An- Najah National University

Faculty of Graduates Studies

Assessment of Life Cycle Cost of Roads Projects in Palestine: A Case Study of the Palestinian Municipalities

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This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Engineering Management, Faculty of Graduate Studies, An-Najah National University, Nablus-Palestine.

2020

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الإهداء

بسم الله الرحمن الرحيم

"نرفع درجات من نشاء وفوق كل ذي علم عليم"

سبحانك يا ربنا لك الحمد والشكر حمداً كثيراً طيباً مباركاً فيه

الى معلم البشرية ومنبع العلم نبينا محمد (صلى الله عليه وسلم)

إلى من جرع الكأس فارغاً ليسقيني قطرة حب

إلى من كلّت أنامله ليقدم لنا لحظة سعادة

إلى من حصد الأشواك عن دربي ليمهد لي طريق العلم

إلى القلب الكبير (والدي العزيز)

إلى من أرضعتني الحب والحنان

إلى رمز الحب وبلسم الشفاء

إلى القلب الناصع بالبياض (والدتي الحبيبة)

إلى القلوب الطاهرة الرقيقة والنفوس البريئة إلى رياحين حياتي (إخوتي)

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الذي تفضل بالإشراف على هذا البحث فجزاه الله عنا كل خير فله منا كل التقدير والاحترام..

إلى من زرعوا التفاؤل في دربنا وقدموا لنا المساعدات والتسهيلات والأفكار والمعلومات، ربما دون ما يشعروا بدورهم بذلك فلهم منا كل الشكر، وأخص منهم (الزميل: م سليمان بليبلة)

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الاقرار

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Abstract

Road projects are considered of the most important projects in Palestine in general, and in the West Bank at specific, since they play a major role in the economic development in Palestine.

Since most of the municipal road projects in the West Bank suffer from cost overrun phenomena, and since there are only few studies made on this subject, there is need to study and analyze the factors that cause cost overrun in road projects in the different phases of the life cycle of projects, so that recommendations to limit this phenomena can be suggested.

The research goals were achieved through analysis of the results of the responses to a questionnaire that studied 47 cases of municipal road projects in the West Bank municipal road projects with cost overrun. Analysis was also done to the outcome of interviews were held with 15 experts in the field of roads. Quantitative and qualitative analysis was conducted to find the causes of the cost overrun, identify what leads to the success of road projects without cost overrun, and then suggest the necessary procedures to minimize cost overrun.

It was found that the factors with the highest impacts on cost overrun for municipal road projects include the rough terrain area of the project site, and that the preparation of design drawings and tender documents is not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project. In addition, other major factors include not considering the timing for tender release and the starting of the project, especially at the start of the winter season. Furthermore, other major factors were found to be awarding the project to the bidder with the lowest price, having changes in project activities during the implementation phase, and financial issues facing project client/government.

The results also showed that the reasons behind the success of projects without having cost overrun include following a clear and professional methodology beginning from the planning and design phase to handover, and that project implementation, is performed by a qualified contractor, and followed up by specialized and professional municipal staff.

Chapter One
Introduction

1.1 Chapter overview

This chapter provides a comprehensive description of this research. It presents a general background, the research problem, the research significance, research questions and objectives, general research framework, research hypotheses, and finally the structure of the thesis.

1.2 Background of the study

Road projects are considered of the most important and common projects in the sector of the construction industry in Palestine, specifically in the municipalities projects in West Bank, because of their large impact on the quality of the infrastructure in the country, and the related major economic and social importance.

This study intends to investigate the factors that cause the overrun of the road project costs, specifically the municipal roads, and the problems that are associated with that, and to learn from the projects that don't exceed their specified costs in order to take advantage of that for the coming projects. This would be needed as part of studying the management of the life cycle cost of these projects. The importance of this study comes from the fact that some road projects in the West Bank exceed the estimated cost.

It has to be stated that the continuation of the cost overrun phenomenon would have an adverse impact on the municipal road projects by changing the scope, delaying the project or affecting the quality of the project, knowing that it might delay financing new projects that could serve the local communities. Adding to this, there could be social, environmental and economic losses.

The main purpose of this study is to evaluate the life cycle cost of the road projects and compare the estimated costs with the actual costs for a sample of municipal road projects in the West Bank, in order to know the factors behind the actual cost increase above the estimated cost for these projects, and then analyze the results, in order to reach proper solutions and recommendations.

Good road networks are considered of great importance for the local economy for any city or town, because they play an important role in disbursement of public services and commodities, as well as in facilitating the movement of people.

The success of any local government depends on the capability of policy makers to accomplish a balance between available resources and the needs to construct new facilities and maintain and repair the components of existing infrastructure (Tiong and Singh, 2005).

Delay in construction projects is a global phenomenon and road construction projects aren't exception and usually accompanied by cost

overruns, which has a debilitating effect on customers - consultants and contractors - in terms of growth in the hostile relations, lack of trust and litigation, arbitration and cash flow problems and the general feeling of fear.

A considerable share of road projects has rarely been accomplished in the specified time and cost, which has led to losses in revenues due to cost overrun and time schedule delay. As a result of cost overruns importance, to both the clients in terms of performance and to the contractors in terms of money, this has been a major source of frequent disputes and claims that may lead to lawsuits, which could result in more expenses and loss of revenue for the interested parties.

Budget overruns if not controlled, may have the ability to impact negatively on project completion, strict management for different risks that might face road projects is required to avoid the devastating effects that they might have on the final cost of the project (Kaliba et al., 2009).

The cost of roads construction includes design expenses, extraction of materials, construction equipment, maintenance strategies, rehabilitation and operations over the whole service life time. Economic analysis process, which is known as the Life Cycle Cost Analysis (LCCA), is used to evaluate the effectiveness of alternative cost based on the concept of Net Present Value (NPV). It is usually necessary to evaluate the sides of NPV in order to get the best life cycle cost (Babashamsi et al., 2016). However,

the intent of this research will be to concentrate on the part of LCCA that ends with construction.

Finally, companies and institutions who are properly dealing with the factors of overrun when evaluating the cost of the project, and whom are seeking to ease the impact of these factors, can improve the accuracy of the cost estimations and program the budgets (Shain et al., 2009).

1.3 Research problem

In the light of this introduction chapter and next literature review chapter, the main problem that this research aims to investigate is the overrun in the final cost of municipal road projects and the factors for exceeding the estimated costs of these projects. This research will study road projects implemented by municipalities in the West Bank.

The research will evaluate the life cycle of projects that have overrun the estimated cost, to understand the way they are managed and implemented, and the factors that have led to failing to predict the right cost. On the other hand, there is a need to look at few examples of projects that succeeded to correctly predict the cost, and identify the factors why they have succeeded. This research also addresses the need to consider the social, environmental and economic factors caused by failing to correctly predict the cost of the project as a result of delays and changing the scope of the project.

1.4 The Significance of the research

Failing to estimate the cost of a municipal road project results in financial difficulties facing the municipalities which might end up deciding to change the scope of the project or reducing the budget for upcoming projects. It also has a huge impact on the society that is being served by the project, since in some cases delays might happen. Therefore, it is important to study this problem, understand the factors that might cause it and come up with proper suggestions to reduce it.

1.5 Research questions

This research is designed to answer the following questions:

1. What is the extent of the presence of the problem of cost overrun for municipal road projects in the West Bank?

2. What is the impact level of factors that are related to the project life cycle on the cost overrun of municipal road projects?

3. What is the impact level of external factors that have caused the cost overrun in municipal road projects?

4. What is the impact level of economic, environmental and social factors that have caused the cost overrun in municipal road projects?

5. What methods should be followed in the planning phase to avoid cost overrun of projects?

1.6 Research hypotheses

The following hypotheses have been identified to be verified and tested:

The main hypotheses of this research are:

HP1: There is no significant difference in the cost overrun percentage due to project characteristics (municipality area, project financing, municipality classification, and contractor classification).

HP2: There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the project characteristics (municipality area, project financing, municipality classification, and contractor classification).

HP3: There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and project size, the percentage of time overrun, external factors, as well as economic, environmental, and social factors.

HP4: There is no significant relationship between the cost overrun percentage and project life cycle, project size, the time overrun percentage, external factors, as well as economic, environmental, and social factors.

1.7 Research objectives

The main objective of this study is to investigate and analyze the factors and circumstances that cause the difference in the estimated cost and the actual final cost of the municipal road projects in the West Bank.

Other objectives of this research include:

1. Determine appropriate work methodology for the success of municipal road projects.

2. Suggest instructions and precautions to be implemented by municipalities and institutions involved in municipal roads projects (e.g., Ministry of Local Government (MOLG), and the Municipal Development and Lending Fund (MDLF)), when predicting the cost of road projects.

1.8 Thesis Structure

The thesis consists of five chapters. Chapter One introduces the thesis subject and objectives, research questions and objectives, and significance of this research. Chapter Two displays literature review and summarizes research to provide needed background and information to understand the research subject, and to achieve it is main objectives. Chapter Three displays the methodology followed in this research and procedures to use to determine the style and methods of collecting information and data from municipalities in the West Bank. Chapter Four illustrates the designed tools for data collection that include questionnaires and interviews illustrates the

descriptive and inferential results of research variables and provides test results for the hypotheses, and discusses the results. Chapter Five provides conclusions with a set of recommendations and suggestions for future research based on the results of the hypotheses testing.

Chapter Two
Literature Review

2.1 Chapter overview

The main concern of this chapter is to provide the needed background and information to understand the research subjects. This chapter reviews key definitions and concepts for life cycle cost of infrastructure projects in general; and road projects at specific, and the overrun of the cost that might happen in these projects. Next, it outlines the causes and danger of overrun in the cost of infrastructure projects. This chapter also presents a set of case studies conducted on the subject of cost overrun in road projects in developed and developing countries.

Next, the chapter presents conducted research on local case studies on the subject of projects cost overrun. Finally, the chapter ends with presenting studies on cost overrun of road projects at municipalities at specific, as well as on factors of success of implementing road projects.

2.2 Key definitions and concepts of life cycle cost of road projects

Life cycle cost, by definition, means “the total cost of the initial project plus all anticipated costs for subsequent maintenance, repair, or resurfacing over the life of the road” (Chan, 2007). As a result, when used to study the financial feasibility of the road projects, road engineers are able to choose the road type and design with the lowest cost in the long run.

In general, life cycle cost of road is usually categorized into three major components: agency cost, user cost, and external cost. Agency cost is the cost directly paid by the construction agency for the project, which includes the initial construction/rehabilitation and future maintenance costs of road. User costs are social costs incurred by the road users, which include user travel delay cost during construction, maintenance and rehabilitation events. External costs pertain to the remaining indirect costs incurred by the non-user public. Its boundary is not well- defined, but pollution damage cost, noise-pollution cost, agricultural crops damage from pollutants and visibility losses are examples of external costs. Basically, they are referred to "externalities" of road construction that are not reflected in market prices but incurred by the non-user public (Chan, 2007).

Life cycle cost of projects (LCCA) is a key component of the infrastructure management process, and it is used extensively to support network- and project-level decisions. LCCA is an analysis technique that builds on the well-founded principles of economic analysis to evaluate the overall long-term economic efficiency between competing alternative investment options. It incorporates initial and discounted future agency, user and other relevant costs over the lifetime of alternative investments. It attempts to identify the best value (the lowest long-term cost that satisfies the performance objective being sought) for investment expenditures (Santos and Ferreira, 2013).

2.2.1 The definition of cost overrun in road projects

Cost overrun, especially in the infrastructure projects, is considered as a worldwide phenomenon, and it effects the relationship between the owner (government or municipality), contractor, and project manager, Molenaar (2005) and Creedy et al., (2010) found that A lot of projects have significant cost overruns.

In the study of Bordat et al. (2004), a formula has been presented in order to calculate the project cost overrun as follow:

Cost overrun = Final Bid Amount - Original Bid Amount

Furthermore, Afetornu et al. (2006) defined the cost overrun of the constructed road projects, as "the additional cost beyond the planned estimated cost of the project", while Nega (2008) defined the cost overrun as "the difference between the finial actual cost of a construction project at completion and the contract amount agreed by and between the client (the project owner) and the contractor during signing of the contract".

Wakjira (2011) defined the cost overrun as "the increase of the final actual cost of a construction project (usually expressed as a percentage of original contract amount) at the completion of the project over the original contract amount, agreed by and between the client (the project owner) and the contractor.

Referring to the analysis of cost overrun in the Palestinian road construction industry, Mahamid (2011) defined the cost overrun in road construction projects as “a deviation that may be expressed as a percent difference between the final cost of the project (actual cost) and the contract award amount (estimated cost)”.

2.3 Causes and impacts of cost overrun in the road projects

The costs of the construction, maintenance and rehabilitation of the highway construction projects are rising dramatically, which make it important for highway agencies and municipalities to use the tools that help them to make proper decisions, follow good management practices, and have an accurate cost estimation (Babashamsi et al., 2016).

Any failure in planning, designing and executing the construction project may lead to budget overruns and work delay. Having an accurate data and surveying plans to be used in the procedures of planning the project is essential to estimate an accurate construction cost so annual budget can be predicted and the resources can be allocated efficiently. Thus, accurate planning and design of a project results in avoiding ending up with a budget that is smaller than the required costs, which lead to delaying the project or not achieving the required standards and quality (Chou, 2011).

When the final cost of the project ends up being different than the early cost estimates of the project, the project might be significantly affected, which might end up with failure of the project. Therefore, it is extremely

important to understand and be able to predict the factors that might influence the final project costs, which might occur during the period between project initiation, concept development, and the completion of the project (Shane et al., 2009).

Cost and schedule overruns can occur due to a wide range of causes on various types of projects. If project costs or schedules exceed their planned targets, client satisfaction would be compromised. The funding profile would no longer match the budget requirement and further slippage in schedule could result. The resulting effects would be detrimental, especially in the case of developing countries whose wealth measure is greatly dependent on their performance in infrastructure provision through the construction industry, especially on road construction projects, which constitute a major component of the industry (Kaliba et al., 2009).

Publicly funded projects, at specific, are highly effected by the increase in project costs, since the public funds are allocated for a limited number of projects and an increase in one of them will lead to another project being effected, and in some cases leads to change of scope to other projects to afford that cost overrun (Shane et al., 2009).

There are two types of factors effecting cost overrun, internal factors and external factors (Shane et al., 2009). Internal factors are cost overrun factors that can be directly controlled by the project's sponsoring agency or owner. While numerous internal factors can lead to underestimation of project costs during the planning and design phases of development, nine

primary internal factors are well documented. These include bias, delivery, procurement approach, project schedule changes, engineering and construction complexities, scope change, scope creep poor estimation, and additionally inconsistent application of contingencies.

The external cost overrun factors are those factors over which the owner has little or no direct control over their impact. However, the owner needs to consider these when estimating project costs. During the planning and design phase of project development, external factors such as local government concerns and requirements, fluctuations in the rate of inflation, and market conditions, can lead to underestimation of project costs (Shane et al., 2009).

2.4 Developed countries case studies

There are many published research papers that had clarified and explained the main factors that led to increase in the cost of projects in general. These papers indicated that the effects of factors on public projects is larger than the effects on the projects of private ones, and that is because the fund of the public sector is available for a limited number of projects, and if any project exceeds its budget, other projects will be down or the budget of these projects will be reduced. In addition, the studies made on a wide range of projects came out with result that the final costs of many projects were larger than the budgeted cost that was expected and released during initial planning, preliminary engineering, final design, or even at the start of construction of “megaprojects”. Such studies suggested and mentioned

that there is a true need to develop a plan to face cost overruns (Shane et al., 2009).

