -0.099 | -.192* | -0.079 | -.168* | -0.107 | 0.007 | 0.103 | 0.014 | .171* | 0.057 | 0.117 | 0.100 | 0.022 | 0.086 | 0.070 | 0.000 | 0.023 | 0.069 | .402** | .310** | -0.001 | .334** | 1.000 | 0.075 | .240** | 0.135 | .252** | 0.100 | -0.035 | -0.013 | .181* |
| **C6** | -0.075 | -0.016 | 0.080 | 0.107 | 0.042 | 0.119 | .185* | -0.037 | 0.009 | 0.121 | 0.082 | 0.021 | -0.136 | 0.076 | 0.040 | 0.086 | -0.038 | 0.087 | 0.120 | 0.093 | .194* | 0.092 | .263** | .261** | 0.075 | 1.000 | 0.027 | 0.065 | 0.023 | 0.112 | .188* | 0.140 | -0.022 |
| **C7** | 0.056 | 0.063 | -0.004 | -0.098 | -.173* | 0.024 | -0.046 | 0.153 | .184* | 0.076 | 0.122 | .177* | 0.153 | 0.121 | 0.097 | -0.015 | 0.002 | 0.066 | -0.002 | -0.023 | .335** | .302** | -0.016 | .166* | .240** | 0.027 | 1.000 | 0.135 | .168* | 0.137 | 0.096 | 0.025 | 0.092 |
| **D1** | .203* | .374** | 0.042 | -0.074 | -.242** | 0.042 | 0.002 | .483** | 0.107 | 0.081 | .262** | .583** | .311** | 0.087 | 0.010 | -0.040 | 0.010 | 0.068 | 0.058 | 0.070 | .212** | .312** | -0.068 | 0.117 | 0.135 | 0.065 | 0.135 | 1.000 | .462** | .257** | .385** | 0.085 | .311** |
| **D2** | .361** | .165* | -0.090 | -.227** | -0.123 | 0.076 | 0.080 | .198* | .283** | .207* | .354** | .330** | 0.143 | .274** | .160* | 0.040 | -0.018 | 0.105 | .176* | 0.094 | .302** | .253** | -0.120 | .300** | .252** | 0.023 | .168* | .462** | 1.000 | .667** | .366** | .339** | 0.141 |
| **D3** | .200* | 0.018 | -0.100 | -0.109 | -0.070 | .243** | .331** | 0.108 | .462** | .292** | .296** | .193* | 0.063 | .182* | .247** | .199* | -0.022 | 0.093 | .240** | .213** | .164* | 0.142 | -0.009 | .345** | 0.100 | 0.112 | 0.137 | .257** | .667** | 1.000 | .466** | .565** | 0.055 |
| **D4** | 0.073 | .199* | .194* | 0.113 | -0.057 | .174* | 0.132 | 0.141 | .241** | 0.078 | .291** | .233** | 0.105 | 0.035 | .201* | 0.084 | 0.100 | 0.114 | 0.136 | 0.134 | 0.078 | 0.135 | 0.102 | .181* | -0.035 | .188* | 0.096 | .385** | .366** | .466** | 1.000 | .423** | .195* |
| **D5** | 0.028 | 0.011 | 0.112 | .204* | 0.119 | .293** | .376** | -0.080 | .339** | .371** | .216** | 0.033 | 0.011 | 0.102 | .256** | .228** | 0.034 | .202* | .210** | .219** | 0.047 | -0.012 | 0.051 | 0.143 | -0.013 | 0.140 | 0.025 | 0.085 | .339** | .565** | .423** | 1.000 | 0.068 |
| **D6** | 0.049 | .208** | .238** | 0.039 | -0.054 | .221** | -0.004 | .185* | 0.005 | -0.107 | 0.144 | .301** | .301** | 0.032 | 0.050 | -0.014 | 0.025 | -0.028 | -0.079 | -0.136 | 0.121 | 0.135 | 0.030 | 0.054 | .181* | -0.022 | 0.092 | .311** | 0.141 | 0.055 | .195* | 0.068 | 1.000 |

**Correlation is significant at the 0.01 level (2-tailed).**

**Correlation is significant at the 0.05 level (2-tailed).**

## 4.4. Relationship between population characteristics and main groups

- **One-Way ANOVA test**

The One-Way ANOVA test" analysis of variance" is a statistical method used to compare the means of three or more groups to determine if at least one of the group means is significantly different from the others. It's particularly helpful to analyze whether there are any differences between the means of multiple independent groups. ANOVA test used here to measure the relationship between Population Characteristics and Main Groups used in the study.

The One-Way ANOVA test calculates the F-statistic by comparing the variance between group means to the variance within the groups. The formula for the F-statistic in a One-Way ANOVA is:

$$F = \frac{MS \text{ between}}{MS \text{ within}} \qquad \textbf{Eq … (5)}$$

Where:

- *MS* between is the mean square between groups. It measures the variability between the group means.
- *MS* within is the mean square within groups. It measures the variability within each group.

This F-ratio is then compared against a critical value from an F-distribution table to determine the statistical significance of the differences between group means. The F-critical value depends on two factors:

1. **Significance Level (α):** This represents the chosen threshold for determining statistical significance. The used value for α is 0.05, if sig less than 0.05 there is a significant difference between pair of means, if sig more than 0.05 there is no significant difference.
2. **Degrees of Freedom:**
   - Degrees of freedom between groups (df between): Equal to the number of groups minus 1.
   - Degrees of freedom within groups (df within): Equal to the total number of observations minus the total number of groups.

- **Post-hoc Analysis (if needed):**

If the ANOVA indicates a significant difference between groups, post-hoc tests (like Sidak, LSD, Tukey's HSD, Bonferroni, etc.) can be used to identify which specific groups differ from each other.

**Bonferroni test** was used in the analysis because it is a powerful tool to analyze data with multiple groups and can provide insights into whether there are significant differences between those groups. A group of statistics can be done for each group in Bonferroni Analysis: mean difference, standard deviation, standard error of the mean, lower and upper bound,95% confidence interval for the mean and sig values for every class in every group.

### 4.4.1. Relationship between project parties and main groups

Table 30 presents the results of the One-way ANOVA test examining the relationship between project parties and the main groups of resource-related factors. The analysis

indicates a significant difference between the classification of project parties and the Manpower-related factors group, with an α value (0.026) which is less than 0.05. However, the α values for the other three main groups (material, money, and equipment) exceeded 0.05, suggesting no significant differences among project parties concerning these factors groups. Further investigation to discern which project party (contractor, consultant, or owner) demonstrates significant differences with the Manpower-related factors group is conducted via a multiple comparison test detailed in section 4.3.8.

**Table 30**:One-way ANOVA (project parties and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | .508 | 2 | .254 | 1.127 | .327 |
| | Within Groups | 34.018 | 151 | .225 | | |
| | Total | 34.526 | 153 | | | |
| **Manpower related factors** | Between Groups | 1.433 | 2 | .716 | 3.731 | **.026** |
| | Within Groups | 28.985 | 151 | .192 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .559 | 2 | .280 | 1.582 | .209 |
| | Within Groups | 26.694 | 151 | .177 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | 1.367 | 2 | .683 | 2.595 | .078 |
| | Within Groups | 39.760 | 151 | .263 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.2. Relationship between respondents' position and main groups

Table 31 examines the relationship between respondents' position and the main groups of resource-related factors through the One-way ANOVA test. The analysis indicates a significant difference between the classification of respondent's position and the

Material-related factors group, with an α value (0.021) which is less than 0.05. Table 21 shows that there is no significant difference between those who filled the questionnaire and the results obtained since α is more than 0.05 for the three main groups of (manpower, money and equipment). In other words, despite who filled the questionnaire, the director, the vice director, the project manager, or the site or office engineer, they have the same point of view regarding the severity of resource related factors groups of (manpower, money and equipment) causes cost overrun while their classification affect the material related factors group. Further analysis done to discern which respondent position demonstrates significant differences with the Material-related factors group is conducted via a multiple comparison test detailed in section 4.3.8.

