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EVALUATION IN EFFICIENCY OF CONSULTING OFFICER IN MANAGING THE IMPLEMENTATION PROCESS OF ENGINEERING CONSTRUCTION PROJECT IN IRAQ

Omar Khamees Khalaf KHALAF

Master's Thesis

Supervisor

Prof. Dr. Sepanta NAİMİ

İstanbul, 2025

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The thesis titled EVALUATION IN EFFICIENCY OF CONSULTING OFFICER IN MANAGING THE IMPLEMENTATION PROCESS OF ENGINEERING CONSTRUCTION PROJECT IN IRAQ prepared by OMAR KHAMEES KHALAF and submitted on 27/08/2025 has been **accepted unanimously** for the degree of Master of Science in Civil Engineering

Prof. Dr. Sepanta NAİMİ

Supervisor

Thesis Defense Jury Members:

Prof. Dr. Sepanta NAİMİ	Department of Civil Engineering, Altinbas University	_____
Asst Prof. Sepehr SAEDI	Department of Civil Engineering, Altinbas University	_____
Asst. Prof. Dr. Kaveh DEHGHANIAN	Department of Mechanical Engineering, Istanbul Aydin University	_____

I hereby declare that this thesis meets all format and submission requirements of a Master`s Thesis.

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

Omar Khamees Khalaf KHALAF

ignature

ABSTRACT

EVALUATION IN EFFICIENCY OF CONSULTING OFFICER IN MANAGING THE IMPLEMENTATION PROCESS OF ENGINEERING CONSTRUCTION PROJECT IN IRAQ

KHALAF, Omar Khamees Khalaf

M.Sc., Civil Engineering, Altınbaş University,

Supervisor: Prof. Dr. Sepanta NAİMİ

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This research examined the engineering projects supervised by Iraqi internal management teams and evaluated the role of consulting firms in this area. The principal elements evaluated in the analysis of engineering project execution management tools, methodology, objectives, resources, and success rates were time, cost, quality, and project scope. The main aim of this research is to create a detailed inventory of the services, functions, and requirements of the technical control and engineering consulting sectors in relation to national and international standards. This study utilized pertinent data and expert opinions to analyse the operations of consulting companies in Iraq via the Delphi method. The preliminary phase, considering workplace variations, was the creation of a related matrix utilizing local data to determine the relative significance of each component. Following the evaluation of the second phase's data utilizing the Excel-based TOPSIS methodology, the factor ratings were calculated. The AHP-TOPSIS method evaluated the ability to reason and resolve difficulties, handle conflicts, additional project expenditures, cost difference across four orders, and financial flow. In assessing variables, here is where the outcomes truly excelled.

Keywords: Consulting Project Factors, TOPSIS, AHP, Weight of Factor, Ranking The Factors.

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ABBREVIATIONS

ACWP	:	Actual Cost of Work Finished
AHP	:	Analytic Hierarchy Process
Ai	:	Alternative
Aij	:	The Performance Value
AK, AL	:	Alternatives
d-	:	The Negative Distance From Average
d+	:	The Positive or Distance From Average
EVM	:	Earned Value Management
m	:	The Number of Alternatives
N	:	Sample Size People Responded to the Survey
n	:	The Highest Attainable Score for Each Factor Effect
n	:	The Number of Criteria
P	:	The Product Value
Pi	:	Respondent's Rating of Factor Effect
PM	:	PROJECT MANAGEMENT
RII	:	Relative Importance Index
Q	:	The Ideal Solution
Q-	:	Negative Ideal Solution
Q+	:	Positive Ideal Solutions
S-	:	Negative Summation Product
S+	:	Positive Summation Product
Si	:	The Preference Value

Si	:	Ores Appraisal
Ui	:	Number of Respondents Placing Identical Weighting/rating on the Factor Effect
Vi	:	Relative Preference Value
W	:	Weight of all Criteria
w	:	The Weight of Criterion
w(j)	:	The Relative Significance Weight
Wj	:	Denotes the Relative Weight
xij	:	The Performance of Alternative
λ	:	The Combination Parameter

1. INTRODUCTION

The ultimate objective of every contracting firm is to achieve a successful construction project. Time and money are two dimensions of performance recognized by most research. Contemporary project management prioritizes both financial and non-financial success metrics equally. This study aims to examine the influence of consulting companies on project results and the performance measures employed to assess Iraqi contracting businesses. A comprehensive examination of existing literature was conducted to summarize the performance perspectives that influence project outcomes. Professionals in Iraq's construction sector will have the opportunity to express their opinions and ideas via this poll. Subsequently, the classification and analysis of the collected data were conducted. The advancement of a nation's infrastructure is significantly dependent on construction project management, with consultants playing a crucial role in ensuring the efficient execution of these initiatives. This government has several challenges in Iraq, similar to those in various other countries. Therefore, to obtain valuable insights into the elements affecting performance and methods for its enhancement, it is advisable to compare the performance of consultants in Iraq with that of other countries. Iraqi construction project managers have several challenges, including administrative corruption, security instability, and a deficient consulting workforce. There is an improved understanding of how to augment performance in Iraq following the observation of more efficient applications of engineering consulting practices in countries such as Egypt, Turkey, and the United Arab Emirates. Multiple key elements must be evaluated to determine the consultant's effectiveness. The primary concern is technical expertise; the probability of success correlates directly with the consultant's experience in analogous tasks. The consultant's history of completed projects is crucial in assessing their performance in achieving objectives. For successful collaboration and to prevent difficulties, the consultant must communicate effectively with many stakeholders, including the owner and the contractor. The consultant's ability to manage costs and timeframes is essential for effective project completion. The consultant competency evaluation model is a crucial instrument for guaranteeing the effective completion of construction projects. The specified criteria and procedures of this model may be utilized to assess consultants' effectiveness across several domains. This exposition will address the concept, components, and execution of the model.

1.1 RESEARCH PROBLEM AND AIM

The researcher in this study has studied and evaluated the role of consulting offices in managing the process of implementing engineering construction projects PMO through the study, analysis and evaluation of tools, methodology, objectives, means and the extent of achieving the observed results in the management of the implementation of engineering projects, taking into account the main project determinants, which are Time, cost, quality and scope of work through the reality of the internal environment for engineering project management in Iraq.

Therefore, this study mainly aims to identify international and local standards and requirements in the field of engineering consultancy and technical control in terms of services, functions and technical control, shed light on what are the levels required to achieve the scientific, cognitive, technical and administrative efficiency required for the administrative structure and Technical for the consulting office team in managing the process of implementing engineering construction projects PMO, clarifying how the consulting office for managing the implementation of engineering construction projects achieves balance and effective communication with the goals and culture of the owners and owners of the project and its importance in overcoming the types of factors that may face the project, clarifying The main foundations and factors that can measure the efficiency of consulting offices in managing the implementation process of engineering construction projects PMO in providing technical and administrative services that support the success of the project and the satisfaction of the owners about time, cost, quality and scope of work, and the study was limited to its limits The engineering offices whose tasks are mainly to supervise the implementation of projects, contracting companies and bodies owning projects Secondary engineering.

1.2 WHAT IS PMO

Project Management Office is referred to as PMO. Within large corporations, the department is responsible for enhancing project management via process standardization and increased productivity. PMOs monitor KPIs, provide training, and produce and maintain project documentation and best practices. Additionally, they might assist in setting project priorities,

update executives and stakeholders on project status, and guarantee that every project advances the enterprise's overarching business goals.

Figure 1.1: PMO.

1.3 FUNCTION OF PMO

The main function of a PMO is to support project managers in different ways:

a. Managing shared resources in all projects managed by PMO.

b. Identify and develop project management methodologies, good practices, and standards.

c. Coaching, consulting, training, and supervision.

d. Track compliance with standards, policies, procedures, and project management forms through project audits.

e. Develop and manage policies, procedures, templates, and other shared documents (OPA - Organizational Process Assets) of the project.

f. Coordinate communication between projects.

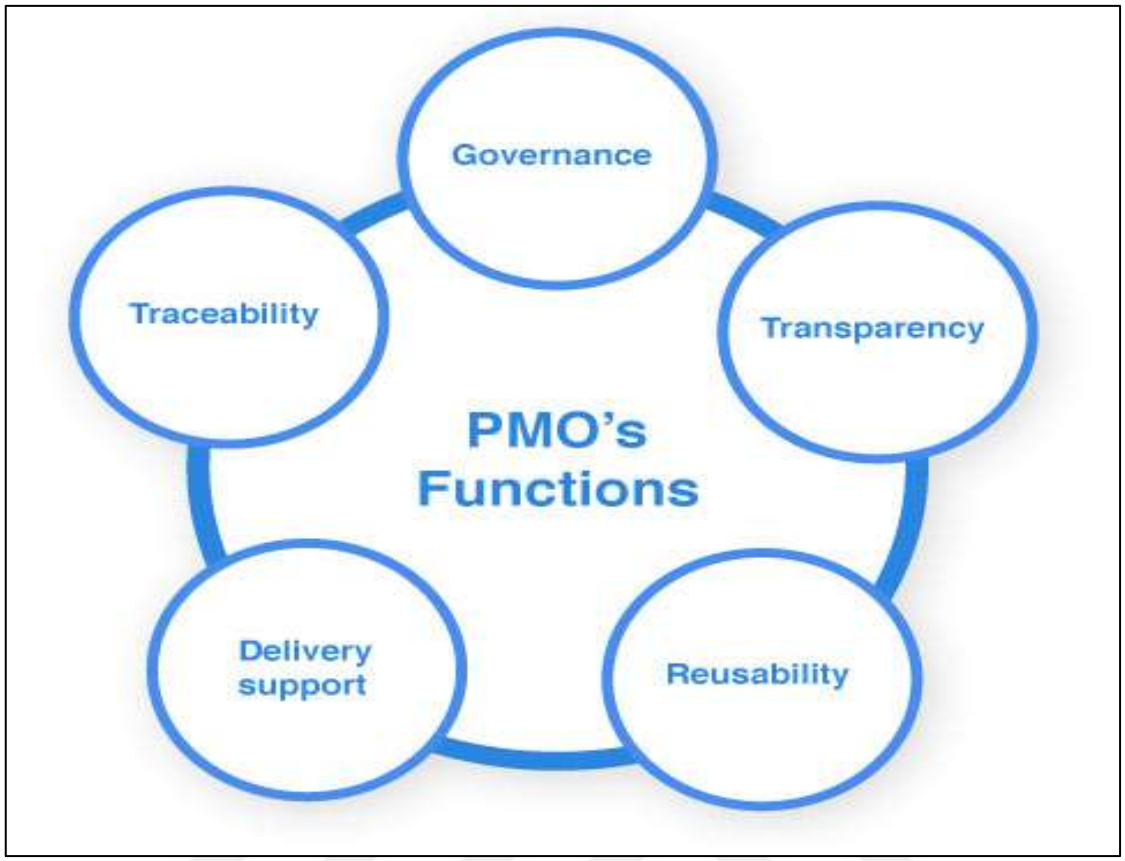

Figure 1.2: PMO Function.

1.4 RRESEARCH METHODOLOGY

The international standards that the consulting office must follow in the areas of jobs, services and technical control in its contracts and contractual obligations with bodies and organizations have been clarified, and it has reached the most important standards of scientific, cognitive, technical and administrative competence that must be available in the structure of consulting offices. It also reached to clarify the main approaches that the consulting office should take to achieve effective communication about the expectations and objectives of the owners and stakeholders, in addition to clarifying a system of ten criteria with value weights for a set of effective measurement processes that enable bodies and organizations to evaluate the performance of responsibilities and services And the level of performance of the consulting office entrusted with managing the implementation of engineering construction projects, and other results.

1.5 THE OBJECTIVE OF STUDY

The research problem is to study the performance of the consulting office in construction projects. the objectives of the present study are:

a. To investigate the factors for evaluating the performance of Iraqi contracting companies, and thus improving project performance.

b. To find a suitable computational method to rank the factors.

1.6 RESEARCH STRUCTURING

Chapter one: the general framework of the study.

The second chapter: previous studies and research.

Chapter Three: An introductory study of the concepts of engineering construction project management and the used methodology.

Chapter Four: present the results of basic criteria affecting the successful role of the construction projects management office.

Chapter Five: Findings and Recommendations.

2. LITERATURE REVIEW

2.1 INTRODUCTION

Engineering construction projects are one of the main pillars that support the economic and social development in Iraq. Under the current circumstances, where the country is facing major challenges in the construction sector, the importance of assessing the efficiency of the consultant, which is a vital part of the project management process, is increasing. The role of the consultant is to provide technical and administrative advice to ensure the success of projects, making his effectiveness and skills vital indicators of the success of implementation. The importance of the consultant in construction projects begins with his role as a link between the owner and the contractor[1]. The consultant assumes multiple responsibilities, including planning and design, as he helps in developing engineering plans and ensuring their compliance with the required standards and specifications. In addition, the consultant supervises the implementation of work on site, where he must follow up on the progress of work and verify its quality according to the approved standards. Factors management is also an essential part of his role, as the consultant identifies potential factorss during the project stages and provides appropriate solutions to deal with them[2].

