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IMPACT OF COST AND TIME OVERRUN IN CONSTRUCTION PROJECTS IN IRAQ

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Master's Thesis

Supervisor

Asst. Prof. Dr. Mohsen SEYEDİ

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ABSTRACT

IMPACT OF COST AND TIME OVERRUN IN CONSTRUCTION PROJECTS IN IRAQ

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Cost and time overruns are the greatest obstacle in the building sector. It is one of the most significant hurdles to economic development. This industry in Iraq suffer from overruns of cost and time. Consequently, the current study explores the numerous causes of cost and time overruns in building projects. Forty factors were considered for this study and categorized into eight groups. The study approach employs three procedures, the first of which is the Delphi method, which is utilized to build the dataset for the inquiry phase. The second approach involves determining the score of each element using relative importance index (RII) in order to assess the influence of each factor, and the third method involves determining the relative risks ratio (RR) and odds ratio (OR) of the primary group of factors based on the cost and time overrun effect. Experts in the building sector were polled to identify the most significant causes of budget overruns. Using measures of frequency and severity, the most important contributors to budget and time overruns were identified.

Keywords: RII, OR, RR, Delphi Method

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ABBREVIATIONS

IFRC	:	International Federation of the Red Cross
CV	:	Cost Variance
CPI	:	Cost Performance Index
SV	:	Schedule Variance
SPI	:	Schedule Performance Index
ETC	:	Ethereum Classic Price
EAC	:	Equivalent Annual Cost
VAC	:	Variance at Completion
TCPI	:	To-Complete Performance Index
BIM	:	Building Information Modeling
CM	:	Construction Management
NESPAK	:	International Engineering Services Pakistan
NLC	:	International Logistics Cell
RII	:	Relative Importance Index
A.H. P	:	Analytical Hierarchy Process

1. INTRODUCTION

An unplanned rise in project budget and duration is referred to as a cost and time overrun, cost and time increase, or cost and time increase. To predict the cost and duration of a program in the future, cost and time estimating requires collecting and analyzing historical data as well as applying quantitative models, approaches, tools, and databases. Cost and time are regarded as the most crucial factors in decision-making in the early phases of the building design process [1]. Estimating costs and timelines is essential for projects at every stage of design. Establishing a workable model and method for cost and time estimates is crucial for the success of a construction project. According to the International Federation of the Red Cross (IFRC) (2011), monitoring and evaluation initiatives enhance project execution by providing the required information for decision-making, organizational learning, and knowledge exchange. When value engineering errors in budgeting result in these cost and time aspects exceeding intended levels, these terms are employed. Three primary factors contribute to this: Economic repercussions of project budget or scope errors Inaccurate predictions or data collecting are examples of technical issues. Scope creep or a reduction in project commitment levels are examples of psychological reasons. It is critical to minimize cost and schedule overruns in order for initiatives to succeed. Even with all of the safeguards in place, you may still exceed your budget. We must first comprehend how to manage cost and time overruns [2]. Preparing for cost and time overruns before starting a project is the best method to avoid them. Many factors contribute to cost and schedule overruns, including relationships with outside vendors and scope creep. Various studies were undertaken in Malaysia to determine the primary reasons of building project time overruns [3]. To determine the main reasons for schedule overruns in building construction projects, Memon performed a questionnaire survey [4]. The results of the survey showed that the most important contributing factors to time overrun were repeated design changes, scope changes, client financial issues, delays in decision-making, unforeseen site conditions, client payment delays, a lack of site workers, inaccuracies and errors in design, a very slow process of preparing and approval of drawing documents, and unreliable subcontractors. The characteristics of a construction are indicated by cost and time-influencing factors, which have an impact on its price. A project is defined by influential aspects, and as the number of influential components increases, it becomes simpler to characterize a project more clearly [5]. There will be a big number of cases to assess if there are multiple influential components. As a result, selecting the appropriate number of components is crucial for increasing estimate efficiency. [6]. The influencing aspects of Korean residential constructions are shown in Table 1.1.

Table 1.1: Influential factors of Korean residential buildings

Influential factor	Contents
Basement Gross area (m2)	Man (all same)
Building coverage (m2)	1508-10318
Units/building	243-914
Units/standard floor	2-10
Floors of base	1-2
Roof type	Slop, flat
Floors	11-15
Cores	1-4
Pilots type	Partial, whole1st floor
Pilotis	0-8
Building type	Flat, tower, flat + tower
Floor height (m)	2.8 in (all same)
Unit size (m2)	49, 59, 84, 114
Combination of unit (m2)	49, 59, 84, 114, 49 + 59, 49 + 84, 59+84, 84+ 114
Type of pubic area	Hall, corridor
Structure type	Wall type (all same)
Level of finish	All same

The settings are altered. It is crucial to choose parameters (or independent variables) for the simple regression from the remaining influential factors after choosing the five major influential factors for data grouping. These clarities in the estimation process is readily guaranteed by the statistical values of the co-efficient of determination and significance level.

1.1 CONTROL COST AND TIME OF PROJECT

Even though there is just one process (PMBOK), it is undoubtedly the most crucial one. Utilizing earned value management is necessary to control project time and expense. The project manager gathers three pieces of data for each project work at any moment (often right now)[7]:

a) Planned value. The value of the work planned to be completed.

b) Earned value. The actual value of all the work completed (earned).

c) Actual cost and time. The actual cost and time of all the work completed.

Using four values—two from a financial standpoint (CV and CPI) and two from a scheduling viewpoint—the project's present stage is then calculated (SV and SPI). To extrapolate the current project stage to the project's conclusion, four more metrics are created (ETC, EAC, VAC, and TCPI). A project status report may include these statistics that are obtained and given to stakeholders. This process is known as the consolidation of individual project task budgets into an overall project budget. It speaks of establishing a time-phased project cost and time baseline that may act as a graduated ceiling for project finance limits as the project advances. Additionally, management reserves (total project contingencies) have been established.

The Estimate Cost and Time and Determine Budget stages may be seen as a single step since a time phased cost and time baseline is often not necessary for short projects[8].

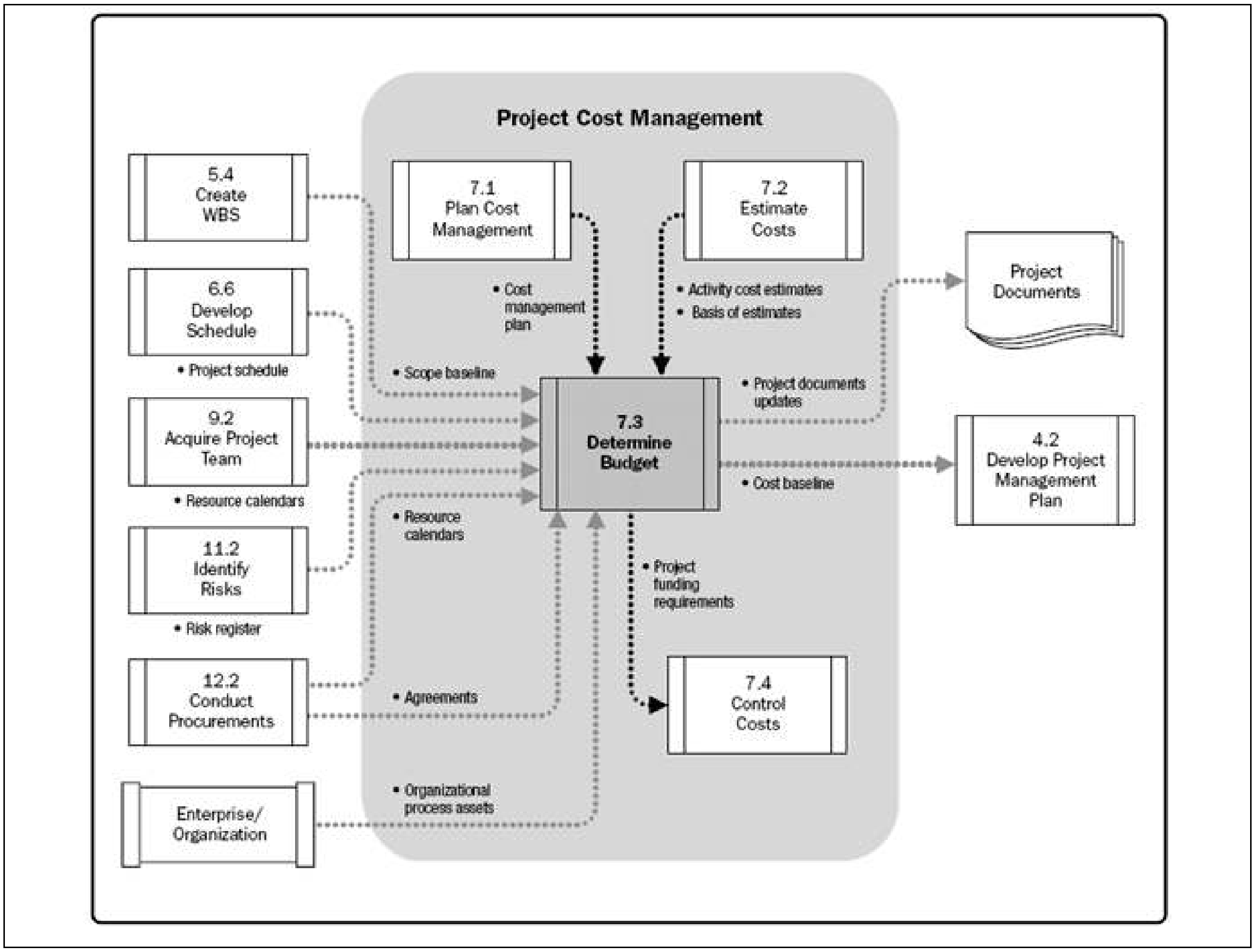

Figure 1.1: Process for Project cost and time control [8]

1.2 PROBLEM STATEMENTS

The cost and time overrun problem is considered as the recurring problem in Iraqi construction projects and gives negative impact to the projects in Iraq. To put it another way, a successful project is one that is finished within the agreed cost and time frame at the time of tender. This sector has been plagued by major issues such as failure to finish projects on schedule and within budget. However, the construction sector throughout the world continues to struggle with project cost and schedule overruns. As a result, this thesis examines the many elements that contribute to cost and time overruns throughout the building life cycle. This issue is created by a number of issues that have hampered the construction process from the start to the finish. The primary contributors in cost and time overrun, according to some research, are fluctuating material costs, cash flow and financial issues experienced by contractors, and inadequate site management and oversight. Other research has discovered that the building sector has causal variables for cost and time overruns. Based on the nature of the construction requirements, the current effort will identify the effective variables in cost and time overrun in Iraq that can assist to address the problem of cost and time overrun in Iraq.

1.3 OBJECTIVE OF STUDY

Purpose of the thesis is to investigate the factors that cause cost and time overruns throughout the life cycle of construction projects in Iraq. In order to obtain this aim, the following objectives will be achieved:

a) to specify cost and time overrun factors.

b) to analyze the effective cost and time overrun factors.

c) to evaluate the factors effect on project cost and time overrun.

1.4 THESIS ORGANIZATION

This thesis has five chapters. Chapter one includes an introduction to cost and time overrun project management.

Chapter residential construction projects in different studies collected from vary researches.

The application program, including the studied parameters and factors, the work methodology, and testing of overrun factors, are presented in Chapter three.

Chapter four discusses the result and the calculation of the work. Chapter five is the conclusion.

2. LITERATURE REVIEW

2.1 OVERVIEW

Construction contracts are frequently offered and chosen based on the lowest cost proposal. Costs may then rise as contractors try to recoup some of their investment. Construction projects involve a wide range of diverse parties, components, regulations, and other elements, making them difficult. projects with a potentially long completion period and fluctuating associated costs. Defects and errors in the design. Ineffective project management. Changes in the demands of the client. Unanticipated expenditures that become apparent as the work is completed. a lack of communication among the project staff. Lack of or bad condition of tools, equipment, and plant, etc. skilled workers may be unavailability. Incorrect pricing is the result of inaccurate cost data (e.g. material prices). unfavorable ground or field conditions. payment delays or withholding [1].

There are numerous considerations to describe linked cost excess, including [2]:

a) A proportion of the whole expense.

b) The overall proportion of the initial budget and the overrun sum.

c) A proportion of the associated cost overruns compared to the initial budget.

d) It is crucial to determine the core reasons of cost overruns in order to address and manage them.

2.2 REASONS FOR COST OVERRUN

While certain incidents, like harsh weather conditions, can create delays or damage that could increase costs, they are frequently the result of more complicated project controlling problems that can be challenging to resolve. Changes in specifications frequently lead to the most related cost overruns. To ensure accuracy and confidence in the project costings, pre-construction estimates and thorough project design are then needed, especially if the construction project is complicated and subject to change [3].

Using cost management software, construction information modeling (BIM), or project-wide construction project management can help mitigate design and construction issues in some cases by ensuring that all stakeholders use the most up-to-date design information and are in a position to make real-time adjustments [4].

Changes in the rules may also contribute to cost overruns. A change order is an amendment to a contract that modifies the scope of work, cost, and/or deadline of the original agreement. It may be considered a breach of contract if one of the parties to a contract fails to carry out the obligations imposed by the agreement and the ensuing increased costs. When a contract is broken, the innocent party may be entitled to file a claim for damages to make up for the losses it has sustained [5].

There are many sub processes in cost management, including estimation, creating a cost reference plan, creating a cash flow strategy, and related cost control. These estimates form the basis for investments and offers. These are largely based on strong understanding, however this is insufficient. When a project is launched or a bid is submitted, there is a lot of uncertainty. As a result, dominant risks are valued, distributed, and priced. It is crucial that the PM participate in budgetary activities and that the CM, TL, and IM actively participate in the solicitation of bids and contract discussions. The situation essential for swiftly deciding what could be done and what the projected cost will be is project information [6].

In a similar vein, one must be able to recognize when a project is on the verge of failing and take appropriate action. Analysis, progress updates, and projections provide information regarding the financial status of the project. The following interactive members are primarily used in the cost parts: Cost estimation; budgeting; cost management; progress reports; forecasts; progress evaluations; responses and active decision-making [7].

