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ISTANBUL GEDİK UNIVERSITY
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ADOPT BIM TO IMPROVE CONSTRUCTION MANAGEMENT IN IRAQ AND TURKEY

MASTER'S THESIS

Oras Mustafa MOHAMMED

Engineering Management Department

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SEPTEMBER 2022

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LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ MÜDÜRLÜĞÜ

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Enstitümüz, Engineering Management Department İngilizce Tezli Yüksek Lisans Programı (201281010) numaralı öğrencisi Oras Mustafa Mohammed'in "Adopt BIM to Improve Construction Management in Iraq and Turkey" adlı tez çalışması Enstitümüz Yönetim Kurulunun 01.09.2022 tarihli kararıyla oluşturulan jüri tarafından *Oy Birliği* ile Yüksek Lisans tezi olarak *Kabul* edilmiştir.

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DECLARATION

I, Oras Mustafa Mohammed, declare that this thesis titled "Adopt BIM to Improve Construction Management in Iraq and Turkey" is original work done by me for the award of the master's degree in the Faculty of Engineering Management. I also declare that this thesis or any part of it has not been submitted and presented for any other degree or research paper in any other university or institution. (01/ 09/2022)

Oras Mustafa MOHAMMED

DEDICATION

To my Parents for their love.

To my life partner with me, endless support and encouragement, my dear husband Dr. Ghassan

To my brothers and sister.

To my sons and daughters, to whom I wish to achieve the best.

To all my friends and colleagues

PREFACE

First of all, I would like to thank My God, who helped me finish this thesis.

I would also like to express my thanks to my supervisor Assist. Prof. Dr. Redvan GHASEMLOUNIA for his persistence, concern, and support.

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September 2022 Oras MOHAMMED

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ABBREVIATIONS

3D	: Third Dimension (Depth, Height)
4D	: Fourth Dimension (Time)
5D	: Fifth Dimension (Cost)
6D	: Sixth Dimension (Environment And Energy Consumption)
7D	: Seventh Dimension (Building Information Modelling/ Facility Management
AECO	: Architecture, Engineering, Construction, and owner-operated
AIA	: American Institute of Architects
BIM	: Building Information Modeling
CAD	: Computer-aided design
CIFE	: The Center for Integrated Facilities Engineering
COBie	:Construction-Operation Building Information Exchange
GIS	: Geographic Information Systems
NIBS	: National Institute of Building Sciences
RfI	: Request for Information
RII	: Relative Importance Index

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ADOPT BIM TO IMPROVE CONSTRUCTION MANAGEMENT IN IRAQ AND TURKEY

ABSTRACT

Building information modeling (BIM) is one of the most important modern technologies that have contributed to improving construction project management. Two surveys were conducted targeting engineers and BIM specialists to evaluate the level of using BIM software, BIM (awareness, benefit, challenge), BIM curriculum, motivation factors, rules, and steps to adopt BIM in Iraq and Turkey. The target of this study is to compare two countries**.** This research is the first study handling comparison between Iraq and Turkey in this field. This study conducted many parameters such as Iraq and Turkey are a poor use of BIM software:

1- Training courses in BIM authoring software were 18% in Iraq, while 17% in Turkey.

2-Training courses of BIM Analysis software 3% in Iraq, while in Turkey30%

3-Training courses of BIM Coordination Software 13% in both countries Iraq and Turkey.

Therefore to Build experts in BIM need courses in analysis software and coordination (Navisworks and Archicad) in Iraq and increase courses in BIM coordination in Turkey, but they have a good level in (AutoCAD, Ms. Project, and Excel) at the same time both countries are still in level one of BIM. Most engineers know BIM from their Universities in Turkey. While the majority of engineers in Iraq learn BIM by themselves from training courses. In addition, Iraq and Turkey have awareness of the benefits, limitations, and challenges of BIM adoption. Both countries agreed on the range of salary from (700-1500) $, and the cost of designing with Revit and AutoCAD is (15-20) $/m2. Respondents' BIM specialists agreed on a few steps to adopting BIM in both countries, for example, the government should support BIM technology and put funds and rules to use BIM. Moreover, Set up BIM Committee with clear roles and responsibilities (leadership). Also contracting with international experts with experience in the BIM field.

Keywords: *BIM adoption BIM in Iraq, BIM in Turkey, BIM benefit, and BIM improve construction management*

IRAK VE TÜRKİYE'DE İNŞAAT YÖNETİMİNİ GELİŞTİRMEK İÇİN BIM'İN BENİMSENMESİ

ÖZET

Bina bilgi modellemesi (BIM), inşaat proje yönetiminin geliştirilmesine katkıda bulunan en önemli modern teknolojilerden biridir. Irak ve Türkiye'de BIM yazılımını, BIM'i (farkındalık, fayda, zorluk), BIM müfredatını, motivasyon faktörlerini, kurallarını ve BIM'i benimseme adımlarını değerlendirmek için mühendisleri ve BIM uzmanlarını hedef alan iki anket yapılmıştır. Bu çalışmanın amacı iki ülkeyi karşılaştırmaktır. Bu araştırma, alanda Irak ve Türkiye arasındaki karşılaştırmayı ele alan ilk çalışmadır. Yapılan bu çalışmada Irak ve Türkiye gibi birçok parametrenin BIM yazılımını kullanma konusunda yeterlilik düzeyi ortaya konulmaya çalışılmıştır.

1-BIM yazılımı alanındaki eğitim kursları Irak'ta %18, Türkiye'de %17 dir.

2-BIM Analiz yazılımının eğitim kursları Irak'ta %3, Türkiye'de ise %30'dur.

3-BIM Koordinasyon Yazılımı eğitim kursları Irak ve Türkiye'de %13 olarak ortaya çıkmıştır.

İşte bu nedenlerle, BIM uzmanları oluşturmak için Irak'ta analiz yazılımı ve koordinasyonu (Navisworks ve Archicad) kurslarına ihtiyaç duyulmakta ve Türkiye'de ise BIM koordinasyonun da kursların arttırılması gerekmektedir.

Ancak bunların (Autocad, Ms projet, Excel) iyi düzeyde olduğu, aynı zamanda her iki ülkede de BIM'in birinci düzeyinde olduğu görülmektedir. Çoğu mühendis BIM'i Türkiye'deki üniversitelerden edindiği eğitimle bilgi sahibi olurken Irak'taki mühendislerin çoğu BIM'i üniversitelerdeki eğitim kurslarından kendi başlarına öğrenmişlerdir. Ayrıca Irak ve Türkiye, BIM'in benimsenmesinin yararları, sınırlamaları ve zorlukları konusunda farkındalığa sahiptirler. Her iki ülke de (700-1500)$ maaş aralığında anlaştılar ve Revit ve AutoCAD ile tasarım maliyeti (15-20) $/m2. Katılımcıların BIM uzmanları, her iki ülkede de BIM'i benimsemek için birkaç adım üzerinde anlaştılar; örneğin, hükümet BIM teknolojisini desteklemeli ve BIM'i kullanmak için fon ve kurallar koymalıdır. Ayrıca, Net rolleri ve sorumlulukları olan (liderlik) BIM Komitesi kurun. Ayrıca BIM alanında deneyime sahip uluslararası uzmanlarla sözleşme yapmak.

Anahtar Kelimeler: *BIM'in benimsenmesi Irak'ta BIM, Türkiye'de BIM, BIM avantajı ve BIM inşaat yönetimini iyileştiriyor*

1. INTRODUCTION

1.1 Background

To fulfill the needs of a project in the construction sector, which is a broad, gigantic, and complicated environment, it is necessary to have effective management, communication, and teamwork. Knowledge of Building Information Modeling, often known as BIM, is one of the most cutting-edge architectural, engineering, and construction techniques for achieving sustainability and unified design (AEC). BIM enables real-time change management, which makes it possible to use a shared digital database platform for building, and a high degree of document reprocessing, all of which combine to catalyze increased quality of work, greater productivity, and decreased costs(Howard, 2021). Many companies have created guidelines for Building Information Modeling (BIM), most of which are owners building and managing several facilities (Eastman et al., 2011). After discovering the benefits that this techy can provide to their construction companies, most countries throughout the world have adopted BIM. These benefits include increased coordination and cooperation among the various sections. (Samimpay & Saghatforoush, 2020). But, in the middle east, there is a limitation in using it, like in Iraq and Turkey. One of the main reasons for the acceptance of BIM is spread widely and globally, the power of the application to incorporate virtualized design concepts and clash detection applications. Before construction implementations, provide reports on projects and support, choose the proper project components that have led to the adoption of BIM to increase the construction industry's performance (Hadi, 2020)and (Aladag et al., 2016). Additionally, BIM is the construction industry's future; companies will be eliminated if they do not accept it (Sun et al., 2017). Most problems in constructions project are overrun in time and cost. As a result of the war, Iraq is one of the countries which needs to reconstruct in different sectors and build a robust infrastructure.

In addition, construction projects confront various challenges, many of which can

lead to an increase in the project's total expected cost and a delay in its completion; it is vital to keep these challenges under control (Aletby & Ibrahim, 2021). Turkey lies on the earthquake line and has a big area for construction and significant transportation projects, some of which have used BIM technology. To find the principle of Turkey’s experience and adopt BIM in Iraq in the same way related to USA and UK standards.

1.2 Statement of the Problem

After the war, Iraq had to be converted to a different scooter. The main problem facing the Iraqi construction sector is the lack of appropriate management skills in the project implementation phases of building strong infrastructure, which requires good construction management to avoid costs, over time, and sequence changes. Financial aspects of contractors, improper planning of the contractor, poor management of the contractor on the site, the poor experience of the contractor, insufficient investment of the client, cost of work performed, problems of subcontractors, labor supply, shortage of materials, loss of communication between parties, the unwillingness of equipment and breakdowns and errors during construction are leading main causes of project delays after the expiry of the contract period. As noted in the 2021 study, construction projects have several numbers of risks that lead to project cost overruns not being completed on time. Classifying these risks is a crucial phase of essential management and control. The inability of the owner to finance the project is the leading min risk factor leading challenging construction projects and ranks first in terms of impact (Aletby & Ibrahim, 2021). Therefore, they should adopt successful technology that enhancement construction management in all departments. In another hand is chosen Turkey to find the level of BIM adoption in construction, especially since Turkey has a challenging environment and a vast constructions industry area; Turkey is known to be organized in the list of the 250 largest contractors in the world, with 46 companies having the second most companies after China in 2018 (Zhou et al., 2019) .as the study showed in 2020 that Turkey has a position at beginner’s level of BIM. Turkey is also seen in a transition period in implementing BIM, and there are several boundaries regarding BIM in Turkey. The countries that have already experienced this transition and are succeeding in implementing BIM can be a reference for Turkey's more effective

transition period (Toklu & Güzelçoban Mayuk, 2020). Another study conducted in 2021 demonstrates the considerable challenges that contractors must overcome and their requirement to utilize BIM technology in the management of construction schedules

1.3 The Aim of the Research

This study aims to help BIM adoption, improve construction management, and investigate the level of BIM in the construction sector for Iraq and Turkey and how to start putting an organizational BIM guide in its importance.

a. To evaluate the level of experience in BIM technology between Iraq and Turkey.
b. Compare BIM software (design, schedule, and coordinate)used in Iraq and Turkey.
c. Diagnostic of the barriers against implementing BIM and what the curriculum needs to adopt it.
d. Define the steps to adopt BIM.as one of the advanced technologies in (managing, designing, implementing construction projects, and monitoring them throughout the life of the building.

1.4 Methodology Overview

During the procedure phase, known as the preliminary work, a first technique review of the previous research on the subject of the study was carried out. The literature research focused on building information technology in the construction environment, the concept of building information modeling (BIM), the benefits of implementing BIM in construction management, and the use of BIM in the construction industry context following are the stages that make up the research procedure:

The research searched for the desired articles using the following databases and was successful in our search.

- Google Scholar (http://scholar.google.com),
- Science Direct (http://www.sciencedirect.com),

- SpringerLink (http://link.springer.com) and compile a wide variety of materials, such as books, theses, articles, reports, and journal and conference publications databases.
- Classify the previous research on adopting BIM according to the benefit and challenges of construction project management.
- Finding the factors limiting the adoption of BIM and how can support this technology to improve construction management.
- Design questionaries survey to stand on the status BIM on Iraq and Turkey and how can take serious steps to adopt BIM technology by the focus on education ground to adopt and improve construction management.

1.5 The Questions and Goals of the Research

Fundamental research issues are broken up into two components based on an analysis of the current condition of affairs, which are as follows:

1-Questionnaire for (engineers in companies and universities) in Iraq and Turkey.

- Find the awareness and level of BIM software, challenge
- 2-qusionnaire for BIM specialist
- To evaluate the level of BIM software like (Revit, Navisworks, and management software, find if there is a BIM curriculum at Universities and motivation factors (cost of 3D design, engineers' BIM employment).
- Find which BIM guide is used.

1.6 Importance of Study

The study's main objective is to identify the obstacles that face or prevent the application of BIM technology in construction management in Iraq, compared with the Turkey process in BIM, and put the solution to adopt BIM as soon as possible. To clarify the desired return from the application of BIM technology at the level of the construction industry and to raise it to a higher level through the introduction of programs covered by the BIM and laying the foundations for a curriculum at the university that adopts this technology, adopting its teaching, training students, and benefiting from the experiences of neighboring countries in this field.

1.7 Overview of Thesis

The thesis contributes to the rapidly expanding field of research known as BIM by examining and analyzing the BIM implementation process from various perspectives, including the academic sector. The thesis's overall framework is four further chapters after this introductory chapter.

The first part, the introduction (Chapter 1)

- A review of the existing literature (Chapter 2)
- Create survey questionnaires, upload them to the platform, and distribute them via email to academic institutions, businesses, and industry professionals (Chapter 3)
- -Analysis of the results using the Spss program (Chapter4)
- -Conclusion (Chapter 5)

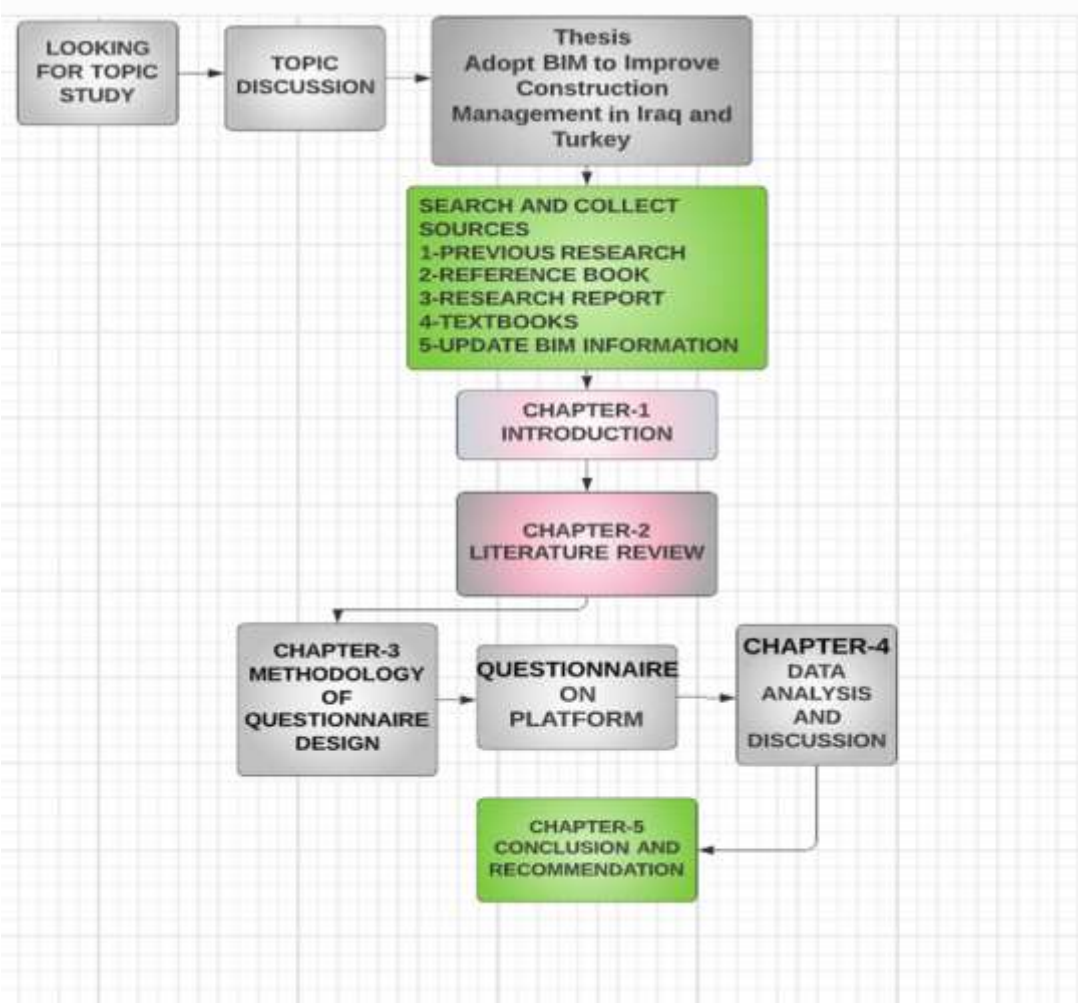


Figure 1.1: Framework for Research Stages

Source: Author

2. LITERATURE REVIEW

Many studies, books, reviews, and articles in this literature have been gathered regarding the implementation of building information modeling (BIM) in construction projects, its advantages, and the difficulties it presents to management. So, what is BIM? what is the BIM advantage, challenge, and barrier to adopting a BIM technology? What is the requirement to adopt it? What is the level of BIM awareness? in Iraq and turkey according to comparing with advanced countries in this aspect?

2.1 Building Information Modeling (BIM) Technology

As a general term, BIM idea approaches are not new, and methodologies have been studied to identify for many years. A working prototype presents one of the early documented examples; the Building Description System, which was presented by Chuck Eastman, known as the "Father of BIM," in 1975.(Chuck Eastman et al., 2008). Since that time, most businesses and academic institutions have focused their attention on research associated with CAD due to the widespread adoption of CAD in the construction industry; in the last decade, various studies related to BIM technologies have been conducted. Many new BIM terminology has sprung up due to differing viewpoints on what constitutes an intelligent building and where research efforts should focus. Such as Building Product Models, Asset Lifecycle Information systems, Building SMART TM, Virtual Design and Construction, nD Modeling, and 4D Product Models are all part of the Building SMART TM integrated design system (Succar, 2009). Meanwhile, Jerry (Laiserin, 2010) popularized the term BIM in 2002, but no consensus exists on what it means. The National Institute of Building Sciences predicts that BIM will play an increasingly important role in the de future design and construction of new buildings (Project Management Institute, 2008). There are several benefits for all stakeholders and society when BIM is used in various construction project stages. As shown, Table 2.1 demonstrates that most descriptions of BIM not just describe a model but a modeling process or activity

rather than a model. As well, BIM characteristics can be seen in the following descriptions.

- It is a collection of datasets that include all of the information there is to know about a structure. It allows all project stakeholders to manage this data over the entire project lifecycle.
- It is modeling technology and a combined process used to create a building data model; this model is an intelligent and parametric numerical description of the building.
- It has the potential to improve communication, coordination, collaboration, and cooperation significantly. Additionally, it can reduce building waste and provide a reliable basis for decisions throughout the entire building lifecycle.

Table 2.1: BIM descriptions

An institution or researcher	**Description**
GSA (2007)	BIM is the turn of events and utilization of a complex program information model that archives a structure configuration and recreates the development and activity of another capital office or a capitalized (modernized) office. The model created is a data-rich, object-based, intelligent, and parametric digital description of the facility. It can be used to obtain views that are appropriate to the needs of various users, and these views can then be analyzed to generate feedback on and further develop the facility's design.
NIBS (2007)	BIM service's physical and functional characteristics are interpreted numerically to provide information and share a facility that forms a consistent basis for judgments during its lifecycle from starting forward.
(c. Eastman et al., 2008)	technology A modeling and combined set of processes for producing, analyzing, and sharing, building models
Organization or Researcher	Description
Harness (2008)	A digital representation of the project's structural and functional details is known as a building information model (the model). The method and tools used to generate the model are known as BIM.
Autodesk (2012)	BIM is an integrated approach that dramatically enhances project understanding and makes it possible to predict the results. Because of this perspective, every member of the project team can maintain coordination, improve accuracy, reduce waste, and make well-informed decisions early in the process, which all confirm the project's successful completion.
Tekla (2013)	The method of modeling and the construction of a building in detail to benefit the whole building development.

Source: (Sun et al., 2017)

2.1.1 BIM Phases

BIM can be applied to the digital building in every phase of a construction project lifecycle, from early starting design to demolition (Chuck Eastman et al., 2008), (Azhar et al., 2010) ,(Borrmann et al., 2018)). BIM capabilities may establish relationships between project activities and the 3D building elements, enabling construction experts to check constructability before the construction stage (C. Eastman et al., 2011) . The dimensions of BIM and the tasks presented in each size vary from (2D to 7D) from other resource research, as shown in Table 2.2 and Figure 2.1.

Table 2.2: BIM Facility

Phases of BIM	**Description**
2D- BIM	Capability of Description
3D- BIM	3D (length +width +high) Model Project visualization, Clash detection
4D-BIM	3D + Construction Planning and the Visualization of the Time Schedule
5D-BIM	4D+ cost is used for cost checking and cost analysis. Creating the building plan is one of the most important parts of the project life cycle. The main task is to specify the building work's cost, including income.
6D-BIM	5D BIM + Facility Management Life cycle, Data catching/Observing (sustainability) is used for evaluating dynamic productivity during the project and operation stage
7D -BIM	6D + Life-Cycle Management (facility management) is used for collecting vital information about a building's operation and maintenance state and devices during their lifetime

Source: (C. Eastman et al., 2011; Howard, 2021; Mesároš et al., 2019)

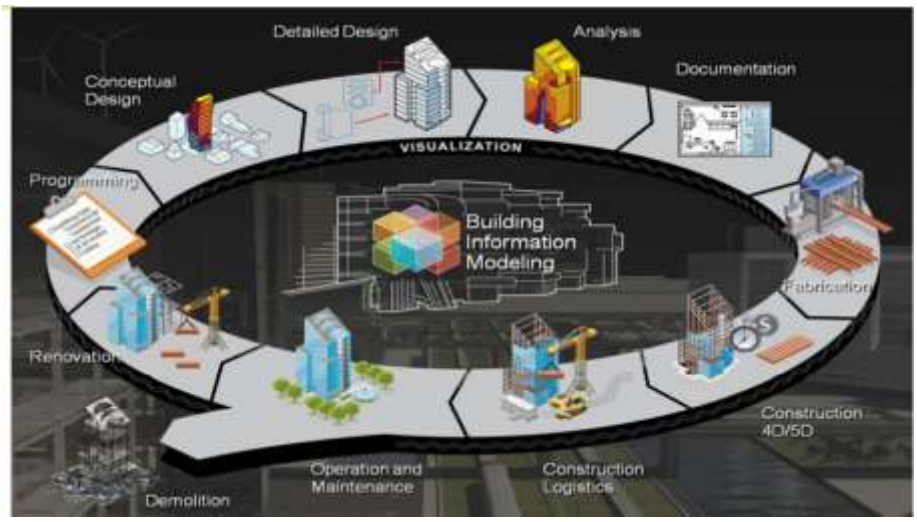


Figure 2.1: BIM used in the different construction lifecycle

Source: (Hamada et al., 2016)

2.2 Where are Dimensions -BIM Used in Construction Management?

BIM technology presents a lot of functionality and is a valuable tool in construction projects and project management. BIM modeling may permit facilities managers to submit the picture in the future at a much earlier stage, where they can affect the design and construction.

BIM allows give visual nature for all stakeholders to get important information before the building is completed and after completed (Azhar et al., 2010).

A building information model (BIM) can be applied for the following functions:

2.2.1 Visualization

3D views, renderings, and walk-throughs can be easily generated. BIM helps clients and owners better understand by visually providing an accurate multi-dimensional model (Hadi, 2020).

2.2.2 Change management

Change: Any building part is automatically changed and coordinated with all the other parts. BIM solutions are unique at this point because they provide the tools for managing and changing relationships within the data (Howard, 2021). Hence develop a shared platform to swap information, tracking of construction activity, reporting on construction issues by connecting all the data by BIM (Hadi, 2020).

2.2.3 Code checking

Local building departments can approve projects under their jurisdiction using building information models. T Fire departments and other authorities can use these 3D models to examine construction developments.

2.2.4 Clash detection

As early as possible in the process, 3D building information models are created. This allows all major systems, such as piping, plumbing, construction equipment, and sheet metal ductwork to be visually checked for time-space conflicts during the preconstruction phase. This results in fewer changes and savings in terms of time, effort, and cost.

2.2.5 Production

The building systems from 3D building information models more quickly and easily created the shop drawings than in traditional mode. Cooperation and Communication: one building information model has all the information, planning, building equipment, the members, building materials, and everything else is joined and shared by it.

2.2.6 Time and cost management

Deliverables known as 4D are based on models and can be utilized for constructability analysis, project delivery timelines, planning of material requirements, and cost estimation.

2.2.7 Facilities management

The primary goal of BIM 6D is to increase the effectiveness of FM practices, which overlaps with the performance of the building over its entire life cycle. Hence its sustainability (Nicał & Wodyński, 2016). 6D BIM can be used for space management, 5D with the location, which needs adding a geographical information system and BIM. With GIS incorporation, all the project site cases present detailed information about the area (Samimpay & Saghatforoush, 2020) and maintenance operations in facilities management (Sun et al., 2017).

