An-Najah National University

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Adopting BIM in Palestinian Construction Projects using ADKAR as an Integrative Model of Change Management

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Dedication

To my parents for their significant sacrifice and everlasting support

To my supportive family that constantly pushes me towards success

To my work colleagues for their persistent collaboration

To all of my friends for their continuous assistance

Acknowledgement

First of all, I faithfully thank God for granting me the power and determination in overcoming all difficulties and accomplishing my goals.

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I express my honest gratitude to the engineering and contracting companies, too, for their honest collaboration.

Last but not least, my thankfulness to all those who supported me in any respect during the completion of this work.

الإقرار

انا الموقع أدناه مقدم رسالة تحت عنوان:

Adopting BIM in Palestinian Construction Projects using ADKAR as an Integrative Model of Change Management

أقر بأن ما اشتملت عليه هذه الرسالة هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وأن هذه الرسالة لم تقدم من قبل لنيل أي درجة علمية، أو أي بحث علمي أو بحثي لأي مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree of qualification.

Student's Name:	**اسم الطالب:**
Signature:	**التوقيع:**
Date:	**التاريخ:**

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List of Abbreviations

ADKAR	(Acronym): Awareness, Desire, Knowledge, Ability and Reinforcement
ANOVA	Analysis of Variance
AEC	Architectural, Engineering and Construction
BIM	Building Information Modeling
C.P	Construction Projects
CM@R	Construction Management at Risk
DBB	Design-Bid-Build
DB	Design-Build
GDP	Gross Domestic Product
IPD	Integrated Project Delivery
L.S.D.	Least Square Difference
PALENG	Palestinian Engineers Association
PNE	Palestinian National Economy
PCBS	Palestinian Central Bureau of Statistics
PCU	Palestinian Contractors Union
R. W.	Relative Weight
SPSS	Statistical Package for Social Science
Sig.	Significance
S. D.	Standard Deviation
FIDIC	International Federation of Consulting Engineers

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Abstract

The aim of this research is to examine the BIM status in the West Bank construction projects after introducing its application advantages. Additionally, it utilizes change management and inspects some hypothesis to increase BIM adoption using ADKAR model of change as a framework to replace the traditional engineering methods of work into modern processes in different engineering fields.

The buildings sector is considered a major branch of the construction industry, which is primarily the main economical part of any country. Therefore, developing this sector will definitely result in improving the whole country. One of the main engineering processes that enhances the buildings sector is the Building Information Modeling (BIM) used worldwide. The process of BIM adoption will develop the engineering procedure of work for the construction projects to be constructed with the required quality at the minimum cost and least duration.

The researcher studied several related books and researches to enlarge his vision, knowledge and information for the purpose of successfully completing this thesis.

Furthermore, interviews with eight major organizations and 242 filled questionnaires from engineering and contracting companies with different specialties added to clearly reach the required research objectives.

It was concluded that the ADKAR components: Awareness, Desire, Knowledge, Ability, and Reinforcement with the exception of Ability in adopting BIM for Civil and Architectural specialties, seemed to be higher in percentage than in Mechanical and Electrical fields. It was noticeable that all fields lack the Ability to implement BIM in real construction projects. Furthermore, adopting BIM in the West Bank construction projects were more effective for higher educational degrees, lower years of experience, smaller size companies, and Architects and Civil engineers.

Luckily, and after collecting the needed data and analyzing the qualitative and quantitative results, a framework was established for different engineering fields such as: Architectural, Civil, Mechanical, and Electrical specializations. The framework supports BIM application with the help of Government and its organizations to engage all stakeholders including the owner, to successfully approve BIM adoption in building projects.

This study adds a contribution to the buildings sector by applying ADKAR change management model in the BIM adoption process for the first time in literature.

In conclusion, the researcher recommends adopting BIM in the developing countries, as well as in other regions possible for their construction projects.

Chapter One
Introduction

1.1 Overview

This chapter exposes the introduction for the whole research. It includes the problem of the study that led the researcher to undertake the procedures to accomplish the work. Furthermore, it contains the objectives that will be achieved at the end of the study in addition to the questions that the research will answer. Moreover, this chapter consists of the research hypothesis that will be examined.

1.2 Introduction

Construction industry is one of the most important sectors contributing to the economy of any country. It includes several branches such as buildings, roads, and solid waste. However, the construction sector is one of the biggest fragmented industries in the World (Isikdag et al., 2007). Any construction project contains activities from planning, design drawings, time scheduling, cost estimation, and bidding to the execution and maintenance of the project. Many quick decisions are taken during these phases based on incomplete information and assumptions when the construction project is not integrated.

In reality, the construction sector has a lot of features that distinguishes it from other industries. These features such as easiness of entry open a chance for a lot of competitors to enter. However, this increases failure probability, especially in its complex nature with many stakeholders involved. One of the most complexities in construction projects is the mutual communication between stakeholders.

In the West Bank, the Palestinian National Economy (PNE) is affected by the construction sector as it encourages the economic growth of the country. It constitutes a high percentage of the Gross Domestic Product (GDP) (Palestinian Central Bureau of Statistics (PCBS), 2015).

During the past three decades, there was a huge growth worldwide using technology (Fisher et al., 2006). However, the construction industry has been standstill in adopting new technology as it depended on traditional methods (Baker, 2015). The latest and most promising technology in the construction sector developments is the use of BIM (Building Information Modeling) (Eastman et al., 2011). The concept of the BIM system goes back as early as 1962 by Douglas Engelbart, but it was first implemented after 1990 (Green, 2016).

BIM is a tool that provides storage and reuse of information knowledge throughout the lifecycle of the project (Vanlande and Nicolle, 2008). Hence, BIM is mainly useful in managing the information between different disciplines and stages within the project throughout its full process. BIM is a collaborative way of working by the digital technology as it unlocks more efficient methods of designing, creating and executing integrally.

Plainly, the key users that utilize BIM are the AEC companies (Architectural, Engineering and Construction) who reduce communication costs during the design and construction processes. One researcher from Palestine (Al-Hashash, 2014) stated that the main problem in the West Bank construction projects is the lack of coordination between project stakeholders. This problem causes clashes in projects ideas, drawings, and documents.

The coordination between stakeholders, though, can be improved through the use of shared design models. Therefore, any change can be communicated easily and instantaneously across all disciplines (Ekstrom & Bjornsson, 2004).

The use of a shared model that can facilitate an ease of communication results in reduction of both uncertainty and connection costs. In fact, effective collaboration of teams with all specializations can enhance modeling applications.

These teams can play a useful role of modeling in engineering firms, or as general contractors and construction managers in the mechanical, electrical, plumbing and fire- protection segments or other engineering fields.

The computer-rendered model would contain all of the building information such as wall material, structural elements, equipment, plumbing fixtures as well as door and window schedules, finishing details and others. This model will create an integrated environment, connecting all stakeholders efficiently. However, in spite of the benefits and potentials of BIM technologies, BIM is not applied in the AEC-Industry in the West Bank due to its dependence on traditional applications as their comfort zone.

According to the Palestinian Contractors Union (PCU), most of the projects are either put off, run over budget, fall short of the planned scope or cancelled before completion. Therefore, BIM may improve its performance relative to these factors. The economic benefits and productivity improvement with effective implementation of BIM is well recognized in the AEC-industry (Bernstein and Pittman, 2005). But this recognition needs to be applied by the modern methods (Arayici et al., 2009).

Adoption of BIM focuses on integration, cooperation and innovation which leads to changes in the industry of the West Bank (Palestine). These changes have to be accomplished by all involved workers. According to Prosci (2002): “change management is the processes, tools and techniques to effectively manage people and the associated human resource issues that surface when implementing change”.

Additionally, change to BIM will need re-engineering the firm. Therefore, a change model will be needed. Many change management models are now available.

What is common among the models is the motivation for change. But each one has its own limitations. For example, in Kurt Lewin’s model, the process of change is simple and short as it contains three steps for carrying out the change. But it does not allow the change to be anticipated or tracked in progress which is essential in the research. It also lacks considering personal feelings and experiences which may lead to a division among the group. The second model, McKinsey 7-S model, provides an ability to allow necessary changes. But this model is quite complex in structure and difficult in tracking changes. Another limitation is that when one step changes, others are affected. Therefore, the model may not be adequate in adopting BIM.

When these models are excluded, the remaining choices are narrowed down to the third choice of Kotter's 8-step approach and the fourth ADKAR choice of change model. Kotter's 8-step approach consumes much time for the change and may not be appropriate for a study.

Though somewhat new and has fewer steps, the **ADKAR** model is considered as the best choice which meets the overall requirements of the project. As a matter of fact, the model is fairly simple in concept and allows change and tracking. ADKAR also embraces process dimension of change in business as well as in individual dimension of change. Because ADKAR is a new model, indeed, achieving successful implementation of it needs trained facilitators (Hancock, 2010).

1.3 Research Problem

The BIM system is used in most of the industrial world countries, as well as in the gulf Arabian countries, and it verifies its feasibility towards construction work. But in Palestine, it is almost ignored (Abu Hamra, 2015).

Due to this issue, this thesis evaluates the possibilities of using the BIM system in the West Bank construction projects. It finds strengths and weaknesses for each engineering field to adopt the new system. It also proposes solutions for overcoming the obstacles that inhibit the adoption for engineering and contracting companies in addition to the client with the help of government support. For ensuring the adoption, ADKAR as a change management model is applied for locating the barriers and getting rid of them.

1.4 Objectives of the Research

This study is the first of its kind to empower and support the adoption of BIM using ADKAR change management model in particular. The objectives of the thesis are to develop a clear understanding about BIM so as to consider adopting its technology using ADKAR. This adoption could enhance application and promotion of construction projects.

The study provides a documentation of reference for BIM status in the West Bank engineering and contracting companies by specifying weaknesses and strengths for each field involved. It could be used as a comparative guide for future understanding and development of construction projects in order to motivate a creative working environment.

The following are the specific objectives of the thesis:

1- Assessing the awareness, desire, knowledge, ability, and reinforcement levels of BIM by professionals in the AEC-Industry in the West Bank for different specializations.

2- Identifying BIM functions and benefits that would convince professionals for adopting BIM in the AEC-Industry in the West Bank.

3- Confirmation of barriers that hinders BIM adoption in the West Bank construction projects.

4- Testing of some hypothesis with the adoption of BIM in the West Bank construction projects.

5- Employing change management to increase adoption of BIM using ADKAR model for different disciplines.

1.5 Questions of the Research

The research questions are:

1) What are the main obstacles in implementing BIM in the construction projects of the West Bank?

2) What are BIM incentives?

3) Are there approved hypotheses with the adoption of BIM?

4) How can leaders utilize change management to increase adoption of BIM for different engineering specializations?

1.6 Hypothesis of the Study

The study assumes the following hypothesis to be examined:

H1: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Gender of the respondents.

H2: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Education Degree of the respondents.

H3: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Field of Study of the respondents.

H4: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Years of Experience of the respondents.

H5: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Current Position of the respondents.

H6: There is no significant difference between the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) and the Size of the respondents' Companies.

1.7 Significance of the Study

The significance of this study represents mainly in that it is the first topic to discuss adoption of BIM using ADKAR. The study is the first of its type to be carried out in Palestine. The study aspires showing a prominent shift to move the application from the old traditional engineering methods to the modern one throughout the project life cycle. It will then be capable to specify the best direction that BIM system could be implemented in engineering and contracting companies with all their disciplines, by using the ADKAR model of change when applying the proposed adoption framework.

1.8 Structure of Thesis

The thesis includes six chapters. The first chapter "**Introduction**" introduces the thesis subject through a brief background overview. It also encompasses the research problem and the importance to support this research. Furthermore, it clarifies aims and objectives of the research, research questions and hypotheses.

The second chapter "**Literature Review**" introduces a literature review and summarizes studies that addressed the BIM, ADKAR, and the construction situation in Palestine, and previous studies which support the hypotheses formulation. In addition, a broader view was taken to look into how the BIM system could be implemented using the ADKAR model. Furthermore, it discusses the expected drivers, barriers and benefits of implementing BIM.

The third chapter "**Methodology**" presents the procedure that has been followed in this research through discussing data collection process used, the population targeted, sampling process, the instrument development for data collection and the data analysis approach.

The fourth chapter "**Data Analysis and Results**" presents the results and findings which illustrate the analytical results of qualitative and quantitative data and presents the hypotheses testing results.

The fifth chapter "**Discussion and Model Development**" discusses the results illustrated in chapter four and presents the model development and its explanations.

Finally, the sixth chapter "**Conclusions and Recommendations**" gives brief conclusions on qualitative and quantitative results in addition to the hypotheses outcomes with a set of recommendations, contributions, and future suggestions.

Chapter Two
Literature Review

2.1 Overview

This chapter contains literature review and theoretical framework of the study. Much literature has been reviewed into the subject of the study. The reader will realize that the literature discussed in this chapter aims at showing the importance of this study and all components of its image.

The subject of the study is rated as one of the first topics in the field of engineering management which makes it very important. For this reason, the researcher prefers to divide it into three different parts and discuss each part separately.

The three main sections of the subject of this study are:

1- BIM (Building Information Modeling).

2- Change Management.

3- Construction Projects in Palestine.

This chapter discusses each section separately, along with all its components in details. At the end of the chapter, the researcher will talk about the way of connecting them together.

2.2 Section One: BIM (Building Information Modeling)

The first issue the research will discuss is the **BIM**, and this section is divided into three main parts:

Part one: Definition of the BIM.

Part two: Benefits beyond adopting the BIM.

Part three: The requirements for successful implementation of the BIM.

2.2.1 Part One: Definition of the BIM

There is a number of definitions for the BIM provided from several writers in this subject. According to Hardin & McCool 2015, BIM is "An integration Model that combines between designers and contractors in order to enable them to work together towards a common goal which is the construction project."

Therefore, BIM is a modern way of creating, communicating, sharing, exchanging and managing the information throughout the entire lifecycle of construction projects (NBIMS, 2007).

BIM is also defined according to Succar (2009) as "a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building life cycle".