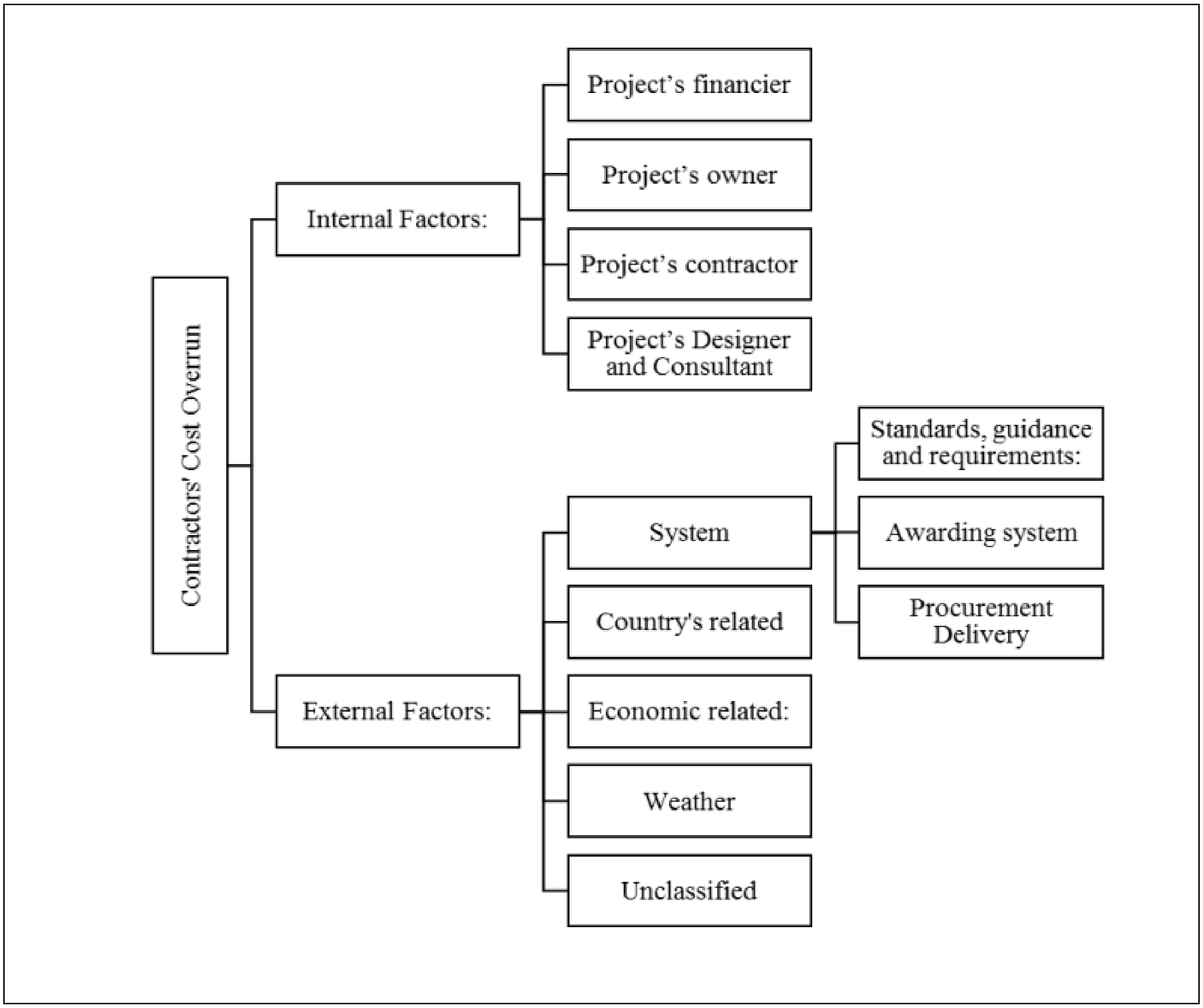

Figure 2.1: Causes of Construction Project Overrun [1]

2.3 COST PREDICTION

When we looked back at constructions where the actual cost exceeded the original estimate, it found that these situations typically resulted from: unclear requirements for scope and performance; items forgotten when calculating; unanticipated needs and requests; delayed projects; unfavorable market conditions; and numerous alterations and additional tasks as a result of the plan [8].

2.3.1 Organizing The Calculation Process

Before beginning the computation, determine which portions can be completed with the help of the firm and where help will be required. The business should complete the necessary components of the results, determine what may be acquired, and designate who is in charge of the calculation-related task. It should be handled how the currency unitability and index discrepancies vary. Compensation kind. Schedule for payment. Level of precision. The scope of the project must be well described[9].

The project specification, historical data from the company, checklists, charts of accounts, WBS descriptions, resource plans, volume calculations, market knowledge, and a risk list are all inputs for the calculation process. The calculation technique is based on the level of knowledge required for each task. Subtasks in the contract should be divided by the contractor. The written materials, illustrations, and descriptions provide as a solid foundation for the calculations. The project manager has more general but less specific knowledge [10].

2.3.2 Cost Reference Plan

A construction project's progress may be evaluated primarily via the use of the time schedule and the budget reference design, often known as the dispositive budget plan. Many of the current reference budget targets (established by customers, designers, and subcontractors) in the construction industry are founded on the methodology used to arrive at these figures. A budget like that cannot be used as an example. Inputs to the budgeting procedures include the project definition, data, chart of accounts, checklists, WBS descriptions, cost estimates, and risk list. Consistent with the allocated funds and anticipated completion date, a graphical depiction of the associated expenditures over time is created[11].

The total of the linked expenditures that have accrued will be calculated as a reference curve that may be used for monitoring during the implementation phase. If the timeline is adhered to and the actual expenses are in line with what calculated, it can also help in determining the funding requirements for the project [12].

2.3.3 Cash-Flow Plan

It's crucial to account for interest expense in the budget and keep interest expenses as low as feasible for contractors, who are typically paid shortly after the task is completed. A payment schedule must be included in the contract so that all parties can understand how money is allocated to the project or to each participant. The "payment in which for salaries and expenses" is situated above the "payments for accomplished work" (dashed line), which denotes the required amount of borrowing. The contractor or supplier frequently tries to obtain a "front-heavy payment arrangement [13].

2.3.4 Cost Management General

Economic predictions, corresponding cost estimates, analysis, and implementation are all part of the cost control process. Change management and schedule adjustments have an impact on the financial status as well. Bond and insurance control, as well as invoice verification, are part of the procedure. The drawings and definitions provided by the design consultants should be viewed as production. For the task, the TL must consequently create a production-driven budget or reference plan (see in the earlier time discussion). The beginning of the project is when there are the most opportunities to influence it. The possibilities shrink as the construction project progresses. Future work (drawings and construction) will be more intense as time goes on [14].

The project's economic turnover, which is evidently highest at the final production stage when all subcontractors are engaged. The dashed curve depicts the project's influenceability. Naturally, all of the really brilliant ideas may occur at the beginning. The applies to the client's project as well as to the work done by the contractor. A well-thought-out initial strategy can help the contractor save money. The schematic/basic derive papers are represented by the vertical dashed line [15].

2.3.5 Related Cost Management Throughout The Design

The investment-related cost against running and maintenance costs is the key factor to be taken into account during the early phases of derive (system/basic derive documents). For instance, low insulation and heat recovery expenditure inevitably results in increased operational expenses [16].

2.3.6 Cost Management While Procuring

Regarding purchasing, the first set of specific responses explains how the design has been maintained in relation to the project's overall economic framework and how successfully the calculations have been able to be made. Potential to Influence potential to affect project prices that are related Basic derived documentation and schematics Time [17].

The capacity to control a project's cost (black line) compared to related costs (dashed line). • A Practical Approach to Project Management in Building and Construction The summarised bid's budget must be available for a professional bid analysis. Additionally, the buyer could assist in a counter calculation of the request documents prior to the opening of bids. If the clients examine the request documents, they will discover inconsistencies and flaws in the documents and detect any irregularities in the store's operation. One can also assess the quality of their own cost calculating tools. Decide on the type of compensation to be employed in dominating [18].

There are several different types of compensation, including: fixed price combined with indexation and/or incentive; quantities and unit pricing; cost reimbursement; and other incentive contracts. There are several bonds, insurances, and guarantees to make sure that the client and contractor can meet their obligations. Are these expenses covered by the budget and bids. The payment schedule is a further economic factor to consider during discussions. How does cash flow appear? Negotiations are used to establish the routines for change management that dominate the financial position [19].

2.3.7 Controlling Costs Throughout The Construction Phase

The disturbance that the contractor experiences in terms of diminished outcomes often costs more than what is subsequently received in reimbursement from the customer. To relocate a door in drywall that hasn't yet been constructed to be visually appealing [20].

Frequently, the contractor's suggested improvement won't result in a huge cost savings. It is crucial to establish who has the power to authorize changes during the production phase of a building project. Be cautious when dealing with "apparent authority." Even though it wasn't intended, this authority appears to have real power due to certain actions, behaviors, or titles. Future production will always involve changes. The does not have to be for the improper controlling to cause. Over a long period of time, soil characteristics or other circumstances may change [21].

The design is dependent on a variety of assumptions, all of which have variable degrees of uncertainty. When changes or additions take place, resolve the situation right away and record the decision. Instead, agree on how it might be regulated if the cost cannot be identified right away. Both the client and the contractor gain from this. Try to organize frequent financial meetings between the contractor and the relevant client. The resulting period's current economic status needs to be frequently assessed. It might be possible to pay for adjustments and additional work as soon as is practical [22].

2.3.8 Cost Estimation for The Project's Completion

It is necessary to estimate the project's final cost while construction is still ongoing and will it fit in the budget or will anything need to be done. Have too many "wishes" that go beyond the needs of the project been granted? What can be done if the cost of the construction project cannot be decreased? Due to the importance of giving the linked client or project owner enough time to act, reporting should always be ongoing. Invoices don't help with project cost estimation. The cost at completion is tracked and documented at the moment the products are ordered [10].

Cost analyses could be performed with system/basic documentation, before to and following acquisitions, and occasionally throughout production. Analyze each cost center for [23]:

a) Completion of purchases

b) Projected future purchases

c) Cost reimbursement versus real expenses

d) Cost reimbursement and anticipated additional expenditures

e) Resolved modification orders

f) Assumed associated costs for unpaid change orders

g) Estimated reserves for orders for future modifications

h) A prediction of final costs

i) Budgetary departure

2.3.9 Track of Project Performance and Earned Value

A performance/forecasting technique that is successfully employed in many projects is the earned value method. The method clearly shows performance over time and associated cost lines. Think about the following: A budget that is broken down month by month has been produced, a manual has been made, and the design has been planned out. If more money has been spent after three months than was budgeted, would there be a budget overrun in the future? it differs The project is either ahead of schedule, on pace, or behind schedule. It's possible that the project is far further along than first anticipated and has less to offer. Analyzing the amount of funding given alone tells nothing. In order to determine where the project stands monetarily given what has been accomplished, it is necessary to first determine where it stands in terms of time [24].

2.4 PROPERTIES OF RISK PATHWAY

Analysis of project risks is necessary for efficient risk management. If risks are not defined, it is impossible to determine what they are, how likely they are, and what potential effects they might have [25]. The general characteristics of project hazards are the focus of this chapter. However, project risk organization goes beyond simply identifying and combining hazards. The goal of risk assessment should always be to be better able to manage project risks through mitigation. It will take more work to create and implement risk management strategies: Tools and techniques for project risk organization, covered later, can help with this endeavor [25].

a) Failure to accurately and promptly characterize threats can have a number of negative effects on the project, including:

b) Resources like time and money could be wasted being ready for hazards that are essentially nonexistent.

c) Contingency payments might be overstated, resulting in budget before schedule overruns and frequently performance and quality deficits as well. In an effort to cut costs quickly, quality then scope are decreased.

d) Neglecting real, major risks might lead to unpleasant surprises for the scheme manager and owner, such as cost overruns, completion delays, loss of project-related activities, and even cancellation.

2.5 GENERAL SCHEME RISK CHARACTERIZATION

The following sorts of project risks are covered in this account: performance, possibility, quality, and technology hazards. These include the possibility that the project as a whole will not function as envisioned or will not accomplish the task or use the corporate resources that produced the project's defense. Performance risks may also lead to schedule and cost hazards if technical difficulties increase the project's length and cost[27].

Risks to the environment, safety, and health. These include the potential negative environmental effects of the project before any concealed hazards are discovered during scheme execution. Serious occurrences can clearly affect the schedule and expenditures [28].

Schedule danger. This is the risk that the project will take longer than anticipated to complete. In addition to performance risk, agenda risk can also lead to financial issues if the project is finished too late to properly complete the intended assignment. Longer projects always cost more. Even if cost increases are not significant, project completion delays lower the scheme's value to the owner [29].

Financial Threat The risk that the plan may end up costing more than originally thought. Cost overruns might translate into performance risk if they force compromises in scope or quality in order to stay inside the original budget. Given that there aren't enough funds to complete the project on time, price risk may also serve as the primary driver of schedule risk [30].

harm to the support. Loss of stakeholder and public support for the project's objectives and goals may, in the end, reduce opportunity and cause funding snags, which would contribute to a subpar project presentation [31].

Although the aforementioned dangers can occur in an almost endless number of techniques and intensities, it is most helpful to focus on two varieties: Increasing hazards. These dangers include those that are not significant on their own but that can add together to create a significant risk. For instance, a cost overrun in a single subcontract might not in and of itself pose a threat to the project's affordability, but if numerous subcontracts begin to swarm for unrelated reasons or if they all experience the same type of disappointment, there may be a serious risk to the project's affordability. While one of these hazards might not be particularly dangerous, their combination and the lack of understanding that their combined effect is a serious project risk provide a concern. A clear example of an incremental risk in construction is weather-related delays, which are normally not severe issues in and of themselves but could pose a substantial threat to the project's schedule and budget if they continue for a lengthy period of time [26].

disastrous dangers These risks include those that pose individually significant threats to the project's cost, or agenda. Despite having an extremely low probability, they can nonetheless have a big influence. Risks include, but are not limited to, relying on critical abilities that may or may not prove to be difficult, scaling up bench-level technologies to full-scale operations, detecting waste products before contamination that is unexpected or inadequately characterized, or relying on a single supplier before sources of critical equipment[27].

2.6 PENALTIES OF INCREASED SCHEME UNCERTAINTY

Studies of projects with low and high levels of uncertainty show that the chance of the following increases as uncertainty rises[28]:

a) Increased project budgets,

b) Increased scheme duration

c) Increased planning effort

d) Increased amount of activities in the planning network,

e) Increased number of design cycles,

f) Increased number of design reviews,

g) Delayed last design

h) Increased need for conversation of information outside of formal meetings and certification

i) Augmented management attention then effort like probabilistic danger assessment, risk extenuation

j) Augmented systems engineering exertion

k) Increased quality management exertion .

When applied to high-uncertainty projects, methodologies and skills that are acceptable for low-uncertainty projects may produce subpar outcomes. For these projects, a flexible decision-creation strategy centered on danger management may be more successful. By doing a risk assessment, which begins with a risk description, the owner can determine if a project has very little risk or significant risk[29].

2.7 RISK MANAGEMENT STRATEGIES

For various project risk outlines, different danger management techniques perform better than others. The following binary examples illustrate how various tactics can be used [36]:

Deliberate decision-making can reduce uncertainties resulting from delays brought on by legislative, political, and economic changes for relatively certain undertakings.

For projects with a high level of uncertainty, delaying some decisions before making commitments on purpose might lower risks by allowing time to gather more or better knowledge that will allow for wiser choices. This includes keeping choices open for as long as possible, but expressly excludes delaying managerial decisions in the hopes that something miraculous would occur [37].

Therefore, risk organization techniques must be matched to the risk profiles, then, objectives, of the scheme, as well as the proprietor's entire project portfolio. Before receiving project clearance for design or construction funding, project directors must prepare comprehensive risk management plans. To do this, they must be informed about scheme risk management techniques [38].

The major steps in decisive the appropriate risk organization strategies include the next [30]:

a) Growth of risk consciousness ,

b) Scheme risk identification,

c) Qualitative danger assessment,

d) Quantitative danger assessment,

e) Risk prioritization

f) Risk mitigation

Project risk management involves raising everyone involved in the project—staff, suppliers, and contractors—to be more risk-aware. Similar to how safety awareness is developed on building sites, the development of risk awareness calls for constant attention from the owner's organization and constant proof of the management's dedication to this subject. One would argue that nothing more needs to be said given the constant assault of care messages, but the goal isn't to say anything new; rather, it's to keep repeating the same message until it gets ingrained in the culture. On construction sites, people may first believe that the safety engineer is in charge of keeping everyone safe, but the persistent message needs to be that everyone is accountable for it. All employees must understand that they cannot ignore any risky condition in order to have safety consciousness. Similar to this, risk awareness is attained when everyone working on the project recognizes that he or she cannot disregard a minor potentially dangerous issue in the mistaken notion that risk management is the job of someone else[31].

The responsibility of certain employees is one aspect of project risk management. Risk value and analysis should be carried out by qualified employees with cutting-edge complexity understanding of the system. Technical risk evaluations may be carried out by external consultants with specialized skills. Risk assessments, regardless of who performs them, should be evaluated by trained, unbiased specialists and reviewed by management for a "reality check" on the validity of the hypotheses, conclusions, and process as a whole. Once flaws are uncovered, corrective action plans must be developed and implemented[41].

A coordinated approach for risk mitigation planning must be developed jointly by owners and contractors before being put into action. This idea suggests that owners and contractors are working together toward a common goal rather than in an antagonistic manner where each party is trying to shift the risk to the other. An indication that risk management is nonexistent or has failed is the presence of adversarial relationships on a project [42].

2.8 CURRENT WORK

The study aimed to examined the reasons that caused the issue of construction project overrun and analyzed them in the way toward identifying the better project schedule for improving the conserving of the project cost. The study investigated the time-cost relationship and the effective of these two concepts on the project implementing. The evaluation of the factors that impact the project cost was part of the study for supporting the results and achieving the better management system for the contractors to be applied on the project stages without wasting of time or cost.

