REPUBLIC OF TURKEY

ALTINBAŞ UNIVERSITY

Institute of Graduate Studies

Civil Engineering

STUDY OF COST CONTROL METHODS IN CONSTRUCTION PROJECTS IN IRAQ

Ahmed Mahmood Issa AL-GHURAIBAWI

Master's Thesis

Supervisor

Assoc. Prof. Dr. Sepanta NAİMİ

Istanbul, 2022

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The thesis titled STUDY OF COST CONTROL METHODS IN CONSTRUCTION PROJECTS IN IRAQ prepared by Ahmed MAHMOOD ISSA AL-GHURAIBAWI and submitted on 12/08/2022 has been **accepted unanimously** for the degree of Master of Science in Civil Engineering.

Assoc. Prof. Dr. Sepanta NAİMİ

Supervisor

Thesis Defense Committee Members:

Assoc. Prof. Dr. Sepanta NAİMİ	Faculty of Engineering and Architecture, Altınbaş University	_____
Asst. Prof. Dr. Mohsen SEYEDİ	Faculty of Engineering and Architecture, Altınbaş University	_____
Asst. Prof. Dr. Kaveh DEHGHANIAN	Faculty of Engineering, Istanbul Aydin University	_____

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I hereby declare that all information/data presented in this graduation project has been obtained in full accordance with academic rules and ethical conduct. I also declare all unoriginal materials and conclusions have been cited in the text and all references mentioned in the Reference List have been cited in the text, and vice versa as required by the abovementioned rules and conduct.

Ahmed Mahmood Issa AL-GHURAIBAWI

Signature

DEDICATION

I dedicate this thesis work to everyone who has been useful in assisting me with the thesis process, as well as to my family and dear friends, who have been a constant source of inspiration throughout this difficult period.

ABSTRACT

STUDY OF COST CONTROL METHODS IN CONSTRUCTION PROJECTS IN IRAQ

Al-Ghuraibawi, Ahmed

M.Sc., Civil Engineering Department, Altınbaş University,

Supervisor: Assoc. Prof. Dr. Sepanta NAİMİ

Date: 08/2022

Pages: 117

One of the most important aspects of the project is cost control. It is an important issue, and it is widely applied by workers in the construction industry in Iraq. To know how to apply it, it is necessary to understand the methods that are used to control project expenses, which continue throughout the life of the project in this research. The cost control methods are studied, the method that the contractor needs to implement in the different stages of the project is studied, and the problems he faces when applying the various methods of cost control and the factors that lead to the deviation of the project cost from the methods used to control it and their causes are studied.

It was concluded through this study that there is a good understanding of the cost control process by contractors and engineers, but it needs to develop and increase awareness and introduce techniques that increase control by linking the project objectives with each other and maintaining the quality of the project within the time required to complete it.

Keywords: Cost Control, Construction Management, Building Resources, Budgets, Data quality

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

ABBREVIATIONS

CEO	:	Chief Executive Officer
CTQ	:	Crucial To Quality
DMAIC	:	Define, Measure, Analyze, Improve, and Control
IFC	:	Issued for Construction
QA	:	Quality Assurance
QC	:	Qualitative Data Controls
SOP	:	Standard Operating Procedures
SPSS	:	Statistical Package for Social Sciences
WO	:	Work Order
WBS	:	Work - Breakdown Structure
5S	:	Sort, Straighten, Shine, Standardize and Sustain

1. INTRODUCTION

1.1. INTRODUCTION

There are numerous details and intricate interlocking relationships between the parties involved in the project construction process, including the owner, the engineering firm, the contractor, suppliers of materials, equipment, and labor, as well as governmental or donor agencies involved in the project implementation. The construction industry provides a diverse range of employment opportunities and utilizes more basic materials and raw materials than any other business in the world. Given the significant and growing demand for the services of the construction industry, we can observe that it has expanded and spread both in terms of its geographical idea and terms of its technological component. We conclude that the management of construction projects serves as a link between all these parties, and it is a team whose members differ according to the quality of the project being managed as well as the stage of the project in which the project is now operating. Typically, the project manager will oversee leading this group, as he is accountable for completing the project in front of the owner. He will also organize, plan, schedule, and oversee the work being done on the project. Project management is also the executive authority and driving force that works on the fusion and cohesion of the many aspects of a project in a work team in which everyone works together to finish the project on time and within the budgetary constraints set forth.

1.2. CONSTRUCTION PROJECT

The construction project is characterized by its complexity and the requirement for time, financial, and material resources to be completed, and the project in its development typically consists of many phases that necessitate the use of numerous specialized services from the beginning of the planning process to the end of the construction project. Complications: The construction project has several distinguishing qualities and features, including the following:

a. Individuality and non-stereotyping are emphasized, with each project being unique in its own right.

b. There are numerous variables.

The accuracy of planning is lacking. Given the peculiarities of the construction project that are unique to it, it requires good and effective management in order to achieve the intended result, particularly from the perspective of the project's owner.

1.3. PHASES OF THE CONSTRUCTION PROJECT

The construction project is divided into the following stages:

a. The preliminary studies stage.
b. The building phase.
c. The completion phase.
d. Stage one of the design process.
e. The stage of bidding and contracting.
f. The implementation stage has begun.
g. This is the step of handover.

A. The following are the primary parties involved in the construction project:

The construction project is implemented through collaboration between its various parties, where each party contributes to turning until the project is completed. Although the focus is on the three parties, namely the owner, the consultant, and the contractor, there are other influential parties involved as well, including the design team and the architect.

B. The following people are part of the construction project's work team:
    a. The owner.
    b. Consultant.
    c. Stylists are people who dress in a particular way.
    d. The general contractor.
    e. Subcontractors are employed.
    f. Vendors and suppliers
    g. The appropriate governmental authorities.

h. Donors are those who give money to charities.
i. Informing the public about the initiative

C. Obligations of the main parties contributing to the construction project:

a. Contractor's Obligations:
    i. Completion of work (replacing) the engineering contract.
    ii. Submitting the aforementioned work after its completion.
    iii. Guarantee of work after delivery.
b. Obligations of the employer:
    i. Enable the contractor to complete the work.
    ii. Receive the work after its completion.
    iii. Pay the fee.
c. The role of the engineer:
    i. The role of technical oversight is to ensure the implementation of specifications and conditions, check measurements and dimensions, conduct tests, follow-up workflow, monitor implementation processes, and hand over completed works.
    ii. The role of an agent for the employer, as he acts on his behalf in managing the contract in terms of issuing an order to proceed, accepting or rejecting materials and mechanical equipment, and issuing change orders.
    iii. Estimating the value of the contract, entitlements, and compensation, explaining the discrepancies between the different bid documents, expressing an opinion on the claims submitted by any party, etc.

As a result of the intricate interactions that exist between the parties to a building project, as well as the material and moral repercussions of this relationship that alters the stage, the construction industry has been characterized by some conflict tendencies, which are listed below.

a. Intense competition, minimal revenues, and a short time frame for execution.
b. Contractors' orientation to claims, as well as owners' orientation to risk mitigation or risk-bearing.
c. Main contractors and subcontractors have a strained working relationship.
d. According to the owner, new and multiple contract models will be implemented.
e. Untrained and inexpensive labor.
f. Identifying and defining the designer engineer's capabilities.
g. In terms of bearing responsibility, there is a partnership between the contractor and the owner.
h. Conflict and arbitration are two phenomena that exist.

1.4. ASPECTS OF A RESEARCH

1.4.1. Research Field

In order to take note of the research problem and understand its various aspects, the research will focus on the extent to which the concept of cost management is applied in construction projects in Iraq, and the study and analysis of the factors affecting the construction industry directly, namely, direct costs (materials, equipment, and labor), and indirect costs. The research will also focus on the construction projects operating in Iraq, specifically the city of Baghdad, as urban activity is concentrated in it in a large proportion.

1.4.2. Research Problem

The main research problem was crystallized in the need to improve the cost management process for construction projects in Iraq by sensing the importance of planning and controlling costs, and the methods used to manage project resources, as well as paying attention to the procedures for predicting the occurrence of risks during the implementation process and how to overcome them in order to control the cost of Construction projects in Iraq.

1.4.3. Research Assumes

The following hypotheses served as research guides. In Iraq, the implementation of the scientific foundations of cost management in building projects is hindered by the lack of understanding and familiarity with the concept and objectives of cost management among the parties involved in a construction project.

a. The absence of skilled cadres in the field of cost planning and control has resulted in the underperformance of administrative departments such as planning, studies, design, supervision, and follow-up in Iraqi construction institutions.
b. Inadequate cash flows and a misalignment between expenditure and revenue are attributable to the failure to carry out financial procedures, which include creating and approving estimates of periodic and final extracts as well as future predictions for required payments from the owner.
c. A flaw in the contractor selection techniques used by project beneficiaries can be attributed to a lack of understanding of legal concerns.

1.5. RESEARCH METHODOLOGY

The descriptive and analytical approaches are used in this study, which includes studying and presenting the principles and tools for their application as well as the reality of the situation, to bridge or reduce the gap to the bare minimum by discussing and analyzing the discrepancy and contradiction between the requirements that achieve financial stability for construction projects in Iraq and the reality of the situation.

In addition, the actual actuality of those projects is discussed. Following the diagnosis of the causes and their link with one another by using methods that represent this relationship to absorb and find the components impacting the research problem, solutions for treating it and preventing its recurrence are developed.

1.6. FUNDAMENTALS OF COST CONTROL IN CONSTRUCTION PROJECTS

Controlling the cost of projects includes a set of important processes and procedures that are related to the completion and completion of the project within the financial budget prescribed for it [1], and they are as follows: -

1.6.1. Resource Planning

Resource planning is necessary to bring about compatibility between the resource demands of the project and the existence of those resources on the other hand, by specifying the details of the resources required to carry out the work that can be provided and the alternatives for these resources in the event of their unavailability and according to the stages of the project[2]. It should also define the activities and estimate the duration of each event, as well as review previous information that includes the types and quantities of resources used to implement similar work for previous projects [3].

1.6.2. Cost Estimation

Every project begins with an estimate of the cost, which can be described as the process of determining the amount of materials, labor, and equipment that are expected to have been used to accomplish the building construction work within specific specifications and then calculating the project cost in accordance with those quantities [4]. Contractors interested in participating in tenders should first establish a defined scope or field inside which costs and quantities are expected to occur. Estimates can be precise and accurate estimates for involvement in bidding from before contractors who desire to participate in tenders. When it comes to business owners, estimating is used to evaluate the expenses of infrastructure investment, determine the economic viability of the project, and estimate the amount of tax that will be due.

As for the advisor, he employs estimating to determine the actual cost of the project, to assist in the selection of the least expensive site, and assist in the selection of the most cost-effective design among several alternatives. Besides the contractor, it is dependent on his or her ability to estimate the costs in order to make a competitive proposal while making a respectable profit [5].

1.6.3. Cost Budgeting Mode

Cost control includes the implementation of the financial procedures stipulated in the construction contract as well as the assignment of the estimated financial resources in order to carry out the completion of project activities [6]. As well as establishing appropriate monetary procedures consistent with known standard practices in the field of construction.

1.6.4. Cost Adjustment

It entails managing adjustments to the project's budget. But it is regarded as the most crucial step since it synchronizes the project from the approval of its inception to its conclusion. As far as it is concerned, cost control and management define the effect of project decisions on all costs utilized to finish the project at any stage to guarantee that it is carried out within the budgeted amount. Life-Cost Cycle [7], which is defined as (a method for computing. The true cost of facilities, which requires determining the operating costs in the pre-planning phase in addition to the costs of design, construction, and maintenance activities), the life cost with the methods of Value Engineering (a branch of engineering that specializes in loading engineering designs or equipment [8]. To modify the design or equipment to facilitate its construction or replace cheaper parts to reduce the quantitative cost without negatively impacting performance, and they are used together to reduce cost and time and improve the quality and overall performance of the design or equipment, and they help in making the best decisions.

1.7. DEFINITIONS

a. Cost: is the sacrificed or wasted resources to achieve a specific goal or purpose, and this cost is measured by a traditional accounting method, that is, in the applicable units of cash that must be paid in the purchase of goods and services [9].
b. Cost aggregation: It is the inventory of cost data systematically through a cost accounting system based on a natural tab such as materials, labor, fuel, advertising, and shipping [10].
c. Determining cost: It is a general term or term that means [11]:
    i. Cost tracking (Affectation of actual expenses to a certain cost aim).
    ii. Allocation of cost (a method of allocating additional costs to a certain cost objective).

d. Expenditure: It is the cost spent during the financial period, which is offset by revenue during that period, and it is also spent to obtain a benefit [12].
e. Loss: It is an economic sacrifice also expressed in monetary values, but it is not matched by any economic benefit, which is the difference between revenue and expenditure (revenue - expenditures), so if the result is negative, then this is the amount of loss, but if it is positive, then this is a profit [13].
f. Revenue: It is all the values that enter the account of the establishment, whether they are in the form of cash or kind, or that result in an increase in the accounts receivable. It is necessary to differentiate between revenue and profit [14].
g. Direct materials: include all commodity requirements that directly enter the production process, such as raw materials (such as cement, sand, gravel, and reinforcing iron) [15].
h. Indirect materials: are materials that are not directly related to the production unit, such as gum in the furniture industry, where the share of the product cannot be accurately determined [16].
i. Direct wages: are all wages paid to direct workers in the production process, whose work is directly devoted to transforming raw materials into a final product [17].
j. Indirect wages: It is all that is paid to workers in the economic unit whose work is indirect concerning the production unit, and whose cost cannot be determined, such as the wages of departmental supervisors in the company [18].
k. Variable costs: are those costs that change in total with the increase or decrease in the volume of activity, that is, they increase by the percentage of increase and decrease by the percentage of decrease in the volume of production. For example, if a factory stops production for 12 days, the total variable costs for this period will be zero, like the electricity necessary to operate the machines [19].
l. Fixed costs: The cost of fixed assets including services available for production as well as various operations in it, and also buildings and land, is included in the total cost and does not change the amount of production; fixed costs vary between both the cost of materials necessary for just any production level, for example, reducing or improved production time does not affect the increase or reduction in the cost of raw materials used to produce a product [20]. Fixed costs are also included in the total cost and do not modify the volume

of production. Fixed costs inside an economy are company costs that do not fluctuate in response to the quantity of products produced by an organization. According to management accounting, fixed costs are defined as expenses that do not fluctuate as a result of the conduct of the business operation. In the long run, there have been no fixed expenses, as defined by the definition [21].

m. Semi-variable and semi-fixed costs: They are the costs that combine the characteristics of the two groups of variable costs and fixed costs, so part of them is variable and part of them is fixed, and examples are the costs of maintenance of machines, meaning that their cost remains constant in the case of periodic maintenance of machines, but these costs increase when the number of times increases [22].
n. Controlled costs: They are the costs that can be controlled in terms of their realization and a clear quantification by one of the officials in the facility during a certain period, such as fixed costs [23].
o. Uncontrolled costs: These are the costs that cannot be controlled and controlled within a certain administrative level, and an example of these are variable costs [24].
p. Total costs: represent the sum of fixed costs and variable costs [25].

1.8. COST ESTIMATE

The stage of estimating the cost of a project starts with the planning stage when the engineer estimates the estimated expenses of the plan and monitors them continually to ensure that the project does not exceed the budget limit set by the client [26]. To be carried out if his proposal is successful, and to be used for cost control purposes during the implementation process. Construction businesses' accounting departments determine the actual implementing cost of a project during the implementation stage in order to keep costs under control during the project's lifecycle. On the other hand, it should be documented so that it can be used in the future to estimate the number of similar initiatives.

1.9. APPROXIMATION COST ESTIMATION METHODS

Cost estimation procedures in this category are employed throughout the planning and design phases of the project when the product is still not firmly defined. These estimates are based on learning the true cost of large units of construction from previous projects [27], and these costs are then adjusted to accommodate for the new project's specific conditions, such as location and time. The following are examples of such methods: -

i. The cost per client: Using the estimated value per client when estimating the project cost, such as when cost estimation of a health center, the cost per student when estimating the cost of a school, or the cost per car because once estimating the cost of a garage, and then calculating the cost of the new project, is referred to as "cost per client estimation". Multiply the projected number of customers by the user fee to arrive at a final figure.
ii. Cost using transactions: Transactions have a price: They have to be paid for. In this example, the adjusted cost to implement some other similar facility is used as a baseline. Then, the cost estimate of incorporating the proposed facility is enhanced by transactions to account for the different working conditions and pay and their expenses, as well as other things.
iii. Unit volume cost: For projects like huge refrigerators, the cost is determined by multiplying the facility's volume by the cost of the unit volume. This method is appropriate since it is based on unit volume costs of similar arrangements, and it is ideal because it is quick and easy to estimate.
iv. A unit area cost: When it comes to unit area costs, the cost of a facility is calculated based on the unit area costs of similar facilities. The cost of a facility is determined by multiplying the facility's area by the unit area cost of the area unit.
v. Sections cost: It is appropriate for calculating the cost of fences that have repeated sections since it is based on a cost estimate of a single block plus the number of parts in the facility.
vi. The cost of the project parts: The following are the costs of the project components. The project's expected cost is based on the sum of the expenses of the project components, which include the costs of the construction stage, foundation, column, ceiling, external walls, plumbing, and woodwork construction.

1.10. PROJECT COST METHODS IN DETAIL

Only after the project designs and specifications have been completed can a comprehensive estimated cost be started, and the estimated cost is based on the creation of a correct and comprehensive inventory of the amounts necessary to complete the work. The detailed cost estimate includes the following items.

To accurately estimate the costs associated with the implementation process, it is necessary to conduct a complete and accurate study of the designs and to have extensive knowledge of the costs associated with labor and materials pricing, equipment, and other resources. It is crucial to remember that project cost estimation is a method with a comparatively small degree of detail, which is due to the uniqueness of each construction project, which makes each project a unique instance. Although this is the case, a qualified and experienced individual can estimate the price of a proposed project with a reasonable degree of accuracy by leveraging information from cost accounting for past projects. The follows are the actions to be taken to estimate costs [28]:

i. Inventory of quantities: the first step in calculating the budget of the building, entails restricting the quantities due to the occupational of the works according to their origins, and the sums are decided by the contractor calculating with incredible precision for these kinds of projects that he wants to take out individually, but he does not restrict the quantities of works that he submits to subcontracting, as well as the contractor re-counts the quantities of works that he submits to subcontractors. It is customary for the designer to prepare quantities for inclusion in unit price contracts for the major behavior control
ii. Most designers indicate that the quantities determined by them are simply approximations of the actual quantities.
iii. The act of collecting amounts provides knowledge and understanding of the project's requirements and specifics to the team's collective expertise.
iv. Most work items could be priced either by a contractor unless they are broken down into smaller components.

1.11. ADMINISTRATIVE INPUT

First, before the project cost process will begin, the choice process in some aspects related to the project's introduction and which genuinely influences the quality of the estimates must be accomplished. These matters include establishing an implementation supervision body, selecting a process of project implementation, establishing an initial schedule, and purchasing implementation equipment. The most effective method of discussing these issues and making decisions relating to them is to convene a meeting that includes members of the construction manager as well as members of the contractor's administrative structure who have the capacity to make decisions. The following are the administrative inputs that will be required for the project's implementation [29]:

i. Execution Supervising Body: Choosing the project's managing the project and among the engineers and observers is a better management procedure since it allows you to not only calculate the financial requirements for getting their money but also match the supervisory body's capabilities with the demands of each project because so many engineers work more efficiently on some types of projects than others.
ii. Project implementation method: In many cases, there are multiple ways to complete a task; the most suitable approach is utilized after weighing the time and cost of the various options; this will not appear to suggest that every site procedure requires this choice; however, in many cases, the company's experience and equipment impact the choice, except for those requiring specialized equipment. Extensive scales to evaluate are required to discover the most appropriate approaches for specific applications.
iii. Initial schedule: The cost estimation procedure necessitates the creation of an approximate project timeline for the project, which is especially important in projects that will take a long time to complete and in which the contractor will postpone the creation of an accurate and detailed schedule until he wins the bid competition. The program defines the fundamental project tasks and the relationships that exist between them, and also the total time required for the project's implementation as a whole, and the start and end times for each project task individually. This is particularly important for a variety of reasons, including the fact that the majority of project owners require the contractor to complete the

project within a specific time frame, that the majority of indirect costs are dependent on the project's implementation timeline, and that the schedule provides valuable information about instrumentation and productivity growth that can be used to increase the accuracy of cost estimations and lower the overall cost of the project.

iv. Execution equipment: Heavy construction projects, roads, and utilities frequently require huge equipment, and because the cost of equipment accounts for a significant portion of the total cost of these projects, and because the cost of equipment differs widely depending on its type and size, the project cost process can only be divided into two parts. The cost estimator is sure that the real cost of equipment will not differ much from the predicted cost after finishing the equipment selection.

1.12. LISTS OF ESTIMATED COSTS

After finishing the inventory and choosing administration inputs, the estimated process is initiated by producing cost estimation lists, which are then used to generate cost estimates. The main contractor self-executes each item of project work, and each list comprises the actual costs of the works which must be accomplished for the work item to be finished [30]. The list is created for each item of project work that the main contractor self-executes. Accordingly, when it comes to the products that the general contractor plans to make available to a specialist subcontractor, he does not provide an estimate of their cost.

1.13. DIRECT COST

An item's actual cost is the amount of money spent directly on the item's implementation during its lifecycle. Each of these categories represents a separate direct cost. Materials are separated into four categories: labor, equipment, and subcontractor [31].

a. Cost of materials: The contractor increasingly recognized specific quotation marks from suppliers of materials for the majority of the materials on the project, and the contractor then obtains written bids from manufacturers and suppliers that include the prices of the materials as well as many other elements of the materials' expenses, such as delivery charges, taxes, rates of supply to the site, and also guarantees, payment options, and other

considerations. As a result, if the numbers were computed with high precision, the cost of the materials could be estimated with the same precision. The contractor can eliminate purchase charges from the overall cost if the owner furnishes specific materials, however, he can add cost factors relating to material capacity to manage.

b. Labor cost: This figure represents the direct cost of an employee's net salary received each working day, and the availability of specific and consistent data from recently concluded projects serves as a foundation for evaluating the cost of labor in any project. Both the unit cost and rate of production methods are employed. To calculate the overall labor cost, you must first determine that however much work should be accomplished in a particular amount of time. After obtaining this information, the duration required for completing the item in its entirety can be estimated. The total labor cost is multiplied by the number of days by the labor cost each day. Furthermore, the unit cost technique is based on knowing the direct labor cost of each unit; this knowledge allows the total labor cost to be determined by multiplying the labour unit cost by the volume of effort to be accomplished. In addition to direct labor costs, there are indirect labor costs such as taxes on salaries, employee insurance premiums, and other benefits such as pensions, health coverage, training courses, and holiday pay. A project's indirect cost is frequently represented as a proportion of its direct labor expenses.

c. Equipment cost: Equipment costs are estimated using results of multiple or unit costs methodologies, similar to how labor costs are calculated in an employment project. By understanding the productivity rate per hour but also the total manufacturing volume that must be implemented, the production rate method estimates the number of required operational hours. Knowing the equipment costs per hour and the total production volume which must be implemented can be used to calculate the total price of the product. The second way involves calculating the overall cost by multiplying the cost of production by the total volume of effort. There are a few things to think about while purchasing equipment, which we've outlined below: -

i. The total cost is calculated by multiplying the production costs by the entire quantity of labor:

ii. The term "equipment" consists of objects used by the constructor in the construction process, as opposed to elements that become structural components when it is completed, such as lifts, escalators, and boilers, which are classified as materials instead of instrumentation.

iii. Although small tools and machines including such concrete breakers and concrete vibrators are not considered equipment, their expenses are included in the total project cost, in addition to hidden costs, as part of the variable costs.

iv. The cost of construction vehicles is determined using the following approach, which must be available on the job site: -

a. During long-term projects, equipment is purchased to begin the project and disposed of at the conclusion, with the difference between the expected purchase and sale values being charged as a total throughout the project.

b. When the equipment is controlled through long-term or fixed-term lease arrangements, the rental rate is utilized to compute the cost of the equipment, which is not always the case.

c. Using the examples above, the cost of operating the equipment is added to the calculated cost, and this includes fuel, oil, grease, maintenance, spare parts, tires, and the cost of the driver. Using the examples above, the cost of operating the equipment is added to the calculated cost.

d. When a contractor owns and operates the equipment, he or she calculates the value of owning and managing the equipment per hour and utilizes that estimate to calculate the cost of the equipment.

e. Some equipment's expenses should be expressed in a different form than the cost per hour because of the nature of the equipment., such as:-

i. Concrete formwork that has been prefabricated In order to minimize costs, it is advisable to estimate their cost based on a specific number of times they will be used.

ii. Due to the fact that scaffolding and building cranes are utilized for extended periods to service the project overall, their costs are estimated on a per unit of time basis, such as per month.

iii. A fee is assessed for each unit of production produced by asphalt and concrete mixing facilities, as well as aggregate producing units.

a. Cost of subcontractors: Once it has been determined that the primary contractor wants to subcontract some of his or her project work to subcontractors, it is critical to gather quotations from those subcontractors in order to finalize the project's overall cost estimate. An additional charge is added to the subcontractor's offer when the subcontractor's costs are incurred on the job site.