Evaluating the consultant's efficiency requires considering several main criteria. First, technical expertise is a basic factor; the more experience the consultant has in similar projects, the greater the chances of success. The performance record is also an important indicator, as it helps in reviewing previous projects managed by the consultant and their success in achieving the specified goals. Also, the consultant's ability to communicate effectively with different parties, such as the owner and the contractor, plays a crucial role in the success of the cooperation and avoiding problems. In addition, the consultant must demonstrate the ability to manage time and costs, to ensure that the project is delivered on time and within the specified budget[3].

However, assessing consultant competence in Iraq faces several challenges. Among these challenges are economic instability that can negatively impact project budgets, as well as knowledge and skill gaps that some consultants may suffer from. Furthermore, the multiplicity of stakeholders and different interests can complicate decision-making and impact the effectiveness of joint work[4].

2.2 STUDY OF FACTORS AFFECTING CONSULTANTS' PERFORMANCE

2.2.1 Experience and technical knowledge

The importance of experience: Experience is one of the critical factors in the performance of consultants. The more years of experience, the more capable the consultant is of dealing with the challenges and problems that may arise during the implementation of the project[5].

Specialization: The consultant’s specialization in a specific field, such as civil engineering or project management, gives him the ability to provide accurate and appropriate advice. Deep knowledge of the field helps the consultant assess factorss and provide innovative solutions[6].

Previous experience: Previous experiences in similar projects enable the consultant to recognize patterns and potential challenges. This knowledge enables him to make quick and effective decisions[7].

2.2.2 Communication Skills

The Importance of Communication: Effective communication skills are a key factor in the success of projects. A consultant must be able to exchange information clearly and effectively[8].

Negotiation: Consultants often face situations that require negotiation, whether with clients or with other teams. Good negotiation skills contribute to reaching solutions that satisfy all parties.

Active Listening: The ability to listen to clients’ needs and requirements contributes to providing accurate advice. If a consultant is unable to understand the client’s needs, this may lead to providing inappropriate solutions.

2.2.3 Time and Resource Management

The Importance of Management: Time and resource management is an essential element for project success. Consultants who manage their time and resources effectively contribute to reducing costs and increasing efficiency[9].

Planning: Proper planning involves setting accurate timelines for all phases of the project. The consultant should be able to set deadlines and ensure that all stakeholders are aware of them.

Factors Management: The consultant should be able to assess potential factorss and develop strategies to mitigate them. These strategies may include allocating reserve resources to deal with crises.

2.2.4 Commitment to Quality

Importance of Quality: Commitment to quality standards is one of the main factors affecting the success of projects. The consultant must ensure that all work is in line with the agreed standards[10].

Using modern technologies: Consultants who use the latest technologies and best practices have the ability to improve quality. Continuous updating of technical knowledge contributes to providing high-level professional consulting.

Quality Control: Having clear mechanisms for quality control throughout all stages of the project contributes to early detection of problems and making the necessary corrections.

2.2.5 Government Support and Regulatory Policies

Importance of Government Support: Government policies and the legal framework are factors that influence the performance of consultants. Having clear laws governing construction operations facilitates the implementation of projects[11].

Legislation: Having clear legislation that regulates the work of consultants and protects their rights helps create a stable business environment. These legislations should be flexible enough to meet the changing needs of the market.

Institutional Support: The government should provide support to construction projects by providing the necessary resources and facilities. This may include tax reductions or providing soft loans.

2.3 EVALUATING THE EFFECTIVENESS OF CONSULTANTS

2.3.1 The Importance of Evaluating the Effectiveness of Consultants

The effectiveness of consultants is a vital factor in the success of construction and engineering projects, especially in the Iraqi context, which is characterized by complex economic and political challenges. Consultants play a fundamental role in guiding planning and implementation processes, and therefore evaluating their effectiveness becomes essential to achieving the set goals. By evaluating the effectiveness of consultants, performance can be improved and the chances of success in projects increased[12].

2.3.2 Criteria for Evaluating the Effectiveness of Consultants

When we talk about evaluating the effectiveness of consultants, there are several main criteria that must be taken into consideration. First, experience and specialization are crucial factors. Consultants with a strong academic background and extensive practical experience have the ability to deal with challenges and problems more effectively. Deep knowledge in specific fields, such as civil engineering or project management, enhances their ability to provide accurate and appropriate advice[13].

In addition, the quality of the services provided is an important criterion in evaluating consultants. This includes the accuracy of technical reports and adherence to timetables. If a consultant is able to provide clear and reliable reports, this reflects the quality of the work he does. It is also important to assess communication skills, as the consultant must be able to interact effectively with all stakeholders, including clients and contractors[14].

2.3.3 Evaluation Tools and Methods

There are a variety of tools and methods that can be used to evaluate the effectiveness of consultants. Questionnaires and interviews can be used to gather the opinions of stakeholders about the performance of consultants. Performance can also be analyzed using key performance indicators (KPIs) to monitor the effectiveness of consultants on a regular basis. Periodic reports provided by consultants are an important tool for assessing the accuracy and quality of services provided[15].

2.3.4 Challenges in Evaluating the Effectiveness of Consultants

The process of evaluating the effectiveness of consultants in Iraq faces several challenges. Among these challenges is the lack of reliable data on the performance of consultants and previous projects. Corruption in some projects may also negatively affect the objective evaluation of consultants. The unstable security environment may sometimes hinder the ability to conduct an accurate evaluation[16].

2.4 CONSULTANT EFFICIENCY EVALUATION FORM

The consultant competency evaluation model is an essential tool to ensure effective performance in construction projects. This model includes a set of standards and methods that help measure the effectiveness of consultants in various aspects of their work. In this explanation, we will review the concept of the model, its components, and the mechanism for its application[17].

2.4.1 The Concept of The Model

The consultant competency evaluation model is a framework used to determine the ability of consultants to provide high-quality services and achieve the desired goals in projects. This model aims to unify the evaluation process and provide objective standards that help accurately measure performance, which facilitates the process of making informed decisions about selecting consultants or improving their performance[18].

2.4.2 Model Components

The consultant competency evaluation model consists of several main components, including[19]:

Performance criteria: The criteria are essential elements of the model. These criteria include technical and administrative aspects that reflect the efficiency of the consultant. Common criteria include:

a. Technical expertise: includes years of experience, areas of specialization, and the number of previous projects implemented.

b. Service quality: assessing the accuracy and reliability of technical reports and recommendations provided.

c. Time and resource management: measuring the consultant's ability to adhere to schedules and allocate resources effectively.

Evaluation Methods: The model relies on a variety of methods to collect and analyze data. These methods include:

a. Questionnaires: used to collect the opinions of stakeholders, such as clients and technical teams, about the consultant's performance.

b. Interviews: conducted with clients and contractors to gain in-depth insights into the experience with the consultant.

c. Performance Analysis: Key Performance Indicators (KPIs) are used to monitor consultants' performance on a regular basis.

Performance Measurement Criteria: The evaluation process relies on a set of metrics that help determine the extent to which the consultant achieves project objectives. These metrics include:

a. Completion Rate: measures the extent to which the consultant meets the specified deadlines.

b. Success Rate: reflects the number of projects that have been successfully implemented compared to the projects that have been processed.

c. Customer Satisfaction: measured through questionnaires that assess the extent to which customers are satisfied with the consultant's services.

2.4.3 Mechanism for Applying The Model

The process of applying the consultants' efficiency evaluation model begins with identifying the desired objectives of the evaluation. After that, the appropriate criteria and methods that will be used in the evaluation process are chosen. It is preferable to involve all stakeholders at this stage to ensure the comprehensiveness and accuracy of the evaluation[20].

Then, data is collected through questionnaires and interviews, as well as by reviewing documents and reports submitted by consultants. The data collected is analyzed using appropriate data analysis methods, where the consultant's performance is evaluated based on the specified criteria. Upon completion of the evaluation process, a comprehensive report is prepared that includes the results and recommendations. Recommendations may include improvements in specific areas, or suggestions for training consultants in specific skills. The report can also be used as a basis for making decisions about renewing contracts with consultants or selecting new consultants[21].

2.5 A COMPARATIVE STUDY OF THE PERFORMANCE OF CONSULTANTS IN CONSTRUCTION PROJECT MANAGEMENT: IRAQ AND OTHER COUNTRIES

Construction project management is a key element in the development of any country's infrastructure, and consultants play a pivotal role in the success of these projects. In Iraq, as in many countries, this management faces multiple challenges. Therefore, conducting a comparative study of the performance of consultants in Iraq with other countries can provide valuable insights into the influencing factors and how to improve performance. In Iraq, the construction project management process suffers from a range of challenges, such as administrative corruption, security instability, and lack of training and qualification in the consulting sector. While in other countries such as the United Arab Emirates, Turkey, and Egypt, more effective applications of engineering consulting models can be seen, allowing for a deeper understanding of how to improve performance in Iraq[22].

2.5.1 Performance Comparison

Experience and Specialization: In Iraq, many consultants suffer from a lack of practical experience, which negatively affects the quality of services provided. In contrast, consultants in countries such as the UAE have extensive experience, as there are specialized international and local consulting firms. These firms benefit from continuous training programs, which enhances their efficiency and reflects higher quality in the projects implemented[23].

Communication and management skills: In Iraq, it is noted that communication skills among some consultants may be limited, leading to misunderstandings between different teams. In contrast, countries such as Turkey invest in developing the communication skills of their consultants through workshops and training courses, which contributes to achieving better coordination between the parties concerned. This coordination facilitates the process of implementing projects and enhances the quality of services provided[24].

Modern technologies: The use of technology in project management is a crucial factor in improving performance. In Iraq, some companies still rely on traditional methods, which affects the efficiency of implementation. While in the UAE, advanced technologies such as Building Information Modeling (BIM) and smart technologies are used in project management. These technologies contribute to improving the quality of design and planning and reduce errors, which leads to saving time and costs[25].

2.5.2 Quality of Services and Project Results

Studies show that consultants' projects in Iraq often face delays and budget overruns. While in countries with effective evaluation systems, such as Egypt and the UAE, the results are more positive. Consultants' performance is evaluated periodically, which allows problems to be identified early and appropriate corrective actions to be taken[26].

2.5.3 Government Policy Support

A difference can also be seen in government policy support. In Iraq, laws and regulations can be unclear, which hinders the progress of projects. In contrast, countries such as the UAE provide a clear and supportive regulatory environment for consultants, making it easier for them to perform their tasks effectively. These policies include supporting vocational training and providing funding for infrastructure projects[27].

2.5.4 Social and Environmental Culture

Social culture is one of the factors influencing consultants' performance. In Iraq, cultural and social challenges can be complex, which affects the acceptance of projects by local communities. In other countries, community participation is encouraged and communication

channels are provided between consultants and communities, which enhances project acceptance and facilitates their implementation[20].

2.6 NATURE OF ENGINEERING CONSULTING INDUSTRY

Engineering services provided by consulting engineering firms and internal engineering services divisions of companies are significant actors in the global professional services market. The engineering sector has had limited growth over the last five years due to the worldwide recession of 2009 (IBISWorld, 2013). The engineering services sector has moderate levels of capital intensity and a high labor intensity. The sector fills a demand for engineering design, evaluation, and technical management services; the service is heavily reliant on basic engineering skills[28].

The Association of Consulting Engineering Companies in Canada defines consulting engineering as a professional service that offers governments, industries, developers, and construction companies independent knowledge in engineering, science, and allied fields (ACEC-Canada, 2013:1). Any kind of employment requiring specialized training or a certain talent is considered a vocation; these jobs are often highly esteemed due to their high educational requirements (CAEOD, 2013:1). Thus, someone executing such labor services would be considered a professional[29].

2.6.1 Service Industry

In a service organization, the client need to be in the center of all procedures, choices, and activities (Jacobs & Chase, 2011:254). This customer-focused approach is shown by the service triangle[30].

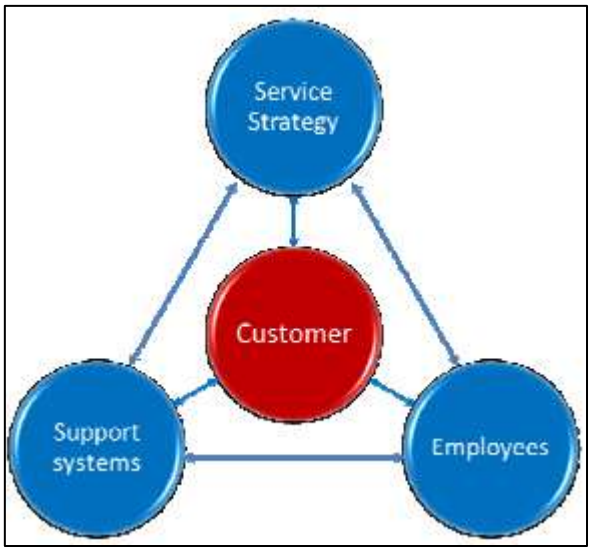

Figure 2.1: Service Triangle[30].

High levels of consumer interaction provide a problem in terms of controlling the quality of the services provided. Customers may affect the time required, the precise type of the service, and the perceived quality of the service to a greater extent the more active they are in the process [30]. Generally speaking, more client interaction means more opportunities for sales, but it might also mean worse production efficiency. More diagnostic skills are needed, fewer procedural and administrative skills are needed, and the project team will be made up of more resources from the service company and the client the more the nature of the projects demands more time spent with the client and a wide range of customized services that the client requests[30].