Both definitions include processes and tools for project management. BIM enhances the opportunity to have better sustainable construction projects and greater performance with lower resources and minimum risk than traditional practices. BIM supports the design using phases starting from the concept of the project and continues during the closing phase until the maintenance of the project. Therefore, it improves all engineering specializations from civil to architectural, mechanical, electrical, and other disciplines involved in the construction project.

If BIM is adopted well, it will encourage an integrated environment between design and construction that facilitates higher quality construction projects with lower cost and decreased duration of time (BIM Handbook, 2011).

According to Kiviniemi (2013), BIM is presented as a way of increasing the past low productivity into a higher rate in the AEC-industry. Studies show that the AEC-industry has much lower development of productivity compared to other production industries. Some even show that AEC productivity has actually decreased during the last 40 years (Lindblad et al., 2015; Merschbrock et al., 2015).

This low productivity was mainly taken from poor information flow and redundancy. By improving information management and cooperation of stakeholders in construction, BIM is a choice to achieve these issues (Aram et al., 2013). BIM is, however, not a goal in itself but rather a tool to enable higher efficiency in all parties (Kiviniemi, 2013; Eastman, 2011). In addition, adopting BIM will require changing the traditional way of mindset of work into creative innovations (GU and London 2010). By applying BIM, new tasks and processes have to be adopted. Hence, to accept BIM effectively, consulting and contracting firms for all specializations should agree with the change.

Although there was lack of awareness in BIM and in the insufficient use of it by professionals in Gaza Strip, contracting and engineering companies still think that BIM functions and benefits are valuable to the AEC industry (AbuHamra, 2015). Therefore, the awareness of the West Bank construction projects will be tested in this study. However, according to Enshassi (2006), the construction industry was falling back from 1980.

According to Hardin and McCool (2015), BIM is not software only; it is a process and software together, and successful BIM requires three key factors:

1) Processes: Engineering firms and contracting companies with all specializations have new technologies, but they still use them in old processes. So, this will not conduct efficient completion and outcomes of the construction projects. For example: the clash detection between specialties and resolution: The need here is to change the processes using new technologies, and BIM is just a tool for coordination between designers and contractors regarding completion of projects.

2) Technologies: There is a need to ask if the new tools are efficient or can improve the engineering activities and are good for the way of working. The question responds that, the way of selecting the tools in construction projects has three methods:

First Method is called “Pile on” method. This method is summarized in that the firm or organization makes a search for tools besides its current tools and system.

Second Method is called “Swap out”. It relies on the replacement of the company’s tools. In this method, the company searches for new tools that decide which internal and current tools could be replaced.

Third Method is called “Process First”. It is a less well-known strategy, but now it is growing to be known because of the increasing of outcome focused trends. The strategy is based on processes through which the team looks first at the current processes, and then it asks about how the processes will be done.

The first approach is the least painful one because it requires less time and less thoughts and meetings.

3) Behaviors: it is the most important aspect that must be taken into consideration in any construction project. Behavior is a set of cultural values that are located in minds of the construction management company. As Scott Simpson stated in the book of Hardin and McCool (2015), that “BIM is 10 percent technology and 90 percent sociology”. This means that when trying to adopt BIM, the cultural values and behaviors must be treated carefully and at the most important issue rather than other issues like Processes or Technologies.

Finally, it should be mentioned that the behaviors are the most difficult issue to be changed. In comparison, processes could be changed easily, as well as the technologies.

BIM concept is a comprehensive one. The integrative model collects all of the efforts by designers, contractors and other parties in order to conduct efficient outcomes and outputs.

2.2.2 Part Two: Benefits Beyond Adopting BIM

BIM system has been adopted since 2007 due to its benefits and many more advantages than disadvantages (Lindblad and Vass, 2015). Whatever were the disadvantages, this section will mention the benefits that come out from using and implementing the BIM.

The first benefit in adopting the BIM as Chen (2015) says, is the most important one for each party of the project, which reduces the cost of construction. It is known that the construction process implies many services and products. Those definitely might be of shortage and not delivered on time, so it will be costly.

The parties involved can think of another way for reducing that cost by applying the BIM during the process of construction.

Hewage (2013), mentioned a second benefit, and that is: the designers for all specializations take the time in designing, but not in commenting and remarking the mistakes exposed during the construction process.

Whereas the third benefit, as Porwal (2013) declared, is that the communications between the parties included in the construction process would be stronger and improved by using the BIM. The software has a life cycle between parties involved in the process, where the involved parties can provide their comments on one document using the software application. This would improve the cooperative and collaborative work between all parties included.

In addition to the mentioned benefits, Brathen (2015), concluded that there is a number of techniques and planning benefits beyond adopting and using the BIM. Here are some explanations for those benefits. Brathen (2015) mentions that there will be a strong control on the documents version by using the BIM system lifecycle and applying it effectively.

This will help designers and other parties involved to estimate construction cost and prepare the budget, and to observe the clash detection that could happen, in addition to solving the clash detected on time. This will drive to reduce the time of completing the construction projects, and decrease the request for information as well (Brathen, 2015).

In reference to Hardin and McCool (2015), they mention that there is a number of factors which could increase the benefits of BIM if it is applied. In fact, it will improve interoperability between the applications of the software in four specialties:

1- Functionality of the BIM software will be improved.

2- Deliverables between all specializations will be clearer by using BIM.

3- More trends will be approved for 3D building manufacturing products.

4- More internal staff with BIM skills will be appointed.

2.2.2.1 The Role of the BIM in Construction Management

Hardin & McCool (2015) define the role of the BIM in the construction projects as a core value of the construction. However, the core value role of the BIM is that the construction industry must be aware of the ability of the BIM and extend it for use in other related workflows and processes.

In reference to Jankowski et al. (2015), BIM affects the functions of the construction process, such as estimating, scheduling, logistics, and safety. Those new competencies have been opened by data flows between all parties involved in the construction projects so any related party will consistently modify the model.

The role of BIM is clear in the team engagement concept as discussed by Merschbrock and Munkvold (2015). They state that through using the BIM system, all parties forming the team of work on the construction project could engage with each other easily and solidly in order to achieve the goals and conduct efficient outcomes. Previously, each part of the construction projects worked separately which made the communications more difficult.

Moreover, the outcomes that were the most important element of the construction would be of less quality and not as required.

2.2.2.2 BIM Integrated Model

Figure 1.1 shows how BIM system is an integrated model that merges all parties and bodies involved in the construction projects together in order to achieve the goals and outcomes of the projects. In fact, it defines the BIM in a simple way, and how BIM plays its role in the construction projects (Hardin & McCool, 2015). Figure 1.1 mentions most of the responsibilities of the parties involved in the construction projects, from the first step that is the planning and designing, until the end of the projects, and conducting the outcomes.

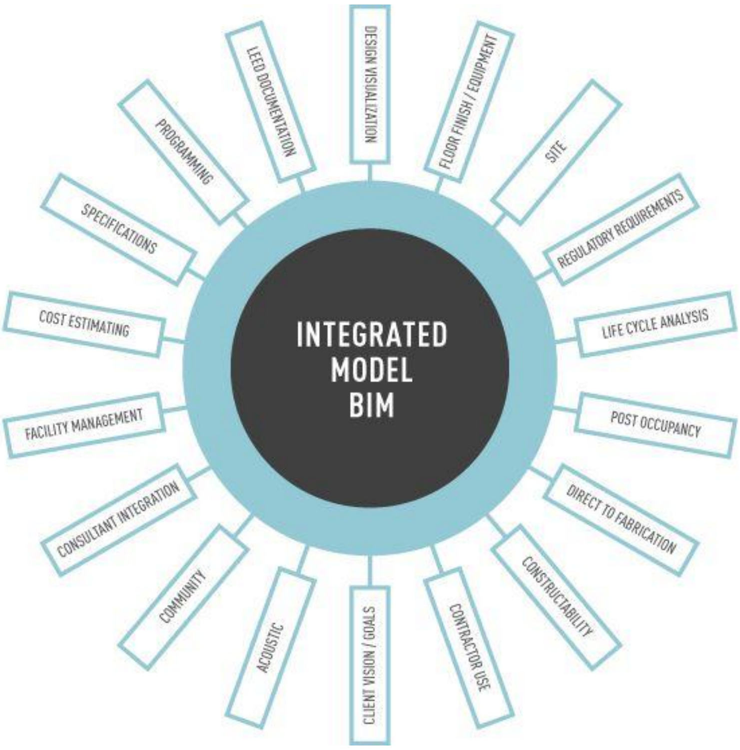

Figure 1.1: BIM as an Integrated Model, Source: Image BIM of Eddy Krygiel (2016)

The AEC-industry is traditionally slow in adopting new technology and BIM will have a great effect on how the work processes look in the projects. But for BIM to be adopted successfully to improve productivity there is a need to change these work processes. The fragmented industry is a problem here because this change cannot be adopted by single actors but must instead affect all involved actors. Adopting BIM emphasizes on integration, collaboration and innovation connected with large cultural changes in the industry (Kiviniemi, 2013).

Adoption of BIM will have a large effect on the work processes and traditional roles in the industry. This adoption will not be easy for actors uncomfortable with change. Furthermore, firms implementing BIM will have to address issues on how workflows should be redesigned, how staff should be assigned and how to distribute responsibilities (Arayici et al. 2009).

2.2.2.3 Who is the designer?

Jankowski et al. (2015) define the designer as the one or the company responsible for planning and designing the project. The designer has to do the first step of the construction project. Additionally, the designer for civil, architectural, mechanical, electrical and all specialties becomes the supervisor responsible for the follow up of each step until the completion of the whole project, along with the contractor.

2.2.2.4 Who is the contractor?

The contractor in Palestine could be a licensed individual or a company entitled to practice the contracting profession according to laws, executing drawings and practice regulations applied in Palestine.

In addition, the contractor shall be registered and classified at PCU (Palestinian Contractors Union). Contractors are classified into five categories according to their area of specialty. The areas of specialists are building, road construction, water and sewage, electro-mechanics, public work and maintenance. Contractors in each field are classified into five categories or classes which are Class 1, 2, 3, 4, and 5. This classification is based on the instructions of contractor classification issued by the National Classification Committee. According to the PCU (2012), there are many requirements used in order to classify the Palestinian contractors. These requirements are:

1. The contractors’ financial situations.

2. The value of their construction equipment.

3. The upper and lower limits of the values of the project carried out by them.

4. The contractors’ years of experience in that field.

5. The areas of their own offices.

2.2.3 Part Three: the requirements for successful implementation of BIM

A study of Hwang and Lim (2013) shows that “The success of BIM adoption and implementation lies in the collective participation and collaboration from all the stakeholders in a building project”. Furthermore, the same study has shown that lack of awareness that focuses on BIM as an advancement to CAD and relative underdevelopment of BIM document handling capabilities, has inhibited the interest by non –design disciplines within the AEC- industry.

Aram et al. (2013) present that in order for BIM to be successful in its implementation, all industry actors have to be informed about the potential benefits to their profession. Together with that, all people involved with BIM need to be skilled in its use in order to utilize these benefits (Arayici, 2009). Therefore, the group of barriers limiting BIM adoption is connected with the individuals actually working with the new technology and their needs of new roles and training to support the change.

2.3 Second Section: Change Management

In general, organizations and official bodies make changes in their procedures and processes. Likewise, the Building Projects and Construction follow this approach. This section is categorized into four subsections so as to be comprehensive and sequenced in talking about the change management.

The following are the four subsections for change process:

Subsection one: The need for change in adopting BIM.

Subsection two: Change management as the way to adopt BIM.

Subsection three: the change management models.

Subsection four: The ADKAR model that will be used as one of the change management models.

2.3.1 The need for change in order to adopt BIM

There is always a need for change in this fast-growth world; the change is not that severe which everybody avoids. According to Buckley (2011), any aspect of life must change consistently due to the normal change of the work environment, either internally or externally.

As with any new tool, BIM is a change in the construction projects, according to Ku and Taiebat (2011). Training, awareness and knowledge of the BIM tool and process are required to transform from a traditional way of construction to a modern way, where there is facilitation and improvement of communications and collaboration between all parties involved in the process of construction.

Furthermore, FIDIC (the International Federation of Consulting Engineers) is a global form of contract in construction projects. Merging BIM with FIDIC could manage the responsibilities between the stakeholders of the construction project that implement BIM. They could take decisions integrally with no conflict with FIDIC as the FIDIC is more guidance for all stakeholders.

In the case of BIM, Vangilder (2006) sees that all those involved into the construction process have to be aware of its capabilities and benefits to their work. Based on the mentioned benefits and explanations about the BIM, there must be a change and transition from the old way to the modern way of construction. Therefore, change management is the best way, which makes the change easy and effective.

2.3.2 The change management as the best way to achieve the goal of adopting BIM

In thinking about what is meant by “change management,” at least four basic definitions come to mind as explained by Nickols (2016):

I. **The Task of Managing Change**: The first and most obvious definition of “change management” is that the term refers to the task of managing change. Managing change is itself a term that has at least two meanings. One meaning of “managing change” refers to the making of changes in a planned and managed or systematic way. The aim is to implement new methods and systems in an ongoing organization more effectively. The changes management lie within and should be controlled by the organization.

However, these internal changes might be triggered by events inherited from outside the organization in what is usually termed as “the environment.” Hence, the second meaning of managing change is the response to changes over which the organization exercises little or no control (e.g., legislation, social and political upheaval, the actions of competitors, shifting economic tides and currents, and so on).

II. **An Area of Professional Practice**: Nickols (2016) stated the second definition of change management as "an area of professional practice." There is a huge number of independent consultants who will quickly and proudly proclaim that they are engaged in planned change, and are change agents who manage change for their clients.

III. **A Body of Knowledge**: Erdogan et al. (2005) stated the third definition for change management is based on the view of change management consisting of the models, methods and techniques, tools, skills and other forms of knowledge that go into making up any practice.