2.9 LITERATURE SURVEY

The research examined the causes and consequences of building project delays and budget overruns in Pakistan. A qualitative informative survey was therefore carried out to include the information that invades each time and expense. In order to get the survey into the hands of as many people as possible in the construction industry in Pakistan, I personally went to the offices of several different companies, including International Engineering Services Pakistan (NESPAK), International Logistics Cell (NLC), and many others. He also created fillable forms and distributed the survey over the Internet and social media, but the turnout was low. I personally delivered the study to a wide range of Pakistani construction firms, including the publicly listed International Engineering Services Pakistan (NESPAK), the privately held the privately held International Logistics Cell (NLC). He also designed online filling information and distributed the questionnaire online (social media), but the response was not enough. More so, a relative importance index (RII) was calculated for all problems, and a rank was assigned to each factor based on the results. In the questionnaire audit, the factor with the highest materiality index (RII = 0.796) was "delay in economic evidence by the owner of the use to the contractor (stage accompanied by assistance in the phase in which payment is made)," which was found to be responsible for the majority of the delays. Sometimes the client is too lazy to properly address a building issue and instead just hands over a "progress payment" to the builder. Why arguments arise between contractors and their clients. In order to improve development rules, work was halted. Find out the results of the information statistics after analyzing the most important issue is “Owner-assisted change orders in construction path” which has a relative importance index (RII = 0.756)[32].

The results of the research demonstrated that building projects often experience budget overruns in both industrialized and developing nations. This is a major problem that must be addressed quickly to ensure the project's success. This means that everyone working on a construction project has to pay particular attention to the issues of safety, cost, and quality. Since the construction business is so large and intricate, cost overruns tend to have a negative effect on project outcomes. Any issue that arises throughout the course of a project's life cycle might have ripple effects across the whole endeavor. Several academics have examined cost overruns, and using the results of prior studies as a starting point, they have pinpointed the most prevalent reasons of cost overruns. The purpose of this research is to determine the most prevalent reasons for building project cost overruns. Based on their origins, these causes may be broken down into 10 categories: design and contract factors, estimating factors, planning and scheduling aspects, project management considerations, work-related variables, financial factors, materials and equipment factors, and construction phase factors. The current study's significance lies in its ability to summarize the most important causes of cost overruns in construction projects, thereby assisting construction project participants in identifying the sources of these factors in order to address them and reduce the negative effects they have on the project[33].

According to the research, the building industry in India is a significant driver of the country's economy. However, it suffers from a slew of problems that compromise its efficiency, effectiveness, and value. Time, money, and quality are the three most important aspects of building project management. The ability to complete construction projects on schedule has become more important and difficult for managers, architects, and contractors. Getting something done is an issue that can be fixed. The overarching goal of this research is to determine what causes a construction project to go over budget and behind schedule and then provide effective ways to fix the problem. Overruns in both time and money are common in Indian construction projects due to poor planning, implementation, and management. Given that it is possible to mitigate its effects by reasonable planning, and since the bulk of its causes are already known to exist[34].

The study showed that the construction industries have a bad reputation for completing projects on time and within budget. Typically, nine out of ten projects have a skills cost overrun. Various reasons for related cost overruns have been identified. This file conducts a critical review of the literature on cost overruns in construction projects in various countries in order to identify the most important causes. 173 causes of cost overruns were found in 17 contexts, with the following factors standing out as major contributors: a high number of design changes, contractor financing, late payment for work completed, lack of contractor experience, poor cost estimation, inadequate bidding documents, and subpar materials management[1].

According to the results, building projects often experience substantial variations between their anticipated and actual prices. An example of a forecasting model where actual construction costs exceed estimates is provided in the file. A primary goal of modeling is to estimate the likelihood that different combinations of costs will lead to different combinations of members of an outcome distribution. A mysterious Mamdani inference technique has been developed for choosing evaluation targets. Models for predicting future costs have included both fuzzy linkages and compound max-min relationships. The model's output is the degree to which different types of businesses are vulnerable to price shifts. Most notably, modeling may be helpful for contractors who are interested in learning not just the likelihood of a total cost overrun, but also the possibility and size of cost increases for particular packages of works or detailed construction work necessary to finish a building project. This method has the potential to enhance the planning of project costs, work schedules, and cash flow throughout implementation[5].

Research was conducted to determine what factors lead to budget overruns on public building projects in Port Harcourt. Critical success metrics for public construction projects in the city of Port Harcourt are established, and an analysis of the actions that may be taken to mitigate the consequences of associated cost overruns on such projects is undertaken. Participants' answers to structured questionnaires were compared to the parameters found in the analyzed literature. Most of these tasks were completed by licensed builders in Port Harcourt. The data set was evaluated and sorted by the average item degree. The poll found that the most significant reasons of budget overruns were delays in making decisions and inadequate designs, as well as variation orders and scope variations. Time overruns, higher construction project costs owing to time extension, disagreements between owner and contractor, insolvency, and wasted public money are all highlighted as major consequences of linked cost overruns in the research. Furthermore, the use of experienced contractors, careful project planning, the appointment of highly experienced, committed design teams, impressive strategic planning, and proper project scheduling were identified as the most effective methods for reducing related cost overruns in Port Harcourt's public sector construction projects, while inexperienced project management, inexperienced construction workers, and a lack of a clear strategy were identified as the most risky aspects of public sector building projects. We end by stressing how crucial it is for Port Harcourt projects to be well-designed with sufficient specifications to provide crew members a clear sense of direction. Consequently, it was suggested that experienced contractors be selected by clients and that public construction projects in Port Harcourt be managed carefully to reduce the likelihood of cost overruns[35].

Explanations for mid-project cost increases in building projects have not been well explored in previous research. The study's primary purpose is to determine the root reasons of building cost overruns in Jordan. Because of this, the researcher used a quantitative strategy for data collection and polled those who had some role in the building project. Cost overruns are a common problem in Jordanian building projects, despite widespread agreement among project planners that they spell doom for the endeavor as a whole. In order to effectively address an issue, it is crucial to identify and address its origins. This research, however, applies multivariate statistical methods to the question of what exactly causes building projects in Jordan to go over budget. The research revealed that in Jordan, budgetary challenges, material concerns, design issues, and overtime were the top four causes of cost overruns. Large transportation costs, unrealistic contract durations, slow decision making, extra quantity during construction, inadequate funds to finance the project, inconsistent cash flows, and payment problems faced by government clients were also identified as critical underlying causes of related cost overruns. Manufacturers might benefit from learning more about the unpredictable factors and underlying causes of cost overruns so that they can implement methods to increase project success[36].

The research found that most construction projects have budget overruns because of the lack of assurance around project information at the derivation phase. In addition, flaws in the derived phase may cause problems in the development stages of a building project, which in turn lowers the quality of the construction process. Therefore, preventative actions must be taken to limit associated cost overruns caused by design flaws. The primary goal of this investigation is to identify effective strategies that may be used during the design phase to lessen building projects' monetary overruns. For this purpose, a survey was sent to engineering professionals involved in construction projects, and their responses were examined. There were basically two primary topics covered in the survey. The report identifies eight main causes of derivation-related cost overruns, such as last-minute modifications to designs, lack of comprehensive or thorough derivation drawings during bid periods, mistakes in the designs themselves, and overly optimistic estimates of how long the contracts would last. In addition, the findings highlighted eight critical methods for minimizing associated cost overruns, with special emphasis on conducting soil tests before the derivation process, creating design drawings with a great deal of precision and detail, and having the bulk of the necessary funding available early on. Phase. This study offers a database that may be used by academics and professionals in the construction sector to aid in the development of various methods to curb associated cost overruns. It is hoped that this research would lead to more cost-effective building projects[37].

According to the research, the customer or the owner of a construction project may expect to bear a large financial burden due to the likelihood of cost overruns. Cost overruns are a common problem in the construction industry, therefore this research set out to identify the root reasons. A questionnaire survey and a desk investigation were utilized to determine the root reasons of budget overruns. Customers, experts, and workers all filled out and submitted 30 surveys. Participants were asked to prioritize the reasons depending on their perceived likelihood of occurrence and the severity of their impact. We weighed the frequency and severity of each contributing factor to establish their relative importance. Agreement in the views between the sets of activities was analyzed using Spearman's rank correlation (client vs. consultant, client vs. contractor and consultant vs. contractor). It seems from the data that there is consensus among responders as to what caused the expense overrun. Issues with land tenure, incorrect estimates due to inaccurate or unreliable estimation methods, insufficient design documentation, delays in design submission, and rework due to incorrect work reasons all contribute to a project's length of completion, as do issues with decision making and schedule control. Most budget blowouts occur in the time frame between the design phase and the bidding phase. We compared our study's findings to those from other nations and found several shared commonalities in the primary factors we uncovered[38].

One of the most significant and volatile contacts, according to the report, is completing the project for the agreed-upon price in the industrial construction industry. In the Sultanate of Oman, building cost overruns are as common as the problem they are anywhere else. The key goals of this research are to (1) identify and (2) analyze significant elements that lead to cost overruns in Omanan construction projects, and (3) estimate the effect of associated cost overruns on construction projects. Future projects may have their budgets reined in by structural building, strategy creation, and improved procedure used by project management teams. This was accomplished via the use of a questionnaire and in-depth interviews with professionals in the building sector. Using a literature search, researchers in Oman were able to identify and analyze twenty-nine factors that contribute to budget overruns. Time to completion, low quality delivered projects, and delays in acceptance of payment were identified as the three most significant outcomes of cost overruns in building projects and industries. Get yourself a superior group of watchdogs, a competent cost controller, a capable project manager, a capable group of project configuration specialists, well-thought-out pre-design courses, and an effective method of acquiring supplies. Construction projects in Oman might benefit from a thorough risk analysis and a plan for mitigating any dangers to the budget. The report suggested actions for controlling construction costs in the future, such as having the employer do a thorough examination of the contractor's proposal and requiring the completion of comprehensive design prior to the awarding of any contracts[39].

Urban construction, one of the most important subsectors of the Iranian construction industry, was found to be particularly susceptible to major cost overruns and delays, according to the research. This study's major goal is to evaluate the cost and time effectiveness of various urban building project sizes. Moreover, this research included construction projects of varying kind (new vs renovated) and type (road versus building). Karaj, capital of Iran's Alborz region, is the focus of this research of urban development schemes. Seventy-two urban construction projects had their paperwork and actual performance analyzed for this research. The acquired data is analyzed using statistical techniques such as the category range accuracy, independent sample T-test, and correlation analysis. This research demonstrates that cost and time overruns are not the only challenges faced by major urban building projects. On top of that, when comparing time and money spent, new builds come out on top when compared to renovations. In addition, urban road projects beat building constructions in terms of cost and performance. The findings provide statistical and descriptive data on time and money that may be used to make accurate time and cost predictions for urban building projects[40].

The research investigated the most serious problems with cost control on Iraqi building projects. To gauge the efficacy of current quantitative methods in the construction industry, a survey was administered to those in the field. One hundred sixty-four questionnaires were sent out to various firms and organizations in the public, commercial, and nonprofit sectors, and the results were examined statistically. According to the data, the most significant factors are the following: a lack of familiarity with and proficiency in using modern concepts, methods, and technologies; a delay in receiving payment for work completed by the specific owner; a lack of stability in retail prices; a lack of knowledge about, and inefficiency with, currently available tools and technology; and a preoccupation with, rather than preparation for, the security situation in the country. The results show that Iraqi construction projects have trouble keeping their costs under control, which leads them to halt or postpone delivery, calling for significant and quick remedies. Adopting and incorporating established technology into the construction industry and developing customized techniques for cost management that are suitable to the Iraqi building environment are two of the most important answers[41].

2.10 EFFECTIVE BUILDING TYPES

Modern buildings are those that provide a high standard of living for their inhabitants at a reasonable cost, utilize energy efficiently, and feature user-friendly design. These buildings are conceived with an emphasis on achieving the best possible synergy among their structural, mechanical, electrical, and administrative components. In addition to the standard architectural design and function, these buildings also incorporate high-tech control systems and smart, interconnected devices. The smart building was at first thought to be the sensor-equipped home with multiple integrated systems. The future of the building trade is in smart building design. Most modern commercial and residential construction is made to consume as little energy as possible. Expanding energy-saving strategies and integrating sustainable design practices are crucial to the success of the industry as a whole. In spite of this, many descriptions of "intelligent buildings" are vague and leave out important details. Due to the lack of a realistic context including all of the factors influencing the design of such systems [42], a comprehensive framework including the con- volute criteria are necessary as a decision-making tool. When it comes to the performance of a building, an intelligent structure goes above and beyond mere integration to achieve interaction, wherein the various systems work together to optimize the building's performance and continuously generate an atmosphere that is most conducive to the goals of its occupants. When it comes to intelligent buildings, systems that are fully interoperable perform better, cost less to operate, and have a smaller environmental imprint than separate utility and communication systems. Power, security, fire alarms, firefighting, air conditioning, diesel generator, water supply, solar energy, solar water heating, access control, and lighting can all be efficiently managed in an intelligent building. It also helps service engineers keep track of when to service certain pieces of equipment. To put it another way, the effectiveness and efficiency of a business are increased by an intelligent building since it allows for the management of its resources[43]. Safety, a healthy internal environment, enduring aesthetic values, and cost-effectiveness are just a few of the benefits that modern organizations can enjoy due to the superior quality of the intelligent building, which enables unimpeded and efficient operation, growth, organizational restructuring, and proper social relations (ease of space arrangement). Therefore, modern intelligent architectures must satisfy all of these criteria [44]. In order to meet the needs of all stakeholders in a manner that is also kind to the environment, sustainable and flexible buildings are developed using integrated and managed building control systems, as well as a sophisticated understanding of technology. Sustainability, stakeholder expectations, and a shifting culture that places a greater emphasis on value than on upfront costs are all elements in this development, which ensures that both quality and overall costs over the lifetime of the product are considered [45].

2.10.1 Factors on Modern Building

However, the large number of factors involved in the design of such buildings has complicated the design decision-making process and necessitates a multi-criterion approach for evaluating influential factors and sub-factors [46]. The primary objective of intelligent building implementation is to reduce energy consumption through energy saving and conservation. To shed light on the selection of smart structures, this research proposes a multi-factor framework for decision making that takes into account 68 criteria. The eight quality environment modules considered most significant in this context were as follows: environmental and energy indicators; space flexibility; cost effectiveness; user comfort; working efficiency; safety; cultural and technological aspects; and technology elements. Based on their relative significance, the indicators for intelligent buildings are organized into eight groups. They are broken down into the categories of Required, Suggested, and Recommended[47]

Through a process of reflective and interpretive reading of publications obtained through a bibliographic search, potential drivers for smart buildings were identified. We studied the many perspectives, categorized the data, drew linkages between the most significant concepts and the current body of knowledge, and compiled a list of prospective drivers [48] to identify which recent breakthroughs would give the most solid theoretical foundation.