**Table 31:**One-way ANOVA (respondents' position and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | 2.925 | 5 | .585 | 2.740 | .021 |
| | Within Groups | 31.601 | 148 | .214 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | .994 | 5 | .199 | 1.000 | .420 |
| | Within Groups | 29.424 | 148 | .199 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .261 | 5 | .052 | .286 | .920 |
| | Within Groups | 26.992 | 148 | .182 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | .625 | 5 | .125 | .457 | .808 |
| | Within Groups | 40.501 | 148 | .274 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.3. Relationship between company field of work and main groups

Table 32 shows that there is no significant difference between the company field of work and the results obtained since α is more than 0.05. Despite the company being engaged in

various fields such as building and construction, roads & transportation, water and sewage, or even working across multiple sectors, the analysis suggests that these different fields of work did not yield significantly different perspectives regarding the resource-related factors causing cost overrun.

**Table 32**:One-way ANOVA (company field of work and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | .961 | 3 | .320 | 1.432 | .236 |
| | Within Groups | 33.565 | 150 | .224 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | 1.100 | 3 | .367 | 1.877 | .136 |
| | Within Groups | 29.317 | 150 | .195 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .115 | 3 | .038 | .211 | .888 |
| | Within Groups | 27.139 | 150 | .181 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | 1.534 | 3 | .511 | 1.938 | .126 |
| | Within Groups | 39.592 | 150 | .264 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.4. Relationship respondents experience and main groups

Table 33's findings indicate that there isn't a notable distinction between the results obtained and the respondent's experience across all main groups. With α values exceeding 0.05 for each main group, the analysis implies that regardless of the number of years of experience, there wasn't a significant difference on the results of resource-related factors contributing to cost overrun.Based on the findings, it can be concluded that heightened experience among construction engineers or stakeholders corresponds to a deeper knowledge and increased capacity to grasp the essence and consequences of resource-related factors that contribute to cost overrun in their respective projects.

**Table 33**:One-way ANOVA (respondents experience and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | .805 | 3 | .268 | 1.194 | .314 |
| | Within Groups | 33.720 | 150 | .225 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | 1.506 | 3 | .502 | 2.604 | .054 |
| | Within Groups | 28.912 | 150 | .193 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .153 | 3 | .051 | .282 | .838 |
| | Within Groups | 27.101 | 150 | .181 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | .515 | 3 | .172 | .634 | .594 |
| | Within Groups | 40.611 | 150 | .271 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.5. Relationship between the size of company's staff and main groups

The findings in Table 34 reveal that there is no significant difference between the size of company's staff and the results obtained since α is more than 0.05for all main groups. In other words, irrespective of the number of permanent employees in the company, there wasn't any significant difference on the results of resource-related factors contributing to cost overrun.

**Table 34**:One-way ANOVA (The number of permanent employees in the company and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | 1.602 | 3 | .534 | 2.432 | .067 |
| | Within Groups | 32.924 | 150 | .219 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | .122 | 3 | .041 | .201 | .895 |
| | Within Groups | 30.296 | 150 | .202 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .196 | 3 | .065 | .361 | .781 |
| | Within Groups | 27.058 | 150 | .180 | | |
| | Total | 27.254 | 153 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Equipment related factors | Between Groups | .508 | 3 | .169 | .626 | .599 |
| | Within Groups | 40.618 | 150 | .271 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.6. Relationship between Number of company projects and main groups

Table 35 displays that the Sig-values for all primary groups exceed 0.05. This indicates the absence of statistically significant differences regarding the relationship between the number of company projects executed in the last five years and the main groups in which α values ≤ 0.05, concerning cost overrun resource-related factors in construction projects within Palestine.

This analysis emphasizes that companies engaging in a higher volume of executed projects encounter a larger spectrum of factors and have more substantial experience in understanding the nature associated with these factors.

**Table 35**:One-way ANOVA (Number of projects executed in the last five years and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | 1.045 | 3 | .348 | 1.560 | .201 |
| | Within Groups | 33.481 | 150 | .223 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | .909 | 3 | .303 | 1.540 | .206 |
| | Within Groups | 29.509 | 150 | .197 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .192 | 3 | .064 | .354 | .786 |
| | Within Groups | 27.062 | 150 | .180 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | .132 | 3 | .044 | .161 | .922 |
| | Within Groups | 40.994 | 150 | .273 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.7. Relationship between Volume of construction work and main groups

Table 36 indicates that all Sig.-values exceeds 0.05. This suggests that there are no statistically significant differences related to the association between the volume of projects or investments executed by the respondents' organization at the $\alpha \leq 0.05$ level concerning resource-related factors in construction projects in Palestine.

From the preceding information, it becomes clear that increase in investment volumes, expanded workforce numbers, and a high in project numbers executed result in escalated project costs and heightened complexity in managing these factors during later stages. This underscores the prevalent issue where a significant number of projects in Palestine encounter challenges related to cost overruns.

**Table 36**:One-way ANOVA (Volume of construction work in the last 5 years and main groups)

| Main Groups | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Material related factors | Between Groups | .059 | 3 | .020 | .086 | .968 |
| | Within Groups | 34.467 | 150 | .230 | | |
| | Total | 34.526 | 153 | | | |
| Manpower related factors | Between Groups | .096 | 3 | .032 | .159 | .924 |
| | Within Groups | 30.322 | 150 | .202 | | |
| | Total | 30.418 | 153 | | | |
| Money related factors | Between Groups | .476 | 3 | .159 | .889 | .448 |
| | Within Groups | 26.778 | 150 | .179 | | |
| | Total | 27.254 | 153 | | | |
| Equipment related factors | Between Groups | .024 | 3 | .008 | .029 | .993 |
| | Within Groups | 41.103 | 150 | .274 | | |
| | Total | 41.126 | 153 | | | |

### 4.4.8. Multiple comparisons- Post Hoc test (Bonferroni analysis)

Bonferroni analysis is a statistical method employed to compare means across various group classes and identify significant differences. In the present study, this analysis played a crucial role in determining significant differences in two key sections. Firstly, in section 4.3.1, it was instrumental in evaluating the relationship between project parties

and the main groups, helping discern which classes exhibited a statistically significant difference in Manpower resource-related factor group. Similarly, in section 4.3.2, the analysis was employed to explore the relationship between respondents' positions and the main groups, aiding in the identification of significant differences between different positions within the Material resource-related factor group.

Table 37 reveals a significant difference in the mean of two groups within the Manpower-related factors category. Bonferroni analysis specifically points to a noteworthy distinction between the perspectives of contractors and owners. The mean responses from contractors surpass those of owners, as indicated by a mean difference of 0.24406 and a significance value (Sig) of 0.037. The fact that the Sig value is less than 0.05 signifies statistical significance, solidifying the conclusion that there is a meaningful and statistically significant difference between the viewpoints of contractors and owners regarding manpower-related factors.