IV. **A Control Mechanism**: Prosci (2017) mentions that Information Systems groups have tried to rein in and otherwise ride herd on changes to systems and the applications that run on them. For the most part, this belongs to “version control”. As a matter of fact, most people in the workplace are familiar with it. In recent years, systems people have begun to refer to this control mechanism as “change management”.

To summarize the up mentioned definitions, there are at least four basic definitions of change management:

1. The task of managing change (from a reactive or a proactive posture).

2. An area of professional practice (with considerable variation in competency and skill levels among practitioners).

3. A body of knowledge (consisting of models, methods, techniques, and other tools).

4. A control mechanism (consisting of requirements, standards, processes and procedures).

2.3.3 The change management models

Calder (2013) stated three types of change management models that are the following:

2.3.3.1 ADKAR model

The ADKAR model was created to implement change "in business, government and community" (Hiatt, 2006, front cover). This model focuses on principles of change that are effective on an individual level. These same principles are designed to be applied to a large group of people or even an entire organization.

ADKAR is an acronym that stands for Awareness, Desire, Knowledge, Ability and Reinforcement. Each of these words represents a step in the change process and must be done in order to achieve the desired change. The focus of this model is on people, how to change people, and that is what needed in this research.

Prosci (2017) discusses the steps of this model, as explained in the following:

Awareness: To initiate a change, an individual must know what needs to change and why. Questions that would come into one's mind are: "What are the risks of not changing? How will the change benefit the individual? What will he or she gain by making the change?" Without knowing that there is a need for change, an individual will not likely have a desire to change. One interviewee, whose profession is based around organizational change, stated that making changes is all about relationships and trust.

Desire: Once an individual knows what needs to be changed, it is imperative to help him or her find the desire to support the change. Without this support, a lot of resistance may impede those who are implementing the change.

"A common mistake made by many business leaders is to assume that by building awareness of the need for change they have also created desire" (Hiatt, 2006). Prosci (2017) sees that a question of “What must be done to create desire?” should be asked during the change process.

In fact, several tactics may be used, which include utilizing past organizational habits and successes, and showing how the change will benefit those affected by the change.

Knowledge: The information necessary to make a change is given to the individual. This includes information about the new programs, systems or behaviors that will be implemented. Providing the information is important because individuals don't always seek to do things they don't know how to do.

Ability: This is the step where knowledge turns to action, or as one interviewee explained “this is where concepts turn into reality.” Thus, an individual will need support and help when utilizing the knowledge needed to make a change.

Reinforcement: The individual needs to know when a person is achieving the desired outcome. Using an accountability system is recommended. Recognizing the progress of an individual who has faced great difficulty in making a change is especially important because this recognition encourages this individual to keep going.

Finally, it is a worth mentioning that ADKAR principles focus on changing one person, an individual. These principles can be used on a larger scale to make changes in an organization or community.

2.3.3.2 Lewin's Change management model

Kreitner and Kinicki (2007), show that this model is a very simple change model which was invented by the social psychologist Kurt Lewin. It includes three steps:

1. **Unfreezing**: This stage is the preparatory stage for a change to occur and takes places as driving forces become greater than restraining forces. Nickols (2016) says that people are more motivated than hesitant to change, when they prepare to make the desired change. However, to get to this point, a lot of resistance such as fear of the unknowns or breaking old habits, must be overcome.

2. **Changing**: This stage is when the change actually occurs. People learn the new behaviors, systems and structures.

3. **Refreezing**: This stage is where the change is reinforced. This is done through feedback and organizational rewards for demonstrating the desired behavior. Lewin's model demonstrates the process of change in one of the simplest forms possible. Specific resistance-reducer tactics are outlined to facilitate the least resistant and least stressful change process possible (Kreitner and Kinicki, 2007).

Nickols (2016) stated that this model assumes that the change is planned and emphasized that no matter what kind of change is being made (related to structure, system, or behavior), people are always the root of the change. This model also places a heavy focus on reducing resistance to change by referring to two forces. These are driving forces and restraining forces. Driving forces motivate people for change. Restraining forces represent reasons people are hesitant to change.

2.3.3.3 Kotter’s Eight Steps Change management model.

John Kotter is a leader and change management expert. This model focuses on leading change rather than managing it. The model indicates that upper-level management carries a heavy responsibility to lead its organization through change.

Kotter gives the following eight steps to organizational leaders as a guide to successful change:

1. Establish a sense of urgency for change.

2. Create the guiding coalition. Gather a group of people from various departments and levels in the organization that is large enough to lead the change.

3. Establish a vision and strategy for the change.

4. Communicate the change vision. Constantly communicate the new vision and strategy, especially to those who will be affected by the change.

5. Empower broad-based action. Remove obstacles to obtain the vision.

6. Create short-term wins. Plan periodic wins and recognize for those who help achieve wins. Therefore, employees do not get discouraged.

7. Consolidate gains and produce more change. Change team should not declare victory very soon. Use of the reputation of short-term wins to continue making changes is a must.

8. Anchor new approaches in the culture.

2.3.4 Comparison between the three models:

The three models differentiate from each other in terms of the subject of the change will take place. Therefore, nobody can say that there is one better than other in all aspects. However, when the choice between the three models exists, a team of the change should study the subject of the change and specify the subject, and then the team could decide the vision of which model is the best for that kind of change.

For this research in hand, the ADKAR change model will be accredited and used for adopting the BIM system in the West Bank; that is the change which the research talks about. This is because the subject of the research talks about changing people's minds involved in the construction process. In addition, the BIM that is the subject of change is a new tool to be used in the West Bank by the people involved in the process (Designers, Contractors, and Owners). Therefore, applying the change management model needs to following up the change which is not exist in Lewin's change management model. Moreover, a model in a study should preferably be simple in process with few numbers of steps, and this is not the case of Kotter's Eight Steps model which has a long procedure to be implemented in a research. Hence, as ADKAR focuses on the effective principles of change on individuals and organizations with the chance of following up the stages of change in simple five steps process, it may be suitable to be applied in adopting BIM in the West Bank construction projects.

To summarize, this research aims at finding how BIM model could be adopted in the construction projects (Buildings) in the West Bank, and it aims at applying the adoption of the BIM in the construction building projects.

The researcher will use the ADKAR model as one of the Change management models in order to apply the change among designers, contractors, and all involved stakeholders of the construction project. The change walks in front to the BIM as an integrated model that merges the work of all parties in one model.

Finally, at the end of this research, an action plan will be provided in order to show how BIM model could be adopted and generalized among designers and contractors in all their specializations in addition to all stakeholders in the West Bank construction projects. This depends on the results of the quantitative and qualitative analysis on the building construction level.

2.3.5 The ADKAR Model

ADKAR is a goal-oriented change management model to guide individual and organizational change. **ADKAR** is an acronym that represents the five outcomes an individual must achieve for change to be successful: **Awareness**, **Desire, Knowledge, Ability, and Reinforcement** (Prosci, 2017).

Hiatt (2004) asserted that, when this model is applied to organizational change, it will allow leaders and change management teams to focus their activities on what will drive individual change and therefore achieve organizational results. ADKAR provides clear goals and outcomes for change management activities. It also provides a simple, easy-to-use framework for everyone in the organization to think about change. Employees, managers and senior leaders with all specializations, alike, can use ADKAR to describe and discuss change together.

2.3.5.1 Understanding Change at an Individual Level

Hiatt and Creasey (2012) claim that change happens at the individual level. So, in order to maintain a change for a group or organization, all the individuals within that group or organization must change. The best project management vision or solution will not result in a successful change. The secret to a successful change is rooted in something much simpler: how to facilitate change with one person.

2.3.5.2 Using ADKAR with Traditional Change Management Activities

Nickols (2016) says that ADKAR outlines the individual’s successful journey through change. Each step of the model also naturally fits into the typical activities associated with change management. Seyda and Naarananoja (2013) stated those steps and those could lead to change when they are carried out consistently and regularly to replace old habits, and those steps are as follows, stated by Seyda and Naarananoja (2013):

Awareness of the business reasons for change. Awareness is the goal/outcome of early communications related to an organizational change.

Desire to engage and participate in the change. Desire is the goal/outcome of sponsorship and resistance management.

Knowledge about how to change. Knowledge is the goal/outcome of training and coaching.

Ability to realize or implement the change at the required performance level. Ability is the goal/outcome of additional coaching, practice and time.

Reinforcement to ensure change sticks. Reinforcement is the goal/outcome of adoption measurement, corrective action and recognition of successful change.

2.3.5.3 The Business Dimension of Change

Prosci (2017) lists below the standard business elements of a typical change project. Most managers will feel comfortable managing these phases:

- Identifying a business need or opportunity.
- Defining the project (scope and objectives).
- Designing the business solution (new processes, systems and organizational structure).
- Developing the new processes and systems.
- Implementing the solution into the organization.

These are the tangible, concrete aspects of projects and are usually the default steps when implementing a new solution. Much less frequently, however, are managers comfortable with the other side of the change which is the people side (Prosci, 2017).

2.3.5.4 Results Assessment of Using the ADKAR

According to Hiatt (2006), the change team must identify the first area that scored (3) or below. This is the "barrier point" and what needs to be addressed first. By addressing the first area with medium or low scores, this will positively impact all the goals that follow.

2.3.6 Change Resistance

In an organization when the administration makes change in the procedures or scope of work or responsibilities of the employees, that change definitely will be resisted. Hiatt (2004) supports this fact when talking about change resistance and how to avoid it.

Hiatt (2004) has discussed how to avoid the change resistance when the change is a must to happen. The first step should be absorbing the employees, or organizations or companies, and then the awareness campaign of the change and its benefits should be done. Whereas the outcome for change must have benefits, development issues for anybody related to change are empowered to proceed.

Moreover, the administration or the party that wants to make the change in a group of work must involve the group and individuals in the process of the change. This will give the team the trust of the change process. Moreover, Hiatt (2004) affirms that when people are involved in any action or activity, they will be responsible to do it in the best way they can due to their participation in the activity. However, when the talking is about change, which is difficult, it will definitely be resisted. So, the best ways to do the change without any resistance is to involve the people into the change process, not to force them to do the change.

In this study, the researcher will do a survey about the subject of the study by using a questionnaire which will be distributed onto designers and contractors who mostly are civil, architectural, electrical, and mechanical engineers. From the results, an action plan will be laid out. It will show the weaknesses and strengths of different disciplines to adopt BIM.

2.4 Construction Projects in the West Bank

The Construction Industry (CI) is considered as a vital sector in most regions of the world. CI is composed of many parts and was described by Hassan (2012) as a collection of industries, due to the several numbers of industries involved in the construction industry such as: Concrete, Steel, Stone, and others.

Construction is the process of constructing a building or infrastructure works. Forde (2017), claims that construction projects differ from manufacturing in that manufacturing typically involves mass production of similar items without a designated purchaser, while construction typically takes place in a location for a known client. Webster (2016) declares that construction as an industry comprises six to nine percent of the gross domestic product of developed countries. Construction starts with planning, design, and financing; and continues until the project is built and is ready for use.

Halpin and Senior (2010) state that large-scale construction requires collaboration across multiple disciplines. An architect normally manages the job, and a construction manager, design engineer, construction engineer or project manager supervises it.

Those involved with the design and execution must consider zoning requirements, environmental impact of the job, scheduling, budgeting, construction-site safety, availability and transportation of building materials, logistics, inconvenience to the public caused by construction delays and bidding. Large construction projects are sometimes referred to as megaprojects.

Callaghan (2016) defines the building construction as the process of adding structure to real property or construction of buildings. The majority of building construction jobs are small renovations such as addition of a room, or renovation of a bathroom. Often, the owner of the property acts as laborer, paymaster, and designer team for the entire project. Building construction projects consist of common elements such as designing, financing, estimating and considering legal issues. Projects of varying sizes may reach undesirable final results, such as structural collapse, cost overruns, and/or litigation. For this reason, those with experience in the field make detailed plans and maintain careful oversight during the project to ensure a positive outcome.

Brathen (2015) notifies that as efficiency codes have come into effect in recent years, new construction technologies and methods have emerged.

University construction management departments are on the cutting edge of the newest methods of construction intended to improve efficiency, performance and reduce construction waste.

According to Fazli et al. (2014), new techniques of building construction are being researched and made possible by advances in 3D printing technology. In a form of additive building construction, similar to the additive manufacturing techniques for manufactured parts, building printing is making it possible to flexibly construct small commercial buildings and private habitations in around 20 hours, with built-in plumbing and electrical facilities, in one continuous build, using large 3D printers.

Othman & Rashed (2016) claim that, since 1967, the construction industry in Palestine has undergone many changes. Most of these changes owe to the restrictive policies imposed on residents by the Israeli Occupation Authority. These policies include confiscation and expropriation of land, restriction on expansion of building and building material manufactures, and finally limitation on transfer of funds from Palestinians working abroad.

Furthermore, a number of indigenous and international factors have affected the nature of this sector's development.

The most important factors affecting the nature of the construction sector development are the rapid international increase in the price of construction material, especially the price of steel, the change in the exchange rate of the

US dollar, and the inadequate planning and control over construction activities, technically & financially (Bakry & Melhem, 2007).

2.4.1 History of the construction projects in Palestine:

After the peace accord, the construction sector was professed as a growth engine in Palestine. The share of this sector of GDP was dramatically increased by 15.2% and 23% from 1989 to 1995 (Enshassi et al., 2007). This situation did not change until the second Intifada “uprising” started in the year 2000. Since the year 2000 until now, the Palestinian construction industry has suffered from many problems mostly due to sharp reversals in the political setting and other problems which will be discussed later. In addition, its share of GDP was decreased to 9% in the year 2004 (Enshassi, 2007).

The construction sector is one of the key economic sectors and the main force motivating the Palestinian national economy. Othman & Rashed (2016), mentions that in 1994 the construction sector witnessed noticeable expansion.

This resulted from the recovery of the construction contracting profession and subsidiary industries; the construction sector has occupied the foremost position among the rest of sectors, mainly attracting investments and creating new jobs. The construction sector contributes 33% to the Palestinian GDP.