2.2.8 Green building

7D BIM can be transferred into other software programs to analyze further the building's comfort, lighting, energy performance, etc.

So, most BIM dimensions specifications match project quality management requirements, as shown in Figure 2.2 and Table 2.2.

In adding to the seven dimensions stated above, there is now an open three "new dimensions of BIM" under discussion, including:

8D REAL AS BUILT, LOD LEVELS OF DETAIL. To give three-dimensional modeling according to information, levels, and volume of work using laser scanning, augmented reality, and drones.

9D LEAN CONSTRUCTIONS. Work methodology is used for the practical completion of the BIM process as part of the construction sector's production structure and digitalization.

10D INDUSTRIALISED CONSTRUCTION. To improve all stages of work, design, implement and manage the infrastructure using the Lean Concrete environment in the BIM.

Figure 2.2: Project Quality.

Source: (Project Management Institute, 2008)

Table 2.3: BIM improves project management

Project Quality Management Overview			
	Plan quality management	Manage Quality	Control Quality
BIM	✓	✓	✓

Source: Author

2.3 Potential Advantages of BIM Adoption

2.3.1 Advantages of BIM in construction management

Many researchers have investigated the positive aspects of implementing BIM. BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors discusses the benefits of each of the four construction stages: pre-construction, design, construction and creation, and post-construction, even though some of the benefits they confer are not currently available

but can be anticipated as BIM technology develops. These stages are pre-construction, design, construction and creation, and post-construction (Chuck Eastman et al., 2008). The management of costs, schedules, and even safety measures may all be accomplished with BIM in construction projects. Fulfilling the owner's requirements is the goal of any building project, and the owner's motivation is the single most critical utilization (Dinesen 2010). They are taking advantage of the benefits of BIM daily by incorporating it into the workflow – beginning with the feasibility study and continuing through facility management BIM (BIM Essential Guide for BIM Adoption in an Organization, 2013). The technological component of Building Information Modeling (BIM) enables members of project members will be created in a simulated setting, which can help identify potential problems with the building's design, construction, or operation (Azhar et al., 2015). A failure in communication and data management costs the construction industry approximately 15.8 billion dollars each year, which accounts for 3-4 percent of the industry's total turnover; the success of building projects requires more collaboration of different disciplinary by sharing accurate, continuous, and real-time information among project team members to resolve conflicts and keep a project on time and within budget (Gallaher et al., 2004). Another researcher summarizes eight benefits of BIM: accurate geometrical description, more rapid and efficient processes, better design, controlled whole-life costs and environmental data, better construction quality, automated construction, better customer service, and lifecycle data (Azhar et al., 2011). BIM integrates design, schedule, and cost information to help a project team enhance the productivity of the planning and estimating activities. Design-cost integration supports the automatic calculation of quantities, thus shortening assessing time and eliminating the duplication of effort in current estimating practices (Ali, 2010). There is an 8–15 percent According to case studies of construction projects that use BIM; there is an 8–15 percent savings on new projects and up to 35 percent on repeat projects result of reusing information, having more (and better) decision-making information earlier, and performing better early-phase analysis (Jernigan, 2007) The building information modeling (BIM) technology represents the current, and it is a valuable tool for construction projects. Cost management is an essential component of construction project management, and precise and information-based cost, management substantial management of construction projects. Managing costs clearly and accurately manner is all to the success of construction projects. A lot of

functionality includes cost management which must produce by BIM technology; the most significant benefit of BIM technology is quality of documentation and cost reduction (Mesároš & Mandičák, 2017). The use of integrating BIM in facility management (FM) for operational cost efficiency, reduce time of decision, resource for taking a decision, improve documentation system, cooperation, and work flexibility, restructured information, and clash detection. In a review of risk management through BIM and BIM-related technologies in 2017, the application of BIM, from a safety management viewpoint, permits an organization or teamwork to save time and effort (Zou et al., 2017). Most of the savings were from eliminating clashes(Sun et al., 2017). The most important advantage of building information modeling (BIM) is the precise geometrical representation of a building's components in an integrated data environment (Mitchell, 2007) Other benefits connected to these quicker and more efficient procedures are that information may be exchanged more easily, has value added to it, and can be reused. A better design is possible because building concepts can be thoroughly studied, simulations can be run fast, and performance can be benchmarked, all of which make it possible to develop enhanced and original solutions.

BIM technology can be used during the design stage to reduce claims during execution by 55.2%so that the functions of this technology can reduce the probabilities of claims rate on construction projects in Iraq (Ibrahim & Al-Kazzaz, 2021). In 2021study, BIM applications are more practical at predicting the practicality of a possible reconstruction solution and preventing unexpected construction failures in Iraq by using BIM applications (Saeed et al., 2021)). Summarizing the benefit of BIM through the literature:

- Benefits of using BIM according to the project's objectives for getting them constructible and lowering delays, repetitions, time, and cost.
- Increasing communication and combination through creating an appropriate setting using BIM
- Educating employers more on emerging technology to appease them and lower the project's likelihood of success. (Samimpay & Saghatforoush, 2020). BIM can manage the requirements, design, construction, and operating information involved in the facilities management lifecycle. The

Center for Integrated Facilities Engineering (CIFE) at Stanford University conducted research in which BIM was applied in 32 significant projects. Previous studies indicate that the adoption of BIM provides the following benefits (Autodesk, 2003; Azhar et al., 2010; both, 2012; C. Eastman et al., 2011; Howard, 2021):

- Cutting costs while simultaneously boosting the precision and throughput of cost estimations
- Try to avoid collisions (up to 10 percent of the contract value is saved by detecting clashes).
- Reducing the length of time (up to 7 percent reduction in project time).
- Ensuring lower total expenses over the asset's lifetime using environmentally responsible design.
- Making construction coordination easier to achieve.
- Modification orders, which cut down on the number of information requests; and (up to 40 percent elimination of unbudgeted change). Assisting with the production of building paperwork.
- supporting the building project's simulation and visualization.

In 2017 research produced the Exploitation and Benefits of BIM in Construction Project Management is a more significant impact rate achieved for Companies that used BIM technology than companies that don't use BIM technology. Cost reduction by using BIM technology is often the reason for the implementation of BIM technology by companies(Mesároš & Mandičák, 2017). The research in 2019 showed adopting BIM Technology for safety managers to prevent fall accidents by using the model to give a clear picture of the workplace in all its details, identifying risks, then giving:

- Identifying the protection systems necessary for each chance with excellent facilities.

Also, increase safety communications and create a safe schedule for the project. The possibility of using this model as a training system for employees to clarify the risks they will face on the worksite.

➢ Prevent any conflicts resulting from using safety equipment and thus prevent any excess time or cost. At the same time, traditional methods based on two-dimensional drawings do not have these features (Abed et al., 2019). From all the above, BIM manages all construction industry processes through sharing data, as shown in figure 2.3.

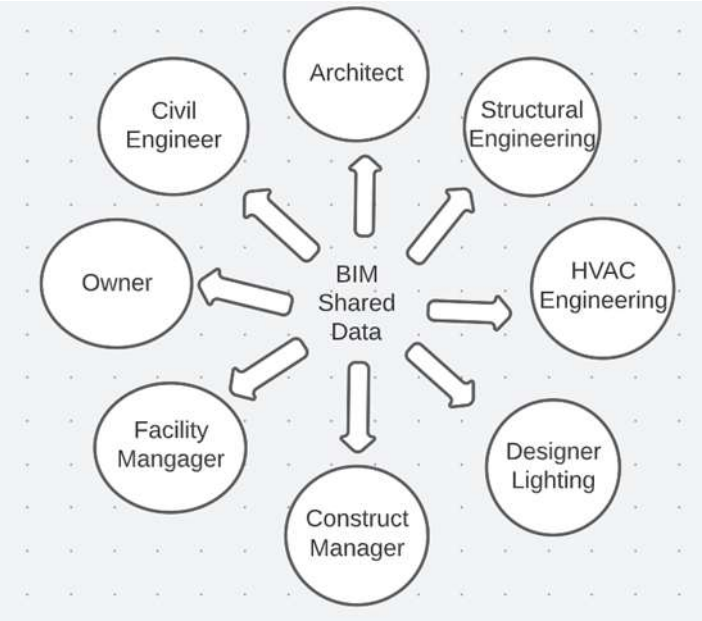


Figure 2.3: BIM shared data.

Source: (Eastman et al., 2011)

2.3.2 Challenges and barriers to using BIM in Iraq

There are lots of thesis research and articles in Iraq which refer to awareness about this technology, but at the same time, Adoption challenges exist in the building industry. In 2017, a survey and analytical evaluation of the Benefits and Barriers of using BIM in construction projects; It is strongly advised to form a committee, carry out a vertical analysis of all the obstacles, and conduct a thorough feasibility analysis of the complete combination (Al-Zwainy et al., 2017). Furthermore, to adopt BIM technology in the Iraqi construction sector, mainly when projects expand, construction preparation and implementation need management techniques and tools are becoming critical, BIM appears recently and solved all complex essentials for projects efficiently (Politi, 2018). Iraq has a weak BIM implementation, with a non-use rate of more than 60% and a potential rate of 75% (Ahmed & Altaie, 2021). The biggest barrier facing BIM is the weakness of companies to adopt BIM in Iraq has been indicated through research based on professional's needs and the requirement

for a government effort to utilize BIM in the construction industry, due to the o lack of experienced experts in BIM applications come in first barriers, lack of support from governments came in the second due, and the third reason is the high cost of BIM software and hardware (Hamada et al., 2016). Thus, professionals are unwilling to let go of the traditional know methods, due to improper training and education on BIM applications because of the lack of knowledge and understanding of how BIM applications could be improved in the Iraqi construction industry (Hadi, 2020). The Iraqi construction industry is not prepared to invest in building information modeling (BIM) because many engineers are content with the traditional methods for the design of projects, there is no leadership from the government, and there is a lack of backing from senior management (Alsaeedi et al., 2020). In another research, the most important barrier to its implementation was the unnamed responsibilities of data co. In contrast, while the least important obstacle was the lack of program efficiency in data exchange and internal collaboration, relative importance (Al-Zwainy et al., 2017b). Requires expertise dealing with information extracted from the Revit software, management and understanding of databases for the program, optimal management for databases within the Revit program to fit with any other project, and all information inserted to configure the model in BIM Revit is available for use in Navis work management (Erzaij & Obaid, 2017). Companies face cultural barriers, believe their software is more accurate than 5D BIM, lack standards for coding building information model objects, and lack the experienced personnel to embrace this technology (Hasan & Rasheed, 2019). Other studies showed that the most significant barriers are lack of authority's support, lack of need, lack of a national specification for BIM, absence of experts, resistance to change towards new technologies in the social and habitual, Weak education and training in universities (Maad et al., 2020),((Hatem et al., 2018). Contractual and legal problems, such as who owns the model, could also become an issue. Who oversees updating the BIM model? And whose fault is the model's accuracy? (Azhar et al., 2015). As well as the study on adopting BIM in 2020 showed legal barriers, organizational barriers, and technological Barrier's cost of new software and hardware with high efficiency, as well as a lack of sufficient training for the company staff on BIM application (Shibani et al., 2020)(Shibani et al., 2020). The biggest factor affecting project time, cost, and quality are enterprises, organizations, and institutions' conviction that their current programs are sufficient for implementing new Employees'. employees'

insufficient BIM training and lack of familiarity with BIM procedures (Ahmed & Altaie, 2021).

2.3.3 Challenges and Barriers to Using BIM in Turkey

The purpose of the study in 2016 was to examine the difficulties and advantages of BIM applications in Turkish construction enterprises, showing that the most important barrier related to the project is the lack of encouraging or mandatory contractual clauses. Effective leadership of construction companies is an important obstacle to the use of BIM in Turkish construction companies regarding the adoption of BIM models. Finally, the high cost of computer hardware and software used in the BIM is indicated as one of the technological shortcomings of stakeholders seen as an essential in the organizational culture of the Turkish construction companies (Aladag et al., 2016),(Kocakaya et al., 2019). In addition, it does not have the necessary legal infrastructure to create essential BIM associations. The mandatory application of BIM must be taken into consideration, which is of utmost significance for those who produce strategies and are specialists in the industry in terms of improvement. However, the application of BIM is restricted due to a lack of understanding in this area, and lack of competence and experience. Other impressive specialties are that Building Information Modeling (BIM) is being taught at multiple universities in Turkey, that certificate programs and BIM specialists are being developed, and that BIM is being implemented in construction projects in major cities. However, there are many technological problems, and challenges involving skills and training, and there are no legislative regulations regulating the utilization of BIM. In the not-too-distant future, it is necessary to ensure that Turkey will be accepted into the BIM framework, and in this regard, regulation is required to be ordered (Kalfa, 2018) Another thesis in 2019 has aimed to find the key to “Knowledge Transfer Partnership for BIM implementation in the AEC Industry in Turkey “ and showed the BIM execution process has effectively begun in Turkey as a portion of the government super activities have as of now adopted BIM innovation and have turned into a key learning center point for all AEC firms in Turkey. Unfortunately, a couple of quantities of firms are carrying out BIM innovation and the explanation for that was the presence of many difficulties, the absence of data assets, the requirement for an unmistakable vision, and tracking down the right method correct (Al-Maabreh, 2019). According to 2020 studies, Turkey is in a transition period in terms of BIM

implementation, and the main reason for the need to integrate BIM with other technologies is a lack of ability to exchange data with several standards competing for data management within the project team and external organizations. As a result, it is necessary to continue working on a standardization process to improve the use of BIM technologies and their anticipated benefits while avoiding conflict with legal challenges (Sarı & Pekeriçli, 2020). Challenges with revising the schedule to account for construction upgrades and quantities are caused by a lack of investment in the BIM implementation process (Saraç Çıracıoğlu & Yaman, 2021) These are essentially summed up as follows (Toklu & Güzelçoban Mayuk, 2020):

- Absence of public standards, guides, and regulations about BIM,
- Shortage of technical personnel and lack of employees at a high level of BIM field as well
- Not working of subcontractors of project participants with BIM,
- Absence of government support to use BIM.
- Lack of BIM execution plan.
- High costs of software and hardware.
- Few institutions providing training for BIM, such as (Kalfa, 2018):
- ITUSEM (Istanbul Technical University)
- INFOTRON BIM Consultancy and Training Services
- Lack knowledge about the contribution of BIM to the construction sector.
- Lack of competent technical personnel in companies offering consulting service

Although the challenges are as follows (Khemlani, 2004) as mentioned by (Alder, 2006)

- ❖ Overcoming change resistance.
- ❖ Creating a new workflow from the existing design process.
- ❖ Training for the new software.
- ❖ Superior hardware.
- ❖ File sizes are large (Ali, 2010)

Table 2.4: Barriers Facing BIM Implement in Iraq and Turkey

Challenges and barriers to using BIM						
	Resource	**Lack in Education**	**Technology cost Software, hardware and training**	**Legal lack**	**Resistance to change**	**No standard**
Iraq	(Hamada et al., 2016)(Abed et al., 2019),(Alsaeedi et al., 2020),(Al-Zwainy et al., 2017),(Hasan & Rasheed, 2019), (Maad et al., 2020), (Erzaij & Obaid, 2017),(Hatem et al., 2018),(Shibani et al., 2020)	✓	✓	✓	✓	✓
		✓				✓
		✓				
			✓			✓
					✓	
		✓				
			✓			
					✓	✓
			✓			
					✓	✓
Turkey	(Ahmed & Altaie, 2021)	✓				
	(Toklu & Güzelçoban Mayuk, 2020),(Kalfa, 2018)	✓	✓	✓	✓	✓
		✓	✓	✓	✓	✓
	(Aladag et al., 2016),(Kocakaya et al., 2019)		✓		✓	✓
	(Al-Maabreh, 2019),(Feliu & Rodríguez, 2017)		✓			
	(Kalfa, 2018)	Taught in several university				Working on
	(Saraç Çıracıoğlu & Yaman, 2021)		✓		✓	✓
			✓		✓	

For the suitability of analysis, all the factors in the above list are classified into five categories:

- Education (lack curriculums, need to educate BIM professionals)

- Technology Cost (“cost of specialized software and hardware then training cost)
- legal lack “contractual environment”, “responsibility between stakeholders” and “ownership of the BIM data and its copyright”
- Resistance to change (to adapt to the new advanced technologies, the problems caused by changes in the workflow should be treated actively.
- No standard (a guide to using BIM according to organizations necessities)

2.4 The Implementation of BIM in the World

Nowadays, developed and under developing countries have been trying to adopt BIM. While some countries such as the USA, United Kingdom, Singapore, Scandinavia Countries, Germany, France, Japan, Australia, Hong Kong, China, and Brazil were Highly provided adoption levels, other countries did not provide them. The adoption of BIM has been increasing day by day all over the world because building information modeling has become essential for efficient project management, better coordination, communication, visualization. Most countries have strategies to implement BIM technology. The UK, the US and the Nordic countries are innovators in these approaches. Critical strategies for successfully using BIM in these countries incorporate strong government support and management, more improvement of BIM standards, education and training on BIM certification and BIM technology (Smith, 2014) (Ademci & Gundes, 2018). The increasing commercial and living demand in the fast expansion of major cities in China, increasing scale, complex, and tall buildings have been built to meet. However, the efficiency of project management and investment is not always satisfactory. A seven-dimensional building information model (7D BIM) is developed to do this, a 3D BIM is firstly developed, which consists of architecture model, equipment model, steel framework model, other solid models, etc. a1D schedule management model, and a 3D project management model (request management, initiative share management, and process management) have been integrated into the 3D BIM, thus starting a 7D BIM for a complex project is very important to know what software is working to use BIM systems properly and to select the software to be used correctly (Wang & Liu, 2020)(. Quality of documentation and cost-reducing is the biggest

benefit of BIM technology, which was based on Slovak construction companies and confirmed the impact of BIM on cost-reducing. Companies that used BIM technology achieved a bigger impact rate than companies that don't use BIM technology. BIM technology has an impact on cost-reducing. This is often the reason, why these companies want to implement BIM technology (Mesároš & Mandičák, 2017).

Best practices for new BIM users in four categories of the education requirement, infrastructure requirement, sound practices, and working with partners with no previous BIM experience in developed and developing countries (Sahil, 2016). One of the most important and major projects produced by BIM is the Istanbul New Airport project (Acar, 2019), which was completed in 2018 and has a total construction area of 76.5 million m2. Some of the projects produced with BIM in Turkey are listed below (Erdik, 2018), (Inusah, 2018), (Acar, 2019). Evaluating the list shows that large-scale projects such as airport, subway, and hospital projects have started to be produced in the country with BIM. Later, the use of mixed-use buildings began to become widespread. When the projects and applications are examined, it can be said that the awareness of BIM in the public and private sectors has been increasing in the last 5 years. One of the most important and major projects produced by BIM is the Istanbul New Airport project (Acar, 2019), which was completed in 2018 and has a total construction area of 76.5 million m2. Some of the projects produced with BIM in Turkey are listed below (Erdik, 2018), (Inusah, 2018), (Acar, 2019).

- Okmeydani Education and Research Hospital (2015-2016)
- Emaar Square Mall (2013-2017)
- And Pastel Housing Project (2016-2018)
- Ataköy-Ikitelli Metro Line (2016-2019)
- Dudullu-Bostanci Metro Line (2016-2019)
- The Istanbul New Airport project (2019)

On the other hand, looking at the usage rate of BIM in Turkey, although many survey studies have been done on this subject, the report covers the 2018 Turkey BIM report (Toklu & Güzelçoban Mayuk, 2020). When the standards and concepts related to

BIM are considered based on experience, it is seen that those with experience between 1-3 years have more knowledge (Basyazici, 2018). Despite other countries have mandatories using BIM, but in turkey Amandatoryat railway projects in Turkey since 2014. Especiallyin Singapore, it has been usedfor all projectsover 5000 m2 (Toklu & Güzelçoban Mayuk, 2020).

2.5 Comparing BIM Guide

2.5.1 Comparing BIM USA and UK Guide with Iraq

The Organization's BIM Standard should define clearly the "what" and "how" to create a BIM model at a particular stage of a project to meet a particular objective (BCA acknowledges, 2013). A similar investigation between BIM Standards and Guidelines in UK and USA. The aftereffects of the investigation uncovered the likenesses and contrasts in the depictions of BIM principles and rules of these two nations. The comparable parts of BIM that can be taken on in the Iraqi principles and rules of BIM are the circumstance of involving BIM in the development, activity, and support stage, the plan procedures, just as the elements of BIM (3D, 4D, 5D). In expansion, there are comparative strategies for a computerized association for data the executives and trade, comparable techniques for an advanced assortment of data/COBie, and comparative strategies for a computerized association for data security. Other comparable perspectives are the incorporation and interoperability in a computerized portrayal of data in BIM, the correspondence and sharing strategies, and the planning group work process approach. Then again, there are changed perspectives on the BIM norms and rules in UK and USA. There is a distinction in the circumstance of involving BIM in the plan stages. As the UK norms decide the planning cycle in a particular arrangement inside four degrees of (0,1,2,3). As opposed to the guidelines of the USA, which give adaptability in demonstrating as per the need inside five degrees of subtleties (LOD 100 to 500). Additionally, the UK guidelines characterize the 6D model for activity and support of the building, and the 7D model for manageability, while the USA guidelines characterize the 6D model as the manageability model and the 7D model as the activity and upkeep model. Furthermore, there is a variety in the grouping frameworks of building data, as the UK embraces the Unclassy and the USA embraces the Omni Class(Ibrahim & Al-Kazzaz, 2021).

2.5.2 Comparing BIM between the USA, UK Guide and Turkey

The innovative countries in BIM application such as USA and UK have still experienced Level – 2, however, Level – 3 stages have taken place in future targets of the government programs (UCL, 2015). Thus, the undiscovered nature of BIM has its own not only useful but also regulative challenges. In the following phases of the research study, regulative gaps in BIM implementation in Turkey have been investigated regarding the case in the USA and UK.

Regulatory gaps in BIM implementation in Turkey as shown in Table 2.5. The USA and UK officially publish BIM documents to regulate the BIM practices and provide guidance to practitioners to efficiently use BIM. Still, BIM has not been fully implemented in any of the countries. BIM execution has been divided into three capability stages Level – 1, Level – 2, and Level – 3 (Isikdag & Underwood, 2010).

Table 2.5: BIM in terms compare with USA, UK, and Turkish BIM practice documents

Document Type	USA	UK	Turkey
Model development and Responsibilities of Parties	completely	completely	No activity
Model Sharing and Model Reliability	completely	partly fully	No activity No activity
Interoperability / File Format	completely	completely	No activity
Model Management	completely	completely fully	No activity
Intellectual Property Rights			
Requirement for BIM Execution Planning	Fully	Partly – Indirectly	No activity
BIM Project Reviews	Fully	Completely Partly – Indirectly	
Model Element Authorship	Fully	Completely Fully	No activity

Source: (Sarı & Pekeriçli, 2020)

Table 2.6: BIM in terms compare with USA, UK and Iraq BIM practice document

Document Type	USA	UK	Iraq
Model development and Responsibilities of Parties	completely	completely	No activity
Model Sharing and Model Reliability	completely	partly fully	No activity
Interoperability / File Format	completely	completely	No Activity
Model Management			No
Intellectual Property Rights	completely	completely fully	activity
Requirement for BIM			No Activity
Execution Planning	Fully	Partly – Indirectly	
BIM Project Reviews	Fully	Completely	
		Partly – Indirectly	No Activity
Model Element Authorship	Fully	Completely Fully	

Source: Author

2.6. BIM (Hardware and Software)

This section defines the BIM environment needed to support the organization in delivering a BIM project. A typical BIM environment consists of the following:

1. List of commonly used software for each task.
   - BIM authoring software
   - BIM reviewing software
   - BIM Coordination software (Best program to deal with BIM is the Naviswork program
   - Analysis software
   - Others
2. Hardware that can run each software with a substantial model comfortably

3. Document management system or project coordination workspace and protocol to house, manage and share the BIM models created within the organization and with external project partners (BCA acknowledges, 2013).

So, the regular projects team consists of:

1. BIM Manager
2. Coordinators
3. Modelers

2.6.1 BIM Assets Management

Many software available can convert 2D design data into a 3-D model. These models can rotate the entire structure to view any side or zoom in on a particular design element. BIM software is not designed analysis software and is intended to evaluate the design's structural integrity but rather to analyze potential errors, omissions, and conflicts within the various design elements. The industry-recognized software is as follows:

Revit by Autodesk, Bentley ® Systems, and Graphisoft ®. This software's compared below:

2.6.2 Revit package

Review of BIM Software Packages Based on Assets Management

Revit Architecture software is Autodesk's product of BIM software; it is created to work the way you think, so you can develop naturally, design freely, and deliver professionally. And because it is purpose-built for BIM, any change you make—anytime, anywhere is automatically coordinated throughout your project. Designs and documentation stay coordinated, consistent, and complete. Revit offers the following compatible modules as shown in Figure 2.4.

