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**CONTROLLING QUALITY COSTS IN IRAQI
CONSTRUCTION PROJECTS USING BIM**

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Master's Thesis

Supervisor

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Amal Salman JAWAD

Signature



DEDICATION

To my creator, Allah, you are the reason for what I am, to my dear Father (God have mercy on him), and to my dear mother, who was the reason for all my success, to my university Altınbaş, and my supervisor, Dr. Sepanta Naimi, to My Sisters, my Brothers and friends.



ABSTRACT

CONTROLLING QUALITY COSTS IN IRAQI CONSTRUCTION PROJECTS USING BIM

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Through this study, the researcher knew the importance of using building information modelling techniques during the various stages of the project in construction projects. The research sample was carefully selected and directed towards companies interested in this field, especially after the great development in the use of this technology in engineering projects. The questionnaire targeted a group of contracting companies that were interested in developing their work system and shifting towards using building information modelling systems in their projects. 51 answers were obtained from companies in the public and private sectors, and the results were analysed using the SPSS statistical analysis program. Through the analysis of the results, it was found that the impact of the use of modern technologies has an important role in all phases of the project, especially the implementation phase of the project, as it gives a clear perception of all project activities. Controlling and managing them and avoiding errors and delays in projects such as delayed arrival of resources (materials and manpower) and delays in implementing project paragraphs according to the project schedule, which avoids companies falling into delay fines occurring in projects due to delayed implementation within the schedule prepared for the project.

Keywords: BIM, Time Management, Cost Management, Quality Management, Likert Scale.

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ABBREVIATIONS

APM : Association for Project Management

ASCE : American Society of Civil Engineers

SCL : Society of Construction Law

KB : Knowledge-Based

QMS : Quality Administration Framework

PMI : Project Management Institute



1. INTRODUCTION

1.1 INTRODUCTION

The construction sector is one of the most important sectors in Iraq through this research, the focus is on administrative issues related to construction projects in Iraq, where project managers face a problem in updating project data, which causes a weakness in the knowledge of the quality of performance [1].

As it is known that every project has a goal and a clear plan, so a plan must be developed and then follow-up on its implementation and evaluation of performance periodically and continuously.

In the reality of the projects that are implemented in Iraq, the quality of performance is not continuously monitored, and we need to develop performance and improve the quality of the implemented projects and control the time and cost management for each project. Therefore, we need to use modern techniques to control performance evaluation and improve quality through the use of modern technologies such as BIM [2].

1.2 PURPOSE OF STUDY

The purpose of this study is to examine the reality of evaluating the quality of implementation of construction projects in Iraq in the public and private sectors, in addition to knowing the extent of the role that project managers play in controlling the quality of the project being implemented, and then knowing the extent of the impact of the use of modern technologies such as building information modelling on controlling the quality of implementation.

1.3 SIGNIFICANCE, SCOPE AND DEFINITIONS

Spatial boundaries: Iraq- Baghdad.

In this study, the researcher used the questionnaire method as it includes questions within two parts that are distributed to know the opinions of the selected sample of experienced engineers in the field of construction projects. The questions were set depending on the reasons or factors that may lead to poor quality in Iraqi projects. An approved scientific

method based on the strategy of idea generation and problem solving to reach collective decisions that the individual person (the researcher) cannot reach alone. In order to obtain necessary data for the objectives assigned to the study the contribution of the test of the survey model and its hypotheses.

1.4 RESEARCH AIMS

- a. Getting rid of the usual traditional methods of knowing the quality of project implementation in Iraq, especially in the public sector, as government institutions have so far relied on traditional methods of quality control and the development of new methods that the review process from start to finish.
- b. focusing on training the staff working in the Quality Assurance Department with the latest methods used in this field.

1.5 RESEARCH PROBLEM

The research problem is that construction projects exceed the cost, the delay in time and the low quality.

1.6 RESEARCH HYPOTHESIS

Through the study, it can be concluded how true or false this hypothesis is:

The use of Building Information Modelling (BIM) systems reduces the cost of projects and enables them to be completed on time and with high quality.

1.7 RESEARCH METHODOLOGY

50 Questionnaire forms were provided to engineering specialists and engineering experts involved in the implementation and administration of construction projects in Iraq.

- a. Part I (general information): this part contains basic information about the responder.
- b. Part II quality execution control in Iraqi construction projects.
- c. Part III construction project management responsibilities.

- d. Part IV use of modern software as building information modelling to control the quality of implementation.as shown in Figure 1.1.

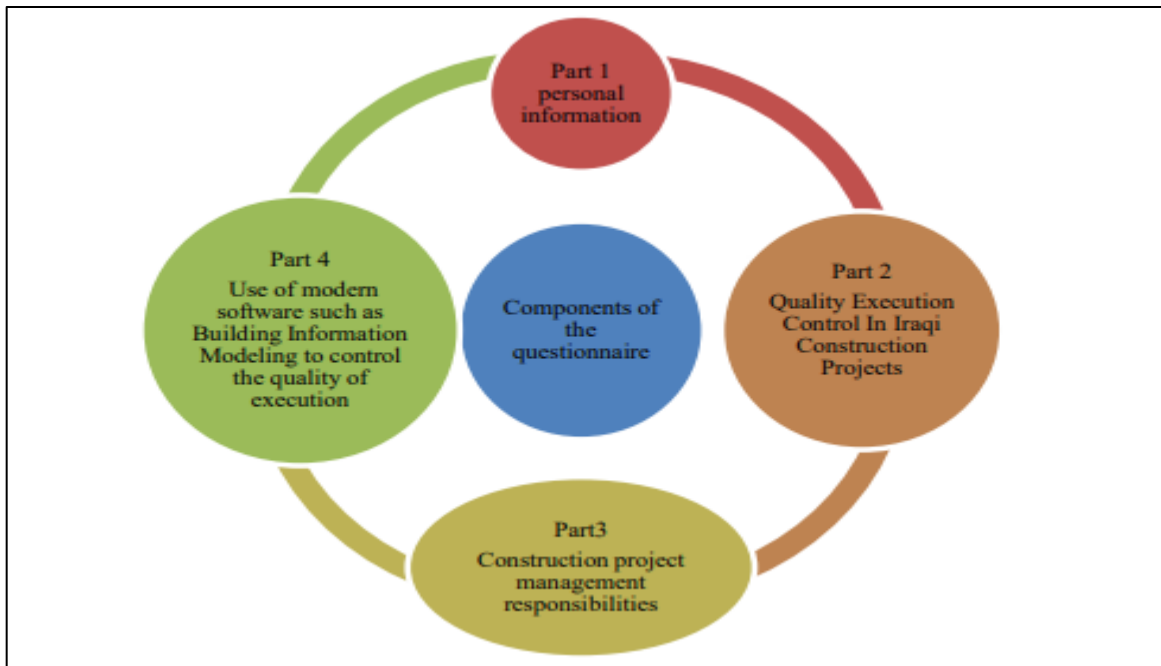


Figure 1.1: Components of the Questionnaire.

1.8 RESEARCH STRUCTURING

The research consists of four chapters:

- a. Contains the introduction, hypothesis and objectives of the study Its methodology,
- b. The second chapter It includes previous studies on the subject, the hypotheses used, and their usefulness.
- c. The third chapter It contains questions related to the questionnaire.
- d. The fourth chapter analyse the results of the questionnaire.
- e. Conclusion &Recommendations.

2. LITERATURE REVIEW

2.1 INTRODUCTION

Basically, quality is what differentiates the successful from the unsuccessful. Whenever a building project is conceived, it is always with the intention of attaining the greatest possible degree of validity for the work involved. To ensure that a project is finished according to the specifications laid forth in its Scope, it is crucial to analyze the current status of construction quality control and the process by which construction validity is verified [3]. There are several factors that might affect the timeline, scope, and budget of a construction project, all of which contribute to its overall quality. Building projects with a higher quality may save time and money for managers by reducing the need for redoing previous work [4].

Project managers in the construction industry are increasingly concerned about quality control and safety. If a building turns out to have major flaws or malfunctions, it might end up costing a lot of money. Reconstruction may be required, and the facility's ability to function may be hindered, even if just little. The outcome is a significant increase in cost and delays. In the worst-case scenario, accidents might lead to serious injuries or even death. Similarly, accidents occurring during building processes may lead to serious injuries and high monetary expenses. These rising direct expenses have a domino effect on related indirect expenses like insurance, inspection, and regulatory fees. The goal of any good construction project manager is to get the work done safely and efficiently from the get-go [5].

Design standards and building methods have changed quickly over the past hundred years. Researchers and engineers were able to design buildings that could handle more realistic loads after earthquake rules were put in place for structural design. Computer modeling of buildings lets planners see how the structure behaves under different loads. This makes it easier to understand and compare how the old building and the new building behave structurally [6].

Just as the most of financial control is exercised during the planning and design phases, the bulk of the choices that will affect the final product's quality are made then. These preparatory procedures determine the final configurations of components, their materials, and their functional performance. It is the responsibility of the quality manager on the job

site to ensure that all construction is carried out in accordance with the plans and specifications established at the outset [7].

While the majority of quality assurance efforts are focused on ensuring that outputs are in line with preexisting business choices, this is not always the case. First, reevaluation of design-related choices may be required along the course of construction due to unanticipated situations, incorrect design decisions, or adjustments needed with the assistance of an owner in the facility's condition of operation. Even while quality concerns may inspire such alterations, each time a design is altered, new goals and limits must be considered. In a second scenario, certain designs depend on competent and suitable decision making throughout the building process. Some tunneling methods, for instance, depend choices on the amount of shoring needed at various sites on observations made of soil conditions as part of the tunneling process. This is because the facility can make more informed judgments depending on the current status of the site [8].

The definition of quality criteria in the design and contract paperwork becomes crucial with the focus on conformity as the measure of quality throughout the construction activities. All stakeholders involved in the project should be able to easily grasp the quality standards and verify that they are being met. In the same way, choices taken before construction begins may have a significant impact on workplace safety on the job site. Although certain derivations or building goals are inherently challenging and risky, others, which are similar, might significantly lessen the chance of mishaps. The risk of accidents is reduced, for instance, when traffic is figuratively segregated from work zones during highway reconstruction. Besides from these design measures, education, monitoring, and collaboration among workers during construction are crucial for ensuring everyone's well-being. Employees should be aware of potential dangers at all times and refrain from taking needless risks on the job [9].

2.2 CONSTRUCTION PROJECT

According to the definition given through the project management institute (PMI), an endeavor has been a stretch attempt grasped to make a new thing, organization, or result. Each adventure must make either a new or a created release of a job, organization, or outcome. Each undertaking must have a particular degree of helplessness in the issue, utmost

quality, time, or cost. Else, it has not been an endeavor. The endeavor has an orchestrated beginning and end, along these lines, a definite life-cycle. It may be catapulted as needs be of one of the going with a proceeding:

- a. The endeavor's goals have been finished.
- b. The endeavor's budgetary arrangement (money just as time) has been wasted, without achieving the objectives, and it has been not potential or advantageous to raise it.
- c. The client demand to end the errand.
- d. Who can never again meet the endeavor's goals?
- e. There has been not, now, any need too the endeavor [10].

Various improvement adventures join a high degree, of dull tasks. Such errands fuse high-rise private and business structures, motels, dwelling homes, and system exercises such as avenues, railways, pipelines, and wharves. Line of Balance focuses on the repetitive parts inside such practices. Working from a vital creation yield, the technique calculates the creation rates and resources basic to satisfy adventure time imperatives. The resulting schedule has been commonly appeared in a graphical structure showing the handover time to the completed segments and the creation plan to the essential sub-segments. A structure adventure has been done therefore of a variety of numerous proceeding and interchanges, masterminded or off the cuff, over the life of a creation basic, with changing individuals and methodology in an eternity advancing condition [11].

The advancement of business has been immovably related to to monetary unforeseen development and living lifestyles. Building the officials, as one of the fundamental trains being developed structuring, clearly impacts nature's life and property security. As society makes, advancement broadens regularly create in scale, including vast numbers of of specialists, long life cycles, and complicated interfaces. The sorts and sums of of improvement-related information have gotten tremendous and complex, which has extended the multifaceted nature of of advancement exercises structures. Improvement broadens now require extraordinarily explicit data and experiential information. Standard operational techniques may not now be important to settling specific issues. The board had been made in like manner to these troubles, through empowering undertaking utilization and movement.

Since of, the obliged information scattered through overall endeavor the administrator's educators, the quick changes in the advancement business critically require engineers who can apply adventure the board systems, gadgets, and aptitudes in the work practice. Quick advances in the administrator's science have driven to improvement of adventure the board into a simple structure of data "Indelicato; 2009". From the start of its work, the board has progressed to secure businesses in the same way as national security requirements have been generated in partnerships between separate organizational operations before the life cycle of the board is finished. In building adventures, an improvement undertaking can be miserable down in wording of five guideline steps: credibility assessment, orchestrating, structure, advancement, and action. In like manner, each stage can be inspected as a lone endeavor, which implies a unique thing or organization has been made at each stage.

Convincing errand the officials has been essential in an endeavor arranged industry such turn of events. Perceiving profitable strategies has been indispensable to adventure accomplishment. to improve adventure results (for instance, execution, accomplishment, and satisfaction), The "Project Management Institute" (PMI) published a "Guide to the Project Management Body of Knowledge" (PMBOK Guide) in 2008 to standardize the recognition of general over the board knowledge, structures, methodology, devices, and abilities. The PMBOK Guide has the focal, benchmark practices which drive results of business to any system, recollecting those relationships for the business's advancement. Through applying these organization strategies, adventure chiefs and undertaking gatherings can bolster the chances of achievement over an extensive range of of adventures [12].

Starting late, the improvement business in China has encountered quick new development and perpetual expansion. Concurring to data of the China statistical yearbook, in 2016, improvement added to 6.7% of the country's full national yield, and there had been 83,017 advancement adventures, pondered to 12,585 30 years already. Inside a comparable thirty-year span, the gross yield regard of advancement had raised through numerous occasions, to extend 19,356.68 billion yuan; The continuous improvement of yield shows the Chinese improvement industry will remain amazing as time goes on. Taking everything into account, the flourishing of the improvement business has in like manner driven to absence of worry with deference to product creation and made it progressively problematic to control the quality of advancement adventures. Chen and Luo¹ raise some improvement firms give up

to the temptation of extended advantage through ignoring noteworthy points of view of quality organization, to model, through enlisting unfit authorities, and through bearing a defective affiliation structure and wrong organization. Subsequently, setbacks have gotten widespread in the Chinese advancement industry, animating broad group apprehension to model. A job stage decomposed on the 16 November 2016 awaiting upgrades — to a cooling tower in the area — to Fengcheng in JiangXi Province. Such events recognize, the individual prosperity of inhabitant has been at risk in China due to the low-quality of advancement broadens and should ring cautions to improvement firms, driving them to take incredible measures to give indications of progress adventure quality. This raises the issue as to which administrator should be tended to to progress the quality of expands and decrease the number and likelihood of advancement scene, with explicit reference to the preparation of deftly chain quality organization. The low-quality organization has been reflected in the internal system just as has been altogether dynamically evident in supplier and subcontractor officials. Unacceptable materials or natural subcontractors have achieved most incidents being developed. Beyond question, material suppliers and subcontractors accept critical occupations in the improvement outfit chain, and their assurance and the board have been head to, ensuring adventure quality. Agreeing on to accepted quality organization in the advancement outfit chain has been crucial considering the way that it has been fit to improve the work efficiency and agent's prosperity to an improvement association, so planning quality organization and smoothly chain will contribute colossally to empowering balanced advancement in the Chinese advancement work" [13].