Pricing construction work entails taking into consideration not only the direct expenses involved with the completion of the works, but also business expenses and a profit. Using unit price, construction project costs can be estimated. This procedure requires extensive experience from the contractor. All of the aforementioned costs must be included in the unit pricing. Traditionally, direct costs are estimated by adding up all the minor expenses that comprise a project. This conventional method is accurate but time-consuming; consequently, new approaches employing current mathematical tools to accelerate the calculation are still being explored. Experiments with artificial neural networks, linear regression, fuzzy sets, and support vector machines are but a few of the many fascinating study fields that could be pursued [9]. Making decisions is a frequent occurrence in the real world. The topic of how to make the best decision, whether it be the selection of a single product or the adoption of a new strategy, is always the same: how to account for the particularities of the variables that form the selection process. Multicriteria decision making is now prevalent in a vast array of sectors and contexts, such as business, medicine, and the sciences. Using AHP, a complicated problem can be decomposed into a hierarchical structure of objectives, criteria, sub-criteria, and alternatives, each of which can be used to describe a distinct part of the overall decision-making process. AHP can be applied to decisions that are complex, lack structure, and have multiple criteria. The options indicated by these criteria challenge a purely linear examination since they incorporate both material and mental factors[49]. The AHP offers a mechanism that can quantify the subjective assessment of the person making the decision in a form that can be measured [50]. In order to analyze and choose the appropriate stations to use in the process of developing cost systems, it is necessary to construct a mathematical and computational model. The Analytical Hierarchy Process (A.H.P.) model offered a rational and illustrative approach to arranging and ranking the various aspects of the decision problem. The AHP approach revolves upon these four key tenets at its core. This conventional method is accurate but time-consuming; hence, new approaches that make use of contemporary mathematical tools in order to speed up the calculation are still being researched. Experiments with artificial neural networks, linear regression, fuzzy sets, and support vector machines are just some of the many intriguing areas of research that may be pursued [9]. There are many more interesting areas of research that could be studied as well. Choosing amongst available options is an activity that occurs frequently in real life. The topic of how to make the best decision, whether it be the selection of a single product or the adoption of a new strategy, always comes down to the same thing: how to account for the particularities of the variables that shape the selection process. This is true whether the decision in question is the selection of a single product or the adoption of a new strategy. These days, multicriteria decision making is considered standard practice in a vast array of industries and contexts, including the commercial world, the medical industry, and the scientific community. With the help of AHP, a complicated issue can be partitioned into a hierarchical structure consisting of objectives, criteria, sub-criteria, and alternatives; each of these elements can be utilized to describe a distinct facet of the general choice process. The application of AHP is useful for a variety of decision-making scenarios, including those that are challenging, lack structure, and involve multiple criteria. Because they take into account both material and mental factors, the decisions that are outlined by these standards cannot be reduced to a straightforward linear analysis[51][52].

3. METHODOLOGY

This section describes the research methods used to prepare and build a strategy for identifying the most significant elements that increase the cost and duration of construction projects. All the necessary measures to meet the research's aims and needs were based on the findings of prior studies, as were the preparations for the influencing elements. However, the researcher made revisions to the variables based on questionnaires and field discussions with specialists. The primary objective of this research is to shed light on the reasons of cost and time overruns in Iraqi construction projects and their management. This section presents a methodology for identifying and evaluating the primary factors, where the researcher began by preparing interrogative questions based on the totals of factors, followed by preparing a questionnaire to clarify the reason for each factor, interviewing experts using the Delphi method, and finally applying the relative risk (RR) and odds ratio between cost and time factors. Interviews and questionnaires were used to compile the data. Due to the in-depth information gleaned through one-on-one interviews, this method often uses a limited sample size. In this approach, the researcher will try to get as much information as possible from the respondent. Though it provides more detailed information about the study's subject than more impersonal surveys, this method of research prevents the researcher from delving into the interviewee's individual motivations and preferences. in-depth interrogations "are a great tool for getting people to elaborate on their experiences and thoughts in a meaningful way. They shed light on how others see the world and the reasons for those assessments." The researcher takes notes during the interview, and those notes should reflect the researcher's own views and findings. Because the researcher uses open-ended and casual questions, the responder is given the chance to respond freely. Never manipulate responses so that they fit the needs of the study.

a) effective factors

In this section, we make some educated guesses about the importance of project management and provide supporting evidence for our hypotheses. The second chapter's focus is on these factors. They found that the most likely causes of budget overruns can be put into a few distinct buckets. The expert has determined that five of these groups can function autonomously in Iraq despite the high costs involved.

Table 3.1: The Used Factors in The Present Study (Dr. Abdussalam Shibnai et al, presented in 2015)

factor code	sub-factor code	
FG1		External Factors site conditions (Location, unforeseen site CONDITION)
	P1	Work accidents
	P2	Government regulation
	P3	Weather condition
	P4	Price inflation
FG2		Material factor
	P5	Material Shortage
	P6	Escalation of material prices
	P7	Poor material management
	P8	Low productivity of materials
	P9	Poor quality of materials
	P10	Delay of material delivery
FG3		Owner factors
	P11	Financial problems (delay payment, etc.)
	P12	Bureaucracy
	P13	Suspension of work
	P14	Interference of the owner
	P15	Change/additional works by the owner
	P16	Poor communication and coordination

Continue to Table 3.1

factor code	sub-factor code	
FG4		Labours and equipment factors
	P12	Low productivity of the labours
	P13	Unskilled labours
	P14	Shortage of skilled labours
	P15	Shortage of equipment
	P16	Equipment breakdown/failure
	P17	Lack of maintenance for the equipment
FG5		Contractor factors
	P18	Contractor's financial problems
	P19	Lack of contractor experience
	P20	Poor distribution of labours
	P21	Poor site management
	P22	Delay/Mistakes because of subcontractors
	P23	Poor communications and coordination
	P24	Lack of project staff and qualified staff

Continue to Table 3.1

factor code	sub-factor code	
FG6		Consultant factors
	P25	Consultant lack of experience
	P26	Lack of experience of consultant team
	P27	Poor communication and coordination
	P28	Delay in giving instructions
	P29	Poor inspections
	P30	Delay in approving major changes in work scope
	P31	by consultant
FG7		Design and documentation related factors
	P32	Incomplete drawings
	P33	Unclear specifications
	P34	Delay in design work
	P35	Change of design
	P36	Inexperienced designer
	P37	Design mistakes
FG8		Professional Management factors
	P38	Poor construction planning
	P39	Slowness in decision making among project team
	P40	Low managerial skills for all parties

b) Relative Importance Index (RII)

In the analysis methodology, the approaches and procedures of this quantitative investigation are discussed. A questionnaire was used to obtain the data. This study utilized a quantitative approach. The questionnaire was created using effective factors that influenced the development of the construction project, which were compiled from prior research. There were both open-ended and closed-ended questions for responders to pick from on the questionnaire. The reliability of the questionnaire has been evaluated to see whether or not respondents who completed it twice would acquire the same findings. The degree or severity of the variables is not the only factor that determines the decisions made throughout the management process; the decision-makers' tolerance for overrun factors is also significant. As a result, once the components have been evaluated, it is necessary to determine whether or not they are fit for usage. The particular level of risk that an individual, a client, or a society is willing to bear is the determining factor in whether or not a decision-maker is willing to make a choice. Before making any further decisions regarding the budget, the timetable, the technical solutions, the construction methods, etc., the acceptable threshold must be determined. To ensure that the earliest phases of the project are driven by the best decisions possible, it is necessary to identify the acceptable level at the onset of the project. The acceptable threshold should be specified in the project's policy. The acceptance factor in a circumstance is determined by the decision maker's willingness to accept a particular component. Acceptance of a factor can be influenced by a number of factors, including an individual's or organization's evaluation of the factor, decision criteria, and prior knowledge and experience with scenarios involving analogous decisions. Acceptance of a factor can be established by how a person or organization actually treats that element. Acceptance of a factor can be categorized as factor avoidance, factor neutrality, or factor taking. The certainty equivalent, which is the anticipated value or the assured amount of resources that are equally valued as a specific condition, can be used to characterize them. The expected value is the quantity of guaranteed resource availability.

C) The Relative Risk (RR)

When comparing the odds of an outcome occurring in an exposed group to those of an unexposed group, the ratio between the two is known as the relative risk (RR) or risk ratio. Relative risk, along with risk difference and odds ratio, quantifies how closely an exposure is linked to an outcome. Ecological, cohort, medical, and intervention studies all employ relative risk in their data analysis to determine the strength of the link between exposures (treatments or risk factors) and outcomes. The incidence rate of the result in the exposed group is calculated as the ratio of the rate in the exposed group to the rate in the non-exposed group. Values of relative risk can be understood as follows, assuming a causal relationship between exposure and outcome:

A risk ratio of 1 indicates that exposure has no effect on the outcome.

For example, if the relative risk (RR) of an exposure is less than 1, we call that exposure a "protective factor." Exposure, here called a "risk factor," is understood to raise the chance of the result if the relative risk (RR) is greater than 1. Although the two may share certain similarities, it is important to remember that correlation does not imply causality.

d) Odds Ratio (OR)

Time delays and budget overruns are linked inextricably, and the intensity of this relationship can be measured by calculating the odds ratio (OR). The odds ratio is defined as the comparison between the probabilities associated with time and the probabilities associated with cost, or, alternatively (owing to symmetry), the comparison between the probabilities associated with money and the probabilities associated with money but without time. If the probabilities of one event happening are the same in the presence or absence of the other, then those occurrences are said to be independent if and only if the odds ratio (OR) equals 1. If the OR is greater than 1, then time and cost factors are related to one another (correlated), in that the presence of cost factors increases the odds of time factors relative to the absence of cost factors, and vice versa. If the odds ratio is less than 1, however, there is a negative correlation between time and cost, and the occurrence of one event decreases the probabilities of the other.

4. RESULTS AND DISCUSSION

Increases in borrowing rates, inflation, and the ambitions of the development plan have all contributed to a heightened sense of anxiety about the pace at which Iraq can realize its construction aspirations. For this reason, it is more important than ever to identify the root reasons of construction project delays and cost overruns. The financial goals of a project must be met for it to be considered a success. How well a business manages its expenses can be an indicator of its efficiency and success. A project's cost overrun is calculated by comparing the original estimate with the final, completed construction expenses. When it comes to meeting deadlines and sticking to budgets, Iraq's construction industry has a terrible reputation. Numerous inquiries have been conducted into the causes of project cost overruns. This paper aims to investigate the effects of building factors to go over budget based on time and cost. The total number of factors revealed in previous research is reduced to 40. On the basis of their root causes, we have classified them into eight distinct groups. The results shown in figure 1 to figure 16.

From figures 1 and 2 Companies' pricing, market entry, production, investment, and product selection decisions can all be influenced by government regulation. The consequences of 'economic regulation,' including pricing and entry regulation and environmental, health, safety, and information regulation, have been the subject of much empirical literature. also, The term "inflation" refers to the average annual percentage rate of price inflation. Increases in general prices or the cost of living in a country are examples of inflation's broad scope. Inflation can be brought about by either demand-pull or cost-push factors. Both contribute to a general inflation in an economy, but they do so in distinct ways. When consumer demand is strong enough, prices will rise, whereas when supply costs are high enough, prices will push up.

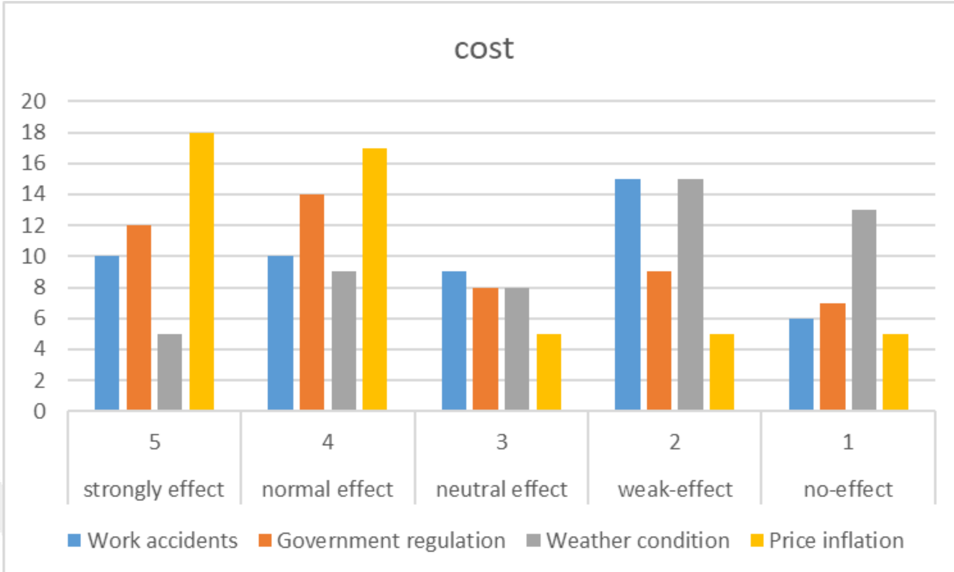

Figure 4.1: Cost External Factors site conditions

Table 4.1: Cost External Factors site conditions

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Work accidents	10	10	9	15	6
Government regulation	12	14	8	9	7
Weather condition	5	9	8	15	13
Price inflation	18	17	5	5	5