The negative consequences caused from the difference between the initial and the final costs are significant. Many factors could have influence on the final cost of the projects along the whole duration of these projects, starting from project initiation concept development until the completion of such projects. Furthermore, the author found that the economic, societal, and political challenges play a major role in the complexity on engineering projects. Such challenges have a big influence on the cost on many projects, and many owners including municipalities, fail to correctly predict the scope of these challenges (Shane et al., 2009).

In the transportation sector, managers and stakeholders started to pay attention to the cost overrun phenomena of transportation projects at the levels of national, state, regional, and local projects. Additionally, many owners of projects in the United States face a major difficulty in managing and controlling the budget of their own projects over the time span between the start and the end of such projects, since over this time span, there are many factors that can influence a project's final costs (Shane et al., 2009).

After making interviews with 20 transportation agencies by Shane et al. (2009), 18 cost overrun causes were identified to include 11 internal factors and 7 external factors.

The internal factors were found to include:

1. Bias which is the systemic tendency shown to be overoptimistic about the main parameters of the project. This is also seen as the purposeful underestimation of project costs to ensure that a project stays in the construction program.

2. delivery/procurement approach affects the allocation of the risks in the project between the agency/owner and the contractors, and such risk is related to project delivery approach and to the question of risk allocation.

3. project schedule changes, especially extensions, caused by budget constraints or design challenges, cause unexpected increases in inflation cost effects, even when the inflation rate is expected accurately.

4. Engineering and construction complexities caused by the location or purpose of the project, will make preparing early design plans very difficult and result in disputes between the supervisor and contractor, as well as errors in the implementation phase of the project.

5. Scope changes, that should be controllable by the owner, can result in project costs being undervalued. These changes may include changes in project construction limits, size, and location, as well as changes in design and/or measurements of key project objects and components.

6. Scope creep is the tendency for certain small changes in design to compound in order to increase project costs. Although individual changes in scope can only have small cost impacts, the implementation of these slight changes, which are often not necessary to the facility's intended operation, may result in major cost increases over time.

7. Poor estimating can lead to underestimation of project costs. Design plans must be in a manner which can be interpreted, validated, confirmed and corrected. Poor estimation involves general mistakes and omissions from planning and estimating procedures and techniques, as well as general inadequacies and poor results.

8. Inconsistent application of contingencies causes confusion as to exactly what is included in an estimate's line items, and what is covered by contingency amounts. Contingency funds are usually intended to cover a range of future incidents and problems not clearly defined or to compensate for a lack of project identification during the preparation of early planning or programming estimates.

9. Faulty execution by an owner in managing a project could lead to project cost overruns, such as the inability to make timely decisions or actions or to provide information relative to the project.

10. Ambiguous contract provisions dilute responsibility and cause misunderstanding between an owner and project design and construction contractors like providing too little information in the project documents.

11. Contract document conflicts lead to mistakes and uncertainty when bidding and, later, during execution of the project, change and rework orders.

The external factors were found to include:

1. local concerns and requirements to mitigate the project effects on the local community, local social climate, and on the natural environment, as well as agreed improvements or adjustments to scope usually included.

2. Effects of inflation is a key factor in the underestimation of costs for many projects, knowing that time value of money can adversely affect projects specially when project estimates are not communicated in year-of-construction costs.

3. Scope changes, considered as external factors in this context are those changes not controllable by the owner that may lead to project cost escalation being underestimated.

4. Scope creep, in this context is the result of several accumulating external small scale changes, that can be attributed to the evolving demands basically from municipal authorities or the residents.

5. Market conditions, inaccurate assessment of the market conditions will lead to incorrect estimate of project costs. Business dynamics impact project costs similar to the consequences during the planning process and during the implementation process. Changing market conditions during the

construction of a project which decreases the number of bidders, affect the workforce and can interfere with the project schedule and budget.

6. Unforeseen events are cases such as flooding, hurricanes, tornadoes or other weather-related events cannot be expected and usually not controllable by the project owner. These are typically called "acts of God."

7. Unforeseen conditions such as unknown soil conditions may have effects on the foundations of construction, compaction, and structure and can lead to cost overruns.

By defining such factors, the supporting efforts made to understand these factors will be more easier, and this understanding will lead to develop new strategies, methods and tools for better cost estimation and management. Also, after defining these factors, this will empower estimators, owners, and contractors to be able to specify each factor and how to deal with. Moreover, understanding such factors will allow to take the appropriate decision to fight factor impacts, and in the same way, project participants can take many actions to control and avoid as much as possible the effects of these factors on the long-life of the project (Shane et al., 2009).

The issue of cost overruns and the issue of timeline delay for large-scale infrastructure projects are considered as the biggest problems face large countries like Canada. Many large-scale projects provide an evidence that the probability for projects to face cost overrun and delay problems increases when the scale of the project increases. The author suggested

three main explanations for cost overruns and delays, which are technical challenges, over-optimism, and strategic misrepresentations (Siemiatycki, 2015).

Technical challenges include scope changes and change orders, problems coordinating a large cast of contractors and subcontractors, increased labor or material costs, inaccurate forecasting, and poor monitoring of projects. The problem with megaprojects is when stakeholders believe that such projects should use less resources and less time than planned; for sure, delays and over budgets will occur. At the same time, promoters of megaprojects may deliberately misrepresent the budget and schedule to ensure approval of projects from which they will gain – financially, professionally, or politically (Siemiatycki, 2015).

Referring to the study of Odeck (2004), the Norwegian road sector found that cost overruns occurs in smaller projects more than large projects, which means more management and efforts should be put on small projects to avoid cost overruns. The Norwegian road sector study also indicated that some other factors might cause cost overrun, such as the completion time of the project and the region where the project is conducted. Surprisingly, neither project type nor work force type seems to highly influence the level of cost overrun.

As for the geographical location and type of the transportation projects and the relation with the cost overrun of the project, and according to a study conducted by (Creedy et al., 2010) using the regression analyses, it was

found that there is a lack of strong correlation between the geographic location of the projects and the project cost overrun. These finding contradicts with the findings of Drew and Skitmore (1992), which argued that the density of population and the extent of the geographic area were important factors contributing to cost overrun for competitive bids in building projects. This difference might be due to the different between highways projects and building projects.

The highway projects analyzed by Creedy et al. (2010) were located in one area, Queensland, Australia and not a broader region as was presented by Drew and Skitmore (1992). In addition, another finding indicated that there is no strong correlation found between highway project type and project cost overrun.

Another study on a broader transportation research base of analyzing rail, fixed-line, and road projects was conducted by Flyvbjerg et al. (2002), where the results of the study showed that the type of transportation project had a statistical effect on the cost overrun. If there was a difference, it might be attributed to Flyvbjerg's use of a much broader range of project types and that the research was conducted on an international scale. Likewise, there was no correlation found between owner project risks and project cost overrun. However, the author found that correlation exists between the indexed highway programmed cost and the increase in cost overrun project in budgeted programmed cost, where the size of the percentage cost overrun decreases (Creedy et al., 2010)

In contrast, another research, carried out by the USA Transportation Research Board in 1992, evaluated construction cost overruns on 468 transport projects completed for the Washington State Department of Transportation, indicated evidence of cost overruns. The results were expressed as a percentage of the original contract amount, which increased with the increase of size of the project (Hinze et al., 1992). In addition, this finding is also inconsistent that found by Williams (2003), who analyzed transportation projects in both the U.K. and the United States. The researcher argued that there is a log linear relationship between the contract size and cost overrun. The reason for the appearance of this inconsistency was attributed only to the contract elements of projects and the size of projects (Williams, 2003).

2.5 Developing countries case studies

Like the rest of the world, developing countries are among the countries that suffer from the phenomenon of cost overrun in road projects. In this section, a number of studies on this subject from three developing countries, Zambia, Ghana, and Jordan, are presented below.

Based on the study case of Zambia's road construction projects (Kaliba et al., 2009), cost overrun was mainly caused by extreme weather conditions such as heavy rain and floods causing to change the scope of the project. In addition, cost overrun was attributed to the cost of protecting the environment, technical challenges and local government pressures. These factors need to be managed and predicted to be able to face them and

correctly prepare for their financial effects early in the planning phase. For the schedule delays, it was found that such delays were affected by financial problems that might face the government (especially in developing countries), changes in drawings, tools and machines unavailability, poor supervision, bad coordination on site between the different parties in the project (owners, consultants, and contractors).

Another study was made to identify the reasons which lead to cost overrun in projects in Ghana (Chileshe and Berko, 2010). The results of the study showed that this is caused by a number of critical factors. The study argued that most of the cases related to project cost overruns were caused by general factors related to technical difficulties, poor management, social and financial conditions. Also, the study showed that the most specific factors include the delay in monthly payment to contractors, inflation, schedule slippage, underestimating project activities correct cost, falling to professionally and completely understand project design plans and tender documents and finally design errors.

The study mentioned above focused on the main reasons which lead to cost overrun in projects supervised by the sector of road construction in Ghana. The study showed implementing the projects with the required quality according to the official specifications and codes and sticking to the budget offered by the government was and still a big issue that faces the government and road projects agencies in Ghana. The study argued that the community in Ghana look at government and road agencies as corrupt and

ineffective parties in general. The clients, consultants and contractors who filled the questionnaire for the study agreed that the main reason caused overrun cost is due to delays to monthly payments to contractors, and therefore the problems mentioned above made the issue of finishing projects in time without the cost of overrun almost impossible (Chileshe and Berko, 2010).

Generally, in public sector, money spent mainly on project change orders, results in reducing the numbers and size of the future projects that can be completed during any fiscal year. To prevent this phenomena municipalities must monitor the process of spending money on different projects (Al-Hazim and Salem, 2015).

The documents and the final reports for several sample projects implemented in Jordan over the years 2000 to 2008 were collected, then analyzed (Al-Hazim and Salem, 2015), knowing that all the projects were administered by the same organization, which is the Jordanian Ministry of Rural and Public Works. The results of the analysis made could provide assists to highway officials in their design, planning, scheduling and projects completions. The study gave 19 factors that might cause cost overrun in road construction projects. It summarized the results that were considered as major causes of cost overrun through more than 25 large projects in Jordan during the indicated period.

According to what was documented, the most important reason that led to cost overrun was terrain conditions. These conditions include difficulties in reaching the work site, difficulties in the work type, land acquisition issues, delay in relocating utilities, and the lack of civil services near the work site, which were not included within the work plan and cost studies. The second main reason in cost and time overrun was weather conditions. These two reasons were the main reasons indirectly leading to additional causes for cost overrun. These include for example, new variation orders and their costs, mistakes in design, emergency working (Al-Hazim and Salem, 2015).

2.6 Local case studies from the Palestine

Researches and studies on delay of projects and cost overruns in Palestine are few despite the significance of the construction sector in Palestine. It is noted that the parties of project (owners, consultants, and contractors) don't give the time and cost overruns the importance in the evaluation phase at the end of project (Al-Najjar, 2008).

A study conducted by Mahamid (2013) had investigated the occurrence frequency of time overrun causes in road construction projects in the West Bank in Palestine from contractors' viewpoint through a questionnaire survey. The field survey included 34 contractors, where 52 factors affecting time overrun were identified during the research. The survey concluded that the top ten frequent factors are segmentation of the West Bank and limited movement between areas, political situation, progress payments

delay by owner, lack of equipment efficiency, difficulties in financing project by contractor, personal conflicts among labors, poor communication between consultant with other subcontractors, conflict between contractor and owner/supervisor, award project to lowest bid price, unreasonable project time frame by the owner.

According to Al-Najjar (2008), the shortage of control of cost overruns and timeline delay might be as a result of:

- Lack of professional monitoring of different project activities during the implementation phase;

- The distribution of delay and cost overruns responsibilities between the three parties (contractors, consultants and owners);

- The contractors who were surveyed believe that the political conditions are the main reason of this problem.

According to Albatsh (2015), the author indicated that the top ten causes which contributed to delays in Palestinian construction projects from the viewpoint of project parties (owners, contractors, and consultants) are: referral of bids to the lowest price, incorrect and inappropriate bid pricing, lack of sufficient cash for project implementation (financial difficulties), contractor failure to regulate the cash flow of the project, irregular cash flow for the project on owner's side, delay of due payments (according to progress), unavailability of required equipment when demanded or delayed availability behind schedule, the kind of tenders in which the selection

process to negotiate lower prices or other criteria, adding a significant changes to the project by the owner after starting the implementation phase of the project (additional work, modifications to the design), and mistakes during the process of implementation (intentionally or unintentionally) which require readjustment.

2.7 Studies on cost overrun of road projects in municipalities

It is very important to analyze and monitor the phenomenon of cost overrun in road projects in municipalities since it has a high impact on the municipal yearly budget and it effects the funding of future projects. In this section, a number of studies on this subject are reviewed and presented.

The challenge in the planning phase of these projects is to predict an accurate cost for the project, so it could be considered by handled to the decision-makers parties in the municipality to correctly allocate municipality funds in the most prioritized way. The best estimation cost for a project is the estimation that is approximately close to the final cost of that project to help to protect the municipality from cancelling future projects to fund old ones (AbouRizk et al., 2002).

The authors found that, most of municipalities underestimate the inherent uncertainty associated with estimating project costs, and this generally leads to serious deviations from established budgets (overruns or underruns). When accountability is based on overall performance of a group of projects, overruns and under runs tend to cancel each other out,

yielding an acceptable level of budget performance. Moreover, when scrutiny is on a project-by-project basis, the inability to establish accurate estimates when projects are approved by decision makers (i.e., at the concept or preliminary phase) becomes more pronounced. Such expectations in terms of estimate accuracies need to be tempered to reflect what is achievable.

Over-riding issues that can improve estimating accuracy include proper scope definition and control, tying the level of estimate to the level of engineering effort expended and not just the design report produced, establishing and maintaining the currency of databases of cost and understanding the influence of market conditions on these costs, and recognizing that elements of uncertainty are abundant in road construction. The last issue could be best managed and controlled through undertaking proper risk analysis techniques. Moreover, modeling uncertainty can be achieved through simulation techniques, and development of contingencies should be integrated within this process. Generally, it was found that improvements were obviously needed in how engineers develop estimates. Until these improvements are implemented, however, it is prudent to be realistic in gauging uncertainty in cost estimating (AbouRizk et al., 2002).

The study of Mulenga and Bekker (2015) focused on uncovering the causes of cost overrun on Municipal Infrastructure Grant allocated to municipalities by National Treasual in South Africa funded projects in the OR Tambo District Municipality. The data were gathered by using a survey

questionnaire of 69 potential factors and other sources of evidence such as project documentation. A total of 65 respondents, out of a potential 115 sampled, representing service providers and sector departments involved in OR Tambo District Municipality, responded to questionnaire. Of the 69 potential factors, 21 factors were found to have significant impact on cost overruns. Data gathered from other sources such as project documentation and archival records confirmed the significance of the 21 factors. Main causes of cost overrun were found to include inadequate planning, inadequate funding, and discrepancies in the procurement processes and policies. The study recommended improvements in project planning, adjustments in the project implementation process and policy as the main focus areas to reduce cost overrun.

2.8 Factors of success for implementing road projects

The definition of the success of any project is associated of whether the project had achieve the aim of the client based on what was planned. The successful project is that accomplished and finished in the agreed time with the estimated budget with the required quality according to the codes and specifications. To call any project as a successful project, project management techniques and tools should professionally be followed and used. Project management is defined as managing the available different resources, workers, money, equipment, machines, materials and methods to ensure projects success (Chileshel and Berko, 2010).

The definition of the project/construction management is the process of guiding a project throughout its life cycle. Modern managerial knowledge in addition to understanding of the design and construction processes are the bases of construction management. Every construction project has its own requirements, aims, objectives and constraints such as a required time schedule to be followed (Spinner, 1997).

Oberlender (1993) argued that the modern managerial knowledge and the understanding of the design and construction processes form the bases of the management of road projects.