Contractors can use unit prices to determine job prices. For this process to work, the worker needs to have a lot of knowledge. The unit price must include all of the prices listed above. The usual way to figure out how much something will cost is to add up all of the direct costs. This old method is correct, but it takes a long time, so new ways are still being tried out with the help of new mathematical tools that can speed up the process [14].

2.2.1 Managing Construction Projects

The project, the executives, has been the overall undertaking in the conveyance of a task. Numerous legitimate writings have been expounded on the hypothesis and practice of venture the board, and along these lines, this content will concentrate barely on the necessities of development ventures. The particular primary case to the past explanation

might be to perceive the three old-style measurements of a venture, in another importance, all activities include the three interlinking variables of time, cost, and quality. These have been represented in Figure 2.1. The relative significance of these elements will change from venture to model, another substation and related circuits to taking care of, state, an Olympic arena may have to be finished through a specific date, and along with these lines, time turns into the common element. By and by, of course, each of the three variables has to be monitored to an undertaking to be esteemed effective [15].

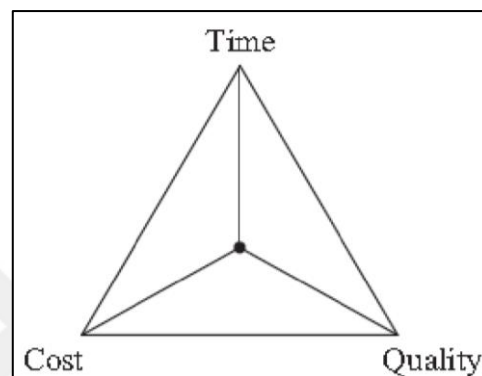


Figure 2.1: Time/Cost/Quality Triangle [15].

Concurring than the institute of project management has characterized venture the board as "the application of information, aptitudes, devices, and procedures to venture exercises to meet the undertaking prerequisites." It has characterized 47 tasks the executive's forms gathered into five classes [9]:

- a. It is initiating: This stage centres on beginning the venture. It targets characterizing the undertaking at an elevated level. The practicality and value of the undertaking has been not generally sure in this stage. As a result, an achievability study, which starts with a business case, might be essential. On the off chance that it has been chosen to begin building up the task, an undertaking sanction plots the reason and necessities of the venture ought to be figured out. The determination of the undertaking's specialized necessities have been not due in this stage, somewhat, it will be progressively formalized.
- b. Planning: This process involves the concept of "movements for the progress of the business," which requires a definition of the target "movements for the business." in this manner requiring distinguishing proof of the extension, costs, schedule, anticipated quality, and assets fundamental.

- c. Executing: In this stage of venture, the board has been carefully related to the advancement life cycle of the item. From the task, the board point of see, pending this stage, progress in the advancement of the undertaking has been spoken to through the discharge of the deliverable.
- d. Monitoring and controlling: Monitoring was related to the assessment of the risk movement when monitoring has been connected to the ID and implementation of the remedial practices when variations from the plans were tracked. Key success metrics can be used to assess if the mission has been monitored.
- e. Closing: This stage concerns the conclusion of the venture. The project manager, who has been the individual picked through the association to lead the task advancement group all together to accomplish the venture destinations, even though everything has a few exercises to perform, such as recording deliverables and outcomes, announcing the implementation of the undertaking and learning activities.
- f. With an expanding multifaceted structure, enormous construction projects (both regarding the development work and acquisition and authoritative structure) have been developed, the need to some normalization in plan configuration got expanding evident. It had been broadly remembered it had been unsuitable essentially to create plans for a specially appointed way and present various timetables with various levels of data. It was important to provide a structure in line with the level of the data given by the brief to model, the undertaking degree and goals, the venture schedule, and so on., and choices relating to the task of the executives and revealing prerequisites. The work breakdown structure, action distinguishing proof coding, action content coding, and action cost coding frameworks will impact the plan and structure of the timetable. Who must set up a reasonable structure to the calendars? The Chartered Institute of Building suggests five degrees of plan revealing. This number of of levels have been generally acknowledged as the favored number of revealing levels to a solitary venture [16].

Everybody overseeing, controlling, and working on development ventures have an obligation to guaranteeing the well-being and security of the laborers. All development work must continue under the present laws and enactment identifying with to wellbeing. In the United Kingdom, the accompanying enactment has been especially significant:

- a. The Health and Safety at Work (Act 1974).
- b. The Management of Health and Safety at Work, Regulations 1999.
- c. The Construction (Design and Management), Regulations 2007.

The ability to recognize and manage the risks associated with the delivery of the project, as described by Johnson and MTR Corporation Limited (2008), has been fundamental to the efficient management of railroad construction projects. In support of the corporate risk the executive's process, MTRCL has developed a project risk management system to assist decrease venture risks. In the introductory section, we'll take a look at the framework for managing risks in a project and express our gratitude for the challenges and successes we encountered along the way.

2.2.2 Time Management and Quality on Construction Project

Restricted usability of the assets will affect the time, expense, and efficiency of production exercises. The improvement model of the necessary asset projects was developed, in which the trade-offs between the time of movement and the expense were understood [17]. Interval intervention has been permitted to improve utilization adaptability of available assets for the asset necessary venture planning [18]. Asset levelling and congruity of asset use in time and cost exchange off investigation had been examined utilizing least second calculation [19]. A period and cost exchange off improvement model with the chance of utilizing night and night work shifts while keeping up work rationale and asset accessibility requirements had been created to recognize ideal work move plans [20].

Most of the current time and cost trade off improvement models gauge action length and cost-based on verifiable records and designing judgment accepting fixed asset use plans and development techniques. In a specific practice, all things considered, unpredicted factors such as climate conditions, spontaneous changes in the plan, and variety in showcase request increment the test of evaluating movement length and cost correctly [21]. Multi-target improvement procedures have helped recognize a set of exchange offs between time, cost, and quality of ventures. Choosing the best undertaking plan among the acquired set of exchange offs has been a difficult assignment, mainly when the recognized exchange offs have been tremendous in number [22]. Strategies to explain TCQT models can by and large

be sorted into two first gatherings: Intended techniques: straight-line programming, complex programming, and branch estimation, and non-precise methods are used to calculate both heuristically and meta-heuristically [23]. Special techniques have been productive and can ensure the distinguishing proof of ideal arrangement to single target models. All things considered, they have been constrained in managing multi-target issues and vulnerabilities. on the other hand, heuristic improvement techniques can be computationally effective, manage multi-target enhancement issues, and have greater adaptability in plan of scientific models. By the by, they do not ensure the optimality of the created arrangements, and the presentation has been usually issued subordinate. Heuristic calculations such as hereditary calculations, which have been utilized in this examination, have been productive in distinguishing the worldwide ideal arrangements in a moderately short computational time. A few studies have been done using tertiary formulas so that ideal exchange offs between market priorities can be recognized: cost, time, and efficiency [24] [25].

Notwithstanding the noteworthy commitment of the current research examines, they have been restricted in distinguishing ideal exchange offs among the undertaking goals of time, cost, and quality. Existing models don't break down shortening venture span by expanding working hours while thinking about specialist effectiveness and extra time costs. Existing examinations have been additionally restricted in considering venture quality while limiting time and cost to building ventures. This exploration paper centers around on tending to the confinements of the current investigations in distinguishing the exchange offs among the significant undertaking goals of time, cost, and quality. It ought to be noticed the current investigation embraces a quantitative research technique that centers around on building up the scientific model and assessing it based on numeric information [24]. Not at all like subjective research work, quantitative research strategies bring about the advancement of models that can be utilized through chiefs to create precise and solid outcomes explicitly to subordinate issue situations. Besides, who can lead the quantitative research technique quicker and more affordable? It permits correlation of model outcomes from one issue to another, and effectively replication through different scientists [26].

2.2.3 Time Management of Construction Project

The following definition of "time the executives" is, "time the board has been the technique of documenting and managing time spent through personnel in the task" [27]. This

explanation explains why "time management" is such an important aspect of construction project management. For a more comprehensive explanation, consider Wideman's 1990 definition: "time the executives has been the capacity required to keep up fitting designation of time to the general lead of the undertaking through the progressive stages of its normal life-cycle, "in another significance, idea, development, execution, and completing," by means of the procedures of time arranging, time evaluating, time booking, and calendar control." In addition, the executive's approaches within a project team are particularly dependent on the timely and accurate implementation of such procedures. Over the past few years, businesses in the architecture, engineering, and construction industries around the world have faced new financial challenges due to the emergency in national economies and the bursting of a few critical property bubbles in the United States (USA), Ireland (Ireland), Spain (Spain), Eastern Europe (Spain), the Gulf of Mexico (Gulf of Mexico), China (China), and other countries. As a result of these challenges, many European Union businesses have altered their outlook. For example, the number of contracting opportunities available to them has decreased dramatically, and the number of businesses that can operate in national markets has grown, even as the European Union has expanded to include 27 countries. Since the available number of contractual positions has decreased, businesses have been compelled to cut expenses wherever possible. One common approach to save money has been to reduce the number of people doing the task, increase the workload for those who remain, and boost overall profitability. As of late, stresses in the design, engineering, and construction industries connected to a shrinking workforce have been easy to justify. The construction industry is notoriously unprofitable and is often seen as a traditionalist field that sticks to tried-and-true approaches to project management and research-and-development funding. A high degree of regional and national protectionism as well as a strong worker's guild influence have also become hallmarks of the industry. This development problem of poor efficiency has been around for a long time. According to data from the "United States Department of Labor Statistics," Figure 2.2 indicates that the development sector in the country has been shrinking at a regular rate of -0.6% from 1964 to 2003. At the same time, the development industry enjoys better payment terms than the manufacturing sector does, notwithstanding its deteriorating efficiency [28].

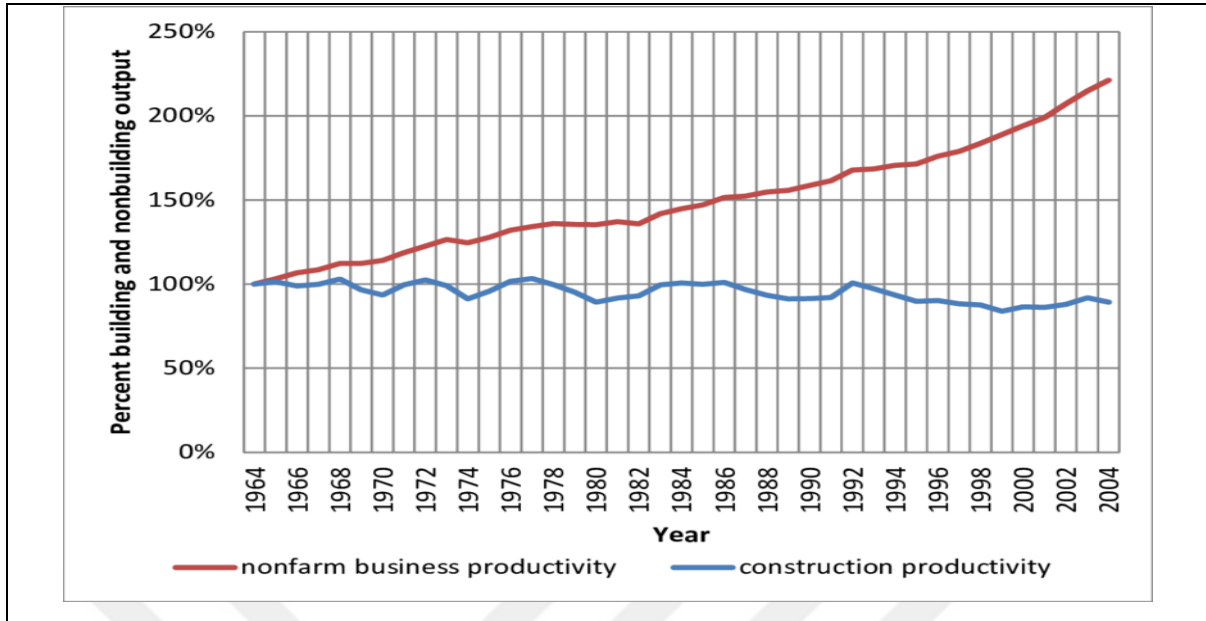


Figure 2.2: List of Shortcomings for the Production of All Non-Companies from 1964 to 2003
 “Sources; United State Department of Commerce & the Bureau of Labor Statistics”.

Considering such disappointing outcomes from the United States, the efficiency of construction was nevertheless higher than that of construction in several other nations [29]. The study reveals that productivity in the United States was 11 percent higher than in the United Kingdom and 6 percent greater than in Western Europe. Another study indicates that efficiency in building in the United Kingdom has increased relative to the United States, and the difference between them has decreased from 14 percent in 1990 to 5.5 percent in 2001. In any case, this distinction has been important for a very long time. Recent reports and hearings in the United Kingdom have focused on the problems of low productivity, wasted time, and massive delays in construction projects. Many authors, including CRINE (1994), Latham (1994), ACTIVE (1996), and Egan (1998), have advocated for future material cost reductions of up to 40%, as well as a considerable reduction in project duration and an improvement in the construction industry's competitiveness in the United Kingdom. Construction integration toolkits, as reported by construction; Excellence "2010" and the strategic forum, will save 35 percent of time, and construction excellence presentations have been more than 65 percent more beneficial than the industry average and have more than 40 percent improved natural performance compared to regular business. Improved environmental management results in fewer assets, less pollution, and lower expenses; higher productivity saves resources, time, and effort. At present, the strengthening of the

productivity and the time-performance of the board processes is essential to the culmination of the beneficial results of the programs and the lasting profitability of the construction enterprise as a corporate framework. Incorrect time management and poor efficiency have a detrimental impact on the state of the undertaking, particularly increased expenses, misfortunes of gain, and damage to notoriety. Powerful time the executives have been essentially significant to the development venture, and yet, the undertaking group should give suitable consideration to different targets of critical path method. The undertaking director has been a key figure in exchanging venture costs, timetables, and degrees. There is also a kind of trade-off that occurs between different businesses. Time cost, time security, and time quality trade off relationship will be carefully dealt with in light of the current workforce reduction and the implementation of focused methods of work and a sustainable time the board. Due to staff reductions, maintaining what little resources remain has become crucial to the success of the business. As a result of staff reductions, development organizations often have no choice but to go from time-bound asset planning to asset-bound asset booking. An organization runs the risk of incurring liquidation damages, late completion penalties, the loss of current and future contracts, and a hit to its reputation if it is unable to meet its deadlines because of insufficient resources being booked. Thus, it is important to keep an eye on quality and safety when efforts to reduce staff and increase efficiency are monitored.