**Table 37**:Multiple comparisons- Post Hoc test (Bonferroni analysis) for project parties and main groups

| Main groups | (I) Project Parties | (J) Project Parties | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Material related factors | Contractor | Consultant | .12793 | .08543 | .409 | -.0789 | .3347 |
| | | Owner | .07013 | .10451 | 1.000 | -.1829 | .3231 |
| | Consultant | Contractor | -.12793 | .08543 | .409 | -.3347 | .0789 |
| | | Owner | -.05780 | .10674 | 1.000 | -.3162 | .2006 |
| | Owner | Contractor | -.07013 | .10451 | 1.000 | -.3231 | .1829 |
| | | Consultant | .05780 | .10674 | 1.000 | -.2006 | .3162 |
| Manpower related factors | Contractor | Consultant | .15139 | .07885 | .170 | -.0395 | .3423 |
| | | Owner | **.24406*** | .09647 | **.037** | .0105 | .4776 |
| | Consultant | Contractor | -.15139 | .07885 | .170 | -.3423 | .0395 |
| | | Owner | .09266 | .09853 | 1.000 | -.1459 | .3312 |
| | Owner | Contractor | -.24406* | .09647 | .037 | -.4776 | -.0105 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Consultant | -.09266 | .09853 | 1.000 | -.3312 | .1459 |
| Money related factors | Contractor | Consultant | .12024 | .07567 | .342 | -.0630 | .3034 |
| | | Owner | .12468 | .09258 | .540 | -.0995 | .3488 |
| | Consultant | Contractor | -.12024 | .07567 | .342 | -.3034 | .0630 |
| | | Owner | .00443 | .09456 | 1.000 | -.2245 | .2333 |
| | Owner | Contractor | -.12468 | .09258 | .540 | -.3488 | .0995 |
| | | Consultant | -.00443 | .09456 | 1.000 | -.2333 | .2245 |
| Equipment related factors | Contractor | Consultant | .19532 | .09235 | .108 | -.0283 | .4189 |
| | | Owner | .17980 | .11299 | .341 | -.0937 | .4533 |
| | Consultant | Contractor | -.19532 | .09235 | .108 | -.4189 | .0283 |
| | | Owner | -.01552 | .11540 | 1.000 | -.2949 | .2639 |
| | Owner | Contractor | -.17980 | .11299 | .341 | -.4533 | .0937 |
| | | Consultant | .01552 | .11540 | 1.000 | -.2639 | .2949 |
| *. The mean difference is significant at the 0.05 level. | | | | | | | |

Table 38 presents evidence of at least two significant differences in the mean responses of respondents based on their positions concerning the Material-related factors group. The Bonferroni analysis further highlights and specifies these differences:

1. The initial distinction arises between the perspectives of quantity surveyors and design engineers. Notably, the mean responses from quantity surveyors are superior to those of design engineers, with a mean difference of 0.48730 and a significant value (Sig) of 0.022. This Sig value, being less than 0.05, attests to the statistical significance of the difference, affirming a notable distinction in viewpoints between quantity surveyors and design engineers regarding material factors.
2. A second significant difference emerges in the perspectives of office engineers and design engineers. In this case, the mean responses from office engineers surpass those of design engineers, with a mean difference of 0.40752 and a significant value (Sig) of 0.026. Similar to the first comparison, the Sig value being less than 0.05 underscores the statistical significance of the difference, indicating a noteworthy

disparity in viewpoints between office engineers and design engineers regarding material factors.

**Table 38**: Multiple comparisons- Post Hoc test (Bonferroni analysis) for respondents' position and Material related factors groups

| Main groups | (I) respondents' position | (J) respondents' position | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Material related factors | project manager | construction manager | .03571 | .17221 | 1.000 | -.4781 | .5495 |
| | | quantity surveyor | -.21032 | .13339 | 1.000 | -.6083 | .1877 |
| | | design engineer | .27698 | .12887 | .498 | -.1075 | .6615 |
| | | office engineer | -.13053 | .10747 | 1.000 | -.4512 | .1901 |
| | | site engineer | -.03644 | .11136 | 1.000 | -.3687 | .2958 |
| | construction manager | project manager | -.03571 | .17221 | 1.000 | -.5495 | .4781 |
| | | quantity surveyor | -.24603 | .18864 | 1.000 | -.8089 | .3168 |
| | | design engineer | .24127 | .18547 | 1.000 | -.3121 | .7946 |
| | | office engineer | -.16625 | .17130 | 1.000 | -.6773 | .3448 |
| | | site engineer | -.07215 | .17377 | 1.000 | -.5906 | .4463 |
| | quantity surveyor | project manager | .21032 | .13339 | 1.000 | -.1877 | .6083 |
| | | construction manager | .24603 | .18864 | 1.000 | -.3168 | .8089 |
| | | design engineer | .48730* | .15013 | **.022** | .0394 | .9352 |
| | | office engineer | .07978 | .13222 | 1.000 | -.3147 | .4743 |
| | | site engineer | .17388 | .13540 | 1.000 | -.2301 | .5779 |
| | design engineer | project manager | -.27698 | .12887 | .498 | -.6615 | .1075 |
| | | construction manager | -.24127 | .18547 | 1.000 | -.7946 | .3121 |
| | | quantity surveyor | -.48730* | .15013 | .022 | -.9352 | -.0394 |
| | | office engineer | -.40752* | .12765 | .026 | -.7884 | -.0267 |
| | | site engineer | -.31342 | .13094 | .269 | -.7041 | .0773 |
| | office engineer | project manager | .13053 | .10747 | 1.000 | -.1901 | .4512 |
| | | construction manager | .16625 | .17130 | 1.000 | -.3448 | .6773 |
| | | quantity surveyor | -.07978 | .13222 | 1.000 | -.4743 | .3147 |
| | | design engineer | .40752* | .12765 | **.026** | .0267 | .7884 |
| | | site engineer | .09410 | .10995 | 1.000 | -.2340 | .4221 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | site engineer | project manager | .03644 | .11136 | 1.000 | -.2958 | .3687 |
| | | construction manager | .07215 | .17377 | 1.000 | -.4463 | .5906 |
| | | quantity surveyor | -.17388 | .13540 | 1.000 | -.5779 | .2301 |
| | | design engineer | .31342 | .13094 | .269 | -.0773 | .7041 |
| | | office engineer | -.09410 | .10995 | 1.000 | -.4221 | .2340 |
| *. The mean difference is significant at the 0.05 level. | | | | | | | |

## 4.5. Effects of cost overrun in construction projects

This part shows the results of effects of cost overrun analysis, which include mean and ranks of effects of cost overrun and their ranking according to project parties. Also, the relationship (correlation)between effects of cost overrun.

### 4.5.1. Mean and ranking of effects of cost overrun

In Table 39, the effects of cost overrun are detailed by their mean values in descending order, alongside their respective ranks. Notably, the impact of "Losses in contractor and owner profits" emerged as the most significant effect with a mean score of 4.40, securing the top rank. Following closely, "Delays in construction projects" ranked second with a mean score of 4.14, while "Loss of contractor reputation" obtained a mean score of 3.94.

Conversely, "Inefficient allocation of resources" registered the lowest mean score of 2.65, indicating its comparatively lower significance as an effect of cost overrun within the construction industry.