The success of any road construction project depends on adopting the right strategies to be followed when managing such projects. The strategies for success in any road construction project are implemented in the management of the project time, cost, and quality and material management (PMBOK, 2013), (Kehinde et al., 2017).

A group of proactive measures should be adopted in the planning phase of project. Some of the common planning strategies are: efficient planning, planning for management of site and supervision of the project; appropriate planning and arrangement of project; organized regulatory mechanism; and planning for considering proper methods for construction (Azis et al., 2012).

The organizational strategies that contribute to the success of projects, including road project need to include: appropriate prominence on previous experience; regular coordination between the associated parties; increasing human resources in the industry; and complete administration of contracts (Ahsan and Gunawan, 2010). Regular meetings on development, employing proficient subcontractors and suppliers, attributing less weight to prices, and more weight to abilities and earlier performance of contractors to improve the contracts and their procedures are some reactive and organizational strategies (Azis et al., 2012). Using channels for perfect information and communication is a proactive and organizational strategy, as well as utilization of latest technology is a proactive and reactive strategy. Undertaking preconstruction planning regarding the procedures and resources of the project is a proactive, reactive, and organizational strategy (Azis et al., 2012).

Chapter Three
Research Methodology

3.1 Chapter overview

This chapter displays the case study methodology followed in this research and the procedures used in collecting the data from municipalities in the West Bank, and conducting analysis using that data. In order to investigate and analyze the factors and circumstances that cause the difference in the estimated cost and the actual final cost of the road projects implemented from 2016-2018 by municipalities in the West Bank, there is need to study a sample and investigate the factors causing this phenomena from the perspective of the municipalities representatives. This chapter presents the research strategy, research design, study sample, location of study, and analysis tools used in the research.

3.2 Strategy of research

In this research, different types of research are used to analyze the data and get to the results of the study desired, which can be classified into the following three types:

Exploratory research*:* It uses contextual study methods that are useful in recognizing the viewpoints of a subject and helps to interpret information in mind and perception states (Saunders et al., 2009). Such research is useful in defining issues and generating ideas for implementation (Neelankavil, 2015). As the name suggests, it merely aims to "explore" the

study discussions and does not mean providing the last and unquestionable answers to unanswered questions. Normally, this type of research is aimed at thinking about an issue that has not been clearly identified yet. It is aimed at identifying the shape and nature of the problem. Exploratory research is not intended to provide definitive evidence, but it allows having a higher understanding of the issue (Dudovskiy, 2016). In this study, the research explores the factors that lead to the overrun costs during the life cycle of municipal road project.

Explanatory research: This research type (referred to also as causal research) aims at identifying the degree and nature of the triggering circumstances and result connections with a specific end goal (Brains et al., 2011). Causal research can be performed to determine the impact of specific changes on existing standards, various processes, and so on (Zikmund et al., 2013). Causal research focuses on researching a situation or a particular issue to clarify the modality of interaction relations (Given, 2008). In this type of research, the researcher aims to demonstrate or explain the relationship between two aspects of a phenomenon or circumstance.

Descriptive research: This research type is concerned with how a matter could be interpreted as an effort to determine, represent or discern what it is (Saunders et al., 2016). Descriptive research is intended to spotlight on problems or issues through a data accumulation process that empowers to explain the circumstances more comprehensively than could be anticipated

without using this technique (Fox and Bayat, 2007). This type of research is intended to explain more than the relationship test. This research aims to describe situations, circumstances or events systematically, to provide knowledge about these projects, or to explain attitudes to certain issues.

3.3 Design of research

Each scientific research has a specific approach followed by the researcher during the study, where the approach based on this study is a qualitative approach, quantitative approach, and mixed methods procedures.

Qualitative approach: Such approach involves data collection, evaluation, presentation, and document writing qualitative methods that vary from the conventional quantitative approach. Purposeful sampling, open-ended data collection, text or image analysis, knowledge representation in figures and graphs, and subjective interpretation of the results qualitative approaches. A qualitative approach is one in which information statements are often made by the investigator mainly based on constructivist perspectives (Creswell, 2014).

Quantitative approach: Different hypotheses or theories are tested in this method and empirical data are gathered to support or disprove the hypotheses. Data obtained using methods to assess attitudes such as questionnaires and then analyzed using programs to test statistics aspects and hypotheses (Creswell, 2012).

Mixed methods approach: This approach is characterized as that dealing with inquiry, including collecting both quantitative and qualitative data, coordinating the two data types, and using unmistakable outlines that may include philosophical presumptions and hypothetical frameworks. The fundamental premise of this type of investigation is that the combination of qualitative and quantitative methodologies offers a more complete understanding than either methodology alone (Creswell, 2014).

3.3.1 Sampling design of research

The first task in this research is to establish a sample to investigate overrun cost road projects implemented by municipalities in the West Bank within three years (2016, 2017, and 2018). The sample need to be taken from all governorates of the West Bank, including all different categories of municipalities in the West Bank classified by MOLG (classes A, B, and C), as presented in Table 3.1.

Table 3.1: The Sample of projects

No.	Name of municipality	Municipality classification	Number of studies projects
Jenin Governorate			
1	Qabatiya	B	2
2	Az Zababida	C	1
Tubas Governorate			
3	Tubas	A	4
4	Tammun	B	1
5	Aqqaba	C	1
Tulkarm Governorate			
6	Anabta	B	3
7	Zeita	C	1
Nablus Governorate			
8	Nablus	A	3
9	Beit Furik	B	3
10	Huwwara	C	4
Qalqiliya Governorate			
11	Qalqiliya	A	3
12	Azzun	C	1
Salfit Governorate			
13	Salfit	A	3
14	Biddya	C	1
Ramallah and Al Bireh Governorate			
15	Ramallah	A	3
16	Beirzeit	B	4
17	Al Mazra’a ash sharqiya	C	2
Jericho Governorate			
18	Jericho	A	2
19	An Nuwei'ma and 'Ein ad Duyuk al Fauqa	C	2
Jerusalem Governorate			
20	Al Eizariya	B	1
Bethlehem Governorate			
21	Bethlehem	A	3
22	Beit Jala	B	2
23	Battir	C	1
Hebron Governorate			
24	Hebron	A	2
25	Yatta	B	4
26	Al Karmil	C	5
Total			63

3.4 Research methodology flow chart

The research methodology flow chart, presented in Figure 3.1, displays the various consecutive stages of the research to achieve its objectives. This research methodology comprises of four main stages, starting from the literature review, and ending with results and recommendations.

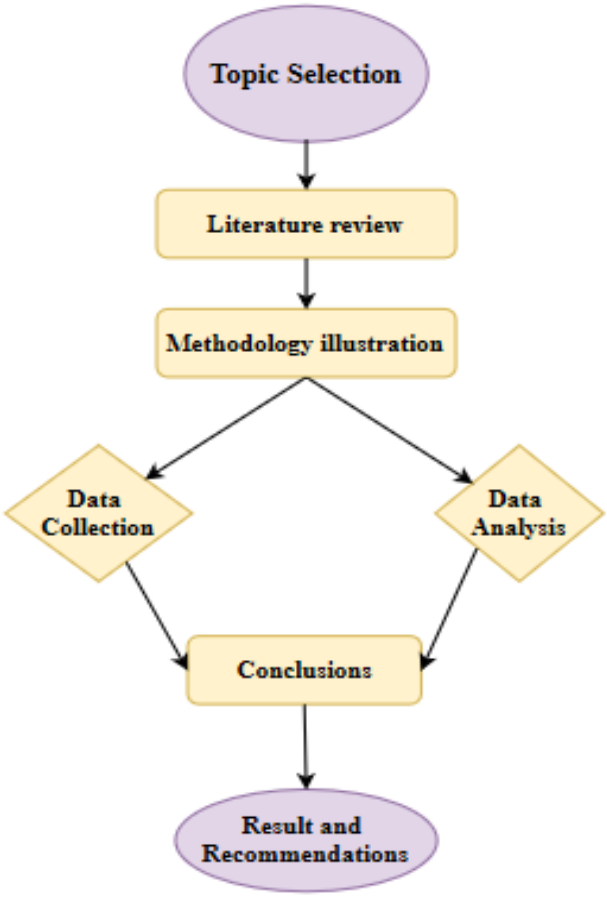


Figure 3.1: Research Methodology Flow Chart**.**

3.5 Data collection methods

This study relies on information collected through documents from the sample municipalities in the West Bank, structured interviews, and questionnaires.

3.5.1 Documents

In order to achieve the research goal, a sample of road projects which has to provide sufficient statistical and objective information about the life cycle costs of these projects is to be selected. The required data, especially that related to the cost, has to be collected from official records and documents from the municipalities. Because of the nature of the road projects, the municipalities would be the most accurate, inexpensive, and objective source for the required data (Ahsan and Gunawan, 2010).

3.5.2 Interviews

The interviews are considered of the most important tools used in qualitative research. There are many types of interviews used in scientific research, including structured interviews, semi-structured interviews, and unstructured interviews. This research relied on structured interviews to collect information. The questions are asked in a set with standardized order and the interviewer will not deviate from the schedule of the interview or probe beyond the answers received.

To use the method of structured interview, some of the benefits and strengths that support their use in this research include the ease to replicate as they use a fixed set of closed questions that are easy to quantify. This ensures that performance and reliability testing is easy. Structured interviews can be conducted relatively quickly, meaning that many interviews can take place in a short time (Mcleod, 2014).

3.5.2.1 Design of interviews

Interviews are conducted with several parties who have an active role in the life cycle of road projects, including design offices and consultants, some of the financiers of these projects, including Ministry of Local Government, Municipal Development and Lending Fund, and Ministry of Public Works and Housing, as well as some engineers with expertise in the field of roads, and academics.

The following questions are addressed and investigated in the interviews:

1. Can the cost overruns be considered acceptable? And why?

2. Is there a percentage of the project cost that can be considered to be unacceptable?

3. What are the most important reasons that lead to increased costs?

- In the planning and design phase
- In the tendering phase.

- In the implementation phase

4. What are the measures that can limit the increase in costs in road projects?

- In the planning and design phase.
- In the tendering phase.
- In the implementation phase.

5. Does the contractor classification and efficiency affect the cost increase in road projects?

6. In what kind of financing is the phenomenon of cost increase more common? And why?

7. Is there an environmental and economic impact due to the increase in the costs of road projects?

8. What are the environmental and economic impacts resulting from increased costs for road projects?

9. What method is proposed to be used to track the progress of work during implementation to avoid cost overrun?

10. What are the reasons for the success of some road projects by not exceeding the estimated cost?

3.5.2.2 Interview content validation

Before interviewing the selected interviewees, content validation was conducted by involving three highly reputable academics, targeted sector two field experts and one post-graduate researcher (see Appendix A). They were asked to arbitrate the interview protocol's standard, accuracy, precision, orientation, order, context, language, and time frame.

3.5.2.3 Interviews analysis

The interviews will be analyzed through thematic analysis, which is considered as the most common method in the analysis of qualitative research resulting in structured interviews. Thematic analysis has many characteristics such as versatility, simple learning process, and useful approaches to qualitative analysis. It is carried out in many phases; familiarization with information, generation of initial codes, a quest for topics between codes, the examination of topics, classification, and naming of topics and final reporting (Braun and Clarke, 2006).

The steps of the analysis are summarized by thematic analysis as follows:

Familiarization: The first step is having the data identified. Until analyzing individual items is started, it is necessary to get a detailed overview of all the collected data. It may include transcribing audio, reading the text, making initial notes, and simply going through the data to get to know it.

Coding: Next, the data need to be coded. Coding involves highlighting parts of the text –usually sentences or phrases– and having shorthand labels or "scripts" to identify their content.

Generating themes: Next, look over the created codes, identify patterns among them, and start coming up with themes. Themes are generally broader than codes.

Reviewing themes: The researcher has to make sure that the themes are useful and accurate representations of the data. Here, the data set is compared with the themes against it.

Defining and naming themes: This involves formulating exactly what is meant by each theme and figuring out how it helps us understand the data. Naming themes involves coming up with a succinct and easily understandable name for each theme.

Reporting: A brief report on each topic is to be written, according to the opinions of the people interviewed.

3.6 Survey

Surveys offer quantitative or empirical summary of a population's patterns, behaviors, or views through the analysis of a population sample. In this approach, quantitative data (numerical data) are collected using a tool such as the questionnaire and then to be statistically analyzed to explain the

patterns from in response to answers to the research questions and hypotheses (Creswell, 2014).

3.6.1 Questionnaire

In this research, the questionnaire is used as a research tool to collect data as part of the descriptive and quantitative approach, which is an instrument used in a survey that allows knowing the reasons for overrun cost in road projects, that this research aims to determine. The questionnaire is suitable for many reasons, such as to cover large responses at different locations, saving time and cost, and to analyze standardized data without personal interaction in a way that affects the questionnaire credibility. In addition, without any confusion, respondents should answer and understand the questions (Denscombe, 2014).

3.6.2 Questionnaire design

The researcher has established a closed question structure to answer by selecting from a variety of options or from a three-point Likert scale to assess the factors and circumstances that cause cost overruns in the municipal road projects, where the respondent selects only one option that represents the case. The questionnaire is designed considering the outcome of the review of relevant literature from academic papers and the other surveys that are related to the topic investigated in the study. After that, the researcher presents the draft questionnaire to experts in the construction

sector and academics. The questionnaire's last revision includes the following:

The first section: The purpose of this section is to collect general information about the road project which the study targets, including name of the municipality, name of the project, location, the date of completion of the project, size, project cost according to the bid, actual final cost, estimated calendar, days actual calendar, project financier, and classification of the project contractor.

The second section: In this section, the factors causing the overrun cost are divided according to the phase of the project life cycle and the external and environmental factors affecting the project. Project phase related factors are divided into three phases: the planning and design phase, including 10 items, the tendering phase including 11 items, and the implementation phase including 19 items. In addition, the external factors include 6 items, and the economic, environmental and social factors include 10 items.

3.6.3 Questionnaire validity

To ensure the validity of the questionnaire and that it is suitable for access for research purposes, the researcher uses different types of validity tests; the content validity and the construct validity through the correlation coefficient.

3.6.3.1 Content validity

The questionnaire was judged by involving three highly reputable academics, two experts in the filed municipal roads, and one post-graduate researcher (see Appendix A). The opinions of the arbitrators were taken into consideration and the necessary deletion, modification, or addition were made in the light of the proposals submitted. Consequently, the questionnaire came out in its final form as shown in Appendix B.

3.6.3.2 Structural validity

To study the structural validity, the correlation coefficient was used. Table 3.2 shows the correlation coefficient for each with item its factor. All coefficients are found to be significant at a significant level of 0.05, which means that there is a high correlation between item and its factor, so these item can be represent their factors.

3.6.4 Questionnaire reliability

To check the reliability of the data, the researcher utilized Cronbach's Alpha tool. The reliability tool is considered as consistency measure to indicate when the measurements are repeated twice with the same respondents, the results would essentially be the same. The range of the values for Cronbach's Alpha ranges between 0 to +1.0, and the closer to the value to 1 the higher degree of internal consistency will be.

Table 3.2: Construct Validity through the Correlation Coefficient

Planning and design phase		**Tendering phase**		**Implementation phase**			
Items	Corr. coff	Items	Corr. coff	Items	Corr. coff	Items	Corr. coff
D1	0.865	T1	0.655	IM1	0.756	IM12	0.808
D2	0.823	T2	0.680	IM2	0.807	IM13	0.739
D3	0.606	T3	0.863	IM3	0.763	IM14	0.797
D4	0.812	T4	0.825	IM4	0.748	IM15	0.716
D5	0.840	T5	0.841	IM5	0.781	IM16	0.783
D6	0.652	T6	0.840	IM6	0.320	IM17	0.796
D7	0.823	T7	0.829	IM7	0.441	IM18	0.671
D8	0.661	T8	0.719	IM8	0.521	IM19	0.730
D9	0.758	T9	0.812	IM9	0.717		
D10	0.638	T10	0.665	IM10	0.286		
		T11	0.383	IM11	0.613		
External factors		**Economic, environmental and social factors**					
Items	Corr. coff	Items	Corr. coff	Items	Corr. coff		
E1	0.823	I1	0.507	I7	0.709		
E2	0.868	I2	0.861	I8	0.667		
E3	0.922	I3	0.893	I9	0.653		
E4	0.923	I4	0.844	I10	0.508		
E5	0.920	I5	0.818				
E6	0.820	I6	0.711				

All Correlation between items and factors are significant at level 0.05 See Appendix C for a definition of each items.

