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(BIM) IMPACT ON CONSTRUCTION MANAGEMENT

Rawaa AHMED

Master's Thesis

Supervisor

Prof. Dr. Tuncer CELIK

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The thesis titled "(BIM) IMPACT ON CONSTRUCTION MANAGEMENT" prepared by RAWAA AHMED and submitted on 20/05/2022 has been **accepted unanimously** for the degree of Master of Science in Civil Engineering

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

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

Rawaa AHMED

Signature

DEDICATION

To my beloved mother and father...

My brother and sisters...

You have always respected what I wanted to do and have given me full support and encouragement throughout my life. I would like to express my great appreciation for your great love.

ABSTRACT

(BIM) IMPACT ON CONSTRUCTION MANAGEMENT

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The use of modern technologies in the implementation of construction projects at the present time is very important, as most of the giant companies keep pace with the development taking place in the world and use modern technologies that contribute to the speed of project completion. Building information modeling is one of the most important of those technologies. Building information on the speed of project completion. The questionnaire was used after it was exposed to specialists in the engineering field, and then analyzed the data using the statistical spss program. The iterative and descriptive analyzes were used. The results showed that the use of building information modeling techniques has an important role in the speed of project completion, and the reason for not applying it in Most companies charge the added cost when using their own programs, in addition to the need to pay additional costs for training engineering cadres to use their own programs

Keywords: SPSS, Buildings Information Modelling BIM, Lika Scale, Revit, Alpha

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ABBREVIATIONS

BIM		Building Information Modeling
M.SC	:	Master of Science
PHD	:	Doctor of Philosophy
S.D	:	Standard Deviation

1. INTRODUCTION

This study aims to find out the effect of Building Information Modeling (BIM) on building performance. It is widely known that BIM is a growing trend in the construction industry, with many researchers and practitioners trying to understand its complex nature better. We will survey projects that have used BIM with other projects that have not used BIM through our research. This is done to create a case for new building information measuring the project's success rate that uses BIM modeling and comparing it with projects that do not use this technology. In addition, this study will evaluate how BIM is currently used in industry to understand how to improve BIM to improve productivity and performance. [1].

From the practitioner's point of view. A better understanding of BIM models, build performance, and how they interact would give insight to BIM professionals for further improvement in the BIM platform and process. For practitioners in the construction industry, this study aims to prepare. They have knowledge and information about where BIM has succeeded in improving and Increasing build performance, highlighting areas that may not have been successful. Allowing for future studies to explore how BIM . can be used to enhance construction performance.[2].

1.1 STUDY TOPIC

Use of Building Information Modeling (BIM) in construction projects. In this work, the major aim is to know the benefit of using building information modeling in construction projects, using modern techniques to improve the construction industry. BIM can be defined as representation related to the digital development from conventional 2-D model to 3-D model, 4-D model (scheduling), 5-D model (cost estimation), 6D (operation), 7D (sustainability), and even 8D (safety), [3]. With a database through the building lifecycle. Figure 1.1 gives the advantages of BIM Dimensions. Distinctive abilities of interoperability and parametric modeling are facilitating such a process of evolution, which will be thoroughly explained in this section.

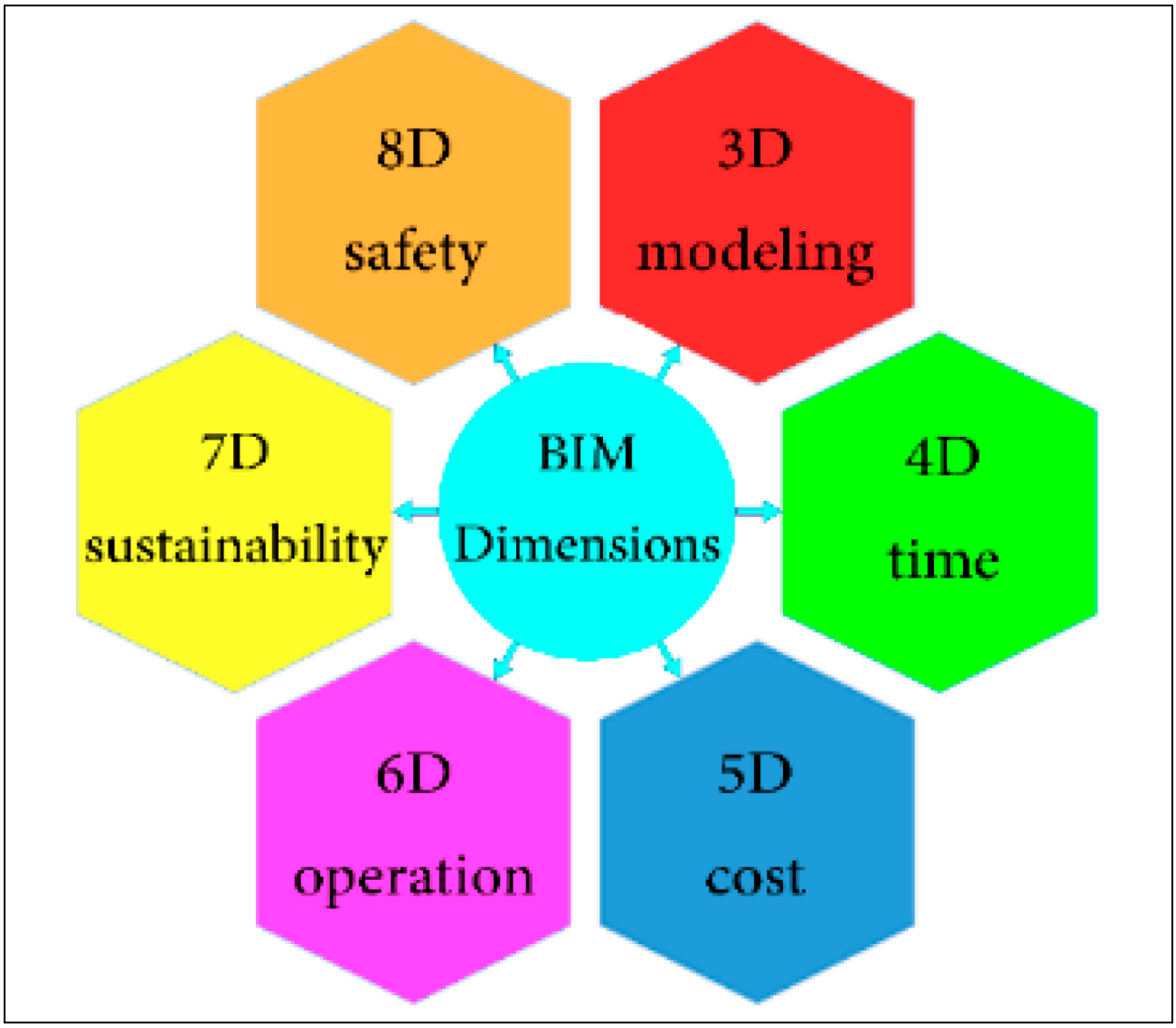

Figure 1.1: BIM Dimensions.

1.1.1 2nd Dimension

Wall elevations and operating room floor plans are designed at this stage. Each of the walls is accurately rendered to show the integrations of medical equipment, monitors, and other installations in 2D.

1.1.2 3rd Dimension

3D objects which are building up the information model are contained in the 3D BIM model. In virtual reality, those objects represent the buildings or buildings spaces. At least, such 3D objects

contain information on length, width, and height. The advantages of the 3D information model are enhanced coordination, enabled visualization, and gathering general information.

1.1.3 4th Dimension

Along with the 3D BIM functionality, the 4D is added – time. Also, each of the model components consists of information regarding its creation data and, likely, destruction time. In addition, errors might already be eliminated in the design phase. It provides such simulation types with significant insights. It allows detecting the errors of planning promptly, rather than solving the mistakes of planning later in the construction phase, since it is very costly to solve problems on-site Furthermore, 4D might optimize the logistical features via many alternate solutions to conduct the constructions weighted and simulated against each other for finding the most effective solutions.

1.1.4 5th Dimension

The 5D cost estimations denote information in BIM; the accuracy and efficiency of dynamically maintaining cost data might be improved greatly, whereas the difficulty and workload of short cycle costs analysis might be decreased There is simplicity in identifying the models that weren't allocated with costs data in terms of real-time inventory management or carrying out quantity take-off via models of building information reflecting the information of actual costs .The project departments and headquarters might communicate anywhere, anytime via the cost information, which is placed online for remotely accessing the information of the costs. At the same time, the cost control capacity might be considerably improved for headquarters. Although 'engineering-related data' is a contributing factor for cost analysis. Yet, is a majorly present phenomenon in various companies of construction is that it is extremely complex to acquit .

1.1.5 6th Dimension

6D BIM is considered to be modeled in procedure handover and developed as a guide with all the vital information dynamically provided. Collecting the data effectively allows a more thorough understanding regarding the performance of buildings, organizing smooth functioning of buildings, specifying a plan to optimize the renovations and consumption of energy in buildings over the whole building's lifetime. Easily accessing the building element databases is a

major advantage of 6D BIM since there will be a possibility at any time for accessing information regarding the type, product, and model of equipment, technical specifications, and service periods. In such an approach, the building manager will easily handle the supplements and information, whereas receiving information materials in conventional FM, like maintenance, completion certificates, are of static significance, as-built drawings, and instructions for operations.