1.14. INDIRECT COST

Direct expenses are those incurred during the project's execution and implementation; variable expenses are those paid that do not directly match all the other project's business expenses. It is categorized into two: the site cost and the firm management cost. Engineers', supervisors', and observers' wages, as well as site preparation and evacuation, project insurance, first aid, fence, signage, and Cadastral site and works testing, are all included in the site cost. This cost is typically computed as a percentage of expenses incurred (5-15%) but can also be computed in greater detail [32]. The contractor's management costs include office rent, insurance, utilities, office supplies, donations, advertisements, travel expenses, and personnel compensation. Office equipment and equipment are among the other costs.

1.15. QUOTATION PROCESSING

After finishing the resulted in cost estimations, the contractor moves on to preparing the quotation by including other cost aspects like taxes and the cost of the letter of credit and then adding the profit margin to complete the quotation preparation process [33]. Since taxes must be paid on expenses incurred by the contractor during the implementation process, taxes are typically computed as a percentage of the total direct and indirect costs spent by the contractor. Profitability of the project, the profit represents the lowest expected return on the contractor's investments. Its value ranges from (5% to 22%) of the estimated cost of construction in any contract, and the percentage that is decided represents the boundary between the contractor's desire to raise the value of profit to reach the optimum return and his desire to reduce the value

of profit to achieve the lowest possible return on his investments. The likelihood of securing the project among a group of rivals. The profit rate is determined by a variety of factors, including the following:

i. The size, complexity, and location of the project are all important considerations.
ii. The method of preparing contract documents is referred to as
iii. Estimation of the challenges and issues associated with the project by the general contractor
iv. The contractor's wish to be awarded the project is expressed in the following way:
v. Owner of the project as well as a consultant designer

1.16. ESTIMATED BUDGET FOR THE PROJECT

When the contractor chooses to implement the project, he restructures the cost elements in a way that enables him to perform cost control during the actual implementation of the project, which is called the project's estimated budget, which will enable him to control the project during implementation where the actual cost is compared to the estimated cost to detect any deviation

1.17. CHANGE COMMANDS

The change may be the result of the owner's desire to modify some of the works by adding or deleting other things, so we find that most of the contracts stipulate that the engineer (the owner's representative) is responsible for giving the order to change the works and others give the owner the right to be a party i.e. to approve an order Change, but we find that the engineer is primarily responsible for issuing change orders.

How are change orders were given: -

Although the terms of the contract give the engineer the right to give change orders, the contractor cannot implement these orders unless they are issued in writing. Also, the conditions often give the contractor the right to prove his right to claim the effect of the change orders on him, and this is either by informing the owner or the consultant of his intention to claim as soon

as the change has occurred or by giving specific periods in which he is entitled to submit the claim. This is because the owner and the contractor do not agree on the value of the compensation resulting from these changes, and the claims arise as a result. The types of changes in construction contracts can be divided into the following types [34]:

a. Direct changes: In this type, the owner or the engineer who represents him asks the contractor to make specific changes to the work stipulated in the contract (whether in specifications or design), and these orders are either verbal or in writing with written confirmation at a later stage on the verbal orders. Disagreement may arise between the owner and the contractor as a result of linking these change orders to the following matters:

    i. The power of the owner's representative to give the change order.
    ii. Written assignment.
    iii. Scope and nature of change.
    iv. The costs associated with the change order.

b. Indirect changes: This type of change is not issued by direct orders from the owner, engineer, or his representative, but the issuance of orders for modifications or other changes in the work leads to a change in another part of the work, whether in the planned time, size or how to accomplish it. In order for the contractor to retain his right to this type of change, two things must be ascertained:

    i. Determining who is responsible for issuing the change orders authorized by the authority in the contract.
    ii. The manner in which the order was given that caused this indirect change and what the conditions stipulated regarding giving orders in the item.

There are prominent types of indirect changes that have become familiar by virtue of their occurrence and the contractor can prove his right to them, including: -

i. The different conditions of the site.
ii. Changes in design.
iii. Changing the payment system or delaying financial payments.

iv. Change in coordinating responsibilities between project objectives.
v. The owner's failure to provide the required supplies.
vi. Additional tests were contrary to the contract.
vii. Refusal to adopt similar alternatives.
viii. Failure to provide the contractor with all information about the project.
ix. Obligating the contractor to higher specifications than what is required in the contract.

c. Costs resulting from the occurrence of damage: When a change occurs, whether direct or indirect to some business, related to this change, effects on other businesses, or damage results as a result of this change. For example, a change in some parts of the project leads to the implementation of other works in weather conditions that differ from what was planned or expected, such as moving to the rainy season, which leads to damages in these works and therefore additional cost and time. Additional examples of these damages are: -

i. Strikes.
ii. Delaying the project time.
iii. Delay in booking deductions for payments.
iv. Delay in running the project.
v. Payments due and their periods.
vi. Cancellation of other contracts as a result of being involved in the work of the current contract.
vii. Accelerate the completion of work and its consequences.
viii. Preparing additional ways to access the project.
ix. Rising prices.
x. The decrease in the level of productivity (efficiency) as a result of the delay.

1.18. THE SIGNIFICANCE AND OBJECTIVES OF THE RESEARCH ARE AS FOLLOWS

The significance of the research lies in ensuring the financial stability of the project by implementing the following measures [35]:

a. Emphasizing the necessity of cost control in construction projects by applying the fundamentals of cost management (resource planning, cost estimating, cost budgeting, and cost control) to achieve financial stability for the project is the goal of this paper.
b. The importance of the project resource management process in supplying and supporting site operations with the necessary resources efficiently and effectively in order to achieve a realistic cost within the predicted budget is emphasized in this section.
c. The importance of project cost control in ensuring that implementation expenses do not exceed the expected budget limits for the project, which have been developed in advance, is emphasized. Early in the project's life cycle, it is important to forecast the end cost.
d. A construction project's financial performance must be carefully evaluated, and this must be done with care.
e. The determination of the owner of whether the project's cost is within his financial capabilities or not.
f. Supporting the contractor in procuring and managing the resources required for implementation during the implementation phase.
g. Assisting the design consultant in selecting the most appropriate design and execution alternatives.
h. When it comes to completing assignments, it is critical to adhere to the deadline. As long as the specifications are followed, the product is of high quality.
i. Consider the introduction of legal difficulties pertaining to the responsibility of each party towards the other party.
j. Acknowledging the significance of scheduling project costs in order to be aware of when receivables are due
k. Determining the extent to which direct and indirect adjustments have had an impact on the progress of the project's execution.

1.19. THESIS LAYOUT

A. Chapter one: The thesis' major elements' fundamental qualities are stressed. It describes the classification introductions, the problem statement interface, and a few groups of factors aspects. Furthermore, it outlines the important use case contributions in terms of applications and services that are expected to be supported in classification through performance indicators like throughput or latency requirements.
B. Chapter Two: A comprehensive view of the literature and background studies with an overview state of the art is presented on topics that relate to the work developed in the thesis from the academic thesis, industry reports, and research standards.
C. Chapter Three: In the third chapter, which is dedicated to methods and the activities and techniques that will be used, which will be covered by the data obtained from the methods described in this chapter, and which will be worked on in the fourth chapter, the activities and techniques that will be used are presented.
D. Chapter Four: In this chapter, the conditions to be examined in the reference parameters of the model will be defined in terms of detection, identification, and classification-related metrics for the models.
E. Chapter Five: Conclusion and future works

2. LITERATURE REVIEW

2.1. INTRODUCTION

This chapter looks at the research on cost overruns, focusing on many reasons and aspects that go into project management. The first part of the evaluation talks about creating conflict between the project's cost and time overruns and the construction industry's problems. It also talks about the reasons for the apparent conflict. They look at how different concepts have been used to improve the project's progress with process improvement.

2.2. THE NARRATIVE STUDY

Customers are primarily responsible for the financial problems in a business, such as cash flow, even though the contractor and other partner organizations are also accountable for most financial delays in the project. Only the cost and time overrun are significant consequences of this delay, with the time increase having a higher impact than the cost overrun. For example, a contractor's inability to fulfill deadlines, an error in the design method implementation, or a combination of these factors could lead to this outcome. As they had earlier implemented risk analysis, there were fewer claims and disputes and fewer legal procedures related to a contract, and arbitration was no longer a delayed impact (Oyewobi 2016) [35].

This point should be emphasized: adequate attention should be devoted to the expense development of design, as well as to the completion of tender documentation, in terms of improving the document's performance, as this would save efficiency by eliminating errors and differences, and thereby lessen the source of the delay.

The approach (Aibinu & Jagboro, 2002) in determining the cause of delays discovered that the client's intervention, the contractor's incompetence, and the financing of the job were all significant contributors to the development of delays [36]. On the subcontractor's end, low labor productivity, poor planning, and sluggish decision-making have been some of the factors that contributed to the lengthy delay. The contractor and consultant also contributed to the delay by employing improper construction techniques, inadequate site management, and a lack of tools

and components, among other things. It was suggested that catastrophic clauses be added to the contract and incentivize early delivery to resolve these concerns. It is advised that human resource management be appointed in the construction industry, as this will aid them in designing training courses and establishing how much money to spend on education and training programs. Instead of focusing just on the contract price, it was recommended that the parties instead consider the contractor's capacity and performance.

The intensity, importance, and regularity of disruptions were all reflected in the results of a poll done in Saudi Arabia. According to researchers, the following 73 primary elements contributed to the delay: clients, the contractor, the consultant, labor, materials, equipment, design, the project, and external influences (Assaf & Al-Hejji, 2006) [37]. It was discovered that 76% of contractors reported a time overrun of approximately 10-30% of the initial planning duration, and roughly 56% of consultants reported a time overrun of the same magnitude, with 25% of consultants reporting a time overrun of 50-30% of the project. In most cases, the client and consultants want to select the lowest bidder, which results in latency, whereas the contractors believe that the client is primarily to blame for the delays. The only cause of delay for which both parties are liable is a change order made by the client during the construction project.

It has been proposed that all parties involved in the delay, such as the contractor, have an adequate number of employees so that they do not experience a labor shortage and that strategic preparation is done either by the contracting company. That appropriate site management is completed as long as the work is awarded, among other things. The proposals from the client's side included timely payment of the contractor, minimizing change, and allocating the assignment to the worthiest contractor possible. In addition, they required that the consultant review and approve the designs before distributing these and that they are adaptable while not sacrificing quality in the name of saving money (Assaf, 1995) [38].

According to the research published by (Sambasivan & Soon, 2007a), the top 10 causes of delay were as follows [39]:

i. failure on the part of contractors to plan and perform work under the original timeline
ii. Inadequate site management principles as a result of a lack of clearly defined processes

iii. related project knowledge on a similar basis
iv. Finance and cash-flow management
v. Communication problems within the organization among stakeholders
vi. Insufficiency of Materials
vii. Inefficiency and scarcity of labor
viii. Failure of the Equipment
ix. Contracts between contractors and following subcontractors that are not correctly described

During the analysis, six significant delay effects were discovered: (arbitration, time overruns caused by scheme delays; stakeholder disagreements; cost overruns; total abandonment; and litigation).

Delayed projects can be caused by various factors, which can have a variety of repercussions, such as raising the site's risk and decreasing its performance. Several factors contribute to this, including customer delays in making payments to the contractor, preliminary project design, claims and compensation worries, and so forth. Similar to this, the consequences of these delays include cost overruns, time overruns, under-or utilization of resources, and other effects. Because of this, it was suggested that they plan the budgets correctly, maintain communication between stakeholders, and invest in the competencies of the project manager (Sambasivan & Soon, 2007b) [40].

The project's goal, i.e., its predetermined goal, which is essentially the delivery of products within the stipulated time and financial restrictions and to the needed quality, may determine its success. The length of time that the project is delayed depends just on the nature of the work.

As according (D. W. Chan & Kumaraswamy, 1997) [41], construction projects can be divided into four major groups, as depicted in Figure 2.1 [8]:

i. The project idea and tendering processes are included in this category.
ii. Project planning and design are two different things.
iii. construction of the project
iv. Repair work.

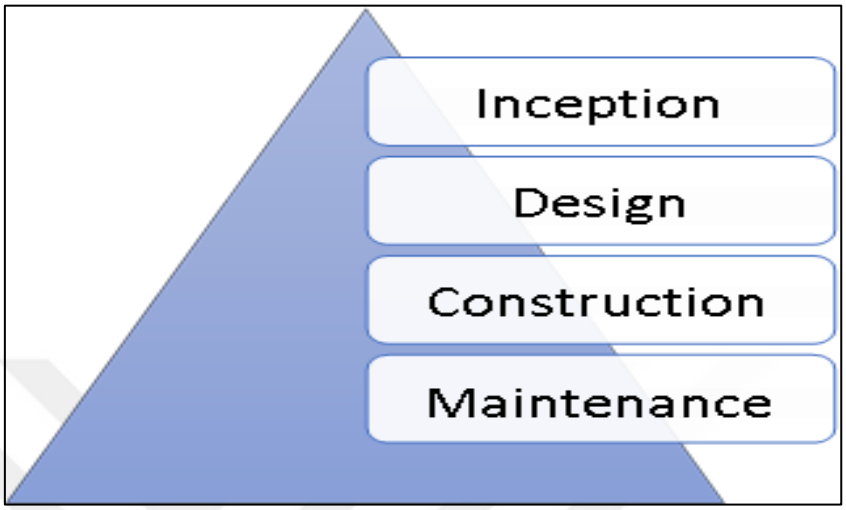

Figure 2.1: Construction Projects Are Divided into Different stages [8]

The most common time for cost overruns is during the project's construction phase. The contractor tends to expedite work when projects fall behind schedule, resulting in a spike in the expense of reduced measures resulting from this expedited work. Additionally, a contingency allowance, which is a fraction of a% of the project's value, should be included in the contract to accommodate for delays of this nature, with the percentage set by the party's discretion or experience. However, while all parties to the project acknowledge the additional time and expense incurred due to the delay, there are often conflicts between the client and the contractor regarding the contractor's ability to guarantee the additional payment (Chan 2011) [42]. It is necessary to address specific facts and agree between the parties involved in such cases. A clear understanding of who is accountable for delays associated with the contract should be established inside the contract provision. The contractor must not be solely responsible for such delays.

According to the study's findings, Delays in construction projects have nasty repercussions for all parties in the construction in terms of cost and time. As a result, the primary objective of process management teams should be to channel and identify these kinds of delays using suitable methodologies and to suggest appropriate advancement and routines and construction

practices. An extensive body of research has demonstrated a variety of causes for the problem, including low productivity and process improvement methods, project quality improvements, and improved site management practices [43]. These findings have resulted in techniques focused on specific aspects of project performance, as demonstrated in previous studies (Ramanathan 2012). Experts with extensive experience in the construction industry should discover viable strategies to lessen the impact of observed delays by employing various techniques and informing the construction industry on how to handle the situation [44].

2.3. SUBSTANDARD QUALITY'S COST

The cost of substandard performance is another measurement of project performance. According to Harrington (1999), the typical cost of quality is divided into four categories: inner failures, exterior failings, appraisal, and preventative measures [45]. The goal is to reduce preventative quality costs while lowering internal and external losses and associated assessment components. Since not all of the expenses caused by poor quality are reviewed inside an organization's structure, it requires considerable effort and time to appraise the quality costs appropriately. Table 2.1 contains an overview of failures and solutions for prevention [10].

Table 2.1: The Cost of Low-Quality Measures [10]

Inner Failures	Exterior Failures	Stoppage
Execution errors	Client Disappointment	Appropriate Scheduling & Planning
Proposal Errors	Appliance Failures	DMAIC set
Re-inspection	Excess Catalogue	Awareness Management
Repair cost	Testing of Excess Materials	5S Instrument
Rework	Charges for lateness	QA/QC Tool
Argument	Contract Faults	Guidance
Engineering Modifications		Audits

According to the author, costs in work can be either evident or hidden (Krishnan, 2006) [46]. The hidden expenses connected with a project can be extensive and can occasionally surpass approximately three times the visible expenditures depending on the project type. The following sections provide an overview of some of the visual plus hidden costs connected with a construction project, as explained by the author:

a. Visual

i. Scrap
ii. Defects
iii. Overruns
iv. Reworks

b. Hidden

i. Requirements and specifications that fall short of expectations.
ii. Non-mandatory procedures.
iii. Communication issues.
iv. Excess Storage.

2.4. OVERRUNS IN TIME AND COST HAVE SEVERAL CAUSES

When a building project is completed on time, with the requisite quality, and even at the estimated cost, the public has deemed it successful (Mpofu 2017). Cost overruns are common in building projects, and budget overruns frequently accompany delays [47].

2.4.1. Issues with Delays and Cost Overruns

A delayed delivery occurs when a project is postponed after the contract has been fulfilled but before the agreed-upon period, which is often the project's lead time. This is a typical occurrence within the construction business, and it delays the completion of several building projects. Delays can have numerous negative consequences for both the contractor and the client. Because he hasn't been able to rent a property, but because the client can't get into the area for production or relies on that area in that interior, it's a revenue loss for him. He has lost the chance to make money.

Completed projects on time demonstrate the contractor's efficiency; hence, he must limit delays in even one activity to avoid accumulating overhead costs while working for an extended time; and (Zailani 2016). In addition, the loss of resources changes throughout hyperinflation, and labor costs impact the situation [48].

For any project to be successful, it is necessary to understand project management thoroughly. Many factors can cause the project to deviate from its original course and fall behind schedule; however, all of them can be prevented with adequate planning. Delays will undoubtedly arise if sufficient preparation is not done at the outset.

The method followed by the engineer in calculating the project's execution period ensures that the project is finished within the time and budget constraints. Many delays occur during the implementation stage, and most of them are indeed the function of several factors that were not foreseeably unforeseen. Even a change in the project's purpose or scope will delay the project's completion. Both the client and the contractor suffer considerable financial consequences due to delays. It is up to a party to determine how they will resolve their differences due to the delay. They may elect to take the matter to court or arbitration to determine who is responsible for the delay and who will bear the financial burden. The court and arbitrator consider a variety of factors, including the contract instrument, the cause of uncertainty, and other factors, in determining who will bear the risk in the event of such a delay (J. H. L. Chan 2011) [42].

Delays can occur at any phase of a construction project and seem to be commonly present, with various implications depending on where the project is in its lifecycle. Delays hurt the contractor's ability to produce and operate efficiently and effectively.

2.4.2. Types of Construction Delays

Delays can be classified into three types:

a. Excusable or not excusable: In the construction industry, excused delays occur due to events that are not due to the contractor and beyond the contractor's control or a third party for whom they are accountable. Depending on the conditions, the client may grant the contractor an extension of the time taken to complete the work or, in rare cases, may award the contractor

delay damages. Delays caused by the client delays already forgiven in the contract form and unexpected delays by both parties present at the time of contracting are all included [51].

Flaws on the contractor or a third party are responsible for non-excusable delays, wherein the contractor bears responsibility. There is no time extension or reimbursement available for contractors because they are held accountable for the delays they cause. It illustrates the contractor's inability to complete the job. As a result, the contractor is liable to the owner for any liquidated losses or delay charges throughout the construction process.

b. Concurrent or not concurrent: This is called concurrent delay when multiple events are delayed around the same time. There are a lot of delays, but the contractor is not entitled to extra time or money for each one. A situation may arise where two or even more delays occur regularly, yet when combined, they impact the overall completion time of the project. If the client is entitled to all the other delays, the contractor may file a claim for the missed time and costs [52].

c. Compensation or non-compensation: The contractor must demonstrate that the delays have been caused by the government or resulted in the project being delayed for a longer time. He must also certify that the delays were due to events beyond his control, which he must do. When he tries to receive his money back from the bank again for the delay, he has to defend his position and present a valid reason for his actions. If the government is allowed a hold that is not eligible for compensation [53].

Natural disasters, such as fires and exceptionally severe weather, strike, flooding, and other non-compensable delays, are also common causes of delays. The question of whether a weather-related delay should be deemed a non-compensable halt or not is frequently debated. Still, the answer is that it should only be considered in extreme weather conditions. Only the same kind of weather is found in that place, which was not assumed because of where it was. The contractor can't get a time extension because the contractor isn't to blame for any of the delays. However, even though the contractor establishes that delay was due to circumstances outside his control and requests reimbursement, he will still be denied compensation. A time extended is approved, and the contractor must pay financial damages due to the decision [54].

2.4.3. Delays' Consequences

Nothing more than change occurs as a result of the occurrence. The consequence may appear due to the project's delay. As a result, both the contractor and client may experience considerable financial losses due to this situation. There are several examples of this: arbitration, time overruns, expense overruns, conflicts, litigation, and the chance that the construction would be suspended indefinitely. Whenever there is a delay in a project, the contractor will need more time, no matter how much the consumer or the contractor is to blame for the delay. The customer, on either hand, doesn't have to pay for the total price overrun [55]. There are penalties for late contractors, so the contractor would have to pay more money if they were to be late. It would make the contractor's costs go up. On the other side, the client will lose money because the meeting was put off.

The most time-consuming consequence of a delay is a dispute involving both the party's client and contractor for claim settlement. Arbitration is regularly used to resolve conflicts between parties. Unless they are successful in their endeavor, they will turn to legal action. The competition is mainly between the clients and contractors of the two parties involved, but the entire operation suffers. They just use the schedule provided either by the contractor at the beginning of the project or as part of the tender papers to minimize conflicts [56].