Table 3.3 illustrates that the Cronbach's Alpha values for all factors are higher than 0.70. Additionally, Cronbach's Alpha for the entire study equals to 0.971 which indicates that the entire questionnaire has a high level of consistency, and in turn has a high level of reliability.

Table 3.3: Reliability Statistics

Factors	No. of Items	Cronbach's Alpha
Planning and design phase	10	0.914
Tendering phase	11	0.915
Implementation phase	19	0.933
External factors	6	0.941
Economic, environmental and social factors	10	0.891
Total	56	0.971

3.7 Data Analysis

The data obtained have been analyzed using SPSS (Statistical Package for Social Sciences) for quantitative analysis. The results are the presented using tables and charts, an illustrated in Chapter Four, in a detailed manner. The quantitative data are analyzed through a different statistical tools as follows:

1. Descriptive statistics (mean, standard deviation, frequencies).

2. One-way analysis of variance (ANOVA), which is used to analyze the differences between the characteristics variables and the questioner dimensions.

3. Sheffe test, which is used to find the source of paired differences between groups. With significance level 5%, a P-value less than 0.05 is considered statistically significant.

It is to be noted that the researcher has used the scale in this study was a three point-Likert scale, where three main classes are considered for easier response interpretation. Table 3.4 illustrates the distribution of mean value for each of the corresponding response classes (Abdel Fattah, 2008).

Table 3.4: Distribution of mean value for each of the response classes

Mean Range	Response Class
Less than 1.66	Low
1.67- 2.33	Moderate
More than 2.33	High

Chapter Four
Data Analysis and Results

4.1 Chapter overview

This chapter presents the findings considering the mixed approach, and analyzing collected data and information. Descriptive and quantitative analyses are conducted through the use of *SPSS* program. This assists to test research hypotheses. Qualitative analysis of the interviews is conducted using thematic analysis approach. Such analyses will assist in reaching the results of the research.

4.2 Interview analysis

Fifteen interviews were conducted with several individuals who have an active role in managing and supervising road projects and have a deep understanding of the life cycle of road projects. These include representatives of including design offices and consultants, financiers of these projects, including Ministry of Local Government, Municipal Development and Lending Fund, and Ministry of Public Works and Housing, some engineers with expertise in the field of roads, and academics. Table 4.1 shows the organizations and job titles for those who were interviewed.

Table 4.1 Targeted organizations and list of interviewees

No	Sector	Organization	Job position	Years of experience
1	Governmental institutions	Ministry of Local Government	Project manager	20
2		Municipal Development and Lending Fund- MDLF	Field supervisor	20
3		Ministry of Public Works and Housing	Head of road supervision department	10
4	Contractors	Al Amjad Arabian Company	Project manager	22
5		Dar Al-bina' for Trading and General Contracting Company	Project manager	12
6	Consultants	Projective office	Roads specialist	10
7		Al Diyar Consultants Company	Project manager	16
8		Universal Group for Engineering & Consulting	Senior civil engineer	36
9	Designers	Diyar consultant company	Director general	39
10		Badrasawi office	Designer	10
11	Academics	Palestine Polytechnic University	Lecturer	17
12		An-Najah National University	Assistant professor	21
13	Municipalities	Jenin Municipality	Civil engineer	10
14		Tulkarm Municipality	Project manager	15
15		Nablus Municipality	Civil engineer	16

The interviews were conducted with the persons indicated in Table 4.1 to answer research questions in order to reach the desired goals, whether in an oral and a written form. Specific questions were asked while interviewing each of the interviewees, on the general factors that cause cost overrun in road projects, factors that might appear at each phase of the project life cycle that lead to cost overrun, and factors that may limit the phenomenon of overrun costs. In addition, the interviews questions included what procedures might be used to implement the project without any overrun in costs and still have appropriate quality.

After interviewing the persons indicated in Table 4.1, the thematic analysis method was used to get to the results required for the research, adopting several steps to reach that goal, as explained in Table 4.2.

Table 4.2: Codes, issues discussed and central themes

Code	Issue(s) discussed	Central theme
Cost overrun	Procedures to reduce overrun cost	Phenomenon of cost overrun
Percentage of cost overrun	Allowed rate of cost overrun	
Poor planning	Follow the project life cycle	Factors of cost overrun
Design errors		
Bid defect		
Wrong expectation		
Implementation mistakes		
Type of financing	Entities that have a primary role in the project life cycle	Stakeholders
Supervision		
Owner		
Contractor classification		
Economical factors	Maintaining the safety of lives, citizens properties and satisfaction of the population	Economic, social, and environmental factors
Social factors		
Environmental factors		
Methodology	Successful job tracking methodology and minimizing cost overrun	Work methodology
Detailed design		
Audit for working documents		
Follow up		
Efficiency of employment		

4.2.1 Theme 1: Phenomenon of cost overrun

The opinions of interviewees on the phenomenon of cost overrun in road projects implemented through the municipalities of the West Bank is split into two opinions. The first, is that this phenomenon is acceptable as long as the percentage of the increase is less than 25% of the total original bidding price which, according to the Palestinian Public Procurement System (in page 157, 2014), can be directly accepted by the supervision team if there was justified causes. The second opinion is that this phenomenon is unacceptable regardless of the legal justifications because it reflects a weakness in the management and planning of these projects, and that cost overrun effects the strategic plans of the municipalities, since it reduces the number of future projects that could serve the community.

4.2.2 Theme 2: Factors for cost overrun

The interviewees identified the factors for cost overruns in road projects, and for each project life cycle phase. They indicated that there is an impact on cost overrun percentage, as follows:

The planning and design phase: One main factor for the cost overruns at this phase is not conducting enough background study for the project. Another factor is the absence of a qualified planning department in some municipalities, where in these cases, members of the municipal councils intervene in making planning decisions while not being qualified for this. These factors lead to making wrong decisions that cause a defect in the design of the project, which leads to an increase in the cost of these projects.

Therefore, defects and errors will be present in the design, due to the fact that the design is not based on sufficient and accurate information. Further factors for cost overrun in this phase are designs which are not audited before adoption, soil tests not being conducted, or engineering offices designing roads without having enough expertise or qualified engineers. These factors cause mistakes and increase the total cost of the project during the implementation phase.

The tendering phase: According to the interviewees, the main factor for the increase in costs at this phase is due to the lack of clarity in the items of the BOQ, and the fact that sometimes there is an inaccurate quantity calculation.

The implementation phase: The factors for cost overrun in this phase include the lack of qualified personnel to find and fix design errors, unexpected events and circumstances during this phase, or the lack of coordination with electricity and water providers in cases when the project includes rehabilitation or expansion of existing water and electricity networks. For example, lack of coordination can lead to re-digging and backfilling of already completed work.

4.2.3 Theme 3: Stakeholders

The interviewees considered that the project stakeholders had an impact on cost overrun in the road projects at all phases of the life cycle. The financier or the owner of the project may cause cost overrun if they fail to successfully and effectively plan and manage the project. The interviewees also stated that municipality funded projects tend to suffer from cost overrun more than projects funded by foreign donors since projects funded by foreign donors are required to have a highly detailed and accurate plans and be implemented under the supervision of highly qualified team of engineers and according to the international codes.

Having a qualified and efficient supervision team is important to prevent or limit cost overrun. Since having such a team means being able to successfully monitor the project activities, identify errors and mistakes during the implementation phase and being able to early make the right decisions to prevent such errors and mistakes, which eventually will help to stay in the limits of the allocated budget and limiting cost overrun in the project.

As for the contractor, the classification and technical capabilities of the contractor should not affect the cost and quality of the project since the contractor signs a contract which details the prices of each project activity and the codes and specifications that should be taken into consideration to perform project activities within the required quality. However, if the contractor is technically unqualified and financially struggling, this may cause delay in the project timeline and may cause less adherence to the code and specifications, which will result in disputes between the owner and supervision team with the contractor, and might result in fines on the contractor.

According to the opinions of most of the interviewees, the method of selecting the contractor that depends on the lowest price is a common factor for increasing the costs, and that the contractor must be chosen on the basis of technical qualification also, not only bidding price.

Finally, having honest, professional communication and transparent relationship between all parties will help to successfully implement the project with better quality and lower cost.

4.2.4 Theme 4: Economic, social, and environmental factors

Given the importance of the environmental, economical, and social factors on the cost overrun in road projects, the opinions of the interviewees were taken on the impact level of these three factors. One main example given was pollution resulting from road works. In order to keep the environment healthy and safe, the pollution resulting from project activities must be controlled. However, in many cases contractors fail to estimate the costs of this process, adding to this in some cases the timeline of the project is extended which means additional costs in the process of maintaining a healthy and safe environment.

As for the social factor on increasing the costs, for example, complaints from the citizens because of the pollution, as well as the demand to prepare alternative access for the impacted citizens, and disrupting the movement of people in the region, might lead to cost overrun.

Failure to satisfy the environmental factor or social demands will lead to the dissatisfaction of the citizens, and consequently the contractor can be fined.

As for the economic situation, it has the greatest impact among the three factors, since the financial challenges that might face the government and some municipalities could lead to delays in payments given to the contractor, and eventually leading to the failure to finance the project activities by the contractor, which will result in cost overrun and delay in the timeline of the project.

4.2.5 Theme 5: Work methodology

According to the opinions of all interviewees, the reason for the success of any project is due to a clear and professional methodology for the project from its planning phase to the completion. This methodology includes the following:

- Successful plans that takes into account all requirements for the nature of the project.

- Conducting sufficient soil investigation tests such as in-situ moisture content, specific gravity of soil, particle size distribution, compaction test, and California Bearing Ratio (CBR) test.

- Preparing professional and fully detailed design plans to prevent any misunderstanding and disputes about project plans between the owner/supervision team and the contractor.

- Preparing clear and comprehensive tender terms for all work activities including accurate values for the quantity and price of each project activity.

- Auditing the tendering process (financial and technical evaluation of the contractors applying for the project) by a transparent and qualified engineer.

- Monitoring work activities by an experienced and appropriately qualified supervision team.

- Implementing the project through a technically and financially qualified contractor.

4.3 Descriptive analysis

Descriptive analysis was conducted to understand the road project work environment and the degree of cost overrun in road projects in municipalities. The majority of projects conducted by municipalities suffer from cost overrun; approximately 50% of the projects.

Table 4.3 shows the total number of road projects for each municipalities, that were implemented during the years (2016-2018), as well as the number and percentage of projects that had experimented cost overrun for each municipalities.

Table 4.3: Municipal road projects and share of projects with cost overrun

No.	Name of municipal	Total number of road projects	Number of road projects with cost overrun	Percentage of road projects with cost overrun (%)
Jenin Governorate				
1	Qabatiya	3	2	66.67
2	Az Zababida	1	1	100
Tubas Governorate				
3	Tubas	6	4	66.67
4	Tammun	4	1	25
5	Aqqaba	2	1	50
Tulkarm Governorate				
6	Anabta	3	3	100
7	Zeita	4	1	25
Nablus Governorate				
8	Nablus	6	3	50
9	Beit Furik	4	3	75
10	Huwwara	5	4	80
Qalqiliya Governorate				
11	Qalqiliya	6	3	50
12	Azzun	2	1	50
Salfit Governorate				
13	Salfit	6	3	50
14	Biddya	3	1	33.33
Ramallah and Al Bireh Governorate				
15	Ramallah	5	4	80
16	Beirzeit	7	4	57.14
17	Al Mazra’a ash sharqiya	3	2	66.67
Jericho Governorate				
18	Jericho	6	2	33.33
19	An Nuwei'ma and 'Ein ad Duyuk al Fauqa	3	2	66.67
Jerusalem Governorate				
20	Al Eizariya	2	1	50
Bethlehem Governorate				
21	Bethlehem	3	3	100
22	Beit Jala	3	2	66.67
23	Battir	2	1	50
Hebron Governorate				
24	Hebron	24	2	8.33
25	Yatta	4	4	100
26	Al Karmil	6	5	83.33
Total number of projects		**123**	**63**	**51.22**

4.3.1 Analysis of survey response

The number of the collected sample projects questionnaires was 63 for those projects with cost overrun, of which 47 were valid, after assessing the completeness of the answers.

4.4 Projects characteristics

Through the questionnaire, the researcher observed certain characteristics of road projects that included four items as shown in Table 4.4, which contain the frequency and percentage for each variable listed according to the survey categories.

Table 4.4: Results of analyzing qualitative project characteristics

Variable	Options	Frequency	Percentage %
Municipality Area	North region of the West Bank	24	51.1
	Central region of the West Bank	14	29.8
	South region of the West Bank	9	19.1
Project completion date	2016	11	23.4
	2017	18	38.3
	2018	18	38.3
Project financing	Self-funded	14	29.8
	Governmental	29	61.7
	External	4	8.5
Municipality Classification	A	18	38.3
	B	14	29.8
	C	15	31.9
Contractor classification	First class	25	53.2
	Second class	21	44.7
	Third class	1	2.1

Table 4.5 shows that the mean of project cost in the sample is 1,118,959 ILS, while the maximum project cost in this sample is 18,480,000 ILS, while the minimum project cost is 78,000 ILS. Also that the mean of project size in the sample, measured by road length, is 1,463 meter. The maximum project size in this sample is 4,500 meters, while the minimum

project size is 300 meters. However, the mean of cost overrun percentage in the sample is 26.9%, while the maximum cost overrun percentage in this sample is 139%, and the minimum cost overrun percentage is 1%. The mean of time overrun percentage is 87.8%.

Table 4.5: Results of analyzing quantitative project characteristics

Variable	Mean	Std. Deviation	Minimum	Maximum
Project cost (₪)	1,118,959	2670174	78,000	18,480,000
Project size (m)	1,463	1,051	300	4,500
The percentage of cost overruns (%)	26.90	27.4	1	139
The percentage of time overruns (%)	87.76	52.5	17	185

4.5 Result of research questions

In this section, the researcher displays the result of research questions.

4.5.1 What is the impact level of the factors that are related to the actions and decisions made in the different phases of the project life cycle on the cost overrun of municipal road projects?

To answer this question, the researcher calculates the means and standard deviations values for the study sample responses to understand the impact level of factors related to the actions and decisions made in the different phases of the project life cycle that have caused cost overrun in municipal road projects. The results are shown in Table 4.6.

Table 4.6: Mean and standard deviation values of the occurrence of the factors in life cycle phases for road projects in municipalities

Rank	Factors	Mean	Std. deviation
1	Planning and design phase	1.88	0.58
2	Implementation phase	1.76	0.49
3	Tendering phase	1.69	0.51
Project life cycle		1.77	0.47

The result from Table 4.6 shows that means and standard deviations values of the sample responses of the impact level of factors related to the actions and decisions made in the different phases of the project life cycle that have caused of the cost overrun in municipal road projects is 1.77 and 0.47 respectively, which indicate a moderate impact level of the factors that are related to the actions and decisions made in the different phases of the project life cycle on the cost overrun. Table 4.6 illustrates that the impact level of factors that are related to the planning and design phase has the largest impact level of on cost overrun, followed by the implementation phase and the tendering phase, respectively. The following discusses the main factors that have caused the cost overrun as a result of the actions and decisions made in each phase of the life cycle of municipal road projects.