Effective period, according to the study by Egan (1998), the board also strengthens the associated primary performance metrics, which had been developed by way of a UK working group – the KPIs.

Reproduced a powerful period in overseeing the danger of the delayed completion project, Also, they showed that the project administrator had the most remarkable rate in the writing and arrangement of meth-d interpretations and the organization of meetings. Most of the participants had their understanding if the agreement was subsequently structured after a debate and formulated method expressiveness, the length of the motion was calculated to some degree. The expense was distributed in separate contingency papers, date constraints were used to restrict the output of the dates given in the contract documents and flat constraints were used to manage the majority lean towards keeping the documents on the paper, however, had been promptly inserted into the database as the progress notes. Many

of them had the experience of allocating extra jobs relevant to labor. At the stage where the resource used was connected to the job undertaken and in which place, it was the experience of the majority of the respondents who accepted the company's preparations for both labor and plant and machinery data. The respondents preferred monitoring the success in reaching the correspondence and what had changed the timetables every month. To conclude, most of them have corrected the reasoning to emphasize to accomplish control of the results of arrangement practice [31].

Figure 2.3 recognizes a variety of indicators to the United Kingdom construction industry [30].

Egan (1998)	Construction Productivity Network (1998)	Construction Industry Board (1998)
Construction cost	People	Capital cost
Construction time	Processes	Construction time
Defect	Partners	Time predictability
Client satisfaction (product)	Product	Cost predictability
Client satisfaction(service)		Defect
Profitability		Safety
Productivity		Productivity
Safety		Turnover & profitability
Cost predictability(const.)		
Time predictability(const.)		Client satisfaction
Cost predictability(design)		
Time predictability(design)		

Figure 2.3: Industry Measurements Efficiency Metrics [30].

Announced deferrals had been now and again revealed as the reason of a few clashes influence the various gatherings engaged with development ventures. Task Time Management incorporates a number of arranging and controlling procedures suggested to

consenting to prerequisites related to venture time. The examination revealed in this paper planned for evaluating the utilization of of venture Time Management procedures and their connection with venture plan execution (in another importance., opportune fruition). Who had distinguished seven venture Time Management procedures and seventy-seven undertakings related to them from the writing has been universally important to venture the executives? The examination incorporated the evaluation of fourteen school development ventures executed through a crowd of people organization in the Yucatan Peninsula, Mexico. These tasks had been observed pending the development stage all together to measure two distinct factors: the utilization of forms related to to venture Time Management (in another importance., plan arranging and controlling procedures) and the undertaking plan execution. to each of these undertakings, the key variable was evaluated by a Usage Matrix, while the following one was estimated by the Schedule Performance Index and the Schedule Variance survey. The outcomes showed there had been measurable reliance between these two factors. Most of the ventures accomplished opportune finishing additionally made more prominent use of the undertaking Time Management forms” [32].

In several ways, claimed that the project deadline approaches the cataclysmic effects of the points and results of the enterprise. Likewise, they recommended to compute the base potential terms to each venture action and gauge the undertaking length security edge coefficient. Based on the wellbeing edge coefficient esteem, it has been proposed to characterize the fringe esteems to venture move from one status to another upon standards of its ideal finish probability. The proposed strategy can be suggested to use through development venture supervisors all together to forestall a potential disappointment of venture finish cutoff times. The framework demonstrating primary task time fluctuation empowers to to start the procedure of venture plan alteration before point of no arrival and herewith forestall venture disappointment. Who had executed the considered philosophy in the present-day venture, the board programming circle? [33].

There is a growing trend in the construction industry to prioritize project completion and commissioning. There are a variety of projects that stand out as ones where it was crucial to prevent a delay in reaching construction goals. For example, the Olympic Projects in Sochi needed to be completed and commissioned in time for the opening ceremonies of the 2018 Winter Olympics, and all of the football stadiums used for the 2018 FIFA World Cup were

finished on time. Late project commissioning not only reduces the efficacy of the project, but also increases the likelihood that the whole program it was a part of would fail. Thus, it has been essential to pay special attention not only to the compilation and optimization of the Construction project Schedule, but also to the development of an efficient system for monitoring, controlling, and managing the project, especially when working on crucial projects where missed deadlines are not tolerated.

In accordance with a generally accepted project management principle, efficient timetable control has been shown to be the secret to the successful execution of the program. Therefore, all main approaches of project management stress the importance of calendar preparation and data control activities. Project Monitoring, a regularly conducted method of gathering genuine information on success exercises, matching them with the arranged criteria, and including performance status notes on exercises. "De-Marco; 2011". "In the "Project Management Body of Knowledge; Guidance2013" of the Project Management Body, which has become the law for most project managers in the world, its principles lie in the premise of such modern applications as Microsoft Project, Oracle Primavera, Spider Project, Asta Power Project. Procedure 6.7 >> Control Schedule, which advises the use of Critical Path Tool, Critical Chain Method, Received Value Monitoring, and/or Pattern Analysis t-work success status reports, is included in the new revision five of PMBOK. The board was established within the execution of the project during the 1950s using two equivalent methods of practice. The Simple Route Approach was suggested by the administration of major projects in DuPont Plants modernization through the companies DuPont and Remington Rend [32]. From the outset to the end of the initiative, the premise of the approach was to define the longest length of the networks' assignments with respect to their relations. The errands are zero-time-saved in the basic way (basic undertakings) and all project deadlines have been changed as their period has been changed. However, this approach needs additional inquiries into the project schedule control. Program assessment and analysis strategies were carried out by Lockheed Corporation, the US Navy's consulting firm Bz, Allen, and Hamilton before the Polaris-Submarine missile system was developed. Basic Chain project Management (Critical Path Method) had been first portrayed «Critical Chain, » the method had been supported through specialists as it had been very close to old-style PERT's method. Program assessment and analysis strategies were carried out by Lockheed Corporation, the US Navy's consulting firm Bz, Allen, and Hamilton before the

Polaris-Submarine missile system was developed. Therefore, it has been observed that in projects where the cost of specific works makes little value of the cost of the project (for the model, basic way requires works on proposal approval on construction grant), predicting the overall length of the project will lead to the wrong result. However, in projects where the planned value of the fundamental works is comparable to the planned value of non-basic works, the strategy of earned value management will contribute to correlating the two. Specifics on when the planned activities will be completed and the impact of their outcomes are needed in the control point overview [35].

Among the most common issues in the construction industry is a delay in the completion of a project [36]. Two-eighths of the contractors who participated in this survey speculated that construction delays had been visiting, and 61 percent saw delays as really visiting, in a prior study conducted in the same precise place where what had transmitted the present assessment happened. Contrarily, just 11% provided evidence of their rarity. So, it seems to be rather usual for contractors to fall short to finish building projects on schedule in the context focused on this circumstance. Consequences of deferrals affect everyone and everything connected to the project. It's become abundantly clear to the owner that postponing the project's launch would prevent him from collecting the usual project revenue and will increase the associated financial expenditures. In addition, the owner may have certain complications because of the obligations that have been established based on the conveyance date specified in the contract (Marzuk, 2008). Nevertheless, if the project's execution time is extended, contractors will likely face cost overruns. These overruns may be attributable to a number of factors, including but not limited to: increased expenses for board personnel, material prices, financial costs, contract penalties, and so on [37]. Furthermore, contractors fail to deliver due to the inherent competitiveness of the construction industry. To finish projects on schedule may find it difficult to get new contracts and repair their damaged reputation. The construction team may devote less time to quality control if meeting the project's deadline is their first priority, therefore any delays in meeting that deadline may have an impact on the final product. When this is the case, employees are often pressured to work around the clock in an effort to increase productivity, even if doing so means experiencing frequent setbacks and reworks. Delays in developing nations until the development of crowd resources, such schools, might cause societal harm due to the fact that this kind of structure is usually desperately needed. Hence, the sooner these projects are

finished, the closer we will be to meeting the societal demands in these nations. Construction firms should follow proper project management procedures to prevent the aforementioned problems. The successful completion of building projects is due in large part to the procedures established by the board. Executive oversight of a project entails a number of planning and monitoring procedures that must be implemented to meet the needs of the project's owners in terms of its timeliness, affordability, and quality (CIB, 2002). The project board has developed into an expert system that maps out the fundamental methodology necessary to carry out each project. Since the skills of project managers and executives have evolved through time, a small number of organizations in various parts of the globe have established guidelines for using this method. To date, the Association for Project Management (APM) has released the sixth version of its own Project Management Body of Knowledge (PMBOK) Handbook, while the Project Management Institute (PMI) has released five iterations of its own PMBOK. The approach for maximizing project efficiency may be attributed, in part, to the widespread adoption of best practices developed during the project's executive phase, which is now standardized [35]. Project Management Body of Knowledge. This data set includes processes including task definition, activity sequencing, activity capital estimation, activity period estimation, schedule creation, and schedule management [36].

Additionally, expressed that the development business, especially in Malaysia, battles in accomplishing the status of prominent time the executives to development venture. Venture directors have an incredible duty to hold the task accomplishment under time of venture culmination. By the by contemplates show delays, particularly in the Malaysian development industry still uncertain due to to shortcoming in dealing with the undertaking. Also, quality of time the board on development ventures have been commonly poor. Due to the dynamically broadened defers issue, time execution turns into a significant subject to be investigated to research postpone factors. The strategy of this investigation has been a survey of writing towards issues in the development business which influencing time execution of the venture when all is said in done through centring towards process included to venture the executives. Based on on study, it had been discovered information, responsibility, participation had been the fundamental measures as a general to deal with the undertaking into a smooth procedure pending venture execution until fruition. It tends to be finished up the quality of the venture supervisor and colleagues in these primary rules while leading the

undertaking towards great time execution has been profoundly required. In any case, there has been a needed of foundation towards factors of poor time execution which firmly related to venture the board. Thus, this examination has been led to to build up factors of poor time execution and its relations with the investment the board [38].

Be that as it may, development has been confronting various issues, and one of them has been the time the board issues have caused postponed fruition of a venture [33]. Agreeing to, time the executives has been the procedure of recording and controlling time spent through staff on the venture[39]. The issues have been poor administration of time, decision of obtainment techniques, interest of investors, lack of foresight of development works, need of execution of programming, poor site records, and so on. Consequently, these issues can lead to to delays that have been guileful regularly, bringing about time invade, cost overwhelm, questions, suit, and complete relinquishment of ventures [40]. An examination led through the Chartered Industry of Building (CIOB, 2008) in 2008 has shown the quality of time-the board on development ventures has been commonly weak. The examination likewise indicates the development in preparing, training, and expertise levels inside the business in the utilization of time the executive's methods has not stayed up with the innovation accessible. Furthermore, there have been additionally not many ventures have been as of now oversaw through reference to present-day techniques of time control. [41] discovered deferral occurs in each development venture, and the extent of these postponements differ extensively from venture to venture. A few undertakings have been just a couple of days bogged down, and some have been postponed through longer than a year. Additionally, clashes in investors have been one of the elements of fruitless ventures [38]. Even so, large-scale building has added a lot of complexity because it involves so many different activities and jobs [42]. recognized various gatherings of development in Egyptian development ventures don't concur with one another on the significance of different variables of deferral, and they, for the most part, accusing each other of delays. He also discovers collaboration has been essential in the achievement of an undertaking. Liberatore et al. (2001) has referenced a high rate of the development respondents utilized venture the executives programming to general work arranging or introduction. Therefore, this has demonstrated the significance of use of venture the board programming in development works. Additionally, Scott and Assadi, (1999) had expressed more significant part of respondents didn't keep records of progress show each of the work exercises on the

temporary worker's modified, precisely when work occurred. The issues had been needed of a composed and formalized methodology, need of clear standards and rules on how the records have been kept and sorted out, challenges in guaranteeing the consistency of announcing through different capable people, freshness staffs and so on [38]. In this manner, the significance of venture control strategies in overseeing time to improve the hazard of deferred venture have been required to be known and perceive so the hazard of venture postponed can be limited.

Tells the executives a more detailed description of the time: Time Management was the ability needed to sustain the fitting assignment at the time of the general lead of the venture via the different phases of its distinctive life-cycle, (In a particular context, concept, change, implementation, and completion) Through the way of measures such as time-arrangement, time-assessment, time-planning and calendar management [43]." Project time, the executives need to make usage of apparatuses and agreements, both of which together provide a standard for controlling and forecasting venture work. Both individual and relegated assignments must be able to catch and oversee time while using the equipment in this procedure. Viable time on the board has been indispensably significant [44].

2.2.4 Quality in Construction Project

As a rule, the development industry acts as a catalyst for the economic growth of a nation. The company has often cited this concept as a key driver of future expansion. Government studies have gradually examined the company's dismal performance, focusing on its poor profitability, quality, and quality management systems. As a whole, the (ISO 9000) arrangement is a comprehensive structure that many construction firms use to ensure consistency and improved performance across all construction projects. This was achieved by establishing a framework for continuous improvement and providing the necessary guidelines for directing development businesses in establishing and maintaining a quality framework inside their organizations. This article examines the merits of implementing the International Organization for Standardization 9000 (ISO 9001) standard into development companies and the criteria used to assess the success of a project. Thirty administrators working for ISO-accredited development organizations were part of a written audit and postal poll assessment that yielded the following findings [44].

With so many different professions and organizations involved, the construction industry has a lot of challenges in delivering high-quality building projects. Analysis of the effectiveness of specialist-delivered care has been a common topic of inquiry. Some clients have been unconcerned about the impact of poor consulting management on the success of a construction project [45]. Mistaken structure, bad agreement organization, or sloppy customer agent management are all to blame for delays, cost overruns, redesigns, variants, claims, and subsequent discussions [46]. The innovative forms of development projects have also often not been standardized. Hence, ensuring quality has proven challenging. In this manner, some neighbourhood building specialists look for to lighten the quality issue through the creation of affirmation to (ISO 9000) compulsory to all temporary workers who have been offering to crowd area ventures.

Mistakes incited through a framework can be forestalled or at any rate limited through the usage of a quality administration framework (QMS). Among different QMSs, (ISO 9000) affirmation has been generally embraced through numerous nations' development business. to occasion, in Hong Kong, all advisors must have a guaranteed (ISO 9000)- based QMS before they can offer to crowd development ventures [47]. With the discharge of (ISO 9000):2000, an exceptional accentuation has been put on consumer loyalty and nonstop improvement (Murphy, 2002). 'Fulfilment' can be estimated by contrasting the distinction between what has been normal and what really got. Customers would fulfil with the exhibition of an advisor when the quality of administration gave surpasses or at any rate lives up to their desires. who must acknowledge ceaseless improvement whether specialists have known of their shortcomings or inadequacies and make comparing changes to fulfill the desires of their customers? (ISO 9000)- based QMSs have been accounted for to be capable to improve the administration quality of the firm. Hence, this will expand the customers' fulfilment, piece of the overall industry, income just as laborers' resolve. In any case, to what degree International Organization to Standardization (ISO)- confirmed contractual workers could fulfil customers' needs in development ventures have been as yet uncertain. There has still been a lot of objections revealed relating to the quality of conveyance. This article will introduce the exhibition of development ventures brought out through ISO-ensured contractual workers along these lines.