- Revit Structure
- Revit Architecture
- Revit MEP

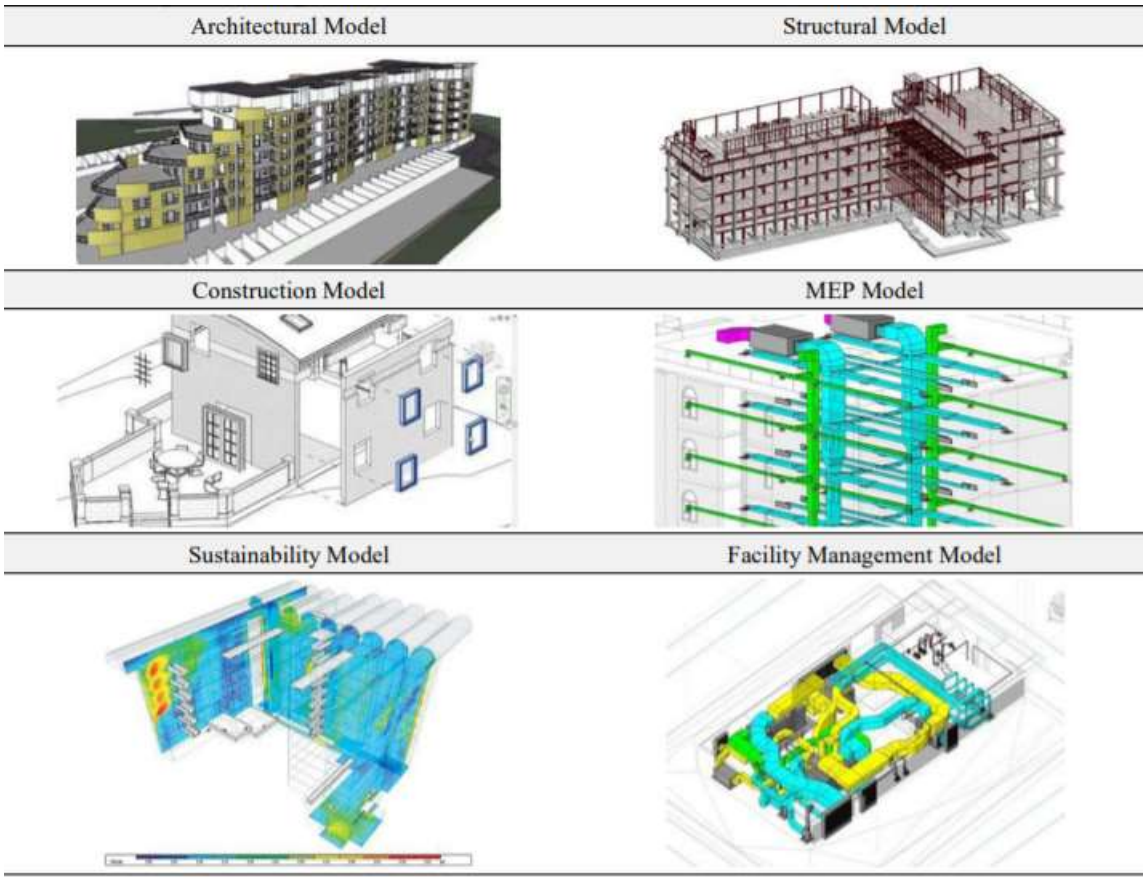


Figure 2.4: Revit Package

Source: Google

2.6.3 Bentley Packages

The Bentley system is based upon the Microsoft Station technologies. Bentley has specific capabilities that Revit cannot perform very efficiently, but these additional capabilities have limited applications. It is considered a more robust program than Revit but requires more programming and developmental costs to implement the systems. The Bentley systems are used extensively by the Army Corps of Engineers

2.6.4 ArchiCAD by graphisoft packages

The Apple Macintosh platforms used ArchiCAD started in the early 1980s. ArchiCAD was the first computer-aided design (CAD) product to be used on a personal computer with 2D / 3D capabilities. The Graphisoft product lets users create 3-D structures with “smart objects” such as walls, slabs, roofs, doors, windows, and furniture. 2-D drawings (plan and elevation views) can be created from 3-D creations.

2.6.5 Other BIM software packages

Other software that can be used in 3ds o Max® (formerly 3D Studio Max) and Google™ SketchUp. This software is much less costly, simpler to learn, and can be produced relatively quickly

2.6.6 BIM analysis packages

The design analysis software provides the structural engineers with the analysis and evaluation of the size and number of the structural members in a design. There are several software with varying capabilities. Most of this software is compatible with the various BIM software, as information and data can be exported and imported. Revit Structure helps you analyze all or part of a structure with bidirectional linking to industry-leading analysis and building code design software. Revit Structure can be linked with any of the following Analysis Partner Software:

- Adapt™
- RISA
- Robobat
- SOFiSTiK
- SOFTEK
- CSC™
- Tekla
- CSI (ETAB)
- Oasys

In addition to the analysis software above, Extensions for Revit extend the abilities of the Revit products in several key areas, including structural analysis and reinforced concrete drafting. Extensions for Revit provide instant value to Revit users and are simple to download, install and apply (Kia, 2013)

2.6.7 BIM essential guide for BIM adoption in an organization

A step-by-step guide to help an organization jump-start its Building Information Modelling (BIM) adoption trip. To improve organizations' drive towards business excellence practices in BIM. The Singapore Service Quality Framework has seven types of the Singapore Service Quality Framework are as follows:

The template is modeled after the seven categories of (BCA acknowledges, 2013)

1. Leadership:

- Involve Major Management
- Set up BIM Committee with clear roles and responsibilities

2. Planning:

- Develop BIM Adoption Plan
- Define BIM Vision, BIM Goal, BIM Themes, Change Management, Software, and Hardware Requirements in the Plan

3. Information

- Define BIM Standard
- Define BIM Quality Assurance Checks
- Define BIM Information Management

4. Processes

- Define Project BIM Process

5. BIM Execution Plan

- BIM Conditions

6. BIM Competency Map

- BIM Training Roadmap
- BIM Roles (Project BIM Manager and Coordinators)
- Customers

7. Results

3. METHODOLOGY

3.1 Introduction

Building Information Modeling (BIM)is not just a single concept or a small program, it includes many programs and processes working together as well as human interactions, therefore must consider the facts related to the level of BIM in Iraq and Turkey as the concept of this study. This chapter consists of the step of methodology to improve the research aim, starting with the aim and parameter for evaluation, description of the questionnaire, questionnaire design, arbitration of the questionnaire, the validity and reliability of the questionnaire, questionnaire distribution, analysis of data collected from the questionnaire statically in chapter four, discussed the result, conclusion, and recommendations have been explained in chapter five. Figure 3.1 shows the methodology flowchart. To improve the research aim, started with the aim and parameter for evaluation, description of the questionnaire, questionnaire design, arbitration of the questionnaire, distributed questionnaire, and analysis of data collected from the questionnaire statically by SPSS v.23 to find reliability and validity in chapter four, discussed the result, conclusion, and recommendations have been explained in chapter five.

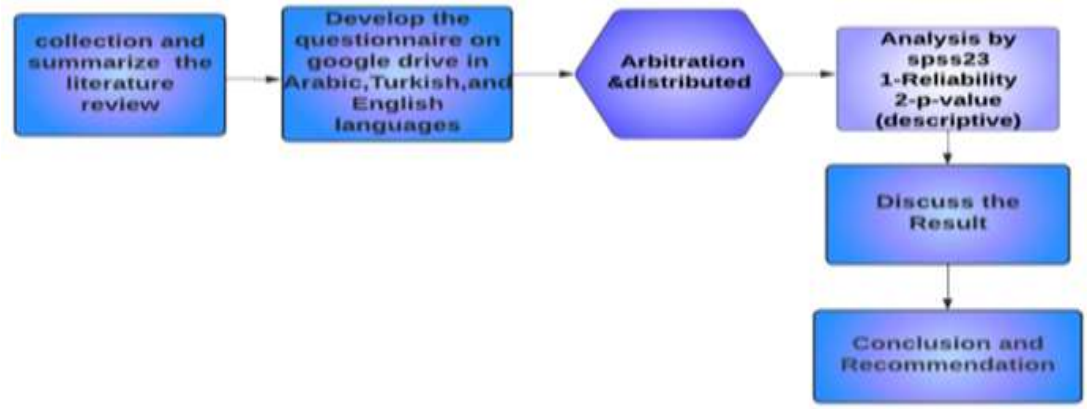


Figure 3.1: The Methodology Flowchart

3.1.1 The aim and parameter for evaluated research

Evaluating the level of BIM in Iraq and Turkey depends on which software is used and compared with BIM maturity levels (Almashjary & Kalsum Zolkafli, 2020) as shown in figure 3.2. Consequently, the challenge of BIM adoption attempts to put essential steps for adopting BIM in all construction projects according to the BIM essential guide (BCA acknowledges, 2013). Encourage the engineers to train on BIM software such as 3D modeling design software (Revit) to enhance construction management.

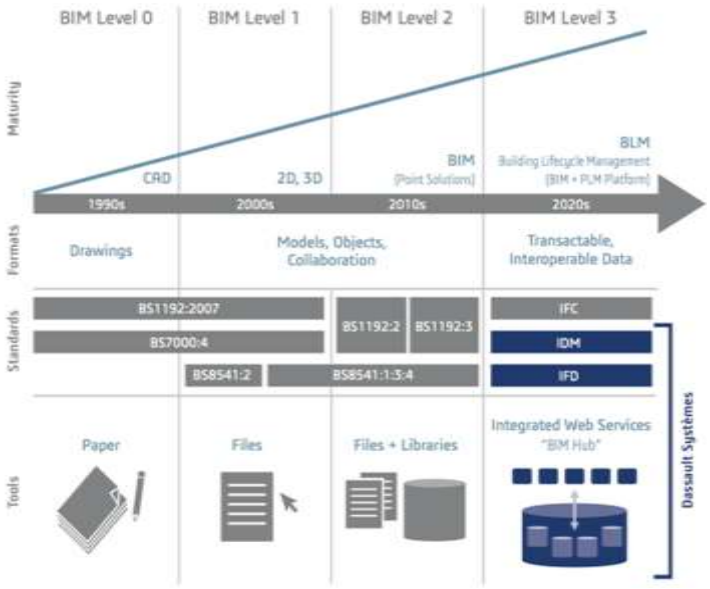


Figure 3.2: BIM maturity levels

Source :(Almashjary & Kalsum Zolkafli, 2020)

3.1.2 The description of the research

The questionnaire method is one of the scientific research methods to find and collect research information about a particular study and to find people's tendencies towards it and the extent of their benefit and knowledge about it. The questions put related to the group, and the information required to conclude is supposed to be examined, To formulate the questionnaire questions, the questions should be clear and uncomplicated where

It is important to collect correct research data (Fox et al., 2007). This thesis used open and closed questions design because the questionnaire's questions intended to explore the level of BIM software used and what the curriculum of BIM in university

found. Hence, this attempted to prove that our country can adopt BIM technology in construction management.

3.1.3 Population

The questionnaire included the field of engineering in all disciplines and the questions were divided into two questionnaires, one for (specialists in BIM and another for engineers which were distributed to universities and companies in both the public and private sectors. The two questionnaires were distributed to most universities by sending emails at Gedik university to researcher professors. Additionally shared by getting some links, emails, distributed on the platform and distributed by own researchers and engineers colleagues in universities at Istanbul, Kultur university, Esenyurt university, Karabuk university, Anker university, Akdeniz University, Bolu university, Konye university, Mersine, Terabzone, Bingol, Eskisehir, Gazintab, Izmir, Samsun, Bursa, Hatay,) also distributed in company construction. Otherwise, it is distributed in Iraq and -in all most universities by sending emails to all the researcher's colleagues and professors that the researcher study and work with them from north to south of Iraq. The participants were 234 distributed as 186 responses to the engineer's questionnaire and 66 responses to the specialist questionnaire distributed between Iraq and Turkey, most of the respondents were civil and architectural engineers. According to the specialist questionnaire, 64%, of participants have skills with BIM.

3.1.4 Design of questionnaire

The questionnaire was designed to achieve the purpose of the study, the research depended on setting the objectives to be extracted from the questionnaire at the beginning, then formulating the questions according to these objectives (Fowler, 1995). The questionnaire survey was created by using google forms in two questionnaires, one for the engineers and another for BIM specialists that were formulated in three languages (Arabic, Turkish, and English) to obtain the largest number of responses. The survey in two questionnaires has closed questions and one opening question. As long as the situation was going through the Corona pandemic, they were distributed electronically through social media platforms (WhatsApp, Facebook) groups and sent by email around Iraq and Turkey to universities and companies after arbitration. The design of the questionnaire is shown in Figure 3.3.

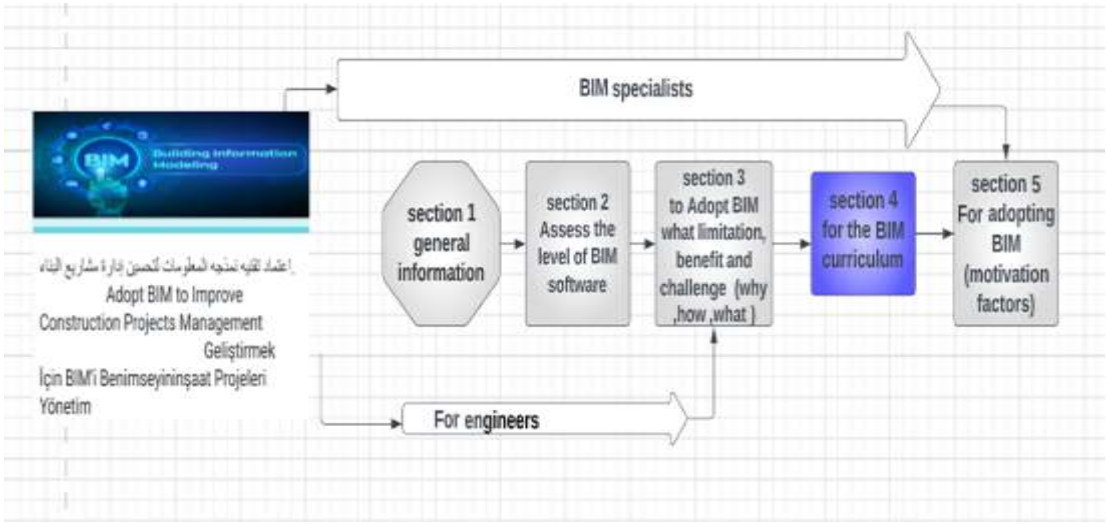


Figure 3.3: The questionnaire design chart

3.1.5 The questionnaire questions description

The questionnaires have cover showing the title and the aim of the questionnaire. The questionnaire focused on (the identification of the respondent, the level of using BIM software, what level of BIM experts, the level of BIM application, the benefit of BIM, and BIM curriculum in the universities, motivation factors(cost of design with Revit compare with AutoCAD/m^2, what is the probability to get a job related to the experience with BIM software steps to adopt BIM according to specialist opinion, the roles of construction design that the government depends on) in Iraq and Turkey. The questionnaires have descriptive questions, closed questions, indirect questions, and one open question to collect the opinions of the respondents. The survey was composed of multiple-choice questions and question variables. some questions used a Likert scale, such that respondents could select five items to respond: (Strongly disagree, Disagree, Neither Agree, Strongly Agree), (Poor, Good, very good, Excellent), (Excellent, Very Good, Good, Fair, I Don't Know), (never used, rarely, sometimes, often always).

The two questionnaires consist as shown below:

A- First questionnaire for engineers: consists of 23 questions distributed in 3 sections

- General information

This part includes the respondents' information about what is (Country, qualification classifications, the field of work (private or public), (university, company), (location, size, and type) of the firm, and how (old, years of practical experience).

- Level of BIM software

This section of the questionnaire included:

- How the respondents evaluated their use of software such as (Revit, AutoCAD, 3Dmax, BIM360, 3dArchcad, Navisworks, Tackle package, Autodesk Green Building Studio (for sustainability design), Autodesk Insight 360

Primavera, MS Project, Etabs, and Excel. the researcher used the Likert 5-scale.

- Which drawing method is used (2D, 3D (by Revit program)) or both.
- How do they rate the respondents' skills in BIM (1. I don't know, Fair, Good, very good, Excellent)?
- Where did the respondents' BIM knowledge come from?

Awareness about the BIM (benefits, limitations, and challenges faced concerning adopting BIM and improving construction management.

- Motivation factor for adopting BIM:

The willingness to take courses to improve construction management

Search about motivation factors such as (the cost of design) $\$/m^2$ comparing (AutoCAD with Revit), between Iraq and Turkey 5-rules and steps

- The opinion of the respondent to adopt BIM.

B- The second questionnaire for BIM specialists

This questionnaire included the same questions for general engineers, such as

1. General information, (same questions for general engineers
2. Level of BIM software (how the respondents evaluated their skill in software), the researcher used the Likert 5-scale (same questions for general engineers)
3. Awareness of BIM (benefits, limitations, and challenges). The researcher used the Likert 5-scale (same questions for general engineers)

4. what the BIM curriculum depends on in their universities, this part aims to assess the kind and period of BIM curriculum if there are found in universities
5. Motivation factor to adopt BIM

- What cost of design by (Revit, autocad),
- Comparison of the salary for BIM engineers in Iraq and Turkey.
- When got skills in software chance to get job increases.

6. Rules and steps, as a BIM specialist

- Which guide they used the UK, USA, or nationality standard
- Arranged the steps as a minimum required to adopt BIM
- Are there BIM projects implemented?
- Is using BIM dependent on the (size, complicated, or cost of the project)
- Open questions to collect respondents' opinions about BIM adoption.

See the appendix for more details about the questions

3.2 The Arbitration for Questionnaire

It is essential when making questionnaires that they are presented to arbitration to know the validity of the questionnaire and its approval of the research idea and what we can conclude (Privitera, 2018). The questionnaire was presented to different specializations such as:

1. Construction management, civil, architecture, mechanic, and BIM engineers to know their opinions on the validity of the research idea.
2. Language specialists (Turkish, English, Arabic) that the questionnaire was in three languages
3. Statisticians to indicate the validity of the questions for statistical analysis. later, it was revised according to their observations, then distributed to universities and companies around Iraq and Turkey. The information about arbitrators is shown in Table 3.1.

Table 3.1: The arbitrator's description

The specialization of expert	Qualification	University /firm	Country	Nationality
BIM	MSc.	The Iraqi Engineers Syndicate	Iraq	Iraqi
BIM manager	BSc.	Mdkour Group	Egypt	Egyptian
BIM	MSc.	Baghdad University	Iraq	Iraqi
Civil	Ph.D.	Istanbul Gedik University	Turkey	Turkish
Construction management Architecture	Ph.D.	Sultan Qaboos university	Oman	Iraqi
Statistics/ English language	Ph.D.	Buraimi University College	Oman	Tunisian
Statistics	Ph.D.	Istanbul University	Turkey	Yemen
Turkish /Education Arabic language	BSc. .	Istanbul Aydin University	Turkey	Turkish

3.3 The Reliability

The reliability shows the quality and accuracy of the measurements distinguished by the quality and accuracy of the measurements. There are various methods to compute the reliability of any questionnaire one of them is the Alpha (Cronbach) model which was used in this research as in equation (3.1). The value of Alpha (Cronbach) when closer to 1 means a high degree of reliability (Yockey.R. D., 2016). It is an internal consistency measure. The measurement is considered accurate and 0.60 is accepted when the test results are greater, as shown in Table 3.2.

Alpha Cronbach $$\alpha = \left(\frac{k}{k-1}\right)\left(\frac{s_y^2 - \sum s_i^2}{s_i^2}\right) \quad \textbf{(3.1)}$$

Table 3.2: Alpha limit

Cronbach's alpha	Degree of Reliability
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

3.4 A Relative Importance Index (RII)

For evaluating software using analysis relative importance index additionally to t-test, which is the mean for a factor that gives it weight in the perceptions of respondents. RII is useful because it considers the size of the population and the relative disadvantage experienced by different groups. so to find the relative ranking of the level of using software, and limitations, using the importance index based on the following formula (**3.2):**

$$R\ II = (\sum w)/AN = (5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1)/5N \quad \textbf{(3.2)}$$

$0 \leq \text{RII} \leq 1$

Where

W=is the weight given to each item by the respondents, rang from 1 to 5

Such as 1 the least implying (Strongly Disagree)

A: is the highest weight (5 on a 5-point Likert scale)

N: is the total number of respondents.

Table 3.3: Relative Importance Index (RII) level

RII value	Importance Level
$0.8 \leq RII \leq 1$	High
$0.6 \leq RII \leq 0.8$	High -Medium
$0.4 \leq RII \leq 0.6$	Medium
$0.2 \leq RII \leq 0.4$	Medium-Low
$0 \leq RII \leq 02$	Low

3.5 Statistical analysis

One of the basic requirements for any research is to find an appropriate measurement method for evaluating its results. This study used statistical techniques analysis such as:

- T-test: An Independent Samples T-test compares the means for two groups. It helps to compare the means of two sets of data. Sampling technique: In this study, a convenience. The sampling method was used to select the target respondents, according to (Etikan & Bala, 2017) such a method is done "according to the researcher's judgment without using any probability technique. To Calculate a t-test needs three important data values. They include the difference between the mean values from each data set, the mean difference, the standard deviation of each group, and the number of data values of each group. This comparison helps to determine the effect of chance on the difference, and whether the difference is outside that chance range. The t-test questions whether the difference between the groups represents a true difference in the study or merely a random difference, as shown in the t-test equation **(3.3).**

$$t = (\bar{x} - \mu) / (s / \sqrt{n}) \qquad \textbf{(3.3)}$$

where

$\bar{x}$ = Observed Mean of the Sample

μ = Theoretical Mean of the Population

s = Standard Deviation of the Sample

n = Sample Size

If the testing P-Value is less than 0.05, there is a difference between the groups

- Alpha (Cronbach) method: The alpha coefficient is a measure of the relationship between the important variables in one group.
- Simple Percentage Analysis and Descriptive Analysis: That shows the respondents' distribution and percentages of each question of the survey and related mean and standard deviation.
- A Relative Importance Index (RII) was assumed by SPSS for more evaluation of the level of BIM software used.

The SPSS software version 23 used for the analysis surveys in this study.

3.6 Methodology Hypothesis Analysis

Descriptive analysis is used to defined as the statistical method or process of summarizing descriptive data in this research is analyzed by exporting the statistical data to software Excel and then SPSS to do the tables and illustrating factors that express the analysis process. Statistical validity is defined as a p-value of 0.05 or less (usually 0.05). Given that there is less than a 5% chance that the null hypothesis is true, this suggests strong evidence against it (and the results are random). As a result, we accept the alternative hypothesis and reject the null hypothesis. Although you can reject the null hypothesis if the p-value is less than your level of significance (usually p 0.05), this does not guarantee that the alternative hypothesis is correct 95% of the time. The null hypothesis was true if the p-value is below your limit (McLeod, 2019).

4. RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter explains the results obtained through the two surveys of engineers in general and BIM specialists. The total number of participants was 231 engineers, 165 (general and BIM specialists) from Iraq and 66 (general and BIM specialists) from Turkey. The results were analyzed using the (SPSS) program, to obtain tables showing the Results and discussed the result of research and comparison between the two countries.

This chapter includes the analysis done for the data collected, it includes reliability, relative index performance (RII) for the level of BIM software, and the Simple percentage analysis that shows the respondents' distribution and percentages of each question of the survey, and related mean and standard deviation to find t-test.

4.2 Reliability Assessment (Cronbach Alpha Test)

When determining the quality of measuring equipment, reliability is used. It is defined as the extent to which test results are free from measurement error that occurs when testing anything. A faulty measurement will render the relationship between the variables insignificant. The Cronbach alpha test, which "shows how closely related a collection of items are as a group and is an internal consistency metric," is one method of evaluating reliability. The measurement is considered accurate and 0.60 is accepted when the test findings are greater than 0.70.

Reliability analysis was conducted for questions that have sub-questions that accumulated represent the main question. The reliability test results of each variable of this study are shown the reliability assessment (Cronbach alpha test) – for the general engineers' survey as in Table 4.1.

Table 4.1: Reliability of the general engineers' survey

The Questions	Cronbach's Alpha - Iraq	Cronbach's Alpha - Turkey	Results
12-What is your assessment of the level of usage of the software below in your firm? Included thirteen (drawing, design, management, coordination) software	0.90	0.91	Good
16-According to your opinion, the limitations, or barriers to using BIM in your country are because (fifteen reasons included)	0.93	0.95	Good
18-Do you know that one of the benefits of building information modeling is (seven benefits Included)	0.89	0.76	Good
20-What is the rate of cost /m2 design in CAD or Revit method? Reliability Assessment (Cronbach alpha test) – For the BIM specialists' survey	0.89	0.85	Good

Table 4.2: Reliability BIM specialist survey

Questions	Cronbach's Alpha - Iraq	Cronbach's Alpha - Turkey	Results
Q12 What is your assessment of the level of usage of the software below in your firm?	0.87	0.85	Good
Q16 According to your opinion, the limitations or barriers to using BIM in your country are because.	0.91	0.97	Good
Q27 Is there any application of the BIM project that has been implemented in your country?	0.81	0.89	Good

Table 4.3: Reliability BIM specialist survey

Questions	Cronbach's Alpha - Iraq	Cronbach's Alpha - Turkey	Results
Q28-Is there any official release of BIM documents to support architecture, engineering, and construction industry practices in your country compared with the USA and UK BIM practice documents?	0.92	0.80	Good
Q29-Identify the level of using BIM applications in your firm.	0.90	0.94	Good
Q32-What is the rate of BIM benefits in your job area?	0.97	0.96	Good
Q34- Which BIM courses do you have in your university curriculum? how long is studying? the period in the month	0.93	0.98	Good
Q37-In your opinion, what are the important and more effective steps should take to adopt BIM at the first stage in your country? arrange the steps	0.86	0.91	Good
Q38-In your opinion, what are the important and more effective steps should take to adopt BIM at the first stage in your country? arrange the steps	0.74	0.74	Accepted
Q43-What is the rate of cost /m2 design in AutoCAD or Revit method?	0.89	0.79	Accepted

The above tables show that the related questions are good reliability.