There is a large proportion covered by this sector; thus, positively affecting various economic, social, educational and vocational sectors, in addition to other Palestinian institutions. According to Najmi (2011), The number of members classified as contractors throughout the West Bank has been 379. According to the latest classification statistics made for the years 2009-2010, 381 members have been classified in the West Bank, while in 2011 the number of contractors increased to reach 422 in it.

Construction Industry in the West Bank is largely affected by the policy of the Israeli Occupation Authorities. It struggles for survival in spite of all the obstacles it faces.

Construction Industry contributes 33% to the GDP of Palestine. It creates jobs for 10.8% of laborers working in the industry (PCBS, 2016). CI in the West Bank also employs other various industries such as factories that supply products to the site of construction. So, it provides a major source of income for Palestinian workers.

The construction projects in the West Bank are mainly residential, institutional, commercial and specialized industrial buildings, as well as infrastructure and heavy construction. These projects could be done by private or public sectors, and sometimes financed by donors. Donations may be funded either by the local government or by international donors (Al-Hashash, 2014).

Construction Industry is very similar to the service sector. Therefore, the construction industry will reveal its better advantages to the client when it is unified in all its processes. The purpose of this thesis is to focus on buildings sector of three main stakeholders: the owner, the designer, and the contractor.

2.4.2 Challenges of the construction sector in the West Bank:

In reference to PECDAR (2008), and due to the Israeli policy of closures, the Palestinian economy has suffered a total loss of $19.9 billion. The losses in the construction industry during 2000-2004 were 1178 million USD. The losses in the construction sector rose due to the Israeli siege and can be classified as direct and indirect losses.

The direct losses are the ones that resulted from the destruction of many facilities whether completed or still under construction (PCU, 2008). Examples of some causes of these losses are the destruction of many roads, water and drainage networks and many subsidiaries construction factories.

The indirect losses in the Palestinian construction industry are because of the Israeli restrictions on the import and export processes as well as on transportation of the construction material (Taha, 2016).

The causes of indirect losses according to Taha (2016) are:

- Restrictions on contractors, engineers, owners, and workers movement between cities and villages.

- Constraints on the transportation process for the construction material between the cities.

- Constraints on the import of construction material from abroad to Palestine.

- Restrictions on the establishment of major building material industries.

- Delaying in the transportation process of the imported construction materials from the Israeli ports to Palestine without reasons explained.

Al- Batsh (2015) declared that there are two types of problems or restrictions that could exist during the process of construction projects, namely internal and external ones. These problems can erupt from many sources. When they appear, there is no doubt that one of the three basic components of the construction process (the Owner, the Designer, or the Contractor), has made mistakes that cause the damages.

Some issues can cause problems that prevent completing the construction projects. The writers in Al-Batsh (2015) pointed out the following sources of problems:

I. Problems caused by Contractor:

1- Mistakes during construction.

2- Misunderstanding of design before starting construction.

3- Poor and unclear planning for the project.

4- Abruption of sequence of work and steps.

5- Lack of internal and external communications.

6- Mistakes caused by humans in the site of the project.

II. Problems caused by Designer:

1- Delay in providing instructions at the site.

2- Visual defects in the design.

3- Poor follow up of the project on the real site.

4- Absence of modern software regarding the designs.

III. Problems caused by Owner:

1- Decisions making process take too much time.

2- Insufficient time for completion of project.

3- Frequent change orders.

4- Delay in payment for the contractor and designer.

IV. External uncontrolled problems:

1- Bad Weather.

2- Economic conditions.

3- Geological issues which may cancel the project.

4- Any natural issue that cannot be changed by humans.

2.4.3 Construction Project Management

Najmi (2011) affirms that project management is the application of knowledge, skills and techniques to execute projects effectively within time, cost, and quality called the project management triangle. It’s a strategic competency for organizations, enabling them to tie project results to business goals and, therefore, compete better in their markets and develop their market share. On the other hand, Fazli et al. (2014) compared that project management is really important when the project faces changes.

These changes may be internal or external, or when it is needed to make alternative solutions or implement contingency plans, especially in urgent cases in which the manager can't keep the original plan. This is clearly true in Palestine, which suffers from a considerable instability in the political, economic, and social condition. In addition to the problems caused by the contractor, designer, owner, or external problems mentioned on previous page, this instability may prevent completing the construction project totally or as planned in terms of time, cost, and quality. Undoubtedly, project managers face many challenges and must always be creative and flexible in order to deal with difficult and unforeseen circumstances.

2.4.4 Overview for traditional delivery methods in the West Bank construction projects

According to the PCU (2008), most Palestinian projects are late, underestimated, failed planned scope or cancelled before completion. Many consulting building firms in the West Bank are still sticking to the old traditional ways in planning, designing, detailing, and managing the execution of the project. They rely on paper-based methods of communication which may cause conflict. Zhao et al. (2007) wrote that the procedure of almost all construction projects is the same. The process starts between client and consulting firm to convert the client's needs into two dimensional drawings for all plans, elevations, sections, and details. Then a complete set of architectural, structural, mechanical, and electrical specialties will be prepared. All are done as recommended by the PALENG.

Although the client may ask to see a three-dimensional shot for the project, the shot is just exposed for visualization.

2.4.5 Types of Delivery Methods in the West Bank Construction Projects

1) **Design-Bid-Build (DBB):** The owner brings a designer firm to prepare working drawings. Then the client and the firm cooperatively choose a contractor with a certain criterion to execute the work according to the set of drawings and specifications.

2) **Design-Build (DB):** The owner brings directly the design-build team. The team prepares the working drawings, and provides an estimate of the cost and time needed to build the project. Therefore, the team works collaboratively from the design phase until delivering the project.

As shown from above delivery methods in the West Bank, the procedure still depends on fragmented nature between client, consulting firm, and contractor for most current processes (Al-Batsh, 2015). Therefore, applying BIM using DBB delivery method prevents taking the full advantages of BIM system as the contractor is not involved in the design phase. Additionally, DB delivery method also prevents having independent designer or contractor to work integrally with all stakeholders during each phase of the construction project life cycle.

Globally, more different contracting methods are used such as:

1) **Construction Management at Risk (CM@R):** The owner hires a designer to prepare design services and also employs a construction manager as an agent to provide management services from design to construction phases. During the design phase, the construction manager calculates the total cost and throughout the execution phase, he works as a contractor and guarantees the total cost.

Thus, in CM@R, the constructor participates in the pre-construction phase as well as in the constructing phase itself. Practically, this approach could be improved by using BIM technology as it permits the builder to be involved during the preconstruction phase (BIM Handbook, 2011).

2) **Integrated Project Delivery (IPD):** The owner hires an integrated team that employs the best cooperative tools to ensure achieving the owner's needs of the project with maximum quality, lower cost and time throughout all project life. The owner or his representative participates to

constitute a major part of the team (BIM Handbook, 2011). IPD approach maximizes the teamwork of BIM technology in particular to cooperate effectively with all specializations and stakeholders in each phase of the project life.

2.4.6 The trend of the research

According to the recommendations of the studies regarding the importance of implementation of the BIM in the construction industry focusing on buildings projects, it is obvious that there is a need to change the traditional system of work in the construction projects in Palestine, and adopt a new system of construction process which is the BIM. BIM implementation in the West Bank is lagging behind globally. Additionally, its implementation in Jordan is also weak as only large size AEC organizations move towards BIM in partial capacities (Matarneh and Hamed, 2017).

Adopting BIM will help in solving problems and challenges of the construction projects in Palestine with different engineering fields. This research will try to give perceptions and facts of the importance of BIM, and its benefits. It is essential to start implementing the BIM as a popular system into the construction projects for all specializations in the whole project life cycle. The process of adoption is by applying a framework using ADKAR change management model.

Chapter Three
Research Methodology

3.1 Overview

This chapter presents the methodology of the research process to achieve research goals. It introduces the approach that will be used to analyze the collected data from the respondents who are the sample of this research.

The chapter explains in detail the methodology used in gathering the information necessary for this study. It highlights the sources of data and the survey design which include the sampling plan and the data analysis method employed. The steps involved are elaborated in detail and have been carried out systematically in order to achieve a high degree of reliability and validity.

The methodology used in this study is integral to the reliability of the findings and the validity of the study. Therefore, this section focuses on the research technique adopted and used for this study with the aim of achieving the research objectives. It also contains a description of the instruments used to measure different information applicable to this study.

3.2 Research Purpose: Exploratory/Descriptive/Explanatory

The word "research" is derived from the Latin word which means, "to know". It is a systematic and a replicable process which identifies and defines problems within specified boundaries. It employs a well-designed method to collect the data and analyze the results. It disseminates the findings to contribute for generalizing knowledge (Creswell, 1997).

There are three types of research: exploratory, descriptive, and explanatory research that will be explained below:

Exploratory Research

It is a study of new phenomenon. Exploratory research is characterized by its flexibility. When a problem is broad and not specifically defined, the researchers use exploratory research as a beginning step. Exploratory studies are valuable means of understanding what is happening; to seek new insights; to ask questions and to assess phenomenon in a new light (Yin, 1994).

Exploratory research, as the name states, intends merely to explore the research questions but does not intend to offer final and conclusive solutions to existing problems.

It is conducted in order to determine the nature of the problem, but not to provide conclusive evidence. It helps to have a better understanding of the problem. When conducting exploratory research, the researcher ought to be willing to change his/her direction as a result of revelation of new data and new insights.

Exploratory research design does not aim to provide the final and conclusive answers to the research questions, but merely explores the research topic with varying levels of depth. It has been noted that "exploratory research is the initial research, which forms the basis of more conclusive research. It can even help in determining the research design, sampling methodology and data collection method." Exploratory research "tends to tackle new problems" on which little or no previous research has been done. Unstructured interviews are the most popular primary data collection method with this type of research.

Exploratory research has the goal of formulating problems more precisely, clarifying concepts, gathering explanations, gaining insight, eliminating impractical ideas and forming hypotheses. Literature research, survey, focus group and case studies are usually used to carry out exploratory research. An exploratory research may develop hypotheses, but it does not seek to test them (Darabi, 2007).

Descriptive Research

When a particular phenomenon is under study, research is needed to describe it, clarify it, and explain its inner relationships and properties (Huczynski and Buchana, 1991). The descriptive research will portray an accurate profile of people, events or situations (Robson, 1993). Descriptive research in contrast with exploratory research defines questions, people surveyed, and the method of analysis prior to the beginning of data collection. In other words, descriptive research defines the research aspects: who, what, where, when, why and sometimes how. Such preparation allows one the opportunity to make any required changes before the process of data collection has begun. However, descriptive research should be thought of as a means to an end rather than an end itself (Yin, 1994).

Explanatory Research

When the focus is on cause-effect relationships, the study can be explanatory explaining which causes produce which effects (Yin, 1994). The concern in casual analysis is how one variable affects, or is “responsible for”, changes in another variable. The stricter interpretation of causation is that some external factor produces a change in the dependent variable.

Explanatory research which is grounded in theory is another research purpose type, and the theory is created to answer why and how questions.

This type of research is interested in understanding, explaining, predicting and controlling relationships between variables. Explanatory studies go beyond description and attempt to explain the reasons for the phenomenon that the descriptive study is only observed. In an explanatory study, the researcher uses theories or hypotheses to represent the forces that caused a certain phenomenon to occur (Lee, 2006).

This study is a mixed of explanatory and exploratory research. Therefore, it is a mixed methodology that describes reality and tries to find the reasons for change and explores BIM system by using the ADKAR model of change. The study tries to explore how the BIM system that is implemented in the world could be adopted in Palestine by engineering firms and contractors in the West Bank with civil, architectural, mechanical, and electrical specialties with all involved stakeholders.

The study is the first of its kind to be conducted in Palestine, and it is explored by adopting the BIM system using ADKAR change management model. The model shows a noticeable change in the transition of application from the old system to the modern one. By gathering information from the respondents, the researcher will be able to explain the best way BIM system could be implemented by using the ADKAR model of change. In this research, both primary and secondary data are required; the primary data are theoretical, and the secondary data are collected from research instruments and tools.

3.3 Research Approach

Wahyuni (2012) affirmed that research approach could be divided into two types:

1. Deductive research approach
2. Inductive research approach

The relevance of the hypotheses to the study is the main distinctive point between deductive and inductive approaches. **The Deductive approach** tests in hand the validity of assumptions (or theories/hypotheses), whereas **the Inductive approach** contributes to the emergence of new theories and generalizations (Wahyuni, 2012).

Discussion of the research approach is a vital part of any scientific study regardless of the research area. Within the methodology of a dissertation it is needed to explain the main differences between Inductive and Deductive approaches and specify each one (Neuman, 2011).

The research approach is deductive when the theory and hypothesis are developed and a research strategy is designed to test the hypothesis. It can be inductive when the data is collected and a theory is developed as a result of data analysis. The deductive approach owes more to positivism, whereas the inductive approach owes more to phenomenology (Saunders et al., 2009).

1. Deductive Approach:

Trochim (2006) explained that the deductive approach gives way to move from general to specific points. So, arguments based on law and rules are expressed deductively. He added that the deductive approach is related to the results of the quantitative research.

From the view point of Creswell and Clerk (2007), they explained that the deductive researcher is the one who starts from theory to hypothesis to gathering data.

2. Inductive Approach:

Trochim (2006), stated that the inductive approach starts from specific details and moves up to general theory. Creswell and Clerk (2007) define the inductive researcher as the one who generates a theory from the bottom (specific) to the general.

In this study research questions are developed. Research strategies are designed and research questions are answered accordingly. Therefore, it can be concluded that the research approach is both deductive and inductive. As this study is trying to build a theory of adopting the BIM system in Palestine, it reflects the inductive approach. On the other hand, when this study is used to adopt the BIM system using the ADKAR change management model, it makes the approach deductive.

Based on that, this study is a mixed approach: deductive and inductive. According to the data collection tools used in this research, deductive approach will be used through the results of the questionnaire (Quantitative), and inductive approach will be carried out through the in-depth interviews (Qualitative). In addition, this study will deduct the conclusions from the quantitative analysis results, and will induct the conclusions from the results of the qualitative analysis results (Amaratunga et al., 2002).