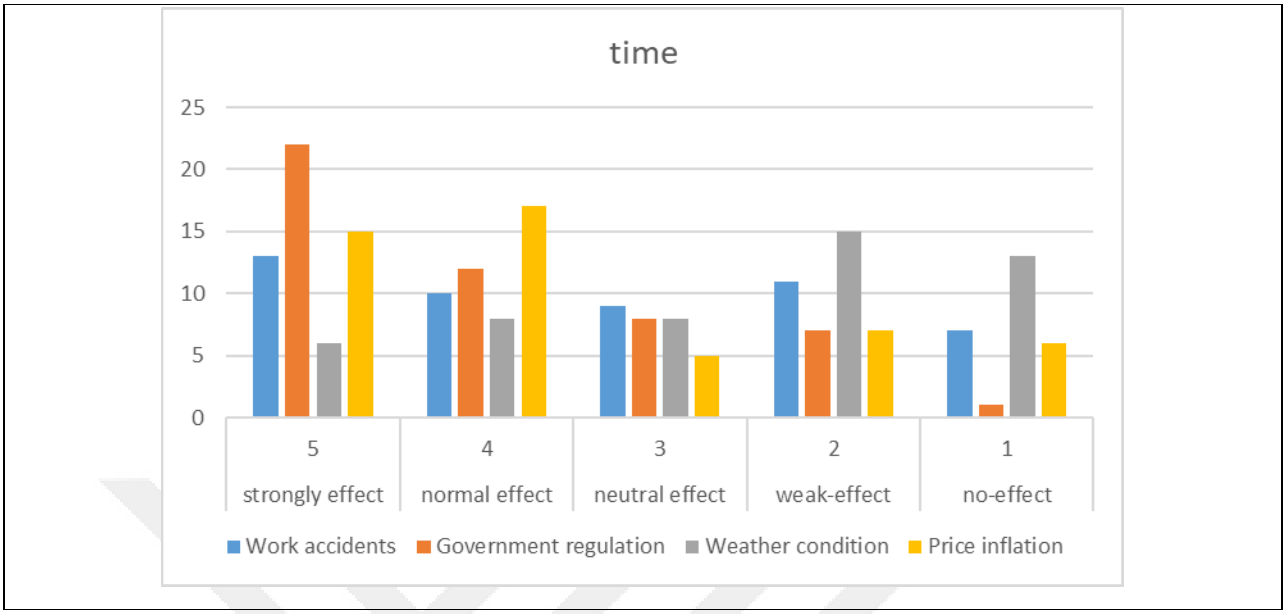

Figure 4.2: Time External Factors site conditions

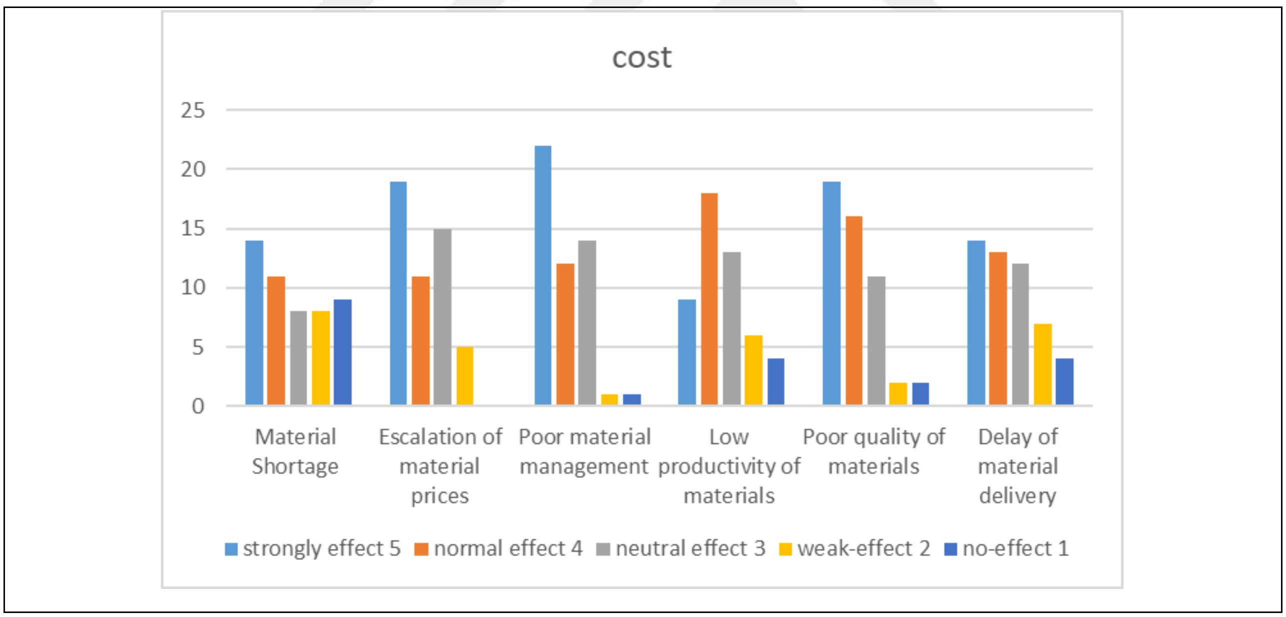

Figure 4.3: Cost Material factor

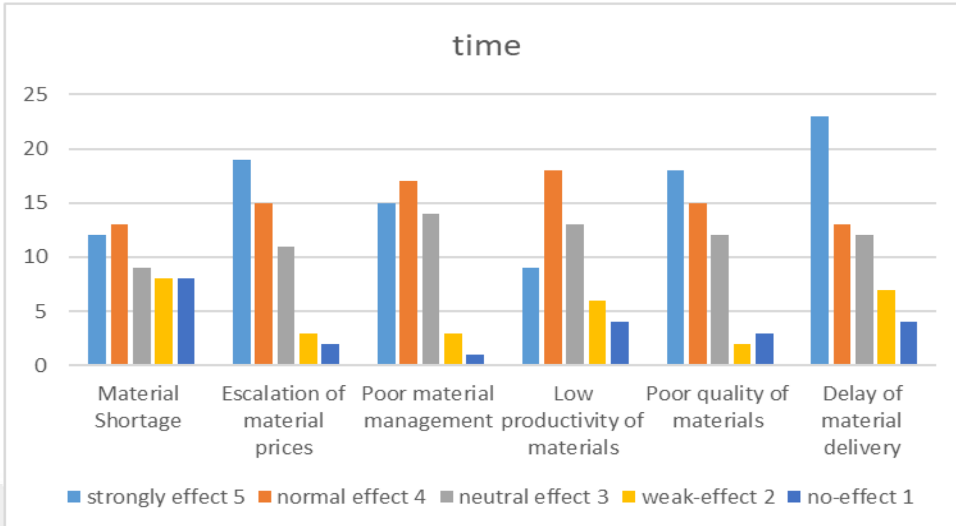

Figure 4.4: Time Material factor

Problems with the engineering company providing a complete or correct Bill of Materials is a common source of frustration for those responsible for material management. Problems with making orders in engineering. Corrections and inaccuracies in purchase orders. mistakes in shipping and receiving that affect inventory counts. Counting errors in the stock of materials. Construction professionals tend to be sloppy when it comes to materials management on sites. Problems with materials flow, project delays, subpar output quality, and waste generation are all possibilities.

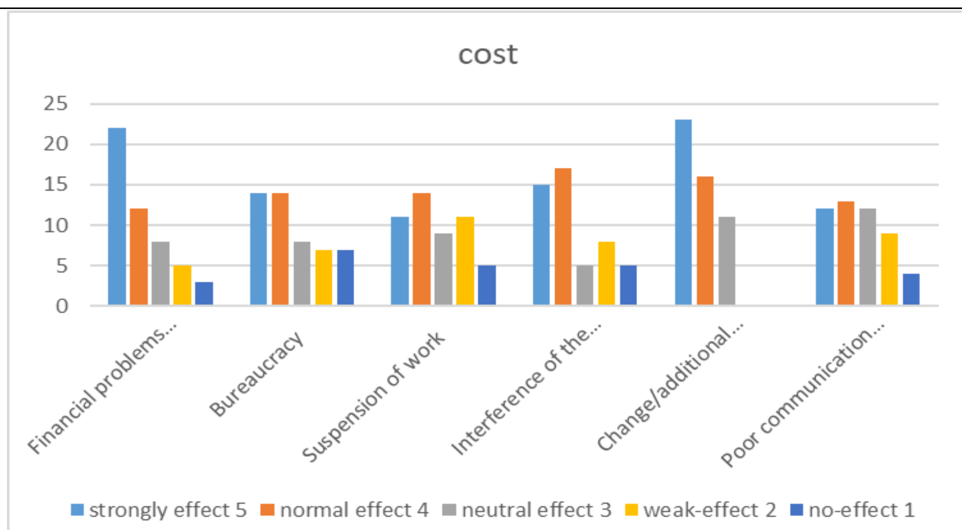

Figure 4.5: Cost Owner factors

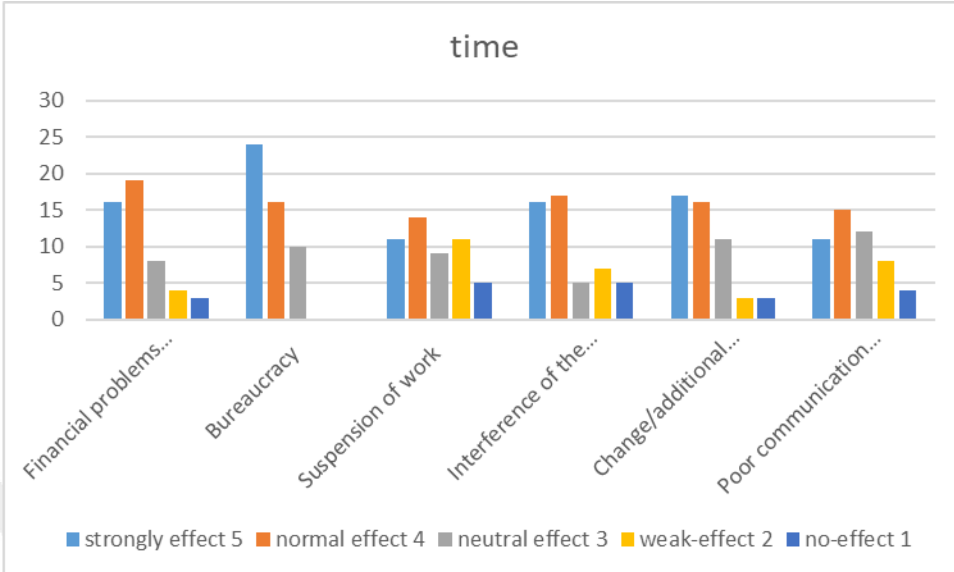

Figure 4.6: Time Owner factors

Some contracts have a broad description of what constitutes a changing circumstance, while others are more detailed. Any deviation from the contractor's original scope of work constitutes a modified condition, which can lead to additional costs and potential legal challenges down the line. When site conditions change (such when an unanticipated flood occurs), the owner may incur additional fees.

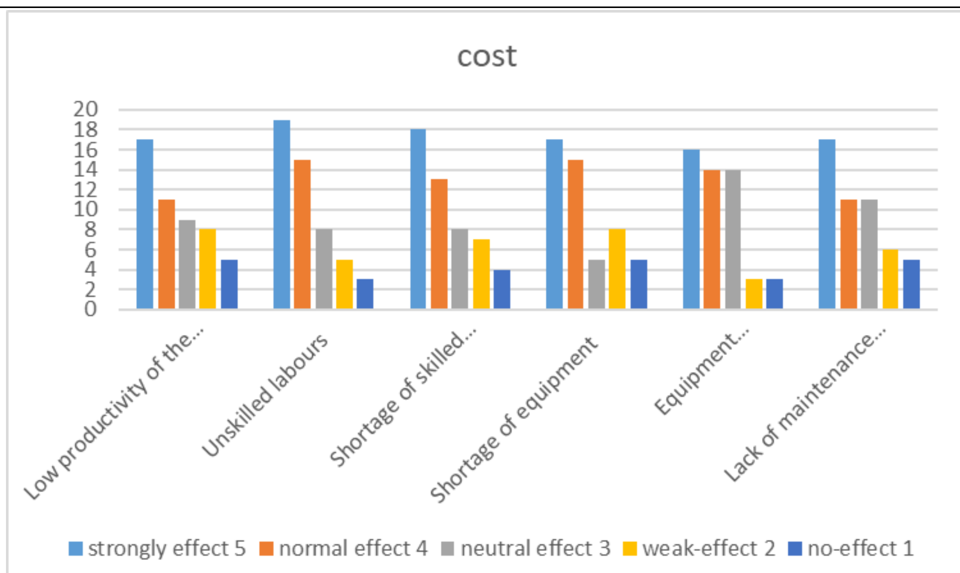

Figure 4.7: Cost Labors and Equipment Factors

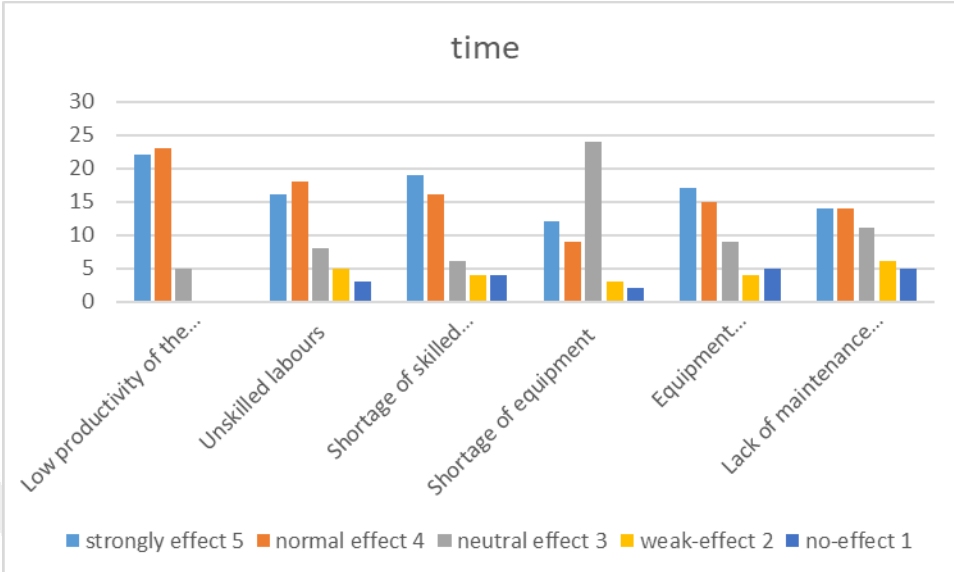

Figure 4.8: Time Labors and Equipment Factors

It's often linked to things like bureaucracy, boredom, slow response times, and rigidity. It's sad that these concepts have gone viral across the industrial sector and altered the very foundations on which businesses are built. The administrative structure of your institution is generally typical of a large organization.

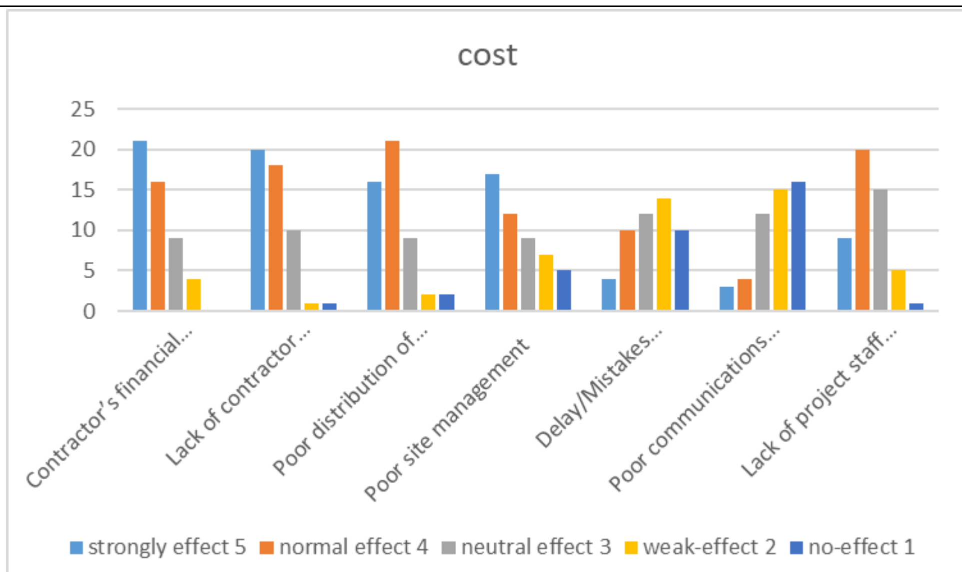

Figure 4.9: Cost Contractor factors

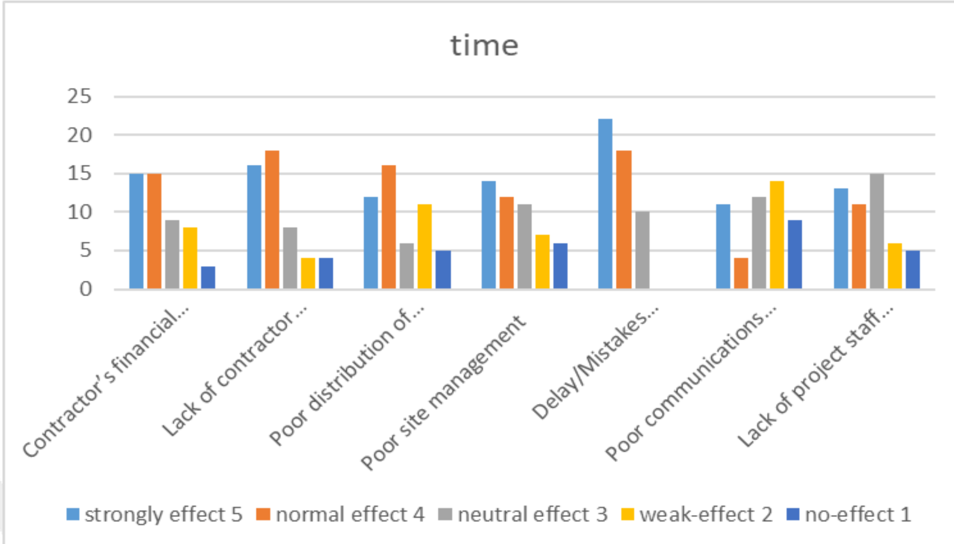

Figure 4.10: Time Contractor factors

Employees are productive when they increase output per unit of time or decrease the number of hours needed to complete a given task. This aids in decreasing the overall cost of operations. Profitability rises as a result of reduced labor costs associated with maintaining output levels. Further, with satisfied customers, businesses have an advantage in the market and more room for expansion. When morale and employee engagement are both higher, burnout is less likely to occur among workers.

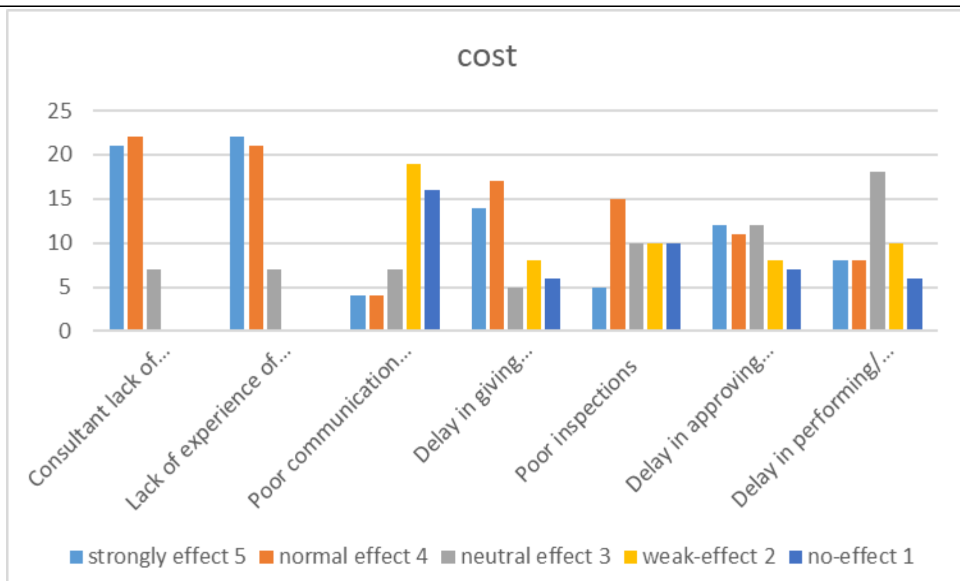

Figure 4.11: Cost Consultant Factors

Also, the Bureau of Labor Statistics uses the phrase "low-skilled/unskilled labor" to describe jobs that need little to no formal education or training and consist mostly of menial, repetitive duties. Workers in these fields need not have any sort of formal education or training beyond high school.