4.3 Simple Percentage Analysis and Descriptive Analysis

To understand the answers of the targeted respondents, a simple percentage analysis was done such analysis gives an accumulated summary of the respondent's answers according to the frequency distribution of the data collected, it is calculated by the following formula:

Percentage = (Number of Respondents * 100) / Total Number of Respondents.

Descriptive statistics explain the basic features of the data in a sample, descriptive statistics are used. They offer quick summaries of the sample and the steps. They form the basis for nearly all quantitative analyses of results. They are represented by the Mean and the Standard deviation. The analysis is divided into two sections one for engineers and the other for BIM specialists. For comparison between Iraq and Turkey T-test was used to see if there is a significant difference between them or not

for section one regular engineers, however, for section two BIM specialists non-parametric U-test was used to compare Iraq and Turkey as the collected data from Turkey for that section is less than 30 sample.

4.4 Results and Discussion for Engineers Questionnaire

4.4.1 General information

This analysis represents the demographic questions that provide information about the respondents:

Table 4.4: The rate of respondents from Iraq and Turkey

	Frequency	**Percent**
Iraq	134	73.2%
Turkey	49	26.8%
Total	**183**	**100%**

Table 4.3 the table shows the total responses in this questionnaire were 183 responses, 73% of them are from Iraq and 27% from Turkey. Hence the researcher was keen to distribute the survey around Turkey and Iraq as shown in Figures (4.1 and 4.2). Table A.1 shows in Appendix A, that the respondents' places were around Iraq and Turkey.

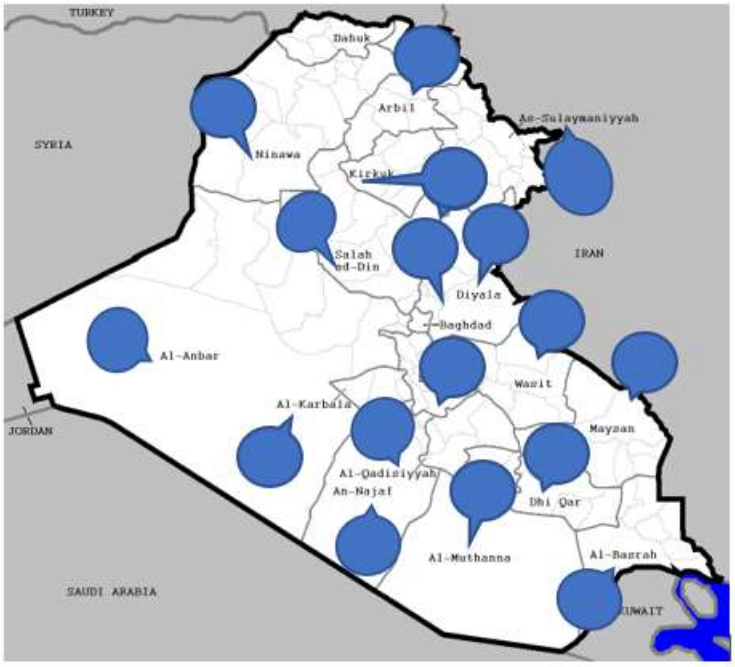


Figure 4.1: Respondents from Different Iraqi Regions

Figure 4.2: Turkey Respondents from Different Regions

Table 4.5: The respondents' qualifications

	Iraq		Turkey		T-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Diploma	2	1.5%	6	12.2%	
BSc.	59	44.0%	18	36.7%	
MSc.	57	42.5%	17	34.7%	0.44
PhD	16	11.9%	8	16.3%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table 4.6: The job sectors comparison

	Iraq		Turkey		T-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Public	106	79.1%	14	28.6%	
Private	28	20.9%	35	71.4%	0.00
Total	**134**	**100.0%**	**49**	**100.0%**	

Table 4.7: The Firm field

	Iraq		Turkey		T-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
University	45	33.6%	24	49.0%	
Company	53	39.6%	19	38.8%	
Consulting office	4	3.0%	6	12.2%	0.002
Other	32	23.9%	0	0%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Tables (4.4,4.5, and 4.6) show that most of the respondents in Iraq and Turkey have BSc. or MSc. In Iraq 44% of the total respondents have BSc., and in Turkey 37% of the total respondents also, have BSc. There are no significant differences between Iraq and Turkey concerning the qualifications of the targeted respondents, this is confirmed by the T-test's P-value which is more than 0.05. That was good to compare their knowledge with BIM because no different levels of qualification between Iraq and turkey respondents. Most respondents in Iraq work in companies (public sector) representing 79% of the total respondents, but the majority of respondents in Turkey work in university (privet sector) representing 71%. There is a significant difference between Iraq and Turkey concerning the job sector of the targeted respondents, this is confirmed by the T-test's P-value which is less than 0.05. The reason behind that is the difficulty to take responses from the public sector.

Table A.2 in Appendix A, represents the ages of respondents in Iraq are between 35 and 40 years old, representing 20% of the total respondents, but in Turkey are between 25 and 30 years old, representing 29% of the total respondents. There is a significant difference between Iraq and Turkey concerning the age of the targeted respondents, this is confirmed by the T-test's P-value which is less than 0.05.

Moreover, the majority of respondents in Iraq and Turkey specialized in civil engineering, they represent 53% of the total respondents in each country. There is no significant difference between them in the specialization of the targeted respondent's work in, this is confirmed by the T-test's P-value which is more than 0.05. As shown in Table A.3 in (Appendix A)

In addition, Table 4.7 shows the majority of respondents in Iraq and Turkey are executive engineering, they represent 44% of the total respondents in Iraq and 33% of the total respondents in Turkey. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries for the position of respondents in their firms, the difference is due to the distribution of the responses in the other alternatives of the question's answers.

Table 4.8: Respondents Positions in the Firm

	Iraq		Turkey		T-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Professor	4	3.0%	3	6.1%	0.037
Assis. prof.	7	5.2%	7	14.3%	
Asso. prof	13	9.7%	2	4.1%	
Lecturer	13	9.7%	2	4.1%	
Executive Engineer	59	44.0%	16	32.7%	
Designer	4	3.0%	1	2.0%	
Consultant	21	15.7%	2	4.1%	
Coordinator manager	5	3.7%	1	2.0%	
General manager	4	3.0%	4	8.2%	
Total	**134**	**100.0%**	**49**	**100.0%**	

For more respondents' information regarding (segment of the Architecture, Engineering, Construction, and owner-operated (AECO) industry, years of experience, and size of the firm) go to Tables (A.4, A.5, and A.6) in Appendix A.

4.4.2 Evaluate the rate of using BIM software

Table A.7 in Appendix A shows in the respondents were asked to describe their level of using software related to engineering. Based on the mean calculation the evaluation was: 1 to 1.5 = Not used, 1.5 to 2.5 = Poor, 2.5 to 3.5 = Good, 3.5 to 4.5 = Very good, 4.5 to 5 = Excellent. Based on the respondents' answers the mean was calculated to summarize their answers and see their level in using each software. The results are as the following:

- In Iraq and Turkey, there is a poor level of assessment in using the Revit software, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey, there is a good level of assessment in using the AutoCAD software, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

- In Iraq and Turkey, there is a poor level of assessment in using the 3Dmax software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, there is a poor level of assessment in using the BIM360, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey, there is a poor level of assessment in using the 3dArchcad software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, there is a poor level of assessment in using the Navisworks software, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq, the Tackle package is not used this is reflected by the mean of responses which is between 1 and 1.5. In Turkey there is a poor level of assessment in using the Tackle package software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is less than 0.05 confirms that there is a significant difference in both countries related to this question.
- In Iraq and Turkey, there is a poor level of assessment in using the Autodesk Green Building Studio (for sustainability design) software, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.

- In Iraq and Turkey, there is a poor level of assessment in using the Autodesk Insight360 software, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey, there is a poor level of assessment in using the Primavera software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq, there is a poor level of assessment in using the MS project software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. But Turkey has 40% a good percentage using Ms project.
- In Iraq and Turkey, there is a poor level of assessment in using the Etabs software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, there is a good level of assessment in using the Excel software, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

So, in both countries, the overall evaluation of assessing the level of using engineering software according to the respondents' responses is poor except for AutoCAD and Excel which have a good level of usage. Turkey has a good level in Ms project too.

In addition, A Relative Importance Index (RII) analysis is used to evaluate the level of software more accurately in Iraq and Turkey, Tables (A.8, and A.9 in Appendix A) it shows the level of relevance for software.

Table 4.9: The RII Result for software in Iraq and Turkey

5-Likert scale RII explanation	Iraq software	Turkey software	The result
Medium to High Relevance	**1. AutoCAD, 2. Excel**	**1. AutoCAD, 2. Excel**	**No different**
Medium Relevance	Ms project	Revit, 3DArchicad, 3Dmax, Autodesk Green building, Autodesk insight360, Primavera Etabs, Ms project	Turkey has most BIM software at the medium level which is used in 3D,4D,5D,6D, and 7D BIM
Medium to Low Relevance	Revit, BIM 360, 3Darchcad Navisworks, Tackle Autodesk Green Building Autodesk insight360 Primavera, Etabs	BIM360, Navisworks Tackle	

In this question, the respondents were asked to describe their level of using software related to engineering. Based on the RII calculation the evaluation was: 0.0 to 0.2= Low, 0.2 to 0.4 =Low- Medium, 0.4 to 0.6 =Medium, 0.6 to 0.8 = Medium-high, 0.8 to 5 = High . Based on the respondents' answers the mean, standard deviation, and mean*0.2) were calculated to summarize their answers and see their level in using each software. The results are as the following:

Table 4.8 illustrated results of RII for Turkey and Iraq. They have medium to high relevance in AutoCAD and Excel. Turkey has a medium level in most BIM software (3D modeling design and visualization such as Revit and 3Dmax, which Revit most important BIM software. Also, in project management software such as primavera, Ms project, which is used in 4D and 5D BIM modeling, and sustainability programs such as Autodesk insight 360 and green building which are used in 6D BIM and 7D. Turkey has a medium level in 3DArchcad which means mostly used 3DArchicad as the BIM coordination more than Navisworks. Otherwise in Iraq most software of BIM in medium to low relevance, in turkey same Medium to a low level by using BIM 360, Navisworks, and tackle (steel design).

Table 4.10: The drawing method compare

Q13: Which is your drawing method used in construction projects?	**Iraq**		**Turkey**		**T-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
2D plan by (CAD program)	78	58.2%	22	44.9%	0.33
3D model by (REVIT program)	7	5.2%	8	16.3%	
Both	49	36.6%	19	38.8%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table 4.9 the table shows the majority of respondents in Iraq are drawing with a 2D plan by (CAD program), they represent 58% of the total respondents. In Turkey, 45% of the total respondents are also drawing with 2D plans (CAD program). There is no significant difference between Iraq and Turkey concerning the drawing method used in construction projects, this is confirmed by the T-test's P-value which is more than 0.05. That's the result in its confirmed because most respondents use AutoCAD rather than Revit.

Table 4.11: The comparing the quantities method that respondents prefer

Q19: Do you prefer calculating quantities 1 or using the design programs to calculate the project quantities?	**Iraq**		**Turkey**		**T-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Manually	83	61.9%	20	40.8%	0.015
By drawing program	51	38.1%	29	59.1%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table 4.10 shows the majority of respondents in Iraq have used a manual approach; they represent 62% of the total respondents. In Turkey, 59% of the total respondents adopt the drawing program approach. There is a significant difference between Iraq and Turkey concerning this question, this is confirmed by the T-test's P-value which is less than 0.05.

4.4.3 Awareness of limitations, benefits, and challenges of BIM adoption

Table 4.12: The Rate of Using BIM comparison

Q14: How do you rate your skill in BIM?	Iraq				Turkey				T-test's P-value
	Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
1. I don't know	28	20.9%			12	24.5%			
2. Fair	44	32.8%			13	26.5%			
3. Good	44	32.8%	2.41	1.013	16	32.7%	2.45	1.119	0.825
4. Very good	15	11.2%			6	12.2%			
5. Excellent	3	2.2%			2	4.1%			
Total	**134**	**100.0%**			**49**	**100.0%**			

Table 4.11 shows in the respondents were asked to describe their skills of using BIM. Based on the mean calculation the evaluation was: 1 to 1.5 = I don't know, 1.5 to 2.5 = Fair, 2.5 to 3.5 = Good, 3.5 to 4.5 = Very good, 4.5 to 5 = Excellent. Based on the respondent's answers the mean was calculated to summarize their answers and see their level in using BIM. In Iraq and Turkey, there is a Fair level of assessment in using the BIM software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. But when see the percentage distributed there was small (21% of respondents in Iraq and 24.5% of respondents in Turkey) did not use BIM.

The willingness to enter BIM courses, Table A.12 in (Appendix A) illustrate that in Iraq and Turkey respondents are ready to enter practical courses in the field of building information modeling to improve the management of engineering projects, this is reflected by the mean of responses which is between 1 and 1.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to differences in the percentages of the answers in both countries.

Table 4.13: The source of BIM knowledge

15-Where is your BIM knowledge come from? (Check all that apply)	**Iraq**		**Turkey**		**T-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
The University	33	19.9%	20	34.5%	0.015
Enrolled in the training courses in my firm	19	11.4%	9	15.5%	
Study BIM software By Myself	39	23.5%	12	20.7%	
Work with the international companies	12	7.2%	3	5.2%	
My graduation thesis on BIM	11	6.6%	1	1.7%	
No deal with BIM	52	31.3%	13	22.4%	
Total	**166**	**100.0%**	**58**	**100.0%**	

Table 4.12 the table shows In Iraq, 31% of the total respondents no didn't deal with BIM software, but in Turkey, 35% of the total respondents got their knowledge of BIM from a university. The difference between Iraq and Turkey is confirmed by the P-value which is less than 0.05. Form this question there is a curriculum BIM in Turkey but in Iraq no BIM curriculum. Additionally, there 23.5% of Iraqi respondents training on BIM by themselves, and 6.6 % of respondents have a thesis on BIM so Iraq is at the bigging BIM step.

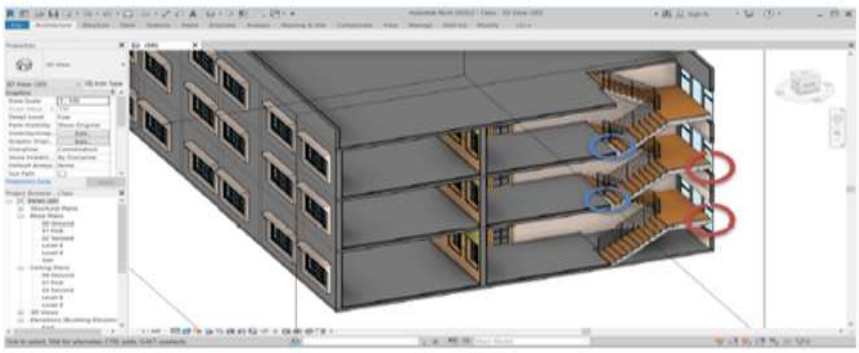
The limitation of using BIM is listed in Table A.10 (Appendix A) According to the responses, it was found that there are some barriers to using the BIM system in Iraq but in Turkey, no clear answers were given by the respondents as they are neutral about all the options of this question. The barriers to using the BIM system in Iraq are:

- The widening gap between the curricula of the faculties of engineering and the field of work and the lack of integration of students in applied courses for BIM.
- Lack of benefit and cooperation with countries that have successful experiences in the field of BIM.
- Lack of experience of the contractor in the implementation of construction works.
- Absence or incomplete national standard for BIM.

- Lack of demand from customers or other companies for projects implemented using BIM technologies.
- Lack of support/lack of BIM-related investments.
- Lack of support for engineering competencies to keep pace with development and improve skills.

Table A.11 shows in (Appendix A), that the evaluation of using BIM benefits such as (3D image helps to reduce(errors, time and cost of project)as shown in Figure 4.3 Accuracy in limited quantities, schedule facilitates project management easily, the operational work of the project and the maintenance, as it is an integrated archive of the project, better than the traditional methods, BIM model facilitates the sharing of information about the project among all project members.

According to the results of this question, it is found that according to the respondents of this question the knowledge of BIM's benefits is the same in Iraq and Turkey.



befor

after

Figure 4.3: Errors in drawing stairs and how correcting it

Source:(Ibraheem & Mahjoob, 2022)

4.4.4 BIM curriculum

Table 4.14: The type of BIM courses

Q17: What is the BIM software courses available as (training courses) in your firm? (Check all BIM software that is available	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
AutoCAD software	56	24.7%	23	33.8%	0.120
Revit	76	33.5%	24	35.3%	
Project management software	71	31.3%	14	20.6%	
Bentley software	1	.4%	0	0.2%%	
Not available	23	10.1%	7	10.3%	
Total	**227**	**100.0**	**68**	**100.0%**	

Table 4.13 the table shows the majority of respondents in Iraq have Revit training in their Firms, they represent 34% of the total respondents. In Turkey, 35% of the total respondents also have Revit training in their Firms. In addition to that training is provided in AutoCAD software and Project management software in both countries. There is no significant difference between Iraq and Turkey for this question, this is confirmed by the T-test's P-value which is more than 0.05.

4.4.5 Motivation factors

In this part of the BIM adaptation, the financial using Revit which is the base modeling program in BIM.

Table 4.15: Compare the cost of design method / m2

Q20: What is the rate of cost / m2 design in CAD or Revit method?		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Revit	(5-10) $/m^2	18	13.4%	3.31	1.447	13	26.5%	2.88	1.523	0.015
	(10-15) $/m^2	25	18.7%			9	18.4%			
	(15-20) $/m^2	35	26.1%			9	18.4%			
	(20-25) $/m^2	10	7.5%			7	14.3%			
	No idea	46	34.3%			11	22.4%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
AutoCAD	(5-10) $/m^2	28	20.9%	2.96	1.548	12	24.5%	2.84	1.505	0.082
	(10-15) $/m^2	37	27.6%			12	24.5%			
	(15-20) $/m^2	22	16.4%			8	16.3%			
	(20-25) $/m^2	6	4.5%			6	12.2%			
	No idea	41	30.6%			11	22.4%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

Table 4.14 shows in this question, the respondents were asked about the rate of cost / m2. Based on the mean calculation the evaluation was: 1 to 1.5 = (5-10) $/m2, 1.5 to 2.5 = (10-15) $/m2, 2.5 to 3.5 = (15-20) $/m2, 3.5 to 4.5 = (20-25) $/m2, 4.5 to 5 = No idea. Based on the respondents' answers the mean was calculated to summarize the following:

- According to the respondents' answers in Iraq and Turkey, the cost of designing with Revit is (15-20) $/m^2, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- According to the respondents' answers in Iraq and Turkey, the cost of designing with AutoCAD is (15-20) $/m^2, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. Therefore the research depends on the percentage to identify the cost of design /m^2 in turkey (5-10) $/m2 for Revit and AutoCAD (5-10)$/m^2 but in Iraq (15 -20)$/m^2 for Revit and (15-20)$/m2 for AutoCAD.

Table 4.16: Chance to Get a Job with Skills of Software.

Q21: Do you support if you have skills in engineering and construction programs, your chance of getting a greater job?	**Iraq**				**Turkey**				**T-test's P-value**
	Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Strongly Disagree	4	3.0%			4	8.2%			
Disagree	5	3.7%			3	6.1%			
Neutral	23	17.2%	3.57	.808	14	28.6%	3.06	.966	0.097
Agree	69	51.5%			14	28.6%			
Strongly Agree	33	24.6%			14	28.6%			
Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation

Table 4.15 shows in this question, the respondents were asked to share their opinion about the barriers to using the BIM system in their countries. Based on the mean calculation the evaluation was: 1 to 1.5 = Strongly disagree, 1.5 to 2.5 = Disagree,

2.5 to 3.5 = Neutral, 3.5 to 4.5 = Agree, 4.5 to 5 = Strongly agree. Based on the respondents' answers the mean was calculated to summarize the following:

- In Iraq, respondents agreed that having skills in engineering and construction programs supports getting a greater job, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey, respondents are neutral that having skills in engineering and construction programs supports getting a greater job, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question, this is due to the distribution of answers which is almost the same in both countries.

4.4.6 Steps to use BIM

keep pace with the development of skills and the uses and uses of modern software in construction projects to facilitate the adoption of BIM building information modeling and the exchange of experiences in this field later.

Most important of the respondents' opinions from Iraq and a few from Turkey were:

1. It should be a governmental endeavor in the first place and with serious steps
2. Incorporating them into the teaching curricula, opening courses in academic institutions for engineers, and using the state to impose them on new practices at work
3. Opening specialized institutes and colleges for building information modeling BIM.
4. Increased workshops on the topic of BIM
5. Availability of a well-qualified workgroup with appropriate and respected standards.
6. Adopting a mandatory government model, including introducing programs into work, and accelerating laws that support it.
7. Provide software
8. Holding courses for engineers in all specializations in skills and sharing the academic experience with a practical framework

9. Participation in scientific conferences, continuous courses at the company level, under the hands of specialists in the field
10. Choosing project management that understands the importance of applying modern software at work
11. Creating courses for program promotion Implementation of government program management.
12. Refinement courses for engineers.
13. Preparing training courses at a reasonable cost.
14. Need to educate newly graduated engineers about the importance of paying attention to supportive electronic programs.
15. Providing intensive scientific courses to communicate with international companies.
16. Activating the private sector and setting new rules for contracting with engineers who have experience in these programs is one of the contracting conditions.
17. Obligating foreign investors to adopt this technology in their projects implemented in the country and training several local engineers with more than five years of experience from 3 to 10 engineers depending on the size of the project

4.5 Results and Discussion of the questionnaire for Engineers BIM Specialist.

4.5.1 General information

This section analysis represents the demographic questions that provide information about the respondents:

Table 4.17: The Respondent's Country

Q1: What is your country?	**Frequency**	**Percent**
Iraq	31	64.6%
Turkey	17	35.4%
Total	**48**	**100%**

Table 4.18: The Respondents' Qualifications

Q2: What is your qualification?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
Diploma	1	3.2%	0	0%	
BSc.	12	38.7%	4	23.5%	
MSc.	11	35.5%	9	52.9%	0.346
PhD	7	22.6%	4	23.5%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.19: The job sector

Q3: What is your job sector? (Public, private)	Iraq		Turkey		U-tests P-value
	Frequency	Percent	Frequency	Percent	
Public	19	61.3%	6	35.3%	
Private	12	38.7%	11	64.7%	0.088
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.20: The firm of respondents

Q4: What is your firm?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
University	13	41.9%	4	23.5%	
Company	7	22.6%	9	52.9%	
Consulting office	4	12.9%	4	23.5%	.982
Other	7	22.6%	0	0%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.21: The specialization

Q7: What is your work specialization?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
Civil	18	58.1%	11	64.7%	
Architecture	6	19.4%	1	5.9%	
Mechanic	5	16.1%	0	0%	.932
Electric	0	0%	3	17.6%	
Environment	2	6.5%	2	11.8%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.22: The Respondent's position in his firm

Q8: What is your position in your firm?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
Professor	3	9.7%	0	0%	.597
Assis. prof.	2	6.5%	1	5.9%	
Asso. prof	5	16.1%	3	17.6%	
Lecturer	2	6.5%	1	5.9%	
Executive Engineer	6	19.4%	10	58.8%	
Designer	3	9.7%	0	0%	
Consultant	4	12.9%	0	0%	
Coordinator manager	1	3.2%	1	5.9%	
General manager	1	3.2%	1	5.9%	
Contractor	2	6.5%	0	0%	
Other	2	6.5%	0	0%	
Total	31	100.0%	17	100.0%	

Table 4.23: The firm job sector

Which segment of the Architecture, Engineering, Construction, and owner operated (AECO)	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
Academic	9	20.0%	3	13.0%	.840
Design	9	20.0%	3	13.0%	
Construction	14	31.1%	12	52.2%	
Owner / Facilities Management / Real Estate	1	2.2%	1	4.3%	
Manufacturer	1	2.2%	4	17.4%	
Technology Consultant	5	11.1%	0	0%	
Engineering	2	4.4%	0	0%	
Other	4	8.9%	0	0%	
Total	**45**	**100.0%**	**23**	**100.0%**	

Table (4.16, 4.17, 4.18, 4.19, 4.20, 4.21, and 4.22) shows the total responses in this part are 48 responses due to difficulties in finding respondents, especially in Turkey, 65% of them are from Iraq, and 35% are from Turkey. Most of the respondents from Iraq were BSc, MSc, civil engineers, who worked in universities (public sector), as executive engineers in the construction segment in slahalden but respondents from Turkey were BSc, MSc, civil engineers working in a company (private sector) in

Istanbul. Most of the respondents age in Iraq are more than 45 years old, they represent 45% of the total respondents, but for the majority of respondents in Turkey, the distribution is almost equal. There is no significant difference between Iraq and Turkey concerning the age of the targeted respondents, this is confirmed by the U-test's P-value which is more than 0.05. as shown in Table (B.1, and B.2) in Appendix A.

Table 4.24: The year of experience

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
0-5	6	19.4%	5	29.4%	
5-10	0	0%	5	29.4%	
10-15	8	25.8%	3	17.6%	
15-20	8	25.8%	2	11.8%	.027
20-25	8	25.8%	2	11.8%	
>30	1	3.2%	0	0%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.25: The Size of Respondent Firm

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Less than 50	12	38.7%	6	35.3%	
50-100	8	25.8%	4	23.5%	
100-200	2	6.5%	2	11.8%	
200-500	2	6.5%	3	17.6%	.938
500-1000	1	3.2%	2	11.85	
>1000	6	19.4%	0	0%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.23, and 4.24 shows the responses to this question in Iraq are almost equally distributed. In Turkey, 60% of the total respondents have 10 or fewer years of experience. There is a significant difference between Iraq and Turkey concerning the years of experience, this is confirmed by the U-test's P-value which is less than 0.05. Additionally, the majority of respondents in Iraq and Turkey are working with less than 50 employees, from Iraq represents 39% of the total respondents, and 35% of respondents from Turkey, 35% of the total respondents.