This result confirms that the effect of "Inefficient allocation of resources" has low importance on cost overrun in the construction industry, so **we reject the null**

**Hypothesis #4 of: "Inefficient allocation of resources was the most severe effect of cost overruns in Palestinian construction industry".**

**Table 39**:Mean and ranking of effects of cost overrun

| Effects of cost overrun | Mean Score | Rank |
|---|---|---|
| Losses in contractor and owner profits | 4.40 | **1** |
| Delays in construction projects | 4.14 | **2** |
| Loss of contractor reputation | 3.94 | **3** |
| Contractual disputes, claims and litigation between parties | 3.90 | **4** |
| A damaging to the whole economy of the country and loss of job and income | 3.66 | **5** |
| Loss of consultant reputation | 3.51 | **6** |
| Project failure and total abandonment | 3.48 | **7** |
| Inefficient allocation of resources | 2.65 | **8** |

### 4.5.2. Ranks of effects of cost overrun according to project parties

As shown in Table 40, there's substantial agreement among contractors, consultants, and owners regarding the rankings of the first, second, and latest effects of cost overrun. However, disparities exist in their perspectives on certain effects. For instance, the effect of "Loss of contractor reputation" was ranked 6th by consultants but held the 3rd position according to contractors. Conversely, the effect of "Loss of consultant reputation" was ranked 4th by consultants but held the 6th position from the viewpoint of contractors.

These differences underscore a notable variance in how consultants and contractors perceive the effects of cost overrun. The higher ranking of "Loss of contractor reputation" by contractors suggests that they perceive this effect as more significant, whereas consultants, by ranking "Loss of consultant reputation" higher, highlight that the impact

on their reputation seems more consequential from their perspective compared to how contractors view it.

**Table 40**: Ranks of effects of cost overrun according to project parties

| Effects of cost overrun according to project parties | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Losses in contractor and owner profits | 4.42 | **1** | 4.40 | **1** | 4.33 | **1** | 4.40 | 1 |
| Delays in construction projects | 4.21 | **2** | 4.05 | **2** | 4.13 | **2** | 4.14 | 2 |
| Loss of contractor reputation | 4.21 | **3** | 3.64 | **6** | 3.90 | **4** | 3.94 | 3 |
| Contractual disputes, claims and litigation between parties | 3.97 | **4** | 3.79 | **3** | 3.93 | **3** | 3.90 | 4 |
| A damaging to the whole economy of the country and loss of job and income | 3.67 | **5** | 3.69 | **5** | 3.60 | **7** | 3.66 | 5 |
| Loss of consultant reputation | 3.26 | **7** | 3.72 | **4** | 3.67 | **6** | 3.51 | 6 |
| Project failure and total abandonment | 3.47 | **6** | 3.31 | **7** | 3.83 | **5** | 3.48 | 7 |
| Inefficient allocation of resources | 2.50 | **8** | 2.52 | **8** | 3.23 | **8** | 2.65 | 8 |

### 4.5.3. Relationship (correlation)between effects of cost overrun

The relationship between pairs of effects of cost overrun was investigated using Spearman's rank order correlation. Table 41 presents the correlation analysis of the effects of cost overrun which likely assesses the strength and direction of associations between different effects of cost overrun.

As indicated in Table 41, "Project failure and total abandonment" demonstrates a notable correlation with "A damaging to the whole economy of the country and loss of job and income" with a correlation value of 0.546. This substantial correlation value suggests a meaningful association between these effects. It implies that instances of project failure

and abandonment are significantly intertwined with broader economic implications, particularly regarding job and income losses within the country's economy.

The study's findings indicate that there is no negative correlation among pairs of effects, revealing exclusively positive relationships ranging from low to moderate. Notably, the effect of "Inefficient allocation of resources" exhibits a moderate positive relationship with two effects: "Project failure and total abandonment" and "Loss of consultant reputation." It is noteworthy that these three effects obtained the lowest mean ranks. In other hand, the effect of "Losses in contractor and owner profits" demonstrates a moderate positive relationship with "Delays in construction projects," with both effects securing the highest mean ranks, as detailed in Table 41. This sheds light on specific dynamics within the relationships studied, emphasizing the importance of resource allocation efficiency and profit considerations in project outcomes.

**Table 41**: Correlation (Spearman's Correlation) between effects of cost overrun

| | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** | **E7** | **E8** |
|---|---|---|---|---|---|---|---|---|
| **E1** | 1.000 | 0.170 | 0.358 | 0.188 | 0.382 | 0.192 | 0.288 | 0.122 |
| **E2** | 0.170 | 1.000 | 0.101 | 0.211 | 0.435 | 0.265 | 0.425 | 0.036 |
| **E3** | 0.358 | 0.101 | 1.000 | 0.383 | 0.073 | 0.365 | 0.108 | 0.352 |
| **E4** | 0.188 | 0.211 | 0.383 | 1.000 | 0.349 | 0.352 | 0.205 | 0.218 |
| **E5** | 0.382 | 0.435 | 0.073 | 0.349 | 1.000 | 0.350 | 0.546 | 0.020 |
| **E6** | 0.192 | 0.265 | 0.365 | 0.352 | 0.350 | 1.000 | 0.327 | 0.238 |
| **E7** | 0.288 | 0.425 | 0.108 | 0.205 | 0.546 | 0.327 | 1.000 | 0.094 |
| **E8** | 0.122 | 0.036 | 0.352 | 0.218 | 0.020 | 0.238 | 0.094 | 1.000 |

**CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).**
**CORRELATION IS SIGNIFICANT AT THE 0.05 LEVEL (2-TAILED).**

# Chapter Five: Conclusion and Recommendations

This chapter includes the conclusions of the study which summarize the most important findings and results from thesis, also offered practical recommendations for major project stockholders including contractors, consultants and owners that may prevent or even reduce construction overruns, and proposed additional future studies that enhance the strength of thesis idea.

## 5.1. Conclusion

The construction industry plays a crucial role in fostering economic development by contributing essential components. However, it distinctly differs from other sectors due to its unique characteristics. Marked by fragmentation, increasing complexity, rapid responsiveness to economic changes, and intense competition fueled by numerous firms and ease of entry, these distinctive features contribute to the heightened prevalence of failures and challenges in the construction sector. Construction projects encountered numerous precise challenges, with cost overruns emerging as a paramount concern. The issue of cost overruns has a widespread occurrence in the construction sector in Palestine as illustrated in the research finding, which also highlighted by previous studies. Every construction project necessitates a specific allocation of resources, meanwhile the issue of cost escalation is intricately linked to these construction resources. Consequently, an examination of cost overruns should commence by focusing on the project resources and their related factors.

The primary objectives of this study are to identify and study resource-related factors contributing to cost overruns in construction projects in Palestine and assess the effects of cost overruns on the Palestinian construction industry.

## 5.2. Summary of thesis results

The findings revealed that a substantial portion of construction companies operated with a limited permanent workforce, as 88.9% maintained a staff of fewer than 15 employees. Additionally, 55.8% of construction firms executed fewer than 20 projects in the previous five years. Furthermore, a notable majority completed projects with a value less than 20 million dollars, encompassing 86.4% of the surveyed firms during the same period. This observed pattern could be indicative of the prevalence of smaller-sized entities in the construction industry, possibly reflecting economic constraints and limitations within the Palestinian construction sector.

Furthermore, the data illustrates the widespread occurrence of cost overruns throughout companies' projects in the construction sector in Palestine. 46.8% of construction companies, confronted cost overruns between 21-40%, while 29.2% of these companies faced an even higher range of cost overruns, falling within the 41-60% margin. In addition, just 19.5% of construction companies taking proactive measures to manage costs before surpassing initially calculated estimates. This underscores a critical issue of cost overrun that necessitates attention and strategic intervention within the construction sector to enhance the accuracy of budgeting and reinforce effective cost control measures.