The most practical, efficient, and fair method should be used to evaluate the consequences of a delay in the delivery of goods or services. The most prevalent result, according to research, is causes of delay, followed by the budget shortfall, arbitration, and litigation in the majority of projects. The investment cost may drop after a pause; the manager could choose to cut back on materials in use in the project to save money and time [57].

Time and expense overruns may occur due to increased different testing times or material unavailability; therefore, it is necessary to forecast the pace at which each activity will appear based upon that event, required skills, employee efficiency, and other factors. Additionally, delays can hurt a contractor's reputation by causing them to receive negative marks for their efforts, regardless of whether the contractor's work was excellent and made significant

contributions to a project. Because of the delay, the contractor's production drops, and his costs rise as a result [58].

2.4.4. Delays and Cost Overruns Have a Variety of Causes

The nine types of delays were classified as follows [59]:

a. Technological, financial, and social dynamics, for example, are all construction elements that must be considered together.
b. Contractor-related factors include, among other things, a lack of contractor knowledge, insufficient planning, poor site management, and faulty subcontractor execution, to name a few examples.
c. In the business world is a regular occurrence of thoughtful decisions, inadequate project completion dates, lack of finance, and other customer concerns.
d. One of the causes of material-related delays is a lack of availability.
e. Consultants give their approval to drawings and contracts.
f. In addition to delays caused by disputes or disagreements that develop during the project's duration, contractual considerations can include misalignment between the stakeholder's plan and the project's overall plan.
g. Unavailability of personnel and equipment and equipment malfunctioning during peak hours and other labour and material issues are all considerations to consider.
h. All of the following variables must be considered: misinterpretation, modification orders, disagreements, and other contract-related concerns.
i. Aspects of the external environment include changes in regulatory requirements, site conditions, weather changes, and other outside influences, among other things.

In Table 2.2, the author gives a specific rationale for the cost and time overruns that have been seen in the construction project [18], which is based on a comprehensive literature study and primary analysis.

Table 2.2: Delay and cost overrun causes [18]

Study of the Research	The Most Important Factors
Big construction projects are experiencing delays.	First, from the client to the contractor, there are financial limits. Inflationary Pressures on Contractors
A comparison of the causes of Hong Kong building project time overruns	Workplace inconsistency, incompetence Design flaws, project team, and technology concerns
Construction delays are caused by a variety of factors, including traditional procurement.	Site transition, approval of designs, choice, and terms & conditions are all unrealistically optimistic.
A variety of factors can cause delays in large building projects.	Site Management Practices That Aren't Up to Snuff Work Delay owing to a human resources shortage, Implausible Planning, and Construction Method
Slows in the Malaysian building industry cause and consequences	Material scarcity Frequently changing scope / ambiguous scope Issues with procurement / The delivery was late. There are no quality standards in place. Inadequate storage
Contractual terms cause construction delays.	Because of the frequent changes in scope, there is a conflict amongst stakeholders. a problem with coordination Contracts for multiple subcontractors are disorganized, resulting in cash flow concerns for the project. Legal wrangling
It's important to know why underground water projects inside a third-world country will not get founded on time or end up costing more than they were planned.	People who don't manage their contracts and sites have cash flow problems Phases and milestones of purchasing and delivering materials
Iraqi construction projects are running behind schedule because of the above.	The contractor is having money problems. Scope changes / There are no standards set. a bad plan Those who aren't very good at their jobs The technical staff has been cut back.
The Factors That Contribute to Delays in Large-Scale Construction Projects	There have been no IFC drawings produced. Difficulties in the contract Standard Operating Procedures (SOPs) or protocols have been specified for a particular process. Accidents involving the safety of others Customer review of drawings takes longer to complete because of the longer cycle time.
Significant factors that contribute to the delay of regulated utility infrastructure projects	Without indicating the contractor's experience and skill, the contract will use the Lowest Bid Win mechanism. Permits from the government Constraints on financial resources
The Value of New Technology in Construction Project Delay Mitigation	Aspects of Design WO Modifications (Work Order) Planning for Procurement Surprises in Site Conditions as a result of the stated design of Natural Catastrophes

2.4.5. Tendering Delays

Because tendering is one of the most crucial and fundamental stages of a site's project development, any delays experienced throughout this stage may ultimately result in an extension of the project's overall completion date and an increase in the project's expenses (Rosenfeld, 2014) [60]. Based on a literature review, the data in Table 2.3 highlights the delays and cost overruns that occurred during this period [20].

Table 2.3: Tendering Delays [20]

	Recommendations that are predicated on a thorough review of the literature
1	Obtaining authorization from the appropriate authorities
2	There were problems with the bid documents in drawing, Bill of Materials, and other things.
3	A lot of scope changes, and not enough communication respectively stakeholders
4	The prices for winning a tender are too low.
5	In the tender documents, there are a lot of terms that aren't clear, ambiguous, or contradict each other.
6	There is a clear risk between both the contractor and the client.
7	Legal documents, such as a contract for claims that aren't clear, can be found in the library

2.4.6. Execution Delays

When an unexpected, unannounced, and unknown mishap happens, the execution is postponed until the situation is resolved. Table 2.4 summarizes the most typical reasons for delays in conducting business [23], which would be based on an analysis of relevant literature.

Table 2.4: Execution Delays [23]

	According to a literature review, execution delays have been determined.
1.	Management and supervision seemed weak.
2.	Financial difficulties because of cash flow difficulties
3.	The building stage of the project is characterized by design revisions and ambiguity over the scope of the project.
4.	Bad project management
5.	Slowly but steadily, design specifications are developed and approved.
6.	Failures in communication between the project stakeholders
7.	The client supplied a time estimate that was far too optimistic.
8.	Inadequate supply of essential inventory
9.	Materials procurement
10.	Method of Construction

Cost overruns are noticed because of the delays outlined in the preceding literature, and subsequent options for resolving the issue will be examined in the section on the topic devoted to reducing such costs [61].

2.5. RESEARCH DISCREPANCY

According to Han et al. (2008), the literature study addresses how lean, and six sigma concepts may be used in construction to reduce risks and delays [62]. As a result, they propose ideas to maximize the performance of buildings simply by embracing lean and six sigma concepts as a concept. The advantages of employing six sigma were investigated and how compared to other construction techniques that are already in use in the industry. According to the study's findings, a six-sigma approach is still a tool for quality assurance and quality improvement. Still, it is also a technique for quality and procedural control, and it is used to set standards and recommendations. When using the six-sigma common tactic as a guide, quality modifications or crucial to quality (CTQs) associated with project process development can be handled in a way that ensures the desired construction results are achieved. The research will seek to bridge

the gap by integrating lean six sigma tools and 5S techniques to assist in risk minimization. It will be accomplished through a case study and survey studies [63,64].

According to (Brue 2002) [65], most of an organization's revenue is lost due to labor expenditures, waste, and delays, which results in an increase in processing times for a procedure, cost hikes, and overall consumer dissatisfaction with the business. Six sigma is an approach to cost reduction that focuses on process improvement and higher productivity.

Following the findings of a study by (Kwak & Anbari, 2006) [66], the application of six-sigma principles in a variety of industries such as financial services (financial services), manufacturing (manufacturing), health care (health care), and research and technology resulted in multiple advantages in terms of quality management, improved productivity, performance measurement, and site management (financial service). As a result, the Bechtel Company was the first to apply six sigma in the construction industry to prevent and detect rework throughout various project phases. The findings showed that the application of such methodologies resulted in significant cost savings [67,68].

2.6. CONCLUSION

Following a review of the literature, the following hypothesis can be made.: In addition to better process quality and customer satisfaction, increased implementation of practices leads to improved processes that result in increased productivity. A questionnaire method is proposed to verify the assumption, and a test case is conducted to evaluate whether the hypothesis is correct or incorrect. The research technique will be discussed in further detail in the later section.

3. METHODOLOGY

3.1. INTRODUCTION

The preceding chapter outlined the study domain and the research hypothesis that would be tested. The authors used the methods mentioned in Chapter 4 to test and illustrate all the concerns presented by the study's objectives, and in the process, they were able to uncover some new theoretical insights as well. Researchers employ a research methodology to describe how they go about developing theories. Theories are constructed by taking a systematic perspective on events and looking for correlations between variables to explain or forecast the behavior of those variables.

3.2. A DESCRIPTION OF THE GATHERED INFORMATION

Scientific research takes the shape of an iterative philosophical process, with each step based on the information and experiences that the researcher already possesses in the field, Figure 3.1 [31]. As a result of digging deeper into the literature, we now have a better grasp of the complexities of the cost control system. This new understanding has been utilized to guide empirical study, which has generated a new understanding of the phenomenon. By going back and forth between parts and wholes, one can understand a subject's structure [69].

This study's first objective is to determine:

a. What is the primary challenge Iraqi contractors experience in reducing project costs?

b. How do Iraqi contractors keep project costs in check? What is the rationale behind the use of these techniques?

c. In what ways might one's ability to regulate spending be influenced?

3.3. DESIGN OF RESEARCH

Research design is a conceptual structure within which a study is conducted. It is a strategy that begins with developing specific research objectives, organized data collection methods, and a straightforward selection of the population and samples to be examined [70]. The study design is a valuable tool for data collecting and analysis. Some of the most common types of research design include descriptive research design and explanatory research design, Figure 3.1 [31].

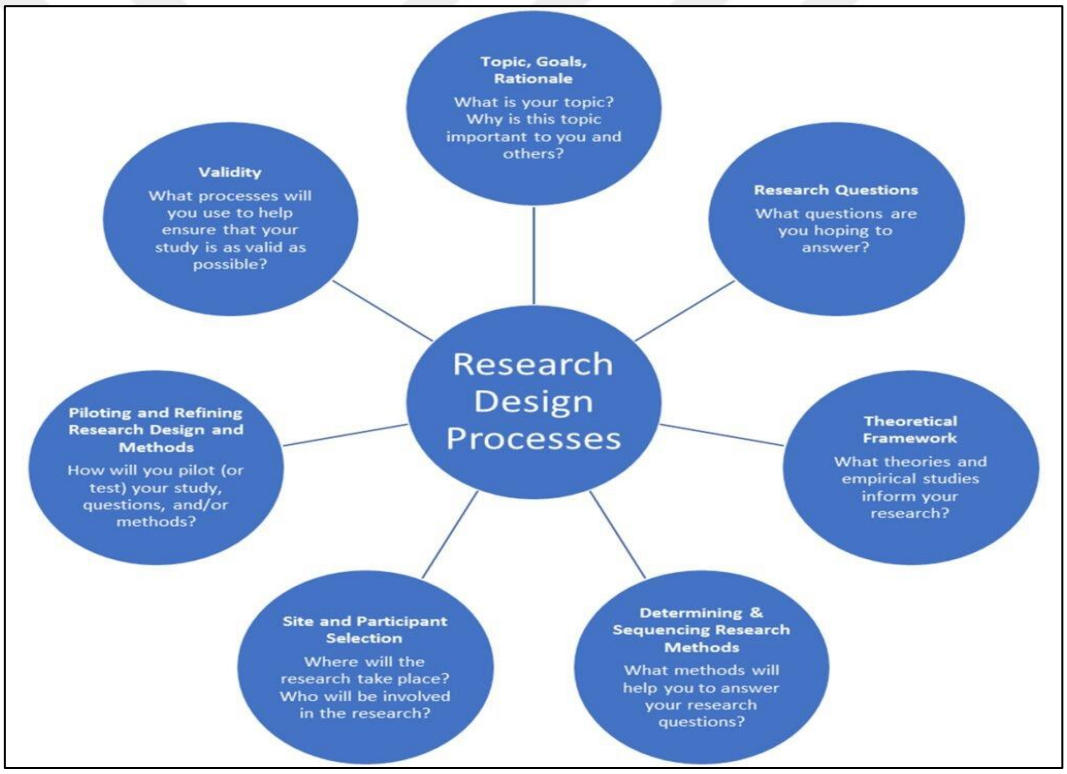

Figure 3.1: Research Design Process [31]

In this study, the influence of cost control on profit maximization will be described using a descriptive research approach, which will be implemented. Using a descriptive technique, the researcher acquired a more profound knowledge of manufacturing organizations' difficulties while generating practical solutions to improve profits. Survey questionnaires are often used in descriptive research, collecting information on the participants during the study's duration.

Researchers had no authority over the conditions and could only provide information about what had been happening at the investigation time [32, 71].

3.4. POPULATION RESEARCH

A targeted demographic is defined as a group of people who are thought to be appropriate to the research project, Figure 3.2 [33]. A population is a group of all members who meet the specific criteria set forth for a research study, and the chosen individuals contribute to the development of a research conclusion using data gathering methods. To study a segment of the population, companies, interpersonal relationships, or events as a population would include selecting a sample of that group from which to pull data from the population under investigation. These were the people intended to be the study's target audience. Controlling expenses impacts all parts of a company's activities, from finance to marketing to sales to human resources to production. It also influences quality control [72,73].

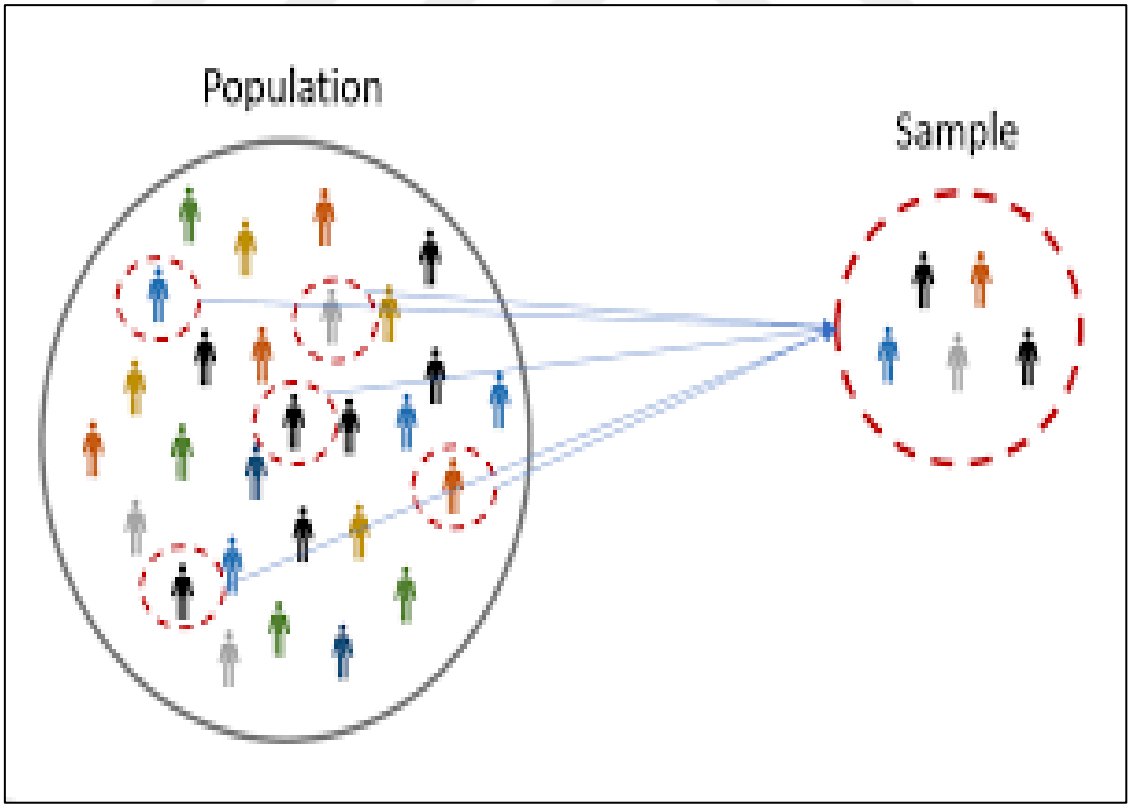

Figure 3.2: Studying the Population [33]

3.5. Collecting Samples Methods

A subset of the sample population (or audience) has been statistically chosen to represent it, Figure 3.3 [34]. Although the sample size was established, it was not essential to draw a representative sample because it was accessible to interview the target population.

Figure 3.3: Size of the Sample [34]

The study's target audience was 165 individuals from various industry organizations, although the sample size was only 117. the researcher used Slovin's formula to compute the sample size. Slovin's formula [35, 74] is widely used in my country to determine the sample size for survey research, particularly in undergraduate theses in education and the sciences, perhaps because it is simple to apply, and the computation is nearly entirely dependent on the population size. The following is Slovin's Formula: n = N/(1+Ne2), where n is the sample size, N is the size of the population, and e is the researcher-determined margin of error. However, its misuse is currently a major topic of investigation in my nation. Typically, students are discouraged from utilizing the algorithm even though its justifications are unclear. Perhaps it would be helpful if we knew who Slovin is and what his formula's foundations were [36, 75, 76] which are as follows:

$$x = \frac{X}{1+(X \times e^2)} \quad (3.1)$$

Where:

X = Population Amount

x = Size of the sample

e = Is the certainty point at 0.05

Substituting into the formula

$$x = \frac{165}{1+(165 \times 0.05^2)} \quad (3.2)$$

$$x = \frac{165}{1+(165 \times 0.0025)} \quad (3.3)$$

$$x = \frac{165}{1+0.4125} \quad (3.4)$$

$$x = \frac{165}{1.4125} = 117 \quad (3.5)$$

Therefore x = 117 respondents

3.6. CONTROL OF DATA QUALITY

Qualitative data controls (QC) are applied to verify whether data satisfy overall quality goals and stated quality requirements for individual values. The term "data quality" relates to the volume and quality of data available to a researcher [77]. Various approaches are available to assess data quality; nevertheless, in general, data is considered good quality if it can be used in operational, decision-making, and planning contexts and is easily accessible. When data accurately depicts the real-world structure to which it is related, it is considered high-quality information. When the number of available data sources increases, normalization becomes even more critical, regardless of whether the data is suited for a specific external goal. Even when investigating the same data collection for the same objective, the quality of the data can vary significantly from one study to the next. It is where data governance comes in to help define and

standardize the data's quality [78]. In certain situations, it may be necessary to do data cleansing and standardization to ensure the quality of the data. Figure 3.4 [37].

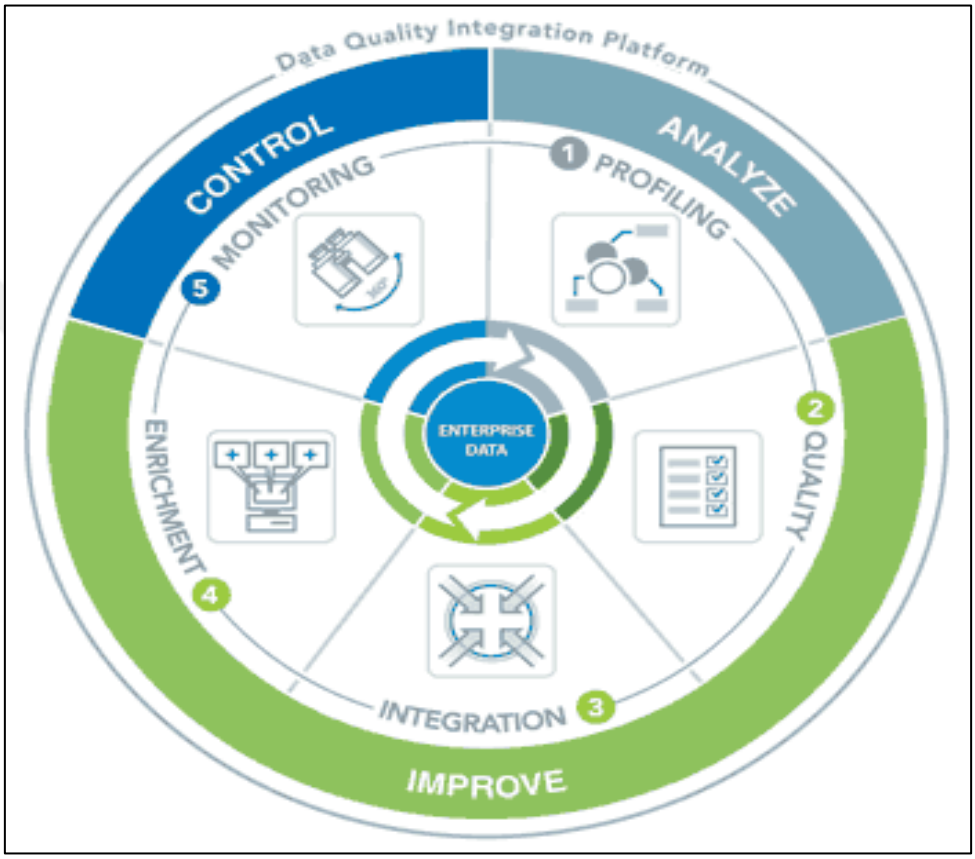

Figure 3.4: Control of Data Quality [37]

a. Validity: The precision and dependability of the findings are critical to the legitimacy of a scientific study's conclusions [79]. The validity of an instrument should be demonstrated by the instrument's ability to accurately measure what it promises to measure, according to validity research. Validity is determined by whether or not the research can accurately measure what was intended to be measured in the first place. Authenticity is determined by the accuracy with which a research instrument measures what it purports to measure and that other variables do not impact it. Inadequacies should not be overlooked due to their catastrophic consequences of them. During the development of questionnaires and interview

guides, the researcher used study objectives and research questions to guarantee that the instruments were valid. Checking the legitimacy of the research instruments utilized confirmed that the questions were posed due to increasing demand for information about the subject under investigation.

b. Reliability: In this meaning, "erroneous information" refers to information that generates reliable results, which is what we mean to say, "information is regarded error-free." Researchers must have the same study equipment to obtain identical results on the same subject matter for information to be considered reliable. It has been argued that the goal of reliability is to eliminate data collection errors. A reproducible outcome may be attained by repeatedly repeating a series of measurements with the same results [80, 81].

   Because the survey was performed at a private university, respondents were concerned about revealing their identities. The researchers established a box where respondents may anonymously drop off their filled questionnaire. Because they covered all parts of the study, structured interview questions helped to ensure that the data was valid and accurate. The questions were created so that they covered all areas of the objectives for each one. The first introduction to the world is the best time to distribute questionnaires to minimize the chances of responders making mistakes [82].

3.7. RESEARCH SYNTHESIS AND ANALYSIS OF THE DATA

Preliminary steps of a research project include a review of relevant works and a synthesis of the information contained within that literature. The literature is reviewed systematically at the start of the project and during the project's duration. As a result, a literature review describes and evaluates the current understanding of the subject topic [83]. This research looked at a wide range of primary and secondary data from twenty-nine different sources for its findings. Find out what was already known about cost control and how it could be better to meet these goals.

a. As a result, academics and practitioners have expanded on their earlier experiences by comparing the gathered primary material (interview session) [84] against the basis of a standard.

b. The inquiry included extensive literature studies, which were a significant component of the process [85]. The fundamental goal of this literature review objective was to have a better understanding and knowledge of cost reduction strategies. An efficient contractor is expected to possess all the qualities and characteristics traditionally considered necessary in the construction industry.

3.8. THE MOST CRITICAL INFORMATION

In this phase, the research technique involved a thorough verification of the constructed potential model based on expert opinions from selected and diverse groups of Iraqi construction enterprises and two case studies. Some of the most important companies in the market did polling data and found that our experts were chosen because they were good at motivating people and making them feel good about themselves [85]. By utilizing Google Forms, we received a perfectly accurate slice of the responses.