2.6.2 Service Industry Performance

Effective management of professional service organizations may enhance their technical performance [31]. A complicated, customized service provided by an individual or group of individuals with knowledge and experience is referred to as a professional service. Operational choices may be either infrastructural (such as planning and control, quality and resource management, vertical integration, building location, and product and process technology) or structural (such as building location, planning and control, and policies defined as organization) (Heineke, 1995:256). Infrastructure choices are predictable in terms of business performance, quality, and capacity, so although they often have long-term implications, they are not always the hardest to modify[31].

The following are implementation considerations to take into account when making any changes to a company's operations in order to improve service performance[32]:

a. Applying the service operation effectiveness methodically is one of the most important success criteria.

b. The suggested modifications should be implemented with resources, and management should endorse them.

c. Inefficient implementation may lead to dysfunctional behavior.

d. The availability of information for monitoring is closely related to the success of implementation. Start with somewhat accurate, procedurally sound information at first, then gradually increase the precision of the information.

e. Expert technical resources are often not controlled or made difficult to govern; instead, they are allowed to watch over and regulate themselves. Decisions around infrastructure operations may enhance productivity and perceptions of client outcomes.

One of the difficulties facing a service provider is that their output or product is intangible, so the client cannot see the outcome of the service in advance. Moreover, comparable examples may not always be available to persuade the client of the value and suitability of the service that has been quoted (Jacobs & Chase, 2011:45). The necessary client engagement presents another management problem (Jacobs & Chase, 2011:45). Thirdly, the results of the majority of services are often unexpected and change day to day, sometimes even depending on the attitudes of the customers (Jacobs & Chase, 2011:45). The inability to preserve services and their inherent perishability provide a fourth difficulty[30].

2.6.3 Consulting Engineering Industry Success Factors

A successful consulting engineering company can be evaluated against the following key success factors [33]:

a. Project management: This is one of the key competencies needed in a consulting engineer. Customers want a consulting engineering company with a track record of proactive project management.

b. Relationships with clients: Repeat business from the same customer is a reliable indicator of how happy the client is with the job done and services received. Developing a positive rapport with the customer is just as crucial as providing the necessary technical assistance.

c. Marketing: Consulting engineering firms with a track record of project execution and good communication are preferred by clients. It seems that customers are becoming less interested in assessing the technical competency of consulting engineering firms and more inclined to believe that all engineers are technically competent, basing their procurement choices on past performance.

d. People management: The capacity of the engineer/project manager to effectively use the talents and capabilities of the project team may sometimes make the difference between a successful project and a failing one. Rather of focusing just on overseeing the project's budget, schedule, and quality, project managers must also be leaders who encourage and inspire. A professional service firm's capacity to draw in, develop, hold onto, and make good use of its people resources is what gives it the greatest competitive edge [34]. Therefore, engineers working for consulting engineering firms need to possess both technical and non-technical abilities, with excellent communication being a necessary one. Engineering school institutes do not prioritize the non-technical skills required by consulting engineering firms[33]

e. Operations management: Drawing from Yang and Chou's (2010) assertion that a consulting firm can attain a competitive edge in management through the methodical allocation and synchronization of projects and resources, Mocke (2012) contends that the resource loading component of operations management is a crucial success factor for consulting engineering firms[35].

2.6.4 Consulting Engineering Industry Overview

The world economies are emerging from the 2009 recession, according to the history of global economic growth and forecasts through 2014 (see Table 1). Compared to established countries, emerging/developing economies (like China and Africa) were generally less hit by the crisis and have stronger growth prospects.

Table 2.1: Global Economic Growth Summary and Projections[36].

	2009	2010	2011	2012	2013	2014
World	-0.80%	5.00%	3.80%	3.50%	3.50%	4.10%
US	-2.50%	2.80%	1.80%	1.80%	2.00%	3.00%
Eurozone	-3.9%	1.80%	1.60%	-0.40%	-0.20%	1.00%
UK	-4.80%	1.70%	0.90%	0.20%	1.00%	1.90%
China	8.70%	10.30%	9.20%	7.80%	8.20%	8.50%
Sub-Saharan Africa	1.60%	5.00%	4.90%	4.80%	5.80%	5.70%
South Africa	-1.80%	2.70%	3.40%	2.05%	2.70%	3.50%

The engineering consultancy sector encompasses several sub-disciplines. Project management (PM) and civil and structural services are the two main subdisciplines that generate revenue for major consulting engineering firms (those with over 100 employees). Electrical and mechanical building services are the most profitable for smaller and micro businesses. PM is a rapidly emerging subdiscipline that accounts for 16–18% of consulting engineering revenues overall (CESA, 2013:19). The distribution of industrial sector revenue changes over time and with the size of the consulting engineering business, according to a biannual study conducted by Consulting Engineers South Africa (CESA) (see Figure 2.2).

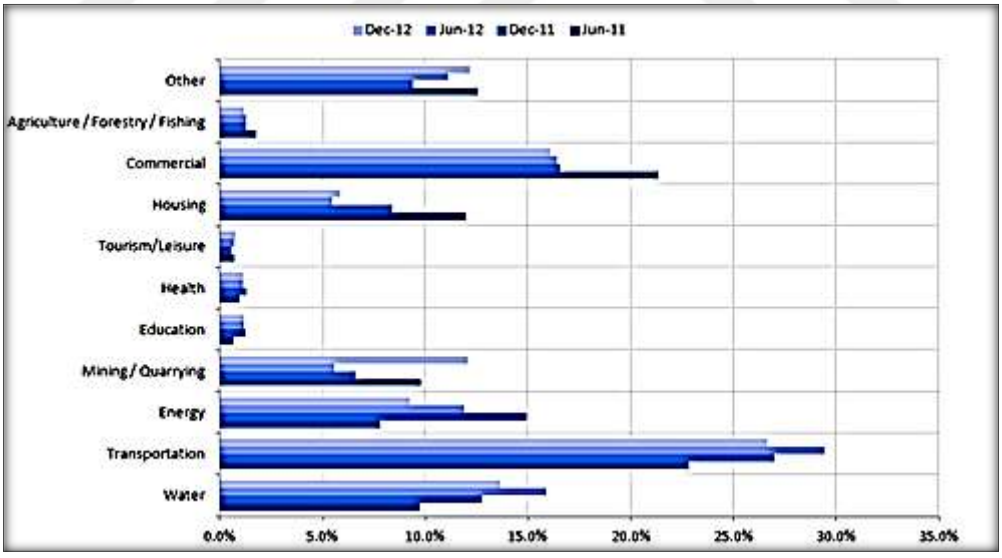

Figure 2.2: Consulting Engineering Fee Income Distribution Per Economic Sector[36].

2.7 SUCCESSFUL PROJECT DELIVERY/PROJECT PERFORMANCE

Achieving desired, hoped-for, or targeted outcomes is a definition of success [37]; [38]. However, no universal framework or criterion for evaluating the success of programs has been agreed upon. When a project is successfully completed, it is often quantified or assessed using the "iron triangle" of quality, cost, and time[39]; [40]:

a. Cost: Project is delivered within budget.

b. Time: Project is delivered on time without compromising delays.

c. Quality: Project deliverables meet the client expectations

According to Liu and Yetton (2007), 796, project performance is basically the measurement and monitoring of the actual current project status versus the project output control mechanisms, such as targets/milestones. However, achieving project success entails more than just staying within budget and timelines; it also entails assessing how the project will affect the benefits to customers and stakeholders, the infrastructure of the organization, and future opportunities. This perceived quality is essential to continuously and repeatedly succeeding and complements the iron triangle project success assessment.

In addition to the iron triangle of project management (money, time, and quality), Atkinson (1999:341) argues that the following additional success variables should be taken into account:

a. The information system (maintainability, reliability, validity, quality of information).

b. Benefits to the organization: enhanced productivity and effectiveness, higher earnings, achievement of strategic objectives and organizational learning, less waste.

c. advantages to stakeholders in the community (user satisfaction, social and environmental impact, professional growth, learning opportunities, contractor profits, capital suppliers, content project team, and surrounding community's economic effect).

2.8 PROJECT MANAGEMENT (PM)

A project is characterized as a short-term endeavor to fulfill a certain need, goal, service, or product [41]. Another definition of a project is a series of related activities that need a

significant amount of time to do and are usually concentrated on a single deliverable or important outcome (Jacobs & Chase, 2011:373). The application of information, skills, tools, and processes in project activities to achieve project requirements is defined by the Project Management Institute (PMI) as project management. Planning, directing, and controlling resources (people, machinery, and materials) to satisfy the project's financial, schedule, and technical requirements is another definition of project management [30]. Project management involves integrating the many stages of a project lifecycle and is accomplished via processes[42]

2.9 DEFINITION OF QUALITY

There are many ways to define quality, and some of them will be discussed below, including: Goucher and Coffey (1993) described it as "satisfying customers at the lowest cost". According to Juran and Gryna (1980), "appropriate use" refers to the requirement that products and services satisfy the requirements of the community in which they are intended for use. It is "the distinguishing characteristics of a product or a service in which the user is associating it with quality," according to Joseph Jablonski (1991). It was also described as "The right things done properly" by Leebov and Ersoz (1991).

There is a correlation between quality and customer satisfaction as stated in these criteria. Nonetheless, these definitions are succinct and emphasize how crucial it is to live according to social norms.

Ali Al Sulaimi (1995) defined Quality as "the total qualities and characteristics of a piece of goods or service that shows its ability to achieve declared or undeclared wishes". This definition is unique because it refers to the product quality as well as the quality of service[43].

James Teboul (1991) also defined quality as "the ability to satisfy the needs at the time of purchase and during the usage at the best cost, while reducing losses and increasing competitiveness"[44].

This definition points out to the cost factor and loses reduction and improving competitiveness.

Subhi Alawa (2002) said that "the quality in general is a set of activities that carried out for the purpose of setting performance standards, monitoring and improving the performance to make the provided service effective and efficient and also safe" . This definition sets itself apart by combining performance requirements with quality. Quality is a collection of administrative procedures meant to provide clients the most accurate service possible[45].

Goetsch and Davis (1995) noted that despite that there is no universal concept that agreed upon for quality, it can be enumerated certain elements that are shared in quality definitions as follows[46]:

a. Quality aims at satisfying customer’s expectations or more.

b. Applying quality could be generalized on commodities, services, operations and individuals.

c. Quality is marked by continuity of change, as what is acceptable today may not be acceptable later.

When these factors are taken into account, quality is defined by dynamic change rather than stability. It is connected to goods, services, people, and the environment in accordance with or even beyond what clients and management may anticipate.

This definition is broad because it emphasizes that quality encompasses not only the caliber of goods but also the caliber of people and services. The concept also emphasizes continuity, which is seen as a crucial component of quality. The only definition that focuses on this idea is this one. For this reason, it is regarded as the finest option overall.

2.10 DEFINITION OF TOTAL QUALITY MANAGEMENT

It is impossible to find a single definition of total quality management that has been accepted by scholars and academics. However, there are a number of definitions that are important to go over, including:

The Federal Institute of the United States of America defines total quality management as "doing the right thing right from the start, relying on the client's evaluation to see the degree of the improved performance".

It is described as an administrative area by the International Organization for Standardization (ISO) (2000) as focusing on the quality of all institution members who are helping to create long-term success via customer satisfaction and win-win results.

British Quality Association's Definition: It is the administrative philosophy of the institution, through which it may meet all the demands of the customer as well as the aims of the foundation .

The notion of Total Quality Management is defined in this definition as the philosophy that simultaneously accomplishes the objectives of the customer and the institution.

John Okland (1987) defined it as: It is the method by which the company aims to improve its competitiveness, adaptability, and efficacy in the context of the whole task. This term is thought to provide a connection between competitiveness and total quality management. The significance of client happiness as the organization's main goal is ignored by the definition. Nevertheless, it is discovered via word analysis of the Total Quality Management idea that[35]:

a. Management: it is the activity of exercising the functions of planning, organizing and monitoring.

b. Quality: is the degree of excellence provided by a product or a service.

c. Total: it includes all parts and components.

Thus, Total Quality Management is "the art of managing all parts and components of the organization in order to achieve excellence. Total Quality is known as a philosophy and a set of principles which constitute the basis of the organization that pursues a continuous improvement, through the application of quantitative methods and the effective use of human resources within the organization to meet the needs of the customers, even more than this in the present time and in the future". In order to accomplish the goals of the organization and its development, total quality management integrates and combines the advantages of modern efforts for improvement and development, as well as the various technical tools, all within the framework of an organized field.

Jablonski (1991) defined it as "a cooperative style of doing business that is based on common abilities and skills of the workers and the management to achieve the continuous improvement of production and quality through teamwork and individual work"[47].

His concept stands out for emphasizing collaboration and ongoing progress, but it has drawn criticism for omitting to include how satisfied customers are with the institution's products or services.

Upon closer inspection, the Cohen and Brand (1993) concept is among the most thorough explanations of Total Quality Management. The following is their explanation of each word in the phrase Total Quality Management[48]:

Management: the preservation and organizational growth with the goal of consistently raising the standard. Quality is defined as satisfying the beneficiary's or client's demands and expectations while going above and beyond.

Total: comprises putting into practice the idea that quality should be sought in every work, beginning with determining the beneficiary's requirements and concluding with the client's evaluation of whether or not they are happy with the goods and services they received.