1.1.6 7th Dimension

The 7D BIM allows project managers/engineers to conduct structure design modification, clash detection, 3D project management, equipment installation, maintenance after construction, and schedule management. Rather than gradually increasing the model's dimensions, the suggested 7D BIM is providing a new viewpoint of BIM developments through integrating a lot of models related to 3D project management. Many functions might be conducted simultaneously, in the 3D project management, including an enterprise-level regarding the quota management, life cycle process management, and visualized bidding management (4) .

1.2 PURPOSE OF THESIS

BIM is promoted as an ideal tool for building collaboration and diversity. Studies looking at the need to increase understanding and efficiency of BIM in technology and operational meaning. This study is important because it understands the importance of technology In the construction industry through certain factors and indicators .Larger companies may use their project data and experience to determine.

The effect of BIM on construction performance ,this study is based on data and information from a wide range of stakeholders and project types that allow for a broader and more meaningful understanding of how BIM affects build performance. Approach this The study aims to provide valuable insights and findings that companies can use of varying sizes and scope to improve their BIM implementation plans. Best Understanding BIM from a practitioner's perspective will also allow it to expand and better Leverage BIM to improve build performance. Academics can use these results to Better prepare their educational programs and educate students on how to lead construction Performance on a construction project with effective use of BIM

1.3 HYPOTHESIS

The following assumptions were inherent to the follow-up of this study:

a) Respondents who are interviewed accurately and honestly throughout the entire interview process, based on their background and experiences with BIM and construction performance.

b) Respondents surveyed answered accurately and truthfully throughout the entire survey process based on their background, experiences with BIM, and build performance.

c) Participants used their freedom to admit that they did not remember or have accurate information about the questions asked during the interview or survey.

d) The participants selected for the qualitative component of the study are accurate a reflection of industry perspectives on BIM and construction performance.

1. 4LIMITATIONS

The following limitations are inherent in pursuing this study:

a) The qualitative component of the study was restricted to volunteer participants,

who cooperated and were willing to participate in the interview component of the study.

b) The quantitative component of the study focuses on the number of participants who

They answered the questionnaire that was published to the practitioners.

c) e study is limited by the number of data and insight respondents are willing to share with researchers

d) The study was limited by a possible misinterpretation of the questions asked during Interviews and surveys.

e) The study is limited to the personal experiences of the research

2. LITERATURE REVIEW

2.1 GENERAL CONCEPTS

BIM stands for Building Information Model. With digital construction/building/infrastructure models, BIM enables diverse construction partners and connected personnel in infrastructure constructions to interact more effectively. Using various implementation technologies and workflows with processes in a managed, specified, and optimized manner inside a BIM project is satisfied. All partners have access to a digital three-dimensional building model. It is a semi-realistic portrayal of construction that connects geometric and information trends [5]. Designers that work with such models are typically professionals with no prior experience in the sector. It entails architects, engineers, and builders. Various designers from each of those areas of 3D BIM contribute to the delivery of structures and infrastructure for their clients. In recent times, they have done it in a sequential manner using a limited number of traditional data and cooperation approaches [6]. Collaboration with assistance of various stakeholders from across manner of a facility's lifetime for the goal of design and planning is a vital action that BIM allows. Everyone is invited to work with the exact concept and approach throughout the project's different obstacles and milestones. Similarly, obtaining a single version of the realistic [7]. For all times, everyone works with the most recent version of replaceable skills and digital state building models. The elimination of manual procedures is the elimination of insufficient collaboration capacity due to the unanticipated of taking less time and challenges in that method. BIM is a far better approach than other models for the bad and also higher amount of communications. Many significant advantages can be acquired, such as: building information, creating a model in essence, and allowing everyone to collaborate for better results [8]. As previously said, BIM can be used within a variety of trends that Showed in figure (2-1)

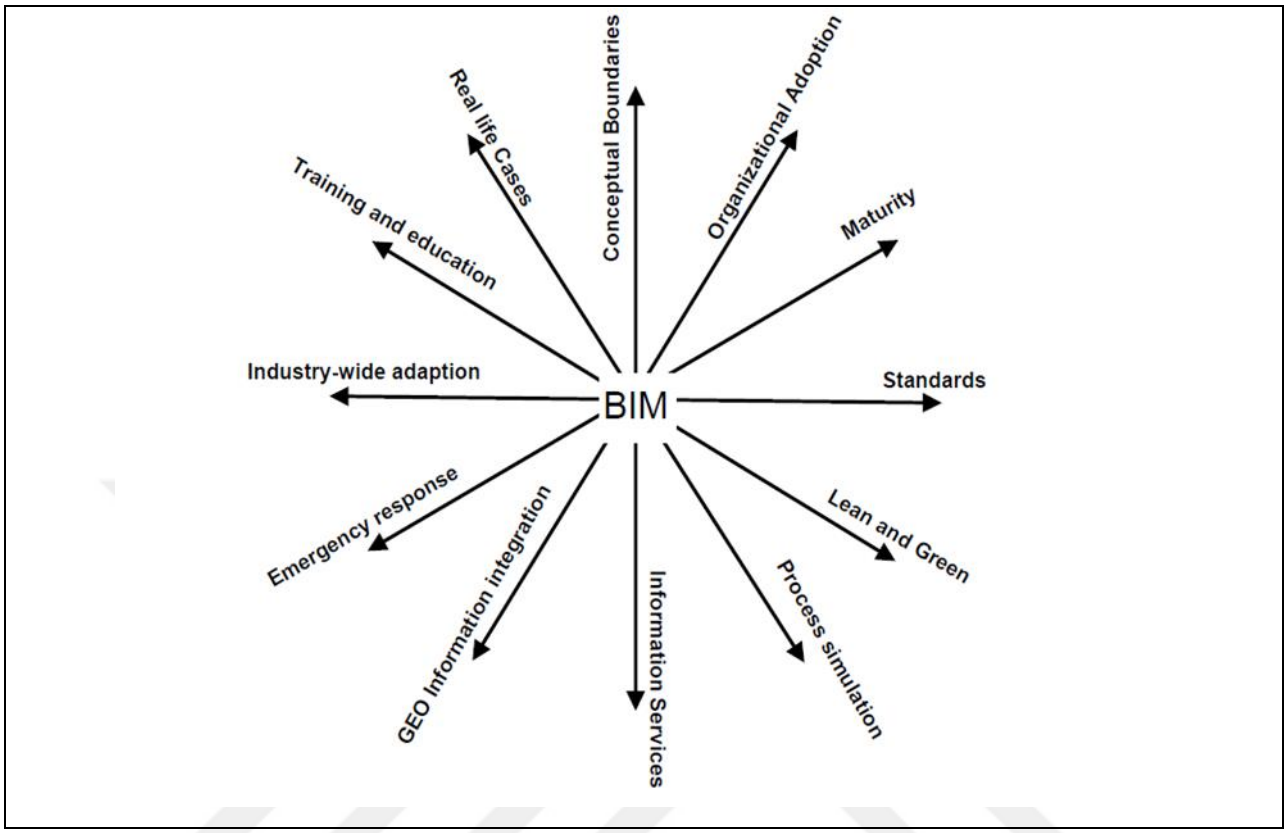

Figure 2.1: The BIM feasible trends [9]

2.2 DEVELOPING OF BIM

Building information modelling (bim is a path toward more promising advancements in the design and engineering professions, as well as in the construction fields. It is transforming the way engineers and contractors carry out their work, but its application is still in its early stages, and there is still greatly to study [10]. One approach to learn is to observe how other organizations are implementing BIM and their judgments and problems laterally the road. BIM was developed over a decade ago to identify architectural data in three-dimension modeling from traditional 2D design. It has been lauded and supported as a lifeline for unclear projects due to its potential to address problems early in the development stage and preciously schedule construction [11]. BIM's history began in the 1950s and 1960s with the use of computer design, often known as CAD. The transformation of the location from two to three dimensions occurred in the year 1970. That year 1980, 3D was introduced, which was before unknown and routing the

industry. In other words, from the 1980s to the 1990s, Autodesk became a common developer and conductor for the data technology sector of industry with their product AutoCAD. From time to time, the improvement of many related competitors has been substantially increased [12]. The numerous related softwares provide varying states of functions and tools, as a result of which the transition from 2D to other new dimensions has altered and been capable of solving various difficulties through the usage of the respective appropriate software . To assist stakeholders, 4D modeling was established as an extension of 3D modeling. Following that, five stages of dimensions were designed to correspond to the magnitude of money estimating for the project [13]. This 5D model is useful for cost estimators and quantity engineers who conduct surveys to determine project costs. The development of 6D is based on sustainable matter, and 7D is for larger quantities to facilities controlling [14].

BIM consists mostly of 3D model conceptions in addition to an information set of data technology an interoperable application in the desktop computer of architects, designers, or contractors may use to create and simulate structures. Members of the building project team can use the technology to examine a virtual model of the building with all its systems in 3D and communicate that information in phases. Similarly, the model necessitates the desired drawings, specifications, and construction details, which include assignments such as building geometry, spatial linkages, quantity characteristics of building elements, and geospatial information. These allow the project team to easily discover and display design and construction themes in a clear virtual world. Following that, work on the real site began. [15]. BIM is primarily a procedure for managing and generating building data throughout the life of a project. It often employs three-dimensional, exact-time control in the implementation of state-of-the-art building-modeling software to regulate and lead to an increase in productivity in building design and other projects. The procedure is based on building information, which includes all necessary information relating to construction geometry, space and site relationships, geographic data, and building element characteristics[16].