The main purpose of this study is to assess the significance of 33 resource-related factors contributing to cost overruns in construction projects within the Palestinian construction industry, factors were selected depending on reviewing of literatures and prior studies. The factors were grouped into four categories of construction resources, as follows:

- Material-related factors
- Manpower-related factors

- Money-related factors
- Equipment-related factors

The findings indicated that the category of resource-related factors with the most significant influence on cost overruns was the money-related factors group, with a mean score of 3.9. This highlights the crucial importance of financial elements and their direct association with the escalation of project costs.

The results delve into the identification of the top ten resource-related factors significantly contributing to cost overruns in Palestinian construction projects. These factors, include "Availability of skilled labor", "Availability of Equipment", "Labors productivity", "Financial difficulties of contractor and cash flow", "Inaccurate cost estimate", "High cost of labors", "Financial difficulties of owner", "High cost of machines and their maintenance", "Availability of materials" and "Fluctuation of prices of materials" , exhibiting the highest mean scores ranging from 3.95 to 4.43, these factors encompass 3 within Manpower, 2 within Equipment, 3 within Money, and 2 within the Material category, underscoring their substantial impact on the escalation of project costs.

In contrast, factors with the least impact on cost overruns include "Loyalty and ethics of labors", "Relationship between labors", "Poor storage of materials", "Amount of materials waste", and "Overmanning and crowding", exhibiting mean scores ranging from 2.81 to 2.86. These particular factors primarily fall within the categories of Manpower and Material-related categories, underscoring their relatively lower influence on cost escalation within the surveyed context.

The findings indicate a consistent pattern in the mean ranking of resource-related factors contributing to cost overruns across the perspectives of contractors, consultants, and

owners, as illustrated in Table 42. Although there may be variations in their specific rankings, the top factors remain largely consistent among all project parties. These factors consistently maintain their positions within the top ten significant contributors to cost overruns in the Palestinian construction industry. This consensus highlights a shared agreement among these stakeholders regarding the critical nature of these factors and their significance impact on cost overruns.

**Table 42**: Top ten resource related factors causing cost overrun according to project parties' perspective and overall mean scores

| Resource- related factors causing cost overrun | Contractor | | Consultant | | Owner | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank | Mean Score | Rank |
| Availability of skilled labor | 4.53 | **2** | 4.48 | **1** | 4.10 | **4** | 4.43 | **1** |
| Availability of Equipment | 4.56 | **1** | 4.41 | **2** | 4.10 | **4** | 4.42 | **2** |
| Labors productivity | 4.56 | **1** | 4.38 | **3** | 3.90 | **6** | 4.36 | **3** |
| Financial difficulties of contractor and cash flow | 4.41 | **3** | 4.38 | **3** | 4.23 | **1** | 4.36 | **3** |
| Inaccurate cost estimate | 4.38 | **5** | 4.22 | **6** | 4.20 | **2** | 4.29 | **4** |
| High cost of labors | 4.39 | **4** | 4.22 | **6** | 4.10 | **4** | 4.27 | **5** |
| Financial difficulties of owner | 4.23 | **7** | 4.31 | **4** | 4.23 | **1** | 4.26 | **6** |
| High cost of machines and their maintenance | 4.21 | **8** | 4.26 | **5** | 4.17 | **3** | 4.22 | **7** |
| Availability of materials | 4.32 | **6** | 4.19 | **7** | 4.03 | **5** | 4.21 | **8** |
| Fluctuation of prices of materials | 4.02 | **9** | 3.91 | **8** | 3.87 | **7** | 3.95 | **9** |

The results of correlation analysis highlight a notable relationship between pairs of factors, the most important is:

- "Relationship between labors and management" and "Relationship between labors", have correlation value of 0.704.

- There is a substantial correlation (0.690) between “Financial difficulties of contractor and cash flow” and "Financial difficulties of owner".
- The correlation analysis reveals significant associations between "Labors productivity" and three distinct factors: “Availability of Equipment”, “High cost of labors," and "Availability of skilled labor." With correlation values of 0.583, 0.516, and 0.567 respectively.
- Moreover, it shows significant connections among various equipment-related factors. Notably, “Suitability of Equipment” has correlation of 0.667 with “Efficiency of Equipment”, also it demonstrates a notable correlation of 0.565 with “Easy access to equipment on site”.

The One-way ANOVA test reveals that there are no statistically significant differences related to the association between the company field of work, in the last five years executed and the main groups of resource related factors defined for all results obtained since $\alpha \leq 0.05$ for all its values.

In other hand, the analysis indicates a significant difference between the classification of project parties and the Manpower-related factors group, with an α value (0.026) which is less than 0.05. Bonferroni analysis specifically points that the mean responses from contractors surpass those of owners, by a difference of 0.24406 and a significance value (Sig) of 0.037, which emphasizing on a meaningful and statistically significant difference between the viewpoints of contractors and owners regarding manpower-related factors.

In addition, the analysis indicates a significant difference between the classification of respondent’s position and the Material-related factors group, with an α value (0.021) which is less than 0.05. The Bonferroni analysis highlights and specifies these differences: the first distinction in viewpoints between quantity surveyors and design engineers with

a favorable mean difference of 0.48730 for the quantity surveyors and a significant value (Sig) of 0.022, and the second were between office engineers and design engineers with a favorable mean difference of .40752 for the office engineers and a significant value (Sig) of 0.026 regarding material-related factors group.

Results reveals that the top effects of cost overrun in construction projects depending on the mean score values are: "Losses in contractor and owner profits" emerged as the most significant effect with a mean score of 4.40, following closely, "Delays in construction projects" with a mean score of 4.14, while "Loss of contractor reputation" obtained a mean score of 3.94 and “Contractual disputes, claims and litigation between parties” have a mean score of 3.90, these four effects have the highest mean ranks which is above the average mean score for all effects of cost overrun with the value of 3.71. Conversely, "Inefficient allocation of resources" registered the lowest mean score of 2.65, indicating its comparatively lower significance as an effect of cost overrun within the construction industry. Results shows a substantial agreement among contractors, consultants, and owners regarding the rankings of the first, second, and latest effects of cost overrun.

Moreover, the findings illustrate that the effect of "Project failure and total abandonment" demonstrates a notable correlation with "A damaging to the whole economy of the country and loss of job and income" with a correlation value of 0.546. It implies that instances of project failure and abandonment are significantly intertwined with broader economic implications, particularly regarding job and income losses within the country's economy.

The results of the study reject all the null hypotheses presented in the thesis. This suggests that the data collected and analyzed during the study did not support the assertions made in the null hypotheses. In practical terms, it implies that there is evidence to suggest a

high occurrence of cost overruns in companies' projects in the Palestinian construction industry, an existence of agreement or consistent patterns in ranking construction resource-related factors according to project parties, a relationship between resource-related factors leading to cost overruns, and that inefficient allocation of resources is not the most severe effect of cost overruns in the Palestinian construction industry. These results can lead to valuable insights, prompting a reevaluation of assumptions and potentially opening avenues for further research or adjustments in industry practices.

## 5.3. Recommendations

Based on the research findings and results, the following fundamental recommendations are anticipated for implementation by key stakeholders in the construction industry, encompassing contractors, consultants, and owners. These measures aim to effectively minimize or prevent cost overruns in construction projects within the Palestinian industry.

### 5.3.1. Recommendations to the contractors

1. The contracting firms should have internal strategies for resource planning as a first step, and focusing on project milestones.
2. Utilize scheduling and project control techniques to ensure the proper distribution and availability of project resources, especially labors and equipment’s, at the right time and location.
3. Provide diverse capacity-construction training programs and motivation incentives for laborers.
4. Establish effective work methodologies to enhance the productivity of both laborers and equipment. Some methods contractors can consider: break down the project into

smaller tasks, developing project management tools, apply lean construction principles to eliminate waste and improve efficiency, prioritize safety protocols, regular equipment maintenance, establish key performance indicators (KPIs) to measure productivity, efficient resource allocation.