4.5.2 Evaluate the rate of using BIM software

Table B.3 shows in Appendix A describe their level of using software related to engineering and construction management. Based on the respondents' answers the mean was calculated to summarize their answers and see their level in using each software. The results are as the following:

- In Iraq and Turkey, there is a poor level of assessment in using the (Revit software, 3Dmax software, BIM360, 3Darchcad, Navisworks, Autodesk Green Building Studio (for sustainability design), the Etabs, software Primavera software) The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, there is a good level of assessment in using the Autocad software, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- -In Iraq and Turkey, the Tackle package is not used this is reflected by the mean of responses which is between 1 and 1.5. The P-value which is more than 0.05 confirms that there is no significant difference in both countries related to this question.
- In Turkey there is a poor level of assessment in using the Autodesk Insight360 software, this is reflected by the mean of responses which is between 1.5 and 2.5, But in Iraq, it is not used, this is reflected by the mean of responses which is between 1 and 1.5 the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey, there is a poor level of assessment in using the MS project software, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq there is a good level of assessment in using the Excel software, this is reflected by the mean of responses which is between 2.5 and 3.5, but in Turkey, the level is very good this is reflected by the mean of responses which is between 3.5 and 4.5. The P-value which is more than 0.05 shows

that there is no significant difference in both countries related to these questions.

So, in both countries, the overall evaluation of assessing the level of using engineering software according to the respondents' responses is poor except for Excel which has a good level of usage and good level in.

Here, a Relative Importance Index (RII) analysis is done to more evaluation the level of software used in Iraq and Turkey. Tables (B.4, and B.5 in Appendix B) it shows the level of relevance for each sub-question of this question.

Table 4.26: The Result RII for software in Iraq and Turkey for (specialist BIM)

5-Likert scale RII explanation	**Iraq software**	**Turkey software**	**The result**
Medium to High Relevance	**1. AutoCAD, 2. Excel**	**1. AutoCAD, 2. Excel**	**No different (with 2d modeling and project software)**
Medium Relevance	Revit,3Dmax Ms project	Revit, 3Dmax, Autodesk insight360, MS project	As respondents on the BIM specialist's questionnaire, Turkey and Iraq has Revit,3Dmax, and MS project at the medium level so they have 3D, (4D +5D) time and cost scheduling for BIM modeling Turkey has also sustainability software at the medium level, which is used in 6D, but Iraq is medium to low.
Medium to Low Relevance	BIM360,3DArchicad, Navisworks, Tackle, Green Building, Primavera insight360, Etabs	BIM360, 3DArchicad, Green building Navisworks, Tackle, Primavera, Etabs,	Turkey and Iraq have BIM coordination (3DArchicad, Navisworks), steel, and analysis concrete construction such as tackle and Etabs at a Medium to a low level.

Hence, from Table 4.25 not all answers the same as general engineers answering the BIM specialist questionnaire have skills in BIM because most of the respondents from Iraq from universities but respondents from turkey work in companies, so they have different software skills. Generally, Iraq has a medium to low level of essential BIM software, but turkey has a medium level of essential BIM software for adopting BIM.

Table 4.27: Compare the drawing methods used

Q13: Which is your drawing method used in construction projects?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
2D plan by (CAD program)	16	51.6%	8	47.1%	.916
3D model by (Revit program)	5	16.1%	4	23.5%	
Both	10	32.3%	5	29.4%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.26 shows the majority of respondents in Iraq are drawing with the 2D plan (CAD program), they represent 52% of the total respondents. In Turkey, 47% of the total respondents are also drawing with 2D plans (CAD program). There is no significant difference between Iraq and Turkey concerning the drawing method used in construction projects, this is confirmed by the U-test's P-value which is more than 0.05.

4.5.3 Awareness of limitations, benefits and challenges of BIM adoption

Table 4.28: The Rate of BIM skill

Q14: How do you rate your skill in BIM?	Iraq				Turkey				U-test's P-value
	Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
I don't know	10	32.3%	2.55	1.207	1	5.9%	3.12	.993	.127
Fair	1	3.2%			3	17.6%			
Good	14	45.2%			7	41.2%			
Very good	5	16.1%			5	29.4%			
Excellent	1	3.2%			1	5.9%			
Total	**31**	**100.0%**			**17**	**100.0%**			

Table 4.27 shows in this question, the respondents were asked to describe their level of using BIM software. Based on the mean calculation the evaluation was: 1 to 1.5 = I don't know, 1.5 to 2.5 = Fair, 2.5 to 3.5 = Good, 3.5 to 4.5 = Very good, 4.5 to 5 = Excellent. Based on the respondents' answers the mean was calculated to summarize their answers and see their level in using BIM.

In Iraq and Turkey, there is a good level of assessment in using the BIM software, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both

countries related to this question. The Respondents' rate who had skill in BIM is above 64%.

Table 4.29: The BIM knowledge comes from

Q15: Where is your BIM knowledge come from? (Check all that apply)?	**Iraq**		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
The University	4	11.8%	8	44.4%	.064
Enrolled in the training courses in my firm	1	2.9%	1	5.6%	
Study BIM software By Myself	16	47.1%	2	11.1%	
Work with the international companies	1	2.9%	0	0%	
My graduation thesis on BIM	2	5.9%	1	5.6%	
No deal with BIM	10	29.4%	6	33.3%	
Total	**34**	**100.0%**	**18**	**100.0%**	

Table 4.28 shows In Iraq, 47% of the total respondents got BIM. Study BIM software by themselves. But in Turkey, 44% of the total respondents got their knowledge of BIM from a university. However, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question, the difference is due to differences in the percentages of the answers in both countries.

4.5.4 The limitation of using BIM

According to Table B.6 in Appendix B the responses to this question. The barriers to using the BIM system in Iraq are:

- The widening gap between the curricula of the faculties of engineering and the field of work and the lack of integration of students in applied courses for BIM.
- Few experts deal with engineering software.
- The change resistance and most the engineers prefer traditional method for estimation of cost and time
- Lack of benefit and cooperation with countries that have successful experiences in the field of BIM.
- Lack of government legislation related to BIM

- The absence of real BIM projects applied in my country
- Lack of support / Lack of BIM-related investments
- The barriers to using the BIM system in Turkey are:
- The change resistance and most the engineers prefer traditional method for estimation of cost and time.
- Lack of benefit and cooperation with countries that have successful experiences in the field of BIM

The BIM implementation

Table 4.30: BIM implementing

Q17: Is your firm implementing a BIM project?	**Iraq**		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	9	29.0%	6	35.35	
No	22	71.0%	11	64.7%	.493
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.29 shows In Iraq and Turkey, the respondents stated that their firms do not implement BIM projects they represent 71% of total respondents in Iraq and 65% of total respondents in Turkey, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table 4.31: The percentage (%) of BIM projects till the year (2022)?

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
0%	17	54.8%	5	29.4%	
<25%	8	25.8%	6	35.3%	
25-50%	4	12.9%	4	23.5%	.092
50-75%	2	6.5%	2	11.8%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.30 shows In Iraq according to 55% of the total respondents, 0% of the projects used BIM in their projects. In Turkey, according to 35% of the total respondents, less than 25% of the projects used the BIM system. The P-value which

is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table B.8 in Appendix B shows, the respondents were asked to identify the rate of BIM benefits in their job area. Based on the respondents' answers the mean was calculated to summarize the following:

- In Iraq respondents stated that the level of BIM in reducing conflict is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey respondents stated that the level of BIM in reducing conflict is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq respondents stated that the level of BIM in better understanding of design among Team Members is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey, respondents stated that the level of BIM in better understanding of design among Team Members is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq respondents stated that the level of BIM in enhancing project quality is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey respondents stated that the level of BIM in enhancing project quality is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq, respondents stated that the level of BIM in decreasing in the number of request information (RfI's) or (Work change orders) because all information is clear is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey, request information (RfI's) or (Work change orders) because all information is clear is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.

- In Iraq and Turkey, respondents stated that the level of BIM in decreasing construction costs is average, this is reflected by the mean which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq and Turkey, respondents stated that the level of BIM in decreasing project duration is average, this is reflected by the mean which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq respondents stated that the level of BIM in marketing a new business is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey respondents stated that the level of BIM in marketing a new business is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.
- In Iraq, respondents stated that the level of BIM in integrating BIM with other technologies, like combined application of various innovative technologies - such as GIS, and AR - visualization of the workplace in real time owing to the different functions is average, this is reflected by the mean which is between 2.5 and 3.5. In Turkey respondents stated that the level of BIM in this question is very poor, this is reflected by the mean which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference between Iraq and Turkey related to this question.

In Iraq the overall level of BIM's benefits in the respondents' job area is average, but in Turkey, it is between very poor and average.

Table 4.32: How long has your firm been using BIM? (In year)?

Q22: How long has your firm been using BIM? (in year)	**Iraq**		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Not used	16	51.6%	9	52.9%	
0-2	5	16.1%	2	11.8%	
2-5	8	25.8%	3	17.6%	.805
5-8	2	6.5%	3	17.6%	
Total	31	100.0%	17	100.0%	

Table 4.31 shows the most respondents in Iraq and Turkey, the BIM was not used in their firms they represent in Iraq 52% of the total respondents and 53% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. But there 25.8% of Iraq and 17.6 % of Turkey used BIM for (2-5) years. Also, 6.5% from Iraq and 17.6 from Turkey used BIM for (5-8) years so they both country in beginning level.

Table 4.33: The rate of BIM application on the project

Q27: Is there any application of the BIM project that has been implemented in your country?		**Iraq**				**Turkey**				**T-test's P-value**
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q27.1	1. Yes	0	0%	2.65	.486	5	29.45	1.76	.562	.000
	2. No	11	35.5%			11	64.7%			
	3. I don't know	20	64.5%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q27.2	1. Yes	3	9.7%	2.55	.675	4	23.5%	1.82	.529	.000
	2. No	8	25.8%			12	70.6%			
	3. I don't know	20	64.5%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q27.3	1. Yes	10	32.3%	2.19	.910	7	41.2%	1.65	.606	.033
	2. No	5	16.1%			9	52.9%			
	3. I don't know	16	51.6%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q27.4	1. Yes	5	16.1%	2.45	.768	6	35.3%	1.76	.664	.003
	2. No	7	22.6%			9	52.9%			
	3. I don't know	19	61.3%			2	11.8%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q27.1: Airport
Q27.2: Transportation construction
Q27.3: Construction building (factory design, hospital, resident building) (as smart building)
Q27.4: Commercial construction

In this question the respondents were asked if there any application of the BIM project that has been implemented in their country. Based on the mean calculation the evaluation was: 1 to 1.5 = Yes, 1.5 to 2.5 = No, and from 2.5 to 3 I don't know. Based on the respondents' answers the mean was calculated to summarize their answers as the following:

- In Iraq respondents do not know if BIM project is implemented in their airports, this is reflected by the mean of responses which is between 2.5 and

3. In Turkey respondents stated that BIM project is not implemented in their airports, this is reflected by the mean of responses which is between 1.5 and 2.5. the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.

- In Iraq respondents do not know if BIM project is implemented in their Transportation construction, this is reflected by the mean of responses which is between 2.5 and 3. In Turkey respondents' responses stated that BIM project is not implemented in their Transportation construction, this is reflected by the mean of responses which is between 1.5 and 2.5. the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey respondents stated that the BIM project is not implemented in their Construction building (factory design, hospital, resident building) (as a smart building), this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to differences in the percentages of the answers in both countries.
- In Iraq and Turkey, respondents stated that the BIM project is not implemented in their commercial construction, this is reflected by the mean of responses which is between 1.5 and 2.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to differences in the percentages of the answers in both countries.

Table 4.34: The project whose need BIM

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	24	77.4%	5	29.4%	
No	7	22.6%	12	70.6%	.001
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.33 shows that in Iraq, 77% of the total respondents think that all construction projects need BIM modeling, but in Turkey, 71% of the total respondents think that

BIM modeling is not needed. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.

Table 4.35: The mostly data generated By the BIM model

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Schedules	15	12.5%	9	34.6%	.054
Specifications	14	11.7%	1	3.8%	
Estimates	14	11.7%	4	15.4%	
Quantity Takeoffs	18	15.0%	3	11.5%	
Construction schedules	21	17.5%	4	15.4%	
Clash detection	18	15.0%	2	7.7%	
Catalog sheets/product data sheets	20	16.7%	3	11.5%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.34 shows in Iraq, the responses are almost equal for this question but 18% of the total respondents generate construction schedules using BIM. In Turkey, 35% of the total respondents generate Schedules using the BIM system. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Challenge

Table 4.36: University has authorized access to Autodesk or not

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	6	19.4%	3	17.6%	.879
No	11	35.5%	6	35.3%	
I don't know	14	45.2%	8	47.1%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.35 shows In Iraq and Turkey, respondents do not know if their universities have authorized access to Autodesk to provide the students with new software that increases their capacity for using BIM. In Iraq, they represent 45% of total responses, and in Turkey, they represent 47% of total responses. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table 4.37: The % not used BIM on limited companies' work

	Iraq				Turkey				T-test's P-value
	Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
I don't know	4	12.9%			2	11.8%			
Strongly Disagree	2	6.5%			7	41.2%			
Disagree	3	9.7%			4	23.5%			
Neutral	8	25.8%	2.97	1.560	1	5.9%	3.00	1.414	.899
Agree	10	32.3%			14	82.4%			
Strongly Agree	4	12.9%			3	17.6%			
Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Table 4.36 shows in this question, the respondents were asked if they think if companies do not adopt BIM technology in construction projects, they will be limited in their work in the future. Based on the mean calculation the evaluation was: 0 to 0.5 = I don't know, 0.5 to 1.5 = Strongly disagree, 1.5 to 2.5 = Disagree, 2.5 to 3.5 = Neutral, 3.5 to 4.5 = Agree, 4.5 to 5 = Strongly agree. Based on the respondent's answers the mean was calculated to summarize the following:

- In Iraq and Turkey, respondents are natural about this question, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question, this is due to the distribution of answers which is almost the same in both countries.

4.5.5 Motivation factors

Table 4.38: The Range of Salary for BIM Engineer

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
300-500$	2	11.8	2	11.8	.079
500-700$	0	0	0	0	
700-1000$	4	12.9	5	29.4	
1000-1500$	15	48.4	5	29.4	
Other	10	26.9	5	29.4	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.37 shows that In Iraq, 48% of the total respondents stated that the range of salary should be between 1000 and 1500 $. In Turkey, the results are almost equal

but an accumulated 58.8 stated that it should be between 700 and 1500 $. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table 4.39: Compare design cost by CAD with revit

		Iraq				Turkey				T-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Revit	1. (5-10) $/m^2	6	19.4	3.13	1.544	5	29.4	3.12	1.691	.991
	2. (10-15) $/m^2	7	22.6			1	5.9			
	3. (15-20) $/m^2	4	12.9			4	23.5			
	4. (20-25) $/m^2	5	16.1			1	5.9			
	5. No idea	9	29.0			6	35.3			
	Total	**31**	**100.0%**			**17**	**100.0%**			
AutoCAD	1. (5-10) $/m^2	8	25.8	2.84	1.551	4	23.5	2.94	1.600	.833
	2. (10-15) $/m^2	7	22.6			4	23.5			
	3. (15-20) $/m^2	6	19.4			3	17.6			
	4. (20-25) $/m^2	2	6.5			1	5.9			
	5. No idea	8	25.8			5	29.4			
	Total	**31**	**100.0%**			**17**	**100.0%**			

Table 4.38 shows in this question, the respondents were asked about the rate of cost / m2. Based on the mean calculation the evaluation was: 1 to 1.5 = (5-10) $/m^2, 1.5 to 2.5 = (10-15) $/m^2, 2.5 to 3.5 = (15-20) $/m^2, 3.5 to 4.5 = (20-25) $/m^2, 4.5 to 5 = No idea. Based on the respondents' answers the mean was calculated to summarize the following:

- According to the respondents' answers in Iraq and Turkey, the cost of designing with Revit is (15-20) $/m^2, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- According to the respondents' answers in Iraq and Turkey, the cost of designing with AutoCAD is (15-20) $/m^2, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05

shows that there is no significant difference in both countries related to this question.

Table 4.40: With skill in BIM software, job chance is bigger

	Iraq				Turkey				T-test's P-value
	Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
1. Strongly Disagree	0	0%	3.84	.820	0	0%	3.51	.800	.132
2. Disagree	2	6.5%			2	11.8%			
3. Neutral	7	22.6%			6	35.3%			
4. Agree	16	51.6%			8	47.1%			
5. Strongly Agree	6	19.4%			1	5.9%			
Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Table 4.39 shows in this question, the respondents were asked if they think if companies do not adopt BIM technology in construction projects, they will be limited in their work in the future. Based on the mean calculation the evaluation was: 1 to 1.5 = Strongly disagree, 1.5 to 2.5 = Disagree, 2.5 to 3.5 = Neutral, 3.5 to 4.5 = Agree, 4.5 to 5 = Strongly agree. Based on the respondents' answers the mean was calculated to summarize the following:

- In Iraq and Turkey, respondents are natural about this question, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question, this is due to the distribution of answers which is almost the same in both countries.

4.5.6 BIM curriculum

Table 4.41: About training courses

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
BIM authoring software	7	18.4%	4	17.45	.168
BIM Analysis software	1	2.6%	7	30.4%	
BIM Coordination Software	5	13.2%	3	13.0%	
BIM reviewing software	5	13.2%	0	0%	
Not study	20	52.6%	9	39.1%	
Total	**38**	**100.0%**	**23**	**100.0%**	

Table 4.40 shows the majority in Iraq and Turkey stated that they didn't study any courses related to BIM in their firms, they represent 53% of the total respondents in Iraq and 39% of the total respondents in Turkey. Other responses stated that they took courses in BIM authoring software and BIM analysis software. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table 4.42: The percentage of using BIM in universities curriculum

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	3	9.7%	4	23.5%	
No	28	90.3%	13	76.4%	.453
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.41 shows in Iraq and Turkey respondents stated that the BIM curriculum is not part of their university. In Iraq, they represent 90% of total responses, and in Turkey, they represent 76% of total responses the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

This analyzed based on the distribution percentage of the responses the mean does not provide an accurate explanation, so it is not used for this question:

- Table B.10 in Appendix B shows the majority of respondents in Iraq and Turkey stated that no BIM program courses are provided at the undergraduate level, they represent 58% of the total respondents in Iraq and 35% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries.
- Most respondents in Iraq stated that no BIM program courses are provided at the postgraduate level, they represent 52% of the total respondents. In Turkey, 35% stated that the period of studying BIM at the postgraduate level is between 1 to 3 months. The P-value which is more than 0.05 shows that there is no significant difference in both countries.
- Many respondents in Iraq and Turkey stated that no BIM practical courses are provided in their universities, they represent 49% of the total respondents in Iraq and 35% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries.

- Most respondents in Iraq and Turkey stated that no BIM training courses are provided in their universities, they represent 45% of the total respondents in Iraq and 35% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries.
- The majority of respondents in Iraq and Turkey stated that no BIM in graduation projects in their universities, they represent 39% of the total respondents in Iraq and 29% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries.
- The majority of respondents in Iraq and Turkey stated that no BIM laboratory course(workshop)in their universities, they represent 45% of the total respondents in Iraq and 35% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries.

The overall response to this question according to the respondents is that no BIM courses are provided at the different studying levels in universities in Iraq or Turkey.

4.5.7 Rules of BIM

Table 4.43: BIM Depend on project size

	Iraq		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	17	54.8	8	47.1	
No	14	45.2	9	52.9	.610
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.42 shows that in Iraq majority of respondents stated that using BIM depends on the size of the project and its complexity degree, they represent 55% of the total respondents. In Turkey, 53% stated that using BIM does not depend on the size of the project and its complexity degree. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Table 4.44: The most BIM standards using

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
UK	8	25.8%	2	11.8%	
USA	9	29.0%	5	29.4%	
National Standard	13	41.9%	9	52.9%	.257
No BIM in my firm	1	3.2%	1	5.9%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.43 shows In Iraq and Turkey, the majority of respondents stated that BIM was not used in their firms representing in Iraq 52% of the total respondents and 53% of the total respondents in Turkey. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. But there 25.8% of Iraq and 17.6 %of Turkey used BIM for (2-5) years. Also, 6.5%from Iraq and 17.6 from Turkey used BIM for (5-8) years. In Iraq and Turkey, most respondents stated that the BIM national standards are used in their countries, they represent 42% of the total respondents. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. Here is the problem with the answer because still program of BIM is not common in Iraq and Turkey as in the previous questions so there's no significant idea about it how can put nationality standards.

Table B.7 in Appendix B shows in this question, the respondents were asked if there are any official releases of BIM documents to support architecture, engineering, and construction industry practices in their country compared with the USA and UK BIM practice documents. Based on the respondents' answers the mean was calculated to summarize their answers as the following:

- In Iraq and Turkey respondents stated that there is no BIM model development and responsibilities of Parties, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents stated that there is no BIM model sharing and model reliability, this is reflected by the mean of responses which is between

1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

- In Iraq and Turkey respondents stated that there is no BIM interoperability/file format, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, respondents stated that there is no BIM model management, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, respondents stated that there are no BIM intellectual property rights, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents stated that there is no requirement for BIM execution planning rights, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, respondents stated that there are no BIM project reviews, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, respondents stated that there is no BIM model element authorship, this is reflected by the mean of responses which is between 1.5 and 2. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

This part analysis the level of using BIM and rules depending on it:

Table B.8 in Appendix B shows in this question, that the respondents were asked to identify the level of using BIM applications in their firm. Based on the mean calculation the evaluation was: 1 to 1.5 = Never used, 1.5 to 2.5 = Rarely, 2.5 to 3.5

= Sometimes, 3.5 to 4.5 = Often, 4.5 to 5 = Always. Based on the respondents' answers the mean was calculated to summarize the following:

- In Iraq and Turkey, respondents stated that 3D - (visualization) is rarely used in their country, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey, respondents stated that 4D-(3D-BIM +time schedule clash detection indicates the errors before start implementation is rarely used in their country, this is reflected by the mean of responses which is between 1.5 and 2.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Turkey, respondents stated that 5D-(4D-BIM+cost schedule) is rarely used in their country, this is reflected by the mean of responses which is between 1.5 and 2.5. In Iraq, respondents stated that it is not used, as the mean is between 1 and 1.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Turkey, respondents stated that 6D-(sustainability by saving energy, green building is rarely used in their country, this is reflected by the mean of responses which is between 1.5 and 2.5. In Iraq, responses stated that it is not used, as the mean is between 1 and 1.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Turkey, respondents stated that 7D-(operation and maintenance) is rarely used in their country, this is reflected by the mean of responses which is between 1.5 and 2.5. In Iraq, respondents stated that it is not used, as the mean is between 1 and 1.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question. So, in Iraq and Turkey, the level of using BIM applications is either rarely or not used at all.

Table 4.45: If a contractor who hasn't dealt with BIM, implements a BIM project

Q31: In your opinion, can a contractor who hasn't dealt with BIM before implement a BIM project?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
Yes	12	38.7%	6	35.3%	.711
No	11	35.5%	9	52.9%	
Maybe	8	25.8%	2	11.8%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.44 shows In Turkey, respondents stated that a contractor who hasn't dealt with BIM before cannot implement a BIM project, they represent 53% of the total responses, but in Iraq, the results are almost equal the highest results are yes, a contractor can with 39% of the total responses. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. No clear result from this answer.

Table 4.46: BIM used /cost of the project

Q40: If the answer is no, what is the project size (in terms of cost) you think BIM is compulsory?	Iraq		Turkey		U-test's P-value
	Frequency	Percent	Frequency	Percent	
<1 million $	15	48.4%	8	47.1%	.680
1-10million $	10	32.3%	8	47.1%	
10-50million $	2	6.5%	1	5.9%	
>50million$	4	12.95	0	0	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.45 shows In Iraq 48% of the projects that costs start from less than 1 million must use BIM, but in Turkey, 47% of the total respondents think as same as the Iraqi respondents, and the other 47% of respondents think that projects that costs start from less than 10 million must use BIM. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question. so all projects need BIM.

Table 4.47: Just knowing with Navisworks could deal with the project

	Iraq		Turkey		U-test's P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	6	19.4%	5	29.4%	.703
No	8	25.8%	3	17.6%	
I don't know	17	54.8%	9	52.9%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.46 shows In Iraq 55% of the total respondents and Turkey 53% of the total respondents have no idea if someone has experience in one of the coordination programs such as Navisworks, it will be easy to deal with the BIM model designed by an external firm, even if his or her information is simple in the Revit. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

4.5.8 Steps to use BIM

The part of this analysis represents steps to the BIM adaptation:

Table B.11in Appendix B shows in this question, the respondents were asked what important and more effective steps should take to adopt BIM at the first stage in their country. To make the steps order the mean was calculated for each step based on the respondents' answers and according to the following:

1. The government should support BIM technology and put funds and rules to use BIM.
2. The universities must depend on new courses of BIM (BIM authoring, analysis, BIM reviewing, BIM Coordination) software and update the curriculum always to build strong engineering skills.
3. Contracting with international experts with experience in the BIM field
4. BIM Competency Map, BIM Training Roadmap, BIM Roles (Project BIM Manager and/or Coordinators).
5. Set up BIM Committee with clear roles and responsibilities (leadership).
6. Define BIM Standard, Define BIM Quality and Assurance Checks (information)

In Turkey the order is as below:

1. The government should support BIM technology and put funds and rules to use BIM.
2. Contracting with international experts with experience in the BIM field
3. BIM Competency Map, BIM Training Roadmap, BIM Roles (Project BIM Manager and/or Coordinators).
4. The universities must depend on new courses of BIM (BIM authoring, analysis, BIM reviewing, BIM Coordination) software and update the curriculum always to build strong engineering skills.
5. Define BIM Standard, Define BIM Quality and Assurance Checks (information)
6. Set up BIM Committee with clear roles and responsibilities (leadership).