4.5.1.1 Planning and design phase

To determine the main factors that have caused the cost overrun in the planning and design phase of municipal road projects, Table 4.7 illustrates the calculated mean and standard deviation for each item used to evaluate the attitudes of respondents towards factors that have caused the cost overrun in the planning and design phase. The results show that the impact

level of the factors related to the planning and design phase of their projects caused a moderate impact level on cost overruns with a mean of 1.88.

Table 4.7: Mean and standard deviation values for the study sample responses towards factors related to the planning and design phase

Rank	Item No.	Item	Mean	Std. dev	Effect Level
1	10	The project is located within rough terrain area with high slopes	2.00	0.692	Moderate
2	1	Preparation of design drawings and tender documents was not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project	1.96	0.806	Moderate
3	8	Inaccurate cost forecasting	1.96	0.721	Moderate
4	6	Insufficient soil tests when conducting soil investigations for the design phase	1.91	0.747	Moderate
5	3	The degree of complexity of the project	1.91	0.747	Moderate
6	9	Modifying the original project design after the contractors submitted their financial statements	1.89	0.814	Moderate
7	7	Mistakes in project design	1.85	0.780	Moderate
8	4	The project detailed design drawings were not adequately prepared	1.81	0.798	Moderate
9	5	Use of aerial photos instead of surveying plans prepared by a professional surveying office for preparing design drawings	1.77	0.813	Moderate
10	2	The design engineer was unqualified	1.74	0.820	Moderate
All items			1.88	0.58	Moderate

Table 4.7 illustrates that all the factors have a moderate impact level. The factor “The project is located within rough terrain area with high slopes” has the highest mean value of 2.00. Then the factor “Preparation of design drawings and tender documents was not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project” and “Inaccurate cost forecasts” has a moderate impact level with a mean value of 1.96. However, the factor

“The design engineer was unqualified” have got the lowest mean value of 1.74. Followed by the factor “Use of aerial photos instead of site plans prepared by a professional surveying office for preparing design drawings” which got 1.77.

4.5.1.2 Tendering phase

To determine the main factors that have caused the cost overrun in the tendering phase of municipal road projects, Table 4.8 illustrates the calculated mean and standard deviation for each item used to evaluate opinions of respondents towards factors that have caused cost overrun in the tendering phase. The results show that the impact level of the factors related to the tendering phase of their projects caused a moderate impact level of the cost overrun with mean of 1.69.

Table 4.8: Mean and standard deviation values for the study sample responses towards factors related to tendering phase

Rank	Item No.	Item	Mean	Std. deviation	Effect Level
1	11	No consideration for the timing of tender release and the starting of the project, especially at the start of the winter season	2.02	0.675	Moderate
2	1	Awarding the project to the bidder with the lowest price	2.00	0.780	Moderate
3	2	Unreasonable project time frame	1.85	0.751	Moderate
4	8	Neglecting the technical evaluation of contractors during selection phase	1.77	0.729	Moderate
5	10	Assigned project timeframe by donor is insufficient	1.72	0.615	Moderate
6	6	The contract terms are vague and it was not explained sufficiently	1.60	0.681	Low
7	4	Client delayed in awarding notice to proceed	1.60	0.712	Low

8	7	Conflict in the contract documents	1.55	0.746	Low
9	5	Scope of work unclear	1.55	0.686	Low
10	3	Delay in project commencement by the client	1.51	0.655	Low
11	9	The contractor was not classified by the National Contractors Classification Committee	1.40	0.648	Low
All items			1.69	0.51	Moderate

Table 4.8 illustrates that "No consideration for the timing of tender release and the starting of the project, especially at the start of the winter season" has the highest mean value of 2.02 with a moderate impact level. Next comes the factor "Awarding the project to the bidder with the lowest price", which has a moderate impact level with mean value of 2.00. However, "The contractor was not classified by the National Contractors Classification Committee" has got the lowest mean value of 1.40 with a low impact level, then comes the reason "Delay in project commencement by the client" has a low impact level with mean value of 1.51.

4.5.1.3 Implementation phase

To determine the main factors that have caused the cost overrun in the implementation phase of municipal road projects, Table 4.9 illustrates the calculated mean and standard deviation for each item used to evaluate the attitudes of respondents towards the reasons that have caused the cost overrun in the implementation phase. The results showed that the impact level of the factors related to the implementation phase of their projects caused a moderate impact level in cost overrun with mean of 1.76.

Table 4.9: Mean and standard deviation values for the study sample responses towards factors related to implementation phase

Rank	Item No.	Item	Mean	Std. deviation	Effect Level
1	10	Changes in project activities during implementation	2.23	0.666	Moderate
2	6	Municipality construction and infrastructure works in conjunction with project activities	2.21	0.657	Moderate
3	7	Contract inclusivity of infrastructure activities such as sewer network and water network	2.00	0.752	Moderate
4	13	Poor qualification of the contractors' technical staff and workers	1.87	0.741	Moderate
5	4	The estimated quantities in BOQ were incoherent with design and tender documents	1.85	0.834	Moderate
6	18	Lack of compliance with shop-drawings and plans by contractor	1.85	0.751	Moderate
7	15	Ineffective human resources management by the contractor	1.83	0.702	Moderate
8	8	Delay in contractor payments due to lack of owners resources	1.79	0.832	Moderate
9	12	The contractor not assigning an engineer with the required years of experience passed on the tender documents	1.79	0.778	Moderate
10	3	Contractor not preparing shop-drawings	1.77	0.813	Moderate
11	2	Lack of initial survey plan for the current status	1.72	0.772	Moderate
12	16	Bad coordination and communication on site between the contractor, supervision, and owner	1.70	0.689	Moderate
13	19	Borders closure and shortage of materials in local markets	1.62	0.768	Low
14	11	Change in material types during implementation	1.62	0.644	Low
15	14	Weak experience of supervision and follow-up work	1.57	0.773	Low
16	5	Delay in response to contractor correspondences by client	1.55	0.619	Low
17	17	Approach to work delivery and procurement system	1.55	0.619	Low
18	9	Delay in responding to test reports and sample materials submitted by the contractor	1.49	0.655	Low
19	1	Late site hand-over by the client	1.43	0.617	Low
All items			1.76	0.49	Moderate

Table 4.9 illustrates that twelve factors have moderate impact on the caused the cost overrun, and seven factors have low impact. The factor “Changes in project activities during implementation” have the highest mean value of 2.23 with a moderate impact level. Then the factors “Municipality construction and infrastructure work in conjunction with project activities”, and “Contract inclusivity of infrastructure activities such as sewer network and water network” have a moderate impact level with the mean value of 2.21 and 2.00, respectively. However, “Late site hand-over by the client” has got the lowest mean value of 1.43, and “Sample materials submitted by the contractor” which got 1.49 with a low impact level.

4.5.2 What is the impact level of external factors that have caused cost overrun in municipal road projects?

To answer this question, the researcher calculated the means and standard deviation values for the study sample responses on the understanding the impact level of external factors that have caused of the cost overrun of municipal road projects, as showed in Table 4.10, the impact level of external factors that have caused of the cost overrun of municipal road projects is moderate with the mean of 1.77.

Table 4.10: Mean and standard deviation values for the study sample responses towards external factors

Rank	Item No.	Item	Mean	Std. deviation	Effect Level
1	2	Financial issues facing project client/government	1.87	0.824	Moderate
2	6	Unforeseen events and conditions	1.85	0.780	Moderate
3	1	Unstable political and economic conditions	1.77	0.729	Moderate
4	3	The constraints on the movement between different areas in the West Bank on equipment and material transportation	1.72	0.800	Moderate
5	4	Continuous increase in material and fuel prices	1.72	0.826	Moderate
6	5	Effects of inflation	1.66	0.760	Low
All items			1.77	0.69	Moderate

Table 4.10 illustrates all factors have a moderate impact level, except one which has a low impact level. “Financial issues facing project client/government” has the highest mean value of 1.87 with moderate impact level. Then the factor “Unforeseen events and conditions” has a moderate impact level of effect with the mean value of 1.85. However, the factor “Effects of inflation" has got the lowest mean value of 1.66 with a low impact level, followed by the factor “Continuous increase in material and fuel prices” which got 1.72 with a moderate impact level.

4.5.3 What is the impact level of economic, environmental and social factors that have caused of the cost overrun in municipal road projects?

To answer this question, the researcher calculated the means and standard deviation values for the study sample responses on the understanding the impact level of economic, environmental and social factors that have caused of the cost overrun of municipal road projects, as shown in Table 4.11. The impact level of economic, environmental and social factors that have caused of the cost overrun of municipal road projects is moderate with a mean of 1.81.

Table 4.11 illustrates all factors have a moderate impact level, except the factor “Restriction of the local students movement in the project location” which has the lowest mean value of 1.66 with low impact level. The factors “Restricting the movement of people in the work areas”, and “Interrupting local citizen movement due to excavation and rerouting” have a moderate impact level with the highest mean value of 1.94. Then the factor “Financial claims due to private and public damages caused by project activities during project execution” has a mean value of 1.87, followed by factor “The demolition and relocation of walls that are in the area of the project” which got 1.85 with a moderate impact level.

Table 4.11: Mean and standard deviation values for the study sample responses towards economic, environmental and social factors

Rank	Item No.	Item	Mean	Std. deviation	Level
1	9	Restricting the movement of people in the work areas	1.94	0.567	Moderate
2	8	Interrupting local citizen movement due to excavation and rerouting	1.94	0.639	Moderate
3	2	Financial claims due to private and public damages caused by project activities during project execution	1.87	0.769	Moderate
4	10	The demolition and relocation of walls that are in the area of the project	1.85	0.751	Moderate
5	7	Environmental impacts, such as dust, noise and waste resulted from project activities	1.81	0.576	Moderate
6	4	Interrupting the commercial activities located within the project routing	1.81	0.798	Moderate
7	3	Damages to the natural environment such as trees and plants in the areas aligning the project location	1.79	0.750	Moderate
8	1	The suspension of some project due to the stopping of government funding	1.79	0.858	Moderate
9	5	Investing more into precautionary measures around project sites for the safety of residents' lives from surrounding excavations	1.70	0.689	Moderate
10	6	Rescheduling school related events and activities around workplaces	1.66	0.600	Low
All items			1.81	0.50	Moderate

4.6 Results related to the testing hypotheses

In this section the researcher presents the results of testing the main two hypotheses of this research which are:

1- HP1: There is no significant difference in the cost overrun percentage due to project characteristics (municipality area, project financing, municipality classification, and contractor classification).

2- HP2: There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the project characteristics (municipality area, project financing, municipality classification, and Contractor classification).

4.6.1 Cost overrun

The first main hypothesis (HP1) is tested through testing of sub-hypotheses as presented in the following sub section:

4.6.1.1 Municipality area

In this section, the researcher tests the hypothesis HP1-1 that states, "There is no significant difference of the project cost overrun percentage due to the municipality area". One Way Analysis of Variance (ANOVA) Test was conducted to check the differences of the project cost overrun percentage according to the municipality area (north region of the West Bank, central region of the West Bank, south region of the West Bank). The results show that there is no significant differences of the project cost overrun percentage according to the municipality area, with P-values 0.532, which is more than the significance level (α=0.05). This is presented in Table 4.12, and therefore the hypothesis HP1-1 is accepted.

Table 4.12: Results of ANOVA of the percentage of project cost overrun according to the municipality area

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	977.285	2	488.643	0.641	0.532
Within Groups	33539.296	44	762.257		
Total	34516.582	46			

According to the result of Table 4.12, Table 4.13 illustrates the mean value of the project cost overrun percentage according to municipality area, the municipality of the north region of the West Bank has the largest mean of the project cost overrun percentage, while the lowest mean value of the project cost overrun percentage for the municipality of the south region of the West Bank.

Table 4.13: Mean and standard deviation value of the project cost overrun percentage according to the municipality area

Municipality area	N	Mean	Std. Deviation
North region of the West Bank	24	30.93	32.65
Central region West Bank	14	24.94	23.68
South region of the West Bank	9	19.19	14.73
Total	47	26.90	27.39

4.6.1.2 Project Financing

In this section, the researcher tested the sub-hypothesis HP1-2 that states, “There is no significant difference of the project cost overrun percentage due to the project financing”. One Way ANOVA Test was conducted to check the differences of the project cost overrun percentage according to some of financing (self-funded, Governmental, external). The results showed that there is a significant differences of the cost overrun percentage

according to the project financing, with P-values (0.000), which is less than the significance level (α=0.05). This is presented in the Table 4.14, and therefore the hypothesis HP1-2 is rejected.

Table 4.14: Results of ANOVA Test of the project cost overrun percentage according to the financing

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	10862.363	2	5431.181	10.103	0.000
Within Groups	23654.219	44	537.596		
Total	34516.582	46			

According to the result of Table 4.14, Table 4.15 illustrates the mean value of the project cost overrun percentage according to the financing, the self-financing projects have the largest mean of the project cost overrun percentage, while the lowest mean value of the project cost overrun percentage for the governmental financing.

Table 4.15: Mean and standard deviation value for the project cost overrun percentage according to financing

Project Financing	N	Mean	Std. Deviation
Self-funded	14	50.23	38.45
Governmental	29	16.87	12.52
External	4	17.93	3.94
Total	47	26.90	27.39

The Scheffe Test was used to check the source of significant differences in the cost overrun percentage according to the project financing.

The two-dimensional comparisons show that there are differences of the cost overrun percentage according to the project financing between the self-funded projects and governmental funded projects in favor of self-

funded projects, with P-values (0.000); which is less than the significance level (α=0.05), as presented in Table 4.16, while there is a significant difference of the project cost overrun percentage between the self-funded projects and external funded projects in favor of self-funded projects at significant level (α=0.10), and therefore the hypothesis HP1-2 is rejected.

Table 4.16: Results of Scheffe Test of significant source of differences of the cost overrun percentage according to the project financing

Project Financing (I)	Project Financing (J)	Mean Difference (I-J)	Sig.
Self-funded	Governmental	33.365	0.000
Self-funded	External	32.305	0.059

4.6.1.3 Municipality classification

In this section, the researcher tested the sub-hypothesis HP1-3 that states, "There is no significant difference of the project cost overrun percentage due to the municipality classification". One Way ANOVA Test was conducted to check the differences of the project cost overrun percentage according to the municipality classification (A, B, C).

The results showed that there are no significant differences of the cost overrun percentage according to the municipality classification, with P-values 0.783, which is more than the significance level (α=0.05). This is presented in Table 4.17, and therefore the hypothesis HP1-3 is accepted.

Table 4.17: Results of ANOVA of the project cost overrun percentage according to the municipality classification

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	382.312	2	191.156	0.246	0.783
Within Groups	34134.270	44	775.779		
Total	34516.582	46			

From Table 4.18, shows that the project cost overrun percentage in the project related to C municipalities have a largest mean value of the project cost overrun percentage, while the lowest mean value of the project cost overrun percentage for the municipality in A area.

Table 4.18: Mean and standard deviation value for the project cost overrun percentage according to municipality classification

Municipality classification	N	Mean	Std. Deviation
A	18	23.36	30.161
B	14	28.30	23.293
C	15	29.84	28.805
Total	47	26.90	27.393

4.6.1.4 Contractor classification

In this section, the researcher tested the sub-hypothesis HP1-4 that states, “There is no significant difference of the project cost overrun percentage due the contractor classification”. One Way ANOVA Test was conducted to check the differences of the project cost overrun percentage according to the contractor classification (first class, second class, third class).

The results showed that there are no significant differences of the project cost overrun percentage according to the contractor classification, with P-

values 0.742, which is more than the significance level (α=0.05). This is presented in Table 4.19, and therefore the hypothesis HP1-4 is accepted.