2.3 IMPORTANCE OF USING BIM

Construction method for BIM procedures is improving with the passage of time as contractors, architectural engineers, and other stakeholders seek new ways to collaborate with the BIM process. One of the many valuable benefits of employing a new BIM design tool is object joining, which is defined as the matter when parameters link to other items in such a way that if a related outcome changes, this object will also alter [17]. Objects in parametric states automatically re-construct themselves based on the roles assigned to them. These tasks can indeed be simple, such as requiring a glass to be completely within a wall and moving the window with wall, or complicated, such as creating volume limits and detailing the physical link between a steel component and a column. However, as previously noted, in order to have a thorough description of BIM, the uncertainty over whether or not it is essential in distinct border circumstances must be clarified [18]. BIM is not, and is not meant to be, CAD. CAD is a replacement for pen and paper or other methods of documentation. CAD papers are basic data made up of members such as routes, arcs, and circles—as well as solids and surfaces—that are used in multiple graphical representations of construction components. Moreover, usually starts of BIM as largely a 3D model of a clinic are inaccurate and therefore do not reflect reality; they also do not adequately express the capabilities as well as essential items of digital, object-based, inter - operable BIM methods and technologies, as well as conventional communication strategies. In recent years, the digital revolution has transformed a variety of industrial sectors, leading in a tremendous productivity increase, quality of products, and product diversity [19]. Online technologies are becoming more widely used in Architecture, Engineers, or Construction business for designing, building, or excusing buildings and infrastructure assets. In just about any case, the continuous use of digital data across the a whole process chain has lagged significantly behind an industry domain, but valuable information is being lost because classic appearance of information is still mostly acknowledged by all related persons over in the shape of drawings, either as physical state printed plots above article or in a digital but restricted format. With such pauses in data flow that occur across a project facility's entire lifecycle: in the stages of design, building, and operation routines, and also key assignments that happen between these stages [20]. The planning of built elements in a dependable condition is a complex task requiring a large number of stakeholders with diverse skill sets. A continual understanding and active data dialogue among those parties is critical for a successful building project. Currently, this includes

the supply of technical sketches of the construction project in the form of horizontal and vertical components, views, and detail drawings in a typical state. The software used to make these drawings replaces the old routines of working on a drawing board. Unfortunately, line designs cannot be interpreted by computers in their entirety. The data they contain can only be partially disrupted and analytically processed [21]. There are failures to harness the amazing potential of information technology for supporting project management and construction operation based on the information travel through drawings without others. The non-uniformity of the various technical drawings, which can only be checked physically, is a major issue. It is a potentially major source of complications, especially when you consider that the designs are often developed by professionals from various design punctualities and across multiple companies. Differences in design are especially difficult if they are not regularly examined and conveyed to other associated designs. Inconsistencies can occur easily and frequently go undetected until the actual building is completed on site [22]. Design modifications are denoted in convention practice by revision clouds in the designs, which can be difficult to distinguish and ambiguous. In the same way, the limited information depth of technical drawings has a huge downside in that data on the building design could be directly attempted using by apps for any type of analysis, measurement, and modeling, but must be manually entered, adding needless time. This time, BIM programs are design applications, with documentation flowing from and through derivatives of the technique, from graphical design to construction to facility management. Furthermore, utilizing Bim, a valuable simulation model of a structure may be constructed in digital form, and once done, the computer-generated version will have any necessary data and correct condition of geometry needed to assist the construction process[23].

This construction sector is currently in the process of moving from a two-dimensional to a simulation models environment. Among the benefits are the various and diverse members of the project team. The entire crew plans and routes some facilities in BIM, utilizing the top talents and making a point on obtaining numerous benefits. Savings might range from a few hundred dollars to thousands of dollars. Project timelines are being shortened by weeks or months [24].

2.4 BIM STRATEGY FOR CONSTRUCTIONS

Building information modeling is the underlying model of building design and construction. BIM is a three-dimensional, object-oriented computer-aided design (CAD) technology used by architects and construction professionals. As the number of BIM-using architectural engineers and builders increases, so will their ranking. One of the most useful characteristics of BIM is its ability to promote collaboration among various design disciplines, hence reducing errors. BIM is critical for meeting an owner's demand for predictable costs, quality, and on-time delivery [25]. BIM uses the Industry Foundation Stages to change information about a construction project in the middle of different CAD collections. An international network language will be used in BIM implementations, allowing raw data to be properly transmitted across the internet site. BIM has the potential to serve as a tool or repository for the design team, contractors, and specific owners, for each group able to add their own notes to the model[26]. BIM is being developed to a worldwide standard, and major connected vendors have supported and backed the effort. BIM has various advantages. An example is the ability of BIM technologies to detect design faults in incompatible and disputed designs. Assume, for example, that a water tube designed by a systems engineer may be fitted to fit within a steel element designed by a structural engineer. Instead of discovering the incident on the construction site, BIM allows design and construction personnel to electronically identify similar collisions. As a consequence, there will be long-term savings as well as a decrease in construction modification rules and associated costs. More crucially, BIM may offer information about the placement, number, and qualities of building components in a product item. This information could comprise all component specifications such as manufacturer, type, assurance preventive preservation, and so on. The data is useful for building procedures and upkeep[27].

For facilities managers, the use of BIM could soon replace traditional computer calculations. Typically, the facilities director scans paper floor plans or obtains electronic CAD files for use in conjunction with the other design choices. Following that, the electronic ground plans are utilized to construct lines to describe an area and identify room sections to name that area.
For a normal commercial facility, this technique can be completed in a matter of weeks. Instead, BIM files can be transferred from BIM development software to facility control software. The BIM paper can be imported into BIM software, which contains the room boundaries, place areas,

place elements, and space specifications from the BIM. As a result, it would perform functions identical to those given by normal software, and with no delay in the development of streamlines [28]. Future design and building initiatives will necessitate the services of an information manager. This person will identify the need for data management for the owner's project crew, design team, and building stakeholders; manage the block of data from layout of construction to procedures; and manage the data integration from construction methods into the landlord's facility organization and work regimes. The economics, technology, increased functionality, and overall value scheme are the drivers[29]. The graphic below depicted the critical success factor in using a BIM model for a destination project.

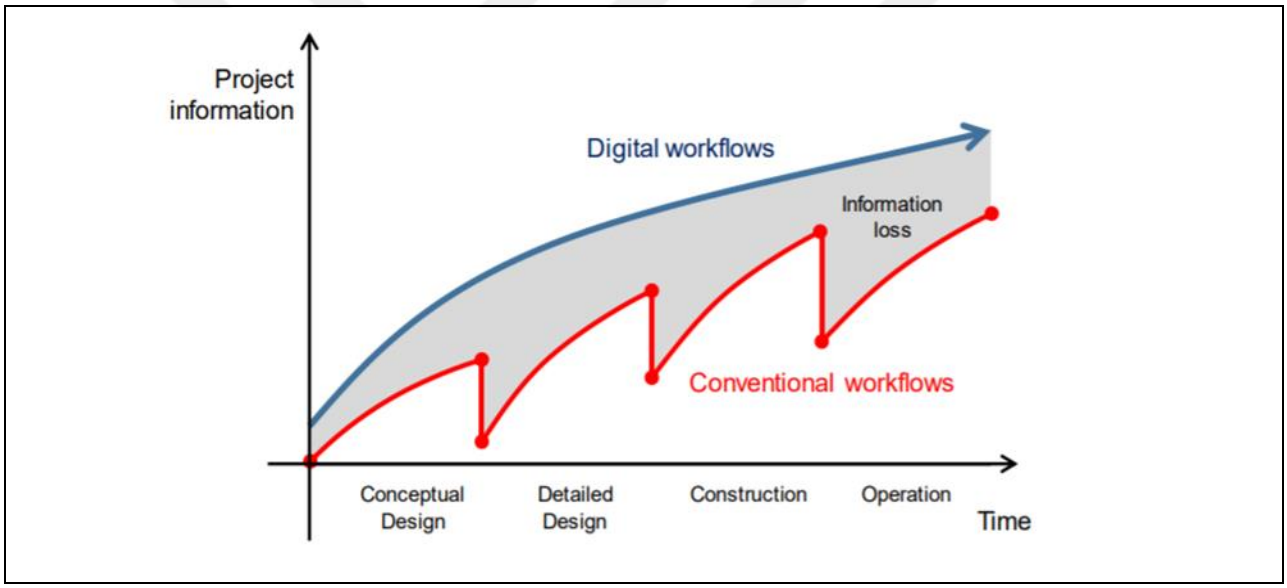

Figure 2.2 : Conventional and digital workflows along construction stage [30]