The cost and requirements for separate projects were covered in the case studies [86]

Survey: A questionnaire was undertaken to acquire information from construction industry professionals through a questionnaire. This survey aims to get input and knowledge from experts on how to best control costs. Here is a breakdown of the questionnaire's four sections:

a. The first section of the questionnaire asks about the respondent's companies, their size, and their fields of work.
b. This section focuses on how construction costs are managed in the real world. There are two sections to each question in this section [87].
    i. First, there are multiple-choice questions focusing on various cost-control methods.
    ii. Based on this evaluation method, it was determined that the techniques used for project cost control were effective.
c. These three parameters have been used to identify the level of exertion performed for cost control in section three [88].
    i. Reporting frequency,
    ii. Work breakdown structure
    iii. Organizational breakdown structure.

d. Questioners' perspective of cost control expertise is an essential issue in Section 4. Additional comments can be made in the open-ended section, including a question regarding a weakness or mistake [89. 90]. The questionnaire framework was re-generated based on the interviewees' (weakness/error) comments.

3.9. COST MANAGEMENT AND CONCEPTS

a. Cost, costing, and cost classification are all terms used to describe the cost of something.

When you think about the cost of something, you think about how much money was spent on making it during the process of making it. In other words, it is the price you spend on the items you must purchase to complete a task. The term "cost" refers to the amount of money required to carry out a specific activity or task. If you want to think about money, it is the quantity of money traded for a good or service expressed in monetary terms. When it comes to cost, determining how much everything will cost, the term "cost" serves as a beginning point for discussion [91].

Costing determines the price of a product or service by employing several methods and procedures known as cost. Various methods can determine the price of a product or service, and each method has its advantages and disadvantages. Accounting has to do with categorizing expenses, their buildup, assignment, and control. Setting budgets, standard costs, actual costs, conducting variance studies, and assessing profitability are all aspects of cost accounting that must be considered.

Costs should be separated into several categories to make internal communication more straightforward within the cost management system. There are several categories in this section, including time (historical and predetermined), sort of stuff or object (Materials, Labour, and Overhead), and traceability (direct or indirect) of your spending (Fixed, Variable, and Semi-variable). In addition to classifying costs by function (manufacturing vs sales and R&D), accounting period (capital vs revenues), and the degree of control available (controllable vs non-controllable), cost management methods can also be classified by the type of decision-making process (analytical vs decision-making) (Opportunity, Marginal, Sunk, Joint, Deferential, Replacement or Common).

b. Cost control is necessary.

Cost control is defined as setting a standard and sustaining performance in compliance with that standard. When it comes to running a business, cost control is essential because it helps with management and reduces unneeded expenditures. It is specifically responsible for the computation of unit costs and the assessment of marginal costs, and it is concerned with ensuring that costs remain within acceptable boundaries.

Cost control refers to monitoring and regulating all expenses by comparing actual expenditure to specified standards or budgets to identify and correct any unfavorable trends from the current condition as soon as they develop.

Keeping costs under control is crucial because it is the most visible backer of any commercial enterprise, and, as a result, it is the bottom line for every company. For a firm to be profitable, individuals in charge of operating it must grasp all that goes into making a company profitable. The cost of the goods is a crucial consideration to bear in mind. All activities, from acquiring things to account for sales, may be expressed plainly; cost control results in the efficient use of resources, and it simplifies the decision-making process for management. These advantages include: Keeping costs under control is extremely important to many firms, particularly in labour, resources, marketing, and administrative costs.

i. It is possible to look at labour costs in three ways: increased base salary, reduced hours worked, or decreased output. Many businesses find it challenging to cut labour costs since they cannot slash wages due to labour union members and minimum wage laws. The contract amount of productivity levels must improve faster than the wage rate increases to reduce labour costs. It would have the effect of enhancing manufacturing efficiency.
ii. Excessive use of materials contributes to higher expenses, waste, and ineffective management. Material waste must be minimized to keep costs down.

iii. Controlling sales necessitates keeping an eye on how much money the company is spending to meet its sales targets. Companies use sales budgets to forecast and control their income.

iv. These include factory costs directly attributed to the product itself, such as overhead costs. Effective absorption, allocation, and apportionment to cost units are ways to cut costs.

To increase profits, a company must keep costs under control and reduce them to a level that can be tolerated. Organizations must implement a cost-control and cost-reduction strategy to ensure that cost management is a successful strategy for their business. Cost control effectiveness is hampered by attitude control measures such as employee motivation and incentives.

c. Controlling and reducing cost

Reducing the cost of goods or services without diminishing their usefulness is called cost reduction, and it is a planned constructive strategy for reducing expenditure. To keep costs under control, one must define an acceptable standard and hold employees accountable for performing to that standard. Cost control and cost reduction are vital to a business because they help control and decrease unnecessary expenditures. As a result, both cost control and cost reduction are integral. The goal of cost reduction is to determine if there are any ways to reduce the costs incurred. There is a clear difference between cost management, but both are necessary and mutually incompatible with achieving the same goal.

Cost control and cost reduction can help any company sell its products more petite than its competition without sacrificing quality. An organization's ability to manage and reduce costs is directly correlated to its cost control and cost reduction efforts. Supported by claiming that cost reduction requires an effort to enhance and achieve a natural and long-lasting reduction in total cost. Reduced waste, lower costs, and increased production are part of a sustainable strategy. Keeping costs down is not enough to maintain performance according to standards; instead, it is assumed that there can be hidden cost benefits in the

standards or norms, which are continually questioned to improve performance by bringing out the benefits.

d. Definition of some cost control

i. Cost Control: this is impossible without a thorough grasp of the factors that cause cost changes over time or deviations from intended levels. Every aspect of business begins with the budgeting process, and budgeting cannot be completed without first grasping why costs change over time. A flexible budget to accommodate variable costs, such as varying volumes, can account for these adjustments. Price adjustments can be influenced by quantity discounts and other factors such as inflation and changes in supplier costs. Consequently, it is simpler to keep track of expenditures.

ii. Cost Containment: A strategy known as Cost Containment must be employed to maintain cost stability throughout time. It can only be used within the company; it is impossible to apply it to external pressures such as inflation, taxation, and regulatory changes in supply and demand. Lower supplier competition, lower quantities purchased, and seasonality are all factors that contribute to increased internal expenses that demand cost-containment measures to keep costs down.

iii. Cost Avoidance: It is stated that cost avoidance is a method for lowering expenditures because it reduces the likelihood of an increase in expenses. When cost reduction is not possible, cost avoidance is used to explore suitable alternatives to avoid wasteful spending on goods and services.

iv. Cost Reduction: The ability to avoid expenses directly impacts reducing overall expenses. Cost avoidance and reduction are intended to result in a smaller overall budget. The ability to reduce expenses early in the design process will aid in the prevention of high costs later in the product's life cycle. Broadening the scope of a cost-cutting strategy to encompass manufacturing has grown commonplace in recent years. The elimination of waste and non-value-adding activities throughout the manufacturing process helps to reduce costs.

3.10. IMPLEMENTING A COST-CONTROL SYSTEM, A STEP-BY-STEP GUIDE

Management has identified a five-step approach for constructing a cost-controlling and cost-managing environment. The steps in the five-step management approach are as follows [92]:

a. Learn about the many costs a business must bear. Identifying the cost paid by a firm is said to be crucial. Are the costs in question fixed or variable, product or period? or precisely what aspects determine the total cost of these services? Did these come from a local store or online? How long ago did you buy something? As a whole, "spend analysis" is a common term for this type of analysis. An efficient cost management system can only be created if a company knows where its revenue comes from and how much money it costs to generate that revenue stream. Finally, it must determine non-revenue producing expenses and overhead expenditures.
b. As a company, all employees must be aware of the importance of cost management and how it may benefit both the company and the individual employee.
c. Teach your staff about the need of saving costs. Workforce members should be informed of cost-cutting concerns and encouraged to provide cost-saving suggestions. They should be compelled to embrace strategies for reducing expenses. Incentives can be as simple as expressing gratitude verbally or financially, or they can be as complex as providing paid time off. Management must be flexible enough to deal with changes in the operating model. According to this, workers should be involved and have access to credible cost information when making cost management decisions. As an additional benefit, requesting employee input will assist management in obtaining a better understanding of the situation and encourage employees to participate. Organizations that actively seek feedback from their employees are guaranteed to develop and have better methods for cost control.
d. Reporting tangible outcomes, comparing projected costs to actual costs, and figuring out discrepancies all pointed to the need for management to produce reports that reflect actual results. To find out why these costs were previously under control or not, management must conduct a thorough investigation. This type of research can expose the cost drivers, allowing for improved control of future cost-driving behaviors.

e. According to management, a long-term approach to cost containment is preferable to a quick fix. Decisions about costs should be focused on the company's long-term strategy rather than the immediate problem at hand. Buying too much inventory is a bad idea because the manufacturer has slashed the price to get rid of it. The company should only buy what it needs to satisfy its customers. It's time to make cost management a regular part of your workflow. We must always be looking for ways to decrease or eliminate non-profitable activities.

3.11. THE EFFECTS OF INEFFECTIVE COST CONTROL MEASURES.

Companies that do not correctly apply cost management techniques risk having their operational performance harmed. Failing to adequately manage your costs can lead to higher waste, maintenance, repair expenditures, and labour costs. Operations will suffer if costs rise without corresponding increases in employees [93].

a. Wastages

The absence of cost management also implies that workers are not effectively overseen, which means that employees are free to use the organization's resources however they see fit without being held accountable, resulting in resource waste on the part of the organization. In comparing the quantities of materials needed to generate the items to the quantities obtained, which is the finished product that has been manufactured, it is revealed that waste has occurred. A distinction can be made between typical waste and atypical waste, which are two different categories of trash. Waste is the amount of material that is estimated and planned for before production begins, but abnormal waste is defined as the amount of material that exceeds the typical loss, resulting in an increase in expenses due to employee carelessness [94].

b. Construction and maintenance

Costs are incurred to restore the asset to its pre-existing condition and ensure that it continues to operate correctly. Repair and maintenance expenditures can be budgeted for; however, some are unpredictably high and unpredictable. Poor management, employee

incompetence, a lack of training, and a large stockpile of inventory can all contribute to this situation. Increasing repair and maintenance expenses indicates that present cost-cutting strategies fail to achieve their intended results.

Maintenance expenditures are kept to a bare minimum due to the prudent maintenance culture of businesses that implement cost-effective cost control measures. To effectively control costs, low-maintenance, high-reliability equipment must be purchased. As a result, the corporation will have a factory that will last for a long time and require little maintenance. The report proposes that manufacturing organizations do equipment lifecycle cost evaluations to save money on repairs and maintenance to reduce costs. Device economic feasibility analysis is a popular expense method in fleet management for lowering overall expenses. It offers fleet managers all of the information they require to make informed decisions about their equipment and vehicles' repair, replacement, and retention. Unless they adopt a cost-management approach that assists managers in optimizing the entire lifecycle value of each item in the fleet, most businesses struggle to keep maintenance and repair expenses under control.

c. Labour costs are high.

Labour expenses must be incurred for a company's goals to be met. These costs include the costs of acquiring and keeping employees. In addition, because the organization is in charge of rising and lowering labour costs, these expenses are classified as long-term controllable costs. The vast majority of firms use labour cost-saving tactics as a competitive strategy. Labour costs can be reduced by integrating modern technology with human resource management in the area that concerns the long [95].

It has been shown that poor cost management results in some rises in labour expenses in most firms; in other circumstances, it has been discovered that management's cost control processes are ineffective. The management's budget should be used to set labour targets to ensure no fluctuation in the amount of work being done. An increase in labour expenses will probably arise if management attempts to correct labour variables caused by faulty management contracts by hiring labour. This will result in an increase in labour overheads,

which will lead to overspending of the labour budget, leading to a decline in operating performance [96].

In a company, labour expenses might rise or fall for many reasons, none of which can be linked back to inadequate management techniques within the business. These expenses are influenced by the market and other factors, including location, efficiency, supply, and demand, among others. Organizations located in economically depressed places almost always have lower labour costs than organizations located in more prosperous areas. When a corporation seeks highly trained personnel in a location where educated workers are scarce, labour costs may be higher because financial incentives must be given to those who relocate.

According to the premise that labour costs fluctuate due to market dynamics such as supply and demand, cost-cutting techniques are unable to account for fluctuations in labour expenses. When it comes to deciding salaries, the forces of supply and demand operate in the same way they do when establishing the price of a product or service price. Because of a scarcity of workers, the firm will be forced to spend a significant amount on labour expenses.

d. Reduced operational efficiency

The more irresponsible a company is with cost management tactics or approaches, the less efficient it is with its resources, pulling down the organization's performance. When there is poor cost management, it also means insufficient worker supervision, which means that employees can spend the organization's resources in any way they want without being monitored, which reduces performance. Operational performance refers to the alignment of the organization's various strategic business units and their activities to ensure that the strategic business units contribute to the achievement of the organization's goals. As a result, cost control can lead to a decrease in operational performance [97].

Cost control measures that are ineffective have an impact on a company's performance and profitability. Profits play an essential role in determining a company's financial status. As

a result, cost control measures must successfully ensure that costs do not exceed acceptable levels; otherwise, profitability will suffer, and expansion and process efficiency will suffer.

3.12. PROJECT STUDY

Multiple projects have already been chosen based on how much they cost and what they need so that we can better understand why the cost of these projects has risen. The costs of the essential contracts and the final payment for these projects were found out. In the next step, I looked at what was agreed to in the original contract on the construction site. Based on a careful look at each project independently [98].

a. Try to Obtain a copy of the primary contract, final payments, maps, and preliminary information about the project's background from the consultant and the contractor as part of the case study methodology and research technique.
b. According to statistical analysis, a monitor works on the bills of quantities and final payment tables independently of one another (re-calculation).
c. The basic terms of the contract are compared to the final payments.
d. Calculate the percentage of each component that contributes to the high construction expenses in each example.

3.13. QUESTIONNAIRE-BASED RESEARCH

Following a review of the literature, the author determined that a survey would be the most effective strategy for eliciting opinions about the hypothesis and data to be collected and validating the research objective. As such, this study makes use of the Questionnaire survey data tool.

a. The Questionnaire's Strengths and Weaknesses

   The survey approach's strength is that it may collect diverse data on people's opinions and views about a research topic. Thus, reliability and validity are two critical criteria for a questionnaire to be valid. Additionally, pilot testing should be conducted before questionnaire distribution to ensure the survey's validity. The questionnaire was piloted with experienced professionals who hold a green belt in the six sigma technique, and based

on their comments; an additional question was included. The questionnaire was developed using a six-point Likert scale. The questionnaire survey makes use of descriptive statistics [75, 85].

b. The Questionnaire's Reliability and Validity

In this Thesis, a survey was used to ascertain the perspectives of industry professionals regarding the benefits of six sigma and 5S in decreasing cost and time variables for a project via a self-created questionnaire survey. Surveys are a reliable data gathering instrument in scientific research methodologies for hypothesis validation. Additionally, such data collection methods can reach a considerable number of people, thereby collecting various data for research.

The significance of a form's dependability and internal validity was emphasized as a legitimate tool for assembling data that measures the examined notions. Cronbach's alpha is a well-known and well-acknowledged methodology for activity; it measures the internal consistency of responses to a series of questions, and a minimum internal consistency threshold of Cronbach's alpha 0,7 is required for valid responses in the study. According to the studied literature, the questionnaire's validity is determined by its content validity.

A sample test is conducted to determine the survey's reliability using participants not included in the final survey. The reliability results using the SPSS program. The test yields a result of 0,725, which meets the criterion of 0.7.

c. Surveyed Population

The primary responders in the study have expertise and experience with lean six sigma methodologies. The authors were asked about their previous jobs for the study, and the majority of their coworkers had green belts in six-sigma. Respondents were found via professional networking sites. The survey included people who had done work on construction projects as part of the more extensive sampling. An 80% sample size is required for the investigation.

The questionnaire is divided into four parts. The first section tells us about the necessary certifications and years of construction industry experience. Based on respondents' experiences, the second segment seeks to identify probable sources of project expense and delays. The questionnaire's last section aids in the identification of various programs and elements that can be employed in the construction sector to reduce errors by applying such instruments.

d. Variables' Measurement

For stage three of the questionnaire, which involves determining the program's parameters, respondents' opinions will be measured on a 6-point Likert scale. Respondents' opinions are recorded using a 6-point Likert scale with a = very high, b = high, c = medium, d = low, e = very low, and f = no answer. Some other options used in the questionnaire are measured on a 3-point Likert scale, and some of the used 5-point Likert scales depend on the type of question used in the questionnaire.

e. Questionnaire Return Rate

For research to be credible, it must have a return rate of 50 to 80%, with an average of 55% being regarded as appropriate. As previously noted, the survey response rate is within the required criteria limit. The survey's response rate was 60%, with a return rate of 75%.

3.14. CONSIDERATIONS ETHICAL

The researcher should maintain ethical standards throughout the research process by safeguarding the respondents' privacy, confidentiality, and anonymity. To adhere to ethical standards, the researcher will seek permission from the company administration to present questionnaires to their personnel, informing them that the knowledge will be used solely for academic purposes. The researcher will maintain the respondents' privacy, confidentiality, and anonymity. The researcher guarantees that the research will be conducted ethically and that all copyright rights will be maintained.

3.15. CONCLUSION

It is decided to use a case study as the significant data collecting instrument; however, various other data gathering methodologies are also used. An example case study and survey findings will be discussed in greater depth in chapter 4, which will cover all methods for data collection.

4. RESULT

4.1. INTRODUCTION

A survey was distributed to professionals with the intention of eliciting truthful replies from those who had direct experience in the relevant working environment. These responses will be disseminated and studied in order to arrive at a conclusion that is agreeable to all parties concerned while at the same time finishing all of the solutions for the task related to this particular thesis.

4.2. MEASUREMENT OF RATING SCALE

A Likert scale with six points will be used to measure the respondents' thoughts for the third and final step of the questionnaire, which will involve the determination of the program's parameters. On a Likert scale with six points, the opinions of the respondents are recorded. Some of the other options in the questionnaire use a Likert scale with three points of measurement, while others use a Likert scale with five points of measurement.

4.3. HYPOTHESIS REVIEWS

Consider the results of the questionnaire that the respondents had the opportunity to fill out. This report is broken up into four sections, and each of these sections will do an independent analysis of the data before presenting an analysis of how those findings connect to the hypotheses.

4.3.1. The First Part

a. Distribution of the study sample according to educational achievement, Table 4.1, Figure 4.1 shows the results from the respondents.

Table 4.1: Educational Achievement.

Educational achievement	Repetition	Percentage
B.Sc.	67	58%
High diploma	10	9%
M.Sc.	31	27%
Ph.D.	8	7%

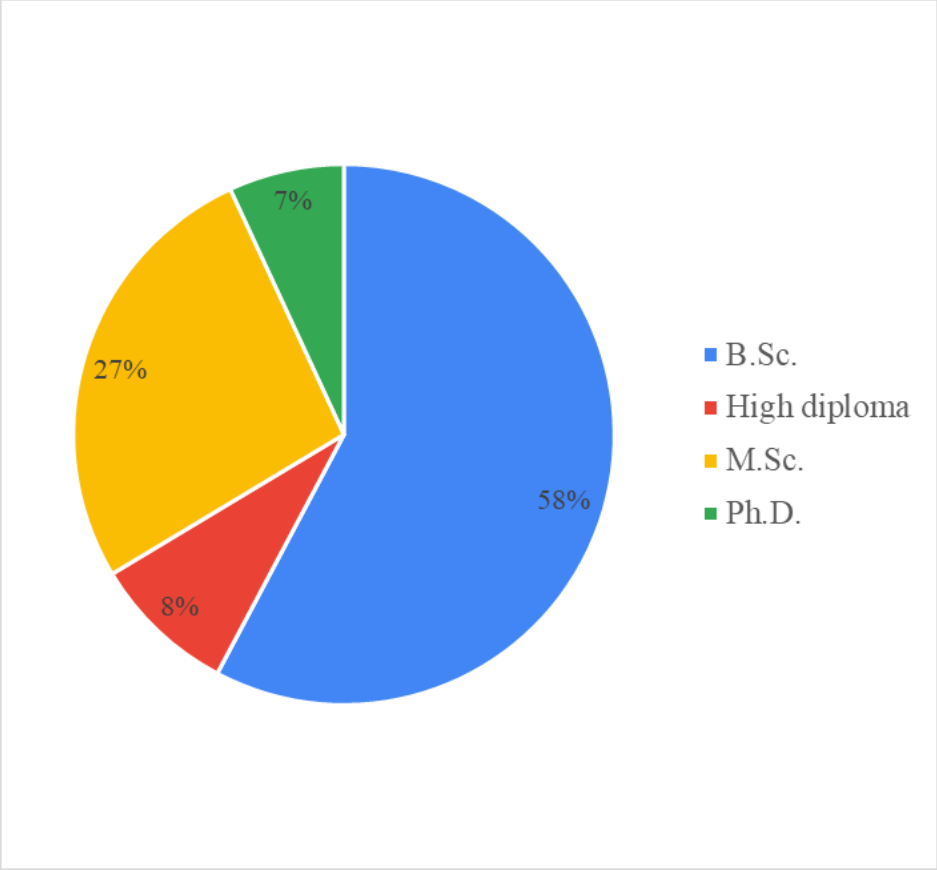

Figure 4.1: Educational Achievement

b. Distribution of the study sample according to Work nature, Table 4.2 and Figure 4.2 show the result for these parts.

Table 4.2: Work Nature.

Work nature	Repetition	Percentage
Design	9	8%
Technical advice	15	13%
Supervision	58	50%
Following up	34	29%

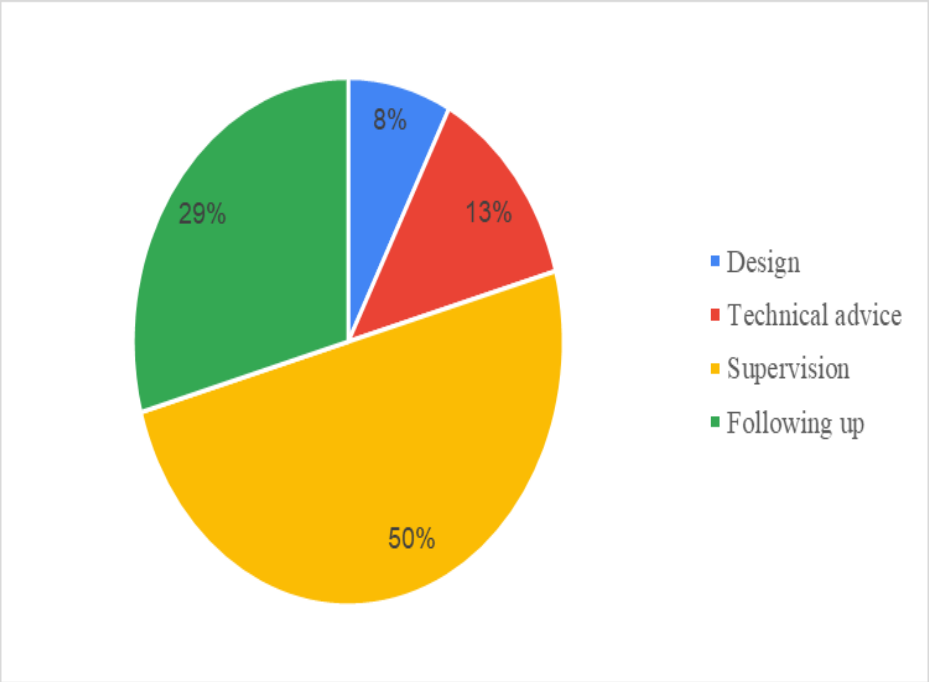

Figure 4.2: Work type.