How to balance time, cost, and quality has been vital to development venture the board. Trade off streamlining among them has been noteworthy to the improvement of the general advantages of of development ventures.

2.3 FACTORS EFFECT QUALITY ON CONSTRUCTION:

2.3.1 Damaged and Low-Quality Materials

Validity issues in a building's structure may be severe if cement, steel, and wood aren't of high enough quality. Moreover, the materials' unpredictable reactions during construction pose a threat to worker safety. The risk of injury to employees increases when sparks fly or a building collapse owing to insufficient support. Be careful you abide by the standards set by trustworthy construction firms. Regularly have a quality control officer accompany one of your workers to double-check all incoming supplies. It's possible that only by completing all of these steps will a project that has been submitted appropriately be verified [48].

2.3.2 Supplier and Vendor Failures

Problems with vendors and suppliers might arise even if problems with the quality of the building materials themselves are not to blame. If this is the case, it might lead to lower levels of validity and higher costs. Substituting non-name brand construction materials that aren't up to par for a job might be a major hassle [49].

2.3.3 Failure to Document Changes and Even Practices

Some problems with quality can't be traced back to a single erroneous decision or resulting modification. To a large extent, it's because of this oversight that we don't have records of that specific change. Inadequate management from the maintenance team may occur from a failure to make final document adjustments if the element is already being submitted for another with a variant replacement cycle and maintenance. Construction project scheduling software may make it easier to keep tabs on and improve project documentation, eliminating any excuse for putting off necessary revisions to things like blueprints and other crucial files [50].

2.3.4 Uncontrolled Changes in Project Plan

Late in the building phase, when key aspects are still being thought about and designed, making significant changes might cause substantial quality issues. For instance, one of the overall projects may fail catastrophically because to a last-minute change in a particular design. Limiting the amount of time that may elapse before a design must be finalized is a crucial step in making sure that appropriate time is allotted for testing and verifying any modifications made to the original blueprints [51].

2.3.5 Complexity of Designs

Complexity in design increases the risk that good work may be overlooked. The intricacy of modern buildings, such as commercial construction projects, might give rise to these problems. The time, quality, cost, and safety targets of a project, as well as the condition of operations and simulations, may all be affected by complexity. Organizational structure, management structure, and the level of knowledge and experience that project managers need to succeed may all be impacted by the complexity of the undertaking at hand[52].

2.3.6 Non-Sufficient Project Management Software

Poor quality program for managing projects The stakeholders of a project could benefit from using a cloud-based project management system to figure out what the optimal testing intervals are for ensuring that the work done so far is free of mistakes and omissions. It might take an excessive amount of time before the necessary inspections on each task are carried out without a clear strategy followed by a system for quality control and assurance. More specialized software based on mobile apps is seen as a more efficient and adaptive approach to effectively managing construction projects[53].

2.4 TYPES OF BUILDING DELAYS

2.4.1 Excusable Delays

There are occasions when holdups can't be avoided. In most jurisdictions, delays attributable to causes outside the control of the property owner or residents hired to do repairs (such as inclement weather or issues specific to the locality) are considered acceptable. Poor planning and other difficulties like low quality work, broken machinery, and slacking subcontractors

are to blame for delays that cannot be justified. In conclusion, these holdups were avoided, but contractors did not need to make allowances for them[54].

2.4.2 Critical Delays

A critical delay is the most urgent kind of delay and has to be addressed immediately. In essence, if there is a considerable delay, the project may have to be halted and there may be little hope of completing the task in the allotted time. Delays, no matter what causes them, waste both time and money. The project manager will need to make adjustments to the project's handbook and budget if delays occur that weren't foreseen. A further risk assessment may need to be performed if management experiences a big delay in order to ensure that such unstable delays do not occur in the future[55].

2.4.3 Compensable Delays

A management or owner has an obligation to fairly pay contractors in the event of a compensable delay. Delays for which compensation is due, such as those caused by mistakes or owner-directed alterations, are often spelled out in the construction contract's beginning. Compensation for the causes of such delays is necessary to maintain a level playing field in contracts between the owner and construction firms. Some of these holdups may be debatable and amenable to compromise, but serious disagreements may be avoided in most cases if the terms of the original contract regarding holdups and compensation are established [56].

2.4.4 Concurrent Delays

Concurrent delays occur when two or more setbacks occur near together and have a negative effect on the projected completion date. Companies in the construction industry who have trouble managing a single delay may find that a cascade of similar issues is threatening the project's forward momentum and will need to be addressed more firmly in the future. While all delays are disruptive, certain wait times are more manageable than others. To solve construction issues as soon as they arise, knowing how one delay may affect others is crucial[57].

The hierarchy of the delays types were explained in Figure 2.4:

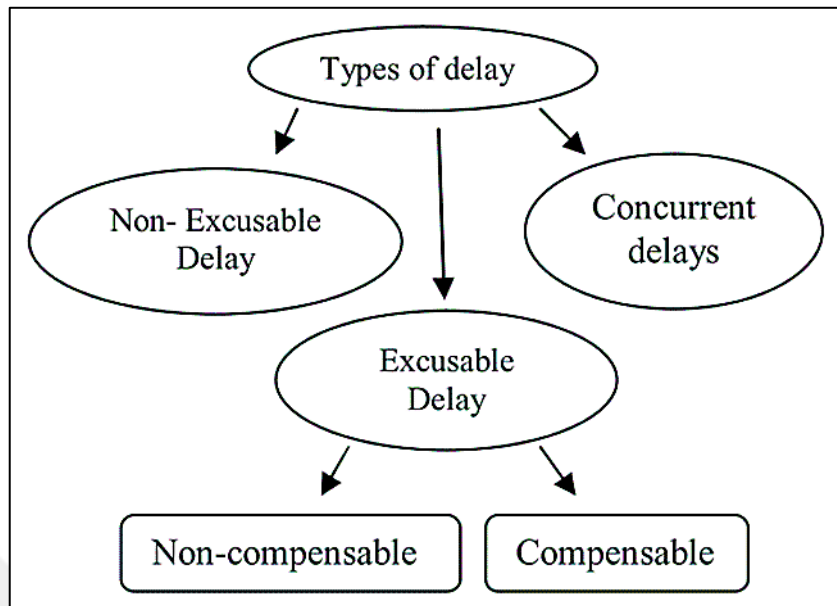


Figure 2.4: The Hierarchy of the Delays in Construction Project.

2.5 MINIMIZING CONSTRUCTION DELAYS

Jobs cannot be finished on time for a number of different reasons. Delays are the result of these kinds of problems. In the future, proficient project managers will be able to distinguish between the many types. When things on a construction site don't go as planned, delays develop. Sequencing in construction may lead to unanticipated outcomes. The contractor has to carefully plan ahead to minimize setbacks [58].

2.5.1 Digital Progress Reporting

Workers in the construction industry are stereotyped as spending large chunks of their days waiting for information, writing reports, and attending meetings. By digitizing performance reporting, however, relevant management teams may save time often spent in meetings or looking for updates across many technologies to compile a single report. If field workers are able to report progress on the project in real time, management can continue to be on the same page. As a result, the contractor can quickly and accurately report progress [59].

2.5.2 Improve Management Methods

Construction delays and eventual collapse are a direct result of poor management. Skilled managers can map out a building project from start to finish, making sure to account for all that has to be done. In order to meet deadlines, construction managers are in charge of delegating responsibilities, organizing staffing, and arranging for the delivery of necessary supplies. The best construction managers are those that can handle a wide variety of tasks within the framework of a comprehensive project plan, all while keeping the project on schedule and eliminating any obstacles to progress. Nothing is ever wasted in terms of time, effort, or money when a project is well-managed [60].

2.5.3 Planning Forward

When it comes to minimizing delays in a construction project, nothing is more important than having a detailed strategy. Construction projects benefit greatly from having a design that can be modified as work goes. To put it another way, it helps managers quickly evaluate urgent issues and fix them before they cause expensive delays. Many people in charge of initiating projects of all types rush into things without first establishing a firm schedule, completing the necessary drawings, or consulting with key subcontractors. Every component necessary to carry out the project should be accounted for in the design. The execution time should be calculated taking into consideration all the possible factors. Contingencies for unforeseen events and the establishment of figurative criteria for the company's response to setbacks are also essential components of a viable future plan [61].

2.6 STRATEGIES FOR EFFECTIVE TIME MANAGEMENT

The planning phase of a project is just as important as the construction phase, and both must be completed before daily operations can begin. The reason for this is that every hour of the day may be used to its full potential. Any number of manual but unforeseen problems might arise and force a change in plans.

2.6.1 Avoiding Distractions

As he or she must address several issues in a limited period of time, this is of paramount importance to the project manager and his team. They must focus on important work, though,

and cannot afford to be sidetracked by less pressing matters. A morning spent figuring out what has to be done first is a good start. Order your tasks by importance, starting with the ones that need to be done first [62].

2.6.2 Organizing Data

The cloud-based nature of building project management software facilitates collaborative work on a wide range of data types. Files may be neatly organized into subfolders that correspond to the selected categories, making it simple to find just the file you need. Facilitating the administration of project facilities, appliances, and equipment is also important for the busy crew members. The scheduling of employees may be handled by a wide variety of similar programs. Several of the most important processes in building, such connecting and communicating, may be sped up with the use of construction manual software [63] .

2.6.3 Take Notes

When a management team has a lot on its plate, it's easy for a job in the project control activity to fall between the cracks. Keeping track of what you've done might assist you recall what has to be done and when. Workers may use the construction project management software to log daily tasks and get timely alerts based on their statuses. Time spent reviewing the list may be saved by marking off completed tasks, and the resulting feeling of accomplishment may inspire the worker to perform a greater number of tasks with more care [64].

2.7 LITERATURE SURVEY

Almost every building project runs behind schedule. Potential causes of these holdups include sloppy design and planning, insufficient resources, and change orders. Concurrent delays are the most contentious kind of delay in building projects. Due to the lack of a standardized or agreed-upon definition, the existence of concurrent delays in a project is often shrouded in confusion. In addition, when problems emerge, there are several ideas on how long and how much they should take to fix. Consequently, this study's goal is to provide light on how Egyptian law views concurrency, and it will also conduct a thorough literature assessment of the generally recognized definitions of concurrent delays. This literature

explores the many ways in which Egyptian, English, and American law each define concurrency and its cure. Additionally, the literature includes how various internationally recognized protocols recommend the definition for concurrency and its reimbursement, such as the Association for the Advancement of Cost Engineering (AACE) 2011, the Society of Construction Law (SCL) 2017, and the American Society of Civil Engineers (ASCE) 2016. The literature also demonstrates how various contract standards, such as FIDIC 2017 and NEC3, recognize concurrency and its effects. The study then suggests an analytical model that can determine concurrency, output who is at fault for the delay and how much time should be given to the contractor, all without the user having to lift a finger. The user may choose from three globally recognized standards (i.e. AACE, SCL Protocol, and ASCE) that are included into the model. Because of its accessibility and versatility, MS Visual Basic was chosen as the programming language to create the model. Then, it was put through its paces using a variety of "what if" tests to establish its viability and identify its boundaries early on. Next, the outcome was verified by comparing it to the contractor's claim and the consultant's counterclaim, using data from the actual project. The model's accuracy was confirmed via checks and balances. As a result, this model has the potential to be a helpful resource for claim management, as it can be used to gather credible proof in the event of a concurrency and then apply the user's preferred method of concurrency analysis to the project [65] [66].

The construction sector is crucial to any nation's progress. When building materials and building projects are of high quality, the construction sector thrives. In Pakistan, quality is essential to the completion of any building project. The incorporation of quality management across the project life cycle has been shown to increase the success rate of construction projects. Quality management is essential throughout a project's life cycle, but it has the greatest impact on a building's ultimate product during the planning and building phases. As a result, this study stresses the importance of quality control throughout the building process. Findings from two large cities in Pakistan are presented, together with recommendations on how to proactively raise standards throughout the building process [67].

Project management frameworks detail the most effective ways to manage quality on a project, as well as the techniques and tools that may be used to do so. Despite this, issues related to poor quality are still prevalent throughout the building process. The purpose of

this research was to better equip researchers and project managers to deal with quality concerns by isolating the most important quality-related aspects in construction project management and establishing relationships between them. In order to find prior research on quality-related factors, a systematic literature review (SLR) was performed. The quality of the construction project as a whole is the outcome of the interplay between the quality of the individual phases of the project, the quality of the organizational processes that underpin the project, and the quality of the final outputs (products). The findings call attention to quality-related aspects that should be considered in future studies and in the planning and execution of construction projects (14 criteria connected to quality of processes, 6 to quality of an organization, and 13 to quality of products). Project managers, sponsors, and steering committees might benefit from considering them throughout the planning phase to assist prevent or mitigate quality issues. Also, new insights about quality are revealed by this research. The quality of procedures and quality of an organization was determined to be more important than quality of the end output. The study's findings were utilized as input for a structural equation modeling (SEM)-based null model for use in future studies of construction-related businesses [68].

This research focuses on quality since it is one of the most important factors for the prosperity of Pakistan's building industry. Life-cycle quality management was applied to a project and its impact on the validity of the structures was assessed. The research found that quality management throughout the design and construction phases resulted in considerably higher quality results for all types of construction projects, proving the importance of validity management across the whole construction life cycle[69]. Thus, the research places an emphasis on the many gains made possible by quality management throughout the planning and building stages. Efforts were taken to improve the quality of building projects throughout both the planning and construction stages in two major cities in Pakistan. As seen by the auditing findings, both consultants understand the importance of management validity throughout the planning and construction stages of a project, when it may have a direct impact on the final product's quality. A lack of quality in project conception and construction might affect funding for ongoing upkeep and repair [70].

BIM technology was talked about and defined in a number of ways. Also, the study found the most important and important parts of BIM technology from 1975, when it was first used,

to 2013. The results of a thorough study of the literature showed that BIM technology has gone through many changes, updates, and improvements that have helped make it better at handling small, medium, and large-scale building projects [71].

Today's businesses place a greater emphasis on refining the quality planning process as part of their quality management initiatives. Unfortunately, contractors in underdeveloped nations like Sri Lanka are still behind the times when it comes to implementing efficient quality planning. That's why we wanted to know, "how do Sri Lankan construction contractors handle quality planning?" The key goals of the research were to answer this issue and determine how prepared Sri Lankan construction contractors are to undertake strategic quality planning and how successful quality planning is among Sri Lankan construction contractors. In this study, we employed a qualitative research approach and focused on three case studies, which mirrored three prominent contractors in Sri Lanka. According to the research, ISO 9000 is the most often used quality management system among Sri Lankan building firms. Due to a number of obstacles, the contractors are not yet in a position to conduct strategic quality planning. Based on the results of this case study, various recommendations for contractors working in similar settings are made on the conditions necessary for the effective implementation of strategic quality planning [72].