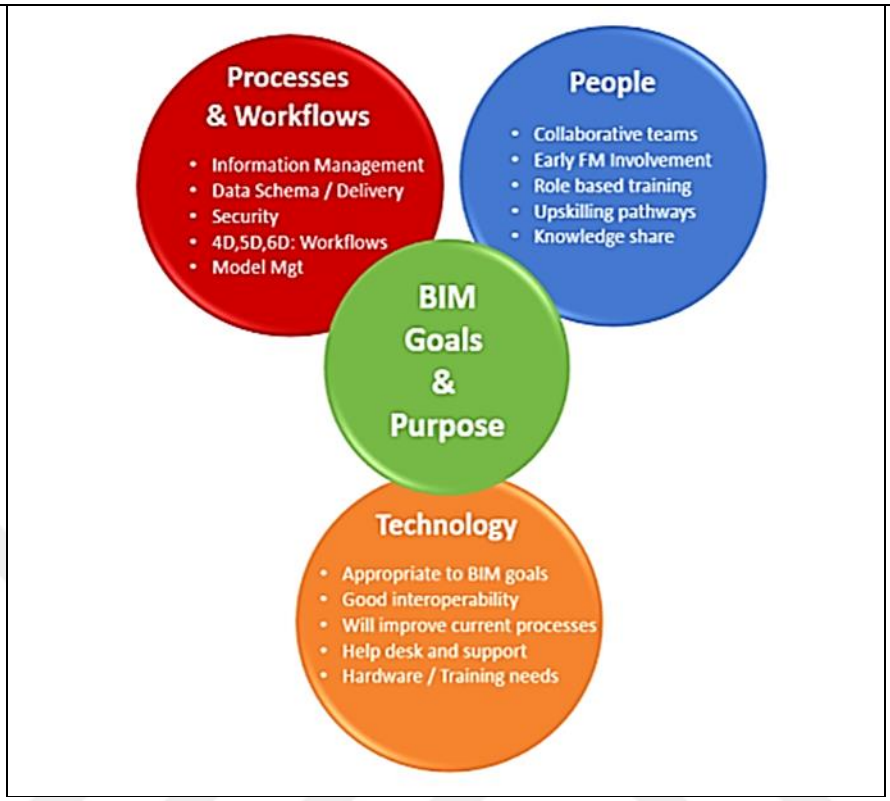

Figure 2.3 : Key element for applying BIM [31]

2.5 SIMULATION OF PROJECT UNDER BIM

BIM techniques highlight issues caused by decentralized control and then use standard exchange protocols such as the industry foundations to guarantee that a cohesive information flow exists among all models as well as the information sources involved in a project. BIM models organize data geometrically and geographically, allowing them to easily augment a core model with construction aspects[32]. In its typical condition, such an element consists of a visual interface associated to the corresponding value geometry as well as an information component that is geometrically linked to the element. Usually, information is retrieved using a physical model and therefore is governed logically. Furthermore, BIM promises to be capable of addressing a building model's whole lifecycle, from planning to operational stages. This is essential for major process-oriented projects like tunneling. In its usual condition, such an element consists of a visual component associated to the main modeling geometry as well as a data component geometrically related to the element. Usually, data is extracted and managed naturally using a geometrical model. Moreover, BIM promises to be capable of covering a building model's

complete lifecycle, from planning to operational stages, which really is critical for major process-oriented initiatives like tunneling. Furthermore, only consistent problem regions are amenable to numerical resolution, thus a simulation of the entire project domain is rarely produced methods to provide these single wants as they occur in dynamic replication findings[33].

2.6 MAIN CONCEPTS OF BIM

BIM is concerned with the production and management of digital depictions of physical spaces. Because a building data model is in digital form, it can be easily shared and utilized as a foundation for joining to improve decision making in construction projects. BIM refers to a model with many dimensions. The first dimension is related to study, planning, and conception, and the second dimension is the execution of which a vector derives. Elements and objects are converted into three-dimensional modeling in the third, or spatial dimension. Time is the fourth dimension, which has been tried out for streamlining construction and factoring in the gathering time of all building-related factors. This information is then transferred to the fifth dimension, where the model is enhanced by cost-related information. The sixth dimension is built and takes environmental impact and sustainability into account. The seven dimension contains information that is used to govern the construction project's activities throughout its life cycle. Along with all of that, the BIM approach was obvious, such as how BIM may be translated for use in clinic or hospital and healthcare firm development projects [35]. BIM inside the design development phase provides several benefits to design and engineering processes. One of the most noticeable advantages of using BIM over traditional 2D procedures is that so many procedural diagrams, such as horizontal and vertical parts, are built immediately from the modeling and also are automatically compatible with each other. The unlike identification between the distinct partial models enables the ability to notice and resolve conflicts in design punctualities at an earlier time stage. Similarly, BIM enables the seamless integration of calculations and simulations. The model can provide a plethora of information on the geometry and material elements in the structure's current state. During the design process, a variety of visual simulations are accessible, such as structural resolving, building performance graphical simulation, clearing graphical simulation, or lightning analysis. Furthermore, the model can be checked for conformity with

norms and codes. Similarly, BIM encourages the smooth grouping of calculations and simulation. This model could provide a plethora of information on the material properties of the structure. A variety of visual simulations are then available for use in the design process, such as structural resolution, building performance graphical simulation, clearing graphic simulation, or lightning analysis. Furthermore, the model can be tested for compliance with norms and codes. As just a result, the detailed planning coordination approach has become unstable, as has the integration of analysis and simulation technologies, and a collective evaluation of the building design occurs only at a relatively late point in the entire process. At this point, the options for design changes are relatively limited, and more expensive to implement. More of this planning effort can be carried forward to the early design phases by creating a comprehensive digital building model in a BIM-based planning process. The importance of anticipating coordination demands in detail, as well as using calculation state of analyses in early design patterns, allows for a more comprehensive evaluation of the impact of design decisions, as well as the early identification and resolution of potential conflicts, significantly reducing the effort required for later phases and significantly improving design quality. The use of BIM gives significant benefits not just for the design of a built institution, but also for the re-arrangement and execution of the actual building[37].

2.7 BIM FEATURES

a) Fundamental cost: In the order model, the fundamental engineering data of BIM can be evaluated prior to the bidding operation, boosting information accuracy and minimizing the likelihood of imbalanced bidding. The elementary price of the bid can be examined throughout the bidding assessment phase, and difficulties pertaining to the amount of engineering or any related inaccuracies can be prevented [38].
b) b) Creating BIM bidding files: The setup and preparation processes for creating BIM bidding files, as well as the 3D BIM, programmer, modeling content, and application scope, are established in the bidding model. Furthermore, the model accuracy needs for each pattern, such as 3D BIM views, BIM bidding instruments, number of views, display meanings, remarks, roaming state, and landmark modeling, are evaluated[27].

c) Contributors include the project process and the system explored within the 3D BIM, as well as the bidding tasks assigned to the project's general stakeholder, supervisors, and cost consultants. Owners of completed bids may resubmit technical applications in BIM[38].

2.8 3D BIM

3D Infrastructure Models are created to digitally depict design data (technical drawings, designs elevations, and so on) in order to provide connected parties with a three-dimensional image of the benefit for infrastructure projects. They are created before an infrastructure project is built, allowing stakeholders to fully understand the asset's design and identify issues early in the project's lifecycle. 3D infrastructure models are employed throughout the project's planning, design, and construction phases, and they have been adopted inside and across many major worldwide infrastructure builds created in recent years [39].

Building Information Modeling (bim (BIMs) are intelligent 3D models that are used to digitally describe the physical state and functional attributes of a valued source. BIM can be used as a source to share knowledge about an asset among stakeholders and can shape the basis for making decisions throughout the asset's existence, from conception through deconstruction. Granular data such as materials, water pressure in tubes, wind forces, and so on are collected in the model to help stakeholders understand the effects of their associated decisions on the magnificent source and environment, as well as their constraints and opportunities. BIM allows architects, engineers, and contractors to collaborate more actively in the planning, design, construction, management, and operation of infrastructure assets [40].

3D modeling allows for the optimization of the design of a single asset or a group of infrastructure assets.

This can lead to reclamation through the decreasing of the all volume of substances to be utilized, limiting the influence on the manner of environment from spoil materials or soil acts [41].

2.9 4D BIM

A planned technique wherein the connections between building activities are defined in time schedules and augmented by 3D models to create an actual time visual simulation of project construction and subsequently toward completion. The four period characteristics allow again for ranking or evaluation of a project's work planning and construction capabilities. This gives excellent statistics to project stakeholders and participants for analyzing and correlating concerns with the temporal, spatial, and quasi components of the building progress[42]. 4D BIM allows for the production of more robust schedules, improved field layouts, and realistic designs, all of which add to the end result. Four Dimensional BIM, often known as building in sequence, refers to strategies for adding an extra layer of scheduling data to a project data model. This forming of information can be gathered and applied to a variety construction project elements that will be constructed in the future as part of this activity. This enables a gradual visualization of the project's progress. In those other words, by merging 3D modeling with the project timetable, 4D BIM facilitates the visualization of each project class. Related individuals can gain a comprehensive summary of the overall process and stay up to date on everything that occurs on-site [43]. Simply said, 4D BIM can help you regulate people or chemicals just on job site. It consists of time-related data which can be linked to a variety of information model processes. The project's different interdependencies with each element or task area are confirmed, represented, and established for a building process in which all stakeholders are ready for what comes next. Integrating time-related data can provide stakeholders with an accurate representation of the course that the building and field should take throughout the process. This can give improvement for productivity and push for a safer and bigger quantity straightforward planning procedure [44].