4.3.2. The Second Part

a. Distribution of the study sample according to the type of projects implemented by the institution. Table 4.3, Figure 4.3 below for this question.

Table 4.3: Type of Projects.

The type of projects implemented by the institution	Repetition	Percentage
Service projects	36	31%
General construction	47	41%
Irrigation channels and dams	25	22%
Road and bridge projects	8	7%

According to the table above 41% of the questionnaire respondents about (The type of projects implemented by the institution) was general construction, which is the highest percentage by 47 repetitions, 31% of the sample responded with service projects by 36 repetitions, 22% from the sample responded with irrigation channels and dams by 36 repetitions and 7% from the sample responded with road and bridge projects dams by 8 repetitions. Where general construction projects are the most prevalent in Iraq and on the other hand road and bridge projects and dams least prevalent.

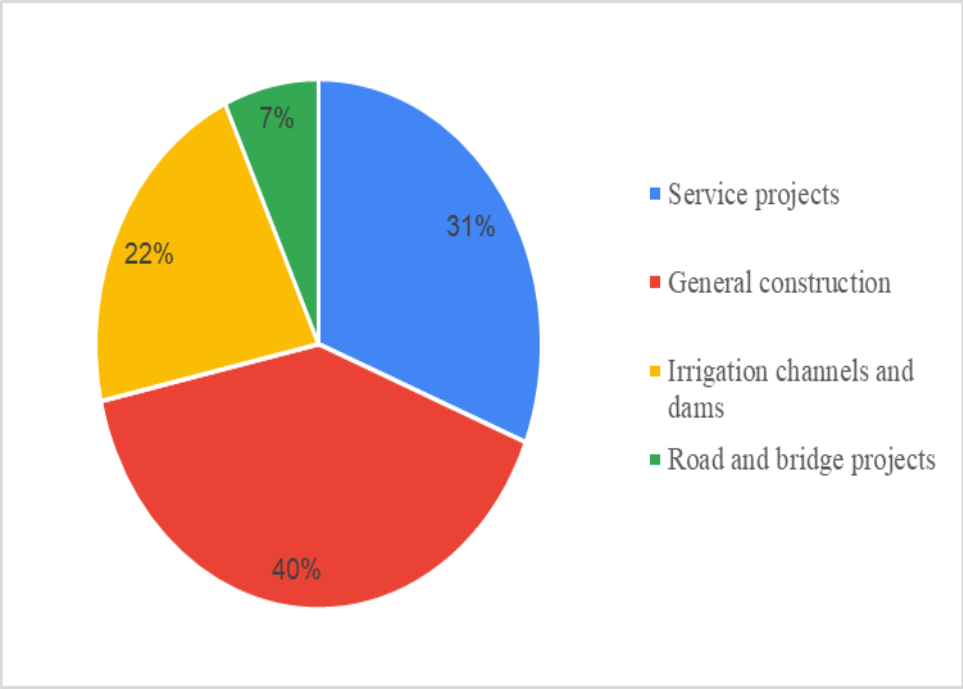

Figure 4.3: The type of projects implemented by the institution.

b. Distribution of the study sample according to the number of employees on the permanent owner in the institution, as shown in Table and figure below:

Table 4.4: Number of employees.

the number of employees on the permanent owner in the institution	Repetition	Percentage
Less than 10	16	14%
10 to 50	25	22%
50 to 100	13	11%
More than 100	62	53%

According to the table above 53% of the questionnaire respondents about (the number of employees on the permanent owner in the institution) was more than 100 employees which is the highest percentage by 62 repetitions, 22% from the sample responded with (10 to 50) employees by 25 repetitions, 14% from the sample responded with less than 10 employees by 16 repetitions and 11% from the sample responded with (50 to 100) employees by 13 repetitions. It is clear from the results that most of the respondents to this questionnaire work in institutions with a large number of employees .

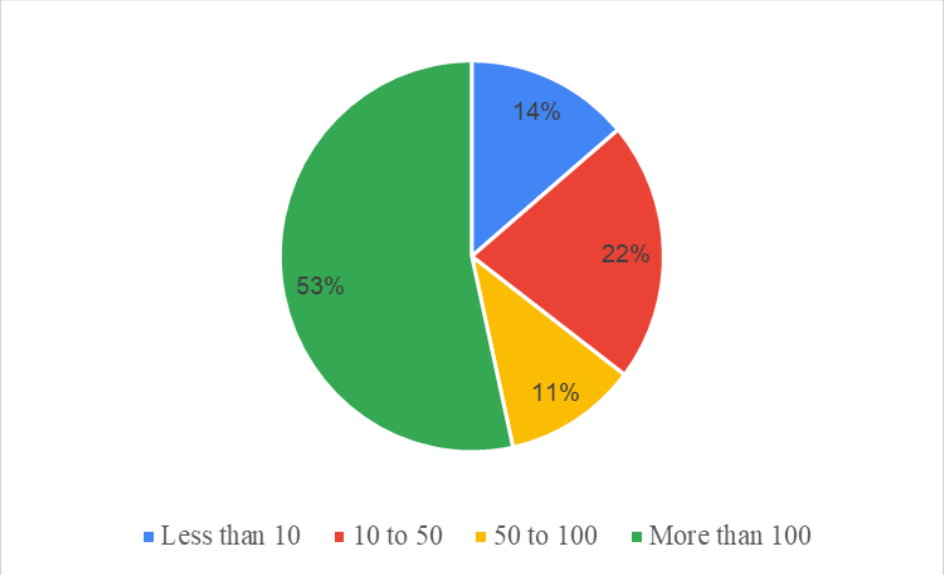

Figure 4.4: Number of employees on the permanent owner.

c. Distribution of the study sample according to the number of temporary employees in the organization.

Table 4.5: Number of temporary employees.

Number of temporary employees in the organization	Repetition	Percentage
Less than 10	38	33%
10 to 50	35	30%
50 to 100	16	14%
More than 100	27	23%

According to the table above 33% of the questionnaire respondents about (Number of temporary employees in the organization) was less than 10 employees which is the highest percentage by 38 repetitions, 30% of the sample responded with (10 to 50) employees by 35 repetitions, 23% from the sample responded with more than 100 employees by 27 repetitions and 14% from the sample responded with (50 to 100) employees by 16 repetitions.

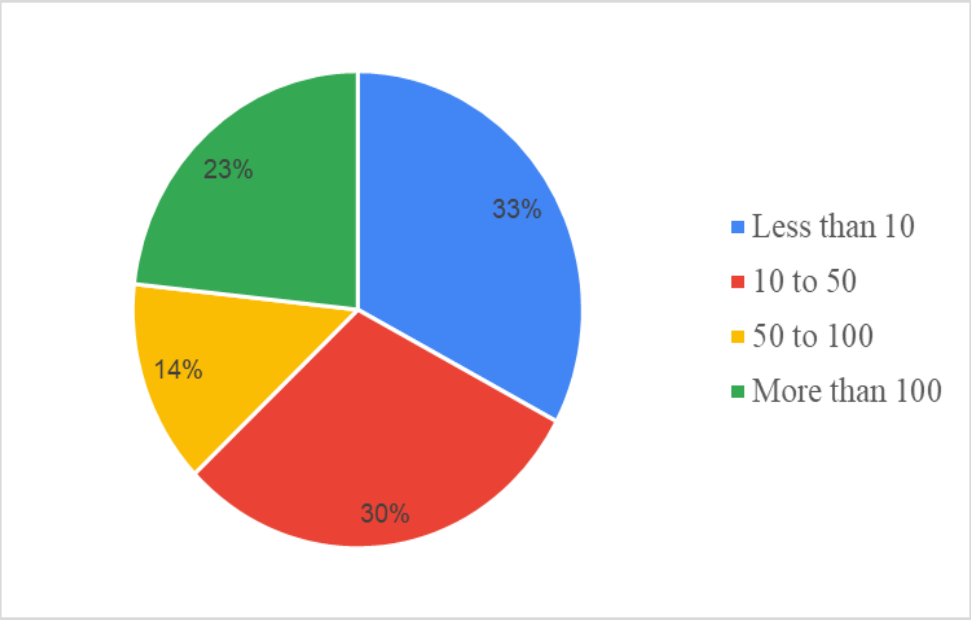

Figure 4.5: Temporary employee's amount.

d. Distribution of the study sample according to the value of the equipment in the enterprise.

Table 4.6: Value of the equipment.

The value of the equipment in the enterprise	Repetition	Percentage
Less than 10000$	38	33%
10000 to 50000$	19	16%
50000 to 100000$	12	10%
More than 100000	47	41%

According to the table above 41% of the questionnaire respondents about (the value of the equipment in the enterprise) was more than 100000$ which is the highest percentage by 47 repetitions, and 33% of the sample responded with Less than 10000$ by 38 repetitions, 16% from the sample responded with 10000 to 50000$ by 19 repetitions and 10% from the sample responded with 50000 to 100000$ by 12 repetitions which is the lowest percentage. As these answers indicate the extent of the diversity of activities carried out by the institutions of the respondents to this questionnaire.

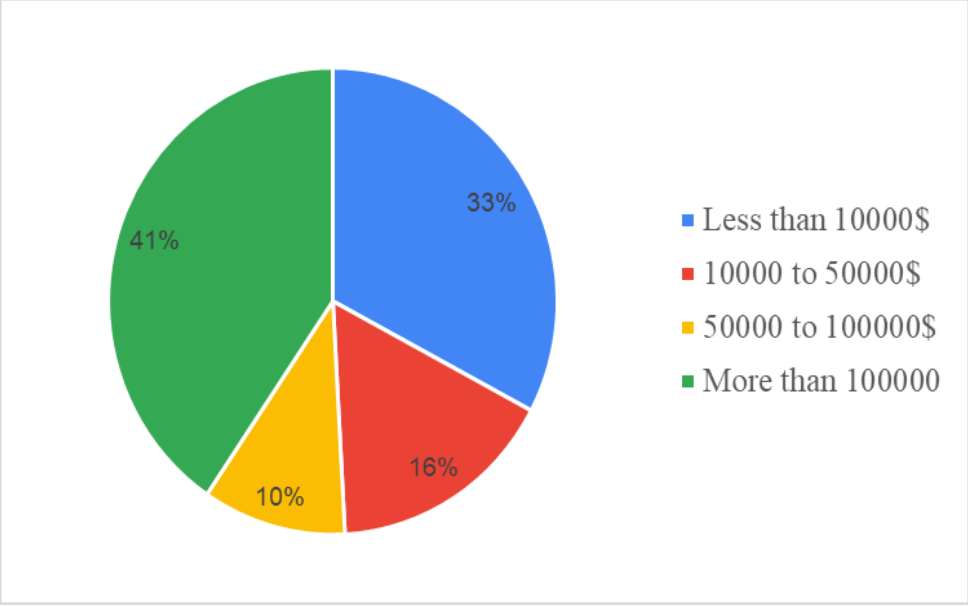

Figure 4.6: The equipment cost value.

e. Distribution of the study sample according to the annual average of the amounts of projects implemented by the institution in Iraqi dinars

Table 4.7: Annual average amounts of completed projects.

The annual average of the amounts of projects implemented by the institution in Iraqi dinars	Repetition	Percentage
Less than 10 billion	62	53%
From 10 to 25 billion	19	16%
From 25 to50 billion	16	14%
More than 50 billion	19	16%

According to the table above 53% of the questionnaire respondents about (the annual average of the amounts of projects implemented by the institution in Iraqi dinars) was less than 10 billion which is the highest percentage by 62 repetitions, 16% of the sample responded with from 10 to 25 billion by 19 repetitions also 16% from the sample responded with more than 50 billion by 19 repetitions and 14% from the sample responded with from 25 to50 billion by 16 repetitions which is the lowest percentage. This reflects the economic reality of companies and institutions working in the construction industry in Iraq.

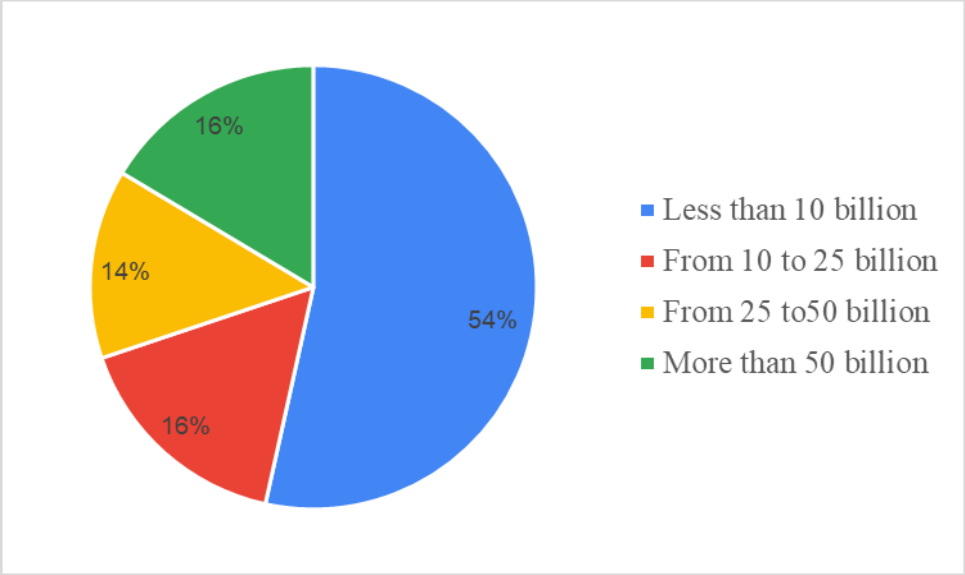

Figure 4.7: Annual average of executed projects in ID.

f. Distribution of the study sample according to the annual average time for the implementation period of the projects completed by the institution

Table 4.8: Annual average time.

The annual average time for the implementation period of the projects completed by the institution	Repetition	Percentage
Less than one year	32	28%
From one to two years	40	34%
From two to three years	23	20%
From three to four years	8	7%
More than four years	13	11%

According to the table above 34% of the questionnaire respondents about (the annual average time for the implementation period of the projects completed by the institution) was from one to two years which is the highest percentage by 40 repetitions, 28% from the sample responded with less than one year by 19 repetitions also 20% from the sample responded with from two to three years by 23 repetitions and 11% from the sample responded with more than four years by 13 repetitions which is the lowest percentage. It is clear from the previous answers the extent of the institutions' activity and the amount of work performed by them.

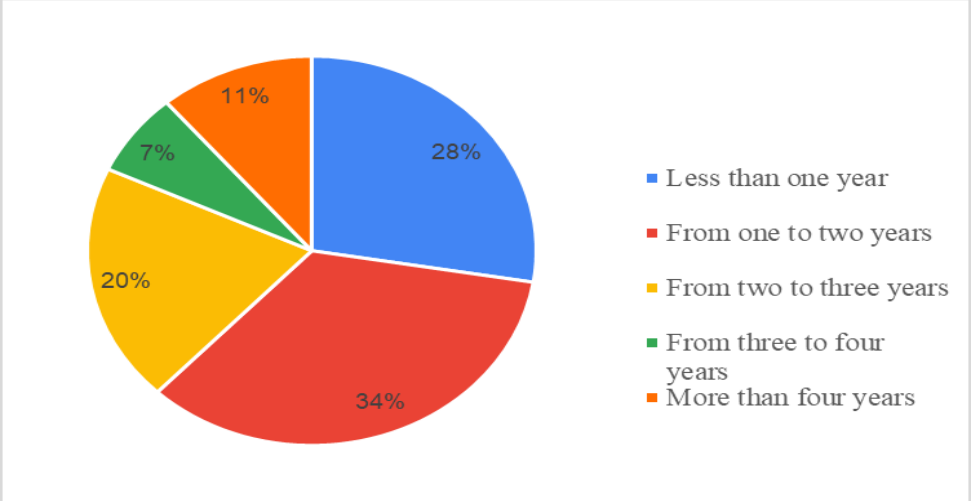

Figure 4.8: Annual average for the duration of completed projects.

4.3.3. The Third Part

a. Distribution of the study sample according to How does the company get new projects.

Table 4.9: Methods of getting new projects.

How does the company get new projects	Repetition	Percentage
Public tender	54	47%
The beneficiary is the same as the executing company	31	27%
Direct contracting method	27	23%
Pre-qualification method	4	3%

As per the answers listed in the table above 47% of the questionnaire respondents about (How does the company get new projects?) was Public tender which is the highest percentage by 54 repetitions, and 27% of the sample responded with the beneficiary is the same as the executing company by 31repetitions also 23% from the sample responded with a direct contracting method by 27 repetitions and 3% from the sample responded with pre-qualification method by 4 repetitions which is the lowest percentage, since the methods of work and contracting above are permitted in Iraq according to the laws and legislation in force.

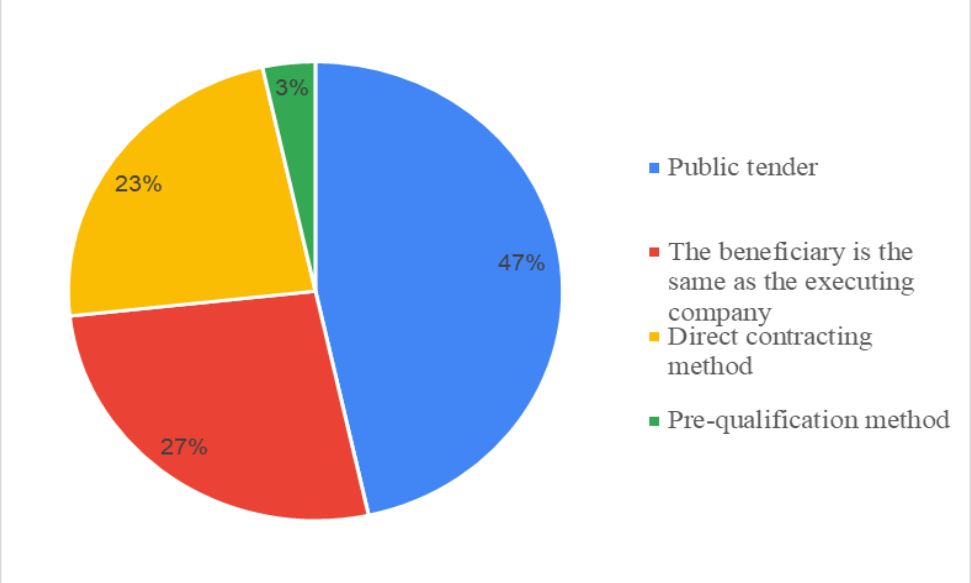

Figure 4.9: Getting new projects.

b. Distribution of the study sample according to the existence of a plan for initial project costs before starting Design in your organization.

Table 4.10: The range of existence of an initial cost plan for the project.

Is there a plan for initial project costs before starting Design in your organization?	**Repetition**	**Percentage**
Less than 25%	44	38%
From25% to 50%	26	22%
From50% to 75%	22	19%
From 75% to 100%	24	21%

As per the answers listed in the table above 38% of the questionnaire respondents about (the existence of a plan for initial project costs before starting design in their organization) was Less than 25% which is the highest percentage by 44 repetitions, 22% from the sample responded with From 25% to 50% by 26 repetitions also 21% from the sample responded with From 75% to 100% by 24 repetitions and 19% from the sample responded with From 50% to 75% by 4 repetitions which is the lowest percentage. The diversity in the answers and the closeness of the ratios indicate the extent of interest in cost planning by the institutions before starting any project.

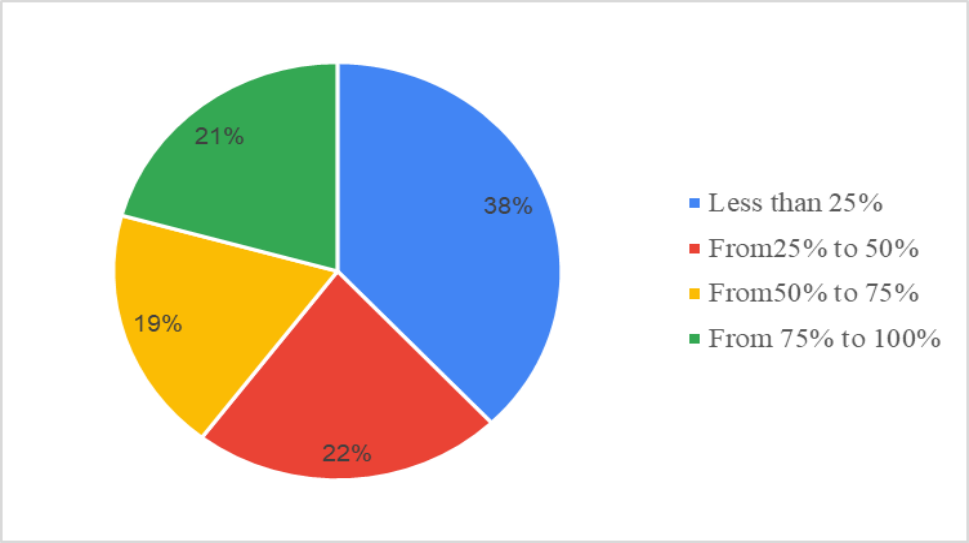

Figure 4.10: Having a plan for initial project costs before design.

c. Distribution of the study sample according to the percentage of projects located far from the center of the institution's location. (Depending on the number of currently operating projects)

Table 4.11: Distribution of the projects distance.

What Percentage of projects are located far from the center of the institution's location?	Repetition	Percentage
0%	11	9%
25%	27	23%
50%	25	22%
75%	37	32%
100%	16	14%

Based on the answers in the table above 32% of the questionnaire respondents about (the percentage of projects are located far from the center of the institution's location. (Depending on the number of currently operating projects) was 75% of the institution's projects which is the highest percentage by 37 repetitions, 23% from the sample responded with 25% by 27repetitions also 22% from the sample responded with 50% by 25 repetitions and 14% from the sample responded with 100% by 16 repetitions and 9% from the sample responded with 0% by 11 repetitions which is the lowest percentage, As most of the main headquarters of the institutions are dedicated to administrative work, while the work sites are located outside them at certain distances.

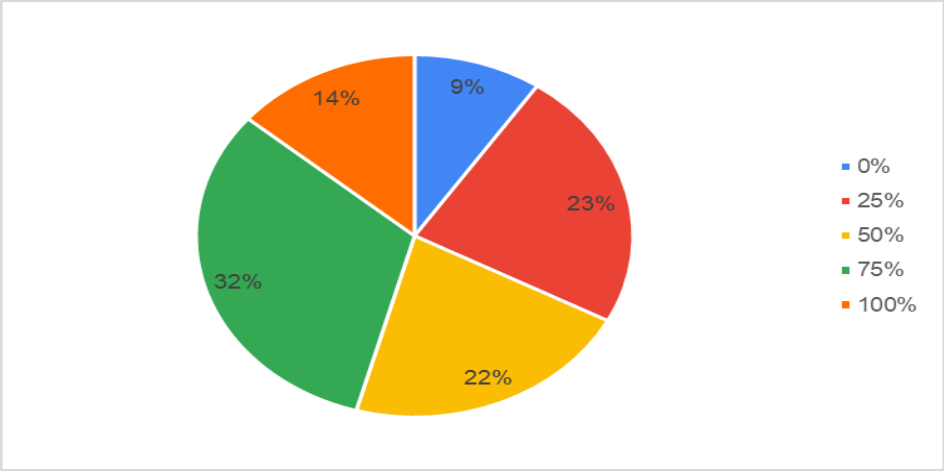

Figure 4.11: Percentage of projects far from the main branch of the institution.

d. Distribution of the study sample Based on their answer to the previous question, how does the company establish a branch or office for the site?