The P-value which is more than 0.05 shows that there are no significant differences between Iraq and Turkey in other words the difference between Iraq and Turkey is not significant.

About BIM requirement

Table B.12 in Appendix B shows in this question, the respondents were asked what the minimum requirements for a contractor are to implement a project designed with BIM. To make the requirements order the mean was calculated for each step based on the respondents' answers and according to that the order is as below:

In Iraq the order is as the following:

1. Programs(software).
2. Workers know.
3. Skill with BIM coordination.
4. Equipment (advance hardware).

In Turkey the order is as the following:

1. Equipment (advance hardware).
2. Workers know.
3. Programs(software).
4. Skill with BIM coordination.

The P-value which is more than 0.05 shows that there are no significant differences between Iraq and Turkey in other words the difference between Iraq and Turkey is not significant.

Table 4.48: The BIM adoption Issues same in countries geographically close

	Iraq		Turkey		U-tests P-value
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	16	51.6%	2	11.8%	.002
No	8	25.8%	4	23.5%	
Maybe	7	22.6%	11	64.7%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.47 shows that In Iraq, 52% of the total respondents think that BIM adoption issues would be the same for countries that have the same environment, and construction material, geographically close. In Turkey, 65% of total respondents stated that maybe BIM adoption issues would be the same for countries that have the same environment, construction material, geographically close. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.

Table 4.49: The Future Expectations for Increasing BIM Technique

Q46: Are the future expectations for using the BIM technique in construction projects increasing in your country?	**Iraq**		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Yes	12	38.7%	10	58.8%	.185
No	7	22.6%	3	17.6%	
Maybe	12	38.7%	4	23.5%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Table 4.48 shows in Iraq and Turkey, respondents think that there are future expectations for using the BIM technique in construction projects increased in the countries. In Iraq, they represent 39% of the total respondents and in Turkey, they represent 59% of the total respondents. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Related to the open question at the end of the survey for BIM specialists. The suggestions for adopting BIM were as shown below:

1. Engineers and government departments must be educated about the importance of this technology to reduce losses and control projects
2. Paying attention to its applications and teaching them in universities
3. increase advertising about BIM
4. Adopting the system to the government and making experts participate
5. Urging contractors to submit BIM for any project
6. Imposing this technique as part of the academic study requirements
7. Make BIM a basic subject for these studies in the college stages
8. Conducting intensive and continuous courses
9. Recommend using BIM programs because they give intelligent construction and avoid mistakes before implementation
10. Establishing courses for engineers in all specialties, training them, and conducting effective workshops to know the pros and cons and the possibilities of avoiding the negatives and comparing them with the traditional case to take advantage of the economic and time differences.
11. If using BIM systems in universities free of charge, encourage engineers to use it.

5. CONCLUSION AND FUTURE RESEARCH

5.1 Conclusion

This research was conducted based on two questionnaires (for genaral engineers and for specailist), so the conclusions are listed below.

1. Iraq and Turkey are poor levels of BIM software such as (Revit 3D modeling, and BIM coordination (Navisworks, ArchiCAD, BIM 360)) In contrast they are good levels in AutoCAD and project management software such as MS Project and excel as shown in table 4.25. In Iraq and turkey BIM in Level 1 is compared with a BIM maturity level as shown in Figure 3.2.
2. Turkey has a BIM curriculum for general engineers, but there is no BIM curriculum in Iraq Universities.
3. The main advantages of BIM technology are collaboration, visualization, time, and cost schedules. Both countries have used BIM for 2-5 years as 26% of Iraqi respondents and 18% of Turkish respondents used BIM. While for 5-8 years users are 7% for Iraq and 18% for Turkey.
4. According to the respondents' BIM specialists in Iraq and Turkey

A. There are steps for adopting BIM

1. The government should support BIM technology and put funds and rules to use BIM because it has become mandatory in most countries of the developed world countries.
2. The universities must depend on new courses of BIM (BIM authoring, analysis, BIM reviewing, BIM Coordination) software and update the curriculum always to build strong engineering skills. Iraq has Revit,3Dmax, and MS projects at the medium level so they have 3D, (4D +5D) time and cost scheduling for BIM modeling, but they so important need BIM coordination (3DArchicad, Navisworks), and analysis software such as tackle and Etabs because they in a low level now.

3. Turkey has also sustainability software at the medium level, which is used in 6D, but Iraq is medium to low so they need courses in sustainability software.
4. Turkey and Iraq have to Contract international experts with experience in the BIM field to give training courses.
5. Put BIM Competency Map, BIM Training Roadmap, and BIM Roles (Project BIM Manager and/or Coordinators).
6. Set up BIM Committee with clear roles and responsibilities (leadership).
7. Define BIM Standard, Define BIM Quality and Assurance Checks (information)
8. The main motivation factors that help in BIM adoption, the cost of the wages of a BIM engineer in Iraq and Turkey(700-1500) $ is almost similar, as well as the cost of design with Revit and AutoCAD (15-20), $/m2 is the same, and this encourages the exchange of experiences between the two countries.
9. Turkey universities must depend on new courses of BIM (BIM authoring, analysis, BIM reviewing, BIM Coordination) software and update the curriculum always, especially courses for BIM coordination software such as Navisworks, and ArchiCAD.

B. B-The minimum requirements to adopt BIM as the following:

In Iraq:

1. Programs(software).
2. Workers know.
3. Skill with BIM coordination.
4. Equipment (advanced hardware).

In Turkey:

1. Equipment (advanced hardware).
2. Workers know.
3. Programs(software).
4. Skill with BIM coordination

5.2 Recommendations

After determining the results and conclusions from this research, the approvals that were achieved are listed below.

1. The Iraq and Turkey universities have BIM modeling software (Revit) but should put a curriculum for BIM coordination software by increasing courses with Naviswork and Archicad to adopt BIM technology that helps to provide the job construction sector with expert BIM engineers.
2. Must increase BIM through the conference, and workshop between Iraq and Turkey, especially between (The Iraqi Engineers Syndicate and Turkey engineers' Syndicate).
3. Government support should be clear and effective through the formulated contract of BIM and interest in information technology.

5.3 Future Research

For future studies, there are some suggestions

- Need to work applying the BIM sustainability model to the drug factory construction project in Iraq because this part of the construction needs professional specifications to meet requirements and with BIM can get the smart factory, sustainability, maintenance document, and whole quality management for factory construction life.
- Study to create the national BIM library in Revit program as the common material used in Iraq
- State why 7D BIM is not used by investigating causes in-depth.

REFERENCES

Abed, H. R., Hatem, W. A., & Jasim, N. A. (2019). Adopting BIM Technology in Fall Prevention Plans. *Civil Engineering Journal*, *5*(10), 2270–2281. https://doi.org/10.28991/cej-2019-03091410

Ahmed, G. A., & Altaie, M. R. (2021). Investigation the Opportunity of BIM with Agile Management Approach in Iraqi Construction Projects. *E3S Web of Conferences*, *318*, 02001. https://doi.org/10.1051/e3sconf/202131802001

Aladag, H., Demirdögen, G., & Isik, Z. (2016). Building Information Modeling (BIM) Use in Turkish Construction Industry. *Procedia Engineering*, *161*, 174–179. https://doi.org/10.1016/j.proeng.2016.08.520

Aletby, N., & Ibrahim, H. (2021). Identification and Qualitative Evaluation of Risk Factors in the Construction Projects in Iraq. *Diyala Journal of Engineering Sciences*, *14*(2), 91–101. https://doi.org/10.24237/djes.2021.14209

Ali, E. (2010). *Development of an Integrated Construction Management System for Building Estimation*. the College of Engineering of the University of Baghdad.

Al-Maabreh, O. (2019). *Knowledge Transfer Partnership for BIM Implementation in the AEC Industry in Turkey*. Eastern Mediterranean University.

Alsaeedi, F., Lafta, M. J., & Ahmed, A. (2020). State of Building Information Modelling (BIM) adoption in Iraq. *IOP Conference Series: Materials Science and Engineering*, *737*(1). https://doi.org/10.1088/1757-899X/737/1/012007

Al-Zwainy, F. M. S., Mohammed, I. A., & Al-Shaikhli, K. A. K. (2017). *Diagnostic and Assessment Benefits and Barriers of BIM in Construction Project Management*. *3*(1). www.CivileJournal.org

Autodesk. (2003). *Solutıons Infrastructure*. www.autodesk.com

Azhar, S., Khalfan, M., & Maqsood, T. (2015). *Building Information Modeling (BIM): Now and Beyond*.

Azhar, S., Sattineni, A., & Hein, M. (2010). *BIM Undergraduate Capstone Thesis: Student Perceptions and Lessons Learned*. http://www.zoomerang.com

BCA Aknowleges. (2013). *BIM Essential Guide For BIM Adoption in an Organization*. www.bca.gov.sg

Borrmann, A., König, M., Koch, C., & Beetz, J. (2018). *Building Information Modeling: Why? What? How?*

Both, Petra Von. (2012). *Potentials and Barriers for Implementing BIM in the German AEC Market*. http://blm.ieb.kit.edu/

Chuck Eastman, Paul Teicholz, Rafael Sacks, & Kathleen Liston. (2008). *BIM handbook A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*.

Eastman, c., Teicholz, p., Sacks, R., & Liston, K. (2008). *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*.

Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). *BIM Handbook A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors Second Edition*.

Erzaij, K., & Obaid, A. (2017). Application of Building Information Modeling (3D and 4D) in Construction Sector in Iraq. *Journal of Engineering*, *10*.

Feliu, V. R., & Rodríguez, A. D. (2017). Knowledge transfer and university-business relations: Current trends in research. *Intangible Capital*, *13*(4), 697–719. https://doi.org/10.3926/ic.990

Hadi, Z. S. (2020). A Review paper on Benefits of BIM Adoption to Improve project performance in Iraqi Construction Industry. *International Journal of Contemporary Applied Researches*, *7*(10). www.ijcar.net

Hamada, H. M., Haron, A., Zakiria, Z., & Humada, A. M. (2016). Benefits and Barriers of BIM Adoption in the Iraqi Construction Firms. In *International Journal of Innovative Research in Advanced Engineering (IJIRAE)* (Vol. 3). www.ijirae.com

Hasan, A. N., & Rasheed, S. M. (2019). The Benefits of and Challenges to Implement 5D BIM in Construction Industry. *Civil Engineering Journal*, *5*(2), 412. https://doi.org/10.28991/cej-2019-03091255

Hatem, W. A., Abd, A. M., & Abbas, N. N. (2018). Barriers of adoption building information modeling (BIM) in construction projects of Iraq. *Engineering Journal*, *22*(2), 59–81. https://doi.org/10.4186/ej.2018.22.2.59

Howard, R. W. (2021). *Dıssertatıon Of Incentive, Bias, and Behaviour: An Empirical Economic Investigation into Project Delivery Constructs Influencing the Adoption of Building Information Modelling*. University College .

Ibraheem, R. A. R., & Mahjoob, A. M. R. (2022). Facilitating claims settlement using building information modeling in the school building projects. *Innovative Infrastructure Solutions*, *7*(1). https://doi.org/10.1007/s41062-021-00646-2

Ibrahim, M. Y., & Al-Kazzaz, D. A. (2021). A comparative analysis of BIM standards and guidelines between UK and USA. *Journal of Physics: Conference Series*, *1973*(1). https://doi.org/10.1088/1742-6596/1973/1/012176

Isikdag, U., & Underwood, J. (2010). *Handbook of Research on Building Information Modeling and Construction ...* Information Sience Reference(an imprit of IGI Global).

Jernigan, F. (2007). *Big Bim Little Bim: the Practical Approach to Building Information Modeling - Integrated Practice Done the Right Way!*

Kalfa, S. M. (2018). Building information modeling (BIM) systems and their applications in Turkey. *Journal of Construction Engineering, Management & Innovation*, *1*(1), 55–66. https://doi.org/10.31462/jcemi.2018.01055066

Kocakaya, M. N., Türkakin, O. H., & Giran, Ö. (2019). A Review of BIM Adoption in Turkey. *International Journal of 3-D Information Modeling*, *7*(4), 59–68. https://doi.org/10.4018/ij3dim.2018100104

Laiserin, J. (2010). *Desıgner's BIM: Vectorworks® Architect keeps design at the center of BIM process. ISSUE No. 26 — Specıal Edıtıon*.

Maad, M., Maad Mahdi, M., & Mawlood, D. K. (2020). Challenges Facing the Implementation of Building Information Modeling (BIM) Techniques in Iraq. *ZANCOJournal of Pure and Applied Sciences*, *2218–0230*. https://doi.org/10.21271/zjpas

McLeod, S. A. (2019). *What a p-value tells you about statistical significance. Simply Psychology*.

Mesároš, P., & Mandičák, T. (2017). Exploitation and Benefits of BIM in Construction Project Management. *IOP Conference Series: Materials Science and Engineering*, *245*(6). https://doi.org/10.1088/1757-899X/245/6/062056

Mesároš, P., Smetanková, J., & Mandičák, T. (2019). The Fifth Dimension of BIM - Implementation Survey. *IOP Conference Series: Earth and Environmental Science*, *222*(1). https://doi.org/10.1088/1755-1315/222/1/012003

Mitchell, J. (2007). *CRC for Construction Innovation (2007) Adopting BIM for Facilities Adopting BIM for Facilities Management : Solutions for Managing the Sydney Opera House. (Unpublished))*. http://eprints.qut.edu.au/27582

Nicał, A. K., & Wodyński, W. (2016). Enhancing Facility Management through BIM 6D. *Procedia Engineering*, *164*, 299–306. https://doi.org/10.1016/j.proeng.2016.11.623

Politi, R. R. (2018). *Project Plannıng And Management Usıng Buıldıng Informatıon Modelıng (BIM)*. İzmir Institute of Technology .

Project Management Institute. (2008). *A Guide to the Project Management Body Of Knowledge (PMBOK® GUIDE)* (six). project Management Institute,Inc.

Saeed, Z. O., Almukhtar, A., Abanda, H., & Tah, J. (2021). Bim applications in post-conflict contexts: The reconstruction of mosul city. *Buildings*, *11*(8). https://doi.org/10.3390/buildings11080351

Sahil, A. Q. (2016). *Adoptıon Of Buıldıng Informatıon Modelıng In Developıng Countrıes: A Phenomenologıcal Perspectıve Submitted by*. Colorado State University).

Samimpay, R., & Saghatforoush, E. (2020). Benefits of Implementing Building Information Modeling (BIM) in Infrastructure Projects. *Journal of Engineering, Project, and Production Management*, *10*(2), 123–140. https://doi.org/10.2478/jeppm-2020-0015

Saraç Çıracıoğlu, A., & Yaman, H. (2021). BIM Based Time Management Among Construction Contractors in Turkey. *Periodica Polytechnica Architecture*, *52*(2), 192–204. https://doi.org/10.3311/PPar.17918

Shibani, A., Abu Awwad, K., Ghostin, M., Siddiqui, K., & Farji, O. (2020). *Adopting Building Information Modelling in Small and Medium Enterprises of Iraq's Construction Industry*.

Sun, C., Jiang, S., Skibniewski, M. J., Man, Q., & Shen, L. (2017). A literature review of the factors limiting the application of BIM in the construction industry. In *Technological and Economic Development of Economy* (Vol. 23, Issue 5, pp. 764–779). Taylor and Francis Ltd. https://doi.org/10.3846/20294913.2015.1087071

Toklu, S., & Güzelçoban Mayuk, S. (2020). *The Implementatıon Of Buildıng Informatıon Modellıng (Bım) In Turkey Process_13-15 October 2020_Konya*. https://www.researchgate.net/publication/350581296

Wang, Z., & Liu, J. (2020). A Seven-Dimensional Building Information Model for the Improvement of Construction Efficiency. *Advances in Civil Engineering*, *2020*. https://doi.org/10.1155/2020/8842475

Zhou, Y., Yang, Y., & Yang, J. Bin. (2019). Barriers to BIM implementation strategies in China. *Engineering, Construction and Architectural Management*, *26*(3), 554–574. https://doi.org/10.1108/ECAM-04-2018-0158

Zou, Y., Kiviniemi, A., & Jones, S. W. (2017). A review of risk management through BIM and BIM-related technologies. *Safety Science*, *97*, 88–98. https://doi.org/10.1016/j.ssci.2015.12.027.

APPENDIX A

Appendix A: For Engineers

Questionnaire For Engineers

Q1-What is your country?

Q2-What is your qualification?

Q3-What is your job sector? (Public, private)

Q4-What is your firm?

Table A.1: Firm respondent location

Q5-Where is your firm located? (Your governorate)	**Frequency**	**Percent**
Iraq		
Anbar	6	4.5%
Arbil	3	2.2%
Babil	1	.7%
Baghdad	40	29.9%
Basra	4	3.0%
Di Kar	2	1.5%
Diyala	2	1.5%
Kadisiya	1	.7%
Karbala'a	2	1.5%
Karkuk	3	2.2%
Kot	1	.7%
Mosul	6	4.5%
Naniwa	5	3.7%
Salahdeen	49	36.6%
Sulaymaniyah	1	.7%
Tikrit	2	1.5%
Wasit	4	3.0%
Total	**134**	**100.0%**
Turkey		
Alanya	1	2.0%
Ankara	3	6.1%
Bursa	1	2.0%
Bingol	1	2.0%
Hatay	1	2.0%
Istanbul	38	77.6%
Karabuk	3	6.1%
Marsin	1	2.0%
Total	**49**	**100.0%**

Table A.2: The age of participation

Q6: How old are you?	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
21-25	5	3.7%	11	22.4%	
25-30	13	9.7%	14	28.6%	
30-35	21	15.7%	7	14.3%	
35-40	27	20.1%	9	18.4%	0.00
40-45	25	18.7%	6	12.2%	
>45	43	32.1%	2	4.1%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table A.3: The specialization of respondents

Q7: What is your work specialization?	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
Civil	71	53.0%	26	53.1%	
Architecture	12	9.0%	8	16.3%	
Mechanic	20	14.9%	0	0%	
Electric	18	13.4%	4	8.2%	0.59
Environment	6	4.5%	7	14.3%	
IT	4	3.0%	3	6.1%	
Other	3	2.2%	1	2.0%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Q8-What is your position in your firm?

Table A.4: The segment of respondent firm

Q9- Which segment of the Architecture, Engineering, Construction, and owner-operated (AECO) industry does your firm represent? (Check all that use)	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
Academic	43	26.4%	26	34.7%	
Design	21	12.9%	12	16.0%	
Construction	40	24.5%	20	26.7%	
Owner / Facilities Management / Real Estate	7	4.3%	8	10.7%	
Manufacturer	20	12.3%	5	6.7%	0.003
Technology Consultant	18	11.0%	4	5.3%	
Engineering	5	3.1%	0	0%	
Other	9	5.5%	0	0%	
Total	**163**	**100.0%**	**75**	**100.0%**	

Table A.5: Year of experience

Q10: Your years of experience are ?	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
0-5	24	17.9%	22	44.9%	
5-10	20	14.9%	13	26.5%	
10-15	23	17.2%	5	10.2%	
15-20	28	20.9%	6	12.2%	0.00
20-25	25	18.7%	3	6.1%	
>30	14	10.4%	22	44.9%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table A.5 shows the responses to this question in Iraq are almost equally distributed. In Turkey, 45% of the total respondents have 5 or fewer years of experience. There is a significant difference between Iraq and Turkey in the years of experience, this is confirmed by the T-test's P-value which is less than 0.05.

Table A.6: The size of the firm

Q11: What is the number of employees in your firm?	Iraq		Turkey		T-test's P-value
	Frequency	Percent	Frequency	Percent	
Less than 50	36	26.9%	17	34.7%	
50-100	29	21.6%	7	14.3%	
100-200	14	10.4%	6	12.2%	
200-500	14	10.4%	7	14.3%	0.505
500-1000	13	9.7%	4	8.2%	
>1000	28	20.9%	8	16.3%	
Total	**134**	**100.0%**	**49**	**100.0%**	

Table A.6 shows the majority of respondents in Iraq are working with less than 50 employees, they represent 27% of the total respondents. In Turkey, 35% of the total respondents are also working with less than 50 employees. There is no significant difference between Iraq and Turkey in the number of employees working in the firms that the respondents work in, this is confirmed by the T-test's P-value which is more than 0.05. Therefore, most respondents' Firms were small size presenting 26.9% in Iraq and 34.7% in Turkey.

The Level of Using BIM Software

Table A.7: The Compare level usage software

12-What is your assessment of the level of usage of the software below in your firm?		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Revit	Not used	57	42.5%	1.87	0.90	16	32.7%	2.22	1.085	0.025
	Poor	44	32.8%			12	24.5%			
	Good	28	20.9%			17	34.7%			
	Very Good	4	3.0%			2	4.1%			
	Excellent	1	.7%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
AutoCAD	Not used	11	8.2%	3.13	0.96	6	12.2%	3.08	1.096	0.751
	Poor	13	9.7%			5	10.2%			
	Good	64	47.8%			21	42.9%			
	Very good	39	29.1%			13	26.5%			
	Excellent	7	5.2%			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
3Dmax	Not used	45	33.6%	2.13	1.01	15	30.65	2.33	1.125	0.254
	Poor	41	30.6%			11	22.4%			
	Good	36	26.9%			17	34.7%			
	Very good	10	7.5%			4	8.2%			
	Excellent	2	1.5%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
BIM360	Not used	82	61.2%	1.57	0.83	23	46.9%	1.96	1.117	0.012
	Poor	30	22.4%			11	22.4%			
	Good	20	14.9%			11	22.4%			
	Very good	1	.7%			2	4.1%			
	Excellent	1	.7%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
3dArchcd	Not used	79	59.0%	1.69	0.95	22	44.9%	2.00	1.155	0.063
	Poor	25	18.7%			12	24.5%			
	Good	24	17.9%			11	22.4%			
	Very good	5	3.7%			1	2.0%			
	Excellent	1	.7%			3	6.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Navisworks	Not used	90	67.2%	1.51	0.86	24	49.0%	1.82	.928	0.036
	Poor	26	19.4%			12	24.5%			
	Good	14	10.4%			11	22.4%			
	Very good	2	1.5%			2	4.1%			
	Excellent	2	1.5%			0	0%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

Table A.7: (Cont.) The Compare level usage software

12-What is your assessment of the level of usage of the software below in your firm?		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Tacla package	Not used	96	71.6%	1.43	0.76	25	51.0%	1.82	.972	0.006
	Poor	20	14.9%			11	22.4%			
	Good	16	11.9%			10	20.4%			
	Very good	2	1.5%			3	6.1%			
	Excellent	0	0%			0	0%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Autodesk Green Building Studio (for sustainability design)	Not used	79	59.0%	1.63	0.84	16	32.7%	2.08	.954	0.002
	Poor	28	20.9%			16	32.7%			
	Good	25	18.7%			15	30.6%			
	Very good	2	1.5%			1	2.0%			
	Excellent	0	0%			1	2.0%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Autodesk Insight360	Not used	78	58.2%	1.62	0.83	20	40.8%	2.10	1.141	0.002
	Poor	32	23.9%			11	22.4%			
	Good	21	15.7%			13	26.5%			
	Very good	3	2.2%			3	6.1%			
	Excellent	0	0%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Primavera	Not used	57	42.5%	1.88	0.92	17	34.7%	2.08	.997	0.202
	Poor	43	32.1%			15	30.6%			
	Good	28	20.9%			14	28.6%			
	Very good	5	3.7%			2	4.1%			
	Excellent	1	.7%			1	2.0%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
MS project	Not used	46	34.3%	2.16	1.06	14	28.6%	2.37	1.093	0.258
	Poor	38	28.4%			10	20.4%			
	Good	34	25.4%			20	40.8%			
	Very good	14	10.4%			3	6.1%			
	Excellent	2	1.5%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Etabs	Not used	70	52.2%	1.82	1.02	14	28.6%	2.14	.957	0.056
	Poor	29	21.6%			18	36.7%			
	Good	26	19.4%			14	28.6%			
	Very good	7	5.2%			2	4.1%			
	Excellent	2	1.5%			1	2.0%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Excel	Not used	4	3.0%	3.33	0.98	7	14.3%	3.37	.951	0.81
	Poor	19	14.2%			26	53.1%			
	Good	58	43.3%			7	14.3%			
	Very good	35	26.1%			9	18.4%			
	Excellent	18	13.4%			7	14.3%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation

Table A.8: Relative Importance Index (RII) Iraq

5-Likert scale RII explanation 12-What is your assessment of the level of usage of the software below in your firm?	Mean	Std. Deviation	RII (Mean*0.20)	Explanation
[Revit]	1.87	0.90	0.37	Medium to Low Relevance
[AutoCAD]	3.13	0.96	0.63	Medium to High Relevance
[3Dmax]	2.13	1.01	0.43	Medium Relevance
[BIM360]	1.57	0.83	0.31	Medium to Low Relevance
[3dArchcad]	1.69	0.95	0.34	Medium to Low Relevance
[Navisworks]	1.51	0.86	0.30	Medium to Low Relevance
[Tackle package]	1.43	0.76	0.29	Medium to Low Relevance
[Autodesk Green Building Studio (for sustainability design)]	1.63	0.84	0.33	Medium to Low Relevance
[Autodesk Insight360]	1.62	0.83	0.32	Medium to Low Relevance
[Primavera]	1.88	0.92	0.38	Medium to Low Relevance
[MS project]	2.16	1.06	0.43	Medium Relevance
[Etabs]	1.82	1.02	0.36	Medium to Low Relevance
[Excel]	3.33	0.98	0.67	Medium to High Relevance

Table A.9: Relative Importance Index (RII) Turkey

5-Likert scale RII explanation. 12-What is your assessment of the level of usage of the software below in your firm?	Mean	Std. Deviation	RII (Mean*0.20)	Explanation
[Revit]	2.22	1.09	0.44	Medium Relevance
[AutoCAD]	3.08	1.10	0.62	Medium to High Relevance
[3Dmax]	2.33	1.13	0.47	Medium Relevance
[BIM360]	1.96	1.12	0.39	Medium to Low Relevance
[3dArchcad]	2.00	1.15	0.40	Medium Relevance
[Navisworks]	1.82	0.93	0.36	Medium to Low Relevance
[Tackle package]	1.82	0.97	0.36	Medium to Low Relevance
[Autodesk Green Building Studio]	2.08	0.95	0.42	Medium Relevance
[Autodesk Insight360]	2.10	1.14	0.42	Medium Relevance
[Primavera]	2.08	1.00	0.42	Medium Relevance
[MS project]	2.37	1.09	0.47	Medium Relevance
[Etabs]	2.14	0.96	0.43	Medium Relevance
[Excel]	3.37	0.95	0.67	Medium to High Relevance

Q13-Which is your drawing method used in construction projects?