Table 4.19: Results of ANOVA of the project cost overrun percentage according to the contractor classification

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	464.159	2	232.080	0.300	0.742
Within Groups	34052.422	44	773.919		
Total	34516.582	46			

From Table 4.20, the cost overrun percentage in the project that contractor in the second class have a largest mean value of project cost overrun percentage, while the lowest mean value of the project cost overrun percentage for the project which contractor in the third class.

Table 4.20: Mean and standard deviation value for the project cost overrun percentage according to contractor classification

Contractor classification	N	Mean	Std. Deviation
First class	25	26.49	30.536
Second class	21	28.36	24.160
Third class	1	6.52	.
Total	47	26.90	27.393

4.6.2 Cost overrun due to the factors that are related to the actions and decisions made in the different phases of project life cycle

The second-main hypotheses HP2 which states: “There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the project characteristics (municipality area, project financing, municipality classification, and Contractor classification)”. In order to test

this main hypothesis, the researcher tested the sub-hypotheses as presented to the following sub-section.

4.6.2.1 Municipality area

In this section, the researcher tested the sub-hypothesis HP2-1 that states, “There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the municipality area”. One Way ANOVA Test was conducted to check the relationship of the impact level of factors related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the municipality area (north region of the West Bank, central region of the West Bank, south region of the West Bank).

The results show that there is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase and implementation phase) that cause cost overrun according to the municipality area, as presented in Table 4.21. The table also displays the impact level of factors related to the actions and decisions made during the different project life cycle phases that have caused the cost overrun of the municipal road projects according to the municipality area, and therefore the hypothesis HP2-1 is accepted.

Table 4.21: Results of ANOVA Test of the impact level of factors related to the actions and decisions made during the different project life cycle phases

Phase		Sum of Squares	Df	Mean Square	F	Sig.
Planning and design phase	Between Groups	0.490	2	0.245	0.715	0.495
	Within Groups	15.082	44	0.343		
	Total	15.573	46			
Tendering phase	Between Groups	0.863	2	0.431	1.677	0.199
	Within Groups	11.315	44	0.257		
	Total	12.178	46			
Implementation phase	Between Groups	1.240	2	0.620	2.831	0.070
	Within Groups	9.640	44	0.219		
	Total	10.880	46			
Project life cycle	Between Groups	0.835	2	0.418	1.940	0.156
	Within Groups	9.471	44	0.215		
	Total	10.307	46			

Table 4.22 display the mean value of impact level of factors related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the municipality area.

Table 4.22: Mean and standard deviation value of the impact level of factors related to the actions and decisions made during the different phases

Phases	Municipality area	N	Mean	Std. Deviation
Planning and design phase	North region of the West Bank	24	1.80	0.60
	Central region West Bank	14	1.89	0.56
	South region of the West Bank	9	2.08	0.59
	Total	47	1.88	0.58
Tendering phase	North region of the West Bank	24	1.69	0.53
	Central region West Bank	14	1.53	0.53
	South region of the West Bank	9	1.93	0.40
	Total	47	1.69	0.51
Implementation phase	North region of the West Bank	24	1.67	0.52
	Central region West Bank	14	1.70	0.44
	South region of the West Bank	9	2.09	0.33
	Total	47	1.76	0.49
Project life cycle	North region of the West Bank	24	1.71	0.51
	Central region West Bank	14	1.70	0.46
	South region of the West Bank	9	2.04	0.30
	Total	47	1.77	0.47

4.6.2.2 Project Financing

In this section, the researcher tested the sub-hypothesis HP2-2 that states, "There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the Project Financing". One Way ANOVA Test was conducted to check the relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the project financing (Self-funded, Governmental, External).

The results show that there is a significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase) that cause cost overrun according to the project financing. This is presented in Table 4.23, and therefore the hypothesis HP2-2 is rejected.

Table 4.23: Results of ANOVA Test of the impact level of factors related to the actions and decisions made during the different project phases according to project financing

Phase		Sum of Squares	Df	Mean Square	F	Sig.
Planning and design phase	Between Groups	1.943	2	0.972	3.137	0.053
	Within Groups	13.629	44	0.310		
	Total	15.573	46			
Tendering phase	Between Groups	1.419	2	0.709	2.901	0.066
	Within Groups	10.759	44	0.245		
	Total	12.178	46			
Implementation phase	Between Groups	1.334	2	0.667	3.074	0.056
	Within Groups	9.546	44	0.217		
	Total	10.880	46			
Project life cycle	Between Groups	1.426	2	0.713	3.532	0.038
	Within Groups	8.881	44	0.202		
	Total	10.307	46			

Table 4.24 display the mean value of impact level of factors that are related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the project financing.

Table 4.24: Mean and standard deviation value of the impact level of factors related to the actions and decisions made during the different project phases according to project financing

Phases	Project Financing	N	Mean	Std. Deviation
Planning and design phase	Self-funded	14	2.14	0.54
	Governmental	29	1.72	0.53
	External	4	2.13	0.80
	Total	47	1.88	0.58
Tendering phase	Self-funded	14	1.79	0.63
	Governmental	29	1.57	0.44
	External	4	2.16	0.32
	Total	47	1.69	0.51
Implementation phase	Self-funded	14	1.91	0.52
	Governmental	29	1.64	0.43
	External	4	2.13	0.49
	Total	47	1.76	0.49
Project life cycle	Self-funded	14	1.94	0.50
	Governmental	29	1.64	0.43
	External	4	2.14	0.41
	Total	47	1.77	0.47

4.6.2.3 Municipality Classification

In this section, the researcher testing the sub-hypothesis HP2-3 that states, "There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the municipality classification". One Way ANOVA Test was conducted to check the relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the municipality classification (A, B, C).

The results show that there is a significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase) that cause cost overrun according to the municipality classification at the significance level (α=0.05). This is presented in Table 4.25, and therefore the hypothesis HP2-3 is rejected.

Table 4.25: Results of ANOVA Test of the impact level of factors related to the actions and decisions made during the different phases according to municipality classification

Phase		Sum of Squares	Df	Mean Square	F	Sig.
Planning and design phase	Between Groups	3.103	2	1.552	5.475	0.008
	Within Groups	12.470	44	0.283		
	Total	15.573	46			
Tendering phase	Between Groups	4.058	2	2.029	10.996	0.000
	Within Groups	8.119	44	0.185		
	Total	12.178	46			
Implementation phase	Between Groups	2.339	2	1.170	6.025	0.005
	Within Groups	8.541	44	0.194		
	Total	10.880	46			
Project life cycle	Between Groups	2.828	2	1.414	8.317	0.001
	Within Groups	7.479	44	0.170		
	Total	10.307	46			

Table 4.26 display the mean value of the impact level of factors related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the municipality classification.

Table 4.26: Mean and standard deviation value of the impact level of factors related to the actions and decisions made during the different phases according to municipality classification

Phases	municipality classification	N	Mean	Std. Deviation
Planning and design phase	A	18	1.56	0.35
	B	14	2.11	0.58
	C	15	2.06	0.66
	Total	47	1.88	0.58
Tendering phase	A	18	1.34	0.26
	B	14	1.77	0.44
	C	15	2.03	0.56
	Total	47	1.69	0.51
Implementation phase	A	18	1.51	0.31
	B	14	1.79	0.47
	C	15	2.04	0.53
	Total	47	1.76	0.49
Project life cycle	A	18	1.47	0.24
	B	14	1.86	0.44
	C	15	2.04	0.54
	Total	47	1.77	0.47

The Scheffe Test was used to check the differences source of the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, implementation phase) that cause cost overrun according to the municipality class.

The two-dimensional comparisons show that there is a difference between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases in the municipality class A and municipality class B in favor of B municipality class. Table 4.27 shows that there is a difference between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases in the municipality class A and municipality class C in favor of municipality class C, respectively in planning and design phase, tendering phase and project life cycle, at significance level (α=0.05). Table 4.27 shows also that there is a difference between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases in the municipality class A and municipality class C in fever of municipality class C in implementation phase at significant level (α=0.05).

Table 4.27: Results of Scheffe Test of significant differences sources of the impact level of factors that are related to the actions and decisions made during the different phases due to municipality classification

Phase	municipality classification (I)	municipality classification (J)	Mean Difference (I-J)	Sig
Planning and design phase	A	B	-.55159	0.021
	A	C	-.50444	0.033
Tendering phase	A	B	-.43434	0.025
	A	C	-.69192	0.000
Implementation phase	A	C	-.53275	0.005
Project life cycle	A	B	-.39206	0.037
	A	C	-.56944	0.001

4.6.2.4 Contractor classification

In this section, the researcher tested the sub-hypothesis HP2-4 that states, "There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the Contractor classification". One Way ANOVA Test was conducted to check the relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the contractor classification (first degree, second degree, third degree).

The results show that there is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, implementation phase, and tendering phase) that cause cost overrun according to the contractor classification at significance level (α=0.05).

This is presented in Table 4.28, and therefore the hypothesis HP2-4 is accepted.

Table 4.28: Results of ANOVA Test of the impact level of factors related to the actions and decisions made during the different phases according to contractor classification

Phase		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Planning and design phase	Between Groups	0.287	2	0.143	0.149	0.862
	Within Groups	42.223	44	0.960		
	Total	42.509	46			
Tendering phase	Between Groups	0.721	2	0.361	0.504	0.608
	Within Groups	31.501	44	0.716		
	Total	32.222	46			
Implementation phase	Between Groups	0.573	2	0.286	1.222	0.304
	Within Groups	10.307	44	0.234		
	Total	10.880	46			
Project life cycle	Between Groups	0.320	2	0.160	0.705	0.499
	Within Groups	9.986	44	0.227		
	Total	10.307	46			

Table 4.29 display the mean value of the impact level of factors related to the actions and decisions made during the different project life cycle phases that cause cost overrun according to the contractor classification.

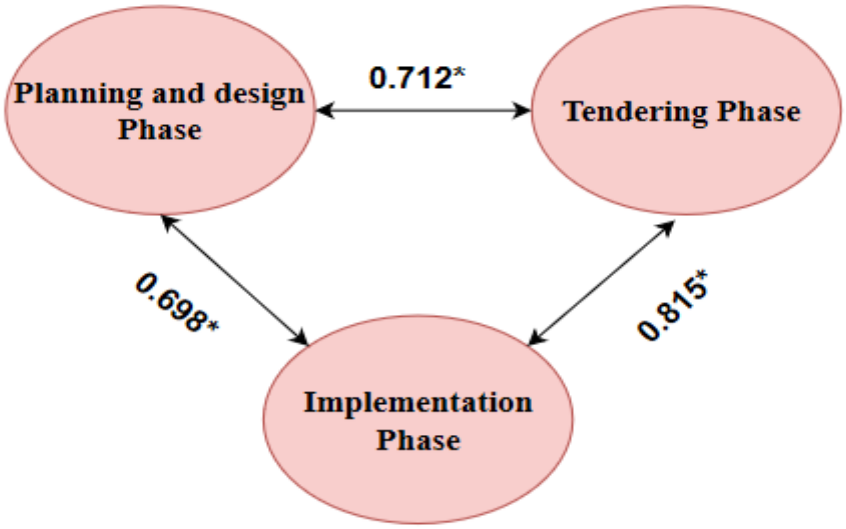
Table 4.29: Mean and standard deviation of the impact level of factors related to the actions and decisions made during the different phases according to contractor classification

Phases	municipality classification	N	Mean	Std. Deviation
Planning and design phase	First degree	25	1.8680	0.58
	Second degree	21	1.88	0.61
	Third degree	1	2.20	
	Total	47	1.88	0.58
Tendering phase	First degree	25	1.61	0.53
	Second degree	21	1.77	0.50
	Third degree	1	2.00	
	Total	47	1.69	0.51
Implementation phase	First degree	25	1.66	0.45
	Second degree	21	1.88	0.52
	Third degree	1	1.89	
	Total	47	1.76	0.49
Project life cycle	First degree	25	1.70	0.47
	Second degree	21	1.85	0.48
	Third degree	1	2.00	
	Total	47	1.77	0.47

4.7 Factors that affect the project life cycle

In this section, the researcher investigates the relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase). As shown in Figure 4.1, the highest relation between impact level of factors that have caused cost overrun related to the tendering phase and the implementation phase with correlation coefficient 0.815 at significant level (α=0.05), followed by the relation between impact level of factors that have caused of the cost overrun that are related to the planning and design phase and the tendering phase, and then relation between impact level of factors that have caused

of the cost overrun that are related to the planning and design phase and the implementation phase.



* Relation is significant at the level (0.05).

Figure 4.1: Relations between phases of life cycle

Table 4.30, illustrates the result of third hypothesis (HP3) that states, "There is no significant relationship between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and project size, the percentage of time overrun, external factors, as well as economic, environmental, and social factors".

- HP3-1: There is no significant relation between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and project size, therefore the hypothesis HP3-1 is accepted.

- HP3-2: There is no significant relation between the impact level of factors that are related to the actions and decisions made during the different project life cycle phases and the time overrun percentage, therefore the hypothesis HP3-2 is accepted.

- HP3-3: There is a significant relation between the impact level of external factors that cause cost overrun and the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase) that cause cost overrun, therefore the hypothesis HP3-3 is rejected, where the highest relation was between the impact level of external factors and the impact level of factors related to the tendering phase.

- HP3-4: There is a significant relation between the impact level of economic, environmental and social factors that cause cost overrun and the impact level of factors that are related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase) that cause cost overrun, therefore the hypothesis HP3-4 is rejected, where the highest relation is the relation between the impact level of economic, environmental and social factors and the impact level of factors related to the tendering phase.

Table 4.30: Matrix relations between phases and project size, time overrun, external factors, and economic, environmental and social factor

Phase	Project size	Time overrun percentage	External factors	Economic, environmental and social factors
Planning and design phase	0.281	0.100	0.387*	0.594*
Tendering phase	-0.087	0.112	0.757*	0.691*
Implementation phase	-0.026	0.180	0.575*	0.647*
Project life cycle	0.048	0.152	0.626*	0.704*

* Significant relation at 0.05

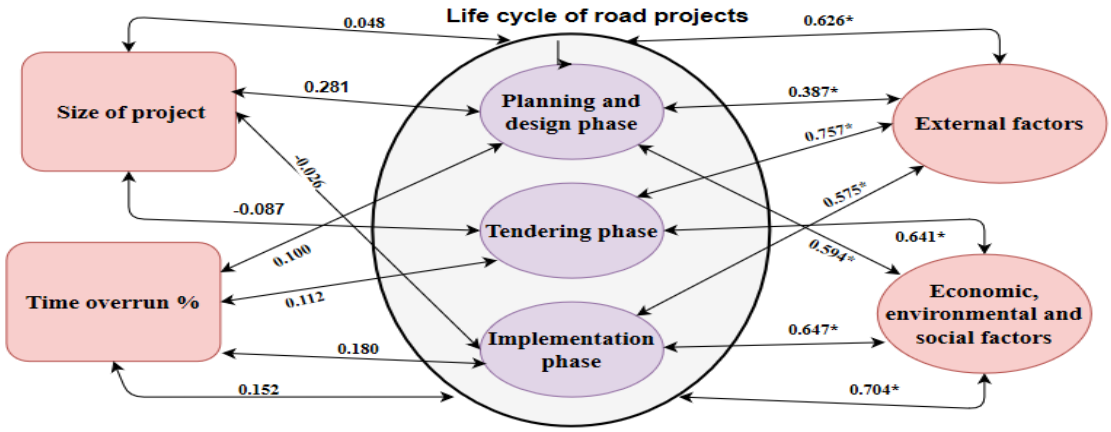


Figure 4.2: Relation between the life cycle of road projects and external factors, economic, environmental, and social factor, project size and time overrun.