In terms of financial representations for construction projects, the rational and more effective sequencing of jobs on the construction site can be a huge game changer. To be more recognizable, an early description of the next project stages would allow for meaningful feedback, potentially reducing the proportion of rework and reducing delay. It is important to highlight that the introduction of 4D BIM means that planners are no longer an essential phase of the process. On the contrary, four-dimensional BIM enables them to accomplish their tasks with higher accuracy. Planners have recently seemed to have the ability to generate suggestions for a

project's far earlier time phase, rather than building programs as they are provided in the plans. Designers may help to change the building process by believing in digital procedures. It has recently become evident that four-dimensional BIM (construction in sequence) can be the trigger for a dramatic change in the way projects are designed, managed, and evolved. It is not an overstatement to argue that it can provide a helpful insight into the future for industry sectors [45]. To add more clarity on how 4D BIM may be useful in which for the project, the following improvements to the work on the field can be implemented for better results:

a) The fundamental stage is planning. In terms of scheduling and design, 4D BIM can be beneficial. In a clause, it can be viewed as a method of removing uncertainty and suspicion from the project. This is accomplished through the use of a digital state workflow. By including management data into the project information modeling, construction stakeholders can receive a holistic view of the project from planning to completion at an early stage. The method of detailed illustration of the project's progress can assist the managing team avoid mistakes, recognize impacts, and re-adjust their approach based on newly gathered data [46].
b) All firms are on the same page Keeping everyone up to date on the final alterations in a construction project, which is more difficult in ancient and classic models. As a result, in many circumstances, these can be implemented in each day on the field and in the office without end meetings and without limit hours on the phone. 4D BIM can be of great assistance in reducing the frequency and duration of those sessions. When numerous stakeholders are collected in order to reciprocate ideas and analyze the current upgrading of the project, the benefit of visualization of project performance that 4D BIM models supply objects becomes much less complicated. A tighter connection between both the site as well as the back-office results in improved understanding of various project parts, which could also help to decrease conflicts[47].
c) Concerning project monitoring Regardless of the kind and breadth of a project, keeping a tight check on everything that happens on-site can be quite difficult. This can be legally difficult when leading to large-scale construction. That is due to the readily and too many issues of the construction process that might have been taken into consideration previously by a project manager who may seek complete management of the progress on-site and ensure that everything is proceeding as it should [48].

d) Avoidance of conflict. All of this, combined with the availability of a common-shared data model, results in tremendous openness and accountability for the entire organization. In other words, every addition or alteration to the site's design can be immediately attributed to whoever is in charge of it. When discussing architectural engineers or designers, it is clear to the entire team who is in charge of project facilities[49].

e) g) Safer data and business sites In terms of data breach and site accident concerns, the adoption of a building animation sequence for monitoring development on the site can have substantial benefits for project safety. To begin with, by keeping all schedule data inside a project information modeling system, stakeholders can feel a little more safe about securing essential construction project information, as the chance of any data being lost or stolen is significantly increased. 4D BIM can be a huge step forward in terms of creating a safe construction site. That is, of course, the natural result of having complete control over the construction process. By being aware of every single detail pertaining to the location of materials, machinery, and workers. Based on that, the management team can organize its assets and make the best, data-driven decisions to keep them safe[50].

2.10 5D BIM

By adding further, real-time information levels to quantity collecting and classifying dynamic quantities and dimensions, 5D BIM models offer precise cost prediction. Embracing the fifth dimension, sometimes known as 5D BIM, allows cost managers to play a vital role in a BIM topography. The standard method for estimating 2D costs is time consuming and error prone. Without the need for a doubt, manual project cost analysis in connection to project parts typically results in miscalculations, with re-measurement from a series of designs being quite labor expensive [51]. Because the cost parameter is connected to a three-dimensional model in 5D BIM, cost estimates procedures become standard, automated, and precise. A sole ability of five dimension BIM is to deliver automated quantity captures and exact costs throughout the early stages of building in real time, showing the overall result with high accuracy. It lowers the need for reworking and redesigns in subsequent classes of construction, saving costs. In the present era, cost managers are increasingly relying on critical data 3D models to provide precise 5D

estimates. Throughout the project's lifecycle, BIM allows for faster and more accurate cost estimation. Cost managers can save a significant amount of money, time, and manual labor by using BIM and automated cost approximations, and they can totally eliminate human intervention or inaccuracies in the final cost[52]. At this place, some advantages of using 5D BIM toward estimation of cost as following:

a) Timelines for construction projects have been shortened. The 5D BIM model supports stakeholders in identifying the implications of project design changes on in-sequence planning and project budget. When all stakeholders are all on the same page, there is much more clarity, and the project as a whole stays on schedule to be completed on time. The time saved by shortening project timelines leads to a more positive and improving company influence workflow[53].

b) Quick cost estimates in the five dimensions of BIM The use of automatic features not only saves time for cost managers, but also ensures precise and accurate estimations. It relieves cost managers of the time-consuming and onerous task of manual quantification. At any step of development, real-time parametric data premise automated cost readjustment to modifications and alerts connected parties to these changes. [54].

c) Useful quantity takeoffs for reducing element quantification mistakes as cost data and quantities are combined, so that all money magnitude computations are automatically upgraded when the derivation or the building is changed. Errors are decreased as a result of cost managers producing more accurate cost forecasts based on precise material quantification and pricing, resulting in greater efficiency and productivity[54].

d) The three-dimensional BIM lead to figurative state assists stakeholders in gaining greater clarity and seeing how various elements would affect the project's cost in 5D BIM. Building enterprises can evaluate various cost estimates as agreed or goal building costs, which will help them make more informed and wise judgments in the future. 5D models and Lean Construction for planning work operations, for example, in reinforced bodies of concrete bridges, the building pre-visualization provided by rate flow drawing maps of the related piles, assisted stakeholders in making smarter and more informed decisions about construction-related magnitude of money [55].

e) Rapid assessments of proposals and complex combinations, as well as real-time information acquisition via cost reevaluation and data consistency, making it simple for cost managers to determine multiple design samples or options. The amount of money that is evaluated using 5D BIM is estimated quickly and accurately in many complex combinations. Reformist variations in projection cost enable managers to fulfill numerous cost prototypes of summaries in accordance with client needs for a successful and acceptable build [51].

f) f) Increased quasi or informed choice through pre-visualization in five dimensions. When used in conjunction with a 3D BIM model, BIM aids in the detection and resolution of clashes during the early stages of construction. This provides stakeholders with more leeway in making an informed decision about materials and equipment and pricing[56].

g) g) Quick cost forecasts in BIM's five dimensions as automatic amount of features not only helps management teams save time, but also guarantees exact and accurate estimates. It frees cost managers from onerous and time-consuming manual quantification. Real-time parametric data premise automatic cost readjustment to changes and alerts connected parties to these modifications at any stage of the construction [54].

h) A brief risk assessment for the project. Stakeholders including such project owners, contractors, freelancers, and others can benefit from 5D BIM because it provides particular information on material prices and schedules. The methodology works together to achieve project cost efficiency and on-time delivery. Automated quantity outflow has an effect on overall connected expenses. The material departing process is sped up with 5D Cost Prediction thanks to an automatic state list creation that is embedded into the model inside component characteristics or libraries. If cost data is linked to the substances or items, an accurate estimate can be created. Organizing faster and more exact model-based quantity surveys improves efficiency and the flow of work within design teams [57].

2.11 6D BIM

With the rising emergence of surrounding environment and energy-related concerns, as well as new needs in terms of sustainability and constructed systems, an up-to-date cultural approach to the project, focusing on the development of Sustainable buildings, has become important. In that with a low environmental combining practical principal connected to time, budget needs, and social and environmental considerations. Nevertheless, for the term Sustainability to have a collective meaning in architectural engineers, architects and designers must use not only logical tools related to their discipline, but also tools for combining and manufacturing following a synergic logic that could guide the entire building and design process [58]. It is thus clear in this context how Sustainable Architecture, determining itself with a variety of in strict fields, all same important for starting the perfect equilibrium between environment and built system, needs a multi-disciplinary and integrated approach to the project. The primary topical of sustainable design is without a doubt force, efficiency, the start factor allows the building to reduce the intake of resources and improves subsequent choices in terms of substances and technological solutions which allow reducing as well the environmental impact through the construction and disposal stages of the building, usually limited if faced with the single determined by the period of consuming [35].

6D BIM is about facility management and processing by building managers. The dimension is being experimented with in order to track key asset data such as its state, maintenance/operation manuals, assurance information, technical criteria, and other parameters for future use. 6D BIM is a unified strategy in which everything relevant to facility management operations is compiled for a single site within a construction information model. Such method aids in increasing the quality of option supply throughout a project's lifecycle. Using 6D BIM ensures that everything in a project remains in good condition from the first day to the day of demolition. Benefits of 6D BIM Optimized asset and facilities management from design through destruction Simplified and easy replacement of parts and fixes at any moment during the life of a building guided maintenance process for contractors and subcontractors [59].

2.12 7D BIM

7D BIM augments BIM models with data on lifespan aspects. This data could include information on the constituent manufacturer, the date of construction, the amount of maintenance required, the expected lifespan, and recommendations for best operation. The data is generated by BIM modeling and delivered to construction operators at the end of a project so that they can improve building performance and estimate maintenance expenses. The 7D BIM model can be utilized in the same way during the design phase to support decision making and shift the focus from capital costs of building to procedure costs of the built asset. That data could comprise specific data such as the necessary maintenance that it requires, as well as when and how to operate it at its optimum stage to boost act or conserve force, as well as its predictable lifespan. After included into the information model, 7D data can aid decision making throughout the design process as well as the operation of the built power source once it is operational [14].

It allows design teams to analyze the influence of their proposals over the life cycle of a built asset, modeling outcomes and predicted costs, during the delivery phase. Project teams can hand along their complete data fix to the last user at handover. The digital approach provides them with a more regulated, attainable, and immediately accessible method of regulating their information. It's a lot more practical than the packs of lever folders that are handed out in the typical state [60].