Table 4.12: The company's reasons for establishing a branch or office for the site.

how does the company establish a branch or office for the site?	Repetition	Percentage
According to the project implementation period	44	38%
Depending on the complexity of the project	17	15%
nothing	23	20%
Depending on the value of the project	32	28%

The answers about (how does the company establish a branch or office for the site) were as follows: 38% of respondents their repetition 44 answered with According to the project implementation period, 28% of respondents their repetition 32 answered with Depending on the value of the project, 20% of respondents their repetition 23 answered with nothing and 15% of respondents their repetition 17 answered with Depending on the complexity of the project. It appears from the answers that every institution has a strategy for establishing its branches and offices, depending on the duration of the project completion in the first place, and then the cost of the project and the degree of its complexity.

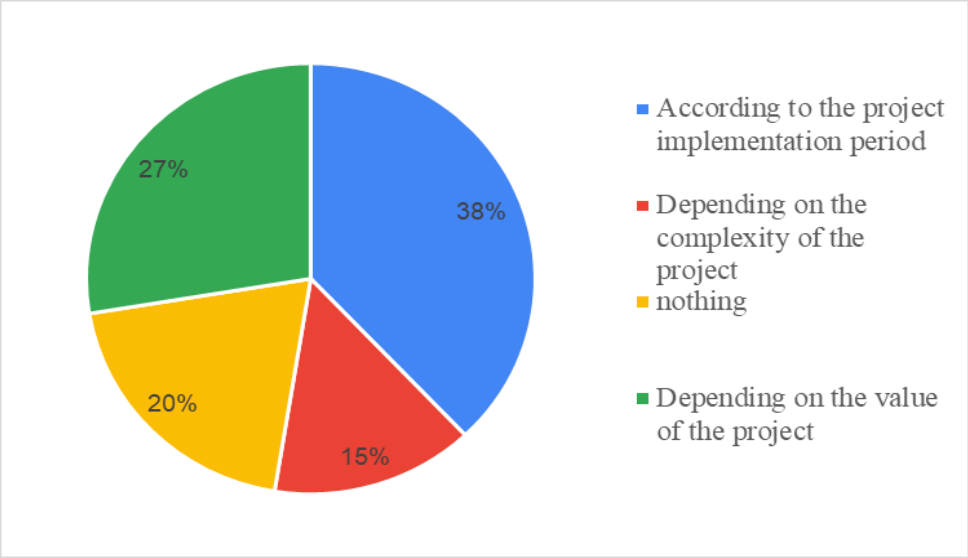

Figure 4.12: Establishment of a branch or office for the site.

e. Distribution of the study sample according to the scope of using computer software in the cost control process is

Table 4.13: The scope of using computer software in the cost control process.

the scope of using computer software in the cost control process is	Repetition	Percentage
Computer use at the site and office level	54	47%
Use the system in the main office only	50	43%
The computer is not used at work	12	10%

The answers about (the scope of using computer software in the cost control process is) were as follows: 47% of respondents repetition 54 answered with Computer use at the site and office level, It was the highest percentage of the answers, 43% of respondents their repetition 50 answered with Use the system in the main office only, 10% of respondents their repetition 12 answered with The computer is not used at work and that is the lowest percentage.

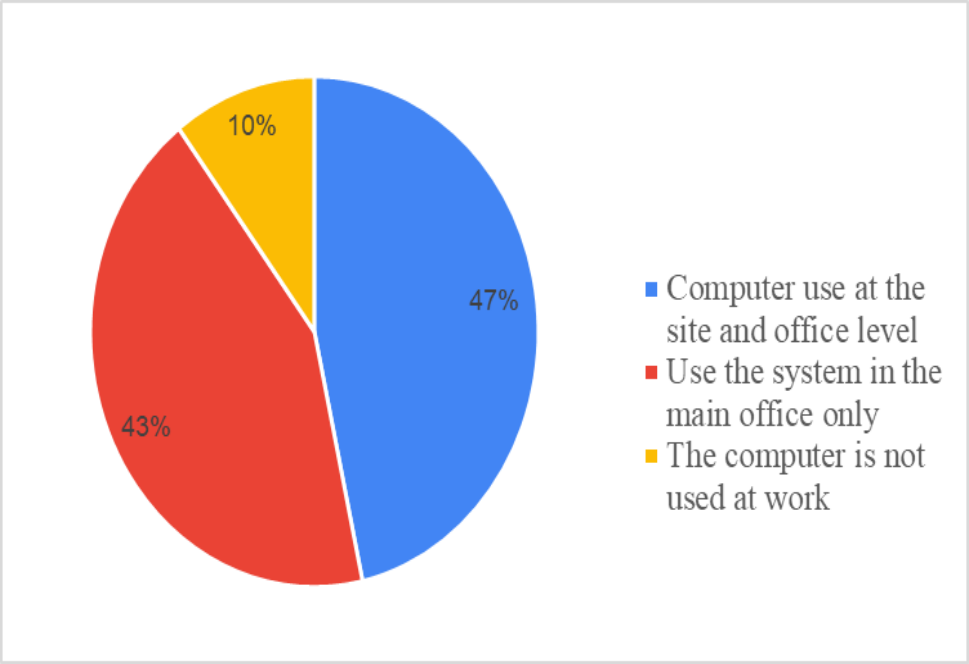

Figure 4.13: The extent of applying computer programs to control project costs.

f. The distribution of the study sample according to the way in which the activities of a W.B.S project are divided depends on

Table 4.14: W.B.S project activities division.

Division of the activities of the W.B.S. project	**Repetition**	**Percentage**
Elements that have been previously identified in the head office or major or overall topics to carry out a specific activity in the project such as brickwork for a particular project and divided according to the main activities of the project	46	40%
Dividing (W B S into concrete structure works - finishing works or dividing them depending on the location of the building, for example, the northern building - the southern building ... and so on)	29	25%
Division of project activities according to the main enterprise resources (type of equipment - a type of materials - type of labor	41	35%
Total	116	100%

According to the table above, 40% of the questionnaire respondents said Elements that have been previously identified in the head office or major or overall topics to carry out a specific activity in the project such as brickwork and divided according to the main activities of the project. 35% of the sample agreed. 25% of the sample responded with Dividing (W B S into concrete structure works - finishing works or dividing them depending on the location of the building, for example, the northern building - the southern building... etc.) by 29 repetitions, which is the lowest percentage. Most answers were based on head office or key or overall subjects to achieve planning and management.

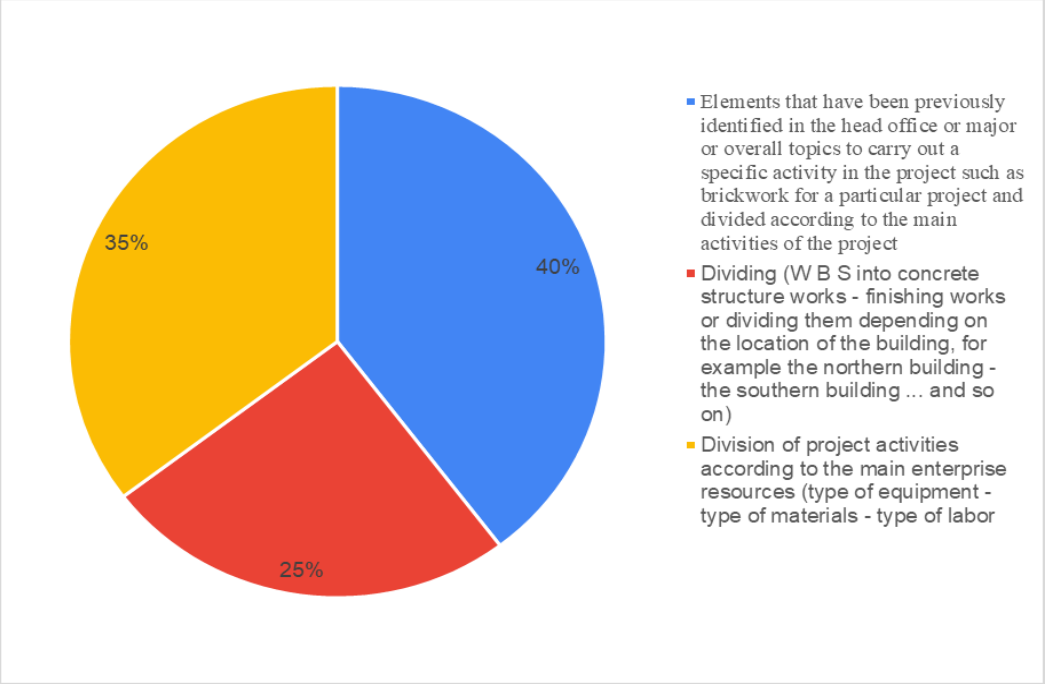

Figure 4.14: Division of W.B.S. project activities.

g. The distribution of the study sample according to the Project budget depends on

Table 4.15: Project budget.

The things on which the project budget depends	Repetition	Percentage
Relying on the previous pricing for similar projects	35	30%
Depending on the bid value	41	35%
The current status of the site	40	34%

The answers about (Project budget depends on) were as follows: 35% of respondents their repetition 41 answered Depending on the bid value, it was the highest percentage of the answers, 34% of respondents their repetition 40 answered the current status of the site, 30% of respondents their repetition 35 answered Relying on the previous pricing for similar projects and that is the lowest percentage.

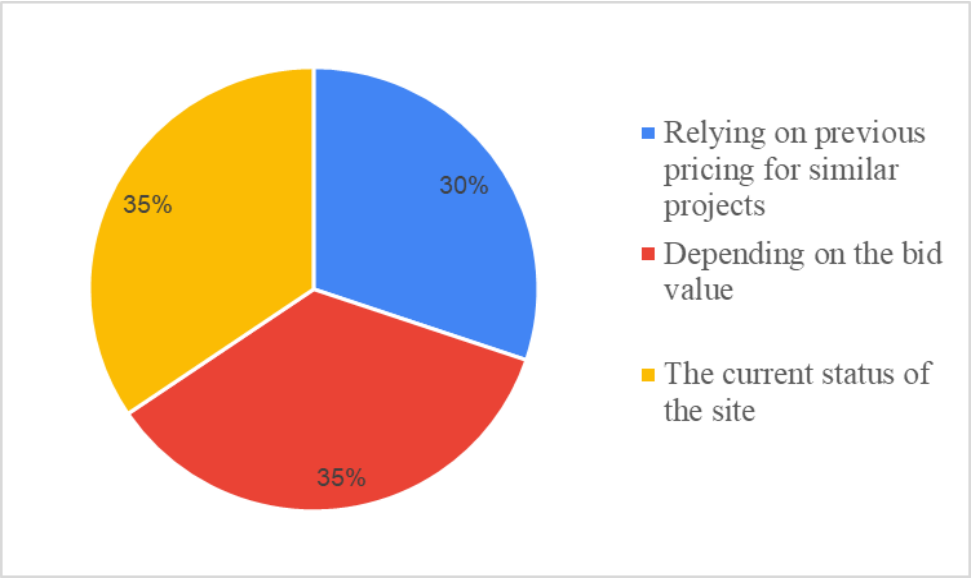

Figure 4.15: The project budget axes.

h. Distribution of the study sample according to a project requirements report is prepared each

Table 4.16: Time period for completing project work completion reports.

A project requirements report is prepared for each	Repetition	Percentage
One week	41	35%
2 to 4 weeks	41	35%
4 to 6 weeks	17	15%
More than 6 weeks	17	15%

According to the table above, the answers about (A project requirements report is prepared each) were as follows: 35% of respondents their repetition 41 answered One week, 35% of respondents their repetition 41 answered 2 to 4 weeks, so the last two answers were the highest percentage of the answers, 15% of respondents their repetition 17 answered 4 to 6 weeks, 15% of respondents their repetition 17 answered More than 6 weeks and that is the lowest percentage.

It is clear from the above answers that most institutions adopt an organized approach in following up on work requirements reports.

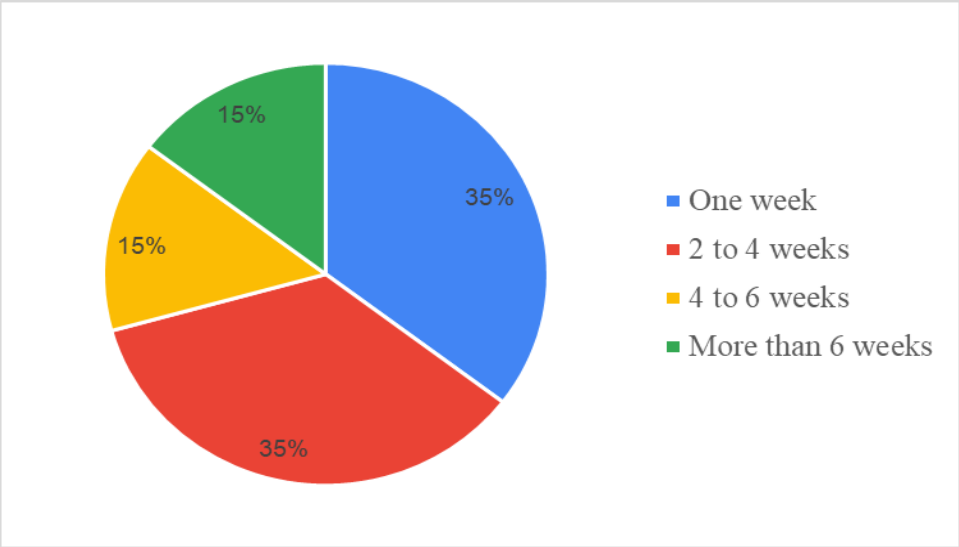

Figure 4.16: The period for submitting completed works reports.

i. Distribution of the study sample according to the method that is approved for preparing the report and planning the construction site.

Table 4.17: Report preparation method and construction site planning.

What is the approved method for preparing the report and planning the construction site?	**Repetition**	**Percentage**
The use of fixed forms that are filled out by site administrators	23	20%
Adopt a timeline (describes the planned and actual development)	57	49%
Meetings in the main office	14	12%
Hold meetings on the project site	22	19%
Total	116	100%

Based on the answers in the table above 49% of the questionnaire respondents about (the method that is approved for preparing the report and planning the construction site) was Adopt a timeline (describes the planned and actual development)which is the highest percentage by 57 repetitions, 20% from the sample responded The use of fixed forms that are filled out by site administrators by 23 repetitions also 19% from the sample responded Hold meetings on the project site by 22 repetitions and 12% from the sample responded that Meetings in the main office is the approved method for preparing the report and planning the construction site by 14 repetitions which is the lowest percentage. The highest percentage of the answers is concerned with studying and comparing what is planned with what is being implemented at present.

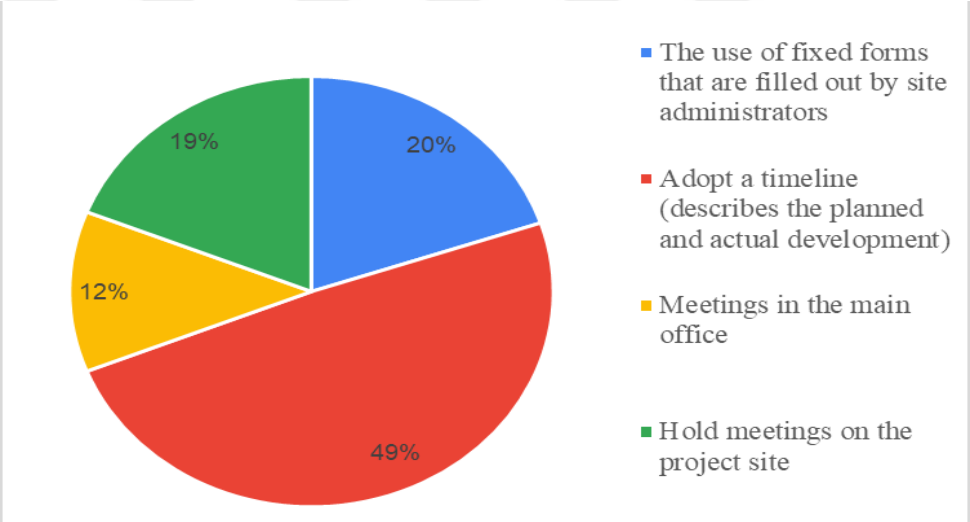

Figure 4.17: Methods of preparing the report and planning the construction site.

j. Distribution of the study sample according to the usual period for measuring actual performance during a project.

Table 4.18: Measuring actual performance period during a project.

What is the usual period for measuring actual performance during a project?	Repetition	Percentage
Monthly	75	65%
Quarterly	13	11%
Weekly	28	24%

According to the table above, the answers about (the usual period for measuring actual performance during a project) were as follows: 65% of respondents their repetition 75 answered Monthly, 24% of respondents their repetition 28 answered Weekly, 11% of respondents their repetition 13 answered Quarterly and that is the lowest percentage. We note that most organizations prepare work completion reports monthly, which is a reasonable period of great importance in checking the completion rate and work within the planned cost.

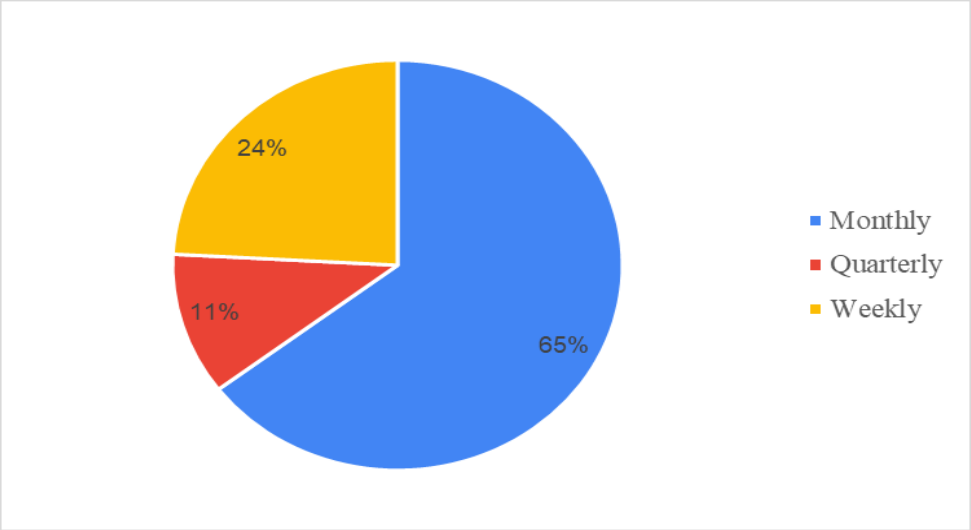

Figure 4.18: Time period for the actual performance of the project.

k. Distribution of the study sample according to the mechanism that is used to submit a report on the volume of work performed.

Table 4.19: The mechanism used to submit a report on the volume of work performed.

What is the mechanism used to submit a report on the volume of work performed?	Repetition	Percentage
Roughly through an approximate description of the work performed	20	17%
The volume of completed pods in units or Percentages	74	64%
According to the stage completed, for example, 40% of the finishing work	22	19%

As per the answers listed in the table above 64% of the questionnaire respondents about (the mechanism that is used to submit a report on the volume of work performed) was Volume of completed pods in units or Percentages which is the highest percentage by 74 repetitions, 19% from the sample responded was According to the stage completed, for example, 40% of the finishing work by 22 repetitions also 17% from the sample responded Roughly through an approximate description of the work performed by 24 repetitions which is the lowest percentage.

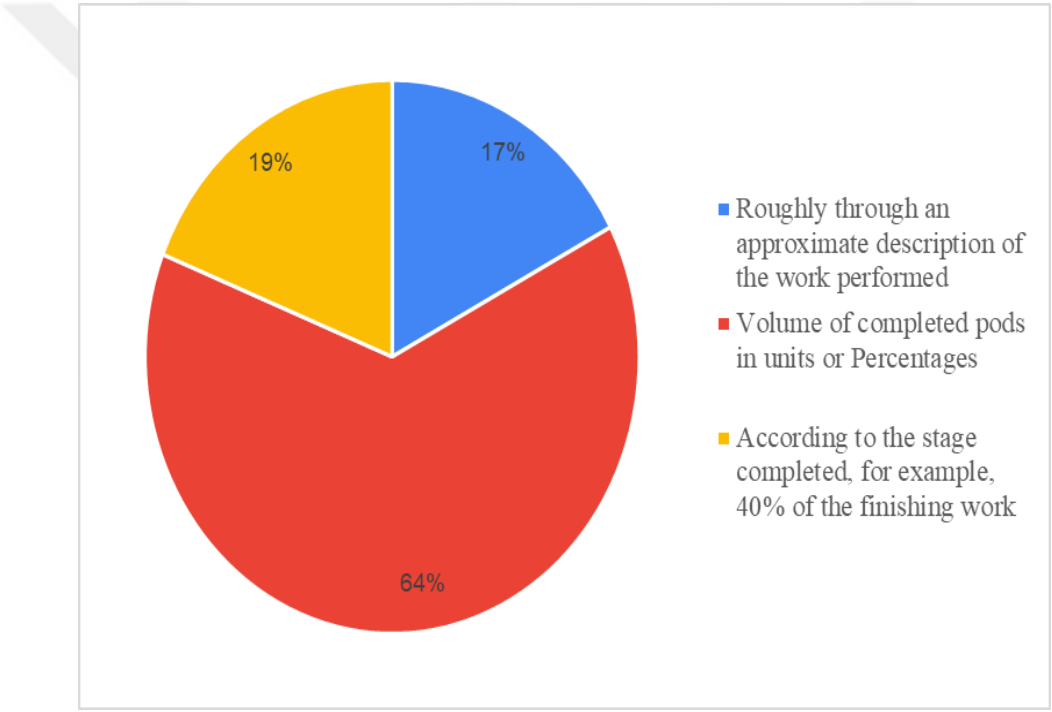

Figure 4.19: Submitting a report on the amount of work performed.

l. The distribution of the study sample according to the method is followed in the process of analyzing the real cost of a project against the project budget.

Table 4.20: Analyzing the real cost of a project against the project budget.

In the process of analyzing the real cost of a project against the project budget, which of the following methods is followed	Repetition	Percentage
Integrate cost control and other administrative processes	17	15%
Compared to the estimated cost in the bidding stage or the previous cost of a similar component in another project	68	59%
General comparison of revenue and expenses	31	27%

As per the answers listed in the table above 59% of the questionnaire respondents about (the method is followed In the process of analyzing the real cost of a project against the project budget) were Compared to the estimated cost in the bidding stage or the previous cost of a similar component in another project which is the highest percentage by 68 repetitions, 27% from the sample responded was General comparison of revenue and expenses by 31repetitions also 15% from the sample responded Integrate cost control and other administrative processes by 17 repetitions which is the lowest percentage, We note that most respondents were biased towards comparing the current cost of works with the cost of similar works, and this method can be adopted in the event that local market prices are stable and not fluctuating, and when the period of completion of similar works converges with the current one.