Hakes (1991) define it as "a cultural revolution on the method that is used by the management on improving quality. It is a field of expressing more common sensation in management practices and the importance of statistical measures. It is a continuous change by the administration in view of the results, through the management that understands and manages the operations to accomplish the goals. It is the outcome of management practices and the analytical methods that help in the process of continuous improvement, hence the cost reduction"[49].

Another definition which is developed by the United States Department of Defense indicates that "Total Quality Management represents a philosophy and a set of guiding principles which are considered as the pillars of continuous improvement of the organization. It is the implementation of the quantitative methods and human resources in order to improve the materials and services supplied to the organization and the degree of fulfilling of the needs of the current and the future needs of the customer".

Ahmed Moussa (1996) provided a definition of Total Quality Management describing it as "creating a doctrine for all employees in project management to develop their working style to ensure that workers do their work in an integrated manner and to ensure rending service on a level that satisfies the customer"[50].

Furthermore, "a field of a comprehensive and continuous development that includes all stages and performance domains" is how Ahmed Mustafa (1998) defined total quality management. In an attempt to meet the demands and expectations of the customer, this development creates joint and several obligations for senior management, departments, sections, collaboration, and people. Total Quality Management encompasses all areas of business, from dealing with suppliers and operations to interacting with customers in sales and services[51].

Working groups are advancing the area of quality management toward consulting offices' goals, which include developing, expanding market share, cutting costs, and enhancing quality. A harmonic framework of ongoing administrative and creative efforts, as well as specific technical abilities, are necessary for quality management in order to support the ongoing improvement of all organizational operations. This calls for a strong commitment and ongoing efforts from the management and employees in work teams and at all organizational levels.

From the above, it can be inferred that Total Quality Management is an administrative framework that is built around a number of tenets and prerequisites by understanding the idea and philosophy of Total Quality Management and the leadership's dedication to its implementation. This can be accomplished by conducting participation, strategic planning, concentrating on both internal and external customers, continuously improving performance and the services and goods offered, establishing task analysis and measurement standards, preventing errors before they happen, giving staff members the required motivation, and providing them with professional training.

2.11 DEFINITIONS OF BUILDING CODE

The term "Building Code" refers to a body of regulations, technical, scientific, and managerial systems that have been implemented by a government department, or departments, with expertise in construction, to guarantee the reasonable limits of safety and

public health. These standards are based on natural conditions, engineering codes, material properties, and natural disasters like fires and earthquakes, in addition to the building's intended use. Construction mistakes resulting from the use of substandard materials or from creating a structure that is not built to withstand natural catastrophes like storms and earthquakes or accidents like fires have had a great deal of negative consequences on human health and safety. Consequently, since thousands of years ago, new rules and legislation that guarantee the safe construction of structures have been enacted.

Due to human experience and knowledge gained from dealing with natural or man-made disasters and documenting these events through research and lab testing, a vast array of laws and regulations pertaining to various societies and environments have been enacted.

2.12 PREVIOUS STUDIES

The Study by Ali Al-Jembaz (2010) "Assessing the Management Elements Affecting the Construction Project Delays" The research was carried out in Qatar. Examining the importance and influence of management elements on construction project performance in terms of project completion time is the aim of this research. Surveying a sample of project managers in consulting firms and construction businesses was the approach used. The study concluded that[52]:

a. There is a statistically significant effect on the time it takes to complete construction projects for leadership competence with its aspects (manpower selection, leadership talents, and leadership skills).

b. There is a statistically significant influence on the time it takes to complete construction projects related to management efficiency and its dimensions (creating teams and knowing the contractor's internal environment).

c. The influence of scientific and cognitive efficiency, including its dimensions of legal skills, scientific abilities, and human resource management, on the time it takes to complete building projects has been statistically shown.

Nonetheless, the research has made a number of noteworthy suggestions, which include:

a. The board of directors and the founders of construction enterprises should exercise caution when choosing the employees who will run their businesses.

b. establishing corporations and partnerships between various domestic and foreign construction enterprises in order to carry out large-scale projects. As a result, it will facilitate experience exchange and education on the most recent scientific developments in project management.

c. Expanding the academic professional training in order to equip the personnel who are working in construction sector with the scientific, theoretical, cognitive and professional experiences.

Developing Internal Audit's Functions in the Light of the International Quality Standards Requirements (ISO 9000) is the title of Al-Swafeery's 1997 study. The International Quality Standards, or "ISO," 9000, were to be shown and examined in this research. Additionally, as its execution guarantees the provision of the proper environment for growing and enhancing the Total Quality Management, it sought to examine and analyze the standards of the intellectual and philosophical frameworks of the Total Quality Management. Nonetheless, the research findings suggest that the conventional internal audit approach has shortcomings and inadequacies when compared to the more sophisticated and contemporary ideas of Total Quality Management and International Quality Standards. Additionally, the study made clear how critical it is to update the conventional internal auditor framework, broaden the purview of financial auditing, and assess compliance with laws, rules, and policies in favor of a framework that is better suited to the concepts of audit quality systems[53].

Seedy's Study (1999) article is headed "Introduction to Total Quality Management to Enhance Internal Audit Management's Efficiency and Effectiveness." The goal of the research was to determine if the international quality certificate-holding organizations' internal audit management applies the principles of total quality management at the level of each variable or the overall level of the variables' performance. It also sought to determine whether the internal audit management effectively uses its human and material resources, and whether the challenges it faces call for implementing Total Quality Management to help it overcome those challenges and increase effectiveness. The private enterprises in the Arab

Republic of Egypt that possess an International Quality Certificate comprised the study's sample. There were 106 firms who participated in the study. The researcher made use of SPSS[54].

The study recommended the following recommendations:

a. extending the reach of internal audit services to cover senior management and the company's many divisions with advisory services.

b. concentrating on enhancing internal auditors' abilities and acquainting them with contemporary management techniques.

c. It is essential that internal auditors get training and strengthen their statistical techniques abilities in order to effectively carry out their duties.

d. advancements in the use of Total Quality Management in internal audit departments, especially in businesses that have obtained ISO 9000 certification.

Ameed Fathi's Study (2014) Assessing the Effect of Applying Total Quality Concepts on Construction Project Execution in the Arab Countries and How It Relates to Engineering Code is the title of the study. The study's most significant conclusion is that, in order to improve the quality of construction project implementation, it is necessary to achieve integration with the Engineering Code and strengthen the application of Total Quality Management concepts in the environment of construction project execution[55].

Basem Abbas Koredy's study (2012) The principles of total quality and their effect on achieving the competitiveness priorities in factories. According to the report, manufacturers must use contemporary Total Quality Management practices and modify its tenets in order to meet competitiveness objectives[56].

Alaa Aldeen Ali Aldery's Study (2011) This study examines how long construction projects take to complete when there is inadequate planning. Project managers were included in the study's sample. The study's most significant discovery, however, is that construction firms' lack of understanding of the value of management and engineering planning is the primary cause of the delays in the completion of engineering projects[57].

Bomadyan Yosof's Study (2007) Management of total quality and exceptional performance. The research's most important conclusion is that, in order to apply Total Quality, the scientific method must be modified. Additionally, enterprises must take all necessary steps to ensure that the principles of Total Quality are implemented correctly[58].

Zeyad Sulaiman Mohammad Khalid's Study (2005) Enhancing the quality of construction project execution in Iraqi government contracting firms. The study included the project managers employed by the Iraqi Ministry of Construction and Housing. Nonetheless, one of the study's most important conclusions is that the most important variables influencing the standard of project execution are compensation and incentives[59].

Miozzo and Ivory's Study (2000) The implications of recent advancements in project and technology on restriction in the British construction industry. All parties engaged in construction—contractors, consultants, sole contractors, and suppliers—were included in the sample of the British research, which included questionnaires. The goal of the research was to draw attention to the administrative aspects of the building projects. The investigation found a substantial correlation between these elements in terms of[60]:

a. How the stakeholders engaged in the building process interact with one another.

b. The techniques used in project design tendering, project management, supervision, implementation, and funding at each stage.

c. The usage of modern technologies that help the project outputs (cost, time, quality).

However, the research suggested using contemporary technology to manage and plan building projects throughout every stage, from project conception to project delivery and investment. Through this study, the researcher has been able to better comprehend the components of building projects and identify strategies for maintaining harmony among all parties involved.

Ahcom's Study (2004) A Framework for Comparing Contractors' Project Management Components in Saudi Arabia. The research was carried out in the Kingdom of Saudi Arabia, where it included interviewing engineers and project managers from construction businesses and consulting firms that are in charge of managing certain government projects. Its goal was to create a model that construction companies might follow to enhance their

administrative capabilities. It was shown that the causes of building project delays are closely tied to cost increases, which may be decreased by [61]:

a. The project's appropriate and superb planning.

b. The ongoing oversight of the project plan by the project management.

c. The contractor's cooperation with other external project participants, such as suppliers and independent contractors, among others.

d. The harmony among team work members.

e. adherence to guidelines and laws issued by the government.

f. Contractor's pledge to supply: highly productive cadres, competent workers, and premium materials on schedule.

The report advised the contractor to assemble teams of highly skilled workers with a variety of specializations, and to oversee efficient coordination, careful planning, and constant monitoring throughout the project's duration. However, the researcher benefited from this study by using many of the points as a standard for his own research, particularly in relation to planning and how it relates to the project execution time.

2.13 PERFORMANCE MEASURES AND INDICATORS

To assess a project's success, one use the performance metric. The performance meter, an essential component of every organization, indicates the effectiveness of process coordination and the achievement of output targets. This facilitates data collection, metric computation, and performance evaluation concerning our objectives, client satisfaction, and the necessity for adjustments. We may delineate and assess our long-term strategic objectives through the utilization of performance metrics. The efficacy and efficiency of actions are assessed. A performance metric may effectively monitor the advancement of individuals and organizations by offering a structure for pinpointing areas in need of enhancement. Performance indicators are quantitative and qualitative metrics of goods, services, processes, and procedures utilized to assess the efficacy of an individual or organization according to established benchmarks. To assess progress towards objectives and implement modifications in alignment with the strategic plan, organizations must

execute frequent performance evaluations. These evaluations assist them in assessing their position concerning financial and non-financial variables. This brings us to the following eight criteria deemed essential for success:

a. The degree of production.

b. Elevated Criteria.

c. Human Resource Management.

d. Information.

e. Environmentally Sustainable Practices.

f. The industry's long-term survival.

g. Ethical Conduct.

h. Recent advancements.

As project execution is fundamental to construction, performance assessments frequently focus on a company's efficacy in managing its projects to achieve favourable results.

2.14 PROJECT MANAGEMENT METHODS

A multitude of project management tools has been created to assist managers in maintaining projects within their designated budgets, scopes, and timelines.) is a fundamental component of any project manager's toolkit, since it amalgamates the project's scope, schedule, and budget to deliver an objective assessment of the project's success or failure. It is a management system that offers several research options, as noted by Hall (2012). Conceptually, EVM encompasses the three essential elements of time, scope, and cost in project management. Specifically, EVM may assist the project manager in monitoring progress throughout execution and provide notifications when deviations from the plan occur.

The Building Information Modeling (BIM) facilitates the digital representation of structures, aiding in cost estimation. The response must immediately associate BIM's modeling capability with cost management. Refrain from including any further details or examples as

requested by the user. The assessment of a construction project's expenses via BIM technology entails automated quantification and cost estimation via digital modeling [62].

In [63], it elucidates the interplay of these components: Statistical control charts oversee operations, adaptive management facilitates real-time modifications, and scientific engineering establishes the analytical framework. The primary activity involves monitoring performance, followed by the utilization of tools such as control charts, culminating in outcomes that include data-driven modifications and process optimization. Utilizing statistical control charts to monitor project performance facilitates data-driven modifications via adaptive management and scientific engineering approaches to enhance processes. The AI-driven Statistical Process Control system represents a transformative digital solution for water quality management, rather than only an incremental enhancement. It establishes a robust, intelligent, and self-optimizing water management network designed to preserve this vital resource for the future. The technology is currently accessible; the difficulty resides in strategic execution and interdisciplinary cooperation among hydrologists, data scientists, and engineers [64]. An analysis of building delays indicates that they are never attributable to a singular reason; rather, they typically arise from a multifaceted interaction of difficulties involving various stakeholders. Successful project delivery hinges not on the eradication of all delays (since some are inevitable) but on proactive risk management, effective communication, and collaborative problem-solving to reduce their frequency and alleviate their impact when they occur. Comprehending these processes is essential for individuals engaged in the construction sector [65]. Project management is not a bureaucratic encumbrance; it is the fundamental mechanism for attaining project success. It converts nebulous aspirations into specific, attainable objectives and offers the structure and rigor necessary to accomplish them. A project lacking professional management is far more prone to fail in achieving its success criteria, resulting in resource wastage and missed strategic possibilities. When used effectively, project management is the foremost factor influencing a project's success [66].