With this data on fixing lifespans and force, operators can analyze the costs of those activities and create expenditure descriptions over the life of a created asset. It is beneficial to adopt a thoroughly designed and proactive trend to operation as opposed to an active one when unpredictability events and costs can arise at any time. 7D BIM entails the addition of other associated information that supports the facility's controlling and operation in the trust that it will produce a more beneficial commercial end. The seven dimension process indicates that a designer's model is updated or changed along the path of the structure. This specific model can be verified by the owner. The model will include all of the data that will be required in the event of a future fix. The data includes things like warranty information, manual information, operation and maintenance data, and so on. The advantages of 7D BIM include the creation of decisions that make the process more intensive, simple, and quick. Throughout the project lifecycle, 7D

BIM provides a complete analysis of the project's economic and operational aspects, as well as assistance in planning for any maintenance phases[61].

2.13 8D BIM

8D BIM is a BIM dimension that adds necessary safety information to the geometric model of the structure during the design and execution phases. It is capable of modeling in all of its elements on the construction site (fencing, storage related areas, machinery, marks, and so on). It can make advantage of cutting-edge technologies such as virtual reality and real-time rendering. With the use of BIM, it is envisaged to present automatic prevention analyses in the building and maintenance stages, resulting in improved operations. 8D BIM can lead to increased communication and coordination among all responsible players, descripting standards and best practices of a shareable environment and parametric modeling, and allowing for non-inert and efficient information collaboration among all project stakeholders [62]. 8D BIM is divided into three phases: preliminary identification of non-safety instances in the semi-realistic model, improvement of ideas for highly relevant remedies, and control of critical more dangerous problems. 8D BIM entails professional problem prevention throughout the life cycle of a contract, thus attracting the attention of all participants, beginning with the early conception and design stage, continuing through the construction, procedures stage, and construction repair, and ending with the asset destruction stage. In this context, 8D BIM appears as a tool capable of delivering improved indicators in the field to designers, engineers, and the building industry [63].

2.14 CURRENT WORK

This current study is significant since it recognizes the significance of approaches. Through continuous factors and marks, large enterprises and organizations in the construction sector might utilise their construction project data and skills. BIM is regarded as a good method for building joining and diversity. This study is based on data from a wide range of relevant people as well as project kinds, permitting for a more comprehensive and useful sympathetic of how BIM affects building behavior. The study aims to give important in-situ and findings that firms can use to better their BIM deployment strategies of different volume and breadth. A better understanding of BIM from the perspective of a practitioner is also assumed. The use of BIM to improve building performance is investigated, leading academics to a condition of forward ease

in employing those results to more advantageous outcomes in their destination studies and projects. The study's pathway includes an answer to the question of in what way to lead performance of construction on the construction project while also making good use of BIM.

2.15 LITERATURE SURVEY

(HeeSung Cha & Jun Kim, 2020) The study studied the concept and exploration of an unique methodology that effectively handles on-site act data by associating three-dimensional objects with construction results elements. The study covers the identification of on-site productivity indicators that might be included in 3D modeling to efficiently test the performance of a specific project. Tests were applied on a commercial building located in Seoul. The study discovered that various on-site productivity difficulties play critical roles in estimating the levels of performance in a specific construction. The study also discovered that the most recent system provided a beneficial tool for controlling construction productivity and performance for better results. BIM object-based management/performance/productivity information, in particular, provides more than just the capability for capturing real-time performance data [39].

(Yu-Cheng LIN, 2012), The study employed a realistic methodology to examine connected building projects utilizing a BIM approach. The study is based on the fact that the BIM approach is being used to enable users to control visual information in three dimensions in CAD (Computer-aided Design environment). This study looks at the implementation of knowledge management in the building pattern. The Building BIM-based Knowledge Management system was used by the research pathway in a selected state of a building project in Taiwan to validate our summary methodology and describe the effectiveness of collaborative knowledge in a 3D environment. The presented an upgraded regime which recognized the platform for enhancing information and experience reciprocation among participants. The CBIMKM system with BIM approach showed visual knowledge and led to problem definition and solutions in the 3D CAD procedure [64].

(Xiong Gao & Yonghong Chen, 2017) Dealed with the concept toward BIM technology and proposes BIM in construction with the required safety and emergency controlling in China. proposed establishing as a sharing platform of incorporation safety with the emergency data as base of BIM techniques in the construct lifecycle. Integrate needed safety & emergency information sharing platform of BIM-based future platform . According to the study, big data and BIM will implement information collaboration and integration in the future, safety data will be routinely collected from a wide range of BIM users overall, it can get regular of the accidents such as relativity, periodicity, and seasonality, through analyzing mass data in the building process, so that the model will be able to make contingency solutions and successfully decrease troubles. The research was expanded to look into the impact of the Internet of Things and BIM. The investigation assigned these two trends as effectively detected for controlling unsafe construction methods[65].

(Mohamad Kassem et al., 2012) produced a holistic plan for the designers impacted by the adoption of BIM and 4D within the use of an exhaustive past studies analysis and a poll of stakeholders and consultants in the UK AEC sector (Architectural, Engineering with the Construction). While non-technical hurdles such as disorganization in the appraisal of the work value of BIM and the four dimension line are demonstrated in the study.

The study was primarily focused with the technical advancements of BIM and four-dimensional technology. A comprehensive map of the driving and restricting forces influencing 4D and BIM was given. The removal of the highlighted non-technical barriers can help to close the gap between technology, end users, and their operations. The study discovered six major types of impediments to the widespread use of BIM and 4D. The employees' lack of competence, their willingness to change, the contract project type, as well as time and cost. These impediments were typically identified with both the linked contractors and for both concepts (Model of BIM and 4D) [66].

(P. Farnood Ahmadi & M. Arashpour, 2020), The study investigated the potential risks related with 4D-BIM project planning, foundation, as well as the future impact of 4D planning inside the construction sector. The initial stage was to present the core notion of 4D BIM simulation, along with its capable uses and capabilities in construction planning. The study then pursued the flaws

and resistance to the development of 4D simulations of conventional and building projects according to the construction handbook. The findings indicate that including a BIM model into the building program is critical for ensuring improved control over construction projects. It may be stated that automation in 4D state planning should be more carefully studied with programs that are optimized. The investigation also discovered the formulation of architectural design and the production of geometric modeling. The analysis supports project managers in improving their management progress with job efficiency, as well as identifying study gaps and chances for future research. The study identified part of noticeable advantages, risks and challenges of the use BIM/4D-BIM [44].

(Jiang Xu, 2017) had investigated the construction stages of project management and the upgrading of the building industry The study examined the implementation of major ideas of BIM methodologies and the modeling of BIM five dimensions. It focuses on the discussion of the integrated use of BIM in 5D state for the construction stages, including visualization to the final stage. Construction simulation in 5D. A thorough study of BIM machinery was used in the Central Grand construction project in China. The research includes introducing BIM technology in the building pattern of the specified implementation method. The emphasis was on improving construction quality, lowering construction costs, and achieving environmentally friendly construction through good management. Better construction management is achieved by the use of an integrated data management system in conjunction with BIM technology in the construction project, which includes the management of information collecting. According to the report, in order to fully realize the potential of BIM technology in China's construction industry, a more mature application scheme of BIM research and improvement must be initiated [67].
(Jana Smetanková et al, 2018) investigated the feasibility of using cost-cutting technologies and BIM in the Slovak construction industry and overseas from several perspectives. The primary theme of this study is to conduct an overview of the use of BIM technique and cost management equipment at home and abroad. BIM expertise is being used. This method has the potential to revert to a previous level in countries all over the world. In Slovakia, the overall status of construction is in its early phases. The study focused on the use of BIM technology, which has proven to be beneficial in countries such as New Zealand and the United Kingdom. The topic of BIM is primarily organized into law in these nations. This is frequently the reason why the usage

of BIM in relation to such is covering. According to the study, inter-country auditing has also highlighted the unique software features and practices that are being used. It emphasized the need of accurate data-driven cost management, which might have a meaningful impact on building success, demonstrating that BIM technology has a lot of control, including cost management[64] .

(Sergey Sinenko, et al., 2020) aimed to provide a figurative understanding of the options of BIM and to supply a suitable route of the of people to made more collective BIM, which in other word, implements analysis. Building information provides strategies and direction for the construction industry. The study analyzed the prospects for BIM application in the site toward implementation, involving the unstable success variables. Being in the manner in which the outline of the study comprised of quantitative and superior attributes. Furthermore, it provided a strong platform for construction sections to make intelligent judgments in implementing BIM in the organization's structure. The major goal was to discover the characteristics that are important for success and the impact of these potentials on improving the performance of organizations that will use BIM in the future.

The study's findings are connected to how stakeholders collaborate with one another to develop a shared vision as the foundation of a popular strategy. The society can benefit from BIM by including more accessible infrastructure and housing to be considered as a safer and larger quantity predictable project fulfillment[6].

(S. Neda Naghshbandi, 2016) The study examined the excellent BIM implementation in the facilities management business, including the collaboration of several organizations throughout the project's life cycle. The study discovered that in order to help BIM fulfillment, it is necessary to demonstrate the veracity of the benefits, uses, and impacted by recognized in the literature. The study, which was based on BIM for facilities management, aimed to aid in the effective implementation of BIM in project facility management patterns. The study follows the identified gaps in BIM for facilities management, as well as the actual problems of BIM adoption during the facility managing phase of development. The study discovered that there is a need for case studies and a concrete guide to demonstrate the benefits of BIM for facilities management and to address practical problems. It is necessary to improve the relationship between various

stakeholders. Furthermore, additional auditing is required to increase the integration of BIM and firm management systems in order to fully apply BIM in rank to improve the building industry creativity[69].