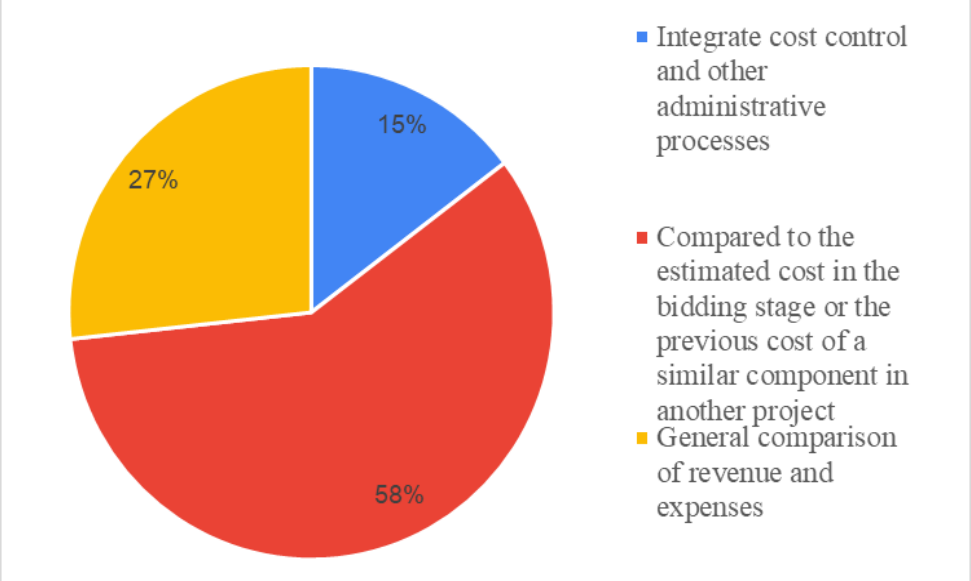

Figure 4.20: Actual cost analysis of the project against the project budget.

m. Distribution of the study sample according to, how the hours worked evaluated in the process of evaluating the resources consumed in the project

Table 4.21: Evaluating the resources consumed in the project.

In the process of evaluating the resources consumed in the project, how are the hours worked evaluated?	**Repetition**	**Percentage**
Special records for calculating working hours for each project	24	21%
Determining a fixed price for labor in proportion to the quantity and unit of work performed	25	22%
Customizing records to fix the hours of entry and exit from the site	19	16%
Relying on personal supervision by the person in charge of the staff	48	41%

According to the table above 41% of the questionnaire respondents about (how the hours worked were evaluated In the process of evaluating the resources consumed in the project) was Relying on personal supervision by the person in charge of the staff which is the highest percentage by 48 repetitions, 22% from the sample responded that Determining a fixed price for labor in proportion to the quantity and unit of work performed by 25 repetitions, 21% from the sample responded that Special records for calculating working hours for each project by 24 repetitions and 16% from the sample responded that Customizing records to fix the hours of entry and exit from the site by 19 repetitions.

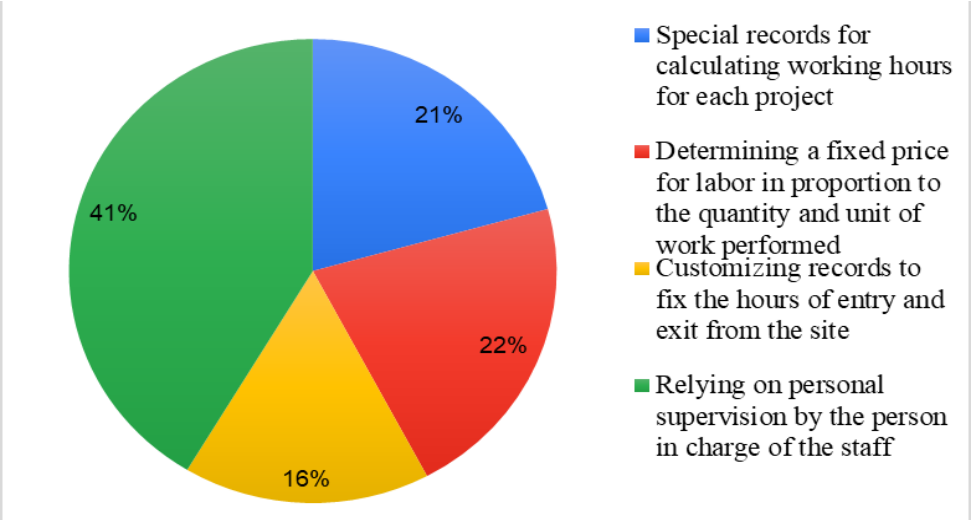

Figure 4.21: Assessment of the resources consumed in the project.

n. Distribution of the study sample according to the response range about Calculation of operating fees for machinery based on

Table 4.22: Equipment running costs.

Calculation of operating fees for machinery based on	Repetition	Percentage
Daily detection of the working hours of the devices for each paragraph in the work	37	32%
Rental receipts for machines	37	32%
Record working hours for machinery	42	36%

According to the table above 36 % of the questionnaire respondents about a mechanism for Calculation of operating fees for machinery based on) was Record working hours for machinery, which is the highest percentage by 42 repetitions, and 32% of the sample responded that Daily detection of the working hours of the devices for each paragraph in the work by 37 repetitions and 32% from the sample responded that Rental receipts for machines by 37 repetitions.

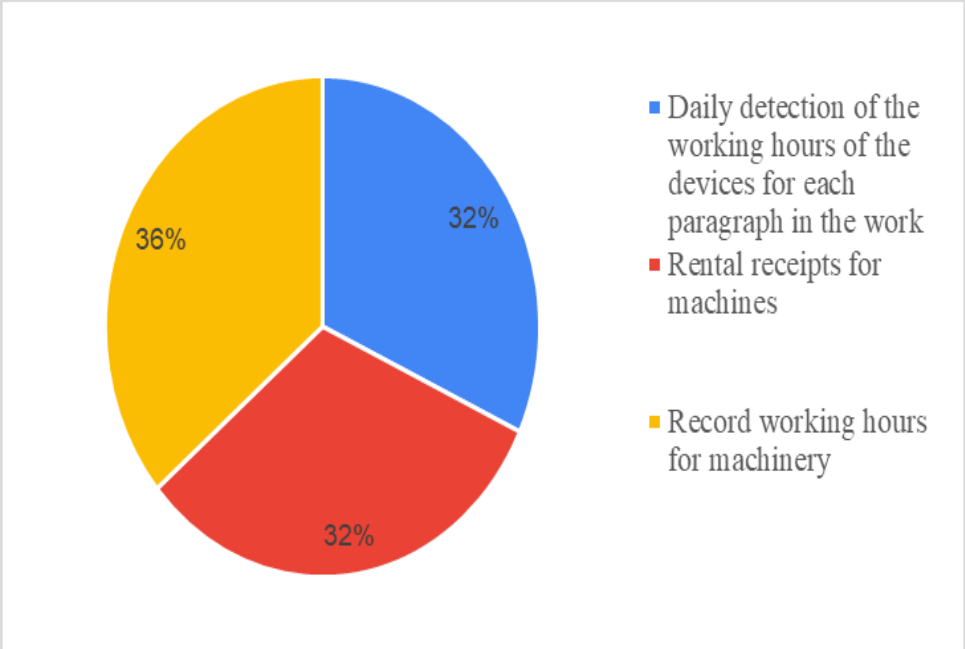

Figure 4.22: Equipment running costs.

o. Distribution of the study sample according to the process of calculating the prices of the building materials consumed in the project is carried out by the procurement committees, what is it based on?

Table 4.23: Procurement committees calculate the prices of project building materials.

The process of calculating the prices of the building materials consumed in the project is carried out by the procurement committees based on	Repetition	Percentage
Purchase Receipts	79	68%
Records of materials consumed for each building material	37	32%

According to the table above 68% of the questionnaire respondents about the process of calculating the prices of the building materials consumed in the project is carried out by the procurement committees, what is it based on?) was Purchase Receipts which is the highest percentage by 79 repetitions and 32% from the sample responded that Records of materials consumed for each building material by 37 repetitions. This requires careful selection of procurement committees who have a high degree of honesty and keenness to do good work to maintain the cost of the planned purchase.

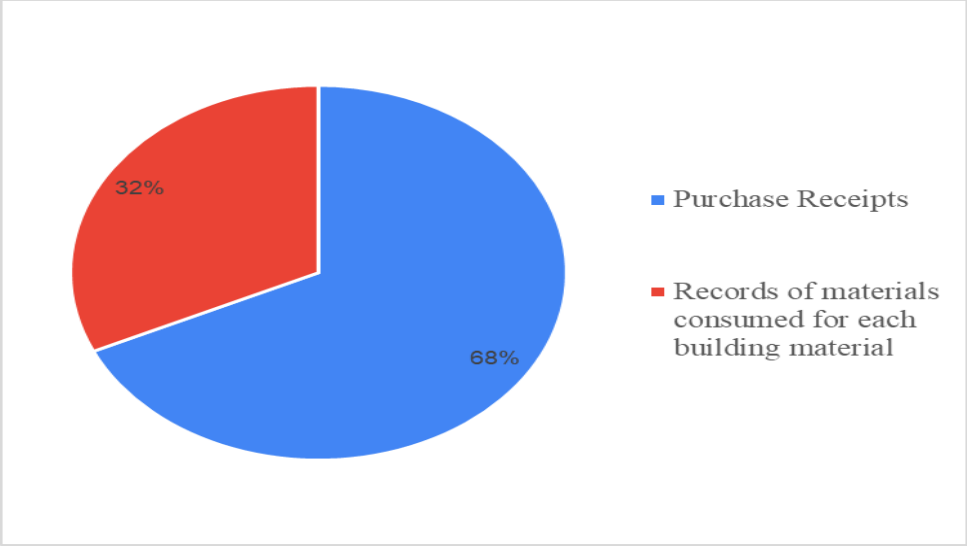

Figure 4.23: The method of the procurement committees in calculating the prices of building materials.

p. Distribution of the study sample according to the answers about the mechanism that is used to detect the cause of the deviation, In the event of a deviation from the cost

Table 4.24: The mechanism used to detect the cause of cost deviation.

In the event of a deviation from the cost, what is the mechanism used to detect the cause of the deviation?	**Repetition**	**Percentage**
Use logical, structured, and practical methods	27	23%
Inquiries and inquiries through field visits	59	51%
Check prices and unofficial search	30	26%

According to the table above 51% of the questionnaire respondents the mechanism that is used to detect the cause of the deviation, In the event of a deviation from the cost was Inquiries and inquiries through field visits which is the highest percentage by 59 repetitions, 26% from the sample responded that Check prices and unofficial search by 30 repetitions and 23% from the sample responded Use logical, structured, and practical methods by 27 repetitions. That mechanism, which obtained the highest answers, may not work in all cases, as following the logical structured, and practical methods have a greater role in revealing the causes of cost deviation.

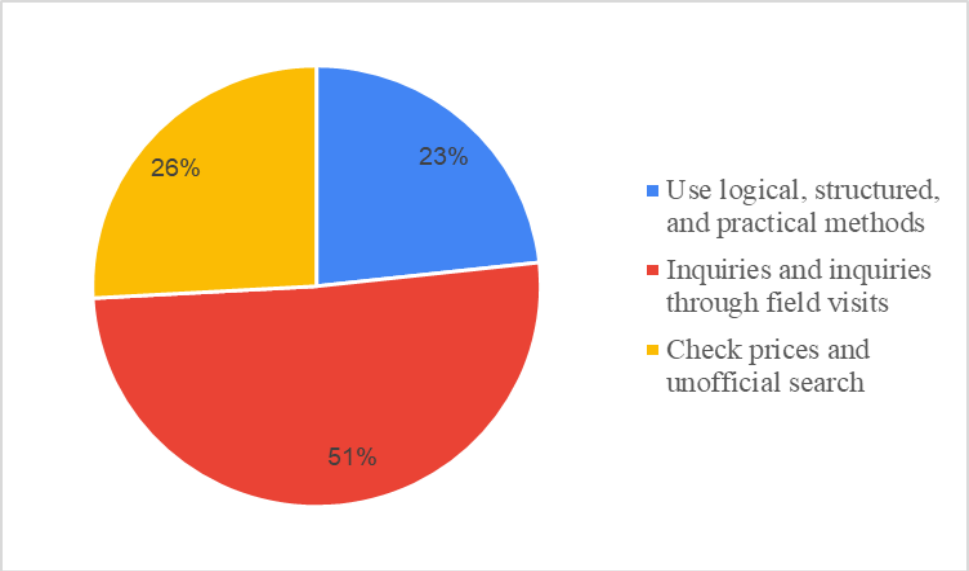

Figure 4.24: The method used to identify the causes of cost deviation.

q. Distribution of the study sample according to the response to the common reasons for the project cost deviating from the pre-prepared cost.

Table 4.25: Common reasons for project cost deviation from pre-prepared cost.

What are the common reasons for the project cost deviating from the pre-prepared cost?	Repetition	Percentage
The level of administrative and technical performance of the project (purchasing, designs...)	19	16%
Unexpected costs	38	33%
There are errors in preparing the estimated cost and project budget.	39	34%
Performance in the implementation phase	20	17%

The sample members answered according to the table above about the common reasons for the project cost deviating from the pre-prepared cost as follows: 34% of the sample responded that There are errors in preparing the estimated cost and project budget by 39 repetitions also 33% from the sample responded Unexpected costs by 38 repetitions, 17 % from the sample responded was Performance in the implementation phase by 20 repetitions and 16% from the sample responded The level of administrative and technical performance of the project (purchasing, designs...) by 19 repetitions which is the lowest percentage.

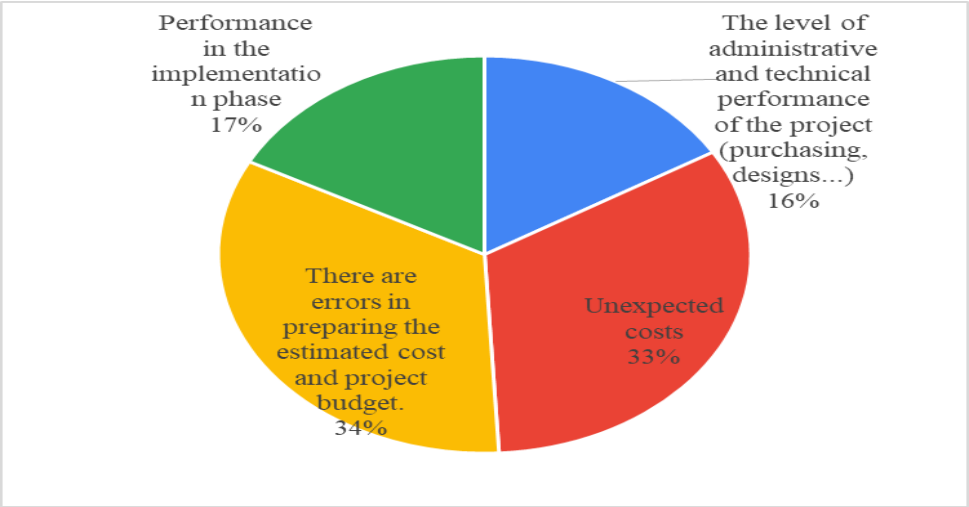

Figure 4.25: Common reasons for project cost deviation from pre-prepared cost.

r. Distribution of the study sample according to the response: If the cost deviation occurs, it is expressed as

Table 4.26: The method of expressing the cost deviation.

If the cost deviation occurs, it is expressed as	Repetition	Percentage
Number and writing	68	59%
Percent	48	41%

According to the table above 59% of the questionnaire respondents about If the cost deviation occurs, it is expressed as. was Number and writing which is the highest percentage by 68 repetitions and 41% from the sample responded that Percent by 48 repetitions.

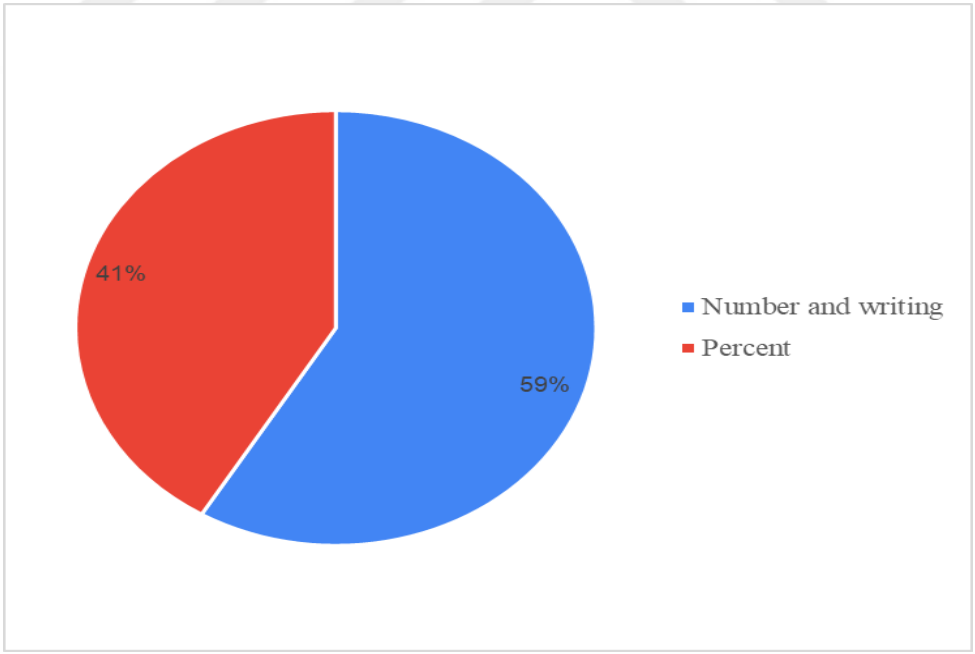

Figure 4.26: Method of expressing the amount of cost deviation.

s. The distribution of the study sample according to the response to the Cost deviation is corrected by:

Table 4.27: Cost deviation correction procedures.

Cost deviation is corrected by	Repetition	Percentage
Study and adjust expenditures to fit the budget allocated to the project	68	59%
Use of the project's budgeted reserve	31	27%
Acceptance of the deviation	17	15%

According to the table above it is clear that the respondents about the Cost deviation are corrected by: 59% from the sample with 68 repetitions responded that Cost deviation is corrected by Study and adjusting expenditures to fit the budget allocated to the project which is the highest percentage, 27% from the sample responded that Use of the project's budgeted reserve by 31 repetitions and 15% from the sample responded that Acceptance of the deviation by 17 repetitions, For the study and adjustment of expenses to be the highest ratio among the answers, this is considered a positive indicator to address the cost deviation and return the project to its planned course as much as possible.

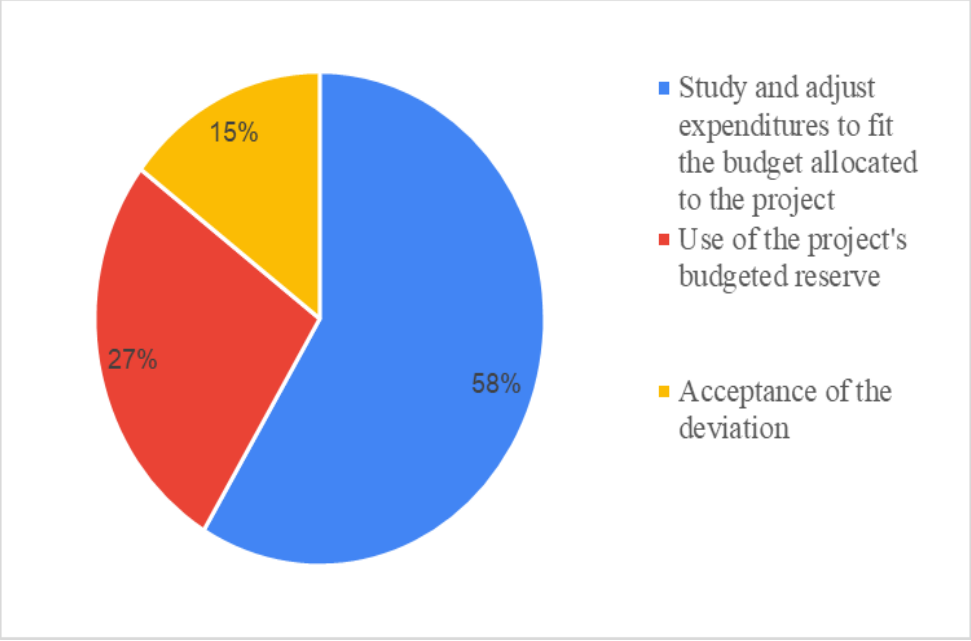

Figure 4.27: Perform cost deviation correction.

t. Distribution of the study sample according to the response to How does the organization correct the deviation in cost?

Table 4.28: Company actions to correct cost deviation.

How does the organization correct the deviation in cost?	Repetition	Percentage
Follow the value engineering methodology	21	18%
Through good management of project resources	71	61%
Reducing the quality of work	5	4%
Adopting new technologies to implement the project	19	16%

According to the table above 61% of the questionnaire, respondents about How does the organization correct the deviation in cost? was Through good management of project resources which is the highest percentage by 71 repetitions that is the best method to restoring matters within control and addressing cost deviation, 18% of the sample responded that the organization Follow the value engineering methodology by 21 repetitions, 16% from the sample responded that Adopting new technologies to implement the project by 19 repetitions and 4% from the sample responded that Reducing the quality of work from the site by 5 repetitions.

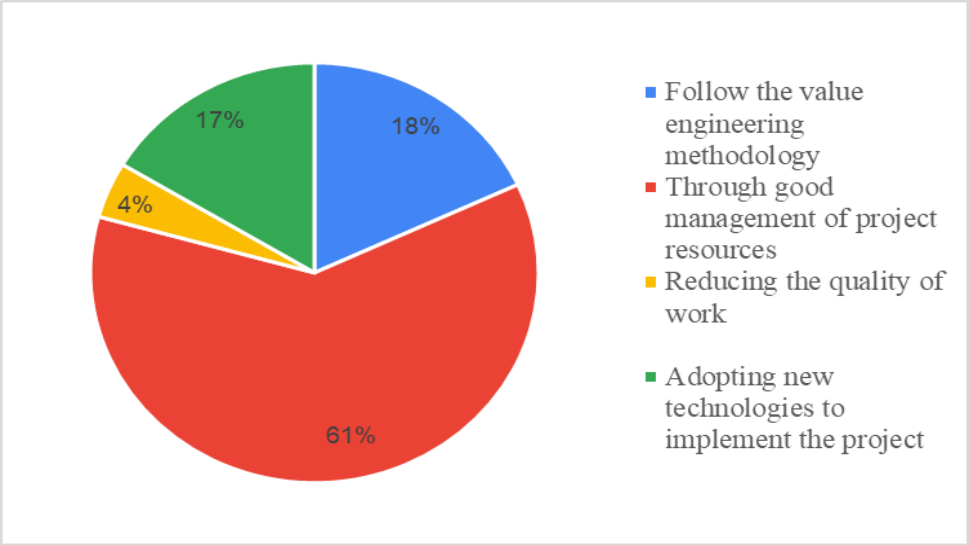

Figure 4.28: The company's procedures to correct the cost deviation.

u. Distribution of the study sample according to define the person who has the powers to disburse from the amount of the project reserve

Table 4.29: The power to spend the project's reserve funds.

define the person who has the powers to disburse from the amount of the project reserve	Repetition	Percentage
General Manager or CEO	58	50%
Enterprise project manager	12	10%
Someone who has more powers than the above	32	28%
Site manager	14	12%

According to the answers given in the table above about (define the person who has the powers to disburse from the amount of the project reserve), we note that the definition of General Manager or CEO had the highest percentage of respondents it is percentage 50% by 58 repetitions, 28%%age of respondents answered that Someone who has more powers than the above by 32 repetitions, 12%percentage of respondents answered that Site manager who has the powers to disburse from the amount of the project reserve than the above by 14 repetitions and 10%percentage of respondents answered that Enterprise project manager who has the powers to disburse from the amount of the project reserve than the above by 12 repetitions.