The Qualitative Approach emphasizes processes and meanings that are not measured in terms of quantity, amount, intensity or frequency. The qualitative approach provides a deeper understanding of the phenomenon within context (Guba and Lincoln, 1994). Moreover, qualitative researchers stress on the socially constructed nature of reality that states the relationship between the researcher and the phenomenon under investigation.

On the other hand, the **Quantitative Approach** emphasizes the measurement and analysis of casual relationships between variables. According to Cochran and Dolan (1984), there are differences between qualitative and quantitative research that relate to the distinction between exploratory (qualitative) and confirmatory (quantitative) analysis. When there is little theoretical support for a phenomenon, it may be impossible to develop precise hypotheses, research questions, or operational definitions. In such cases, qualitative research is appropriate because it can be more exploratory in nature (Sullivan, 2001).

Qualitative research involves conducting interviews during the explanatory stage of a research project with the aim of uncovering factors that play a role in the marketing problem. The interviews should aim at uncovering new qualitative information rather than gathering quantifiable results. As a result, exploratory interviews are open-ended to stimulate respondents to share their thoughts and feelings (Miles & Huberman, 1994).

According to Gabriel (1990), qualitative research can be used to probe deeply into the consumer's underlying needs, perceptions, preferences and level of satisfaction.

In addition, such research can be used to gain greater familiarity and understanding of construction problems whose causes are unknown.

Furthermore, ideas can be developed that can be further investigated through quantitative research.

According to Malhotra and Birks (2003), Quantitative research is suitable for measuring both attitudes and behavior. Quantitative research can be used to create models that predict whether someone holds a particular opinion or would act in a certain way based on an observable characteristic.

After comparing the two research approaches in this study, both quantitative and qualitative data collection methods have been chosen. This mixed method is used in order to collect and analyze the data gathered from the sample of the research population.

As for examining and answering the questions of the research statistically, quantitative tool for collecting the data, contains a number of axes to cover the aspects of the research (Gardner, 1996). In addition to the quantitative tool, there is a qualitative tool for gathering the data. This tool is the in-depth interview that will be carried out during the research in order to know the perspectives of the official parties and unions regarding the subject of the research.

3.4 Research Strategy

Research strategy is a methodology that helps the researcher to investigate the research issue. According to Saunders et al. (2009), research strategy is a general plan that helps the researcher in answering the research questions in a systematic way.

Cierniak et al. (2010), stated that an effective research strategy contains clear objectives, research questions, data collection resources and various constraints that affect the research in different ways such as access limitations, time limitations, location and money limitations, ethical issue constraints and many others.

An effective research strategy helps the researcher define why a researcher who employs a particular research strategy has to conduct the research study in an effective manner. Research strategy is also helpful for the researcher to use specific data collection methods to support the arguments (Corbin, 2007).

In order to do so, this study will use the concurrent nested strategy shown on figure 3.1. The concurrent nested strategy is characterized by giving priority to one of the methods and guides the project, while another is embedded or “nested” (Creswell, 2003). This proposes to address a different question than the dominant one, or seek information from different levels. Hopefully, this is suitable for the purpose of the study (Creswell, 2003).

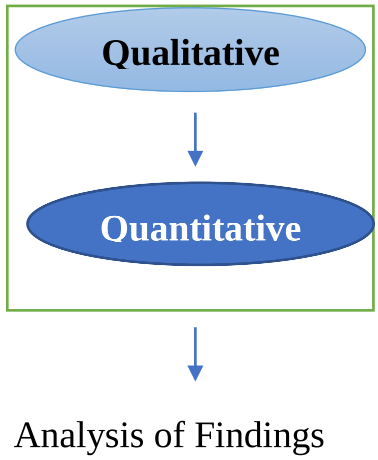

Figure 3.1: Concurrent Nested Strategy

This study will use the concurrent nested strategy in order to collect the information using two tools in which the questionnaire (Quantitative tool) will take the priority in this study. The qualitative analysis will support the quantitative, as the responses come from the both tools expected to be nested or “Overlapping”. The interview responses might be also descendant from the quantitative responses. That’s why the Concurrent Nested Strategy has been chosen. The goal of this study is to explore the BIM system in Palestine, and to describe how it could be implemented from the perspectives of two different levels: the private sector that includes the contractors and engineering firms in the West Bank with all their specializations, and the public sector which includes the municipalities and other companies as well.

3.5 Research Method

As this study will use the mixed methods approach, the following is briefly an explanation of the advantages of using the mixed method:

3.5.1 Qualitative Method

A Qualitative Method is primarily an exploratory research. It is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem or helps develop ideas or hypotheses for potential quantitative research. A qualitative research is also used to uncover trends in thought and opinions, and dive deeper into the problem. Qualitative data collection methods vary using unstructured or semi-structured techniques. Some common methods include focus groups (group discussions), individual interviews, and participation/observations. The sample size is typically small, and the respondents are selected to fulfil a given quota (Miles and Huberman, 1994).

The advantages of using the Qualitative method as stated by Creswell (2009), are that the qualitative tool is rich in details (e.g., participants can elaborate on what they mean), and also that perceptions of participants themselves can be considered (as a human factor). In addition, the qualitative method is appropriate for situations in which detailed understanding is required, and events can be seen in their proper context, more holistically as well.

However, the disadvantages of using the qualitative method according to Neuman (2011), are that the qualitative tool isn't always generalizable due to small sample sizes and the subjective nature of the research. Also, conclusions need to be carefully hedged. Furthermore, the accusations of unreliability are common (different results may be achieved on a different day with different people).

3.5.2 Quantitative Method

A Quantitative Method is used to quantify the problem by way of generating numerical data or data that can be transformed into usable statistics. It is used to quantify attitudes, opinions, behaviors, and other defined variables, and generalize results from a larger sample population (Kumar, 2005). Quantitative method uses measurable data to formulate facts and uncover patterns in research. Quantitative data collection methods are much more structured than Qualitative data collection methods. Quantitative data collection methods include various forms of surveys, online surveys, paper surveys, mobile surveys and kiosk surveys (Creswell, 2009).

According to Leedy (1993), the advantages of using quantitative method are summarized in the larger sample sizes which often make the conclusions from quantitative research. Also, generalizable statistical methods mean that the analysis is often considered reliable. In addition to that, the quantitative method is appropriate for situations where systematic, standardized comparisons are needed.

On the other hand, Creswell (2009), viewed that the disadvantages of using quantitative method as the quantitative method doesn't always shed light on the full complexity of human experience or perceptions. Furthermore, this method can reveal what / to what extent, but cannot always explore why or how. It may give a false impression of homogeneity in a sample, as well.

Mixed methods research involves collecting and analyzing both quantitative and qualitative data. The quantitative data include closed-end information that undergoes statistical analysis and results in a numerical representation. Qualitative data, on the other hand, are more subjective and open-ended (Creswell, 2009).

It allows for the "voice" of the participants to be heard and interpretation of observations. Considering the methods discussed in the quantitative and qualitative modules, here are some examples of how the methodologies may be mixed to provide a more thorough understanding of a research problem.

Creswell (2009), stated the advantages of using the mixed methods in a research, as follows:

- Both quantitative and qualitative research have weaknesses. Quantitative research is weak in understanding the context or setting in which data are collected.

Qualitative research may include biases and does not lend itself to statistical analysis and generalization. Mixed method strategies can offset these weaknesses by allowing them for both exploration and analysis in the same study.

- Researchers are able to use all the tools available to them and collect data that are more comprehensive. This provides results that have a broader perspective of the overall issue or research problem.

- The results may include both observations and statistical analyses. Therefore, the results are validated within the study. Using both approaches in one study provides additional evidence and support for the findings.

- Mixed method combines inductive and deductive thinking and reasoning.

- The researcher can use both words and numbers to communicate the results and findings and thus, appeal to a wider audience.

- Combining methodologies helps to reduce the personal biases of the researcher.

3.6 Research Design

A research design describes the procedures for conducting the study including when, from whom, and under what conditions the data have been obtained and analyzed for required information (Creswell, 2009). According to Kerlinger and Lee (2000), research design has the purpose of providing answers to research questions and controlling variance when the research design must enable researchers to answer research questions as validity, objectively, accurately and economically as possible in addition to their validity.

Therefore, it is important to select the research design that would best satisfy the research questions as identified.

For the purpose of using mixed methodologies, this study uses two tools for collecting information from both levels:

1) Interviews: In this study, an in-depth interview will be used. In-depth interviewing is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Creswell, 1997).

The in-depth interview is a loosely structured interview. It allows freedom for both the interviewer and the interviewee to explore additional points and change direction, if necessary (Boyce and Neale, 2006). In qualitative data collection method, in-depth interviews offer the opportunity to capture rich, descriptive data about people's behaviors, attitudes and perceptions, and unfolding complex processes. They can be used as a standalone research method or as part of a multi method design, depending on the needs of the research (Patton, 2002).

In-depth interviews are normally carried out face to face so that a rapport can be created with respondents. Body language is also used to add a high level of understanding to the answers (Boyce and Neale, 2006).

Telephones can also be used by a skilled researcher with little loss of data and reduced cost. The style of the interview depends on the interviewer. Successful in-depth interviewers listen rather than talk.

They have a clear line of questioning and use body language to build rapport. The interview is more of a guided conversation than a staccato question and answer session (Boyce and Neale, 2006).

The interview is conducted using a discussion guide which facilitates the flushing out of the respondent's views through open ended questioning. Projective techniques can be incorporated into the interview too (Patton, 2002).

The in-depth interview is divided into five components shown on appendix A.1. The interview protocol asks about the awareness of the BIM if the respondents have heard about it. The second part of it is about the desire to adopt BIM: "Is there a desire or intention to start implementing the BIM system?" The third issue is the knowledge of the benefits of BIM as an integrated model which involves all related parties in the construction projects. The fourth part is the ability of applying and implementing it in Palestine. Therefore, the researcher here measures the challenges and obstacles faced by adopting the new system.

Finally, the interview protocol evaluates the reinforcement of the BIM of how it could be sustainable in implementation.

According to the object of this study, and the purpose of using the qualitative tool, the in-depth interview has been found as the best type of interviews that helps in achieving the goal of the study. The study requires the perspectives of a small number of respondents regarding the BIM technology, in which eight organizations will be interviewed.

Boyce and Neale (2006) stated that the in-depth interview conducts with small number of sample and random sampling methods are not used. In addition, creating and discussing new issues related to the BIM (the main subject of this study) is important because talking about change needs more than one opinion or answer.

The researcher here seeks for more than one answer and for different types of answers, that could be gained from the in-depth interview. Therefore, the in-depth interview will be used in this study in order to refine new perspectives and questions for other coming studies related to this study as it is the first study towards this subject. Boyce and Neale (2006) declared that In-depth interviews are useful when the interviewer wants detailed information about person’s thoughts and behaviors, or wants to explore new issues in depth. Interviews are often used to provide context to other data (such as outcome data), offering a more complete picture of what happened in the program and why.

2) The Questionnaire: This study uses the closed-ended questionnaire, which implies questions that have multiple options as answers and allows respondents to select a single option from amongst them. Such questions are called closed-format or closed-ended questions (Kothari, 2004). As a fixed answer set is provided, these are ideal for calculation of statistical information and percentages of various types. Closed-ended questions help to arrive to opinions about a product or service, and sometimes, about a company, in a more efficient manner (Saunders, et al., 2009). This tool will be a supportive and a main tool in order to understand the ability and desire to implement the BIM system along the Palestinian contractors and engineering firms with all specializations.

Sekaran and Bougie (2010) noted that social as well as business research is a systematic attempt to provide answers to questions. Research design is defined as the plan devised by the researcher that will guide the research process from A to Z. In other words, choosing the topic, conceptualizing, studying and absorbing similar studies, then assembling, organizing and integrating information (data) results in a specific end product (research findings).

It is within these parameters that key questions are to be asked and answered such as the nature of research questions posed; the degree of control an investigator desires on events to be studied; the nature and particularities of the subjects under investigation and the extent of focus on contemporary phenomena and their relationships to present realities (Moser & Kalton, 1971).

This study is divided into two main items that are: the implementation of the BIM system in Palestine, and the way of changing from the old system of building projects to the new one: the BIM, by using ADKAR. Regarding these items the data collection tool (Questionnaire), is divided into six items that are the demographic data in addition to the ADKAR components (Awareness, Desire, Knowledge, Ability, and Reinforcement). Those are the main dependent variables that will be correlated in the data analysis with the independent variables, which are: Size of the company and others that follow below. The relationships between the dependent variables and the independent ones will be explored through the implementation of the new system (BIM), and knowledge will occur concerning the effect related by other variables to this implantation.

3.6.1 Research Tools Contents

As Appendix 1. C shows, **the questionnaire** consists of six parts that cover the objectives of this study as the following:

The first part includes the independent variables that are: The gender, education degree, field of study, years of experience, current position and the size of the company. This is in addition to a three sub questions.

Here, the dependent variables start from the second part that measures the awareness of the study population (contracting and engineering firms with all specializations) about the BIM which consists of eight items.

The third part measures the desire of the study population (contracting and engineering companies with all specializations) to implement the BIM, which consists of thirty-four items.

The fourth part confirms the knowledge of the study population (contracting and engineering firms with all specializations) about the BIM that includes nine items.

The fifth part evaluates the ability of the study population (contracting and engineering firms with all specializations) to adopt and implement the BIM as a new tool in the construction projects. Therefore, this part consists of twenty items.

The sixth part evaluates the reinforcement and sustainability of this new adoption by the study population (contracting and engineering firms with all specializations) which will be measured through seven items.

3.6.2 Research Framework

In this study, the design shown in figure 3.2 is used to be the design of the research, in which it shows the steps that this study will follow to achieve its goals and objectives, as well as to get the sufficient number of respondents, and tools valid and reliable.