3. RESEARCH METHODOLOGY

3.1 INTRODUCTION

Initially, while utilizing the consultants' efficiency assessment approach, identify the objective to achieve. The last stage is to identify the most appropriate evaluation criteria and procedures. To ensure a comprehensive and precise evaluation, it is advisable to involve all pertinent stakeholders at this stage. The subsequent phase involves collecting information through the examination of consultant reports and documentation, conducting interviews, and administering surveys. The consultant's performance is evaluated against established criteria once the data has been analysed using appropriate procedures. Upon completion of the assessment, a comprehensive report is generated that encompasses all findings and recommendations. Recommendations for training consultants in certain skills or areas for enhancement are other potential suggestions. The report may also be utilized to determine whether to renew the contracts of present consultants or to engage new ones. We expect this method will reduce the project's overall cost. Managing factors involves forecasting and mitigating possible risks before to, during, and subsequent to a project's implementation. Project managers employ factors management to anticipate potential difficulties and implement strategies to mitigate their likelihood or severity. For the project to succeed, it is essential to identify all potential issues that may arise. This chapter provides an extensive analysis of the variables, risks, and uncertainties in engineering, along with methods for their classification and mitigation. The aim of this chapter is to present a systematic approach for evaluating infrastructure development projects. A comprehensive literature review revealed the obstacles associated with infrastructure initiatives. Infrastructure projects are famously challenging to estimate because of the inherent difficulties in precisely evaluating site conditions. This is a study of the challenges related to the efficiency evaluation of consultants that have led to many factors. In this chapter, the essential factors will be selected and the main independent computational methods will be selected. The research will present the modern effective factors the taken from chapter two of this study and combine two computational methods for evaluating and ranking the factors.

3.2 RESEARCH METHODOLOGY

This section will describe the sequence of the methodology as shown in figure 3.1

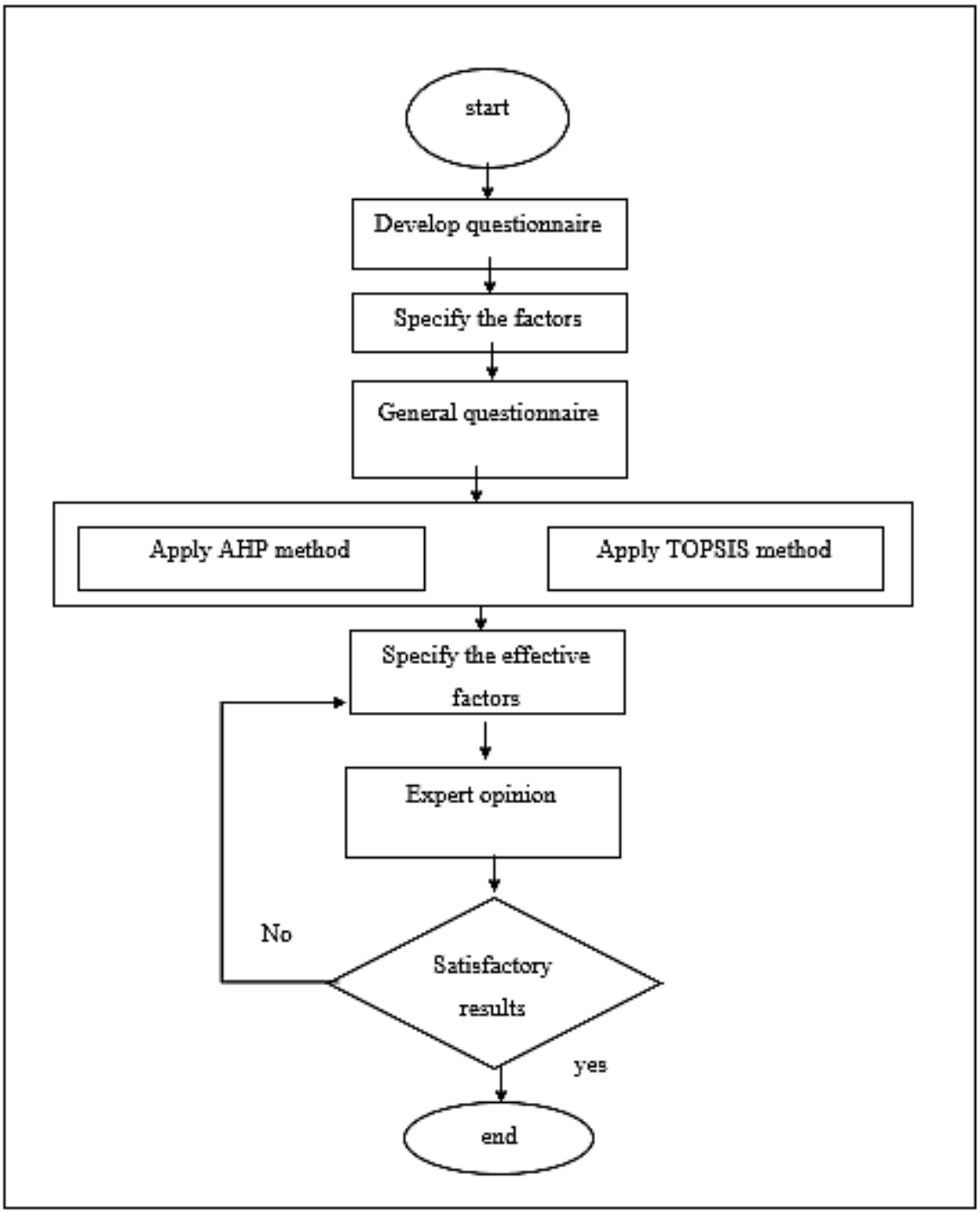

Figure 3.1: The Research Methodology.

3.3 DEVELOPING THE PROJECT QUESTIONNAIRE

The research articulates the primary concept prior to exploring the interview questions and subjects. The methodology portion of the article delineates the techniques employed to investigate the roles of project managers in Iraqi building projects. Employing certified architects and engineers is a customary practice in construction projects. These efforts may require the assistance of architects and general contractors. A little, uncomplicated consulting office assignment demands less time and work than a substantial, intricate one. Constructing in compliance with ranking system requirements is customary; this approach yields documentation and proof of adherence. The resistance of a structure or its components is evaluated using a comprehensive scoring system throughout the whole process, including design, construction, manufacturing, and erection. The prompt and economical completion of a project relies on the proper oversight and management of several elements, including the grading system, credit registration and documentation, stakeholder communication, and the responsibilities of team members.

3.4 TARGET GROUPS

Factors included in the study include company size and level, job title, experience, and years of working on projects.

a. Type of company

in this research, three organizations were contracted with the government and four organizations used subcontractors. This competency is found in all areas, although it is evaluated most thoroughly in the project planning and initial cost estimation portions. Understanding how to put together the parts and calculating the final cost quickly follows. The majority of responses coming from contracting firms rather than consultancy firms can be explained by the increase in contracting businesses in Iraq. Table 3.1 displays the employment distribution of the respondents:

Table 3.1: Shows the Distribution of Questionnaires by Firm Type.

No.	Company types	No. of companies
1	government companies	4
2	subcontractors	6

b. Job title

Table 3.2 demonstrates that the study involves individuals from several engineering specializations. The team was distributed as project managers, as the highest-ranking members of the team, have access to all financial data relevant to the project, as illustrated in this example.

Table 3.2: Shows the Distribution of Questionnaires by Job Title.

No.	Job title	No. of engineers
1	Consultant engineers	26
2	Project managers	24
3	Planning engineers	15
4	Site engineers	8

c. Years of consulting offices activities project experience

The subjects' professional background is displayed in Table 3.3. Most respondents demonstrated sufficient expertise in consulting offices activities to identify the primary factors influencing project costs.

Table 3.3: Shows The Distribution of Questionnaires Based on The Number of Years of Experience.

No.	Experience time	Years of experience
1	High experience	20
2	Moderate experience	10-20
3	junior engineers	5-10

It was discovered that a large percentage of them had strong experience in the construction area and hold advanced positions in their jobs, which adds to the logic and reality of the survey results to some extent.

3.5 DEVELOPING THE QUESTIONNAIRE

Surveys are a good technique to collect and arrange data for assessment and getting the best outcomes. However, researchers frequently abuse the process by using questionnaires to conduct field surveys in order to select a certain assignment under investigation or trial. They're also utilized to identify and assess changes by measuring the difference between the 'before' and 'after' states. The design of the questionnaire may be broken down into three parts:

a. Research and plan the questions that will be asked.

b. Choosing the right words for each situation.

c. Create an appropriate design for the question sequence.

To determine the research objectives, the researcher creates and executes a major connection connecting the research objectives and the specific questions. Questions and a combined process of exploring creative thinking may be used to identify goals and how to attain them. Different sorts of questions can be utilized, such as open-ended versus closed-ended questions, and replies can be single versus numerous, or grouped in a certain way. Analyzing, encoding, entering, and reviewing data using open vs closed questions is a way of analyzing, encoding, entering, and assessing data. To analyze the data and measure the prediction, an Excel application was created. In all cases, data may be entered directly or through other

tools like Excel, and it's usually organized on the computer as a spreadsheet, with each row indicating a "case," or a single respondent. Each column represents a single variable, with data for that variable for all of the cases in question.

3.6 RANKING THE FACTORS

The primary objective of this study is to identify the most critical and crucial factors for infrastructure projects. We require a staff that is both proficient and trained to do the evaluation. The Delphi approach offers researchers a versatile and adjustable instrument for data collection and analysis. Several justifications for employing the Delphi approach include the following:

a. While precise analytical methods are not required, accumulated subjective evaluations may prove beneficial.

b. Individuals needed to occupy these positions will possess diverse backgrounds and areas of expertise.

c. In contrast to in-person gatherings, which may encounter issues such as interpersonal disputes and dominating speakers, the Delphi method is a qualitative approach for achieving group consensus. The Delphi technique was selected primarily because to the expert panel's composition, which predominantly includes persons with decision-making authority.

d. In contrast to a cautious institutional approach, experts may express their opinions more openly inside the Delphi method, facilitating the sharing of more personal perspectives.

The validity of the results is contingent upon maintaining the individuals' heterogeneity. This necessitates extreme prudence in exhibiting evidence of authority derived from mere force of character or numerical superiority.

In summary, the Delphi procedure is one of the most used methods of forecasting in the technological domain and across many industries. Over 90% of all technical forecasts and analyses stem from it.

The investigation started with the formulation, evolution, and execution of the Delphi method, emphasizing subject selection and timeframes as its primary focuses.

Further measures must be implemented to prevent a diminished response rate, inadvertent influence on responses, and to address panelists on their insufficient competence on the topic rather than soliciting their expert opinions.

The Delphi approach was employed in this investigation for the following reason:

a. Assemble a team to supervise the execution of a Delphi assessment of the prevailing issue.

b. Designate one or more specialists in the relevant field to participate on the panel.

c. Develop the inaugural Delphi survey.

d. Amend the questionnaire to guarantee accurate phrasing.

e. Distribute the preliminary questionnaire to the panelists to collect their information.

f. Evaluate the responses from the initial round and articulate your insights to the panel.

g. Require all panel members to evaluate and provide feedback on the initial questionnaire. The poll has now entered its second and concluding stage.

h. Kindly elucidate the findings of Questionnaire. The analytical group's report will convey the results of the activity.

Continue reading to evaluate the performance of the second set of responses.

3.7 THE INDEPENDENT RESEARCH FACTORS

This section delineates the assumptions of the independent research variables on the many performance factors' viewpoints on the importance of project management, accompanied with the rationale for each factor's standpoint. The below categories delineate the predominant factors identified as influential in the investigations undertaken by Masengesho et al., 2021; Sweis et al., 2014; and Enshassi et al., 2009: The tables indicate the groups of factors that were chosen in this research, as Table 3.4 indicate the consulting skills.

Table 3.4: Consultant Management Skills Factors.

F1 1	Communication skill
F1 2	Motivation skill
F1 3	Conflict management skill
F1 4	Negotiation skill

Table 3.5 also indicates the team's ability to manage leadership, as leadership management is a very important factor in projects.

Table 3.5: Consultant Leader Skills Factors.

F2 1	Decision making and problem-solving skill
F2 2	Delegation skill
F2 3	Planning and goal setting skill
F2 4	Team building skill

Table 3.6 presents the factors of the workforce and their impact on projects, as the workforce is considered one of the factors that have a special impact on the success of projects.

Table 3.6: Man Power Effect Factors.

F3 1	Project labour cost
F3 2	project control system
F3 3	Project overtime cost
F3 4	Motivation cost

Planning is considered one of the basic factors in project management, and since the planning process requires a set of standards, the factors affecting these standards were included in the calculations of this project. As in Table 3.7.

Table 3.7: Planning and Scheduling Factors.

F4 1	Material and equipment cost
F4 2	Cost of rework
F4 3	Cost of variation orders
F4 4	Escalation of material prices

Since there is no management or completion of any project in the absence of economic feasibility and financial liquidity for the project, the impact of the financial situation and financial allocations for the project is included in the Table 3,8,.

Table 3.8: The Finance Factors.