Q14-How do you rate your skill in BIM?

Q15-Where is your BIM knowledge come from? (Check all that apply)

Table A.10: The limitation to using BIM

Q16: According to your opinion, the limitations, or barriers to using BIM in your country are because		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q16.1	1. Strongly Disagree	7	5.2%	3.50	.891	7	14.3%	2.92	1.077	0.004
	2. Disagree	8	6.0%			7	14.3%			
	3. Neutral	37	27.6%			20	40.8%			
	4. Agree	75	56.0%			13	26.5%			
	5. Strongly Agree	7	5.2%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.2	Strongly Disagree	4	3.0%	3.40	.910	2	4.1%	2.96	.865	0.343
	Disagree	19	14.2%			11	22.4%			
	Neutral	39	29.1%			25	51.0%			
	Agree	64	47.8%			9	18.4%			
	Strongly Agree	8	6.0%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.3	Strongly Disagree	13	9.7%	3.01	1.114	5	10.2%	2.84	.965	0.006
	Disagree	29	21.6%			10	20.4%			
	Neutral	50	37.3%			24	49.0%			
	Agree	28	20.9%			8	16.3%			
	Strongly Agree	14	10.4%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.4	Strongly Disagree	3	2.2%	3.49	.856	5	10.2%	3.06	1.107	0.356
	Disagree	12	9.0%			9	18.4%			
	Neutral	46	34.3%			17	34.7%			
	Agree	62	46.3%			14	28.6%			
	Strongly Agree	11	8.2%			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.5	Strongly Disagree	7	5.2%	3.21	1.077	5	10.2%	3.04	1.117	0.013
	Disagree	28	20.9%			10	20.4%			
	Neutral	46	34.3%			16	32.7%			
	Agree	36	26.9%			14	28.6%			
	Strongly Agree	17	12.7%			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.6	Strongly Disagree	6	4.5%	3.50	.978	5	10.2%	3.02	1.127	0.038
	Disagree	16	11.9%			9	18.4%			
	Neutral	37	27.6%			21	42.9%			
	Agree	62	46.3%			8	16.3%			
	Strongly Agree	13	9.7%			6	12.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

Table A.10: (Cont.)The limitation to using BIM

Q16: According to your opinion, the limitations, or barriers to using BIM in your country are because		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q16.7	Strongly Disagree	8	6.0%	3.51	1.000	2	4.1%	3.10	.872	0.000
	Disagree	14	10.4%			8	16.3%			
	Neutral	35	26.1%			24	49.0%			
	Agree	65	48.5%			13	26.5%			
	Strongly Agree	12	9.0%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.8	Strongly Disagree	4	3.0%	3.54	.947	5	10.2%	2.92	1.057	0.001
	Disagree	14	10.4%			10	20.4%			
	Neutral	38	28.4%			22	44.9%			
	Agree	61	45.5%			8	16.3%			
	Strongly Agree	17	12.7%			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.9	Strongly Disagree	5	3.7%	3.50	.979	5	10.2	2.94	.966	0.001
	Disagree	15	11.2%			6	12.2			
	Neutral	39	29.1%			28	57.1			
	Agree	58	43.3%			7	14.3			
	Strongly Agree	17	12.7%			3	6.1			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.10	Strongly Disagree	4	3.0%	3.40	.943	8	16.3%	2.84	1.087	0.001
	Disagree	16	11.9%			6	12.2%			
	Neutral	51	38.1%			24	49.0%			
	Agree	48	35.8%			8	16.3%			
	Strongly Agree	15	11.2%			3	6.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.11	Strongly Disagree	5	3.7%	3.45	.985	5	10.2%	2.88	1.053	0.000
	Disagree	18	13.4%			11	22.4%			
	Neutral	38	28.4%			22	44.9%			
	Agree	58	43.3%			7	14.3%			
	Strongly Agree	15	11.2%			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.12	Strongly Disagree	3	2.2%	3.41	.911	6	12.2%	2.84	1.048	0.000
	Disagree	20	14.9%			8	16.3%			
	Neutral	40	29.9%			28	57.1%			
	Agree	61	45.5%			2	4.1%			
	Strongly Agree	10	7.5%			5	10.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.13	Strongly Disagree	3	2.2%	3.50	.856	7	14.3%	2.84	1.048	0.011
	Disagree	13	9.7%			8	16.3%			
	Neutral	42	31.3%			22	44.9%			
	Agree	66	49.3%			10	20.4%			
	Strongly Agree	10	7.5%			2	4.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

Table A.10: (Cont.)The limitation to using BIM

Q16: According to your opinion, the limitations, or barriers to using BIM in your country are because		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q16.14	Strongly Disagree	7	5.2%	3.25	1.001	6	12.2%	2.82	1.074	0.000
	Disagree	22	16.4%			11	22.4%			
	Neutral	46	34.3%			22	44.9%			
	Agree	48	35.8%			6	12.2%			
	Strongly Agree	11	8.25			4	8.2%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q16.15	Strongly Disagree	2	1.5%	3.57	.808	3	6.1%	3.06	.966	0.011
	Disagree	11	8.2%			9	18.4%			
	Neutral	40	29.9%			22	44.9%			
	Agree	71	53.0%			12	24.5%			
	Strongly Agree	10	7.5%			3	6.1%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation
Q16.15: Lack of support for engineering competencies to keep pace with development and improve skills

Table A.10 shows in this question, the respondents were asked to share their opinion about the barriers to using the BIM system in their countries. Based on the mean calculation the evaluation was: 1 to 1.5 = Strongly disagree, 1.5 to 2.5 = Disagree, 2.5 to 3.5 = Neutral, 3.5 to 4.5 = Agree, 4.5 to 5 = Strongly agree. Based on the respondent's answers the mean was calculated to summarize the following:

- In Iraq respondents agreed that the widening gap between the curricula of the faculties of engineering and the field of work and the lack of integration of students in applied courses for BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that few experts who deal with engineering software are considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

- In Iraq and Turkey respondents are neutral that legal risk to determine is ownership of the BIM data and how to protect it through (security reasons) is considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey respondents are neutral that the change resistance and most the engineers prefer the traditional method for estimation cost and time is considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that the high cost of software and hardware which support BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq respondents agreed that lack of benefit and cooperation with countries that have successful experiences in the field of BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq respondents agreed that the lack of experience of the contractor in the implementation of construction works is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is

less than 0.05 shows that there is a significant difference in both countries related to this question.

- In Iraq respondents agreed that the absence or incomplete national standard for BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq respondents agreed that the lack of demand from customers or other companies for projects implemented using BIM technologies is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that uncertainty of the benefits of BIM implementation is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey respondents are neutral that the lack of government legislation related to BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq and Turkey respondents are neutral that the absence of real BIM projects applied in their country is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and

3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.

- In Iraq, respondents agreed that lack of support/lack of BIM-related investments is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that the cost of hiring BIM specialists and additional staff is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq respondents agreed that lack of support for engineering competencies to keep pace with development and improve skills is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.

17-What are the BIM software courses available as (training courses) in your firm?....(check all BIM software that is available)

Table A.11: The Benefits of BIM compared in Iraq and Turkey

Q18: Do you know that one of the benefits of building information modeling is..		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q18.1	1. Yes	113	84.3%	1.16	.365	33	67.3%	1.33	.474	0.001
	2. No	21	15.7%			16	32.7%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q18.2	1. Yes	113	84.3%	1.16	.365	30	61.2%	1.39	.492	0.095
	2. No	21	15.7%			19	38.8%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q18.3	1. Yes	113	84.3%	1.16	.365	36	73.5%	1.27	.446	0.007
	2. No	21	15.7%			13	26.5%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q18.4	1. Yes	108	80.6%	1.19	.397	30	61.2%	1.39	.492	0.000
	2. No	26	19.4%			19	38.8%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q18.5	1. Yes	110	82.1%	1.18	.385	28	57.1%	1.43	.500	0.084
	2. No	24	17.9%			21	42.9%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation

Q18.1: It gives you a three-dimensional image and provides an opportunity to find design errors before starting implementation on the ground, thus reducing cost and time

Q18.2: Accuracy in limited quantities

Q18.3: The BIM model with a cost schedule and schedule facilitates project management easily

Q18.4: The BIM model facilitates the operational work of the project and the maintenance work later, as it is an integrated archive of the project, better than the traditional methods

Q18.5: The BIM model facilitates the sharing of information about the project among all project members

Table A.11: (Cont.) The Benefits of BIM comparing in Iraq and Turkey

		Iraq				Turkey				T-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q18.6	1. Yes	109	81.3%	1.19	.391	34	69.4%	1.31	.466	0.003
	2. No	25	18.7%			15	30.6%			
	Total	**134**	**100.0%**			**49**	**100.0%**			
Q18.7	1. Yes	114	85.1%	1.15	.358	32	65.3%	1.35	.481	0.000
	2. No	20	14.9%			17	34.7%			
	Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation
Q18.6: Quality work and fewer conflicts
Q18.7: The 3D model gives the contractor a good idea what his responsibilities

Q19-Do you prefer calculating the quantities manually or using the design programs to calculate the project quantities

For motivation adopting BIM

Q20-What is the rate of cost /m2 design in CAD or Revit method?

21-Do you support if you have skills in engineering and construction programs, your chance of getting a greater job?

Table A.12: About the willingness to enter BIM courses

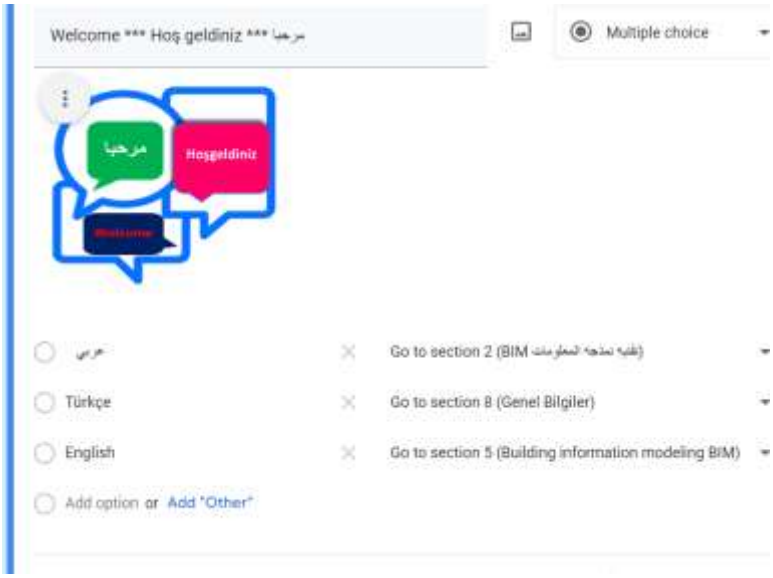
Q22- Are you ready to enter practical courses in the field of building information modeling to improve the management of construction projects?	**Iraq**				**Turkey**				**T-test's P-value**
	Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Yes	113	84.3%	1.31	.730	29	59.2%	1.49	.834	0.013
No	0	0%			9	18.4%			
Maybe	21	15.7%			11	22.45			
Total	**134**	**100.0%**			**49**	**100.0%**			

* Standard deviation

Q23-Do you have any suggestions to keep pace with the development of skills and the uses and uses of modern software in construction projects to facilitate the adoption of BIM building information modeling and the exchange of experiences in this field later? (Open question)

Appendix B: For Specialists

B-Questionnaire for BIM specialists



General information

Q1-What is your country?

Q2-What is your qualification?

Q3-What is your job sector? (Public, private)

Q4-What is your firm?

Table B.1: The firm located

Q5: Where is your firm located?	**Frequency**	**Percent**
Iraq		
Anbar	3	9.7%
Baghdad	6	19.4%
Basra	1	3.2%
Diyali	2	6.5%
Nainawa	4	12.9%
Salahdeen	12	38.7%
Sulymaniya	1	3.2%
Tikrit	1	3.2%
Wasit	1	3.2%
Total	**31**	**100.0%**
Turkey		
Istanbul	15	88.3%
Karabuk	2	11.8%
Total	**17**	**100.0%**

Table B.1 shows in Iraq the majority of respondents are from Salaheddin, they represent 38% of the total respondents, and from Baghdad, they represent 19% of the total respondents. In Turkey the majority of respondents are from Istanbul, they represent 88% of the total respondents.

6- responses How old are you?

Table B.2: The age of respondents

Q6: How old are you?	**Iraq**		**Turkey**		**U-test's P-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
21-25	2	6.5%	2	11.8%	
25-30	3	9.7%	3	17.6%	
30-35	5	16.1%	3	17.6%	
35-40	5	16.1%	3	17.6%	.115
40-45	2	6.5%	3	17.6%	
>45	14	45.2%	3	17.6%	
Total	**31**	**100.0%**	**17**	**100.0%**	

Q7-What is your work specialization?

Q8-What is your position in your firm?

Q9- Which segment of the Architecture, Engineering, Construction, and owner-operated (AECO) industry does your firm represent? (Check all that use)

Q10- Years of experience are:

Q11-What is the number of employees in your firm?

The level of using BIM software

Table B.3: The level of usage (Revit, AutoCAD,3Dmax) software

Q12: What is your assessment of the level of usage of the software below in your firm?		Iraq				Turkey				U-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Revit	Not used	8	25.8%	2.13	.957	8	47.1%	1.94	1.029	.503
	Poor	14	45.2%			3	17.6%			
	Good	7	22.6%			5	29.4%			
	Very good	1	3.2%			1	5.9%			
	Excellent	1	3.2%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
AutoCAD	Not used	1	3.2%	3.19	.910	2	11.8%	3.12	1.219	.963
	Poor	4	12.9%			3	17.6%			
	Good	17	54.8%			5	29.4%			
	Very good	6	19.4%			5	29.4%			
	Excellent	3	9.7%			2	11.8%			
	Total	**31**	**100.0%**				**100.0%**			
3Dmax	Not used	10	32.3%	2.16	1.068	4	23.5%	2.29	.985	.581
	Poor	10	32.3%			6	35.3%			
	Good	8	25.8%			5	29.45			
	Very good	2	6.5%			2	11.8%			
	Excellent	1	3.2%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
BIM360	Not used	20	64.5%	1.42	.620	11	64.7%	1.41	.618	.980
	Poor	9	29.0%			5	29.4%			
	Good	2	6.5%			1	5.9%			
	Very good	0	0%			0	0%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

Table B.3: (Cont.) The level of usage (3dArchcad, Navisworks, Tackle package) software

		Iraq				Turkey				U-test's P-value
		Percent	Mean	S. D*		Frequency	Percent	Mean	S. D*	
3dArchcad	Not used	17	54.8%	1.61	.761	9	52.9%	1.71	.849	.756
	Poor	9	29.0%			4	23.5%			
	Good	5	16.1%			4	23.5%			
	Very good	0	0%			0	0%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
Navisworks	Not used	19	61.3%	1.51	.677	10	58.8%	1.71	.985	.596
	Poor	9	29.0%			3	17.6%			
	Good	3	9.7%			3	17.6%			
	Very good	0	0%			1	5.9%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
Tacla package	Not used	22	71.0%	1.39	.667	12	70.6%	1.41	.712	.946
	Poor	6	19.4%			3	17.6%			
	Good	3	9.7%			2	11.8%			
	Very good	0	0%			0	0%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
Autodesk Green Building Studio(for sustainability design)	Not used	20	64.5%	1.52	.675	7	41.2%	1.76	.752	.126
	Poor	8	25.8%			7	41.2%			
	Good	3	9.7%			3	17.6%			
	Very good	0	0%			0	0%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
Autodesk Insight360	Not used	21	67.7%	1.39	.615	6	35.3%	2.00	.935	.015
	Poor	8	25.8%			6	35.3%			
	Good	2	6.5%			4	23.5%			
	Very good	0	0%			1	5.9%			
	Excellent	0	0%			0	05			
	Total	**31**	**100.0%**				**100.0%**			

* Standard deviation

Table B.3: (Cont.) The level of software

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Primavera	Not used	13	41.9%	1.90	.908	8	47.1%	1.88	1.111	.730
	Poor	9	29.0%			5	29.4%			
	Good	8	25.8%			3	17.6%			
	Very good	1	3.2%			1	5.9%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
MS project	Not used	8	25.8%	2.16	.860	5	29.4%	2.49	1.281	.345
	Poor	11	35.5%			3	17.6%			
	Good	11	35.5%			5	29.4%			
	Very good	1	3.2%			3	17.6%			
	Excellent	0	0%			1	5.9%			
	Total	**31**	**100.0%**				**100.0%**			
Etabs	Not used	12	38.7%	1.90	.870	5	29.4%	2.35	1.272	.271
	Poor	11	35.5%			5	29.4%			
	Good	7	22.6%			5	29.4%			
	Very good	1	3.2%			2	11.8%			
	Excellent	0	0%			0	0%			
	Total	**31**	**100.0%**				**100.0%**			
Excel	Not used	2	6.5%	3.26	1.125	0	0%	3.76	.970	.146
	Poor	5	16.1%			1	5.9%			
	Good	12	38.7%			7	41.2%			
	Very good	7	22.6%			4	23.5%			
	Excellent	5	16.1%			5	29.4%			
	Total	**31**	**100.0%**				**100.0%**			

* Standard deviation

Table B.4: Relative Importance Index (RII) Iraq

5-Likert scale RII explanation 12-What is your assessment of the level of usage of the software below in your firm?	Mean	Std. Deviation	RII (Mean*0.20)	Explanation
[Revit]	2.13	0.96	0.43	Medium Relevance
[AutoCAD]	3.19	0.91	0.64	Medium to High Relevance
[3Dmax]	2.16	1.07	0.43	Medium Relevance
[BIM360]	1.42	0.62	0.28	Medium to Low Relevance
[3dArchcad]	1.61	0.76	0.32	Medium to Low Relevance
[Navisworks]	1.48	0.68	0.30	Medium to Low Relevance
[Tackle package]	1.39	0.67	0.28	Medium to Low Relevance
[Autodesk Green Building Studio]	1.45	0.68	0.29	Medium to Low Relevance
[Autodesk Insight360]	1.39	0.62	0.28	Medium to Low Relevance
[Primavera]	1.90	0.91	0.38	Medium to Low Relevance
[MS project]	2.16	0.86	0.43	Medium Relevance
[Etabs]	1.90	0.87	0.38	Medium to Low Relevance
[Excel]	3.26	1.12	0.65	Medium to High Relevance

Table B.5: Relative Importance Index (RII) Turkey

5-Likert scale RII explanation 12-What is your assessment of the level of usage of the software below in your firm?	Mean	Std. Deviation	RII (Mean*0.20)	Explenation
[Revit]	1.94	1.03	0.39	Medium Relevance
[AutoCAD]	3.12	1.22	0.62	Medium to High Relevance
[3Dmax]	2.29	0.99	0.46	Medium Relevance
[BIM360]	1.41	0.62	0.28	Medium to Low Relevance
[3dArchcad]	1.71	0.85	0.34	Medium to Low Relevance
[Navisworks]	1.71	0.99	0.34	Medium to Low Relevance
[Tackle package]	1.41	0.71	0.28	Medium to Low Relevance
[Autodesk Green Building Studio]	1.76	0.75	0.35	Medium to Low Relevance
[Autodesk Insight360]	2.00	0.94	0.40	Medium Relevance
[Primavera]	1.88	1.11	0.38	Medium to Low Relevance
[MS project]	2.53	1.28	0.51	Medium Relevance
[Etabs]	2.35	1.27	0.47	Medium to Low Relevance
[Excel]	3.76	0.97	0.75	Medium to High Relevance

Q13-Which is your drawing method used in construction projects?

Q14-How do you rate your skill in BIM?

Q15-Where is your BIM knowledge come from? (Check all that apply)

Table B.6: The limitations or barriers to using BIM

Q16: According to your opinion, the limitations, or barriers to using BIM in your country are because. (continued)		Iraq				Turkey				U-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q16.1	Strongly Disagree	1	3.2%	3.71	.902	1	5.9%	3.12	1.166	.036
	Disagree	3	9.7%			4	23.5%			
	Neutral	3	9.7%			7	41.2%			
	Agree	21	67.7%			2	11.8%			
	Strongly Agree	3	9.7%			3	17.6%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.2	Strongly Disagree	1	3.2%	3.55	.888	2	11.8%	3.24	1.348	.378
	Disagree	4	12.9%			3	17.6%			
	Neutral	4	12.9%			5	29.4%			
	Agree	21	67.7%			3	17.6%			
	Strongly Agree	1	3.2%			4	23.5%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Q16.1: The widening gap between the curricula of the faculties of engineering and the field of work and the lack of integration of students in applied courses for BIM

Q16.2: Few experts who deal with engineering software

Table B.6: (Cont.) The limitations or barriers to using BIM

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q16.3	Strongly Disagree	2	6.5%	3.19	1.167	2	11.8%	3.06	1.345	.682
	Disagree	8	25.8%			4	23.5%			
	Neutral	7	22.6%			6	35.3%			
	Agree	10	32.3%			1	5.9%			
	Strongly Agree	4	12.9%			4	23.5%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.4	Strongly Disagree	0	0%	3.84	.969	1	5.9%	3.65	1.367	.814
	Disagree	4	12.9%			3	17.6%			
	Neutral	5	16.1%			4	23.5%			
	Agree	14	45.2%			2	11.8%			
	Strongly Agree	8	25.85			7	41.2%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.5	Strongly Disagree	3	9.7%	3.26	1.237	1	5.9%	3.29	1.359	.956
	Disagree	6	19.4%			5	29.4%			
	Neutral	7	22.6%			4	23.5%			
	Agree	10	32.3%			2	11.8%			
	Strongly Agree	5	16.1%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.6	Strongly Disagree	1	3.2%	3.61	1.054	1	5.9%	3.65	1.367	.772
	Disagree	4	12.9%			3	17.6%			
	Neutral	7	22.6%			4	23.5%			
	Agree	13	41.9%			2	11.8%			
	Strongly Agree	6	19.4%			7	41.2%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Q16.3: Legal risk to determine is ownership of the BIM data and how to protect it through (reasons for security)

Q16.4: The change resistance and most the engineers prefer traditional method for estimation of cost and time

Q16.5: High cost for software and hardware which support BIM

Q16.6: Lack of benefit and cooperation with countries that have successful experiences in the field of BIM

Table B.6: (Cont.) The limitations or barriers to using BIM

Q16.10: Implementation		Iraq				Turkey				U-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q16.7	Strongly Disagree	0	0%	3.61	.955	3	17.6%	3.00	1.414	.109
	Disagree	5	16.1%			3	17.6%			
	Neutral	7	22.6%			6	35.3%			
	Agree	14	45.2%			1	5.9%			
	Strongly Agree	5	16.1%			4	23.5%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.8	Strongly Disagree	1	3.2%	3.61	.919	1	5.9%	3.41	1.326	.641
	Disagree	3	9.7%			4	23.5%			
	Neutral	6	19.4%			4	23.5%			
	Agree	18	58.1%			3	17.6%			
	Strongly Agree	3	9.7%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.9	Strongly Disagree	2	6.5%	3.35	1.112	2	11.8%	3.18	1.468	.713
	Disagree	6	19.4%			5	29.4%			
	Neutral	5	16.1%			3	17.6%			
	Agree	15	48.4%			2	11.8%			
	Strongly Agree	3	9.7%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.10	Strongly Disagree	2	6.5%	3.19	1.138	2	11.8%	3.47	1.463	.413
	Disagree	7	22.6%			3	17.6%			
	Neutral	9	29.0%			3	17.6%			
	Agree	9	29.0%			3	17.6%			
	Strongly Agree	4	12.9%			6	35.3%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Q16.7: Lack of experience of the contractor in the implementation of construction works

Q16.8: Absence or incomplete national standard for BIM

Q16.9: Lack of demand from customers or other companies for projects implemented using BIM technologies

Q16.10: Uncertainty of the benefits of BIM implementation

Table B.6: (Cont.) The limitations or barriers to using BIM

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q16.11	Strongly Disagree	1	3.2%	3.68	1.045	3	17.6%	3.12	1.453	.191
	Disagree	4	12.9%			3	17.6%			
	Neutral	5	16.1%			4	23.5%			
	Agree	15	48.4%			3	17.6%			
	Strongly Agree	6	19.4%			4	23.5%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.12	Strongly Disagree	1	3.2%	3.58	.958	2	11.8%	3.06	1.345	.123
	Disagree	3	9.7%			4	23.5%			
	Neutral	8	25.8%			6	35.3%			
	Agree	15	48.4%			1	5.9%			
	Strongly Agree	4	12.9%			4	23.5%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.13	Strongly Disagree	2	6.5%	3.65	1.082	2	11.8%	3.18	1.425	.230
	Disagree	2	6.5%			4	23.5%			
	Neutral	7	22.6%			5	29.4%			
	Agree	14	45.2%			1	5.9%			
	Strongly Agree	6	19.4%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q16.14	Strongly Disagree	2	6.5%	3.45	1.028	2	11.8%	3.18	1.425	.442
	Disagree	3	9.7%			4	23.5%			
	Neutral	8	25.8%			5	29.4%			
	4. Agree	15	48.4%			1	5.9%			
	5. Strongly Agree	3	9.7%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q16.11: Lack of government legislation related to BIM
Q16.12: The absence of real BIM projects applied in my country
Q16.13: Lack of support / Lack of BIM-related investments
Q16.14: The cost of hiring BIM specialists and additional staff

Table B.6 shows in this question, the respondents were asked to share their opinion about the barriers to using the BIM system in their countries. Based on the mean calculation the evaluation was: 1 to 1.5 = Strongly disagree, 1.5 to 2.5 = Disagree, 2.5 to 3.5 = Neutral, 3.5 to 4.5 = Agree, 4.5 to 5 = Strongly agree. Based on the respondents' answers the mean was calculated to summarize the following:

- In Iraq respondents agreed that the widening gap between the curricula of the faculties of engineering and the field of work and the lack of integration of

students in applied courses for BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is less than 0.05 shows that there is a significant difference in both countries related to this question.