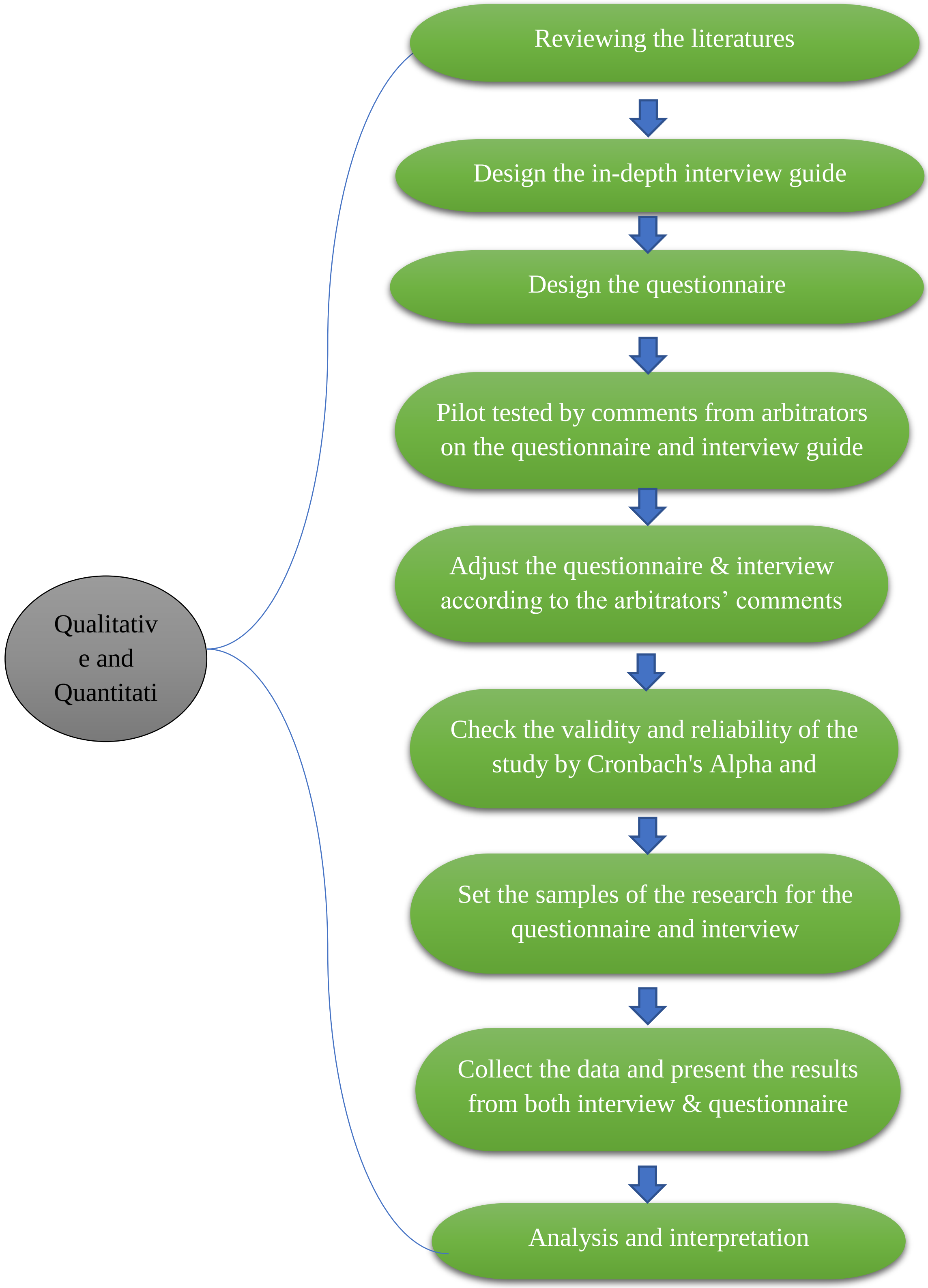

Figure 3.2: Research Methodology Flow Chart.

3.7 Research Population and Sampling

As this study aims to describe the BIM system and explore how it could be implemented in Palestine using the ADKAR change management model, the population of this study consists of all the engineering firms in addition to the contracting companies with all their specializations in the West Bank. These are registered officially into the PALENG and the PCU unions' records. Table 3.1 shows their distribution in the West Bank:

Table 3.1: Distribution of the Engineering Firms and Contracting Companies in the West Bank.

No.	District	No. of Engineering Offices and Firms	No. of Contracting Companies
1	Jenin	41	57
2	Tubas	6	18
3	Tulkarem	42	29
4	Nablus	130	109
5	Qalqilia	13	5
6	Salfit	11	7
7	Ramallah	135	81
8	Jericho	4	8
9	Bethlehem	43	39
10	Hebron	112	83
	Total	**537**	**436**

Source: PALENG & PCU (2015)

3.7.1 Sample of The Research

According to the huge number of the respondents for this study, the researcher has calculated the representative sample for the research community as 973 engineering and contracting companies around the West Bank.

Quantitative Research Sampling

To calculate the sample size that is fit with appropriate confidence level, and appropriate margin of error, the researcher used the following simple formula as stated by Daniel (2009):

Sample size = N/$\boldsymbol{n}$ =N/($\boldsymbol{z2pq}$ ÷$\boldsymbol{d2}$)

Where:

z = ***z*** statistic for a confidence level (The researcher worked with 95 percent level of certainty, so ***z*** = 1.01 for 95% confidence level that used in this research).

p = percentage picking a choice (The researcher used *p* = 0.5 for a sample size needed). *P* = 0.5 yields a maximum value of n when used in the formula. Additionally, this procedure should be used when the researcher is unable to reach the best estimation of *p* (Daniel, 2009).

***q* =** *(1 – p)*. This implies that *q = 0.5*

d = confidence interval, expressed as decimal (The researcher used *d* = 0.05).

In this study the implementation of the formula is: N/n=973/ (1.01*2*0.5*0.5/0.05*2) =973/ (0.505/0.1).

The sample Size= 973/5.05= 193 Respondents.

The population size in this study is 973 registered engineering and contracting companies according to PCU and PALENG. So, the sample size of this research is 193 samples with 95% confidence level based on the above equation. 193 responses are about 20% of the population size.

As based on the whole numbers of both parties, the representative sample for this research is: 86 contractors divided onto the 10 districts in the West Bank. This means the questionnaire will be distributed onto 20% of the number in each district for the contractors. In addition, 107 engineering offices around the West Bank will answer the questionnaire. Furthermore, the number will be divided onto 10 districts in the West Bank as well. So, the questionnaire will be distributed to 20% of the number in each district.

In summation of the representative sample, a minimum number of 193 questionnaires need to be analyzed. In order to get all those 193-questionnaire ready and completed to be analyzed, 300 questionnaires should be distributed onto the engineering and contracting companies around the West Bank, and this is obvious in table 3.2.

However, the actual sample size that was filled is 242 which yields a better confidence interval with (97) civil, (68) architectural, (61) mechanical and electrical engineers, and (16) others.

The sample size of the **qualitative research** for the in-depth interviews is with three international engineering and contracting companies, and three municipalities, in addition to an interview with the union of the Palestinian Engineers (PALENG).

Table (3.2) shows the division of the population and the sample of the research. When the 20% is taken from each district, the minimum sample becomes 199 responses as shown on table 3.2.

Table 3.2: Division of The Sample Between the Districts of The West Bank

District	No. of contractors	Sample	Req. %	No. of engineering offices	Sample	Req. %
Jenin	57	**11**	20%	41	**8**	20%
Tubas	18	**3**	20%	6	**1**	20%
Tulkarem	29	**6**	20%	42	**9**	20%
Nablus	109	**22**	20%	130	**26**	20%
Qalqiliah	5	**1**	20%	13	**3**	20%
Salfit	7	**2**	20%	11	**2**	20%
Ramallah	81	**16**	20%	135	**28**	20%
Jericho	8	**2**	20%	4	**1**	20%
Bethlehem	39	**8**	20%	43	**10**	20%
Hebron	83	**17**	20%	112	**23**	20%
Total	**436**	**88**	**20%**	**537**	**111**	**20%**

Sample division was distributed into 10 districts of the West Bank. A minimum percentage of 20% from the whole number of contracting and engineering firms will be randomly selected in each district without taking into consideration the classification of the companies as shown in figures 3.3 and 3.4:

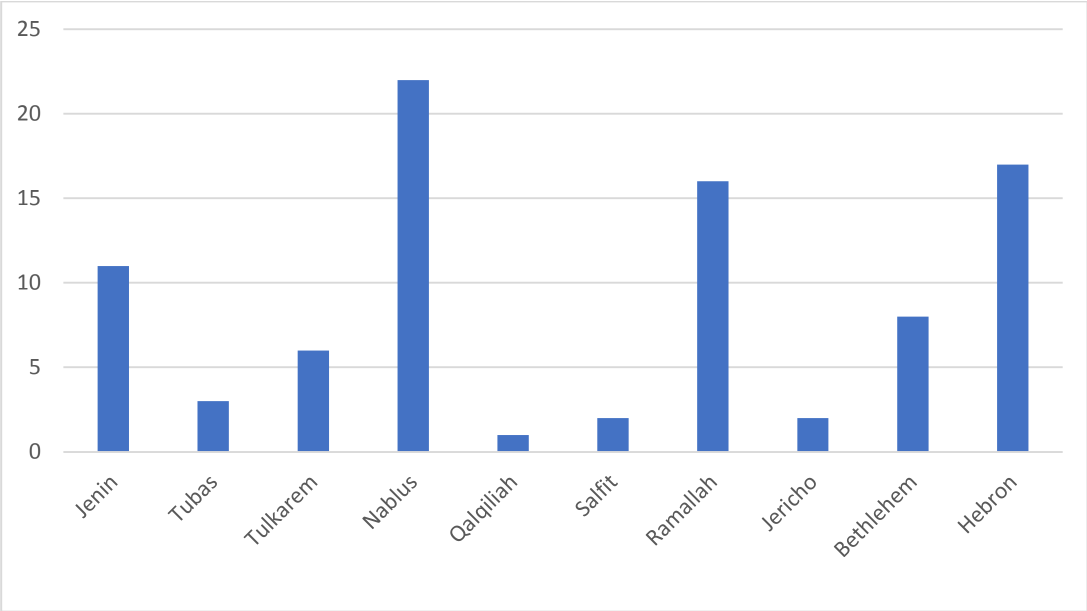

Figure 3.3: Number of required contracting companies' samples of the West Bank

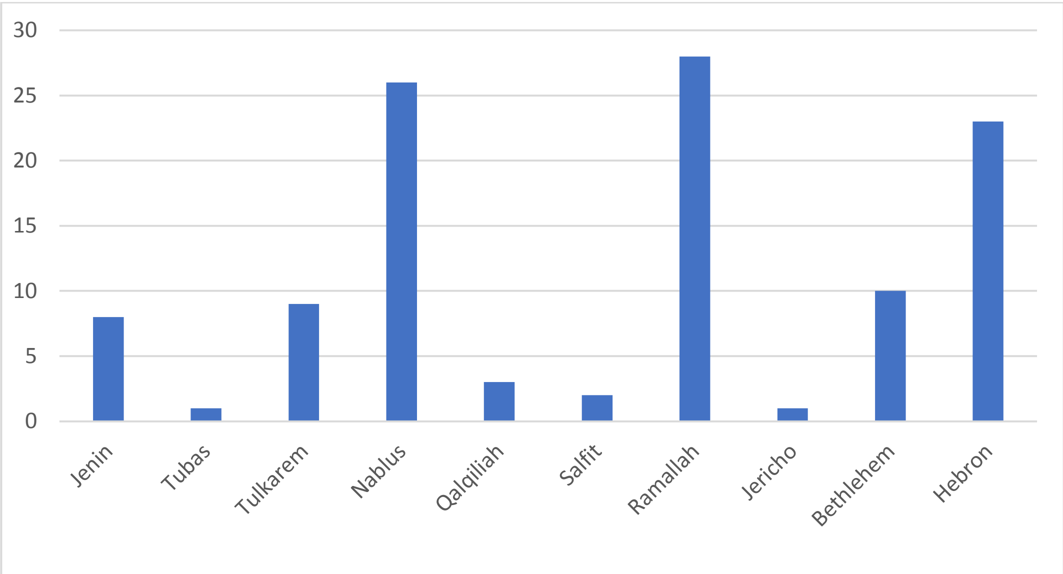

Figure 3.4: Number of required engineering firms' samples of the West Bank.

3.7.2 Sampling Method

According to the population size and features, and according to the sample calculation in addition to the factors of the licensed companies, this research will use the Stratified Random Sampling. This method involves the division of a population into smaller groups known as strata. In stratified random sampling, the strata are formed based on members' shared attributes or characteristics (Phrasisombath, 2009). A random sample from each stratum was taken in a number proportional to the stratum's size when compared to the population. These subsets of the strata are then pooled to form a random sample (Investopedia Academy, 2016).

This drives the researcher to use the stratified random sample as a convenient type of samples to the subject of the research. The selection of the respondents will be at random from each area (district), based on the number of the engineering and contracting companies in each district with all specializations for civil, architectural, mechanical, and electrical engineering, whereas the percentage from each district will be at least 20% from the whole number of engineering firms and 20 % of the contracting companies in each district. For example: Nablus has 130 official engineering companies, the representative sample for it is 20%. So, the representative sample in Nablus will be 26 companies. Those companies will be chosen randomly by using the list of engineering companies in Nablus. This will also be implemented in the contracting companies.

3.8 Research Variables

Based on the subject of the study, the questionnaire which was designed by the researcher served the objectives of this study. The variables of the study are the following:

Independent variables are the variables that do not change when the data is being analyzed, while dependent variables are the variables that change during the analysis and affect the relationship with the independent variables (Skinner, 2007). These variables are shown on tables (3.3) and (3.4) below:

Table 3.3: Independent Variables of The Study

Independent Variables	Description
Current position	This is important to cover if the respondent is working in an engineering firm or a contracting company
Gender of the respondents	To know the correlation between the gender and the implementation of BIM
Education degree	To discover the relationship between the educational degree of the respondent and the knowledge and implementation of BIM
Field of study	This will serve the study by dividing the respondents into the several types of engineering specialties (Architectural, civil, mechanical and electrical)
Years of experience	To know the number of years of experience that will provide useful data to measure the possibility of applying BIM
Size of company	The size of the company, whether it is an engineering firm or a contracting company, is important to be measured in order to know the relationship between the size of the company and how useful it is to implement BIM

Table 3.4: Dependent Variables of The Study.