Key quality variables in construction project processes in Bosnia and Herzegovina and Croatia were studied, and it was found that investors, contractors/subcontractors, and project managers/consultants/designers do not all accept these elements in the same way. There is a wide range of importance placed on the first four aspects, which are coordination of participants, communication, expertise/knowledge, and planning and control. The research has also shown that the weight given to certain quality indicators varies from one stage of a building project to the next and from one management perspective to the next [73].

Building information modeling (BIM) is one of the most important parts of the building business. The building industry has done a good job of helping 13 construction companies switch to technology based on BIM. The goal of this study 14 is to find out how building information modeling techniques are used in building projects. Because of how far this technology has come in its use in engineering projects, the study group was carefully picked and sent to companies that were interested in the subject. The evaluation was meant for a group of contracting firms that wanted to improve their work processes and change their

projects so they could use building information modeling technologies. The companies sent in 55 answers, which were looked at with the SPSS 19 statistical analysis program. After that, Navisworks was used to look at and test how the most important ideas were carried out [74].

Project completion on schedule and other important project milestones are the focus of this essay. If the project's deadline is missed, it might have disastrous effects on the intended consequences. This article addresses these pressing concerns by exploring a methodology for project schedule control that makes use of the Schedule Timeliness Index and the Schedule Progress Index, both of which serve to flag when extreme deviations from the projected duration of the project's targeted implementation have reached a critical value. In this paper, we propose estimating the project duration safety margin coefficient and determining the minimal allowable durations for each activity in the project. It is advised that the thresholds for changing the project's status based on the criteria of its timely completion be defined using the safety margin coefficient value. Construction project managers may benefit from the proposed approach, which has been shown to reduce the risk of missing delivery dates. Project failure may be avoided by adjusting the project timeline before the critical point is reached, as indicated by the system. This research technique has been applied to the world of cutting-edge project management applications [75].

Health care costs are rising at a worldwide snowball pace that is unsustainable. So, it is essential that healthcare facilities have a reliable quality management (QM) system. Such a solution will help healthcare administration improve efficiency and save costs. It will aid in reducing danger and improving patient security. Development of an electronic monitoring system and verification of the dedication of decision-makers at all levels are two of the many obstacles to healthcare QM in Oman. Oman's 2016 RQPS Report on Quality and Patient Safety criticized the country's dismal patient safety and quality culture. Implementing a clear organizational structure that is tailored to each healthcare provider's goals is strongly advised. To this end, it is crucial to establish a national certification system recognized on a global scale. This action will facilitate the prioritization of requirements and reduce the overall cost of system upkeep and improvement. This paper presents a unique approach of a hybrid knowledge-based (KB) system to evaluate quality management in the healthcare setting (QMHE) by means of a benchmarking tool that accounts for the lack of prerequisites

and a prioritization technique based on an analytical hierarchy. Each healthcare provider in the world may be evaluated in terms of their QM using the KB-QMHE model. At a tertiary hospital in Oman, the quality managers answered 852 questions, revealing a bad-points proportion of 32%. The KB-QMHE model has revealed that the patient-centered component of the healthcare quality dimensions submodule should be the first priority, at the introductory level. A prioritized action plan for the modules of healthcare governance, healthcare leadership, and healthcare organization resources was also proposed as an output [71].

Based on the CNKI database from 2002 to 2019, this paper does a complete study of how BIM is used in building engineering. Aiming to summarize the pros and cons of the current study, BIM shows great promise and the linked education is a fast-changing area in building engineering [76].

Claim and dispute avoidance in construction involves familiarity with the contractual provisions and the factors that give rise to claims. The purpose of this article is twofold: first, to determine what factors contributed to the delays of 130 public projects in Jordan, and second, to help construction managers set up acceptable review procedures before awarding contracts. This research looked at a wide range of construction projects, including homes, offices, administrative buildings, schools, hospitals, and even communication hubs. It was shown that designers, user changes, weather, site circumstances, late delivery, economic conditions, and increases in quantity are the most common reasons of delay in public project development. Having these issues present might delay or prevent a project from being finished by the deadlines specified in the contract. According to the results, professionals in the business may assist reduce the likelihood of contract disputes by paying close attention to the elements identified in this research [73].

a very intricate mechanism. Initially consisting of just a small number of nodes, local networks have expanded rapidly over the last several decades to become a vast, interconnected continental infrastructure. Changes in the economy, population, government, and technology all played roles in the expansion of these networks. This article examines the development of the French 400 kV power transmission network from its inception in 1960 to the year 2000. We investigate how the growth process is reflected in many topological features, such as the number of nodes, the number of lines, the average

connectedness of nodes, and the total length of wires. In order to determine what elements are related to the expansion of the power grid, we compare these findings with a number of economic and demographic indices. Topological efficiency and vulnerability metrics (clustering coefficient, information centrality, betweenness centrality) are also assessed over time. Cost, coverage area size, demand, fault tolerance, dependability, and quality of service are only a few examples of the various, sometimes conflicting, considerations that impact choices about the power grid's architecture. Our findings provide further information on the building of CI systems [60].

Inaccurate cost and time estimates, lack of teamwork, and other issues plague architectural projects carried out by the public sector in Iraq utilizing conventional techniques. Efforts to address these issues should learn from the practices of forward-thinking nations, such as the United Kingdom and the United States. Some nations have adopted innovative methods of building, such as Building Information Modelling, in step with technological progress (BIM). In this study, we compare and contrast the BIM regulations and policies of the United Kingdom with the United States. With the results of this comparison in hand, BIM standards in Iraq may be established with more certainty. This article compiled a list of commonalities that should be included into the BIM standard in Iraq, including methods of design, duties of designers, and elements of information management. These distinctions also highlight the country-by-country uniqueness of BIM implementation. The Iraqi BIM standard may take cues from the UK and US definitions, for example in how design data is structured, or it can take into account Iraqi particulars, such the country's own BIM library [77].

To finish a job on time and on budget, it is very important to keep track of building costs in the right way. Even when cost management is done well, which happens in a very small number of cases, there is almost always a significant amount of cost increase that can't be avoided. Because of this, it will be important to have access to thorough project projections and budgets in order to finish the project on time and without spending more than planned. In order to get ready, it's important to do early calculations and make preliminary plans. If the real costs of the project aren't kept track of and handled as they happen, it won't be possible to finish the work within the budget [78].

3. METHODOLOGY

This study used the results of a questionnaire to ascertain the extent to which the use of building information modelling has affected the execution of construction projects in Iraq. It is well known that many companies in Iraq have recently started to use modern techniques for project management and control on time, cost, and quality of production in construction projects.

3.1 RESEARCH DESIGN

This questionnaire's goal is to identify the construction tasks that are most essential to the project's success as a whole. Because the poll was designed with closed questions, respondents could only offer one response. A survey was sent to those people after new project management techniques were implemented in the public and private sectors, as well as engineering offices. We then arranged the information, looked over it, and reached our findings. The survey was sent out to managers, engineers, and contractors. The questionnaire's inquiries are grouped according to the various software and tool types used for building information modeling and the part they play in achieving project objectives throughout each stage of the project's lifecycle (from planning through closure and handover). Once the form was created, questions were written for each section so that the survey could be used to test the study's hypotheses and determine whether or not its objectives had been reached.

3.2 THE COMMUNITY OF THE STUDY COLLEGE

A study community is made up of a particular subset of people who have similar personality traits and other distinguishing characteristics. Project managers and civil engineers from the public and private sectors took part in this research., and engineering offices that have recently relied on using the best technologies to improve the quality of projects and implement projects within the time periods specified for each project were selected.

3.3 RESEARCH EXAMPLE

The researcher distributed questionnaires to as many pertinent experts as she could in order to gather the data for this study. Just a few examples are engineers, contractors, and other

industry workers. I spoke with engineers from a variety of engineering specialties, including civil, architectural, electrical, and mechanical, during in-depth interviews that I conducted at numerous construction sites and in the offices of private and public construction companies.

3.4 CRITERIA FOR EXCLUSION FROM THE QUESTIONNAIRE

We had to discard some of the forms in order to ensure the validity of the results because they contained inaccurate or missing information, were completed by engineers with insufficient experience, or were too distant from their intended area of specialization.

3.5 DESIGN OF THE QUESTIONNAIRE

The questionnaire's responses will be the primary source of information and data for the study. It was designed to assess the causal factors that have an effect on project quality management. This undertaking was completed in line with:

- a. Identify the key factors that could prevent the project's goals from being attained.
- b. Classifying the influencing variables in terms of their importance.

We were able to determine the relative weight of each category after settling on the number of inquiries to include in each of the four categories that make up the questionnaire. The entire process—starting with the initial stages of project conception and ending with its completion—was discussed.

Once the questionnaire is created, it is distributed to subject-matter specialists so that data can be gathered and analyzed with statistical software. The steps taken by the researcher to create the study instrument, review the literature, and read completed books on the subject of how organizational problems affect building projects.

Researchers avoided possibly offensive language and questions in an effort to honor the participants' literacy and cultural background. The questionnaire was modified for the study's intended audience and representative sample before it was translated into its final form in English. The location of the database for Iraqi study.

3.6 QUESTIONNAIRE QUESTIONS

The questions were divided into four main axes, which included the stages of project implementation, starting from the planning stage of the project until the closure of the project, according to what is shown below.

i. PROJECT START

- a. Project management monitors changes in initiatives using building information modeling methods.
- b. Creating a working group for building information modeling with the intention of hearing the project employees' opinions.
- c. The presence of a project team composed of people with experience in using contemporary technologies.
- d. Project management is keen to use contemporary technologies to define tasks and schedule financial resources for the project, which helps to manage the quality of costs in the project.
- e. For the feasibility study, the project management collects data from various stakeholders who make use of comparable systems.

ii. PROJECT PLANNING

- a. The project management is eager to use these techniques to create an efficient risk management strategy.
- b. When determining the project implementation schedule, the project management takes into account the environmental changes that have occurred and the use of modern technologies.
- c. Project management determines the start and end date for each project activity by preparing schedules in modern ways.
- d. The project management prepares the stages of the project within a specific timetable and simulates it using modern programs and technologies.

iii. PROJECT EXECUTED

- a. The project management conducts surprise checks to ensure the quality of the project work and compares it with the project bills of quantities prepared using building information modeling techniques.
- b. During the project execution process, the project management adheres to the practice of external monitoring.
- c. Project management is able to deal with unexpected emergencies for which a risk plan has been prepared in advance.
- d. The project activities are carried out in accordance with the timetable that was created beforehand.
- e. The project management is committed to using contemporary techniques and worldwide standards to raise the project's quality.

iv. PROJECT CLOSED

- a. By achieving success, the project management hopes to distinguish itself from its rivals.
- b. By implementing the most recent technologies, the project management aims to increase confidence with the project's beneficiary.
- c. The building information modeling team's and the project management's success is highly regarded.
- d. The project plan is compared to the work that has been completed, and the outcomes are determined and compared.

4. RESEARCH RESULTS

60 individuals were selected to answer the questionnaire. Nine of them were returned as incomplete, as the response rate is considered acceptable. Fifty-one surveys were successfully completed, and quantitative analysis confirmed their validity.

Responses were rated on a 5-point Likert scale from very weak to very strong according to how much they agreed with each assertion. The answers to forty surveys were satisfactorily provided, and descriptive statistics were used to assess the findings. A number value was assigned to each answer (1 for strongly agree, 2 for agree, 3 for somewhat agree, 4 for not agree, and 5 for not agree at all). Details on these statistical analyses are provided in the subsequent part.

4.1 EVALUATING THE DEPENDABILITY AND APPROPRIATENESS OF THE RESULTS.

Using the Cronbach's alpha scale to assess the reliability of the data, we evaluated the questionnaire's suitability for gathering the entered information. Cronbach's alpha score ranges from 0 to 1, with 1 being the most trustworthy result. Dependability and internal coherence are enhanced as this coefficient's value rises. Cronbach's alpha value was calculated and is shown in Table 4.1. It was determined to be 0.918. The scale is superb because these numbers are greater than 0.80. The parameter values thus show the high degree of reliability of the questionnaire.

Table 4.1: Information about Dependability.