4.8 Factors that affect the cost overrun percentage

In this section, the research studies the result of fourth hypothesis (HP4) that states, "There is no significant relationship between the cost overrun percentage and project life cycle, project size, the time overrun percentage,

external factors, as well as economic, environmental, and social factors". Figure 4.2 illustrate the correlation between the cost overrun percentage and independent variables. Figure 4.3 illustrate:

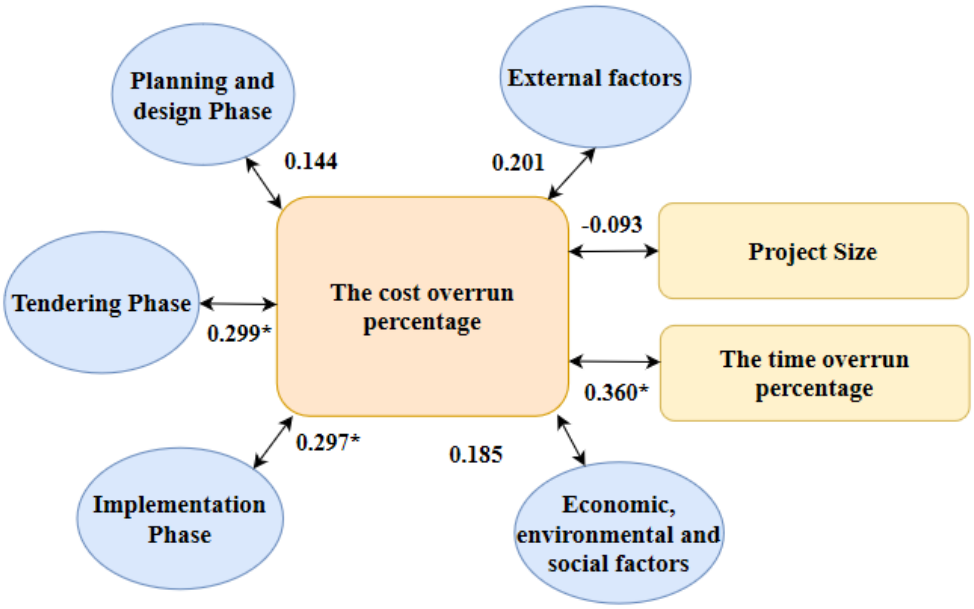
- HP4-1: There is a significant relation between the cost overrun percentage and the time overrun percentage, therefore the hypothesis HP 4-1 is rejected.

- HP4-2: There is a significant relation between the cost overrun percentage and the impact level of factors related to the implementation phase that have caused of the cost overrun at significant level (α=0.05), therefore the hypothesis HP4-2 is rejected.

- HP4-3: There is a significant relation between the cost overrun percentage and the impact level of factors related to the tendering phase that have caused of the cost overrun at significant level (α=0.05), therefore the hypothesis HP4-3 is rejected.

- HP4-4: There is no significant relation between the cost overrun percentage and the impact level of factors related to the planning and design phase that have caused of the cost overrun at significant level (α=0.05), therefore the hypothesis HP4-4 is accepted.

- HP4-5: There is no significant relation between the cost overrun percentage and the impact level of economic, environmental and social factors that cause cost overrun at significant level (α=0.05), therefore the hypothesis HP4-5 is accepted.



* Correlation is significant at the (0.05) level

Figure 4.3: Correlation between the cost overrun percentage and other independent variables

- HP4-6: There is no significant relation between the cost overrun percentage and the impact level of external factors that cause cost overrun at significant level (α=0.05), therefore the hypothesis HP4-6 is accepted.

- HP4-7: There is no significant relation between the cost overrun percentage and project size at significant level (α=0.05), therefore the hypothesis HP4-7 is accepted.

4.9 Discussion

The purpose of this study is to understand and analyze the factors that cause cost overrun in municipal road projects in the West Bank. In this section, the results of this study are discussed.

4.9.1 Discussion of the factors related to the actions and decisions made in the different phases on cost overrun

The results of analyzing the questionnaires in this study showed that these factors have a moderate impact on cost overrun. They also showed that the decisions and work performed in the planning and design phase has the highest impact on cost overrun compared to activities and factors in other phases. This result is consistent with the interviewees opinions. This is because of the importance of the plans and documents prepared in this phase, since they highly impact other phases in the project. Any defects in the design plans and documents will be reflected on the project implementation and consequently on bid items. Also, as discussed in the Chapter Two, studies of Chou (2011), Shane et al., (2009), and Al-Hazim and Salem, (2015) emphasized the impact of the planning and design phase on the cost overruns. Furthermore, the results showed that the most effecting factors related to the **planning and design phase** are ranked as follows:

- The project is located within rough terrain area with high slopes.
- Preparation of design drawings and tender documents was not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project.
- Inaccurate cost forecasting.

- Insufficient soil tests when conducting soil investigations for the design phase.

- The degree of complexity of the project, modifying the original project design after the contractors submitted their financial bids.

For the **tendering phase**, the most effecting factors are ranked as follows:

- No consideration for the timing of tender release and the starting of the project, especially at the start of the winter season.

- Awarding the project to the bidder with the lowest price.

- Unreasonable project time frame.

- Neglecting the technical evaluation of contractors during selection phase.

- Assigned project timeframe by donor is insufficient.

Finally, the most effecting factors related to **the implementation phase** are found to be ranked as follows:

- Changes in project activities during implementation.

- Municipality construction and infrastructure works in conjunction with project activities.

- Contract inclusivity of infrastructure activities such as sewer network and water network.

- Poor qualification of the contractors' technical staff and workers.
- The estimated quantities in BOQ were incoherent with design and tender documents.
- lack of compliance with shop-drawings and plans by contractor.
- Ineffective human resources management by the contractor.
- Delay in contractor payments due to lack of owners resources.
- The contractor not assigning an engineer with the required years of experience passed on the tender documents.
- Contractor not preparing shop-drawings, lack of initial survey plan for the current status.
- Bad coordination and communication on site between the contractor, supervision, and owner.

The results showed that the change in the project activities during the implementation phase was a frequent cause of cost overrun in most of the surveyed projects. This result was also concluded from the analysis of the conducted interviews, and this is consistent with results from study of Al-Hazim and Salem (2015), as discussed in Chapter Two. This is an evidence of poor management and planning in the municipalities, and the existence of mistakes in the design of such projects.

In the studies of Shane et al. (2009), Al-Najjar (2008), and Chan (2007), it was confirmed that external factors, which are difficult to control and predict, have an important role on the road project cost overrun. This is consistent with by the interviewees opinions that external factors have an impact on cost overrun in municipal road projects.

The external factors that resulted in cost overrun in the analyzed municipal road projects have a moderate impact level, in which the most effecting **external factors** were ranked as follows:

- Financial issues facing project client/government.
- Unforeseen events and conditions.
- Unstable political and economic conditions.
- The constraints on the movement between different areas in the West Bank on equipment and materials transportation.
- Continuous increase in materials and fuel prices.

The effect of the economic, environmental and social factors were also investigated, and the findings concluded that their impact level was moderate. The most effecting **economic, environmental and social factors** were ranked as followings:

- Restricting the movement of people in the work areas.
- Interrupting local citizen movement due to excavation and rerouting.
- Financial claims due to private and public damages caused by project activities during project execution.
- The demolition and relocation of walls that are in the area of the project.
- Environmental impacts, such as dust, noise and waste resulted from project activities.
- Interrupting the commercial activities located within the project routing, damages to the natural environment such as trees and plants in the areas aligning the project location.
- The suspension of some project due to the stopping of government funding.
- The risk of injuries while crossing the site due to the excavation or not implementing related safety requirements.

Those results match with finding from previous studies that were discussed in Chapter Two (e.g., (Shane et al., 2009), (Chan, 2007), and (Al-Najjar, 2008)).

4.9.2 Discussion of hypotheses

In this section, the results of each hypothesis testing is discussed.

Based on the data analysis, the result of testing first hypothesis, “There is no significant difference in the cost overrun percentage due to project characteristic (municipality area, project financing, municipality classification, and contractor classification)”, show that there is no significant difference in the project cost overrun percentage according to the municipality area. This can be explained by having similar geographic nature of the north, central and south regions of the West Bank. This outcome is similar to that of the study of Creedy et al. (2010).

The findings also demonstrate that there is a significant difference of the cost overrun percentage according project financier. The results show that the cost overrun percentage in self-financed is higher than governmental funded and external funded projects, which is an evidence of poor management and planning and inaccurate cost estimation by the engineering departments in the municipalities, the acceptance to increase the amount of project activities in a poorly studied manner, the weak monitoring of the project activities, and the unprofessional evaluation of the finished projects to understand the mistakes that lead to cost overrun. This result is consistent with the outcome of the interviews, and is similar to that found in the studies of AbouRizk et al. (2002) and Mulenga and Bekker (2015).

The results showed there is no significant relationship between the cost overrun percentage and the municipality classification. The findings indicated that the classification of municipalities, which depends on the population within the municipal area, does not affect the percentage of the cost overruns. This can be clarified by the fact that all the municipalities in the West Bank follow the same regulations for bids and projects implemented by them. This finding is similar to that in the study of Creedy et al. (2010).

Finally, the results showed that there is no significant relationship between cost overrun percentage and the contractor classification. The contractors are bound by a signed contract that indicates the project agreed upon amount and prices of each project item, as are not entitled to override the agreed upon terms. This was confirmed by the outcome of the analysis of interviews.

4.9.3 Factors related to the actions and decisions made during the different project phases

The second tested hypothesis, "There is no significant relationship between the impact level of factors that is related to the actions and decisions made during the different project life cycle phases and the project characteristic (municipality area, project financing, municipality classification, and Contractor classification)", was investigated, where the analysis of the results showed that there is no significant relationship between the impact level of factor related to the actions and decisions made

during the different project life cycle phases and municipality area. The explanation of this result can be attributed to the fact that the municipalities in the West Bank generally have a close topographic characteristics and work under the same regulations set by the Ministry of Local Government. This is similar to the findings of the study of Creedy et al. (2010).

The results show that there is a significant relationship between the impact level of factor related to the actions and decisions made during the different project life cycle phases, especially in the planning and design phase, and the financier of the project whether it is the government, or the municipality itself, or a donor. This is because the financier has a major role in the management, planning and designing of the funded projects. Planning and design is the most important phase that has an impact on cost overruns and effects the next phases, mainly the implementation phase.

As for the classification of municipalities, the results showed that there is a significant relationship on the impact level of factors related to the actions and decisions made during the different project life cycle phases because usually in large municipalities such as Class A and Class B, where there is a specialized department of planning and development in a municipality in these classes, that consists of a professional and qualified team of engineers. This it is mainly reflected in the planning and design phase, preparation of bids, and monitoring project activities in the implementation phase. This is consistent of with the studies of Chou (2011), Babashamsi et al. (2016) and Mulenga and Bekker (2015).

Finally, the results showed that there is no significant relationship between the impact level of factors that is related to the actions and decisions made during the different project life cycle phases and the contractor classification, because the contractor is bound by the agreement and its terms, and has no right to interfere with the preparation phases of the project. This was confirmed by the outcome of the interviews.

4.9.4 Relationship between factors related to the actions and decisions made during the different phases

The research results showed that cost overrun factors related to the tendering phase have the highest level of impact, meanwhile the factors related to the tendering phase impact the factors related to the implementation phase with correlation coefficient 0.815 at a significant level (α=0.05). The explanation of this relationship can be related to the fact that errors or unclear design plans or project documents created in the tendering phase will affect the implementation phase significantly, through increasing the disputes during implementation between the contractor and the consultant, and increasing change orders that are considered as an important reason for cost overrun in road projects. This is also consistent with the outcome of the study of Al-Hazim and Salem (2015).

The results showed there is no significant relationship between the impact level of the factors that have lead to cost overrun that is created during the different project life cycle phases with the project size and the time overrun percentage. This can be explained by knowing that each project

has its own planning and design according to its nature, therefore, the size of the project is not related to cost overrun if each phase of the project is properly planned, and the factors are not related to time overrun, but it has an impact on the entire cost of the project due to overhead. This is similar to the outcome of the study of Williams (2003).

The results show also that there is a significant relation between the impact level of external factors that cause cost overrun and the impact level of factors that is related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase). For example, the results showed that there is a significant relation between the impact level of external factors and the impact level of factors related to the tendering phase, because external factors, such as constant price changes and the unstable political status, have caused changes in the prices and specifications of the agreed materials, and consequently an increase in project costs. This is similar to the outcome of the studies of Chan (2007) and Al-Najjar (2008).

The research results also showed that there is a significant relation between the impact level of economic, environmental and social factors that cause cost overrun and the impact level of the factors that is related to the actions and decisions made during the different project life cycle phases (planning and design phase, tendering phase, and implementation phase) that also cause cost overrun, especially the factors causing cost overrun related to the tendering phase.

This can be clarified by the fact that there are different precautions that should be taken into consideration to protect the residents living near the project area, such as building needed walls, reconstructing old walls close to the work area, and finding alternative access for residents, as these requirements must be added to the terms of the contract, meaning that the tendering phase must take into account all of these activities. Failing to correctly predict the actual cost of these activities will lead to an increase in the original project cost. This is similar to the outcome of the study of Shane et al. (2009).

Chapter Five
Conclusions and Recommendations

This chapter presents the summary and the conclusions of the study and offers a guide and suggests recommendations for engineers working in the road projects in general and in the municipalities road projects in particular. It also shows the limitations of the study and offers suggestions for future researches.

5.1 Summary

This research has explored the factors that cause cost overrun which can be divided into three main groups, factors that are related to the actions and decisions made during the different project life cycle phase (planning and design phase, tendering phase, and implementation phase), external factors, and other economic, environmental, and social factors.

The research also has determined appropriate work methodology for the success of road projects by estimating the adequate cost for the size and complexity of the project. The research also suggests instructions that must be executed by involved parties when predicting the project cost. In order to satisfy the aim of the research, documents from the selected municipalities in the West Bank were collected, structured interviews were conducted, and questionnaires outcomes were studied. Analyses of these were conducted considering qualitative and quantitative approaches.

5.2 Conclusions

This study explored the causes of cost overruns during the life cycle of municipal road projects since there has been limited research on this important issue, in developing countries, especially in Palestine.

The study highlights the importance of successful management and planning, which has an effective role in every phase of road projects. It also illustrates the importance of working with a qualified team of engineers to plan and design a professional project, with proper detailed drawings and tender documents, which set proper guidance for the implementation phase and help in specifying precise time and cost, thus preventing the potential of the cost overrun phenomena from occurring or reducing its impacts.

The number of projects with cost overrun has reached 63 out of the total number of 123 projects from 26 municipal in the West Bank, which form about 51% of the total projects, indicating a large share of projects that suffer from the phenomenon of cost overrun.

The factors that have the greatest impact on road municipal projects in the West Bank and which are frequently observed in most projects are:

In planning and design phase, the most important factors are ranked as follows:

1. The project being located within rough terrain area with high slopes

2. The Preparation of design drawings and tender documents is not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project.

In the tendering phase, the most important factors are ranked as follows:

1. Not considering the time for tender release and the starting of the project, especially at the start of the winter season

2. Awarding the project to the bidder with the lowest price.

In the implementation phase, the most important factors are ranked as follows:

1. Changes in project activities during the implementation phase.

2. Municipality construction and infrastructure works in conjunction with project activities.

3. Contract inclusivity of infrastructure activities such as sewer network and water network.

4. Poor qualification of the contractors' technical staff and workers.

5. The estimated quantities in BOQ were incoherent with design and tender documents.

The impact level of the external factors is moderate, and the most important factors are s ranked as follows:

1. Financial issues facing project client/government.

2. Unforeseen events and conditions.

The impact level of economic, environmental and social factors is moderate, and the most important factors are ranked as follows:

1. Restricting the movement of people in the work areas.

2. Interrupting local citizen movement due to excavation and rerouting and financial claims due to private and public damages caused by project activities during project execution.