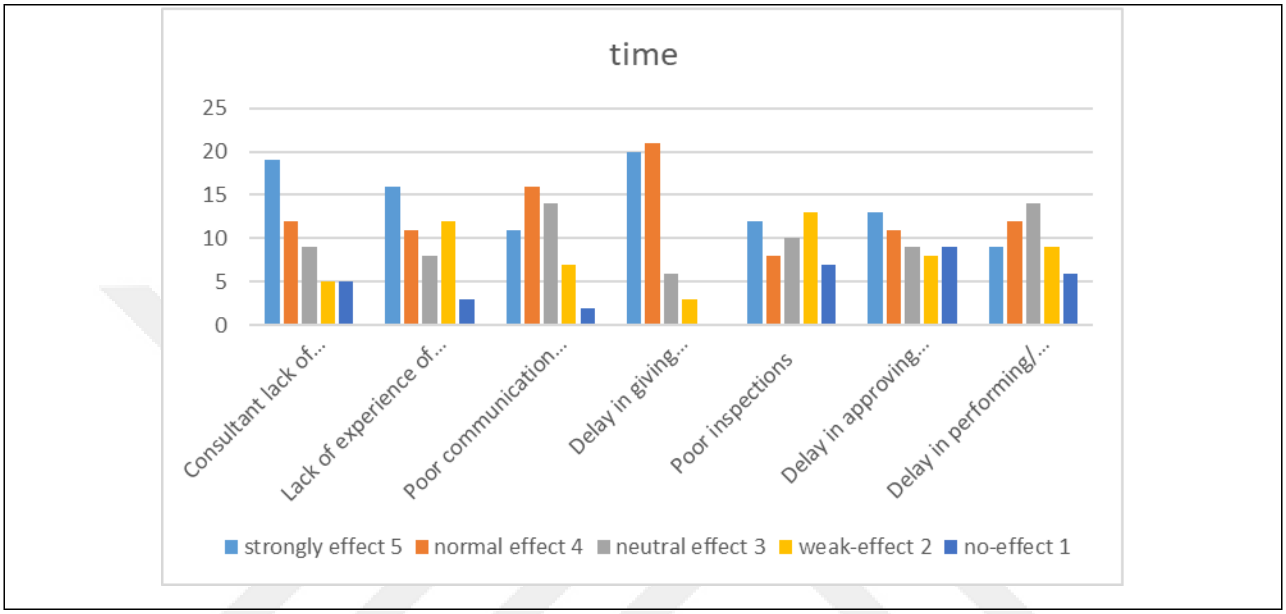

Figure 4.12: Time Consultant Factors

Documenting a process is writing down each and every one of the moves that must be made to complete a job. As close to instantaneous as possible is preferable. Tasks are documented as they are completed by personnel. The design process entails determining what has to be done and then carrying it out. It's possible that you'll fix something, get somewhere, or make something along the route. One must first realize that there is no "proper way" or "wrong way" to go about the design process. While, Content, including lessons, modules, and all associated deliverables, are formally documented in the full design document. The content's design is documented in depth in the document's subsequent design phase. The Project Design Document (PDD), which is a comprehensive description of the proposed project and includes a management plan and methods for quantifying the proposed project, shall contain all appropriate, pertinent, and required documentation and materials necessary for the validation of the proposed project against the requirements of the Natural Forest Standard. Simply said, it is a collection of all materials that might be used as proof and supporting documentation.

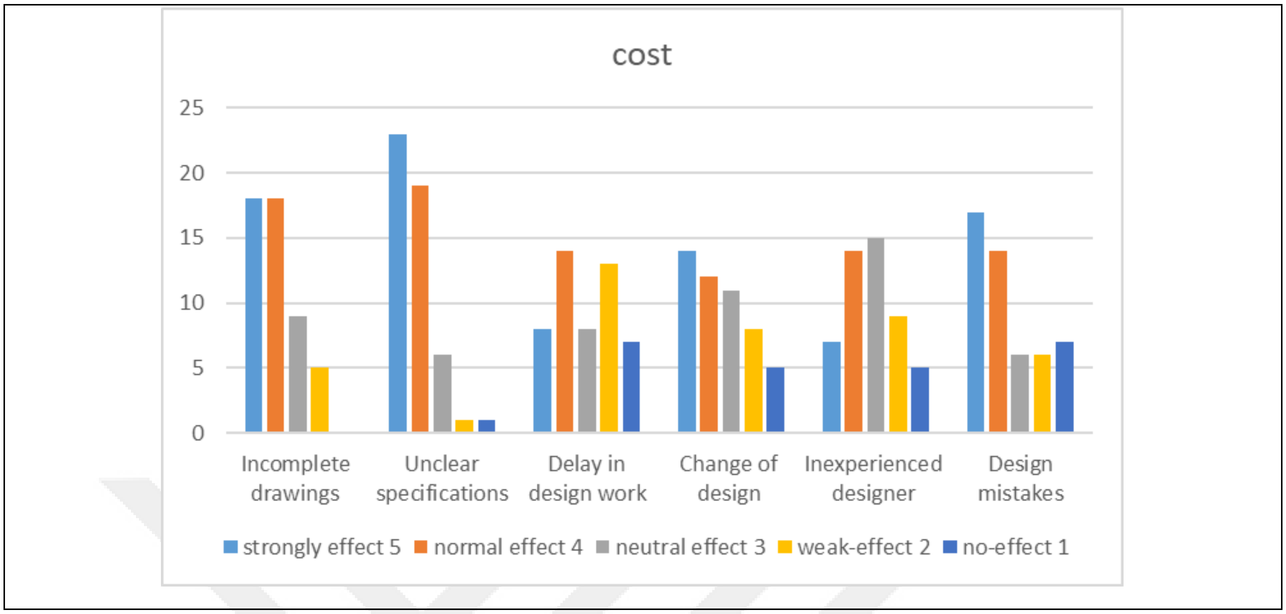

Figure 4.13: Cost Design and Documentation-Related Factors

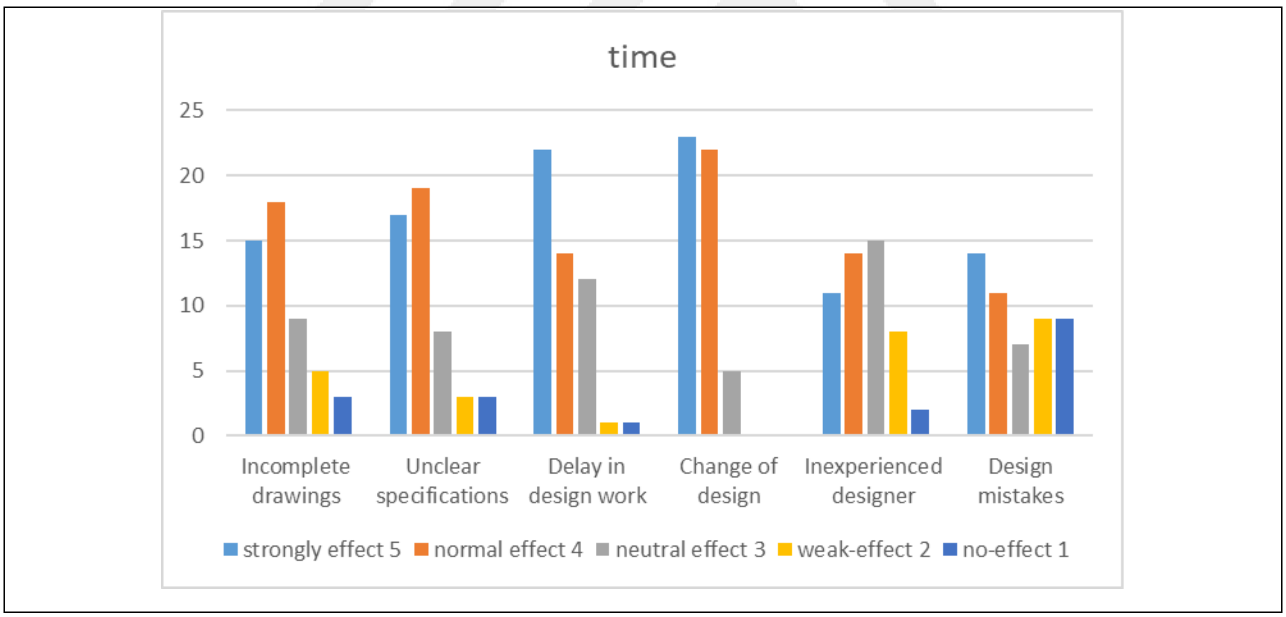

Figure 4.14: Time Design and Documentation-Related Factors

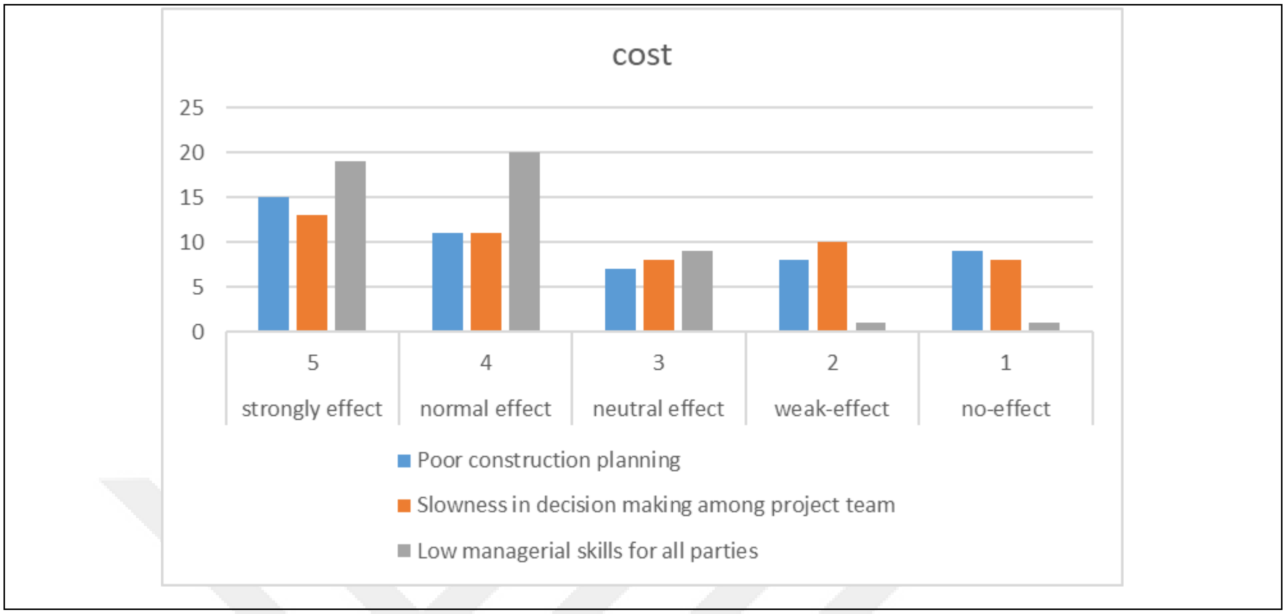

Figure 4.15: Cost Professional Management factors

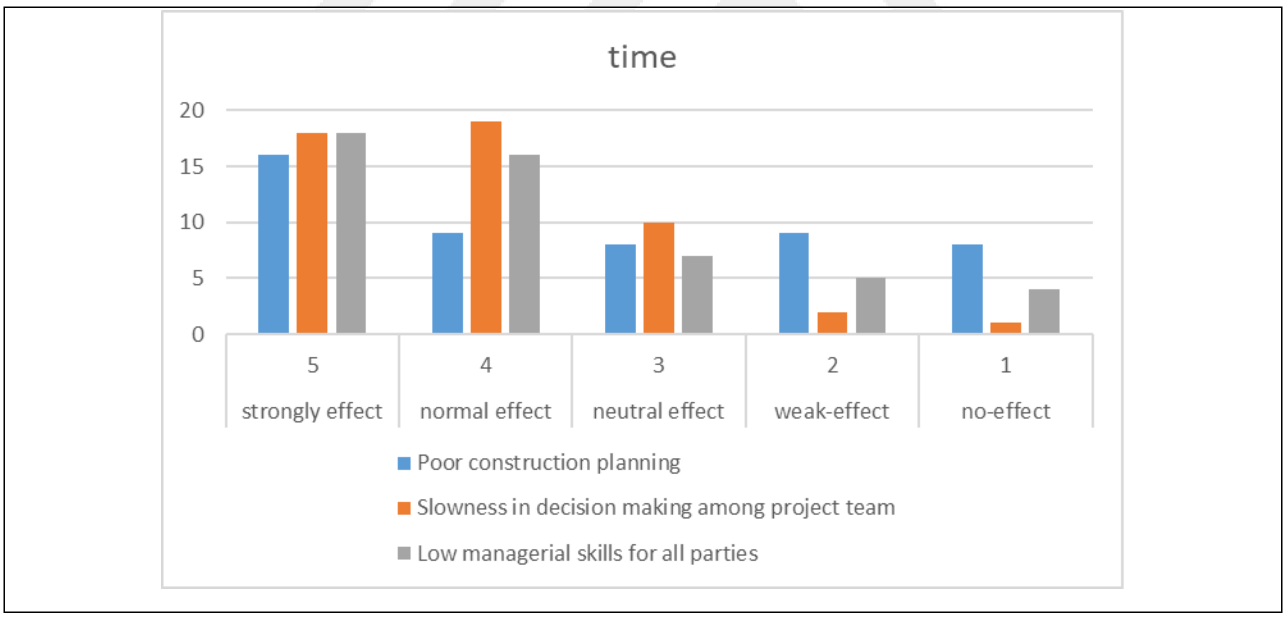

Figure 4.16: Time Professional Management Factors

Hiring a professional manager frees you up to concentrate on the big picture rather than the minutiae of running the firm. It effects the process of moving from "doing" to "building" your company. A skilled manager may do wonders for a business. His principal responsibilities include supervising workers and overseeing the business's many operations. This requires him to have exceptional interpersonal, social, technical, and conceptual abilities.

Table 4.2 : Numerical Cost Factor of Group 1

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Work accidents	10	10	9	15	6
Government regulation	12	14	8	9	7
Weather condition	5	9	8	15	13
Price inflation	18	17	5	5	5

Table 4.3 : Numerical Time Factor of Group 1

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Work accidents	13	10	9	11	7
Government regulation	22	12	8	7	1
Weather condition	6	8	8	15	13
Price inflation	15	17	5	7	6

These individuals can be categorized by two primary factors: Past research has taken into account the unique features of accidents that occur in construction zones. Most studies that looked at injury rates in work zones focused on either single-vehicle accidents or the worst cases of multiple-vehicle accidents. also, Increases in both employment and earnings boost household incomes and spending, which in turn boosts aggregate demand and gives businesses room to increase prices. When this occurs over a wide range of industries, it might cause inflation to rise. The time-cost relationship can be defined as the negative association between project duration and final cost. The price tag increases as the urgency of the project increases. However, reducing expenses on a project means spending more time on it overall. In the present work, the results of time and cost separated in investigate the results of factors effect between them separately. It is clear that One of the most crucial skills in project management is managing the time allotted to a project because of the significant effect it has on the project's quality, scope, and cost. When time is managed well, the project is more likely to be completed on schedule and within the allotted budget. Furthermore, it elucidates the timeframe in which a given job must be completed.