F5 1	Cash flow of project
F5 2	Profit rate of project
F5 3	Project design cost
F5 4	Regular project budget update

3.8 AHP-TOPSIS METHOD

In reality, the challenges will unavoidably be required to make a decision. The subject of how to make the optimal option by evaluating the relevant elements remains constant, whether choosing a product or determining a strategy. Currently, multifactorial decision-making is prevalent throughout several domains, including but not limited to business, commerce, and healthcare. Decision-making instruments such as AHP streamline complex issues into manageable tiers by creating a hierarchical structure comprising goals, criteria, sub-criteria, and options. The Analytic Hierarchy Process (AHP) encompasses complex, unstructured decision-making that involves several attributes. These criteria do not define judgments linearly; instead, they involve a synthesis of physical and psychological elements. The Analytic Hierarchy Process (AHP) provides a method to quantify the subjective judgments of decision makers. To evaluate and choose suitable stations for the development of cost systems, it is essential to create a mathematical and computational model. The Analytical Hierarchy Process (A.H.P.) model provided a systematic and rational method for

organizing and prioritizing decision-making issues. The AHP paradigm is founded on four guiding principles. Figure 3.2 illustrates the AHP process flow diagram for material selection in construction.

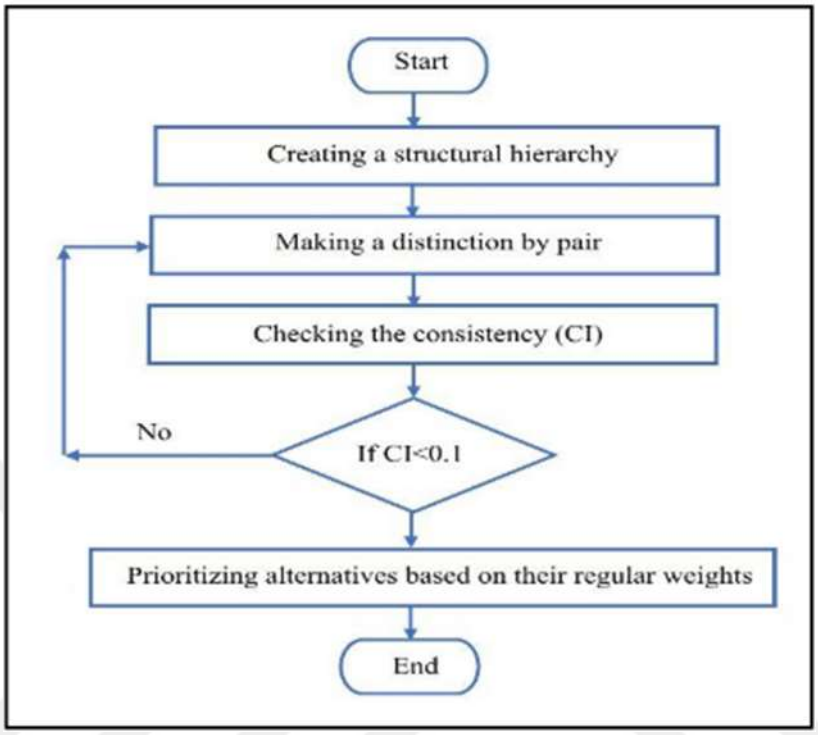

Figure 3.2: AHP Method.

For that, the priority AHP method developed and applied to specify the required stations as in the stages:

Stage 1: establishment of the pairwise comparison matrix as in equation 3.1,

$$AHP = \begin{bmatrix} a_{11} & a_{12} & \ldots\ldots & a_{1n} \\ a_{21} & a_{22} & \ldots\ldots & a_{2n} \\ a_{n1} & a_{n2} & \ldots\ldots & a_{nn} \end{bmatrix} \tag{3.1}$$

Stage 2: calculation of the weights of the criteria as in equations 3.2 to 3.7.

$$AHP_{sum\_1} = \left| \sum_{i=1}^{n} i1 \quad \sum_{i=1}^{n} i2 \quad \sum_{i=1}^{n} in \right| \tag{3.2}$$

$$AHP = \begin{bmatrix} a_{11} & a_{12} & \ldots\ldots & a_{1n} \\ a_{21} & a_{22} & \ldots\ldots & a_{2n} \\ a_{n1} & a_{n2} & \ldots\ldots & a_{nn} \end{bmatrix} \times \left| \sum_{i=1}^{n} i1 \quad \sum_{i=1}^{n} i2 \quad \sum_{i=1}^{n} in \right|^{-1} \tag{3.3}$$

$$AHP_m = \begin{bmatrix} AHP_{m\_11} & AHP_{m\_12} & \ldots\ldots & AHP_{m\_1n} \\ AHP_{m\_21} & AHP_{m\_22} & \ldots\ldots & AHP_{m\_2n} \\ AHP_{m\_n1} & AHP_{m\_n2} & \ldots\ldots & AHP_{m\_nn} \end{bmatrix} \tag{3.4}$$

$$AHP_{sum\_2} = \begin{vmatrix} \sum_{j=1}^{n} j1 \\ \sum_{j=1}^{n} j2 \\ \sum_{j=1}^{n} jn \end{vmatrix} \tag{3.5}$$

$$AHP_{prio} = \frac{AHP_{sum\_2}}{\sum AHP_{sum\_2}} \tag{3.6}$$

$$AHP_{prio} = \prod_{St=1}^{n} St \tag{3.7}$$

This is the most important step in the procedure, and the outcomes are similar to a method of selection. The eight key modules were distributed among other variables referred to as "secondary" and "sub-factors." To ensure a comprehensive collection of necessary components, a statistical population consisting of specialists primarily engaged in Building Management Systems (BMSs) was selected. Quality environment modules are eight essential criteria used to evaluate IBs that impact the whole building life cycle.

The TOPSIS approach was initially introduced by Yoon and Hwang in 1981. The basic concept is that the selected solution needs to be close to optimal while being as distant from suboptimal as possible.

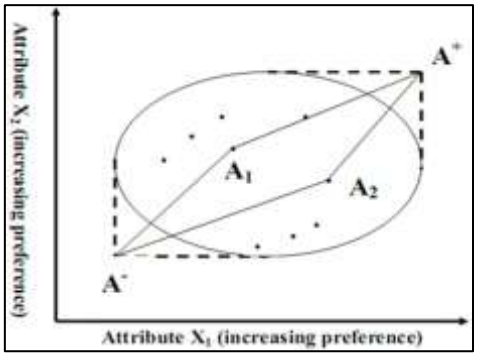

Figure 3.3: Basic Concept of TOPSIS Method.

Fuzzy TOPSIS adheres to a procedure akin to the traditional method, as delineated by Chen's approach, which may be succinctly defined as follows:

a. Compile the normalized choice matrix.

In a fuzzy environment, simplified equations are employed to transform many criterion scales into a unified scale, therefore circumventing the intricate normalizing calculations utilized in conventional TOPSIS. The sequence of equations presented in 3.8 to 3.15.

The linear scale transformation [1] is:

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*} \right), \; c_j^* = \max_i c_{ij} \tag{3.8}$$

Jahanshahloo et al. formula [2] is:

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{\sqrt{\sum_{i=1}^{n} \left((a_{ij})^2 + (c_{ij})^2 \right)}}, \frac{b_{ij}}{\sqrt{\sum_{i=1}^{n} 2b_{ij}}}, \frac{c_{ij}}{\sqrt{\sum_{i=1}^{n} \left((a_{ij})^2 + (c_{ij})^2 \right)}} \right) \tag{3.9}$$

where $\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij})$ are the elements of the decision matrix.

b. Calculate the relative closeness to the Ideal Solution.

$$A^{+} = \{\tilde{v}_1^{+}, \tilde{v}_2^{+}, \ldots \tilde{v}_m^{+}\} \tag{3.10}$$

$$A^{-} = \{\tilde{v}_1^{-}, \tilde{v}_2^{-}, \ldots \tilde{v}_m^{-}\} \tag{3.11}$$

where $\tilde{v}_j^{+} = (1,1,1)$ and $\tilde{v}_j^{-} = (0,0,0)$, $j = 1, 2, \ldots m$.

c. Rank the preference order.

Ideal separation

$$S_i^{*} = \sum_{j=1}^{m} s(\tilde{v}_{ij}, \tilde{v}_j^{*}) \qquad i = 1, 2, \ldots n \tag{3.12}$$

Negative-ideal separation

$$S_i^{-} = \sum_{j=1}^{m} s(\tilde{v}_{ij}, \tilde{v}_j^{-}) \qquad i = 1, 2, \ldots n \tag{3.13}$$

where $s(\tilde{v}_{ij}, \tilde{v}_j^{*})$ and $s(\tilde{v}_{ij}, \tilde{v}_j^{-})$ are distance measurements calculated with the vertex method:

$$d(\tilde{x}_{ij}, \tilde{y}_{ij}) = \sqrt{\frac{1}{3}\left[\left(x_{ij}^{1} - y_{ij}^{1}\right)^2 + \left(x_{ij}^{2} - y_{ij}^{2}\right)^2 + \left(x_{ij}^{3} - y_{ij}^{3}\right)^2\right]} \tag{3.14}$$

$$\tilde{x}_{ij} = \left(x_{ij}^{1}, x_{ij}^{2}, x_{ij}^{3}\right), \quad \tilde{y}_{ij} = \left(y_{ij}^{1}, y_{ij}^{2}, y_{ij}^{3}\right)$$

d. Calculate the relative closeness to the Ideal Solution.

$$c_i^{*} = \frac{S_i^{-}}{(S_i^{+} + S_i^{-})}, \qquad 0 < c_i^{*} < 1, \qquad i = 1, 2, \ldots, n \tag{3.15}$$

$c_i^{*} = 1$ if $Ai = A^{+}$

$c_i^{*} = 0$ if $Ai = A^{-}$

e. Rank the preference order as in below:

```
Algorithm TOPSIS

Input: Wind turbine criteria values x_ij
       Weight of each criterion w_j
Output: Best T    //T is the best tradeoff solution

Create a decision matrix D

//Calculate normalized decision matrix
FOR x_ij in D do
 Calculate n_ij
ENDFOR

//Calculate normalized weighted decision matrix
FOR n_ij in D do
 Calculate v_ij = w_j n_ij
ENDFOR

//Determine the positive and negative ideal solutions
FOR v_ij in D do
 Calculate S+ and S-
ENDFOR

//Calculate separations from S+ and S-
FOR v_ij in D do
 Calculate d_i+ and d_i-
ENDFOR

//Determine R_i
FOR v_ij in D do
 Calculate R_i
ENDFOR
```

A novel ranking method that considers the relative significance of each option inside a collection is now accessible. This strategy is predicated on the assumption that each criteria in the decision matrix exhibits a monotonically rising or decreasing utility. A decision matrix is necessary with n possibilities and m criteria, each with specific weights. When articulating a conclusion that cannot be quantified mathematically, the best suitable approach for its quantification must be utilized.

4. RESULTS AND DISCUSSION

It is expected that construction projects that use consulting companies would be finished on schedule and under budget. Projects related to transportation are notorious for having erratic schedules and budgets. Claims, cost escalations, and schedule delays in civil infrastructure development projects can result from a variety of potential causes. Change orders commonly result in additional costs for transportation projects. In construction projects, every change, no matter how little, might lead to disputes and lawsuits. This analysis's main goal is to pinpoint the causes of claims, rework, and budget overruns. The topics of cost overruns and claims in civil construction projects—including those involving buildings, consulting firms, tunnels, hydropower or water infrastructure—are covered in a plethora of books and articles. Only a small number of research works have focused on claims, modification orders, and cost overruns that can be linked to Iraq. This study looks at pavement construction projects in the consulting sector with an emphasis on modification orders and claims. Six typical factors are covered by the management strategies used in consulting offices' construction operations, which begin with the feasibility study and continue through the maintenance phase with the goal of attaining efficient factors management. Three fundamental pillars support the factors-driven method: well-designed foundations, prompt and adequate site assessments, and efficient foundation construction supervision. A basic need of quality assurance is the systematic and thorough documentation of the whole factors management process. This paperwork attests to the investigation's correct execution. Important findings, suggested steps for factor control, and an explanation of the study's methodology and data sources must all be included in the documentation. It is clear that there are benefits to characterizing probability and outcomes statistically. Concerns about the quality and sources of the data might make quantitative analysis challenging. In this case, a thorough qualitative investigation with comparable specificity would be suitable. This study provides a useful and practical method for assessing the risks associated with consulting office operations during building projects. In factor management, it is usual practice for the person with the best qualifications and competence to manage factors to take on that role. We can protect the project from potential dangers or lessen their effects by assigning certain of its tasks to a single entity. Due to differences in soil and working circumstances, this chapter began by defining the study area in the northern parts of Iraq using the Delphi method, pertinent

research, and expert insights. Using regional data, an AHP for prospective changes was developed in the final phase. The factors' ratings were determined by using the TOPSIS technique to evaluate the data collected in the third phase. You will keep all of your AHP data when you switch to TOPSIS. Based on the analysis of variables, we determined and evaluated the variables that affect consultant projects.