(Marta Andreani, et. al., 2019) has investigated BIM possibilities in both acts preceding design decisions and also the assisting of complicated analysis through the advanced derive phase, as part of the overall sustainable design process. A technological rail building path is being studied in the Application Control Centre for the new Oman Railway, whose preliminary construction concept was developed with the assistance of the Italian design society. The 7D BIM approach is utilized to identify potential problems and flaws during the early stages of construction, which can serve as a foundation for a future design development proposal. The following step involves studying and experimenting with the possibility of BIM appliances in conjunction with the Conceptual Design, utilizing the Autodesk® Revit application. For each pattern of the project's procedure, it was clear how BIM practice essentially directed toward the path of sustainable design. As a result, the acceleration of the administration of massive amounts of diverse trending information related with the project should ease the process in manifestations of an integrated design and certifications. The importance of the study's focus on the challenges in managing sophisticated state of BIM models cannot be overstated: the phase of preparation of design options that can provide a broad perspective of assessment[59].

(**Imriyas Kamardeen, 2010)** The study dealt with the notions of Prevention-through-Design (PtD) as an important method during the action of 8D BIM that may be used to quickly reduce hazards during the building phase. The stydy discovered that, since the construction business remains one of the most risky for employees, (PtD) is one of the most effective techniques of contacting with dangers. The PtD approach encourages designers to do comprehensive troubleshooting of each design component for the facility they design. According to the study, the expanding prediction of building data modeling has created the option for grouping multidisciplinary information in a single digital state of storage and therefore optimizing designs. The project sought to bridge the gap between derive and occupational safety and safety principles by expanding BIM for PtD. The system architecture of an 8D model tool has been modified to support BIM-based PtD. The program may detect hazards in BIM models and generate risk profiles for members, which would be assessed in three stages of severity: critical, moderate, and low. The study also suggested related reclamations for design by on-site hazard

manage for elements that have been rated moderate. The in site hazard control decisions would be covered to critical parts which hazards could be without eliminated by the help of design revisions. The research is to be extended to create a model of the proposed scheme and authorize it in the industry [62].

(Shalaka Hire, et al., 2021), These findings are backed up by an examination of BIM knowledge in Indian construction, and the benefits and challenges found in Indian building. In the same way, this study demonstrates the benefits of BIM implementation for critical safety management. The goal of this research was to establish the amount of BIM awareness in the Indian construction sector. The survey was carried out among building experts from all throughout India. The Statistical Package for the Social Science was used to analyze the data.

The internal audit concludes that the Indian mortgage market must work above the three major aspects of BIM awareness and its benefits for organizations, accumulation of BIM in the higher education scheme, and delivery of share training throughout building organizations in order to better realize benefits through BIM execution. Moreover, the study focused on its potential consideration for safety, where present safety measures are contrasted to a benefits of BIM in which for safety are evaluated, leading to the approaching time and vision of BIM inside the Indian building sector of industry. It has been discovered that design approaches such as Revit from Autodesk are widely employed as a tool in Indian construction firms[63].

3. REARCH METHODOLOGY

The methodology of this research relied on making a questionnaire through which to know the extent of the impact of projects implemented using building information modeling programs on other projects that operate using traditional methods, as it is no secret that at the present time many companies in the public and private sectors have used modern technologies to manage projects Building ,Building information modeling technology is one of the modern methods of project management through its usefulness in solving the issue of intersections between architectural and construction plans and services, in addition to many benefits, including speed in calculating quantities and managing work progress schedule and other benefits that helped speed the completion of projects.

3.1 RESEARCH DESIGN &METHODOLOGY

In this chapter, a questionnaire is designed to determine the importance of using BIM in construction projects and its importance in achieving project objectives. Closed questions were used to design the questionnaire by selecting one option from among several available options. The questionnaire was distributed to a group of engineers and specialists from engineering and academic institutions such as (University of Anbar - University of Tikrit - University of Kirkuk). After that, we collected, categorized and analyzed the data to arrive at the results. The questionnaire was distributed to a number of workers in this field (engineers, contractors, administrators ... The questions asked in the questionnaire are related to each type of building information modeling software and tools and their impact on achieving the project objectives. The classification of the questionnaire form was first determined and then the questions were designed for each A category of questionnaire, the purpose of choosing a survey is to determine the content of the study that achieves its objectives and proves its hypotheses by defining the content of the study and collecting sources of information.

3.2 THE STUDY COLLEGE'S COMMUNITY

Research community can be defined as a specific group of individuals that have standard traits and characteristics. In this research, a group of engineers working in the public and private contracting sector and project managers specialized in civil engineering were selected, in addition to a group of academics in the engineering departments of some Iraqi universities.

3.3 STUDY EXAMPLE

The researcher relied on sending the questionnaire to the largest number of workers in the field of study to obtain the data of this study. The example includes project managers, contractors, and engineers from different disciplines and diverse engineering experiences. Interviews were conducted with a large number of engineers in some work sites and in the headquarters of construction contracting companies in the public and private sectors and in various disciplines, in addition to academics in engineering disciplines in some of the prestigious Iraqi universities.

3.4 THE QUESTIONNAIRE'S EXCLUSION CRITERIA

Some of the forms were excluded because they were incomplete answers, in addition to the presence of answers by engineers with insufficient experience, as well as those who were far from specialization were excluded to ensure the credibility of the results.

3.5 THE QUESTIONNAIRE'S DESIGN

In order to obtain the initial information and data for this study, the questionnaire was designed to assess the causative factors affecting project management using building information modeling. The work was done according to the following:

a) Identify the main points that may hinder the achievement of the project objectives.
b) Arrange the influencing factors according to their severity.

Questions were identified for each category of the questionnaire, then a questionnaire was designed to determine the importance of each category, which included five sets of questions.

After completing the questionnaire design, it is distributed to specialists for the purpose of data collection and then analyzed within a statistical program. The steps taken by the researcher during the process of building the study tool, reviewing the literature related to the subject of the study and reading the books that have been completed on the organizational factors that affect construction projects.

The researcher tried to take into account the educational and cultural level of the center members participating in the study by avoiding problematic vocabulary and embarrassing questions. Accordingly, the questionnaire was modified to suit the study population and the study sample, and then the questionnaire was formed in its final form as it was written in English. Site for conducting a questionnaire for the study in Iraq.

3.6 THE QUESTIONNAIRE

The questionnaire consists of the following questions:

The first part: is concerned with information about the person who will fill out the form, as shown in the table below:

Table 3.1: User Survey Information

	Name (optional)	……			
1	Background	Civil	Architecture	Mechanical	Other ( )
2	Degree	Institute	B.Sc.	M.Sc.	PhD
3	Sector	☐ Engineering consultant	☐ Government sector	☐ Contraction	Other ( )
4	Experience	☐ less than 5 years	☐ 5-10 years	☐ 10-15 years	☐ More than 15 years
5	Programs that you/your company use	AutoCAD	Sketch up	Revit	3Ds max
		S Solid works	☐ Other		
6	BIM experience	☐ 0-5 years	☐ 5-10 years	☐ 10-15 years	More than 15 years

The second part: Some questions are answered in the event that the person is using Building Information Modeling in his current or previous currency. These questions include the following:

a. What is the program(s) that used for BIM technology?
b. Is BIM technology used in all of your projects?
c. If the project is classified as a " small project", how many employees (designers) needed for publishing full detailed design and being able for editing it later?
d. How much time does it take for training an employee he/she is being able to work on any of BIM programs?

The third part: Evaluate specific questions and categorize the answers from very weak to very strong. The questions in this category include the following:

a. As a relation of spend-revenue, the amounts spent on BIM employees make a good revenue during the project life?
b. I observed a remarkable different on the project's performance before and after adoption of BIM technology.
c. Quantity surveying done with BIM is highly matched with the as-built quantities.
d. Quantity surveying done with BIM is faster and more accurate than traditional methods.
e. Using of BIM technology have a positive effect on the time schedule of the project.
f. Using of BIM technology effects, the quality of the project positively and reduces the mistakes
g. BIM technology has an effect on sustainability of buildings.

The fourth part: Questions include the main reasons for not adopting BIM technology in some companies The questions in this category include the following:

a) The high cost of BIM software programs, also the cost of devices (computers) needed to run those programs.
b) The lack of knowledge with BIM technology by the owners, directors, project managers, and engineers.
c) Inability to adopt new programs and ideas.
d) Thinking that currently used programs are adequate and no need to use any of BIM programs.
e) Financial issues might be a main reason for not adopting BIM technology especially in small companies.
f) The absence of skilled employees who would be able to run BIM programs.
g) Because of the requirements of training (time and money), employees are not be trained.
h) Government considerations, BIM technology is not adopting by the government and companies may face some troubles.

The fifth part: This part includes questions about what are the main reasons for not adopting BIM technology in some companies. The questions in this category include the following:

a) The high cost of BIM software programs, also the cost of devices (computers) needed to run those programs.
b) The lack of knowledge with BIM technology by the owners, directors, project managers, and engineers.
c) Inability to adopt new programs and ideas.
d) Thinking that currently used programs are adequate and no need to use any of BIM programs.
e) Financial issues might be a main reason for not adopting BIM technology especially in small companies.
f) The absence of skilled employees who would be able to run BIM programs.
g) Because of the requirements of training (time and money), employees are not be trained. Government considerations, BIM technology is not adopting by the government and companies may faces.