5. Contracting company must Consider all factors influencing construction costs to mitigate the risk of inaccurate cost estimates and employ experienced estimators or quantity surveyors when tendering a project.
6. Implement techniques and alternative methods to minimize the risk of financial difficulties and cash flow challenges for the contractor. Such as: depending on accurate cost estimation, develop a detailed financial plan and budget, build contingency funds, utilize financing options such as lines of credit, business loans to cover short-term cash flow gaps and conduct regular financial analyses for every project.
7. Contractors should employ strategies to avoid and manage the impact of material price fluctuations, thorough market analysis, regular communication with suppliers and lock-in prices with diverse Suppliers, or may use alternative materials after obtaining approval from the project supervisor.

### 5.3.2. Recommendations to the Consultant

1. Formulate project-specific strategies and leverage recent techniques for monitoring project progress effectively.
2. Consultant should review and authorize design documents, material specifications, and cost estimates for required resources, as mandated by owners.

3. Ensure the presence of skilled workers, particularly for main and complex tasks on the construction site, to achieve the required work quality.
4. Collaborate with the Palestinian Engineers Association (PEA) to conduct continuous training programs for engineers, focusing specifically on cost estimation and control.
5. Ensure contractor payments and design changes in alignment with contract documents to avoid any delay that leads to escalation in cost.
6. Maintain consistent records and conduct thorough market assessments for construction materials to stay informed about pricing trends.

### 5.3.3. Recommendations to the Owners

1. Allocate a proper budget aligned with the cost estimation, including contingency, to avoid financial difficulties that may arise later.
2. Commit to timely payments to other parties, especially contractors, to avert negative impacts on project progress.
3. Consider appointing a dedicated construction management consultant for expeditious decision-making, particularly for major projects involving feasibility studies, design, and tender document preparation.
4. Clearly define the scope of projects to minimize variations and change orders after project commencement.
5. Owner should prioritize checking material availability in the market at the contract initiation, assess the contractor's ability to provide these materials, and not relying on the lowest prices only in the contract.

## 5.4. Study limitations

The issue of cost overruns is pervasive, particularly within the construction sector in Palestine, as many studies have highlighted (Enshassi et al. ,2010) (Mahamid & Bruland,2012), (Mahamid & Dmaidi ,2013) (Mahamid, 2014) (El-Sawalhi & Eleyan ,2018). Despite many researches on the subject, there has been a notable gap in addressing the specific factors related to construction resources and their impact on cost overruns in Palestine. Insufficient documented information on the topic poses a challenge, making a difficulty for the researcher to readily formulate ideas aligned with the research objectives.

The research faced significant limitations, primarily stemming from the political division between Palestinian regions, particularly the West Bank and Gaza Strip. This division rendered regional comprehensiveness unattainable, limiting the scope of the research to the West Bank only. Another constraint involved delays in the completion and return of questionnaires by respondents in the construction industry.

## 5.5. Proposed future studies

To enhance the robustness of the thesis findings and contribute to the overall comprehensiveness of research of resource-related factors leading to the construction industry's cost overrun, the following key study areas, aimed at providing deeper insights into this concept, are recommended for future investigations:

1. Conducting periodic research every five years to monitor new trends among major project stakeholders (contractors, consultants and owners).

2. Extending a similar study to examine resource-related factors in construction projects in the Gaza Strip, comparing findings with studies conducted in the West Bank and Gaza Strip regions.
3. Conducting field studies for upcoming projects to thoroughly investigate resource-related factors leading to cost overruns, examining each resource group separately.
4. Directing future studies towards exploring resource-related factors contributing to cost overruns from the perspectives of small and medium-sized construction firms, contrasting these with the viewpoints of larger corporations.
5. Develop cost overrun prediction models that incorporates resource-related factors to enhancing project management like a model inspired by the fuzzy inference model, developed by Plebankiewicz and Wieczorek (2020).
6. Develop and design tools and methods to mitigate the effects of cost overruns in construction projects.

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## Appendix 1: Questionnaire in English


الجامعة العربية الأمريكية
ARAB AMERICAN UNIVERSITY

Master Program in Construction Management

Questionnaire

# *Studying Construction Resource Factors Affecting Cost Overruns in Construction Projects in Palestine*

This questionnaire represents one of the important aspects of the research, which helps in finding the construction resource related factors that clearly affect the cost of construction projects in Palestine. The excess in the actual costs of construction projects over those calculated before implementation is a matter worthy of study, and standing at this transgression and knowing the main reasons leading to it helps all parties to the project in making strategic decisions, whether at a stage before or during the implementation of the project. I kindly ask you to answer the questions posed with the answers you deem appropriate, and i hope that your answers will enrich the research and give it a scientific character. Please note that all questions asked within this questionnaire are for scientific research purposes and that your answers will be surrounded by complete confidentiality and the utmost scientific care.

Thank you for your cooperation and kind response.

Submitted by: Fida' Hamdan Ahmad
Supervised by: Prof. Ibrahim Mahamid
2023

## Part One: General Information

**1. Relevancy to the construction project*:***

- o Contractor
- o Consultant
- o Owner

**2. General information about the Corporation*:***

- Company name (optional):----------
- Company filed of work:

  ☐ Building Construction □ Roads & transportation

  □Water and sewage ☐ Others: state _____

  .

- Job of the person who fills out the questionnaire:

  □ quantity surveyor □ project manager □ construction manager

  □ site engineer □ office engineer □ Design engineer

  □

- Number of years of experience for those who fill out the questionnaire:

□ 1-3 years □ 3-5 year □ From 5-10 years □ More than 10 years

- The number of permanent employees in the company:

□ less than 10 □ from 10-15 □ from 15-20 □ more than 20

- Number of projects executed in the last five years:

☐ 1-10 ☐ 11-20 ☐ 21-30 ☐ more than 30

- Volume of construction work in the last 10 year

  □ less than 5 million US$ □ less than 10 million US$

  □ less than 20 million US$ □ more than 20 million US$

- Percentage of the company's projects whose cost exceeds the pre-calculated cost:

□ 0%-20 □ % 21%-40% □41%-60% □ 61%-80% □ 81%-100%

- Percentage of cost overrun in the whole company's projects:

□ 0%-20 □ % 21%-40% □41%-60% □ 61%-80% □ 81%-100%

- Do you apply any software to plan, monitor, and control cost?