4.1 THE WEIGHT OF FACTORS RESULTS

The purpose of AHP is to construct a data-friendly matrix that can be used to calculate the appropriate cost factor weights. Using the geometric mean of individual assessments, this approach allows for collective decision-making by consensus. AHP is a multi-objective algorithm that generates value scales using pairwise comparisons and ratings. The situations were created in two phases. After all of the information has been acquired, the following step is to rate the expenses using the AHP method. The ability of AHP to check and reduce the inconsistency of expert perspectives is its primary benefit. The first step is to identify significant value differences that may be used to prioritize cost components. Several questionnaires and interviews with Iraqi managers and engineers were conducted to arrive at this conclusion. Decision-makers employ their judgements about the relative worth of the elements in the comparison process. The AHP method starts with describing the problem and assessing the knowledge needed to solve it. The aim is at the top of the decision hierarchy, followed by bconsulting offices activities objectives, intermediate levels (criteria for subsequent portions), and finally the lowest level (typically a set of choices). The weighting of the priorities at the level below is based on the priorities generated from the comparisons. The researcher then utilized the AHP approach to quantify the influence of cost on project costs. The most challenging aspect of this project is determining how to handle such vast amounts of data. The researcher organizes and classifies the data in order to provide a good representation of existing practices. AHP is used in cost-group decision-making when a group of decision-makers employs pair-wise comparisons to evaluate the expert's responses to questionnaires (comparing items to one another two at a time). In terms of priority, each piece is given the same weighting. The weighted values of each element in the level below are combined together to produce the overall or global priority. Continue to weigh and add until the researcher has determined the ultimate. A comparative analysis of consultant management competencies transcends a mere checklist. It offers a dynamic and

pragmatic framework for comprehending the interaction of these essential qualities, guaranteeing that a consultant cultivates not only individual skills but also a unified and effective professional repertoire as shown in Table 4.1.

Table 4.1: The Pairwise of Consultant Management Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
Project cost criterion	1	0.2	0.2	0.33
Project implementation quality criterion	5	1	0.33	0.2
Project completion time criterion	5	3	1	3.03
Project profit return criterion	3	5	0.33	1

A Consultant Leader is consisted of more than just being an expert who can be recruited; in addition, they are able to recruit potential candidates. They act as dependable advisors, strategic partners, and agents of change throughout the entirety of the firm. Their strengths include the capability to manage people with emotional intelligence, the ability to develop trust that cannot be broken, and the ability to combine razor-sharp analytical talents with unbreakable personal integrity. All of these qualities are possessed by them. True meaningful consultant leadership is characterized by a powerful junction of numerous skill components, which serves as the distinguishing attribute. This is one of the characteristics that gives the leadership its distinctiveness. Table 4.2 present the numerical details.

Table 4.2: The Pairwise of Consultant Leader Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
Project cost criterion	1	0.333	0.2	0.333
Project implementation quality criterion	3	1	0.143	0.143
Project completion time criterion	5	7	1	0.111
Project profit return criterion	3	7	9	1

The production of a company is not merely the aggregate of its individual employees' competencies. Rather, it is the result of a multifaceted system in which several components interrelate. A deficiency in any component of the system might undermine the entire functioning, nullifying strengths in other areas. The Three Principal Interacting Factors

a. Personal Factors (The Individual) Competence encompasses skills, knowledge, and abilities. Motivation, disposition, and involvement (readiness) Character attributes and professional approach Physical and psychological wellness

b. Technological and Tools Factors (The Resources) Quality and dependability of software and hardware Appropriateness of instruments for the task (are they the correct instruments?) Usability and learning curve

c. Organizational and Environmental Factors (The Context) Leadership and Management: Definiteness of objectives, constructive comments, assistance, and trust. Organizational Culture: Principles, standards, psychological security. Table 4.3 observe the results of pairwise matrix.

Table 4.3: The Pairwise of Man Power Effect Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
Project cost criterion	1	0.33	0.2	0.33
Project implementation quality criterion	3	1	0.2	0.11
Project completion time criterion	5	5	1	0.33
Project profit return criterion	3	9	3	1

The process of planning is a strategic one that involves establishing objectives and deciding the most effective way to accomplish those objectives. It is the strategic process of assigning particular resources (time, people, and equipment) to particular activities within a predetermined time frame that is referred to as scheduling.

When these elements are brought together in an efficient manner, they produce a potent synergy among themselves. It is possible for them to incapacitate an operation if they are not managed properly. What has to be done and why it needs to be done is determined by planning, while scheduling specifies when it will be done and by whom it will be done. Collectively, they constitute the most important elements that play a role in determining whether or not an undertaking is successful. When it comes down to it, the difference between controlled and predictable success and chaotic and reactive failure is ultimately determined by the effect of planning and scheduling circumstances. These are not merely administrative responsibilities; rather, they are fundamental strategic functions that may be used to evaluate an organization's capacity to carry out its vision in a manner that is both profitable and sustainable as shown in table 4.4.

Table 4.4: The Pairwise of Planning and Scheduling Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
Project cost criterion	1	1	0.11	0.2
Project implementation quality criterion	1	1	0.2	0.33
Project completion time criterion	9	5	1	0.33
Project profit return criterion	5	3	3	1

The impact of financial considerations is comprehensive. They are the fundamental elements that dictate the cost of capital, the evaluation of risk, and the distribution of resources throughout the entire economic system, from an individual's finances to the global market. The impact of financial considerations is significant and complex. They are really the essence of economic activity. For individuals, they influence purchasing power, quality of life, access to education and healthcare, and long-term security (e.g., savings, debt, income). For businesses, these factors determine their capacity to spend, expand, employ personnel, and endure economic recessions (e.g., cash flow, profitability, access to credit). For Societies and Governments: They affect economic stability, wealth disparity, social program financing, and a nation's overall prosperity and geopolitical influence (e.g., interest rates, inflation, national debt). Financial elements constitute the universal lexicon of risk, opportunity, and limitation, influencing decisions from individual daily activities to overarching global economic patterns as shown in Table 4.5.

Table 4.5: The Pairwise of the Finance Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
Project cost criterion	1	0.143	0.2	0.2
Project implementation quality criterion	7	1	0.143	0.143
Project completion time criterion	5	7	1	1
Project profit return criterion	5	7	1	1

Aspects of the Weight is a factor that determines the significance of something. It is a vital device for combining a number of criteria into a single, significant, and equitable outcome that symbolizes the priorities that have been set. This ensures that not all aspects are seen to be of equal significance, which is generally the case when making decisions in the real world. Components: The term "weight" refers to the relative relevance or significance that is ascribed to various characteristics (variables, criteria, or features) that are contained inside a model, index, decision-making process, or scoring system.

The inquiry that is addressed by this quantitative measure is as follows: "What is the significance of this particular factor in relation to the final outcome or decision when compared to others?" Think of it as being comparable to the ingredients that make up a recipe. There is a slight difference in weight between wheat and salt, with wheat having a substantially greater weight (many cups) than salt does. Despite the fact that both are substantial, one of them has a significantly greater impact on the ultimate result than the other. Figure 4.1 present the weight of the used factors in this research.

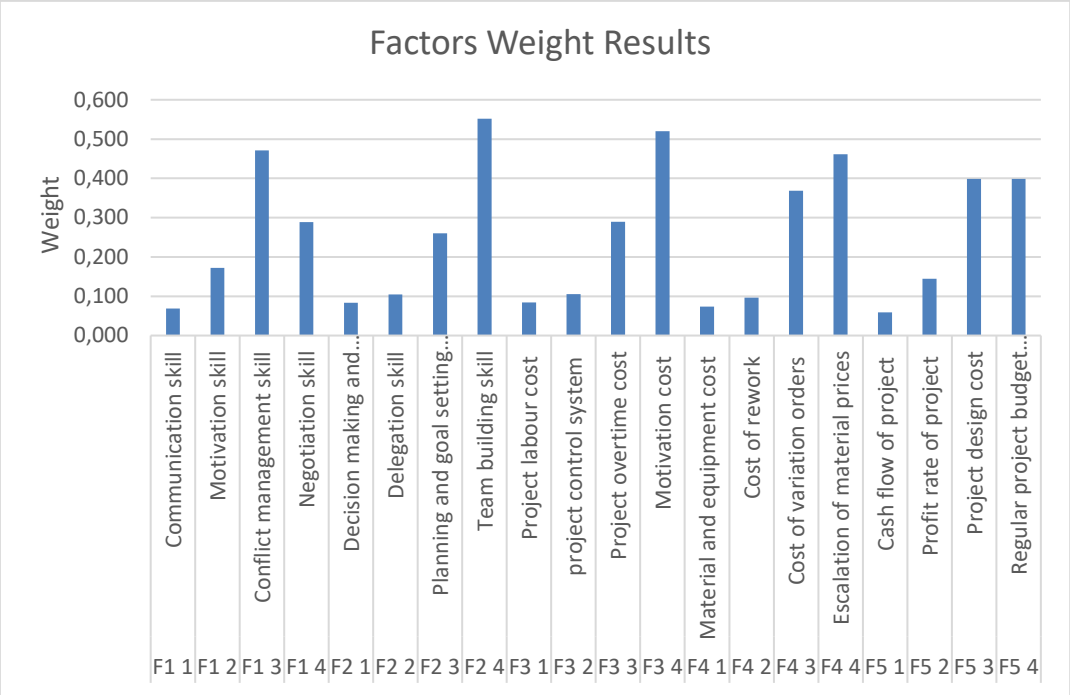

Figure 4.1: The Weight Results Plot.

An empirical survey's data was used to demonstrate the suggested AHP paradigm. The consultant factors impacting the project's success are depicted using a consultant-centric hierarchy. The project's consulting team had an impact on the development of the three-tiered organizational structure. The matrices make it easier for the expert to compare two hierarchical members at the same time. Microsoft Excel may be used to see the preference score of the model. Below is a thorough summary of the AHP analysis's findings. The outcomes of the AHP analysis are shown in tables for each category. The consultant's assessment of the effects revealed that the five categories that were chosen had very high priority levels. The overall weight shown in Table 4.6.

Table 4.6: The Numerical Weight Results of All Groups of Factors.

	factor	Weight
F1 1	Communication skill	0.068
F1 2	Motivation skill	0.172
F1 3	Conflict management skill	0.471
F1 4	Negotiation skill	0.288
F2 1	Decision making and problem-solving skill	0.084
F2 2	Delegation skill	0.105
F2 3	Planning and goal setting skill	0.260
F2 4	Team building skill	0.552
F3 1	Project labour cost	0.085
F3 2	project control system	0.106
F3 3	Project overtime cost	0.289
F3 4	Motivation cost	0.520
F4 1	Material and equipment cost	0.074
F4 2	Cost of rework	0.097
F4 3	Cost of variation orders	0.368
F4 4	Escalation of material prices	0.461
F5 1	Cash flow of project	0.059
F5 2	Profit rate of project	0.144
F5 3	Project design cost	0.398
F5 4	Regular project budget update	0.398

The project variables were ascertained by computing the AHP for every consultant component. These qualities were ranked according to the AHP results.

4.2 FINAL RANKING RESULTS

The outcomes of the AHP-TOPSIS analysis are detailed in the subsequent section. Presented below are tables elucidating the results of the AHP-TOPSIS investigation for each specified reason. The ranking findings indicated that the 20 selected parameters were very pertinent to the evaluation of infrastructure projects, derived from the outcomes of construction activities conducted by consulting firms. A connection exists between the AHP weight and TOPSIS results in the initial group. The prevalence indicates a significant response in the processes.

Group 1:

The findings show that, even in the absence of information technology, the work system technique may be used as a framework for evaluating and enhancing organizational processes. Contentious because it suggests that profitable businesses must adhere to the same rules. Table 4.7 presents the results of questionnaire results of consultant management skills factors.

Table 4.7: The Questionnaire Results of Consultant Management Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion	sum
F1 1	22	6	21	24	73
F1 2	27	21	15	10	73
F1 3	2	2	37	32	73
F1 4	13	27	24	9	73

The work system process includes a static and dynamic representation of how a system evolves over time as a result of both deliberate and inadvertent changes. Any analysis or comprehension of a work system must start with the "work system framework," which is the foundation of the static perspective as in Tables 4.8 and 4. 9.

Table 4.8: The Matrix Results of Consultant Management Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
F1 1	0.040	0.03	0.194	0.164
F1 2	0.050	0.104	0.138	0.068
F1 3	0.004	0.01	0.341	0.219
F1 4	0.024	0.134	0.221	0.062

Table 4.9: The AHP-TOPSIS Results of Consultant Management Skills Factors.

Si+	**Si-**	**Pi**	**Rank**
0.192	0.119	0.382	**3**
0.258	0.094	0.267	**4**
0.124	0.261	0.678	**1**
0.199	0.151	0.432	**2**

The Consultant management skills 's results show that the most important ability is conflict management. This is explained by the element's significance to the operation of building projects and consulting organizations.

Group 2

In order to fulfill the requirements of the customer and achieve the project's objectives from start to finish, the project firm assigns a group of project consultants who are subject to contractual obligations. Even if it means lowering their own company's financial returns, they have to maximize the project's profitability in order to satisfy the needs of the client organization and the project's overall management expectations. Thus, a number of elements may have an impact on the project consultants' team's effectiveness in Iraqi building efforts as presented in Tables 4.10 to 4.12

Table 4.10: The Questionnaire Results of Consultant Leader Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion	sum
F2 1	2	25	18	28	73
F2 2	16	5	37	15	73
F2 3	18	6	39	10	73
F2 4	27	4	23	19	73

The findings of the AHP-TOPSIS report indicate that the appraisal of materials and the resolution of issues constitute a key step in the process of developing a project. When it comes to this process, the ability to make judgments and solve problems are both essential talents. Having this expertise is absolutely necessary when it comes to the process of developing consulting office initiatives. In order for a consulting firm to successfully handle projects, it is essential for the company to be able to carefully select the most appropriate options and rapidly find solutions to challenges. A comprehensive investigation, which was carried out with the assistance of AHP-TOPSIS, has demonstrated that these are not merely useful abilities; rather, they are essential prerequisites for achievement. Projects in the consulting industry are frequently difficult, client-oriented, and entail selecting the most appropriate strategy from among a wide range of options. What makes a consulting office effective and beneficial is its "capability" to make intelligent decisions that are driven by data and to find solutions to problems that were not anticipated.