Alpha scale	Items number
0.918	18

4.2 FREQUENCY ANALYSIS

4.2.1 Frequency Table

Table 4.2: A-1 Project Management Monitors Changes in Initiatives Using Building Information Modeling Methods.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	14	27.5	28.0	28.0
	WEAK	27	52.9	54.0	82.0
	AVERAGE	6	11.8	12.0	94.0
	STRONG	2	3.9	4.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.3: A-2 Creating a Working Group for Building Information Modeling with the Intention of Hearing the Project Employees' Opinions.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	13	25.5	26.0	26.0
	WEAK	20	39.2	40.0	66.0
	AVERAGE	11	21.6	22.0	88.0
	STRONG	2	3.9	4.0	92.0
	VERY STRONG	4	7.8	8.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.4: A-3 The Presence of a Project Team Composed of People with Experience in Using Contemporary Technologies.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	13	25.5	26.0	26.0
	WEAK	26	51.0	52.0	78.0
	AVERAGE	9	17.6	18.0	96.0
	VERY STRONG	2	3.9	4.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.5: A-4 Project Management is Keen to Use Contemporary Technologies to Define Tasks and Schedule Financial Resources for the Project, which Helps to Manage the Quality of Costs in the Project.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	12	23.5	24.0	24.0
	WEAK	30	58.8	60.0	84.0
	AVERAGE	6	11.8	12.0	96.0
	STRONG	2	3.9	4.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.6: A-5 For the Feasibility Study, the Project Management Collects Data from Various Stakeholders who Make Use of Comparable Systems.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	10	19.6	20.0	20.0
	WEAK	31	60.8	62.0	82.0
	AVERAGE	6	11.8	12.0	94.0
	STRONG	2	3.9	4.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.7: B-1 The Project Management is Eager to Use these Techniques to Create an Efficient Risk Management Strategy.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	19	37.3	38.0	38.0
	WEAK	19	37.3	38.0	76.0
	AVERAGE	8	15.7	16.0	92.0
	VERY STRONG	4	7.8	8.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.8: B-2 When Determining the Project Implementation Schedule, the Project Management Takes into Account the Environmental Changes that have Occurred and the Use of Modern Technologies.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	10	19.6	20.0	20.0
	WEAK	22	43.1	44.0	64.0
	AVERAGE	12	23.5	24.0	88.0
	STRONG	3	5.9	6.0	94.0
	VERY STRONG	3	5.9	6.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.9: B-3 Project Management Determines the Start and End Date for Each Project Activity by Preparing Schedules in Modern Ways.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	11	21.6	22.0	22.0
	WEAK	26	51.0	52.0	74.0
	AVERAGE	8	15.7	16.0	90.0
	STRONG	3	5.9	6.0	96.0
	VERY STRONG	2	3.9	4.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.10: B-4The Project Management Prepares the Stages of the Project within a Specific Timetable and Simulates it Using Modern Programs and Technologies’.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	15	29.4	30.0	30.0
	WEAK	26	51.0	52.0	82.0
	AVERAGE	5	9.8	10.0	92.0
	STRONG	3	5.9	6.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.11: C-1 The Project Management Conducts Surprise Checks to Ensure the Quality of the Project Work and Compares it with the Project Bills of Quantities Prepared Using Building Information Modelling Techniques.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	17	33.3	34.0	34.0
	WEAK	24	47.1	48.0	82.0
	AVERAGE	6	11.8	12.0	94.0
	STRONG	1	2.0	2.0	96.0
	VERY STRONG	2	3.9	4.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.12: C-2 During the Project Execution Process, the Project Management Adheres to the Practice of External Monitoring.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	14	27.5	28.0	28.0
	WEAK	20	39.2	40.0	68.0
	AVERAGE	10	19.6	20.0	88.0
	STRONG	2	3.9	4.0	92.0
	VERY STRONG	4	7.8	8.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.13: C-3 Project Management is Able to Deal with Unexpected Emergencies for which a Risk Plan has been Prepared in Advance.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	7	13.7	14.0	14.0
	WEAK	25	49.0	50.0	64.0
	AVERAGE	12	23.5	24.0	88.0
	STRONG	5	9.8	10.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.14: C-4 The Project Activities are Carried Out in Accordance with the Timetable that was Created Beforehand.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	13	25.5	26.0	26.0
	WEAK	24	47.1	48.0	74.0
	AVERAGE	7	13.7	14.0	88.0
	STRONG	5	9.8	10.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.15: C-5 The Project Management is Committed to Using Contemporary Techniques and Worldwide Standards to Raise the Project's Quality.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	11	21.6	22.0	22.0
	WEAK	26	51.0	52.0	74.0
	AVERAGE	13	25.5	26.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.16: D-1 By Achieving Success, the Project Management Hopes to Distinguish Itself from its Rivals.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	19	37.3	38.0	38.0
	WEAK	23	45.1	46.0	84.0
	AVERAGE	6	11.8	12.0	96.0
	STRONG	1	2.0	2.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.17: D-2 By Implementing the Most Recent Technologies, the Project Management Aims to Increase Confidence with the Project's Beneficiary.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	13	25.5	26.0	26.0
	WEAK	29	56.9	58.0	84.0
	AVERAGE	4	7.8	8.0	92.0
	STRONG	3	5.9	6.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.18: D-3 The Building Information Modeling Team's and the Project Management's Success is Highly Regarded.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	15	29.4	30.0	30.0
	WEAK	24	47.1	48.0	78.0
	AVERAGE	7	13.7	14.0	92.0
	STRONG	3	5.9	6.0	98.0
	VERY STRONG	1	2.0	2.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

Table 4.19: D-4 The Project Plan is Compared to the Work that has been Completed, and the Outcomes are Determined and Compared.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	VERY WEAK	13	25.5	26.0	26.0
	WEAK	17	33.3	34.0	60.0
	AVERAGE	12	23.5	24.0	84.0
	STRONG	4	7.8	8.0	92.0
	VERY STRONG	4	7.8	8.0	100.0
	Total	50	98.0	100.0	
Missing	System	1	2.0		
Total		51	100.0		

4.2.2 Bar Chart

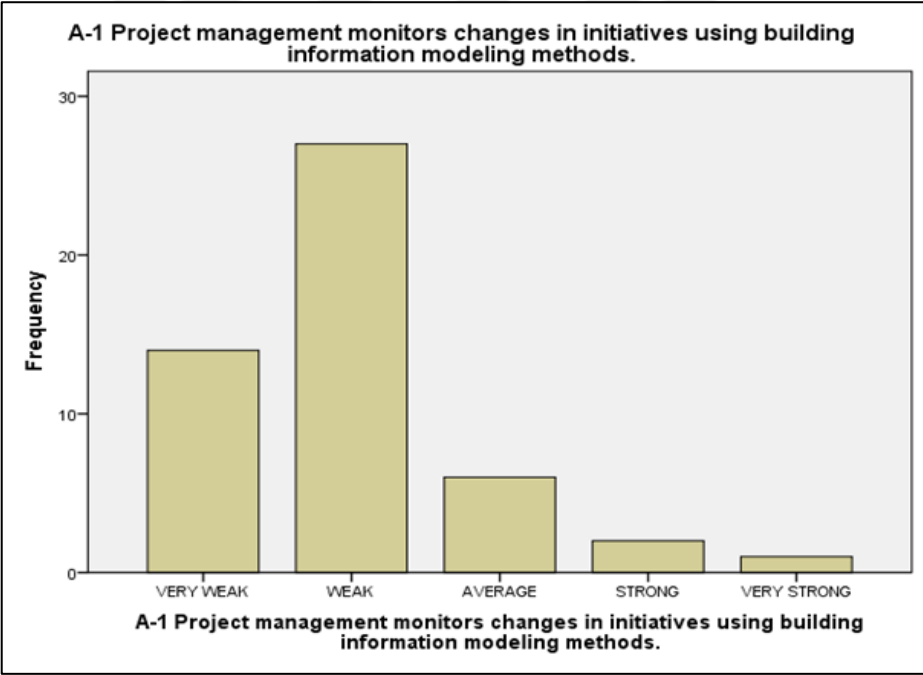


Figure 4.1: A-1 Project Management Monitors Changes in Initiatives Using Building Information Modelling Methods.

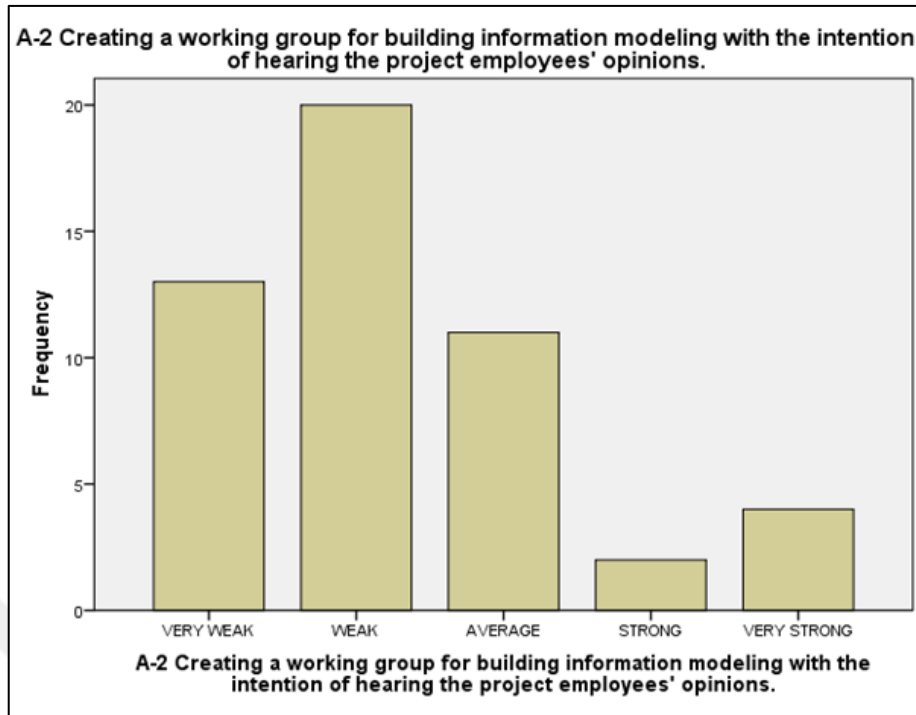


Figure 4.2: A-2 Creating a Working Group for Building Information Modelling with the Intention of Hearing the Project Employees' Opinions.



Figure 4.3: A-3The Presence of a Project Team Composed of People with Experience in Using Contemporary Technologies.

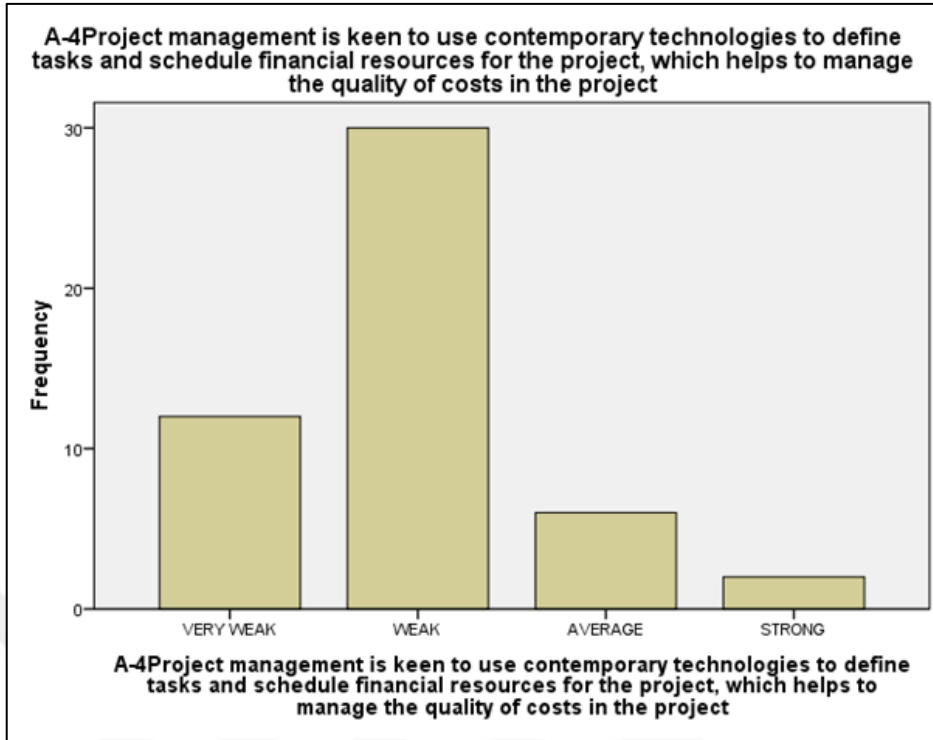


Figure 4.4: A-4 Project Management is Keen to Use Contemporary Technologies to Define Tasks and Schedule Financial Resources for the Project, which Helps to Manage the Quality of Costs in the Project.

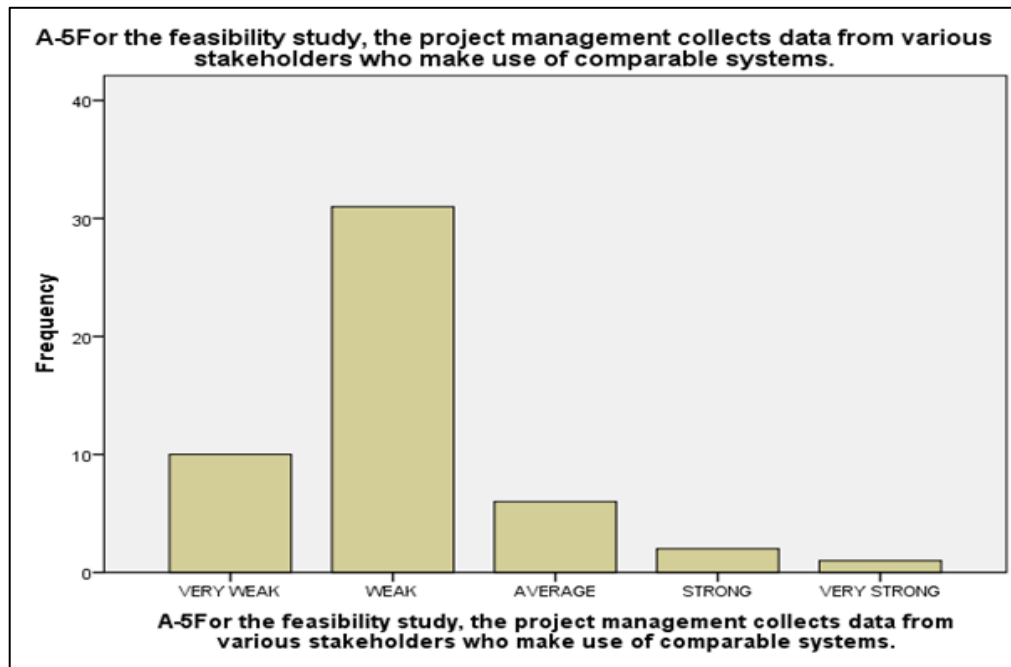


Figure 4.5: A-5 For the Feasibility Study, the Project Management Collects Data from Various Stakeholders who Make Use of Comparable Systems.

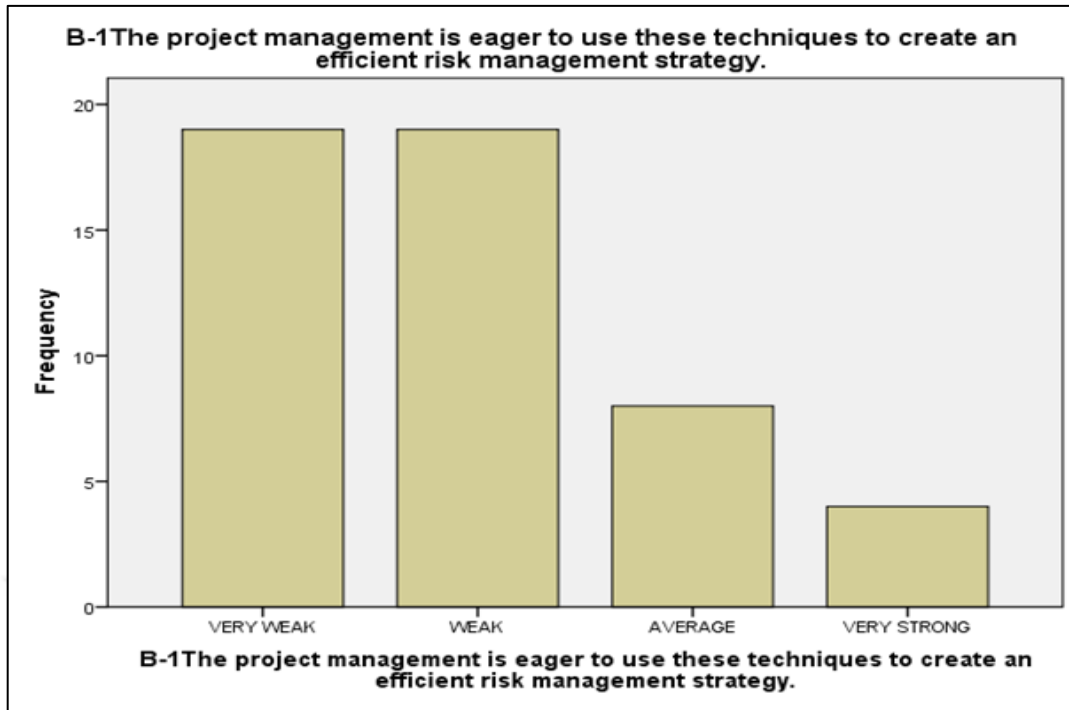


Figure 4.6: B-1 The project Management is Eager to Use these Techniques to Create an Efficient Risk Management Strategy.