Dependent Variables	Description
The Level of awareness about the BIM system.	Eight questions will be asked to know the level of awareness of the BIM system
The desire to apply BIM.	Thirty-four questions will be asked for the samples of the research in order to discover the desire of implementing the BIM
The level of knowledge of the issues regarding BIM.	This variable consists of nine questions, in order to measure the level of knowledge of the BIM
The level of ability to apply the BIM system on the ground.	This variable consists of twenty questions regarding the measurement of the ability to implement the BIM
The evaluation of the reinforcement of the suggested ideas in order to sustain the implementation of the BIM.	This variable, which consists of seven questions will evaluate the reinforcement of the implementation of the BIM

This research, as mentioned previously will use the ADKAR model as one of the change management models. Therefore, the dependent variables of the study are the main axes of the questionnaire to measure the five components of the ADKAR model and their relationships with the independent variables.

In addition, three other variables might intervene in the process of data analysis:

1- The types of projects that respondents often work on.

2- The software that respondents often use to work on.

3- The trainings that respondents have had regarding the BIM.

These variables will be considered as sub-questions towards supporting the research results. Moreover, they are considered as intervention variables that could affect the independent variables.

Figure 3.5 shows the control variables of the study for independent and dependent variables.

Independent Variables **Dependent Variables**

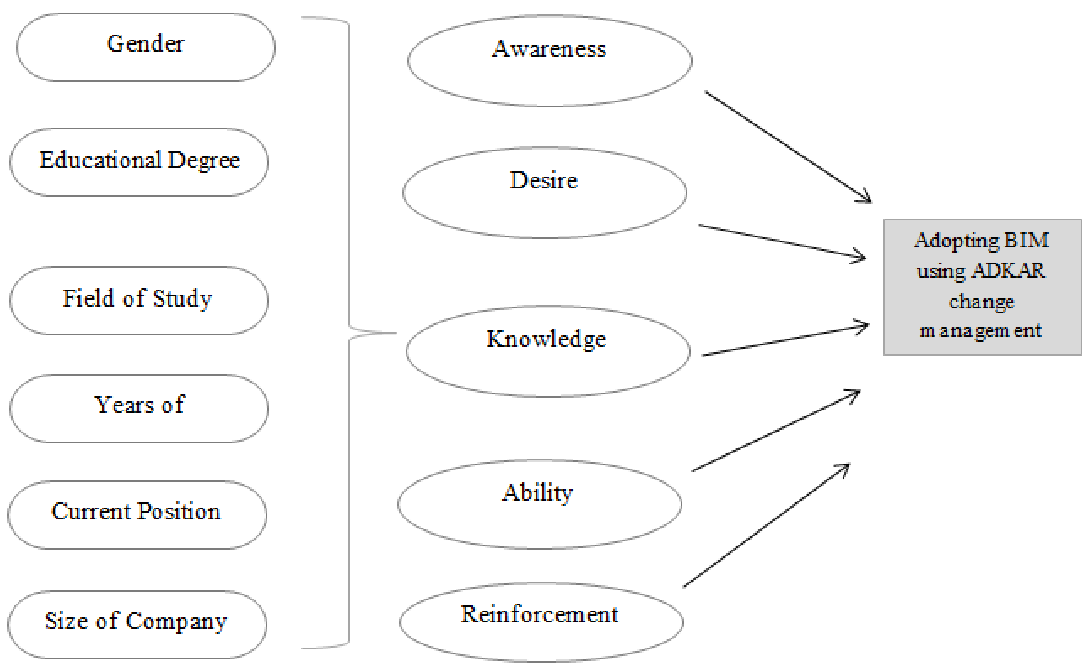

Figure 3.5: Control Variables

3.8.4 Pilot Study

The term pilot study is used in two different ways in social science research. It can refer to so-called feasibility studies which are "small scale version, or trial run, done in preparation for the major study". However, a pilot study can also be the pre-testing or 'trying out' of a particular research instrument (Baker, 1994). One of the advantages of conducting a pilot study is that it might give advance warning about where the main research project could fail.

Or where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated (Baker, 1994).

According to Hundley et al. (2000), the researchers use the pilot study for many reasons which include:

1. Developing and testing adequacy of research instruments.
2. Assessing the feasibility of a (full-scale) study/survey.
3. Designing a research protocol.
4. Assessing whether the research protocol is realistic and workable.
5. Establishing whether the sampling frame and technique are effective.

In this study, a pilot study has been conducted into an empirical sample which consists of five engineering and contracting companies. This is done to ensure that the questionnaire is fit and is convenient with the sample individuals, and that the study can rely on the tools and validate the results of the instruments of this study.

3.9 Data Collection

There are two types of methods that this research will use. The first one will be a questionnaire designed by the researcher after reviewing the literatures related to the subject of this study. This questionnaire has been distributed to the sample from contracting and engineering companies for different specializations as mentioned in table (3.1). It will be analyzed statistically (Quantitatively) using the SPSS software in order to show the correlations between the variables and the equations used in the analytical process in addition to the results of the analyzing process.

In this section, the researcher explains the questionnaire and the in-depth interviews:

3.9.1 The Questionnaire

The questionnaire tool used for the engineering and contracting companies differentiating the engineering specialties to civil, architectural, mechanical and electrical ones has been chosen randomly stratified. The companies will be contacted and asked to be part of this study and help the researcher in data collection. In case of their acceptance, the researcher will send them the questionnaire by e-mail and Facebook to be fulfilled correctly and returned as soon as possible. Then the received questionnaires will be reviewed in order to filter them as those convenient to be analyzed and those neglected for not fulfilling the conditions.

3.9.2 The In-depth Interview

The in-depth interview will be conducted with seven main official parties. These are considered as the umbrellas of the engineering firms and contracting companies. This interview will be analyzed qualitatively based on the answers that come out from the respondents using the thematic analysis.

The process of data collection by using the in-depth interviews is described after the interviewer has contacted the persons who are recommended by supervisors of this study and the unions of the contracting and engineering companies. Phone calls are made to make appointments for conducting the interviews with them. After each phone call, the researcher writes an e-mail for each person who had a phone call regarding the interview. After confirmation by the interviewees for conducting the interviews, the researcher meets those persons for interviews.

The interview length is between 25-40 minutes with each person. The interviewees details have been listed in appendix B.

3.10 Research Tools Validity and Reliability

Two tools for data collection serve the objectives of this research. It is worth and essential to ensure that the possibility of getting the answer wrong has been reduced (Heale and Twycross, 2015). It is worth paying attention to two particular focuses on research design that are: validity and reliability.

Validity: The accuracy with which a method measures what it is intended to measure (Golafshani, 2003). This yields data that really represent "reality" (Heale and Twycross, 2015). Validation does not belong in some separate stage of the investigation, but instead as an ongoing principle throughout the entire research process.

Reliability: The reliability of a research implies the consistency of the research findings (Golafshani, 2003). Ensuring reliability requires diligent efforts and commitment to consistency throughout interviewing, transcribing and analyzing the findings.

This section will report on these issues:

1- Survey (Questionnaire) Validity.

2- Survey (Questionnaire) Reliability.

3- Interviews Content Validity.

A. 3.10.1 Survey Validity

Validity is a test tool that is concerned with how well a developed instrument measures and what the researcher intends to measure. In this research, the researcher used different techniques or methods to measure the validity of the questionnaire (Heale and Twycross, 2015). Two types are carried out:

a. Construct Validity

Construct validity occurs when the theoretical constructs of cause and effect accurately represent the real-world situations they are intended to model. This is related to how well the experiment is operationalized. A good experiment turns the theory (constructs) into actual things you can measure. Sometimes just finding out more about the construct (which itself must be valid) can be helpful (Kimberlin and Winterstein, 2008). In this study the construct validity has been done by the following methods:

1. It was essential to rely on the literature when designing the research model and its hypothesis. Furthermore, the validity was tested and trusted in the previous empirical studies in the field of new model and technology adoption.

2. It was important to refine the instruments and statements of the research tool based on the arbitrators and experts' comments in order to achieve the research purpose. Five persons who are doctors and professors specialized in the engineering management and English language have arbitrated the questionnaire. Names of the experts are shown in Appendix A.5. After the feedback from the arbitrators, adjustments had been done before the questionnaire was confirmed to be distributed.

3. It was a functional task to refine the research tool more than once to ensure that the measuring fit with what the research intends to measure.

b. Convergent Validity

Convergent validity occurs where measures of constructs expected to correlate do so. This is similar to concurrent validity which looks for correlation with other tests (Shneider, 2005).

In this study, the statistical tests related to validity will show the rate of validity in addition to the convergent validity which will be shown after making quantitative and qualitative data analysis. If there are correlation in the results of the survey and the interview, the convergent validity will be presented. From the pilot study that were held for both tools, the results of the both pilot studies for each questionnaire and interview have been convergent. So, this is an indicator of the convergence validity that occurred.

B. 3.10.2 Survey Reliability

Reliability indicates that the scores yields from an instrument are consistent and stable. In other words, the results should be nearly the same when researchers carry out the tool instruments in the same way in multiple times at different occasions (Heale and Twycross, 2015).

In this research, in which the questionnaire is based on **Likert-type Scale**, the researcher examined the questionnaire reliability by using the Cronbach's alpha method explained below, which tests the internal consistency. By this method, the correlation between each item and another in the questionnaire is measured.

Cronbach's Coefficient Alpha: This is considered as the most popular, the perfectly adequate index, and the most frequently used for examining whether measure items and the subsets of items are correlated highly (Brown, 2002). This test will be implemented and measured during the data analysis process of this research.

Improper use of alpha test can lead to situations in which either a test or scale is wrongly discarded or the test is criticized for not generating trustworthy results. To avoid this situation, an understanding of the associated concepts of internal consistency, homogeneity or uni-dimensionality can help to improve the use of alpha. Internal consistency is concerned with the interrelatedness of a sample of test items, whereas homogeneity refers to uni-dimensionality (Tavakol and Dennick, 2011). A measure is said to be unidimensional if its items measure a single latent trait or construct. Internal consistency is a necessity but not a sufficient condition for measuring homogeneity or uni-dimensionality in a sample of test items. It has been well documented that a multidimensional test does not necessarily have a lower alpha than a unidimensional test. Thus, a more rigorous view of alpha is that it cannot simply be interpreted as an index for the internal consistency of a test (Brown, 2002).

According to Wacha (2017), the lowest value of Cronbach’s alpha test could be 75%, and the highest might be 99%, which is the best value that Cronbach’s alpha can give. Therefore, the researcher can say that the questionnaire is reliable when the value comes out between 75-99% from the Cronbach's Alpha test.

In this study, after conducting the test for the questionnaire, the reliability value for the total degree of the tool is: 98.5%, which means that the data collection tool of this study is reliable to a high degree. So, it could be used to generalize the results of this study as the table (3.6) shows noting that the data in table (3.6) below are taken from the quantitative analysis done in chapter four.

Table 3.5: Reliability Test Results

Number	Domain	Cronbach's Alpha	N of Items
1	Awareness	0.954	8
2	Desire	0.992	34
3	Knowledge	0.972	9
4	Ability	0.780	20
5	Reinforcement	0.947	7
Total Degree		**0.985**	**78**

3.10.3 Interview Content Validity

A. **Validity:** Qualitative inquirers may use a second lens to establish the validity of their account: the participants in the study. The qualitative paradigm assumes that reality is socially constructed and it is what participants perceive it to be. This lens suggests the importance of checking how accurately participants' realities have been represented in the final account. Those who employ this lens seek to actively involve participants in assessing whether the interpretations accurately represent them. A third lens may be the credibility of an account by individuals external to the study. Reviewers not affiliated with the project may help establish validity as well as various readers for whom the account is written (Creswell and Miller, 2000).

In this study, the validity of the interview has been measured in reviewing it by experts and arbitrators through their checking of the interview questions. It has been ensured that the questions are related to the subject of the study and the answers are convergent.

B. **Reliability**: The reliability of the interview embodies trust values, consistency and neutrality of the interview contents (Morse et al., 2002). The study is done to explain how to implement new system along with the engineering and contracting companies with all their specializations; that is the BIM system for building projects around the West Bank. In addition, the reliability has been measured through the review of the arbitrators.

3.11 Data Analysis Approach

This section talks about the data analysis approach for both qualitative and quantitative data.

3.11.1 Qualitative Data Analysis

3.11.1.1 Transcription

Almost all qualitative research studies involve some degree of transcription – the data may be tape recorded interviews, focus groups, video recordings, or handwritten field notes. It is usually inappropriate to write up summary notes from a tape recording – unless the words are transcribed verbatim.

The researcher is likely to bias the transcription by only including those sections that seem relevant or interesting to them (Baker, 1994). Many researchers who include some non-verbal cues in the transcript - silence may communicate embarrassment or emotional distress, or simply a pause for thought. Words such as “well…., I suppose, ….” are important elements of a conversation and should not be ignored. Laughter or gestures may also give added meaning to the spoken word. If someone else is transcribing your material, it is important to tell him how much of this non-verbal matter to include. If you have never transcribed material, it is a useful exercise to do a little yourself (Flick, 2013).

3.11.1.2 Organizing the Data

After transcription, it is necessary to organize the raw data into easily retrievable sections. The researcher may give each interview a number or code or break up field notes into sections identified by date or by context. Interviewees will need to be given pseudonyms or referred to by a code number (Tashakkori and Teddlie, 1998).

A secure file will be needed that links pseudonyms and code numbers to the original informants. But as with any research, this file is confidential and would usually be destroyed after completion of the project. Similarly, names and other identifiable material should be removed from the transcripts (Bryman and Bell, 2015).