- In Turkey respondents are neutral that few experts who deal with engineering software are considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5, but in Iraq, respondents agreed with this question as the mean is between 3.5 and 4.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that legal risk to determine is ownership of the BIM data and how to protect it through (security reasons) is considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is a significant difference in both countries related to this question.
- In Iraq and Turkey respondents agreed that the change resistance and most the engineers prefer traditional method for estimation cost and time is considered as a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that the high cost of software and hardware which support BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. However, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq respondents agreed that lack of benefit and cooperation with countries that have successful experiences in the field of BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is

between 3.5 and 4.5. In Turkey respondents also agreed on this question. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

- In Iraq respondents agreed that the lack of experience of the contractor in the implementation of construction works is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq respondents agreed that the absence or incomplete national standard for BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq respondents are natural that lack of demand from customers or other companies for projects implemented using BIM technologies is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq and Turkey respondents are neutral that uncertainty of the benefits of BIM implementation is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq, respondents agreed that the lack of government legislation related to BIM is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. In Turkey, respondents are neutral on this question as the mean is between 2.5 and 3.5. The P-value

which is more than 0.05 shows that there is a significant difference in both countries related to this question.

- In Iraq, respondents agreed that the absence of real BIM projects applied in their country is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. In Turkey, respondents are neutral on this question as the mean is between 2.5 and 3.5. However, the P-value which is more than 0.05 shows that there is a significant difference in both countries related to this question, the difference is due to the distribution of the responses in the other alternatives of the question's answers.
- In Iraq, respondents agreed that lack of support/lack of BIM-related investments is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 3.5 and 4.5. In Turkey respondents are natural about this question this is reflected by the mean of responses which is between 2.5 and 3.5. The P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.
- In Iraq respondents agreed neutral that the cost of hiring BIM specialists and additional staff is considered a barrier to using the BIM system, this is reflected by the mean of responses which is between 2.5 and 3.5. In Turkey, respondents are neutral on this question as the mean is between 2.5 and 3.5. However, the P-value which is more than 0.05 shows that there is no significant difference in both countries related to this question.

Q17-Is your firm implemented a BIM project?

Q18- What is the percentage (%) of your projects which used BIM until this year (2022)?

Q19-What are the BIM software courses available as (training courses) in your firm? (Check all BIM)

For BIM Specialist

Q20-Do you have any subscriptions to journals, magazines, scientific research websites, etc., related to BIM?

Q21- What is your responsibility in your firm if you BIM specialist?

Q22- How long has your firm been using BIM? (in a year)

Q23-In Your Opinion What is The Most Critical Program used in BIM coordination and enhancing construction management in your Firm?

Q24-Is the BIM system compulsory in construction projects in your country?

Q25- Is using BIM depend on the size of the project and its complexity degree?

Q26-Which is the BIM standard depending on it in your country?

Q27- Is there any application of the BIM project that has been implemented in your country?

Table B.7: (Cont.) Official release of BIM documents

Q28: Is there any official release of BIM documents to support architecture, engineering, and construction industry practices in your country compared with the USA and UK BIM practice documents?		**Iraq**				**Turkey**				**T-test's P-value**
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q28.1	1. Yes	1	3.2	1.97	.180	2	11.8	1.88	.332	.247
	2. No	30	96.8			15	88.2			
	Total	31	100.0%			17	100.0%			
Q28.2	1. Yes	1	3.2	1.97	.180	2	11.8	1.88	.332	.247
	2. No	30	96.8			15	88.2			
	Total	31	100.0%			17	100.0%			

* Standard deviation
Q28.1: Model Development and Responsibilities of Parties
Q28.2: Model Sharing and Model Reliability

Table B.7: (Cont.) Official release of BIM documents

		Iraq				Turkey				T-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q28.3	1. Yes	3	9.7			1	5.9			
	2. No	28	90.3	1.90	.301	16	94.1	1.94	.243	.653
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q28.4	1. Yes	3	9.7			2	11.8			
	2. No	28	90.3	1.90	.301	15	88.2	1.88	.332	.823
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q28.5	1. Yes	4	12.9			1	5.9			
	2. No	27	87.1	1.90	.396	16	94.1	1.94	.243	.693
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q28.6	1. Yes	2	6.5			1	5.9			
	2. No	29	95.5	1.97	.315	16	94.1	1.94	.243	.770
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q28.7	1. Yes	2	6.5			2	11.8			
	2. No	29	93.5	1.94	.250	15	88.2	1.88	.332	.529
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q28.8	1. Yes	3	9.7			1	5.9			
	2. No	28	90.3	1.90	.301	16	94.1	1.94	.243	.653
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q28.3: Interoperability / File Format
Q28.4: Model Management
Q28.5: Intellectual Property Rights
Q28.6: Requirement for BIM Execution Planning
Q28.7: BIM Project Reviews
Q28.8: Model Element Authorship

Figure B.1: BIM applications

Table B.8: The usage percentage of BIM application

Q29: Identify the level of using BIM applications in your firm...		**Iraq**				**Turkey**				**U-test's P-value**
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q29.1	1. Never used	17	54.8%	1.77	1.203	5	29.4%	2.41	1.278	.051
	2. Rarely	10	32.3%			5	29.4%			
	3. Sometimes	1	3.2%			3	17.6%			
	4. Often	0	0%			3	17.6%			
	5. Always	3	9.7%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q29.1: 3D - (visualization)

Table B.8: (Cont.) The usage percentage of BIM application

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q29.2	Never used	18	58.1%	1.55	.850	6	35.3%	2.12	1.111	.057
	Rarely	11	35.5%			6	35.3%			
	Sometimes	1	3.2%			2	11.8%			
	Often	0	0%			3	17.6%			
	Always	1	3.2%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q29.3	Never used	23	74.2%	1.45	1.028	8	47.1%	2.00	1.118	.041
	Rarely	6	19.4%			3	17.6%			
	Sometimes	0	0%			4	23.5%			
	Often	0	0%			0	0%			
	Always	2	6.5%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q29.4	Never used	22	71.0%	1.39	.803	8	47.15	2.00	1.118	.039
	Rarely	8	25.8%			3	17.6%			
	Sometimes	0	0%			4	23.5%			
	Often	0	0%			0	0%			
	Always	1	3.2%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q29.5	Never used	22	71.0%	1.39	.803	6	35.3%	2.12	1.111	.008
	Rarely	8	25.8%			6	35.3%			
	Sometimes	0	0%			2	11.8%			
	Often	0	0%			3	17.6%			
	Always	1	3.2%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q29.2: 4D-(3D-BIM + time schedule, indicates the errors before starting implementation.
Q29.3: 5D- (4D-BIM+cost schedule).
Q29.4: 6D- (sustainability by saving energy, green building.
Q29.5: 7D- (operation and maintenance).

Q30-What data is directly generated by your BIM models? (Check all that apply)

Q31-In your opinion, can a contractor who hasn't dealt with BIM before implement a BIM project?

Table B.9: The percentage of benefits in the job area

Q32: What is the rate of BIM benefits in your job area		Iraq				Turkey				U-test's P-value
		Frequency	Percent	Mean	S. D*	Frequency	Percent	Mean	S. D*	
Q32.1	1. No idea about BIM benefit	11	35.5%	2.77	1.521	5	29.4%	2.29	1.047	.284
	2. Very poor	1	3.2%			4	23.5%			
	3. Average	8	25.8%			6	35.3%			
	4. Above average	6	19.4%			2	11.8%			
	5. Excellent	5	16.1%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.2	1. No idea about BIM benefit	9	29.0%	2.97	1.602	5	29.4%	2.24	1.033	.136
	2. Very poor	4	12.9%			5	29.4%			
	3. Average	5	16.1%			5	29.4%			
	4. Above average	5	16.1%			2	11.8%			
	5. Excellent	8	25.8%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.3	1. No idea about BIM benefit	9	29.0%	3.19	1.621	6	35.3%	2.35	1.320	.080
	2. Very poor	1	3.2%			4	23.5%			
	3. Average	5	16.1%			3	17.6%			
	4. Above average	7	22.6%			3	17.6%			
	5. Excellent	9	29.0%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.4	1. No idea about BIM benefit	10	32.3%	3.10	1.620	5	29.4%	2.18	1.015	.052
	2. Very poor	1	3.2%			6	35.3%			
	3. Average	3	9.7%			4	23.5%			
	4. Above average	10	32.3%			2	11.8%			
	5. Excellent	7	22.6%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q32.1: Reduce conflicts.
Q32.2: Better Understanding of Design Among Team Members.
Q32.3: Enhanced Project Quality.
Q32.4: Decrease in the number of request information (RFI's) or (Work change orders) because all information is clear.

Table B.9: (Cont.) The percentage of benefits in the job area

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q32.5	1. No idea about BIM benefit	9	29.0%	2.94	1.482	5	29.4%	2.53	1.281	.329
	2. Very poor	2	6.5%			3	17.6%			
	3. Average	7	22.6%			5	29.4%			
	4. Above average	8	25.8%			3	17.6%			
	5. Excellent	5	16.1%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.6	1. No idea about BIM benefit	9	29.0%	3.06	1.569	5	29.4%	2.59	1.372	.283
	2. Very poor	2	6.5%			3	17.6%			
	3. Average	5	16.1%			5	29.4%			
	4. Above average	8	25.8%			2	11.8%			
	5. Excellent	7	22.6%			2	11.8%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.7	1. No idea about BIM benefit	9	29.0%	3.16	1.573	5	29.4%	2.35	1.115	.056
	2. Very poor	1	3.2%			4	23.5%			
	3. Average	4	12.9%			5	29.4%			
	4. Above average	10	32.3%			3	17.6%			
	5. Excellent	7	22.6%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q32.8	1. No idea about BIM benefit	11	35.5%	3.00	1.653	8	47.1%	1.82	.883	.017
	2. Very poor	1	3.2%			4	23.5%			
	3. Average	3	9.7%			5	29.4%			
	4. Above average	9	29.0%			0	0%			
	5. Excellent	7	22.6%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Q32.5: Reduce construction costs.

Q32.6: Reduce Project Duration.

Q32.7: Marketing New Business.

Q32.8: Integrate BIM with other technologies, like combined application of various innovative technologies - such as GIS, and AR - visualization of the workplace in real time owing to the different functions.

Table B.9: (Cont.) The percentage of benefits in the job area

BIM curriculum

Q33- Is BIM part of the curriculum in your university?

Q34- Which BIM courses do you have in your university curriculum? how long is studying?

Table B.10: About BIM courses

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q34.1	1. 1-3	11	35.5%	4.00	2.422	5	29.4%	3.24	2.195	.437
	2. 3-6	1	3.2%			4	23.5%			
	3. 6-9	1	3.2%			2	11.8%			
	4. 9-12	0	0%			0	0%			
	0. No programs	18	58.1%			6	35.3%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q34.2	1. 1-3	10	32.3%	3.84	2.339	6	35.3%	2.94	2.135	.274
	2. 3-6	2	6.5%			4	23.5%			
	3. 6-9	3	9.7%			2	11.8%			
	4. 9-12	0	0%			0	0%			
	5. No programs	16	51.6%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q34.3	1. 1-3	11	35.5%	3.71	2.369	4	23.5%	3.41	2.093	.872
	2. 3-6	3	9.7%			3	17.6%			
	3. 6-9	0	0%			4	23.5%			
	4. 9-12	2	6.5%			0	0%			
	0. No programs	15	48.4%			6	35.3%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q34.4	1. 1-3	13	41.9%	3.52	2.407	4	23.5%	3.35	2.120	.863
	2. 3-6	2	6.5%			4	23.5%			
	3. 6-9	0	0%			3	17.6%			
	4. 9-12	2	6.5%			0	0%			
	5. No programs	14	45.2%			6	35.3%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q34.1: Undergraduate course.
Q34.2: Postgraduate course.
Q34.3: Practical courses.
Q34.4: Training courses.

Table B.10: (Cont.) About BIM courses

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q34.5	1. 1-3	11	35.5%	3.45	2.249	4	23.5%	3.41	1.970	.937
	2. 3-6	3	9.7%			2	11.8%			
	3. 6-9	2	6.5%			4	23.5%			
	4. 9-12	3	9.7%			2	11.8%			
	0. No programs	12	38.7%			5	29.4%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q34.6	1. 1-3	11	35.5%	3.58	2.349	4	23.5%	3.29	2.144	.954
	2. 3-6	4	12.9%			5	29.4%			
	3. 6-9	0	0%			2	11.8%			
	4. 9-12	2	6.5%			0	0%			
	0. No programs	14	45.2%			6	35.3%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q34.5: Graduation projects.
Q34.6: Laboratory course(workshop).

Q35-Does your university have authorized access to Autodesk to provide the students with new software that increases capability for using BIM?

Q36-Do you think if companies do not adopt BIM technology in construction projects, they will be limited in their work in the future?

Steps and rules

Q37-In your opinion, what are the important and more effective steps should take to adopt BIM at the first stage in your country? arrange the steps

Table B.11: Effective steps (government should support BIM, new course, BIM standard define)

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q37.1	1. No idea about BIM	4	12.9%	1.29	.902	1	5.9%	1.65	1.057	.251
	2. Step 1	18	58.1%			9	52.9%			
	3. Step 2	6	19.4%			3	17.6%			
	4. Step 3	2	6.5%			3	17.6%			
	5. Step 4	1	3.2%			1	5.9%			
	6. Step 5	0	0%			0	0%			
	7. Step 6	0	0%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q37.2	1. No idea about BIM	3	9.7%	1.61	1.283	1	5.9%	2.00	1.225	.191
	2. Step 1	16	51.6%			6	35.3%			
	3. Step 2	8	25.8%			5	29.4%			
	4. Step 3	0	0%			2	11.8%			
	5. Step 4	2	6.5%			3	17.6%			
	6. Step 5	2	6.5%			0	0%			
	7. Step 6	0	0%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q37.3	1. No idea about BIM	3	9.7%	2.13	1.384	1	5.9%	1.82	1.015	.473
	2. Step 1	10	32.3%			6	35.3%			
	3. Step 2	3	9.7%			6	35.3%			
	4. Step 3	12	38.7%			3	17.6%			
	5. Step 4	2	6.5%			1	5.9%			
	6. Step 5	0	0%			0	0%			
	7. Step 6	1	3.2%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation

Q37.1: The government should support BIM technology, put funds and rules to use BIM.

Q37.2: The universities must depend on new courses of BIM (BIM authoring, analysis, BIM reviewing, BIM Coordination) software and update the curriculum always to build strong engineering skills.

Q37.3: Contracting with international experts with experience in the BIM field.

Q38: what are the minimum requirements for a contractor to implement a project designed with BIM? (Arrangement as). first (minimum) required, then. [Equipment (advance hardware)

Table B.12: The minimum requirements for a contractor to implement a project

		Iraq				Turkey				U-test's P-value
		Frequency	**Percent**	**Mean**	**S. D***	**Frequency**	**Percent**	**Mean**	**S. D***	
Q38.1	1. I have no experience with BIM	5	16.1%	1.84	1.463	1	5.9%	1.59	.939	.776
	2. First req	13	41.9%			9	52.9%			
	3. Second req	2	6.5%			3	17.6%			
	4. Third req	4	12.9%			4	23.5%			
	5. Forth req	7	22.6%			0	0%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q38.2	1. I have no experience with BIM	5	16.1%	1.23	.884	1	5.9%	1.76	1.251	.139
	2. First req	18	58.1%			9	52.9%			
	3. Second req	4	12.9%			3	17.6%			
	4. Third req	4	12.9%			1	5.9%			
	5. Forth req	0	0%			3	17.6%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q38.3	1. I have no experience with BIM	5	16.1%	1.32	.979	1	5.9%	1.65	.996	.240
	2. First req	16	51.6%			8	47.1%			
	3. Second req	6	19.4%			5	29.4%			
	4. Third req	3	9.7%			2	11.8%			
	5. Forth req	1	3.2%			1	5.9%			
	Total	**31**	**100.0%**			**17**	**100.0%**			
Q38.4	1. I have no experience with BIM	5	16.1%	1.52	1.122	1	5.9%	1.82	1.074	.304
	2. First req	13	41.9%			6	35.3%			
	3. Second req	7	22.6%			7	41.2%			
	4. Third req	4	12.9%			1	5.9%			
	5. Forth req	2	6.5%			2	11.8%			
	Total	**31**	**100.0%**			**17**	**100.0%**			

* Standard deviation
Q38.1: Equipment (advance hardware).
Q38.2: Programs(software).
Q38.3: Workers know.
Q38.4: Skill with BIM coordination.

Q39-Do you think all construction projects need BIM modeling?

Q40-If the answer is no, what is the project size (in terms of cost) you think BIM is compulsory?

Q41- If you have experience in one of the coordination programs such as Navisworks, is it easy to deal with the BIM model designed by an external firm, even if your information is simple in the Revit?

Q42-To employ engineers who have skills in BIM design, what is the range of the salary approximately have to pay when started to adopt BIM in your firm?

Q43-What is the rate of cost /m2 design inAutoCAD or Revit method?

Q44-In your experience do you think that BIM adoption issues would be the same for countries that have the same environment, construction material, geographically close?

Q45-As your opinion if you have skills in BIM software, your chance to get a job is bigger.

Q46-Are the future expectations for using the BIM technique in construction projects increasing in your country?

Q47- Do you have any suggestions about the adoption of BIM or participation and exchange of experiences in this field? (Open question)

Appendix C: Samples of Answers

Table C.1: Samples of Answers

Table C.1: (Cont.) Samples of Answers

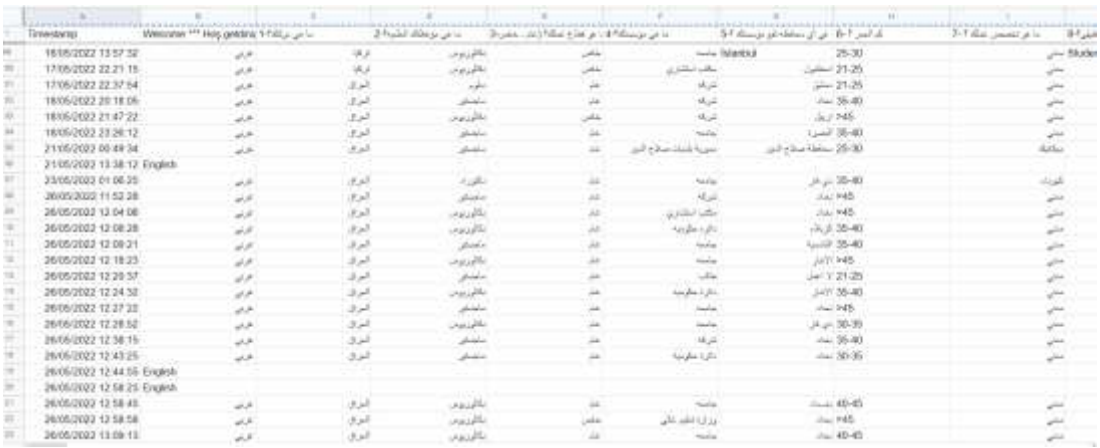


Table C.1: (Cont.) Samples of Answers

6-How old are you?	7-What is your work spec	8-What is your position in	9- Which segment of the	10-Years of experience a	11-What is the number of	12-What is your assessm	12-What is your assessm	12-What is your assessm	12-What is y
>45	Mechanic	Assoc.Prof.	academic	0-5	less than 50	Poor	Very good	not used	not used
35-40	Civil	Executive engineer	Construction	10-15	less than 50	not used	Good	Poor	not used
25-30	Civil	Executive engineer	Construction	5-10	100-200	Poor	Excellent	Good	Poor

2-Yetkiliğiniz nedir?	3-İş sektörünüz nedir?	4-Firmanız nerde?	5-Firmanız nerede?şehir	6-Kaç yaşındasınız?	7-İş ünvanlığınız nedir?	8-Firmanızdaki pozisyon	9- Firmanız Mühendis, Mü	10- Kaç yıllık iş deneyimi	11-Firmanızdaki ay
PhD	Civil	Üniversite	Istanbul	35-40	Inşaat	Assoc.Prof.	akademik	5-10	>1000
MSc.	Civil	Üniversite	Istanbul	25-30	Mimari	Research assistant	akademik	5-10	No info

15- BIM'i nereden öğrend	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkemizde E	16- Size göre ülkem
üniversite	4-Kabul	3.Orta	2. Katılmıyorum	4-Kabul	4-Kabul	5. Kesinlikle Katılıyorum	3.Orta	4-Kabul	3.Orta	
üniversite	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıy
üniversite, Firmamdaki iş	4-Kabul	3.Orta	3.Orta	3.Orta	3.Orta	3.Orta	3.Orta	3.Orta	3.Orta	3.Orta
BIM yazılımını tek başımı	2. Katılmıyorum	3.Orta	4-Kabul	4-Kabul	4-Kabul	5. Kesinlikle Katılıyorum	4-Kabul	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıy
üniversite	3.Orta	3.Orta	2. Katılmıyorum	4-Kabul	2. Katılmıyorum	2. Katılmıyorum	4-Kabul	3.Orta	2. Katılmıyorum	
BIM ile ilgili deneyimle sal	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	
BIM ile ilgili deneyimle sal	3.Kısmen	1. Kesinlikle Katılmıyorum	3.Kısmen	2. Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	2. Katılmıyorum	
Üniversiteden	1. Kesinlikle Katılmıyorum	2. Katılmıyorum	2. Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	2. Katılmıyorum	2. Katılmıyorum	2. Katılmıyorum	2. Katılmıyorum	
BIM ile ilgili deneyimle sal	3.Kısmen	3.Kısmen	4-Katılıyorum	4-Katılıyorum	2. Katılmıyorum	2. Katılmıyorum	4-Katılıyorum	4-Katılıyorum	5. Kesinlikle Katılıy	
Çalıştığım firmadaki eğitir	5. Kesinlikle Katılıyorum	4-Katılıyorum	4-Katılıyorum	1. Kesinlikle Katılmıyorum	4-Katılıyorum	4-Katılıyorum	3.Kısmen	2. Katılmıyorum	1. Kesinlikle Katılmı	
Üniversiteden	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmı	
BIM ile ilgili deneyimi sal	4-Katılıyorum	3.Kısmen	3.Kısmen	5. Kesinlikle Katılıyorum	4-Katılıyorum	4-Katılıyorum	4-Katılıyorum	4-Katılıyorum	4-Katılıyorum	
BIM yazılımını nereden ön	3.Kısmen	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	4-Katılıyorum	5. Kesinlikle Katılıyorum	5. Kesinlikle Katılıyorum	4-Katılıyorum	4-Katılıyorum	
Ulusalarası şirketlerde çı	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	3.Kısmen	
Üniversiteden	2. Katılmıyorum	3.Kısmen	2. Katılmıyorum	1. Kesinlikle Katılmıyorum	3.Kısmen	2. Katılmıyorum	3.Kısmen	2. Katılmıyorum	3.Kısmen	
Çalıştığım firmadaki eğitir	1. Kesinlikle Katılmıyorum	2. Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmıyorum	2. Katılmıyorum	2. Katılmıyorum	1. Kesinlikle Katılmıyorum	1. Kesinlikle Katılmı	

RESUME

- **Bachelor:** 1994-1995, Tikrit University, Civil Engineering Department
- **Master:** 2021 - 2022, Istanbul Gedik University Institute of Science and Art, Engineering Department, Engıneering Management Program

PROFESSIONAL EXPERIENCE /PRESENTATIONS ON THE THESIS

Certificate in Revit training from Autodesk, one of the important visualization BIM programs,

- Course on Revit essential for 16 hours training for period 4-June-2022.
- Course on Revit structure for 24 hours training for period 6-July -2022