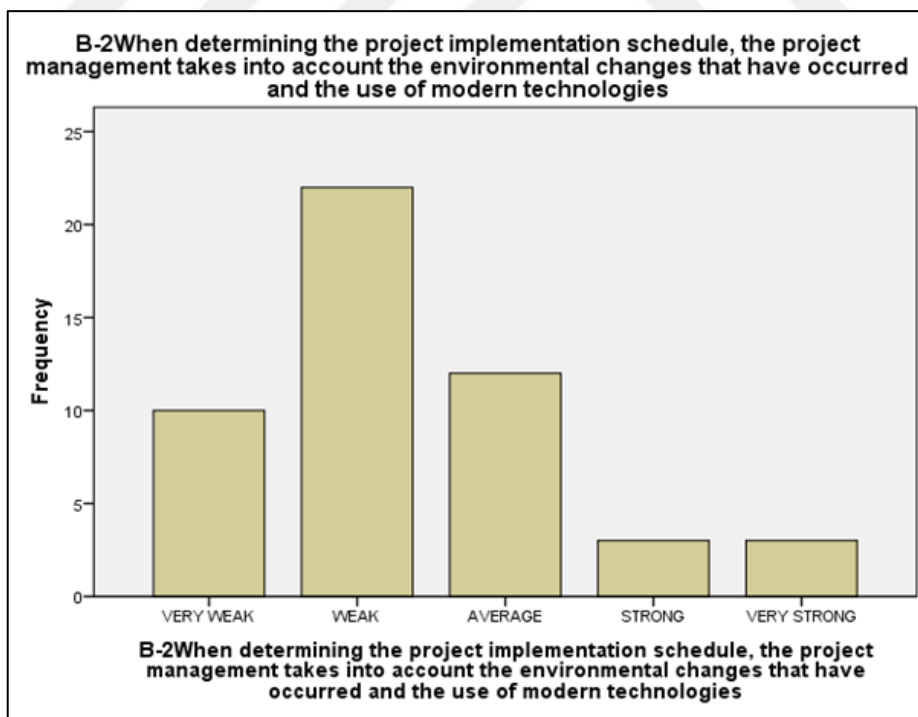


Figure 4.7: B-2 When Determining the Project Implementation Schedule, the Project Management Takes into Account the Environmental Changes that have Occurred and the Use of Modern Technologies.

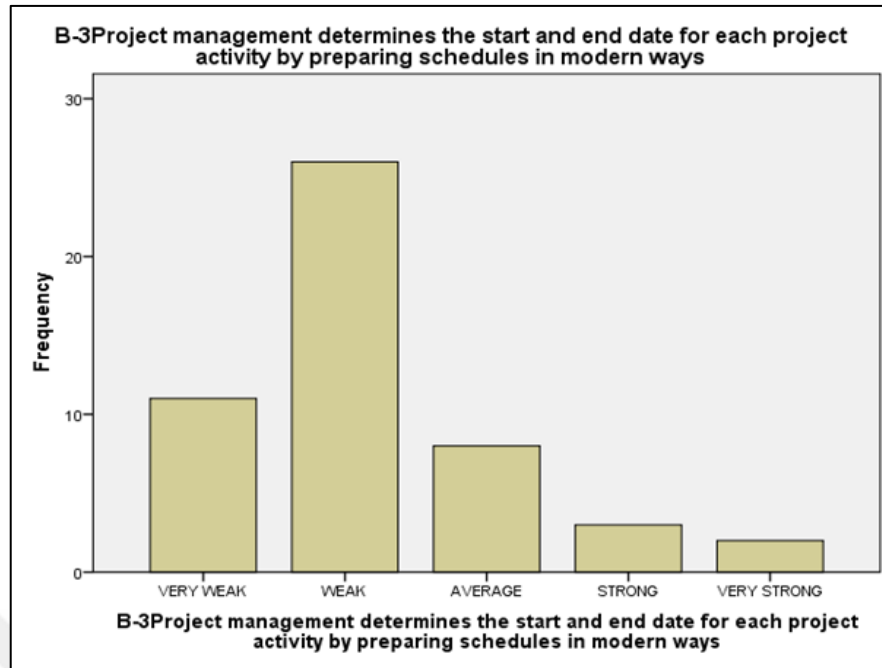


Figure 4.8: B-3 Project Management Determines the Start and End Date for Each Project Activity by Preparing Schedules in Modern Ways.

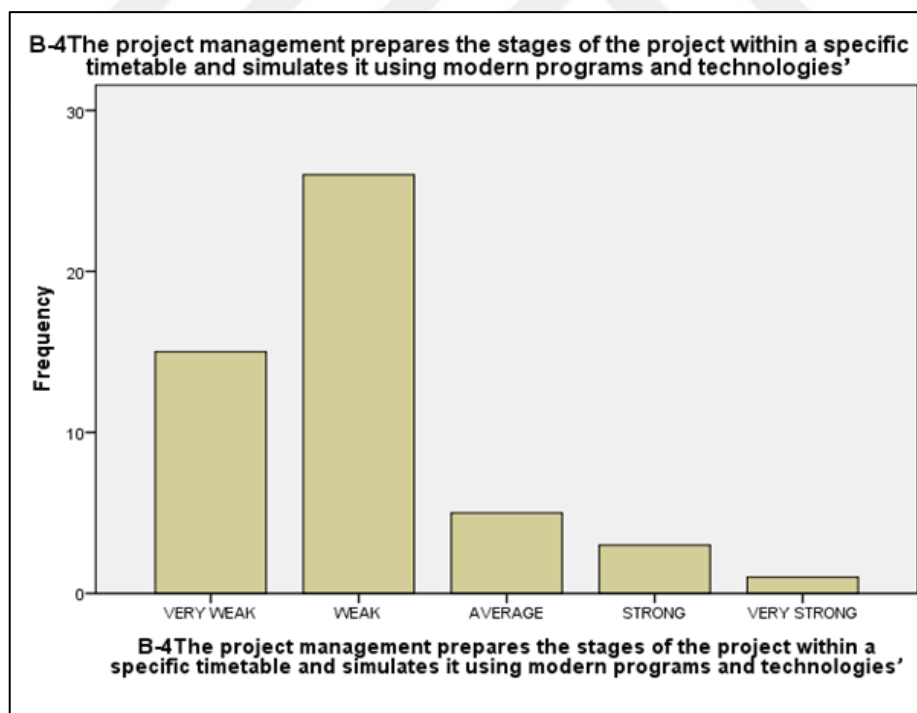


Figure 4.9: B-4 The Project Management Prepares the Stages of the Project within a Specific Timetable and Simulates it Using Modern Programs and Technologies’.

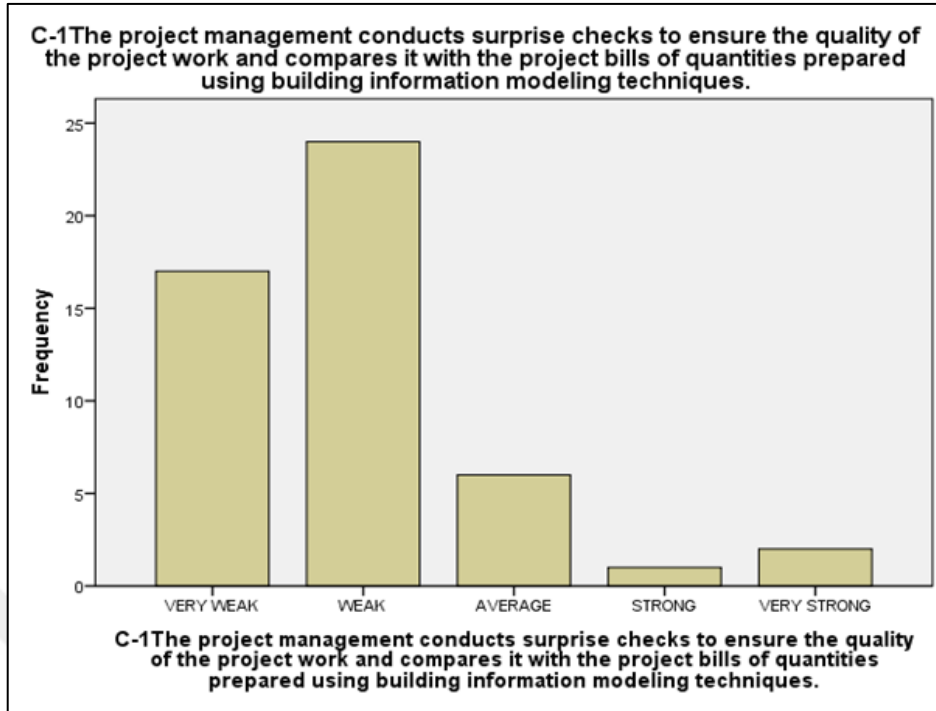


Figure 4.10: C-1 The Project Management Conducts Surprise Checks to Ensure the Quality of the Project Work and Compares it with the Project Bills of Quantities Prepared Using Building Information Modelling Techniques.

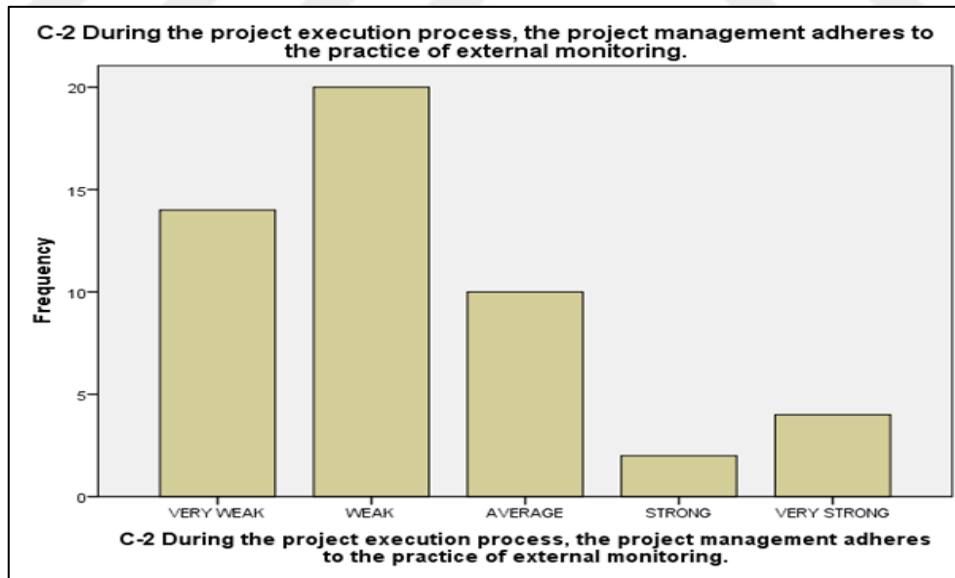


Figure 4.11: C-2 During the Project Execution process, the Project Management Adheres to the Practice of External Monitoring.

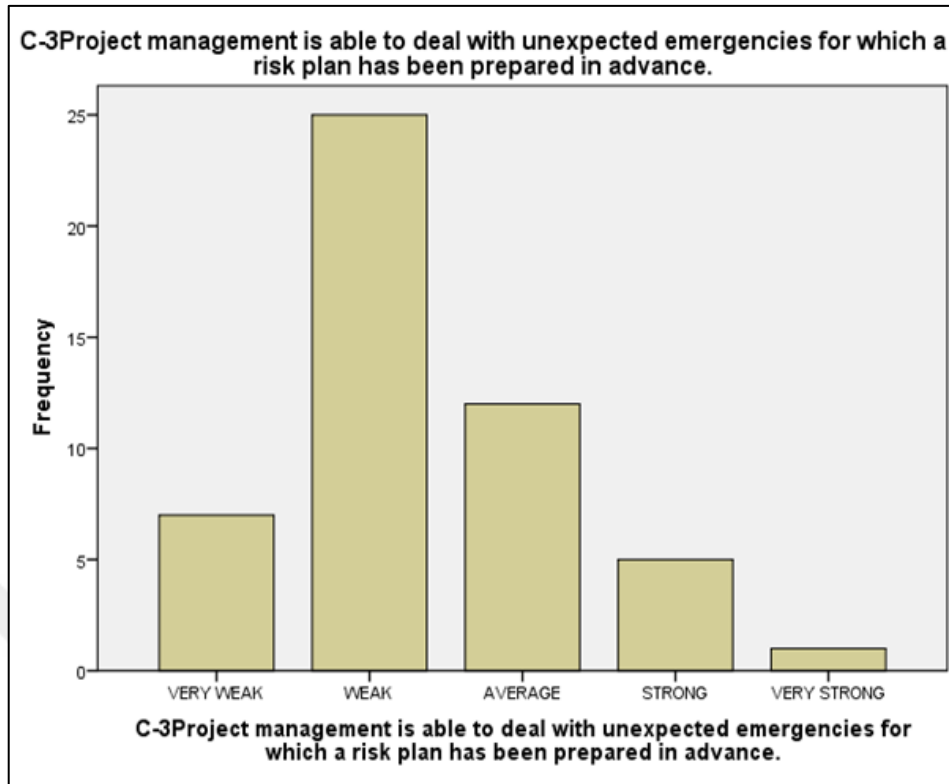


Figure 4.12: C-3Project Management is Able to Deal with Unexpected Emergencies for which a Risk Plan has been Prepared in Advance.

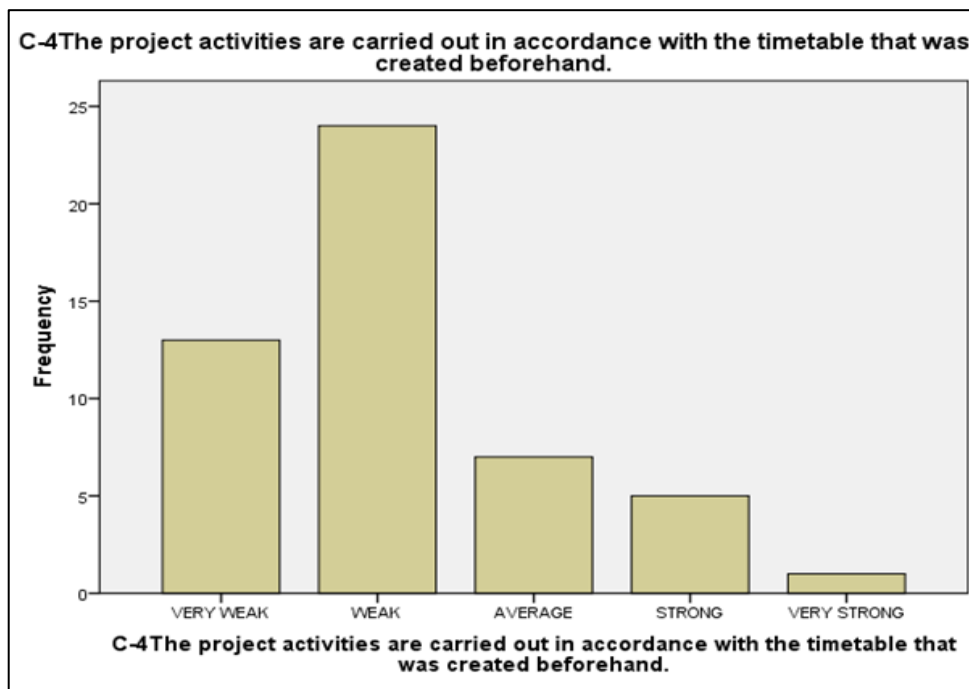


Figure 4.13: C-4The Project Activities are Carried Out in Accordance with the Timetable that was Created Beforehand.