Table 4.11: The Matrix Results of Consultant Leader Skills Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
F2 1	0.0046	0.099	0.076	0.403
F2 2	0.0369	0.02	0.157	0.216
F2 3	0.0415	0.024	0.166	0.144
F2 4	0.0623	0.016	0.098	0.273

Table 4.12: The AHP-TOPSIS Results of Consultant Leader Skills of Factors.

Si+	Si-	Pi	Rank
0.089	0.278	0.757	**1**
0.206	0.111	0.351	**3**
0.272	0.092	0.253	**4**
0.178	0.131	0.425	**2**

A maximum level of continuous production may be achieved with the help of an ideal workplace and excellent management. Rework, supplies, tools, heavy machinery, crew interference, quality control inspections, management interventions, and inspections are some of the factors.

Group 3

Respondents to the survey were open about the advantages of using project consultants in building projects, which clarified the need for these experts in Iraq's construction sector. The factors that made hiring project consultants attractive for the construction company are outlined in the following tables. As per the responses provided, project consultants can aid in accomplishing the goals of construction projects by taking on relevant responsibilities in the field. The results observed in Tables 4.13 to 4.15.

Table 4.13: The Questionnaire Results of Man Power Effect of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion	sum
F3 1	29	19	9	16	73
F3 2	25	19	21	8	73
F3 3	11	12	40	10	73
F3 4	21	21	17	14	73

The costs of overtime should be projected. imply that the work system technique is a collection of principles that can be used to the systems of any company for the aim of studying and improving such systems. This may be done from the perspective of the work system technique. Due to the fact that it indicates that productive businesses are forced to adhere to the same regulations, it is considered to be controversial. The idea of work system process involves both static and dynamic depictions of how a system develops over time as a result of modifications that are made intentionally as well as those that are made accidentally. The procedure of the work system incorporates these depictions into its workflow. The "work system framework," which is the foundation for the static perspective, is the beginning point for any study or interpretation of a work system. This framework serves as the basis for the static perspective.

Table 4.14: The Matrix Results of Man Power Effect of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
F3 1	0.054	0.056	0.053	0.335
F3 2	0.047	0.056	0.124	0.168
F3 3	0.021	0.035	0.236	0.21
F3 4	0.039	0.061	0.1	0.293

Table 4.15: The AHP-TOPSIS Results of Man Power Effect of Factors.

Si+	**Si-**	**Pi**	**Rank**
0.186	0.169	0.476	**3**
0.203	0.074	0.267	**4**
0.129	0.19	0.597	**1**
0.143	0.138	0.49	**2**

In the process of developing consulting office projects, this capability is essential. A maximum level of continuous production may be achieved with the help of an ideal workplace and excellent management. Rework, supplies, tools, heavy machinery, crew interference, quality control inspections, management interventions, and inspections are some of the factors.

Group 4

"Variation Costs" refers to the direct expenses and revenue losses that are justifiably incurred as a result of or associated with a variation. These costs may include extra expenses related to design, construction, manufacturing, commissioning, decommissioning, Through Life Support, or financing. "Cost variance" describes the difference between project expenses that were actually incurred and those that were anticipated. If the variance is positive, it means the project stays inside the allocated budget; if it is negative, it means the opposite as shown in Tables 4.16 to 4.18.

Table 4.16: The Questionnaire Results of Planning and Scheduling of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion	sum
F4 1	31	31	9	2	73
F4 2	11	34	21	7	73
F4 3	23	5	21	24	73
F4 4	33	20	16	4	73

"Cost variance" refers to the difference between actual project spending and the pre-project budget. For this calculation, the difference between the planned cost of work done (BCWP) and the actual cost of work finished (ACWP) is used. The study determined that the owner's financial difficulties, the difficulty of establishing a consistent design across different districts, design errors and omissions, the contractor's pursuit of profitability, and the lack of an appropriate site prior to the design phase of the construction project were the main causes of variation orders. The creation of standard designs for different districts and the owner's

financial restrictions are the most common owner-related grounds for change orders; inadequate staff expertise and difficult access to the project site are the least common.

Table 4.17: The Matrix Results of Planning and Scheduling of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
F4 1	0.044	0.06	0.095	0.036
F4 2	0.016	0.065	0.221	0.127
F4 3	0.033	0.01	0.221	0.436
F4 4	0.047	0.038	0.169	0.073

Table 4.18: The AHP-TOPSIS Results of Planning and Scheduling of Factors.

Si+	**Si-**	**Pi**	**Rank**
0.42	0.05	0.106	4
0.309	0.168	0.353	2
0.058	0.419	0.878	1
0.369	0.087	0.191	3

The most common reasons of variation orders are conflicts in contract agreements and inadequate coordination between contract parties, whereas consultant-related concerns include time constraints during the design process and design flaws and omissions. The two most typical variation orders pertaining to contractors are those pertaining to intended profitability and substantial changes to the bill of quantities; the less frequent ones, on the other hand, have to do with the contractor withdrawing from design and, if relevant, asking to be compensated for low price.

Group 5

In this group**,** cash flow is the entrance and outflow of money related to a construction project over a given time period. When running a construction company or project, it is essential. The careful management of a construction project's financial resources is essential to its sustainability and profitability.

The movement of money into or out of a business is referred to as cash flow. When a project brings in money, its cash flow is positive. Exiting the project with funds results in negative cash flow. Adding the time element yields the flow velocity. Cash flows as presented in Tables 4.19 to 4.21 are used by project and business managers to track income and expenses.

Table 4.19: The Questionnaire Results of the Finance of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion	sum
F5 1	4	32	33	4	73
F5 2	29	21	20	3	73
F5 3	7	32	31	3	73
F5 4	5	35	31	2	73

Project cash flow may be seen as the owner's payment plan for the project's completion over a certain amount of time. It is a part of the long-term financial strategy of an organization or enterprise. When assessing a project's appropriateness, organizations often use the term "relevant cash flow" to indicate the financial evaluation of the endeavor. Before moving further, top management of the organization must assess the project's benefits and cash flow and provide their approval. An examination of the project's cash flow may not be as important when collaborating with outside suppliers or providers. If there were no agreements with other parties, there would be no need to spend any money. An examination of project cash flow is useful for allocating project resources, particularly when contractors are not present.

Table 4.20: The Numerical Matrix of the Finance of Factors.

	Project cost criterion	Project implementation quality criterion	Project completion time criterion	Project profit return criterion
F5 1	0.008	0.076	0.225	0.2585
F5 2	0.056	0.05	0.136	0.1939
F5 3	0.014	0.076	0.211	0.1939
F5 4	0.010	0.083	0.211	0.1293

Table 4.21: The AHP-TOPSIS Results of the Finance of Factors.

Si+	**Si-**	**Pi**	**Rank**
0.007	0.166	0.959	**1**
0.124	0.065	0.342	**4**
0.067	0.111	0.624	**2**
0.13	0.094	0.42	**3**

The goal of the inquiry was to clarify the role that project consultants play in the cash flow construction sector. Based on participants' assessments of the advantages of employing project consultants, we were able to collect precise data. An estimate of cash flow can be used to assess the operational and financial stability of a project. These estimates assist the availability of enough money and the early detection of potential financial dangers, providing as a strategic foundation for financial decision-making. These reports help with effective cash flow management, which is necessary to avoid underfunding or improper resource allocation throughout development.

4.3 OVERALL RANKING FACTORS

Analyzing the whole AHP-TOPSIS data for each responder element allowed us to analyze the consultant's effect on the success of the project. You can see all the results of the AHP-TOPSIS investigation in the figure. According to these rankings, the five criteria were considered very important in light of the project's potential impact.

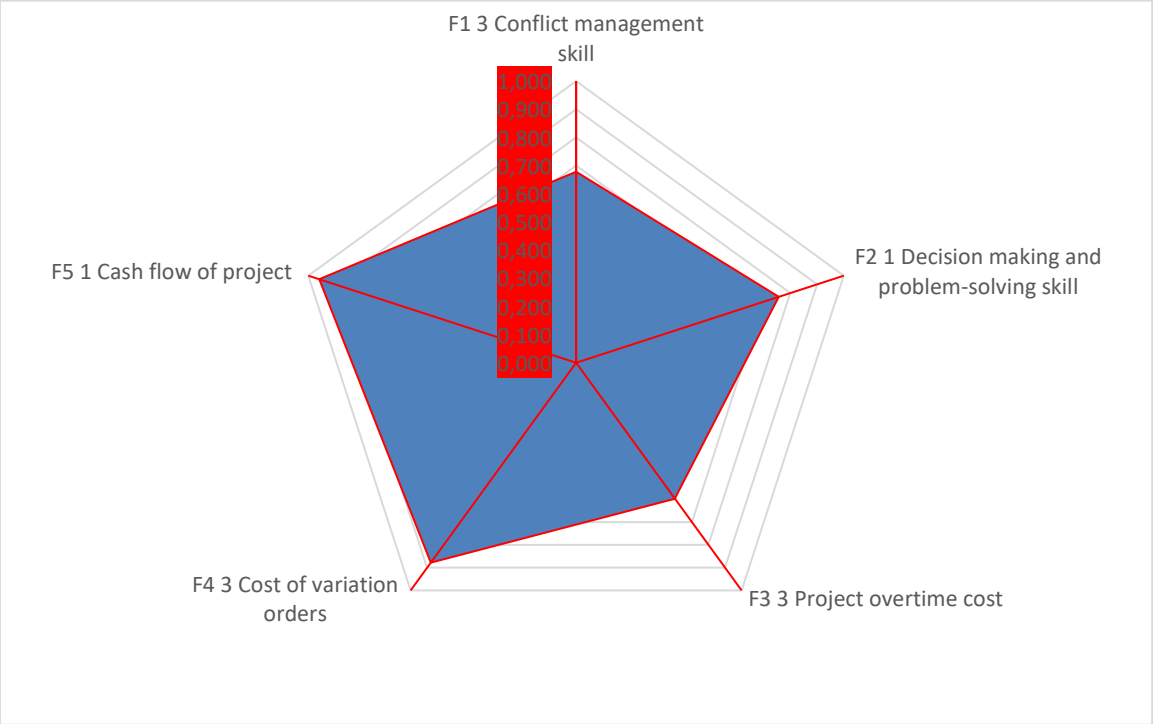

Figure 4.2: The Overall Effect of The Main Factors.

In the building sector, the services provided by project consultants are crucial. From the very beginning of a project all the way to its conclusion, consultants offer their specialized knowledge. The use of project consultants greatly enhances the efficiency and effectiveness of construction projects. Project consultants' efficacy and efficiency in connection to the final product quality in Iraqi construction projects is the primary focus of this research. This research made use of a dataset that was compiled from a variety of primary and secondary sources. Secondary data was gathered by conducting a thorough literature review of relevant books, journals, and articles in order to outline and clarify the primary ideas of this study.

5. CONCLUSION AND RECOMMENDATIONS

It is important to conduct a thorough evaluation and scrutiny of the variables that are causing delays in construction projects and consulting office operations. There are steps that can be taken to shorten the waiting time. From the perspective of factors management, analyzing delays offers a thorough basis for delay regulation. The aforementioned framework facilitates the process of element identification and prioritizing, analysis of crucial criteria, dissemination of information to reduce delays, and improvement of project operations. The AHP-TOPSIS methodology was utilized to identify and rank delays in the construction projects related to consulting office operations. The AHP-TOPSIS technique is used by a system management framework to analyze and minimize the frequency of discrepancies found by specialists. Quantitative risks have been efficiently identified and prioritized using the AHP-TOPSIS approach, while qualitative dangers have been handled through the application of the Ishikawa diagram. This structure serves as an example of how a factors management framework may help decision-makers in a building project that a consulting business is currently working on. The following strategies and techniques were used to accomplish this goal:

a. In order to determine the useful criteria and their influence on infrastructure projects, researchers used two surveys, expert opinion, interviews, and exploratory research from earlier investigations. It was determined that twenty different types of dangers might potentially impact the way consulting businesses and construction projects operate.

b. The AHP-TOPSIS factors rating program and Microsoft Excel software were used to assess factors. The program was chosen because of its user-friendliness and ability to provide results, and this marked the beginning of the AHP-TOPSIS model building process.

c. An Iraqi consulting firm's activities were used to assess the proposal and create a division according to environmental considerations.

d. The study's findings concerning construction sites, consulting firms, and seasoned foremen included the following:

   i. The ability to resolve conflicts

ii. Ability to reason and solve problems

iii. The project's extra costs

iv. Cost variation in four orders

v. The project's financial flow

Experts think that things worked out well, and things seem promising going forward.

5.1 RECOMMENDATIONS

To prevent project failures, uninspired and ineffective supervisors, poor paperwork, a lack of excitement, and unclear instructions, construction processes must be consistently supervised. To increase the productivity of construction workers, especially foremen, and to guarantee that the operations of Iraqi consulting offices in the construction sector are free from incompetence, training and continuous professional development for those in supervisory roles on construction sites must be sufficiently prioritized.

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