In group tow, material shortage, escalation of material prices, poor material management and low productivity of materials have been considered.

Table 4.4 : Numerical Cost Factor of Group 2

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Material Shortage	14	11	8	8	9
Escalation of material prices	19	11	15	5	0
Poor material management	22	12	14	1	1
Low productivity of materials	9	18	13	6	4
Poor quality of materials	19	16	11	2	2
Delay of material delivery	14	13	12	7	4

Table 4.5: Numerical Time Factor of Group 2

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Material Shortage	12	13	9	8	8
Escalation of material prices	19	15	11	3	2
Poor material management	15	17	14	3	1
Low productivity of materials	9	18	13	6	4
Poor quality of materials	18	15	12	2	3
Delay of material delivery	23	13	12	7	4

The fact that building supplies take up a sizeable portion of the total cost of building a structure makes it imperative that these supplies be purchased. The cost of the building's components might account for anything between one-half and two-thirds of the entire expenditure. Because the cost of construction materials is often the single highest price, proper management of these resources is an essential stage in every building project. For this reason, proper material management is an essential component of the overarching structure of every project. Defining materials across departments and organizations, purchasing those materials, and finally disposing of those items in the field are all functions and procedures that fall within the purview of material management. The following procedures and functions will be investigated: project planning, material take-off, supplier inquiry, purchasing, material control, warehousing, expediting, and shipping. The goal of material control is to ensure that construction projects do not have shortages or surpluses of any materials. This area includes anything that has to do with the storage, transportation, and exploitation of various resources. Because information technology has the potential to increase productivity in this area, the degree to which it is incorporated into this process has an effect on the material control.

Table 4.6: Numerical Cost Factor of Group 3

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Financial problems (delay payment, etc.)	22	12	8	5	3
Bureaucracy	14	14	8	7	7
Suspension of work	11	14	9	11	5
Interference of the owner	15	17	5	8	5
Change/additional works by the owner	23	16	11	0	0
Poor communication and coordination	12	13	12	9	4

When there is a period of time between when a client receives a bill and when the bill is paid, this is referred to as a payment delay. If another date is not indicated on the invoice, the normal conditions for making a payment are thirty days after the date of delivery of items or completion of services; however, these terms are subject to change depending on the business, the country, and the industry.

Table 4.7 : Numerical Time Factor of Group 3

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Financial problems (delay payment, etc.)	16	19	8	4	3
Bureaucracy	24	16	10	0	0
Suspension of work	11	14	9	11	5
Interference of the owner	16	17	5	7	5
Change/additional works by the owner	17	16	11	3	3
Poor communication and coordination	11	15	12	8	4

A delay in payment from a client can occur for a number of different causes, such as the customer failing to remember the payment's due date or the customer's account having insufficient funds. Nevertheless, there are preventative actions you may take to decrease the likelihood that your payments will be delayed in the future. Create a budget for yourself and create a forecast of your cash flow in order to set yourself up for monetary success. In order to adequately plan for extended delays in receiving payments, it is essential to have a general idea of how much time you have left before you will no longer be able to pay your bills. In light of the current state of the economy, it is essential to maintain a flexible mindset and to formulate conservative projections.

Table 4.8 : Numerical Cost Factor of Group 4

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Low productivity of the labours	17	11	9	8	5
Unskilled labours	19	15	8	5	3
Shortage of skilled labours	18	13	8	7	4
Shortage of equipment	17	15	5	8	5
Equipment breakdown/failure	16	14	14	3	3
Lack of maintenance for the equipment	17	11	11	6	5

By definition, "unskilled labor" describes tasks that do not call for specialized education or experience. This work is sometimes referred to as "unskilled jobs" for short. "Low-skilled labor" or "unskilled labor" is a classification used by the Bureau of Labor Statistics to describe work that entails either routine tasks or requires little to no expertise or training to execute. Unskilled laborers are not expected to have any specialized knowledge or training to do their work. As a direct result of technological and societal developments, the number of tasks that can be performed by unskilled individuals is steadily reducing. Work that once required no formal education at all is now expected to have at least a high school diploma. A worker's proficiency in technology may be required, for instance, since tasks that were once performed manually may now be performed with the help of computers or other technology. Jobs that need technical expertise include vegetable farming, sewing, bricklaying, construction, and utilizing a computer in an office. Participation in work placement programs affiliated with secondary schools and formal technical and vocational education, as well as traditional apprenticeships and agricultural cooperatives, are all viable options for gaining the technical and vocational skills necessary for employment.

Table 4.9: Numerical Time Factor of Group 4

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Low productivity of the labours	22	23	5	0	0
Unskilled labours	16	18	8	5	3
Shortage of skilled labours	19	16	6	4	4
Shortage of equipment	12	9	24	3	2
Equipment breakdown/failure	17	15	9	4	5
Lack of maintenance for the equipment	14	14	11	6	5

The first derivative is one that makes obvious sense: more labor supply elasticity for skilled individuals signals higher worker mobility. Regarding the manner in which one should think about the second derivative, there is less of a natural development. Because the number of unskilled workers leaving an area is directly proportional to the number of skilled workers moving in, an increase in the elasticity of the labor supply for unskilled workers will result in a decrease in the amount by which the price of homes goes up as a direct consequence of the movement of skilled people.

Table 4.10: Numerical Cost Factor of Group 5

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Contractor’s financial problems	21	16	9	4	0
Lack of contractor experience	20	18	10	1	1
Poor distribution of labours	16	21	9	2	2
Poor site management	17	12	9	7	5
Delay/Mistakes because of subcontractors	4	10	12	14	10
Poor communications and coordination	3	4	12	15	16
Lack of project staff and qualified staff	9	20	15	5	1

In this group, building projects are becoming more difficult to complete, necessitating more time and expertise. In contrast, skilled and qualified craft worker shortages are impacting the building sector as a whole. Eighty percent of construction firms report difficulty filling these positions. When a contractor lacks both experience and expertise, costly and time-consuming rework is always a possibility. Rework adds more time and money to a project, and can also cause it to go behind schedule. In fact, more than half of businesses reported that a scarcity of available workers forced them to extend the completion period of projects already in progress. In addition, these positions are typically filled by less seasoned tradesmen in construction organizations.

Table 4.11: Numerical Time Factor of group 5

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Contractor's financial problems	15	15	9	8	3
Lack of contractor experience	16	18	8	4	4
Poor distribution of labours	12	16	6	11	5
Poor site management	14	12	11	7	6
Delay/Mistakes because of subcontractors	22	18	10	0	0
Poor communications and coordination	11	4	12	14	9
Lack of project staff and qualified staff	13	11	15	6	5

Table 4.12: Numerical Cost Factor of Group 6

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Consultant lack of experience	19	12	9	5	5
Lack of experience of consultant team	16	11	8	12	3
Poor communication and coordination	11	16	14	7	2
Delay in giving instructions	20	21	6	3	0
Poor inspections	12	8	10	13	7
Delay in approving major changes in work scope	13	11	9	8	9
Delay in performing/ approving of tests and inspection	9	12	14	9	6

The phrase "professional consultant" is often used in the construction business to refer to the vast number of specialists who work on or consult for various building projects. This can include architects, engineers, interior designers, landscape architects, and more. The accompanying Practice Note delves deeper into the roles that professional consultants play on construction sites and explains everything in greater detail. These experts are brought in at the very beginning of the process and remain a part of it all the way through to its conclusion and beyond. The vast majority of them are involved in the process of design, while the other ones provide a variety of professional services such as management, inspection, and quality control testing. It's possible that one group is involved in each and every stage of the process, whereas another may be contributing to the endeavor in only one particular phase. It is not unusual for consultants to attempt to impose liability caps. This is typically done because the professional indemnity insurance that consultants hold may not be adequate to cover all potential claims, particularly on larger projects. Consultants regularly make requests for financial responsibility ceilings, net contribution provisions, and/or exclusions for specific types of damage, such as consequential loss.

Table 4.13: Numerical Time Factor of Group 6

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Consultant lack of experience	21	22	7	0	0
Lack of experience of consultant team	22	21	7	0	0
Poor communication and coordination	4	4	7	19	16
Delay in giving instructions	14	17	5	8	6
Poor inspections	5	15	10	10	10
Delay in approving major changes in work scope	12	11	12	8	7
Delay in performing/ approving of tests and inspection	8	8	18	10	6

Table 4.14: Numerical Cost Factor of Group 7

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Incomplete drawings	18	18	9	5	0
Unclear specifications	23	19	6	1	1
Delay in design work	8	14	8	13	7
Change of design	14	12	11	8	5
Inexperienced designer	7	14	15	9	5
Design mistakes	17	14	6	6	7

The modification made to the product is known as a change in design. It is conceivable to occur at any time during the product development process. Compared to those that occur after the product has entered full-scale production, the costs associated with design modifications that occur early in the product's design phase are lower. It is common for construction projects to undergo design adjustments; sadly, these modifications sometimes lead to an increase in the number of claims and disputes. The nature of the construction project, which is both complex and dynamic, therefore provides both risks and uncertainties. Changes generally occur at any stage of a project owing to a variety of causes stemming from a range of sources, and these modifications can have significant repercussions. Lack of timely and effective communication, lack of integration, uncertainty, a changing environment, and increased project complexity all contribute to project change. Depending on the nature of the project revisions, significant changes may also be required to the term of the contract, the time permitted, the total direct and indirect cost, or both. The sooner required modifications are identified and addressed, the less impact they will have on the overall project. When the issue is identified at an early stage of the project, the possibility for conflict resulting from project revisions can be reduced. Therefore, including design change management into construction projects should be regarded as a project management best practice.

Table 4.15: Numerical Time Factor of Group 7

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Incomplete drawings	15	18	9	5	3
Unclear specifications	17	19	8	3	3
Delay in design work	22	14	12	1	1
Change of design	23	22	5	0	0
Inexperienced designer	11	14	15	8	2
Design mistakes	14	11	7	9	9

The project manager is responsible for handling all of the crucial aspects that have an impact on the end result of the project. This is an important function. The inability of project managers to make the most of their skills and capabilities to achieve maximum productivity results in the loss of both money and time, which, given the state of the economy, can be catastrophic for any company.

Table 4.16: Numerical Cost Factor of Group 8

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Poor construction planning	16	9	8	9	8
Slowness in decision making among project team	18	19	10	2	1
Low managerial skills for all parties	18	16	7	5	4

As part of his or her managerial responsibilities, the project manager is required to have an indirect impact on the construction industry's overall productivity. There is no one exact standard that can be adhered to; rather, the administration of each individual project calls for a distinct amalgamation of different approaches. In unsuccessful initiatives, the project managers and stakeholders ignored significant aspects that, as a result, became liabilities and posed a threat. Low levels of production are directly correlated to inefficient administration of projects. It is believed that the primary motivation for this study was the inability of project managers to utilize their talents, expertise, adaptability, and capacity to handle the constant movement toward project deliverables, such as the required level of productivity. This study was carried out in order to investigate this hypothesis.

Table 4.17: Numerical Time Factor of Group 8

	strongly effect	normal effect	neutral effect	weak-effect	no-effect
	5	4	3	2	1
Poor construction planning	15	11	7	8	9
Slowness in decision making among project team	13	11	8	10	8
Low managerial skills for all parties	19	20	9	1	1

An initial ranking is determined by analyzing the collected answer data with the RII method. The decision that a decision-maker is willing to make is founded on the specific effective factor level that an individual, a consumer, or society is willing to take into consideration.

Before making any choices on, say, the budget, timeline, technical solutions, or building approaches, it is crucial to establish the level of risk that is acceptable. To make sure the first stages of the project are driven by the finest decisions possible, it's important to establish the acceptable factor effect early on.

Table 4.18: RII Numerical Results of Factors group

FG1		External Factors site conditions (Location, unforeseen site CONDITION)	RII cost	RII time
	P1	Work accidents	0.612	0.644
	P2	Government regulation	0.66	0.788
	P3	Weather condition	0.512	0.516
	P4	Price inflation	0.752	0.712
FG2		Material factor		
	P5	Material Shortage	0.652	0.652
	P6	Escalation of material prices	0.776	0.784
	P7	Poor material management	0.812	0.768
	P8	Low productivity of materials	0.688	0.688
	P9	Poor quality of materials	0.792	0.772
	P10	Delay of material delivery	0.704	0.884
FG3		Owner factors		
	P11	Financial problems (delay payment, etc.)	0.78	0.76
	P12	Bureaucracy	0.684	0.856
	P13	Suspension of work	0.66	0.66
	P14	Interference of the owner	0.716	0.728
	P15	Change/additional works by the owner	0.848	0.764
	P16	Poor communication and coordination	0.68	0.684

Continue to Table 4.18

FG4		Labours and equipment factors	RII cost	RII time
	P12	Low productivity of the labours	0.708	0.868
	P13	Unskilled labours	0.768	0.756
	P14	Shortage of skilled labours	0.736	0.756
	P15	Shortage of equipment	0.724	0.704
	P16	Equipment breakdown/failure	0.748	0.74
	P17	Lack of maintenance for the equipment	0.716	0.704
FG5		Contractor factors		
	P18	Contractor's financial problems	0.816	0.724
	P19	Lack of contractor experience	0.82	0.752
	P20	Poor distribution of labours	0.788	0.676
	P21	Poor site management	0.716	0.684
	P22	Delay/Mistakes because of subcontractors	0.536	0.848
	P23	Poor communications and coordination	0.452	0.576
	P24	Lack of project staff and qualified staff	0.724	0.684
FG6		Consultant factors		
	P25	Consultant lack of experience	0.856	0.74
	P26	Lack of experience of consultant team	0.86	0.7
	P27	Poor communication and coordination	0.444	0.708
	P28	Delay in giving instructions	0.7	0.832
	P29	Poor inspections	0.58	0.62
	P30	Delay in approving major changes in work scope	0.652	0.644
	P31	by consultant	0.608	0.636

Continue to Table 4.18

FG7		Design and documentation related factors		
	P32	Incomplete drawings	0.796	0.74
	P33	Unclear specifications	0.848	0.776
	P34	Delay in design work	0.612	0.82
	P35	Change of design	0.688	0.872
	P36	Inexperienced designer	0.636	0.696
	P37	Design mistakes	0.712	0.648
FG8		Professional Management factors		
	P38	Poor construction planning	0.66	0.664
	P39	Slowness in decision making among project team	0.644	0.804
	P40	Low managerial skills for all parties	0.82	0.756

Finally, the calculations of RR, OR, RII for time and cost effects with the percentage of occurrence of risks presented in table 4.19.

Table 4.19: The Results of Ranking and Effect of the Main Groups of Factors

factors code	RR	OD	RII cost	RII time	percentage of cost factors effect	percentage of time factors effect
FG1	63%	36%	0.752	0.788	42%	67%
FG2	75%	50%	0.812	0.884	50%	67%
FG3	88%	70%	0.848	0.856	58%	67%
FG4	88%	70%	0.768	0.868	58%	67%
FG5	89%	67%	0.816	0.848	67%	75%
FG6	100%	100%	0.856	0.832	58%	58%
FG7	67%	50%	0.848	0.872	33%	50%
FG8	100%	100%	0.82	0.804	67%	67%

Base on the RII results, contractor factors must be considered when there are many contractors to be done since the top ranking factor for those factors must also be planned. There could be repercussions for the ongoing projects if the planned sequence of events is disrupted. In terms of importance, "increased in project management activities" is the second most important factor. Next on the list of most crucial factors is a deterioration in communication between the contractor and the client, followed by a rise in the project's financial needs, an increase in the demands for site logistics, and finally an escalation in the project's complexity. In regards to what was left out, "bad contractor relationship with the client" was rated the most as a contributing factor. Depending on the nature of the missed work, the contractor may have already done some purchase in preparation. The client's relationship would suffer as a result, which would only make matters worse. There has been an uptick in project replanting, so that's the number two most important element right now. Increased project management efforts, diminished contractor reputation, and increased contractor overhead expenses follow as the next highest rated factors.

5. CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

By developing a model that may aid the parties involved in construction projects in getting the barriers and overruns in the early stages of the project, this study aims to provide a novel method for calculating the project overruns resulting from Iraqi projects. When making substitutes, the most crucial factor to take into account is whether or not there will be an increase in the need to replan projects. In light of the new additions, it is required to rearrange and replan the project in order to accommodate them. The phrase "additional reworks and demolition works" comes in at number two on the list of most essential reasons. The increased project management efforts, the efficiency loss due to work stoppage, and the postponement of progress payments are, in descending order of importance, the second, third, and fourth most critical reasons, respectively. An increase in project re-planning is the most important factor for additional work, substitutional work, and omission work; it is also the second most important factor for omission work. If there is a change to the plan, the work that was already done on the project will need to be redone. Making an effort to improve project management is widely regarded as one of the most crucial aspects of a successful endeavor. As a result of the disruption they cause to the workflow, the negative impacts that change orders have on the performance of the project require a great amount of effort to fix. The third most important factor is an increase in the expense of projects involving repairs and demolition. As a consequence of this, the project can require some significant adjustments, such as modifying the strategy or increasing the amount of resources allocated to it. Change orders can result in production losses because they disrupt the flow of work and the learning curve, both of which are crucial to achieving the highest possible level of efficiency. The history of late payments was the single most critical consideration. A halt in funding could put an end to the work that is now being done and cause further difficulties. It is imperative that the contractors and subcontractors receive the progress payment so that they can pay their material suppliers. Delays in making payments to contractors have a substantial impact on their payment schedules, which in turn can have a detrimental impact on the management of cash flow and the overall efficiency of the project. The following methods and techniques were used to accomplish this, as indicated by the findings of the aforementioned research:

a) Effective overrun elements factor from RII, OR. RR results are monitoring the time schedule.

b) the effective factors groups in the present research were; External Factors site conditions, Material factor Owner factors, Labor and equipment factors, Contractor factors Consultant factors, Design, and documentation-related factors Professional Management factors,

c) The system was tested and the results were excellent, and the overrun prognosis was excellent, according to experts' opinion

d) Time, quality, productivity, and performance are all affected by the availability of critical supplies and equipment.

e) Due to the quality of the employed materials, there is a correlation between the time, cost, and performance of a project. The timeliness and efficacy with which materials are acquired have an effect on time and cost performance. An efficient inventory management system can impact time and waste performance.

f) Changes that are reasonable have an effect on turnaround time. There is a relationship between timely deliveries and efficiency. There is a correlation between minimizing procurement costs and financial effectiveness. Conditions of on-site storage have an impact on productivity and waste management efficiency.

g) A well-organized project management influences productivity and efficiency.

h) When a site is easily accessible, it has an effect on productivity.

i) The site characteristics supplied in an office influences both productivity and efficiency.

5.2 RECOMMENDATIONS

The most recent study revealed encouraging findings in terms of locating cost overruns, and it is anticipated that this technology will continue to make important strides forward, particularly in the domain of construction engineering. To validate the findings of this research, however, in addition to doing additional research, the following suggestions should be given to those in charge of making decisions in the field of project implementation:

a) The researchers need to investigate the impact of project staff factors on the overruns and concentrate on how the utilization of these information effects the overruns.

b) The researcher suggests extending the studies on effective assessment and that standardized studies be separated on the basis of the effectiveness of the classification of overrun factors.

REFERENCES

[1] A. Aljohani, "Construction Projects Cost Overrun: What Does the Literature Tell Us?," *Int. J. Innov. Manag. Technol.*, vol. 8, no. 2, pp. 137–143, 2017, doi: 10.18178/ijimt.2017.8.2.717.

[2] M. El-Ahwal, S. El- Attar, and W. Abdel-Hafez, "Factors Leading to Cost Overrun Occurrence in Construction Projects," *Port-Said Eng. Res. J.*, vol. 20, no. 1, pp. 71–77, 2016, doi: 10.21608/pserj.2016.33641.

[3] S. Famiyeh, C. T. Amoatey, E. Adaku, and C. S. Agbenohevi, "Major causes of construction time and cost overruns: A case of selected educational sector projects in Ghana," *J. Eng. Des. Technol.*, vol. 15, no. 2, pp. 181–198, 2017, doi: 10.1108/JEDT-11-2015-0075.

[4] M. Hafeez, S. Attar, and A. Hafez, "Factors Leading to Cost Overrun Occurrence in Construction Projects," *Port Said Eng. Res. J.*, vol. 20, no. April, pp. 71–77, 2017.

[5] E. Plebankiewicz, "Model of predicting cost overrun in construction projects," *Sustain.*, vol. 10, no. 12, 2018, doi: 10.3390/su10124387.

[6] G. A. Niazi and N. Painting, "Significant Factors Causing Cost Overruns in the Construction Industry in Afghanistan," *Procedia Eng.*, vol. 182, pp. 510–517, 2017, doi: 10.1016/j.proeng.2017.03.145.

[7] C. Kandiah, "Causes and effects of contractor oriented cost overruns in building project." PhD diss., 2015.

[8] S. Petruseva, V. Zileska-Pancovska, V. Žujo, and A. Brkan-Vejzović, "Construction costs forecasting: Comparison of the accuracy of linear regression and support vector machine models," *Teh. Vjesn.*, vol. 24, no. 5, pp. 1431–1438, 2017, doi: 10.17559/TV-20150116001543.

[9] A. Leśniak and K. Zima, "Cost calculation of construction projects including sustainability factors using the Case Based Reasoning (CBR) method," *Sustain.*, vol. 10, no. 5, 2018, doi: 10.3390/su10051608.

[10] Idan, Mahmoud Fadhel, and Sara Nazar Dheyab. "Estimate Costs Management in Construction Projects." International Journal of Applied Engineering Research 14, no. 19 (2019): 3734-3741.

[11] A. Warsame, *Supplier structure and Housing construction costs*. 2006.

[12] J. Tang, M. Zhang, H. Tang, and Y. Chen, "Research on Cost Management of Construction Project Based on Activity-based Costing," *Proc. 2nd Int. Conf. Civil, Mater. Environ. Sci.*, vol. 11, no. Cmes, pp. 51–54, 2015, doi: 10.2991/cmes-15.2015.15.

[13] T. Zayed and Y. Liu, "Cash flow modeling for Construction projects," *Eng. Constr. Archit.*

Manag., vol. 21, no. 2, pp. 170–189, 2014, doi: 10.1108/ECAM-08-2012-0082.

[14] P. Gholizadeh, E. Behzad, and B. Memarian, "Cost Management Practice of Construction Firms and Its Influencing Factors: Lessons from Southwestern Nigeria," *Constr. Res. Congr. 2018 Downloaded*, vol. 2010, no. 2012, pp. 725–735, 2018.

[15] S. Chen, "Construction Project Cost Management and Control System Based on Big Data," *Mob. Inf. Syst.*, vol. 2022, 2022, doi: 10.1155/2022/7908649.

[16] M. Miri and M. Khaksefidi, "Cost Management in Construction Projects: Rework and Its Effects," *Mediterr. J. Soc. Sci.*, vol. 6, no. 6, pp. 209–215, 2015, doi: 10.5901/mjss.2015.v6n6s6p209.

[17] K. Potts and N. Ankrah, "Construction Cost Management," *Constr. Cost Manag.*, no. February, 2008, doi: 10.4324/9780203933015.

[18] A. Construction, "Construction costs and value management : study of multinational practices in Nigeria," no. July 2015, 2022.

[19] L. Chen and H. Dai, "Application of Big Data Technology in Cost Management and Control in Construction Project," *J. Phys. Conf. Ser.*, vol. 1881, no. 2, 2021, doi: 10.1088/1742-6596/1881/2/022036.

[20] A. P. Kern and C. T. Formoso, "A model for integrating cost management and production planning and control in construction," *J. Financ. Manag. Prop. Constr.*, vol. 11, no. 2, pp. 75–90, 2006, doi: 10.1108/13664380680001081.

[21] P. R. C. Marchesan and C. T. Formoso, "Cost Management and Production," *Annu. Conf. Int. Gr. LEAN Constr. 9., 2001, Singapore*, no. August, 2001.

[22] T. Cunningham, "Cost Control during The Construction Phase of the Building Project : - The Consultant Quantity Surveyor ' s Perspective .," *Dublin Inst. Technol.*, pp. 0–30, 2012, doi: 10.21427/mfyw-ag98.

[23] J. L. Sorrels and T. G. Walton, "Cost Estimation: Concepts and Methodology," *Epa Air Pollut. Control Cost Man.*, pp. 1–45, 2017.

[24] S. Suresh and G. Ramasamy, "Analysis of Project Performance Using Earned Value Analysis," *Int. J. Sci. Eng. Technol. Res.*, vol. 4, no. 4, pp. 1080–1085, 2015.

[25] H. A. Vu, J. Wang, L. Min, S. H. Mai, and H. P. Nguyen, "Research on Cost Overrun Risk of Construction Phase of Vietnam Highway International Contracting Project," *Engineering*, vol. 08, no. 03, pp. 86–98, 2016, doi: 10.4236/eng.2016.83011.

[26] A. A. Oladapo and H. Odeyinka, "Assessing risk impacts on construction cost," no. August, 2014.

[27] D. Cooper, D. MacDonald, and C. Chapman, "Risk analysis of a construction cost

estimate," *Int. J. Proj. Manag.*, vol. 3, no. 3, pp. 141–149, 1985, doi: 10.1016/0263-7863(85)90065-1.

[28] O. Torp and O. J. Klakegg, "Challenges in cost estimation under uncertainty—a case study of the decommissioning of barsebäck nuclear power plant," *Adm. Sci.*, vol. 6, no. 4, 2016, doi: 10.3390/admsci6040014.

[29] B. B. AKOMAH, M. ZAKARI, and E. AYEH, "Impact of Cost of Construction Projects in Cape Coast Metropolis.," *Impactul Costului Proiectelor Construcţii În Metropola Cape Coast.*, vol. 70, no. 1, pp. 95–112, 2020.

[30] G. R. Ryser, "Qualitative and Quantitative Approaches to Assessment," *Identifying Gift. Students*, pp. 33–57, 2021, doi: 10.4324/9781003235682-2.

[31] "Analysis of Mitigation Strategies against the Risk of Cost-Overrun during Implementation of Construction Projects," 2019.

[32] D. A. Shibani, "Time and Cost Overrun in Construction Projects of Pakistan," *URL https//www. Res. net/profile/Dr_Abdussalam_Shibani/publication*, vol. 2, no. September, pp. 22–29, 2015, doi: 10.51846/vol2iss2pp22-29.

[33] A. M. F. Albtoush and S. I. Doh, "A Review on Causes of Cost Overrun in the Construction Projects," *Int. J. New Innov. Eng. Technol.*, vol. 12, no. 3, pp. 015–022, 2019.

[34] S. S. Mulla and A. P. Waghmare, "A Study of Factors Caused for Time & Cost Overruns in Construction Project & their Remedial Measures," *J. Eng. Res. Appl. www.ijera.com ISSN*, vol. 5, no. 16, pp. 2248–962248, 2015.

[35] O. A.L, A. U.O, and N. O.P, "The Critical Causes and Effects of Cost Overruns in Public Sector Construction Projects in Port Harcourt, Nigeria," *Int. J. Sci. Res. Publ.*, vol. 11, no. 10, pp. 304–317, 2021, doi: 10.29322/ijsrp.11.10.2021.p11835.

[36] A. M. Faten Albtoush, S. I. Doh, and R. A. Rahman, "Underlying factors of cost overruns in developing countries: Multivariate analysis of Jordanian projects," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 682, no. 1, 2021, doi: 10.1088/1755-1315/682/1/012019.

[37] A. M. F. Albtoush, S. I. Doh, A. K. A. M. Al-Btoush, and R. A. Rahman, "Techniques To Reduce Cost Overruns During the Design Phase of Construction Projects," *J. Eng. Sci. Technol.*, vol. 17, no. 1, pp. 583–603, 2022.

[38] T. Subramani, "Causes of Cost Overrun In Construction," *IOSR J. Eng.*, vol. 4, no. 6, pp. 01–07, 2014, doi: 10.9790/3021-04640107.

[39] H. N. Al Siyabi and O. Khaleel, "Cost overrun in construction projects in Oman: Case study," *J. Student Res.*, no. Ramabhadran 2018, 2021, doi: 10.47611/jsr.v10i3.1382.

[40] G. Heravi and M. Mohammadian, "Investigating cost overruns and delay in urban construction projects in Iran," *Int. J. Constr. Manag.*, vol. 21, no. 9, pp. 958–968, 2021, doi:

10.1080/15623599.2019.1601394.

[41] N. N. Abbas and A. M. Burhan, "Investigating the Causes of Poor Cost Control in Iraqi Construction Projects," *Eng. Technol. Appl. Sci. Res.*, vol. 12, no. 1, pp. 8075–8079, 2022, doi: 10.48084/etasr.4661.

[42] O. Omar, "Intelligent building, definitions, factors and evaluation criteria of selection," *Alexandria Eng. J.*, vol. 57, no. 4, pp. 2903–2910, 2018, doi: 10.1016/j.aej.2018.07.004.

[43] A. M. Elewe, K. Bin Hasnan, and A. Bin Nawawi, "HYBRIDIZED FIREFLY ALGORITHM FOR MULTI-OBJECTIVE RADIO FREQUENCY IDENTIFICATION (RFID) NETWORK PLANNING," vol. 12, no. 3, pp. 834–840, 2017.

[44] K. Hasnan *et al.*, "GRADIENT-BASED CUCKOO SEARCH (GBCS) AND (MC-GPSO) TECHNIQUES FOR OPTIMAL RFID NETWORK PLANNING," no. April, 2019, doi: 10.1109/JEEIT.2019.8717490.

[45] D. Belani, A. H. Makwana, J. Pitroda, and C. M. Vyas, "Intelligent building new era of todays world," *Trends Challenges Civ. Eng. Today"s Transform. World*, no. March, pp. 1–16, 2014, doi: 10.13140/RG.2.1.1723.4965.

[46] N. H. Talib, K. Hasnan, A. Nawawi, and H. B. Abdullah, "GRADIENT-BASED CUCKOO SEARCH (GBCS) AND (MC-GPSO) TECHNIQUES FOR OPTIMAL RFID NETWORK PLANNING," vol. 10, no. 01, pp. 677–689, 2019.

[47] C. Tih-Ju, C. An-Pi, H. Chao-Lung, and L. Jyh-Dong, "Intelligent Green Buildings Project Scope Definition Using Project Definition Rating Index (PDRI)," *Procedia Econ. Financ.*, vol. 18, no. 14, pp. 17–24, 2014, doi: 10.1016/s2212-5671(14)00908-3.

[48] M. M. Froufe, C. K. Chinelli, A. L. A. Guedes, A. N. Haddad, A. W. A. Hammad, and C. A. P. Soares, "Smart buildings: Systems and drivers," *Buildings*, vol. 10, no. 9, pp. 1–20, 2020, doi: 10.3390/buildings10090153.

[49] N. Sael, T. Hamim, and F. Benabbou, "Implementation of the Analytic Hierarchy Process for student profile analysis," *Int. J. Emerg. Technol. Learn.*, vol. 14, no. 15, pp. 78–93, 2019, doi: 10.3991/ijet.v14i15.10779.

[50] S. Tayefeh Hashemi, O. M. Ebadati, and H. Kaur, "Cost estimation and prediction in construction projects: a systematic review on machine learning techniques," *SN Appl. Sci.*, vol. 2, no. 10, pp. 1–27, 2020, doi: 10.1007/s42452-020-03497-1.

[51] Mohanad I. Altuma and Redvan Ghasemlounia, "Effects of Construction Materials to Achieve Sustainable Buildings," *Int. J. Eng. Manag. Res.*, vol. 11, no. 1, pp. 25–30, 2021, doi: 10.31033/ijemr.11.1.4.

[52] K. T. Azari, E. Asadian, and A. V. Ardebili, "Evaluation of Multi-criteria Selection Factors of Intelligent Buildings," *Res. Cell An Int. J. Eng. Sci.*, vol. 16, no. 1, pp. 31–37, 2016.