4. RESEARCH RESULTS

The questionnaire was delivered to 50 target respondents. A total of 40 questionnaires were returned from the respondents, so the overall response rate is considered good.. As a result, a total of 40 questionnaires were satisfactorily completed and were recognized as valid according to the quantitative analysis.

The questionnaire consists of one main section containing basic general information about the respondents such as background, sector, degree and experience, and then divided into five other parts. In these sections, respondents were asked to rate their agreement with each statement using a 5-point Likert scale, which ranges from very weak to very strong. Responses of 40 satisfactorily completed questionnaires were assigned numerical codes (1 = very weak, 2 = weak, 3 = moderate, 4 = strong, and 5 = very strong) and analyzed using descriptive statistics. Details of these statistical analyzes are provided in the next section.

Testing the results' dependability and appropriateness.

Cronbach's alpha is a reliability test.

We used Cronbach's alpha scale to find out the reliability of the data and to make sure that the questionnaire was suitable for collecting the data that had been entered. The value of Cronbach's alpha coefficient ranges from 0 to 1. The reliability and internal consistency increase with the increase in the value of this coefficient. Cronbach's alpha coefficient was calculated as 0.875, as shown in Table 4.1. Since these values are greater than 0.80, it is considered a 'good scale' Thus, the parameter values show that the questionnaire is very reliable.

Table 4.1: Statistics on Reliability

Cronbach's Alpha	N of Items
0.869	33

4.1 FREQUENCY ANALYSIS

4.1.1 Respondents' General Information And Background

General information about the participants and their basic details are provided in this section based on the survey results. In terms of scientific backgrounds, as shown in table 4.2

Table 4.2: Respondents' General Information and Background

Background	Frequency	Percent	Valid Percent	Cumulative Percent
Civil	10	25.6	25.6	25.6
Architecture	2	5.1	5.1	30.8
Mechanical	2	5.1	5.1	35.9
Other	25	64.1	64.1	7.7
Total	39	100	100	100

In terms of the backgrounds, 25% of the respondents are civil engineers, 5.1% are architects, and 64.1 from other departments.

Table 4.3: Shown the degree about the participants

Degree	Frequency	Percent	Valid Percent	Cumulative Percent
B.Sc.	2	5.1	5.1	5.1
M.Sc.	12	30.8	30.8	35.9
PhD	25	64.1	64.1	
Total	39	100	100	100

Also, the degrees of respondents were 5.1% bachelor degree, 30.8% MSc.64.1% PhD degree.

Table 4.4: Shown the sector about the participants

sector	Frequency	Percent	Valid Percent	Cumulative Percent
Engineering consultant	2	5.1	5.1	5.1
Government sector	20	51.3	51.3	56.4
other	17	43.6	43.6	100
Total	39	100	100	

We also note in the above table that the largest proportion of the participants are government sector workers.

Table 4.5: Shown the experience about the participants

experience	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 years	2	5.1	5.1	5.1
5-10 years	8	20.5	20.5	25.6
10-15	8	20.5	20.5	46.2
More than 15 years	21	53.8	53.8	100
Total	39	100	100	

We also note in the above table that the largest proportion of the participants are more than 15 years' experience.

Table 4.6: Shown the Programs that you/your company use

Program	Frequency	Percent	Valid Percent	Cumulative Percent
AutoCAD	7	17.9	17.9	17.9
Sketch up	5	12.8	12.8	30.8
Revit	5	12.8	12.8	43.6
Other	22	56.4	56.4	100
Total	39	100	100	

Table 4.7: Shown the BIM experience

BIM experience	Frequency	Percent	Valid Percent	Cumulative Percent
0-5 years	23	59	59	59
5-10	6	15.4	15.4	74.4
More than 15 years	10	25.6	25.6	100
Total	39	100	100	

4.1.2 General information

General information is provided about the type of software used in companies that use BIM, whether it is used in all or part of projects, the number of employees working on BIM, and whether they are involved in training courses.

Table 4.8: Shown the program(s) that used for BIM technology

Program	Frequency	Percent	Valid Percent	Cumulative Percent
Autodesk Revit	9	23.1	23.1	23.1
Graph iSOFT ArchiCAD	3	7.7	7.7	30.8
Other	27	69.2	69.2	100
Total	39	100	100	

Table 4.9: Shown the percentage of use BIM technology in projects

Projects	Frequency	Percent	Valid Percent	Cumulative Percent
In most projects	8	20.5	20.5	20.5
Half of the projects	7	17.9	17.9	38.5
Other	24	61.5	61.5	100
Total	39	100	100	

Table 4.10: Shown how many employees (designers) needed for publishing full detailed design and being able for editing

Numbers	Frequency	Percent	Valid Percent	Cumulative Percent
1-2	11	28.2	28.2	28.2
3-5	6	15.4	15.4	43.6
6-8	6	15.4	15.4	59
Other	16	41	41	100
Total	39	100	100	

Table 4.11: Shown how much time sufficient to train the employee who can work on BIM software

Time	Frequency	Percent	Valid Percent	Cumulative Percent
10-20HR	10	25.6	25.6	25.6
20-40	4	10.3	10.3	35.9
40-60	7	17.9	17.9	53.8
Other	18	46.2	46.2	100
Total	39	100	100	

4.2 DESCRIPTIVE ANALYSIS

In this section, respondents were asked to rate their agreement with each statement using a 5-point scale (Likert scale), ranging from very weak to very strong. Satisfactorily completed questionnaire responses were assigned numerical codes (1 = very poor, 2 = poor, 3 = neutral, 4 = medium, and 5 = very strong), and the data were analyzed using descriptive statistics. The average of each category will be represented by a Likert scale and therefore the average score will be obtained. Details of these statistical analyzes are provided in the next section.

Likert scale used for analyze data and according to the inputs that were defined at the beginning and according to the table shown below:

Table 4.12: five point of Likert scale

Mean	Result
1-1.8	Very weak
1.81-2.6	weak
2.61-3.4	average
3.41-4.2	Strong
More than 4.2	Very strong

4.2.1 The Effect Of Using Building Information Modeling On Construction Project Management

The second section of the main questionnaire consists of 7 variables that identify specific variables, the frequency of responses and their means are shown in Table (4.13).

Table 4.13: Descriptive Statistics of the effect of using building information modeling on construction project management

Question	N	Mean	St. Deviation	Result
the amounts spent on BIM employees make a good revenue during the project life	39	3.1538	1.06471	average
I observed a remarkable different on the project's performance before and after adoption of BIM technology	39	3.4359	1.07103	strong
Quantity surveying done with BIM is highly matched with the as-built quantities.	39	3.3846	1.06661	average
Quantity surveying done with BIM is faster and more accurate than traditional methods.	39	3.4103	1.09347	strong
Using of BIM technology have a positive effect on the time schedule of the project	39	3.5897	1.20782	strong
Using of BIM technology effects, the quality of the project positively and reduces them is takes	39	3.3590	1.06344	average
BIM technology has an effect on sustainability of buildings.	39	3.3590	1.06344	Average
		Mean of this section =3.94		Strong

4.2.2 The main reasons for not adopting BIM technology in some companies.

This part of the questionnaire represents the main reason for not applying BIM technology in construction projects. It consists of 8 variables that determine certain variables, and the frequency of responses and their means are shown in the table below:

Table 4.14: The main reasons for not adopting BIM technology in some companies.

Question	N	Mean	St. Deviation	Result
The high cost of BIM software programs, also the cost of devices (computers) needed Torun those programs.	39	3.0769	1.03580	average
The lack of knowledge with BIM technology by the owners, directors, project managers, and engineers.	39	2.8718	1.10452	average
Inability to adopt new programs and ideas.	39	3.1795	.91398	average
Thinking that currently used programs are adequate and no need to use any of BIM programs.	39	2.8718	1.12810	average
Financial issues might be a main reason for not adopting BIM technology especially in small companies.	39	3.4872	1.04810	strong
The absence of skilled employees who would be able to run BIM programs.	39	3.3077	1.00404	average
Because of the requirements of training (time and money), employees are not be trained.	39	3.4103	1.11728	Average
Government considerations, BIM technology is not adopting by the government and companies may face some troubles.	39	3.3333	1.17727	Average
		Mean of this section =3.18		Average

5. CONCLUSION

We concluded through our research and after obtaining the required analyzes through the statistical analysis program and categorizing them into two types as shown below

5.1 THE FIRST TYPE: ITERATIVE ANALYSIS

This type of analysis relied on the classification of the participants in the questionnaire, both according to their scientific degree, engineering specialization, and the sector in which they work. It was found by collecting data on forty people that the percentage of participants from the civil engineering major is higher than other disciplines, where it constituted approximately 25%, and that the number of participants in the questionnaire Of the PhD holders, they represent 64%, and this is normal, since questionnaire forms were distributed to the teaching staff in Iraqi universities, as well as the largest percentage of workers in the government sector, at a rate of 51%, and this is normal because the universities in which the questionnaire forms were distributed belong to the government sector in Iraq, and the percentage of people 53% of those have more than 15 years of work experience

Public opinions were also surveyed about the use of building information modeling, and many questions were asked, including the most used programs in building information modeling, and the largest percentage was the use of the Revit program

5.2 THE SECOND TYPE: THE USE OF DESCRIPTIVE ANALYSIS

Likert scale was adopted and according to classification from lowest to highest, and many questions were raised about the importance of using building information modeling in construction projects and its role in increasing the speed of completion. Its application, especially in small projects to the high cost when using affiliated programs for building information modeling, and the need to train the cadres who work on it, since most of the cadres are not trained to work on it.

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