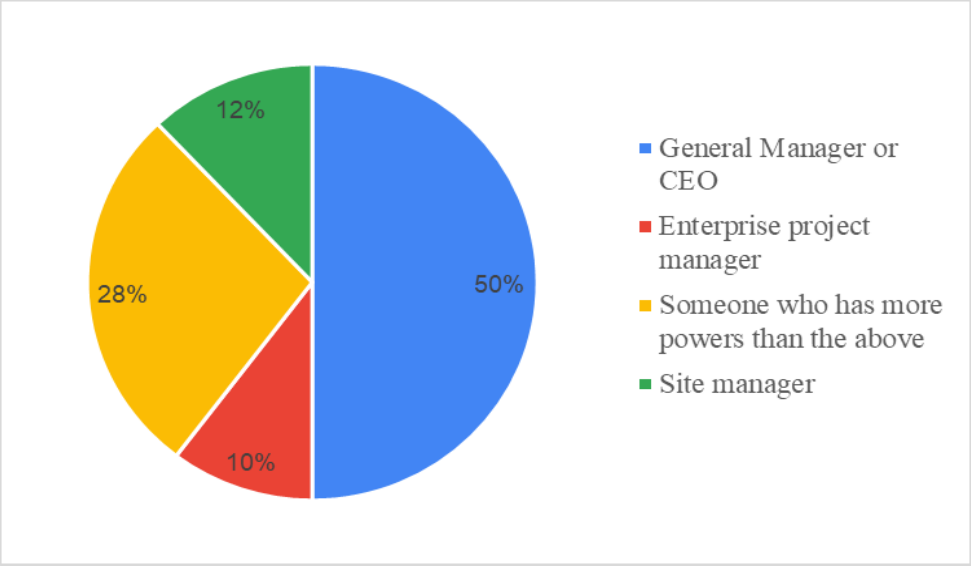

Figure 4.29: Ability to disburse reserve funds for the project.

4.3.4. The Fourth Part

What is the impact of the following factors on the controlling of the cost project

a. Project size (nature of the project, duration, project location)

Table 4.30: Project components.

Project size (nature of the project, duration, project location)	Repetition	Percentage
Frequently	89	77%
Slightly	20	17%
No effect	7	6%

According to the answers given in the table above about the impact of Project size (nature of the project, duration, project location) on the controlling of the cost project, the highest percentage of respondents is Frequently Its percentage 77% by 89 repetitions, 17%%age of respondents answered that the impact is Slightly by 20 repetitions, 6%percentage of respondents answered that there is no effect by 7 repetitions. The highest proportion of the answers believes that the size, components, and nature of the project have a frequent impact on the fact that every part of it is dealt with accurately and professionally, taking into account the quality requirements and not complacency in specifications and completion time.

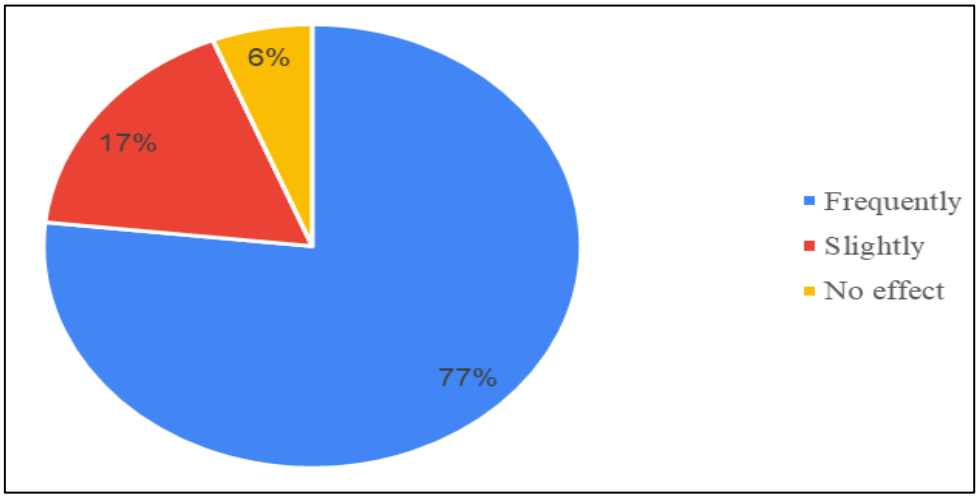

Figure 4.30: The elements of project.

b. Accuracy in estimating the project budget

Table 4.31: Budget accuracy.

Accuracy in estimating the project budget	Repetition	Percentage
Frequently	84	72%
Slightly	29	25%
No effect	3	3%

According to the answers given in the table above about the impact of Accuracy in estimating the project budget on the controlling of the cost project, the highest percentage of respondents is Frequently Its percentage 72% by 84 repetitions, 25%%age of respondents answered that the impact is Slightly by 29 repetitions, 3%percentage of respondents answered that there is no effect by 3 repetitions. This factor has a very big impact, as stated in the results of the questionnaire, as it is a decisive factor in the implementation of the project or not. It is an absolute necessity for any project, and it must be prepared in scientific methods based on accurate realistic foundations for the project to be completed satisfactorily, avoiding its cancellation or delay until an unknown time.

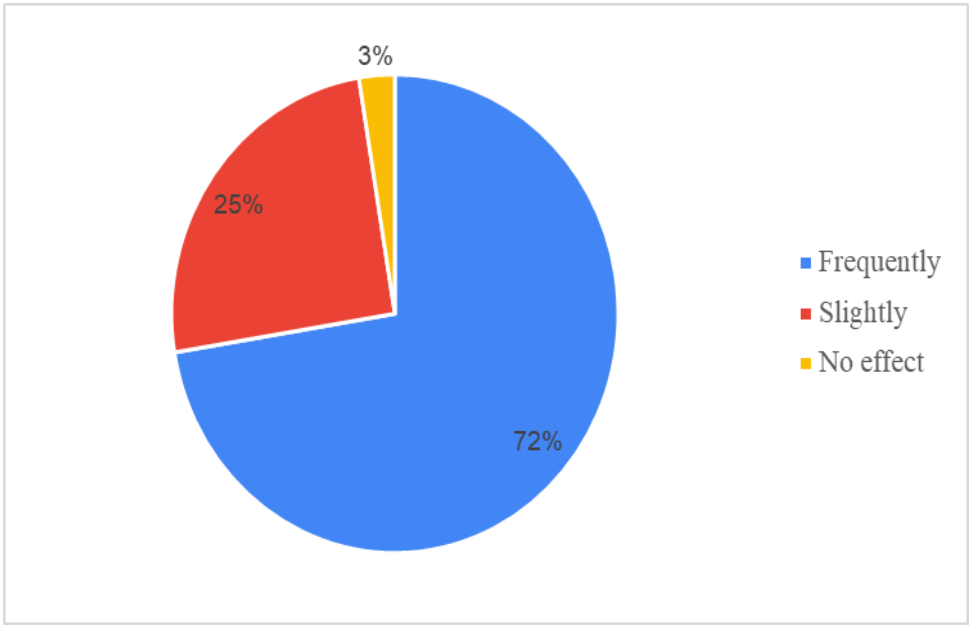

Figure 4.31: Accuracy in estimating the project budget.

c. Clarity and comprehensiveness of the articles and paragraphs of the contract

Table 4.32: Contract clarity and completeness.

Clarity and comprehensiveness of the articles and paragraphs of the contract	Repetition	Percentage
Frequently	95	82%
Slightly	19	16%
No effect	2	2%

According to the answers given in the table above about the impact of Clarity and comprehensive ness of the articles and paragraphs of the contract on the controlling of the cost project, the highest percentage of respondents is Frequently Its percentage 82% by 95 repetitions, 16%age of respondents answered that the impact is Slightly by 19 repetitions, 2% percentage of respondents answered that there is no effect by 2 repetitions. Comprehensiveness and accuracy in regulating contracts is a factor that has a significant impact on reducing the risks of claims and disputes that cause additional expenses and losses that may be incurred by the parties to the contract.

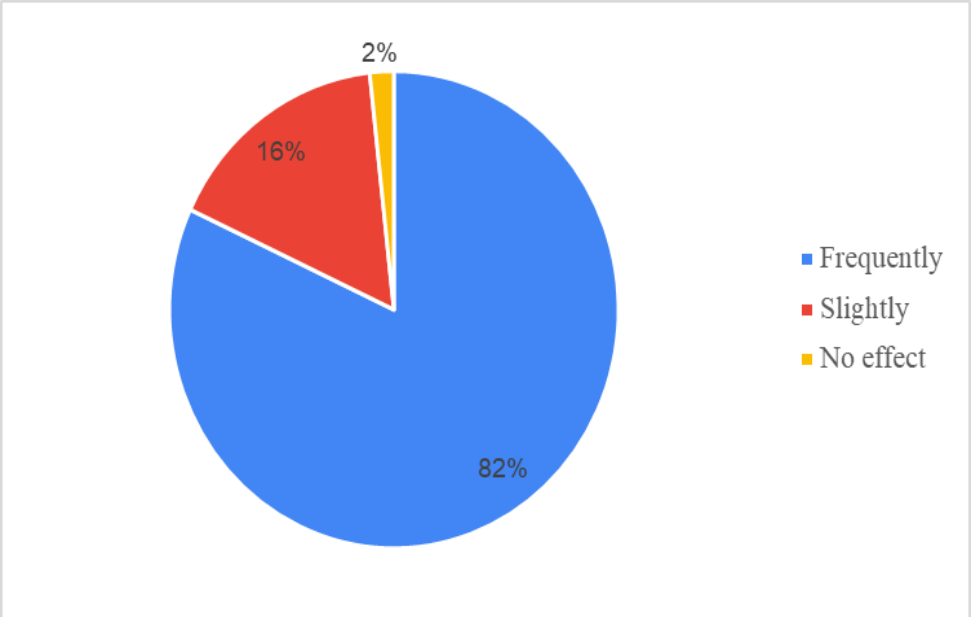

Figure 4.32: Comprehensiveness of the terms of the contract.

d. Accuracy of designs and bills of quantities

Table 4.33: Design and bills accuracy.

Accuracy of designs and bills of quantities	Repetition	Percentage
Frequently	101	87%
Slightly	13	11%
No effect	2	2%

According to the respondents in the table above, 87% from the study sample believe that the Accuracy of designs and bills of quantities has Frequently impact on the controlling of the cost project, 11%percentageof the respondents refer as this factor has a Slightly impact and 2% refer as this factor does not affect the controlling of the costly project. Awareness of the extent of the impact of this factor on cost control by the study sample is a positive indicator, as the accuracy in the design phase and the preparation of bills of quantities reduces the possibility of issuing change orders in the future, which avoids the project risks and potential losses and makes the work in continuous progress without financial constraints and legal.

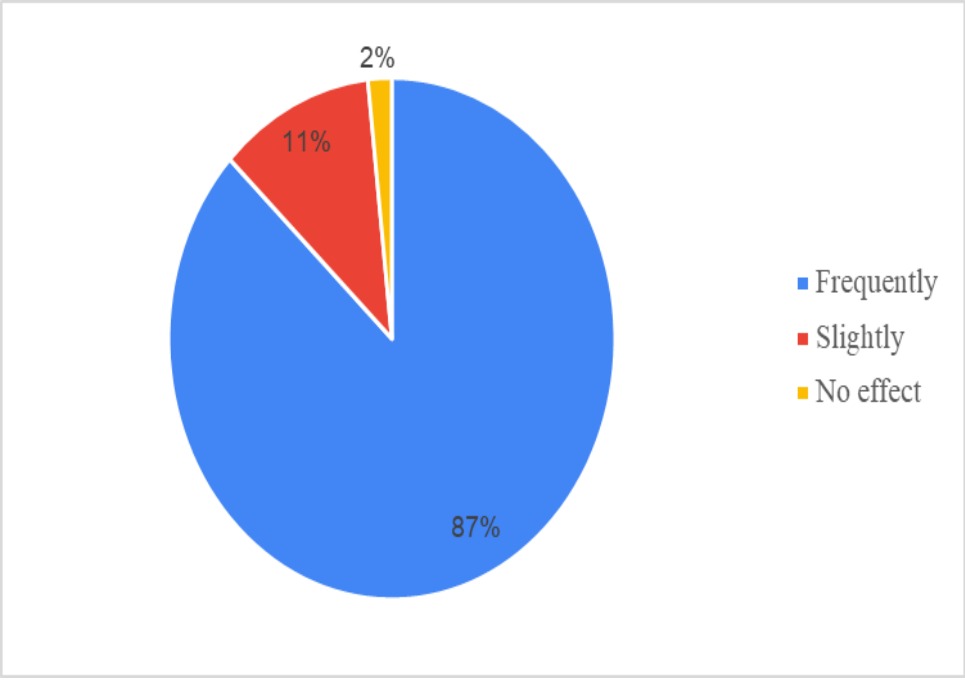

Figure 4.33: Accurate designs and bills of quantities.

e. The number, productivity, and skill level of the manpower

Table 4.34: Manpower quantity, productivity, and skill.

The number, productivity, and skill level of the manpower	Repetition	Percentage
Frequently	80	69%
Slightly	32	28%
No effect	4	3%

According to the respondents in the table above, 69% from the study sample believe the number, productivity, and skill level of the workforce has Frequently impact on the controlling of the cost project, 28%percentageof the respondents refer as this factor has a Slightly impact and 3% refer as this factor does not affect the controlling of the costly project. The manpower is one of the most important project resources through which the level of achievement and the extent of compliance with the specification are reflected according to the skill and the availability of a sufficient number of manpower, thus proceeding to complete the project within the specified period, and it is the desired productivity that is closely related to cost control and the extent of control over it.

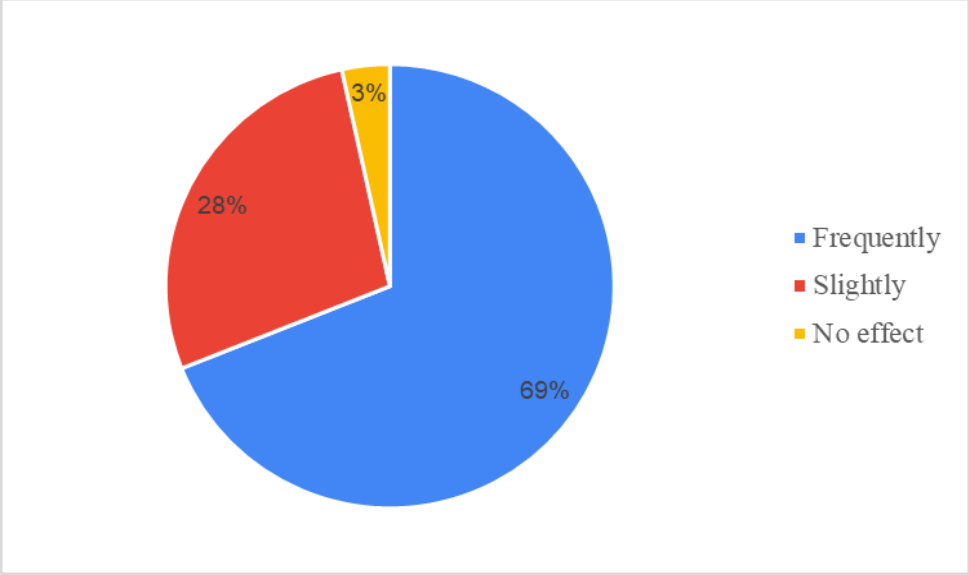

Figure 4.34: Workforce effect.

f. Changing and amending the laws and regulations in the country

Table 4.35: Changing laws and regulations.

Changing and amending the laws and regulations in the country	Repetition	Percentage
Frequently	59	51%
Slightly	45	39%
No effect	12	10%

According to the respondents in the table above, 51% of the study sample believe that changing and amending the laws and regulations in the country has Frequently impact on the controlling of the cost project, 39%percentageof the respondents refer as this factor has a Slightly impact and 10% refer as this factor does not affect the controlling of the costly project. Respondents to the factor of changing laws differed, and most of them considered that this factor has a significant impact on the available powers and the determinants of spending, and therefore cost control.

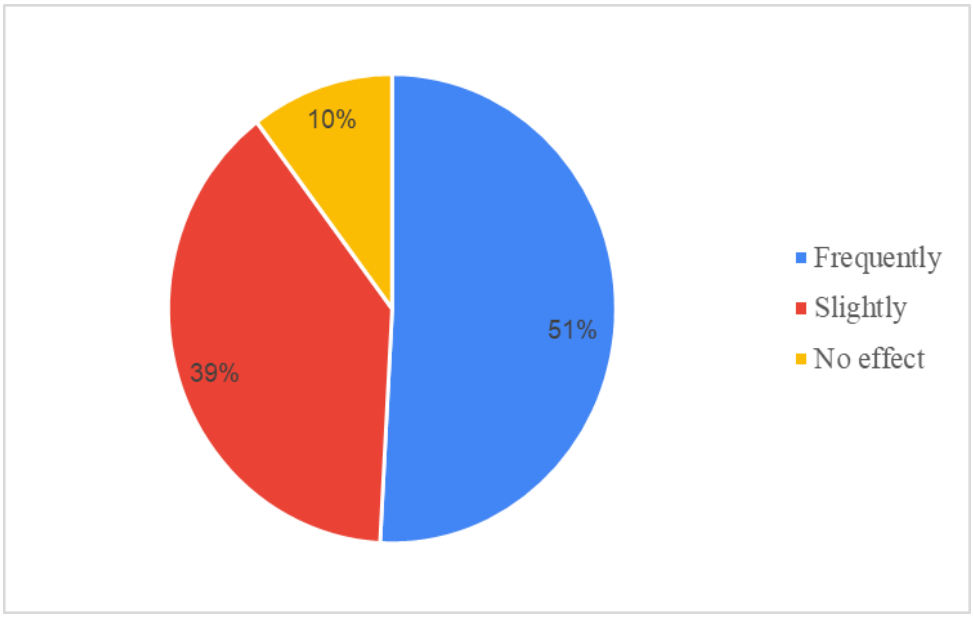

Figure 4.35: The effect of changing and amending legislation.

g. The lack of experience of decision-makers in the organization in managing some types of projects

Table 4.36: Lack of project management experience among organization's decision-makers.

The lack of experience of decision-makers in the organization in managing some types of projects	Repetition	Percentage
Frequently	78	67%
Slightly	35	30%
No effect	3	3%

According to the respondents in the table above, 67% of the study sample believe that the lack of experience of decision-makers in the organization in managing some types of projects has Frequently impact on the controlling of the cost project, 30%percentageof the respondents refer as this factor has Slightly impact and 3% refer as this factor does not affect the controlling of the costly project. The lack of experience and interest on the part of decision-makers in projects and the lack of knowledge of the scientific foundations for managing and resolving project issues have many risks to all project outputs, and the answers have statistical implications with a positive indicator in knowing the extent of the impact of professional management in addressing delay and overcoming difficulties to reach the project's planned goals.

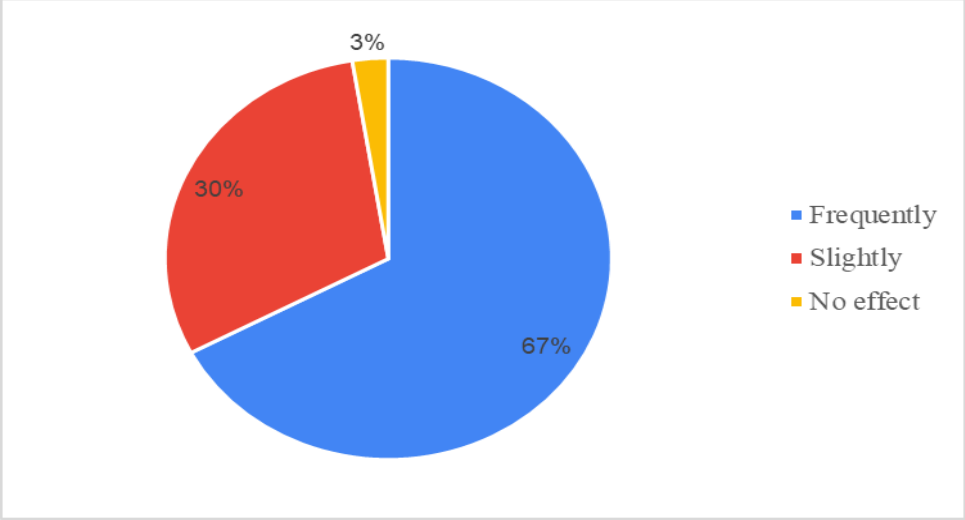

Figure 4.36: Experience of decision makers in project management.

4.4. SUMMERY

Controlling project expenses is a primary and crucial concern for any contractor. Because of the importance of the subject, the purpose of this research is to discover how Iraqi construction contractors are now controlling their expenses. Case studies and surveys are major sources for achieving the aims. Furthermore, completing a literature review helps to achieve the goals. This chapter demonstrates how to evaluate data using the relative index and hypothesis testing.

5. CONCLUSION AND FUTURE WORKS

The findings from this research study are summarized and conclusions drawn from them. In addition, recommendations and ideas for further research are presented based on the results of the research.

5.1. CONCLUSION

a. According to the findings of the initial research study, a relatively low number of employees are not involved in the actions or decisions about cost reduction. Because management can improve costs on its own, and because budgetary control is a currently underway activity that requires the involvement and assistance of all workers in the company, management is required to involve all employees in the process of proposing cost control attempts within departments. This may be because cost control is indeed an active process.

b. Companies should also run efforts to raise awareness about the necessity of cost containment inside their ranks. Monthly or quarterly meetings and initiatives should be held to educate staff on the need for cost-cutting. Almost all of the participants in the study felt that organizations should educate their employees about cost-control issues. Research on the importance of cost management as a cost-control tool to help organizations maintain a competitive edge is encouraged, according to the researcher. This study suggests that finances and cost control are critical in identifying areas where costs might be reduced.

5.2. FUTURE WORKS

a. The research has resulted in the generation of various outlines that can serve as a strong foundation for a variety of in-depth investigations, including but not limited to the following:

b. Now that the relationship between the stage of the project and the technique for cost containment has been revealed by the study, it appears that project monitoring is more possible in the early stages of the project. Because of it, more research can be utilized for cost management during the tender phase, tendering estimation, and other similar purposes.

c. Research via survey could be carried out about the software now available on the market that helps with cost budgeting, monitoring, and analysis.

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