□ Yes □ No □ Sometimes

## Part Two: Factors affecting cost escalation in construction projects.

Below are numbers of factors was grouped into 4 categories depending on their relation to resources which affect the cost overrun of construction projects? From your experience, please express your opinion on the importance of the following factors as cost overrun indicators of construction projects in Palestine. (Please tick the appropriate box).

| Code | **Category/Factors** | Very low important | Low Important | Medium important | High important | Very high important |
|---|---|---|---|---|---|---|
| A | ***Material*** | | | | | |
| A-1 | Fluctuation of prices of materials | | | | | |
| A-2 | Availability of materials | | | | | |
| A-3 | Changes in material specification and type | | | | | |
| A-4 | Delay in delivery of materials | | | | | |
| A-5 | Bad materials quality | | | | | |
| A-6 | Amount of materials waste | | | | | |
| A-7 | Poor storage of materials | | | | | |
| B | ***Manpower and Labors*** | | | | | |
| B-1 | Availability of skilled labor | | | | | |
| B-2 | Overmanning and crowding | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| B-3 | Turnover and absenteeism | | | | | |
| B-4 | Amount of work/workload | | | | | |
| B-5 | Labor productivity | | | | | |
| B-6 | High cost of labors | | | | | |
| B-7 | Low wages of labors | | | | | |
| B-8 | Morale/motivation of crew | | | | | |
| B-9 | loyalty and ethics of labors | | | | | |
| B-10 | Number of change/extra work orders | | | | | |
| B-11 | Amount of rework | | | | | |
| B-12 | Relationship between labors | | | | | |
| B-13 | Relationship between labors and management | | | | | |
| C | ***Money*** | | | | | |
| C-1 | Financial difficulties of owner | | | | | |
| C-2 | Financial difficulties of contractor and cash flow | | | | | |
| C-3 | Financing methods, bonds and payments | | | | | |
| C-4 | Inflation of prices | | | | | |
| C-5 | Change in currency exchange rate | | | | | |
| C-6 | Poor financial control on site | | | | | |
| C-7 | Inaccurate cost estimate | | | | | |
| D | ***Machinery and Equipment*** | | | | | |
| D-1 | Availability of Equipment | | | | | |
| D-2 | Efficiency of Equipment | | | | | |
| D-3 | Suitability of Equipment | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| D-4 | Insufficient number of equipment's | | | | | |
| D-5 | Easy access to equipment on site | | | | | |
| D-6 | High cost of machines and their maintenance | | | | | |

## Part Three: The Effects of cost overrun on construction projects:

Below are number of effects that resulted from cost overrun factors which have influence on construction projects. From your experience, please express your opinion on the importance of the following effects as result of cost overrun on construction projects in Palestine. (Please tick the appropriate box).

| Code | Effects/importance | Very low | Low | Medium | High | Very high |
|---|---|---|---|---|---|---|
| **E-1** | A damaging to the whole economy of the country and loss of job and income | | | | | |
| **E-2** | Inefficient allocation of resources | | | | | |
| **E-3** | Delays in construction projects | | | | | |
| **E-4** | Contractual disputes, claims and litigation between parties | | | | | |
| **E-5** | Project failure and total abandonment | | | | | |
| **E-6** | Loss of contractor reputation | | | | | |
| **E-7** | Loss of consultant reputation | | | | | |
| **E-8** | Losses in contractor and owner profits | | | | | |

## Appendix 2: Questionnaire in Arabic


**ماجستير ادارة الانشاءات**

استبيان

# دراسة العوامل المرتبطة بموارد البناء التي تؤثر على زيادة التكاليف في مشاريع التشييد في فلسطين

يمثل هذا الاستبيان أحد الجوانب المهمة للبحث، والذي يساعد في إيجاد العوامل المرتبطة بموارد البناء والتي تؤثر بشكل واضح على تكلفة مشاريع البناء و التشييد في فلسطين. إن تجاوز التكاليف الفعلية لمشاريع البناء عن تلك المحسوبة قبل التنفيذ أمر يستحق الدراسة، والوقوف عند هذا التجاوز ومعرفة الأسباب الرئيسية المؤدية إليه يساعد كافة أطراف المشروع في اتخاذ القرارات الإستراتيجية , سواء في مرحلة ما قبل التنفيذ أو أثناء تنفيذ المشروع. لذلك أرجو منكم الإجابة على الأسئلة المطروحة في هذا الاستبيان بالإجابات التي ترونها مناسبة، وأتمنى أن تكون إجاباتكم إثراءاً للبحث وتضفي عليه طابعاً علمياً. يرجى العلم أن جميع الأسئلة المطروحة ضمن هذا الاستبيان هي لأغراض البحث العلمي وأن إجاباتك ستكون محاطة بالسرية التامة وأقصى درجات العناية العلمية .

الباحثة : م. فداء حمدان أحمد

اشراف : د. ابراهيم محاميد

2023

**القسم الأول: معلومات عامة**

1. **الصلة بمشروع البناء:**
   - مقاول
   - استشاري
   - مالك

2. **معلومات عامة عن المؤسسة/المكتب:**

- اسم الشركة /المكتب/البلدية (اختياري) ----------
- مجال عمل الشركة :

□ التشييد و البناء □ الطرق والمواصلات □ المياه والصرف الصحي

□ مجالات اخرى: _____

- وظيفة الشخص الذي يملأ الاستبيان:

□ مساح الكميات □مدير المشروع □ مدير انشاءات

□ مهندس موقع □ مهندس مكتب □ مهندس تصميم

- عدد سنوات الخبرة لمن قام بتعبئة الاستبيان:

□ 1-3 سنوات □ 3-5 سنوات □ من 6-10 سنوات □ أكثر من 10 سنوات

- عدد الموظفين الدائمين في الشركة:

□ أقل من 10 □ من 10-15 □ من 15-20 □ أكثر من 20

- عدد المشاريع المنفذة خلال الخمس سنوات الماضية:

□ 1-10 مشاريع □ 11-20 مشروع □ 21 -30 مشروع □ أكثر من 30 مشروع

- حجم الأعمال الإنشائية في آخر 10 سنوات:

□ أقل من 5 ملايين دولار أمريكي □ أقل من 10 ملايين دولار أمريكي

□ أقل من 20 مليون دولار أمريكي □ أكثر من 20 مليون دولار أمريكي

- النسبة المئوية لمشاريع الشركة التي تتجاوز تكلفتها قيمة التكلفة المحسوبة مسبقًا:

□ 0% - 20 %  □ 21% -40%  □ 41% -60%  □ 61% -80%  □ 81% -

100%

- النسبة المئوية لتجاوز التكلفة في مشاريع الشركة بأكملها:

□ 0% - 20 %  □ 21% -40%  □ 41% -60%  □ 61% -80%  □ 81% -

100%

- هل تطبق الشركة أي برنامج لتخطيط ومراقبة و التحكم بالتكلفة؟

□ نعم  □ لا  □ في بعض الأحيان

## الجزء الثاني: العوامل المؤثرة في تصاعد التكلفة في مشاريع البناء:

فيما يلي عدد من العوامل تم تصنيفها الى 4 مجموعات بناءا على علاقتها بالموارد التي تؤثر على تجاوز التكلفة في مشاريع البناء.من واقع خبرتك ، يرجى إبداء رأيك في **أهمية** العوامل التالية كمؤشرات لتجاوز التكلفة في مشاريع البناء في فلسطين. (الرجاء اختيار الخانة المناسبة حسب الاهمية).