The success of any project depends on a clear and professional methodology through all project phases, including:

1. Successful and detailed planning, sufficient soil investigation tests before design of the project.

2. Preparing and auditing clear and comprehensive tender terms for all work activities.

3. Monitoring and implementing the project through an experienced and qualified supervision team, and a technically and financially qualified contractor.

5.3 Recommendations

This section presents recommendations suggested to minimize the cost overrun phenomena. These are proposed for each phase of the life cycle of the municipality road project as follows:

1. Planning and design phase: It is recommended that the municipalities have a qualified planning and design department, or they should be soliciting consulting services from professional and qualified engineering offices to design their projects and later to supervise their implementation. This will facilitate developing proper design plans, to arrive at the most feasible design that suits the nature, complexity of the design and the size of the project, to correctly estimate the required time and cost of the project, and to effectively manage resources.

2. Tendering phase: It is recommended to prepare the tender documents by well qualified engineers who take into consideration the financial aspect of the tender, and prepare clear and understandable contract documents that prevent any future disputes between the owner and the contractor. It is also recommended to adopt unified approaches for preparing the plans and bidding documents designed by highly qualified engineers, which need to be adopted and implemented by all municipalities in the West Bank.

It is also recommended to ensure that the wining contractor is technically well qualified and financially fit to implement the project and not only assigning the project to the lower price. It is also recommended to choose the right time of the year for tendering of the road projects and to not start the project at the beginning of winter season.

3. Implementation phase: It is recommended to avoid change orders, which lead to a big increase in cost overrun, and to ensure coordination between municipality construction of infrastructure works and the road project to avoid activities' conflict and delay. In addition, it is recommended to provide detailed shop drawings by the contractor to facilitate the implementation of activities and assist in cost control.

Moreover, recommendation include that project implementation is to be done by professional qualification of the contractors' technical staff and workers, to use of monitoring and evaluation systems, and to utilize the official and certified documentation system to benefit from it in future projects.

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Appendix A

Table 1: Experts and arbitrators who reviewed the questionnaire

No.	Position
2	Teaching staff at An-Najah university (Department of Civil Engineering)
1	Teaching staff at Palestine polytechnic university (Department of Civil Engineering
2	Experts of road sector (Operations Manager / Acting General Manager in Technical Group Company, and Civil Engineer in Ministry of Local Government.)
1	Researcher (Student in the M.Sc. of Engineering Management)
Total	6

Appendix B

The questionnaire

جامعة النجاح الوطنية

كلية الدراسات العليا

برنامج الماجستير في "الادارة الهندسية"

السادة / رئيس وموظفي البلدية المحترمين

تحية طيبة وبعد:

ارجو من حضرتكم التعاون من خلال التواصل مع الدائرة الهندسية/ قسم الطرق في البلدية وذلك بهدف دراسة مجموعة من مشاريع الطرق" **المنفذة خلال فترة 2016-2018** " لاستكمال دراستي العلمية لرسالة الماجستير بعنوان:

"**تقييم دورة حياة التكلفة لمشاريع الطرق في فلسطين : دراسة حالة للبلديات الفلسطينية**"

حيث تهدف الدراسة الى تقييم اسباب زيادة تكلفة مشاريع الطرق عن التكلفة المحددة لها في وثائق العقد الرسمية المنفذة من خلال بلديات الضفة الغربية.

وهذه الدراسة هي ضمن متطلبات الحصول على درجة الماجستير في الإدارة الهندسية.

إن جميع البيانات التي سيتم جمعها خلال الدراسة هي سرية للغاية ولن تستخدم إلا لأغراض البحث العلمي.

شاكراً لكم سلفناً تعاونكم

وتقبلوا بفائق الاحترام،

الباحثة:

م. ميس حسن المخارزه

المشرف: أ.د. سمير أبو عيشة

برنامج الماجستير في الإدارة الهندسية

المعلومات العامة:

اسم البلدية:.....

اسم المشروع:.....

موقع المشروع:.....

تاريخ انجاز المشروع:.....

حجم المشروع (م.ط) :.....

قيمة التكلفة بالعطاء الاصلي :.....

قيمة التكلفة النهائية بعد التنفيذ:.....

التقويم الزمني المقدر:.....

التقويم الزمني الفعلي:.....

ممول المشروع:.....

تصنيف المقاول المنفذ للمشروع:.....

الأسئلة المتعلقة بالعوامل المسببة لزيادة تكاليف المشروع:

آمل من حضرتكم وضع علامة (✓) أمام الإجابة المناسبة.

الرقم	العامل	تأثير كبير	تأثير متوسط	تأثير قليل
	مرحلة التخطيط والتصميم			
1	عدم قيام مكتب مختص ومصنف لدى النقابة بإعداد المخططات والتصاميم ووثائق العطاء حسب الاصول.			
2	عدم كفاءة المهندس المصمم.			
3	درجة التعقيد في المشروع.			
4	عدم وجود مخططات تفصيلية.			
5	عدم رصد نقاط حقيقية مساحية لتصميم الطرق، والاعتماد على صور جوية فقط.			
6	عدم القيام بإجراء فحوصات التربة اللازمة في مرحلة التصميم.			
7	اخطاء في تصميم المشروع.			
8	التنبؤ غير الدقيق للتكاليف.			
9	تغيير في التصميم بعد التسعير.			
10	حالة التضاريس الصعبة، والميول والانحدارات المرتفعة.			
	مرحلة العطاءات			
1	ترسية المشروع على اقل الاسعار.			
2	الاطار الزمني غير المنطقي للمشروع.			
3	تأجيل بدء تنفيذ المشروع من قبل المالك.			
4	التأخير في اصدار وثائق الموافقة على الاحالة وامر المباشرة من قبل المالك.			
5	عدم وضوح نطاق المشروع.			
6	عدم وضوح بنود العقد وعدم تفسيرها بشكل واضح.			
7	تضارب في وثائق العطاء المختلفة.			
8	عدم وجود تقييم فني للمقاول اثناء الاختيار، والاكتفاء بالتقييم المالي.			
9	المقاول غير مصنف لدى اتحاد المقاولين.			
10	تحديد اطار زمني مضغوط من قبل المانح.			
11	عدم مراعاة الوقت المناسب لطرح العطاءات ووقت تنفيذها، بما في ذلك عدم اعتبار فصل الشتاء.			
	مرحلة التنفيذ			
1	التأخير في تسليم موقع العمل للمقاول.			
2	عدم القيام بعمليات رصد مساحية في البداية لرفع الوضع القائم.			
3	عدم اعداد مخططات تنفيذية (shop drawing) من قبل المقاول.			
4	عدم اعداد حصر للكميات حسب الاعمال المساحية والمخططات التنفيذية.			

5	التأخر في الرد على مراسلات المقاول من قبل المالك.			
6	قيام البلدية بأعمال انشائية او صيانة بنية تحتية في منطقة العمل ،تزامناً مع الشروع.			
7	شمول العقد لعناصر ذات صلة بالبنية التحتية من مياه ومجاري وانارة.			
8	التأخر في دفعات المقاول من قبل المالك/ الحكومة بسبب شح الموارد المالية لديهم.			
9	التأخير في الرد على طلبات الفحص المقدمة من المقاول.			
10	تغييرات في انشطة المشروع اثناء التنفيذ.			
11	تغيير في انواع المواد اثناء التنفيذ.			
12	عدم تواجد مدير او مهندس من قبل المقاول حسب وثائق العقد.			
13	قلة تأهيل الكوادر الفنية المنفذة للمشروع.			
14	ضعف في خبرة الاشراف ومتابعة العمل.			
15	خلل في ادارة الموارد البشرية من قبل المقاول.			
16	سوء التنسيق والتواصل في موقع العمل بين المقاول والاشراف والمالك.			
17	النهج المتبع في تسليم العمل ونظام المشتريات.			
18	عدم الالتزام بمخططات تنفيذية.			
19	اغلاق المعابر/ الحدود ونقص المواد في الاسواق.			
عوامل خارجية				
1	الوضع السياسي والاقتصادي غير المستقر.			
2	المشاكل المالية التي قد تواجه الحكومة والمالك.			
3	القيود على الحركة بين المناطق في الضفة الغربية وعلى نقل المعدات.			
4	الزيادة المستمرة في اسعار المواد والوقود.			
5	اثار التضخم الاقتصادي.			
6	احداث وظروف غير متوقعة.			
عوامل اقتصادية وبيئية واجتماعية				
1	توقف عدد من المشاريع بسبب توقف التمويل لأسباب اقتصادية خاصة بالحكومة.			
2	التسبب بشكاوى بمطالبات مالية بسبب الضرر الناتج من المشاريع مثل رش مياه وغيرها			
3	اضرار بالأشجار والمحاصيل الزراعية المجاورة لمشاريع الطرق.			
4	تعطيل عمل المحلات التجارية التي تكون على مسار المشروع.			
5	زيادة اجراءات السلامة في موقع المشروع لحماية حياة السكان التي قد تتعرض لخطر الحفريات.			
6	تأخير بعض الأنشطة بالقرب من المدارس الموجودة في مكان العمل.			
7	التلوث البيئي (مثل الغبار) الذي يضر بصحة السكان.			
8	تعطيل حركة السيارات للسكان المجاورين للمشروع بسبب الحفريات.			
9	تقييد حركة السكان في مناطق العمل.			
10	هدم او اعادة بناء اسوار او منشآت قائمة ضمن حرم الطريق من قبل البلدية.			

ملاحظات:

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Appendix C

Items	Factor
Planning and design phase	
D1	Preparation of design drawings and tender documents was not conducted by a specialized engineering office adequately classified by the Engineers Association for the size and complexity of the project
D2	The design engineer was unqualified
D3	The degree of complexity of the project
D4	The project detailed design drawings were not adequately prepared
D5	Use of aerial photos instead of site plans prepared by a professional surveying office for preparing design drawings
D6	Insufficient soil tests when conducting soil investigations for the design phase
D7	Mistakes in project design
D8	Inaccurate cost forecasting
D9	Modifying the original project design after the contractors submitted their financial statements
D10	The project is located within rough terrain area with high slopes
Tendering phase	
T1	Awarding the project to the bidder with the lowest price
T2	Unreasonable project time frame
T3	Delay in project commencement by the client
T4	Client delayed in awarding notice to proceed
T5	Scope of work unclear
T6	The contract terms are vague and it was not explained sufficiently
T7	Conflict in the contract documents
T8	Neglecting the technical evaluation of contractors during selection phase
T9	The contractor was unclassified by the National Contractors Classification Committee
T10	Assigned project timeframe by donor is insufficient
T11	No consideration for the timing of tender release and the starting of the project, especially at the start of the winter season
Implementation phase	
IM1	Late site hand-over by the client
IM2	Lack of initial survey plan for the current status
IM3	Contractor not preparing shop-drawings
IM4	The estimated quantities in BOQ were incoherent with design and tender documents
IM5	Delay in response to contractor correspondences by client
IM6	Municipality construction and infrastructure works in conjunction with project activities
IM7	Contract inclusivity of infrastructure activities such as sewer network and water network
IM8	Delay in contractor payments due to lack of owners resources
IM9	Delay in responding to test reports and sample materials submitted by the contractor

IM10	Changes in project activities during implementation
IM11	Change in material types during implementation
IM12	The contractor not assigning an engineer with the required years of experience passed on the tender documents
IM13	Poor qualification of the contractors' technical staff and workers
IM14	Weak experience of supervision and follow-up work
IM15	Ineffective human resources management by the contractor
IM16	Bad coordination and communication on site between the contractor, supervision, and owner
IM17	Approach to work delivery and procurement system
IM18	Lack of compliance with shop-drawings and plans by contractor
IM19	Borders closure and shortage of materials in local markets
External factors	
E1	Unstable political and economic, conditions
E2	Financial issues facing project client/government
E3	The constraints on the movement between different areas in the West Bank on equipment and material transportation
E4	Continuous increase in material and fuel prices
E5	Effects of inflation
E6	Unforeseen events and conditions
Economic, environmental and social factors	
I1	The suspension of some project due to the stopping of government funding
I2	Financial claims due to private and public damages caused by project activities during project execution
I3	Damages to the natural environment such as trees and plants in the areas aligning the project location
I4	Interrupting the commercial activities located within the project routing
I5	Investing more into precautionary measures around project sites for the safety of residents' lives from surrounding excavations
I6	Rescheduling school related events and activities around workplaces
I7	Environmental impacts, such as dust, noise and waste resulted from project activities
I8	Interrupting local citizen movement due to excavation and rerouting
I9	Restricting the movement of people in the work areas
I10	The demolition and relocation of walls that are in the area of the project

جامعة النجاح الوطنية

كلية الدراسات العليا

تقييم دورة حياة التكلفة لمشاريع الطرق في فلسطين: دراسة حالة للبلديات الفلسطينية

إعداد

ميس حسن المخارزه

إشراف

أ. د. سمير أبو عيشة

قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الإدارة الهندسية، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

2020

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الملخص

تعتبر مشاريع الطرق من أهم المشاريع في فلسطين بشكل عام، وفي الضفة الغربية على وجه الخصوص، حيث تلعب دورًا رئيساً في التنمية الاقتصادية في فلسطين.

ونظرًا لأن معظم مشاريع الطرق البلدية في الضفة الغربية تعاني من ظاهرة تجاوز التكلفة، ونظرًا لمحدودية الدراسات التي أجريت حول هذا الموضوع، فإن هناك حاجة ماسة لدراسة وتحليل العوامل التي تسبب تجاوز التكلفة في مشاريع الطرق في مختلف مراحل دورة حياة المشاريع، بحيث يمكن بالتالي اقتراح توصيات للحد من هذه الظاهرة.

وقد تم تحقيق أهداف البحث من خلال تحليل نتائج استبيان لدراسة سبع واربعين حالة من مشاريع الطرق البلدية في الضفة الغربية التي تجاوزت التكاليف. كما تم تحليل نتائج المقابلات التي أجريت مع خمسة عشر خبيراً في مجال الطرق. وقد تم إجراء تحليلات كمية ونوعية لمعرفة أسباب تجاوز التكلفة، ولتحديد المنهجية التي تؤدي إلى نجاح مشاريع الطرق دون تجاوز التكلفة. ومن ثم، تم اقتراح الإجراءات اللازمة لتقليل تجاوز التكلفة.

وبينت نتائج الدراسة أن العوامل ذات التأثير الأكبر والتي تتسبب بتجاوز التكلفة لمشاريع الطرق البلدية تشمل وقوع المشروع في منطقة ذات تضاريس وعرة، وعدم إعداد مخططات التصميم ووثائق العطاء من قبل مكتب هندسي مختص ومصنف من قبل نقابة المهندسين، وبشكل يتناسب مع حجم ودرجة تعقيد المشروع. وبالإضافة إلى ذلك، تشمل العوامل الرئيسية الأخرى عدم مراعاة توقيت طرح العطاء وبدء المشروع، خاصة لبداية فصل الشتاء. علاوة على ذلك، تم تحديد عوامل رئيسة أخرى تتمثل في إحالة المشروع للمقاول لأقل سعراً، ووجود تغييرات في أنشطة المشروع أثناء

مرحلة التنفيذ، وإضافة الى القضايا المالية التي تواجه صاحب العمل والحكومة اثناء تنفيذ المشروع.

فيما أظهرت النتائج أن الأسباب الكامنة وراء نجاح المشاريع دون تجاوز التكلفة تتمثل في اتباع منهجية واضحة ومهنية، تبدأ من مرحلة التخطيط والتصميم، وانتهاء بالتسليم، وأن يتم تنفيذ المشروع من قبل مقاول مؤهل، ومتابعته من قبل من هو متخصص في الإشراف من موظفي البلدية المسؤولين عن مثل هذه المشاريع.