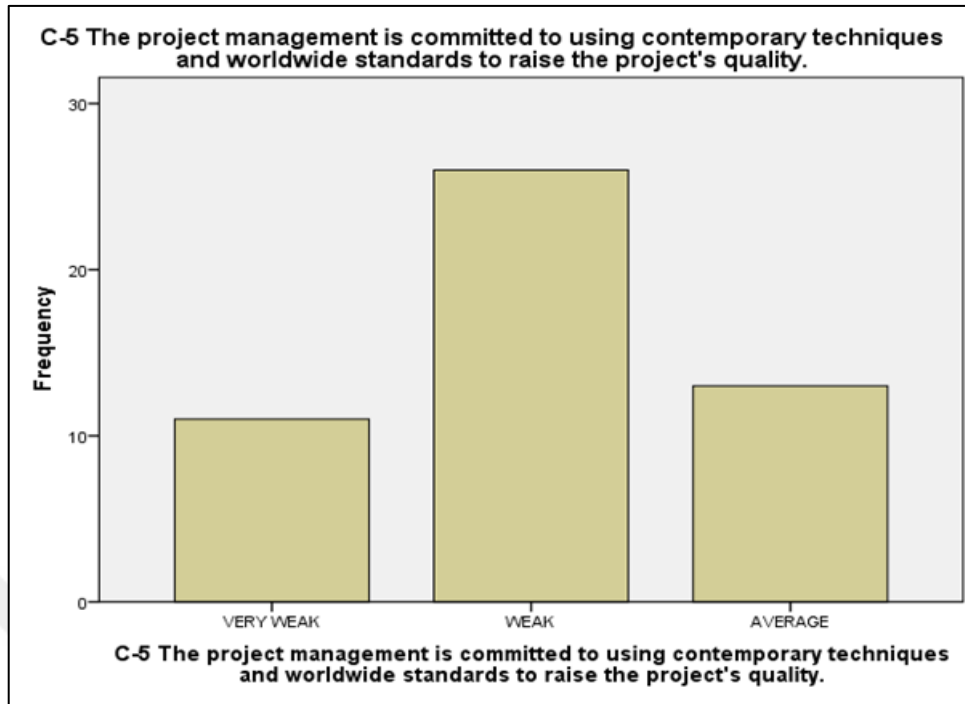


Figure 4.14: C-5 The Project Management is Committed to Using Contemporary Techniques and Worldwide Standards to Raise the Project's Quality.



Figure 4.15: D-1By Achieving Success, the Project Management Hopes to Distinguish Itself from its Rivals.

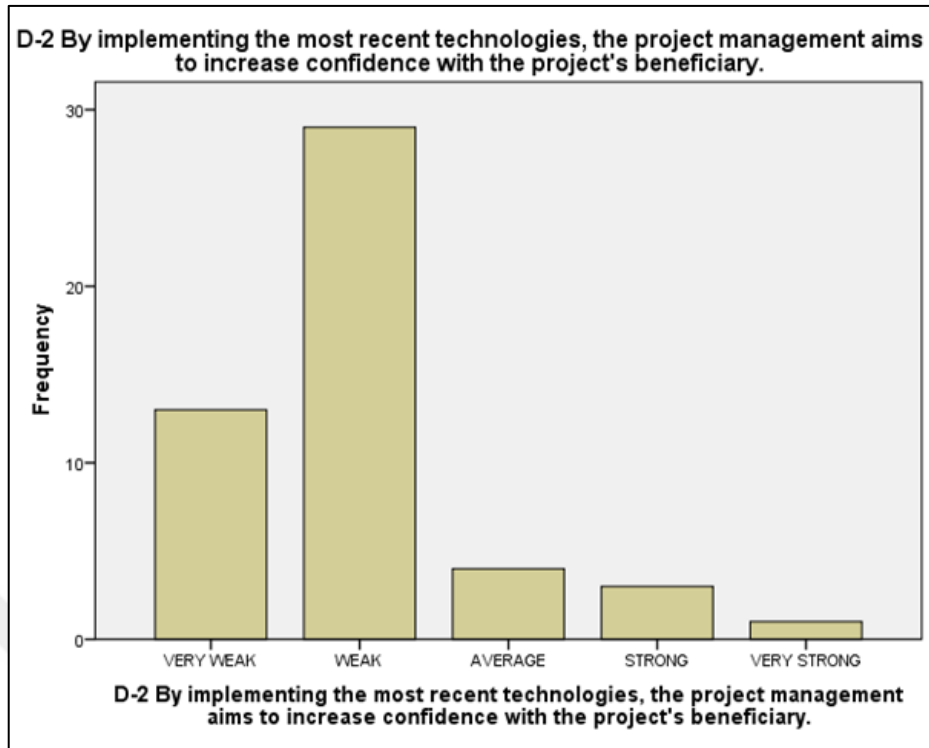


Figure 4.16: D-2 By Implementing the Most Recent Technologies, the Project Management Aims to Increase Confidence with the Project's Beneficiary.

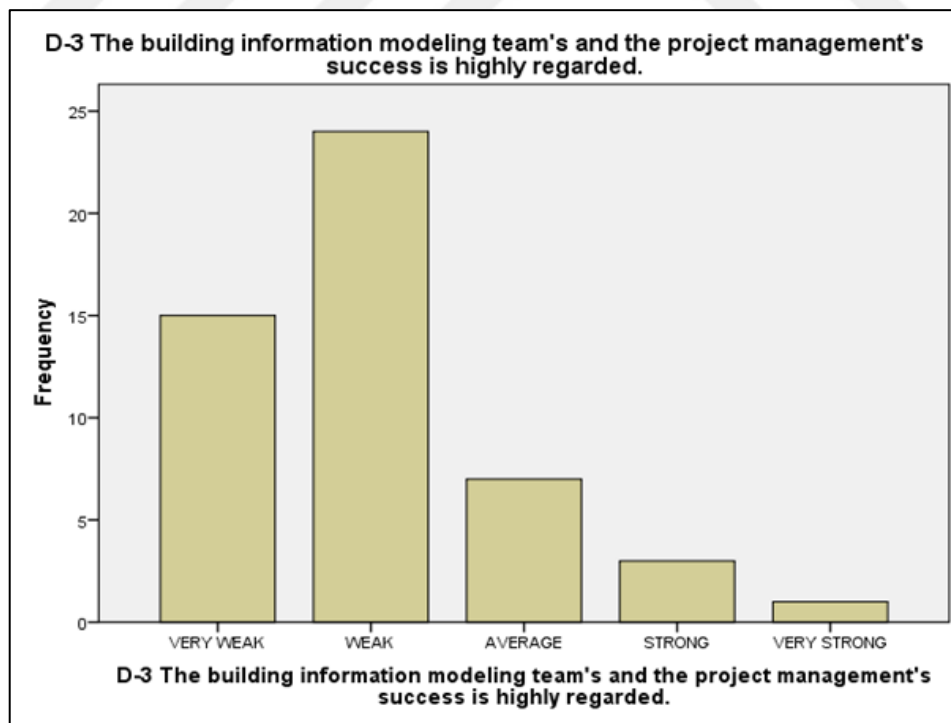


Figure 4.17: D-3 The Building Information Modelling Team's and the Project Management's Success is Highly Regarded.

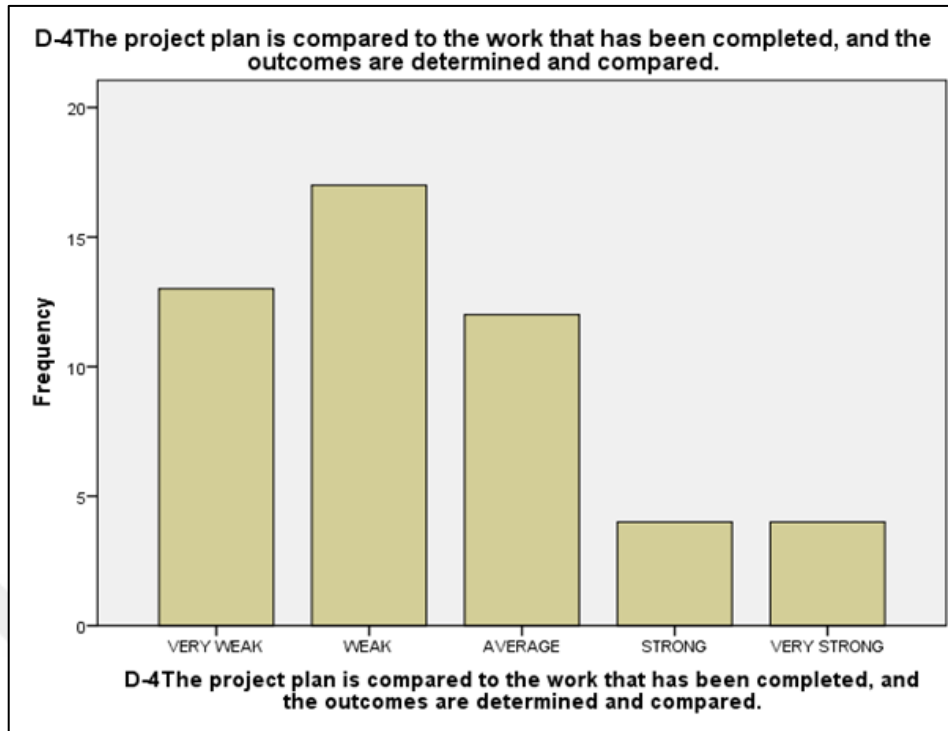


Figure 4.18: D-4 The Project Plan is Compared to the Work that has been Completed, and the Outcomes are Determined and Compared.

4.3 DESCRIPTIVE ANALYSIS

Each statement was assigned a 5-point (Likert scale) agreement/disagreement rating for the respondents. Completed questionnaires were assigned number values (1=strongly agree, 2=agree, 3=fair, 4=not agree, 5=not agree at all) and analyzed using descriptive statistics. The details of these statistical analyses are provided in the following part. Descriptive statistics were used to analyze the data. A Likert scale will be used to calculate the average number by showing the average of each category. The next section gives specifics of these statistical analyses.

According to the initial inputs and the accompanying table, the Likert scale was used to analyze the data:

Table 4.20: Likert Measure of Five Points.

Likert-scale description	Likert-scale	Likert scale interval
Strongly disagree	1	1.00 – 1.80
Disagree	2	1.81 – 2.60
Neutral/Uncertain	3	2.61 – 3.40
Agree	4	3.41 – 4.20
Strongly agree	5	4.21 – 5.00

The primary questionnaire has 11 variables that each identify a particular variable; Table shows the frequency of answers and their means (4.20).

Table 4.21: Descriptive Statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
A-1 Project management monitors changes in initiatives using building information modeling methods.	50	1	5	1.98	0.869
A-2 Creating a working group for building information modeling with the intention of hearing the project employees' opinions.	50	1	5	2.28	1.144
A-3The presence of a project team composed of people with experience in using contemporary technologies.	50	1	5	2.04	0.903
A-4Project management is keen to use contemporary technologies to define tasks and schedule financial resources for the project, which helps to manage the quality of costs in the project	50	1	4	1.96	0.727
A-5For the feasibility study, the project management collects data from various stakeholders who make use of comparable systems.	50	1	5	2.06	0.818
B-1The project management is eager to use these techniques to create an efficient risk management strategy.	50	1	5	2.02	1.134

Table 4.21: Descriptive Statistics “Table continued”.

	N	Minimum	Maximum	Mean	Std. Deviation
B-2When determining the project implementation schedule, the project management takes into account the environmental changes that have occurred and the use of modern technologies	50	1	5	2.34	1.062
B-3Project management determines the start and end date for each project activity by preparing schedules in modern ways	50	1	5	2.18	0.983
B-4The project management prepares the stages of the project within a specific timetable and simulates it using modern programs and technologies’	50	1	5	1.98	0.915
C-1The project management conducts surprise checks to ensure the quality of the project work and compares it with the project bills of quantities prepared using building information modeling techniques.	50	1	5	1.94	0.956
C-2 During the project execution process, the project management adheres to the practice of external monitoring.	50	1	5	2.24	1.153
C-3Project management is able to deal with unexpected emergencies for which a risk plan has been prepared in advance.	50	1	5	2.36	0.921

Table 4.21: Descriptive Statistics “Table continued”.

	N	Minimum	Maximum	Mean	Std. Deviation
C-4The project activities are carried out in accordance with the timetable that was created beforehand.	50	1	5	2.14	0.990
C-5 The project management is committed to using contemporary techniques and worldwide standards to raise the project's quality.	50	1	3	2.04	0.699
D-1By achieving success, the project management hopes to distinguish itself from its rivals.	50	1	5	1.84	0.866
D-2 By implementing the most recent technologies, the project management aims to increase confidence with the project's beneficiary.	50	1	5	2.00	0.881
D-3 The building information modeling team's and the project management's success is highly regarded.	50	1	5	2.02	0.937
D-4The project plan is compared to the work that has been completed, and the outcomes are determined and compared.	50	1	5	2.38	1.193
Valid N (listwise)	50				

5. CONCLUSION

During this research paper, an opinion poll was conducted on the possibility of using building information modelling systems in construction projects and its role in improving the reality of project implementation in Iraq and knowing the extent of its impact on the quality of project cost management and results analysis, as well as the scientific review of related research, which used the same techniques for the subject of research. Fifty-one answers were obtained to eighteen questions on the subject, One of the answers was deleted because it was illogical, so the total answer was fifty, which were divided into four phases, which included the phases of project implementation (the first axis, starting the project, the second axis, project planning, the third axis, project implementation, and the fourth axis, closing and handing over the project). The answers varied according to the nature of the work. Engineering companies in Iraq between the public and private sectors. Likert scale was used to analyze the data descriptively. The results were according to the stages of project implementation. The most influential factor in the project initiation stage was the preparation of a specialized work team to work on building information modelling techniques. As for the project planning stage, the most influential factor was the use of modern technologies when preparing project schedules, as they give a clear and accurate perception of the project. The times of implementation of each project activity. The most influential factors in the project implementation phase are due to the preparation of a risk management plan in advance through the building information modelling team. The most influential factors in the project closing and handover phase are the importance of comparing the work plan that was prepared in advance with the work that was done. Has been accomplished [26]

When comparing the stages of project implementation and what is the most important stage for using modern technologies in it, it turns out that the most important stage is the project implementation stage, because planning using building information modelling techniques gives a clear visualization of the project implementation steps.

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