| الرمز | المجموعة / العوامل | اهمية منخفضة جدا | منخفض الاهمية | متوسط الاهمية | عالي الاهمية | اهيمة عالية جدا |
|---|---|---|---|---|---|---|
| A | المواد | | | | | |
| A-1 | تقلب اسعار المواد | | | | | |
| A-2 | توفر المواد اللازمة | | | | | |
| A-3 | تغيير في مواصفات و نوعية المواد | | | | | |
| A-4 | تأخر تسليم المواد اللازمة | | | | | |
| A-5 | جودة المواد سيئة | | | | | |
| A-6 | كمية و حجم مخلفات المواد | | | | | |
| A-7 | تخزين سيء للمواد | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| B | القوى العاملة | | | | | |
| B-1 | توفر عمال مهرة | | | | | |
| B-2 | الازدحام والافراط في عدد الموظفين في الموقع | | | | | |
| B-3 | التدوير و تغيب الموظفين عن العمل | | | | | |
| B-4 | حجم العمل / عبء العمل | | | | | |
| B-5 | انتاجية العمال | | | | | |
| B-6 | ارتفاع سعر العمالة | | | | | |
| B-7 | انخفاض رواتب العمال | | | | | |
| B-8 | الدافع المعنوي لطاقم العمل | | | | | |
| B-9 | الولاء للعمل و اخلاقيات العمل | | | | | |
| B-10 | عدد الاوامر التغييرية / الاضافية و حجمها | | | | | |
| B-11 | حجم /كمية اعادة العمل من قبل العمال | | | | | |
| B-12 | علاقة العمال ببعضهم البعض | | | | | |
| B-13 | العلاقة بين العمال و الادارة | | | | | |
| C | رأس المال | | | | | |
| C-1 | صعومات مالية لدى المالك | | | | | |
| C-2 | صعوبات مالية لدى المقاول | | | | | |
| C-3 | طرق التمويل (السندات/الشيكات/الدفعات) | | | | | |
| C-4 | تضخم الاسعار | | | | | |
| C-5 | التقلب في سعر صرف العملة | | | | | |
| C-6 | ضعف الرقابة المالية في موقع العمل | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| C-7 | تقديرات و حسابات غير دقيقة للتكلفة | | | | | |
| D | **المعدات و الآلات** | | | | | |
| D-1 | عدم توافر الالات و المعدات اللازمة | | | | | |
| D-2 | عدم كفاءة المعدات | | | | | |
| D-3 | عدم ملائمة المعدات المستخدمة للعمل | | | | | |
| D-4 | عدم كفاية عدد المعدات المستخدمة | | | | | |
| D-5 | صعوبة الوصول الى المعدات في الموقع | | | | | |
| D-6 | ارتفاع تكلفة الآلات والمعدات و صيانتها | | | | | |

## الجزء الثالث: آثار تجاوز التكلفة على المشاريع الإنشائية:

فيما يلي عدد من الآثار التي تنتج عن تجاوز التكلفة في مشاريع البناء بشكل عام. من واقع خبرتك ، يرجى إبداء رأيك في مدى أهمية الآثار التالية نتيجة تجاوز التكلفة على مشاريع البناء في فلسطين. (الرجاء اختيار الخانة المناسبة حسب الاهمية).

| الرمز | التأثيرات / مدى التكرار | منخفض جدا | منخفض | متوسط | عالي | عالي جدا |
|---|---|---|---|---|---|---|
| E-1 | الإضرار باقتصاد البلد بأكمله وفقدان الوظائف والدخل | | | | | |
| E-2 | تخصيص و توزيع الموارد بشكل غير فعال | | | | | |
| E-3 | التأخير في مشاريع البناء | | | | | |
| E-4 | النزاعات و الخصومة بين أطراف المشروع | | | | | |
| E-5 | فشل المشروع والتخلي التام عنه او ايقافه | | | | | |
| E-6 | التأثير السلبي على/ فقدان سمعة المقاول | | | | | |
| E-7 | التأثير السلبي على / فقدان السمعة للاستشاري | | | | | |
| E-8 | انخفاض ارباح المالك و المقاول | | | | | |

## Abstract in Arabic

**الملخص ؛**

تلعب صناعة البناء والتشييد دورًا حيويًا في دفع النمو الاقتصادي من خلال المساهمة في تطوير البنية التحتية و تطوير النشاط الاقتصادي وخلق فرص العمل. ويمتد تأثيره إلى مختلف الصناعات ذات الصلة، و يعتبر بمثابة مؤشر رئيسي على اقتصاد البلد. ومع ذلك، يواجه قطاع البناء تحديات في جميع أنحاء العالم، وخاصة في البلدان النامية. تواجه صناعة التشييد الفلسطينية، مثل غيرها، قضايا مثل تجاوز تكاليف البناء، والتي لا تؤثر على الانشاءات فحسب، بل تعيق التقدم في مجالات أخرى أيضًا. إدارة موارد البناء تعتبر عامل رئيسي يؤثر على تكاليف البناء و التشييد.

يهدف هذا البحث إلى دراسة العوامل المتعلقة بالموارد التي تساهم في تجاوز التكاليف في قطاع البناء والتشييد الفلسطيني. تشمل الأهداف الأساسية للبحث دراسة مدى تجاوز التكاليف في مشاريع التشييد في فلسطين، وتقييم أهمية العوامل المتعلقة بالموارد التي تساهم في هذه التجاوزات، وقياس أهمية كل عامل من وجهة نظر أصحاب المصلحة (المقاولين، والاستشاريين، والمالكين)، وتحديد الآثار الناجمة عن تجاوز التكاليف في قطاع البناء والتشييد الفلسطيني.

تم جمع البيانات الأولية من خلال تصميم استبيان منظم لتقييم أهمية العوامل المرتبطة بالموارد التي تساهم في هذه التجاوزات وآثارها. تم الحصول على عينة البحث من خلال العينات الطبقية، حيث تم اختيار المشاركين بشكل عشوائي، والذي يشمل المقاولين والاستشاريين والمالكين , باعتبارهم أصحاب المصلحة الأساسيين المشاركين في مشاريع البناء و التشييد. وبلغ عدد الاستبيانات الموزعة 195 استبانة، في حين بلغ إجمالي عدد الاستبيانات المعادة 154 استبانة, وبنسبة استجابة بلغت 79%. تم تقسيم الاستبيان إلى 3 أجزاء، الجزء الأول عبارة عن معلومات عامة عن المشاركين، والجزء الثاني

يشمل العوامل المتعلقة بالموارد التي تؤثر على تجاوزات التكاليف، وقد تم اختيار هذه العوامل من خلال مراجعة الأدبيات والدراسات السابقة التي تركز على موضوعات مماثلة. أما الجزء الثالث فقد ناقش آثار تجاوز التكاليف في مشاريع التشييد في فلسطين.

تم توظيف أدوات تحليل البيانات المختلفة ومنها الأساليب الإحصائية البسيطة مثل معاملات ارتباط رتبة المقياس، و معامل ارتباط سبيرمان، واختبار التباين الأحادي (One-Way ANOVA) لتحليل التباين، وتحليل (Bonferroni) لمقارنة الوسط وتحديد الاختلافات الهامة.

تسلط نتائج البحث الضوء على الوجود المهيمن للمؤسسات الصغيرة والمتوسطة في صناعة البناء والتشييد الفلسطينية، وتسلط الضوء على الانتشار الشائع لتجاوز التكاليف في مشاريع التشييد، حيث تعاني 46.8% من الشركات من تجاوزات في نطاق 21-40% بالاضافة الى ان 30.5% من الشركات تواجه تجاوزات في التكاليف بنسبة أعلى من 40٪. حددت الدراسة أهم العوامل المرتبطة بالموارد التي تؤدي إلى تجاوز التكاليف في مشاريع التشييد الفلسطينية، و هي تتضمن توفر العمالة الماهرة، وتوافر المعدات، وإنتاجية العمال، والصعوبات المالية التي يواجهها المقاول والتدفق النقدي، وتقدير التكلفة غير الدقيق ، على التوالي. علاوة على ذلك، اوضحت النتائج أن أهم التأثيرات الناجمة عن تجاوز التكاليف هي: خسائر في أرباح المقاولين والمالكين, والتأخير في مشاريع التشييد وفقدان سمعة المقاول على التوالي .علاوة على ذلك، تقدم الدراسة آثارًا عملية وتوصيات أساسية تضمنت المقاولين والاستشاريين والمالكين و التي ترتبط بالنتائج التي توصلت لها الدراسة و بالاسباب التي تؤدي لتجاوز التكاليف , تهدف إلى منع و التقليل من تجاوز التكاليف في مشاريع التشييد في فلسطين.