Narrative data need to be numbered using line or paragraph numbers, so that any unit of text you use can be traced back to its original context (Flick, 2013).

The best way to organize the data is to go back to the interview guide. Identify and differentiate between the questions/topics that the researcher is trying to answer, and those that were simply included in the interview guide as important, but for the moment, not essential (Dey, 2005). Data should be organized in a way that is easy to look at, and that allows the researcher to go through each topic to pick out concepts and themes. One way to do this is to organize all the data from the interview transcript (Lacey and Luff, 2007).

3.11.1.3 Familiarization

The above procedures will have begun the process of familiarization. This means that the researcher was listening to tapes and watching video material, reading and re-reading the data, making memos and summaries before the formal analysis begins (Dey, 2005). This is an essential stage, and is particularly important if the main researcher has not gathered all the data themselves (Flick, 2013).

Each of the response categories has one or more associated themes that give a deeper meaning to the data. Different categories can collapse under one main over-arching theme (Lacey and Luff, 2007).

3.11.1.4 Coding

Coding is the process of combing the data for themes, ideas and categories, and then marking similar passages of text with a code label so that they can easily be retrieved at a later stage for further comparison and analysis (Kawulich, 2004). Coding the data makes it easier to search the data, to make comparisons and to identify any patterns that require further investigation (Braun and Clarke, 2006).

Codes can be based on Flick (2013):

- Themes, Topics
- Ideas, Concepts
- Terms, Phrases
- Keywords found in the data.

Usually passages of a text are coded but can be sections of an audio or video recording or parts of images.

All passages and chunks that are coded the same way that is given the same label have been judged (by the researcher) to be about the same topic, theme and concept (Kuwalich, 2004).

The codes are given meaningful names that give an indication of the idea or concept that underpins the theme or category. Any part of the data that relate to a code topic are coded with the appropriate label (Brawn and Clarke, 2006). This process of coding (associating labels with the text, images etc.) involves close reading of the text (or close inspection of the video or images). If a theme is identified from the data that does not quite fit the codes already existing, then a new code is created (Dey, 2005).

In this study, a thematic data analysis will be used in order to analyze the qualitative data from the in-depth interview that will be conducted with eight companies.

3.11.2 Quantitative Data Analysis

In order to answer the study questions and to examine the hypothesis of the study, the SPSS software will be used towards doing the statistical tests. Means, frequencies, standard deviations, t-test, Pearson correlation test, and the regression results will be extracted towards giving the results of the quantitative collected data.

The SPSS software was used to analyze the collective data and the first test done was the Cronbach's alpha test. This test was conducted and applied to verify the reliability rate of the used questionnaire in which a number of tests and data have been revealed. These included frequency, means, percentages, Pearson correlation, t-tests for independent samples. In addition, for the purpose of testing the hypothesis, one-way ANOVA test has been done.

3.12 Summary

In this chapter, the research purpose was explained to be exploratory and explanatory approaches. Additionally, the research approach was examined to be deductive and inductive. Furthermore, the research strategy and design were clarified to be concurrent nested strategy from qualitative and quantitative data until the explanation of the analysis of findings. Moreover, a general framework was designed and demonstrated, and the control variables were selected for the adoption of BIM using ADKAR.

The research tools validity and reliability were explained within qualitative and quantitative approaches.

The following chapter presents the research results and findings based on the analysis of the data that have been collected using these two tools.

Chapter Four
Data Analysis and Results

4.1 Overview

This chapter presents the collected data analysis and its results via questionnaire and interviews.

From the questionnaire, this chapter shows the descriptive analysis of the collected data through the results of hypotheses testing and study questions. In addition, it presents the factors that affect the adoption of BIM system as a new model among Palestinian engineering and contracting firms with different specialties by using the Statistical Package for Social Sciences (SPSS) software.

The chapter displays the Palestinian image of adopting the BIM system and its theoretical framework. Moreover, the chapter shows the scope of acceptance of adopting the BIM system among Palestinian engineering and contracting offices with all their specializations. Furthermore, it explains the reality of implementing the BIM system in Palestine and the possibility of its adoption throughout the answers of respondents via interviews.

The chapter also focuses on analyzing the gathered data from respondents through a questionnaire form. The descriptive statistics of the data provides a quantitative insight and an invaluable contribution to the aims of this study. The analysis presented here is based on the data from the demographics of respondents.

Additionally, an in-depth analysis is presented to understand the factors which are critical in the implementation of BIM in construction industry in the West Bank.

The results are actually structured to determine the ADKAR and assess the level of importance of the BIM. The findings have been presented here in a statistical format such as charts and tables to enable examination and description in the view of the responses.

4.2 Qualitative Data Analysis and Results - Interview Analysis

The interview form contains six questions that have been asked to eight respondents in eight organizations, companies and unions which are described in chapter three. The methodology of presenting the qualitative results was chosen to be thematic analysis. It is a way used for identifying, analyzing, and reporting themes or patterns of the data, and is widely known in analyzing interviews (Braun and Clarke, 2006). Table 4.1 below summarizes the results of the qualitative analysis:

Table 4.1: Thematic analysis of interviews from codes to central themes:

Codes	Issues discussed	Central themes
• Useful time • Resources reduced • Errors reduced	• Decreasing variations and changes • Reducing redesign issues • Reusing the data • Better use by employees • Compatible 2D drawings at any stage • Instant revision • Clash detection	• BIM advantages in increasing work productivity
• Weak Authority • Lack of Ability • Few large sizes project • Need • Political situation • Time • Cost • Client	• The difficulty of forcing engineering specialties to use BIM by law. • Lack of supervision • Lack of electrical or mechanical engineers who use BIM more than civil or architectural ones • Decision makers in most engineering or contracting companies are old people • Sticking to the old traditional methods • Using BIM benefits partially, especially for visualization • Most of the projects are small • No need to use BIM in most projects • Unstable political situation • Lack of continuous projects • Increased design period of time • Increased design cost • Low design price • Hard to convince the client to use BIM • Clients are always urgent	• BIM adoption limitations
• Motivation • Promotion	• Show BIM benefits for a long run • Upload useful BIM tutorials on the PALENG and PCU main websites • Start freely to change a small group of individuals • Free workshops and training courses	• Increasing BIM adoption

4.2.1 Theme 1: BIM advantages in increasing work productivity

The purpose of this theme is to focus on how BIM increases productivity in the construction projects of the West Bank. The interviewees here discussed how BIM lowers projects modifications when responsibilities are understood well by all involved parties. The BIM model is much clearer than traditional and independent work. Therefore, it helps using the same data by different parties at different times instantaneously. This will enhance the project time and reduce conflicts between parties when it is applied throughout its full life cycle. It will also improve designers work in the design phase, in addition to the workers implementation during the execution phase.

4.2.2 Theme 2: BIM adoption limitations

This theme concentrates on the limitations that inhibit the adoption of BIM in the West Bank construction projects. Weak authority is one of the main factors that prevent implementing the system. For example, the PALENG is not interested in the way the engineering firms deliver their drawings. The most important issue for them is to have the needed drawings for license without taking into consideration the benefits of integration between parties as one model. The worst setback is that they don’t force the construction projects to have a compulsory supervision.

Clearly, engineering firms are not interested in adopting BIM for only project design. They prefer to do it with traditional methods which they are familiar with. This is especially true for mechanical and electrical engineers who design the project traditionally faster and simpler. Even architectural and civil engineers employ few benefits of BIM, mostly for 3D visualization. They generally view the benefits for the decision makers who grow old and resist change.

Furthermore, the design work using BIM is more expensive when it is only done for planning purposes, particularly for small projects, as BIM is more feasible for large size projects during life time. Unfortunately, most construction projects in the West Bank are small and suffer from the unsuitable political situation. Hence, they are mostly inappropriate for BIM adoption. This is also true for a few numbers of projects with lots of engineering firms. The client here primarily seeks the least design price within a shorter time, and chooses the best engineering office that works traditionally.

4.2.3 Theme 3: Increasing BIM adoption

The last theme aims at some ways of increasing BIM adoption by raising motivation and promotion of its implementation. The interviewees suggest inspiring the engineers imagine themselves using BIM and improving their work throughout the project life time for a long run. Promotion is also helpful using official unions as more confident parties. This also includes encouraging individuals to implement the system with free training courses sponsored by the PALENG, the PCU, or any formal union.

4.3 Quantitative Data Analysis and Results – Questionnaire Analysis

About 300 questionnaires were distributed but 242 were returned. The questionnaire was written in Arabic and later translated into English. The questionnaire was used to collect quantitative data in order to test the research hypotheses (formulated in section 3.8.3). Questionnaires were designed by using online forms, and then distributed by email and Facebook to the appropriate executives of each company.

All respondents' replies were stored as anonymous in a database, which makes analyzing the responses easier. Then its variables were coded and defined into the (SPSS V20) program. The first test using SPSS was done through questionnaire design phase to test the reliability of the questionnaire using Cronbach's Coefficient Alpha test by SPSS software. Cronbach alpha method was used to test the internal consistency of the questionnaire (formulated in section 3.10.2). The resulted total degree was 98.5% which considered as high reliability. Then many statistical analysis tools such as frequency, means, percentages, Pearson correlation, and ANOVA tests were used to investigate the relations between questionnaire elements.

The researcher reviewed the literatures for selecting the sample size as mentioned in Chapter three. The questionnaire was distributed randomly for each region after taking the lists of engineering and contracting companies from the PALENG and the PCU. The chance for each member in the list to become in the questionnaire sample is equal. The questionnaires were distributed regionally at random around the West Bank. Therefore, the sampling method chosen is the Stratified Random Sampling. So, the sample can be generalized for all the community as one normally distributed.

4.3.1 Questionnaire Sample Characteristics

Sample characteristics of the persons who filled the questionnaire and the employed company were analyzed. The respondents' characteristics provided descriptive information on the individual respondents. Specifically, the questionnaire provides information on position, gender, education level, field of study, and experience.

This information was necessary to confirm the validity of the results obtained, and to develop an understanding of the respondents' background with accompanying experience in the construction sector in the West Bank. The sample distribution was presented with respect to the following questionnaire respondents' and companies' characteristics.

The study population consisted of contractors and engineering offices with their different specialties of architectural, civil, mechanical and electrical engineers. The sample was selected randomly. It consisted of (242) filled questionnaires. The distribution of the sample is shown in table (4.2).

Table 4.2: Sample distribution

No.	Paragraph	Answers	Frequency	Percentage (%)
1	**Position**	Contractors	99	40.9
		Engineering office	143	59.1
2	**Gender**	Male	186	76.9
		Female	56	23.1
3	**Education**	Diploma	12	5.0
		Bachelor	177	73.1
		Master	37	15.3
		PhD	5	2.1
		Other	11	4.5
4	**Field of Study**	Civil	97	40.1
		Architect	68	28.1
		Mechanic or Electric	61	25.2
		Others	16	6.6
5	**Years of Experience**	Less than 5 years	59	24.4
		5-10 years	81	33.5
		11-15 years	43	17.8
		16-20 years	25	10.3
		More than 20 years	34	14

Table (4.2) confirms that with regard to the position, 59.1% are engineering offices, while 40.9% are contractors.

Gender also can be determined from table (4.2), 76.9% of the sample are male; while, 23.1% are female. As for education, the largest proportion (73.1%) was for those with a Bachelor's degree, followed by those with a Master's degree (15.3%), while the Ph.D. certificate owners was the lowest (2.1%).

With respect to the field of study, 40.1% of the samples are civil engineers; while, 28.1% are architects, 25.2% are mechanical or electrical engineers and 6.6% are others (Diploma or less). With respect to the years of experience, 33.5% of the sample has 5- 10 years' experience; while, 24.4% have less than 5 years, and 14.0% have more than 20 years.

4.3.2 Companies' Characteristics

The companies' characteristics provide information about the size of the organization, and the type of projects done by respondents at work. The distribution of companies' characteristics is shown in table (4.3).

Table 4.3: Companies Characteristics.

No.	Paragraph	Answers	Frequency	Percentage (%)
1	**Size of Organization**	5 or less persons	59	24.4
		6- 20 persons	113	46.7
		20- 50 persons	32	13.2
		50 – 100 persons	14	5.8
		More than 100 persons	24	9.9
2	**Type of Projects**	Residential & commercial buildings	126	52.1
		Interior architecture or design	13	5.4
		Urban design	10	4.0
		Public buildings	57	23.6
		Others	36	14.9

Table (4.3) confirms that, according to the size of organization, 46.7% hire employees between 6- 20 persons; while 24.4% have 5 or less persons, and 9.9% have more than 100 persons.

With respect to the type of projects, the largest proportion (52.1%) was for those working in residential and commercial building projects, followed by those working in public buildings (23.6%), while those working in urban design projects showed the lowest (4.0% of the sample).

4.3.3 Awareness of BIM

This section provides information about the awareness and understanding of what BIM is, and any other training courses in this field. The preliminary knowledge about BIM is shown in the table (4.4) below:

Table 4.4: Awareness of BIM

No.	Paragraph	Answers	Frequency	Percentage (%)
1	**What do you know about BIM?**	I haven't heard about BIM technology before	77	31.8
		I heard about BIM technology but I don't exactly know it well	97	40.1
		I have an idea about the concept of BIM technology	48	19.8
		I have a high level of information about BIM technology	13	5.4
		I know it well and use it at my work	7	2.9
2	**Did you have BIM training courses**	yes	27	11.2
		No	215	88.8

Table (4.4) confirms that, according to the awareness of BIM, 40.1% of the sample have heard about BIM technology, but don't exactly know it well; while, 31.8% haven't heard about BIM technology before.

However, 19.8% have an idea about the concept of BIM technology, 5.4% have high level of information about BIM technology, and 2.9% know it well and use it at work. With respect to the training courses in BIM, table (4.4) shows that 88.8% of the sample didn't have any BIM training courses, while; 11.2% had training courses in BIM.

4.4 Evaluation of Current Level of BIM Implementation in Palestinian Construction Projects Using ADKAR.

The following are the results gathered from section two. There were 78 questions dispensers on 5 dimensions for respondents to answer.

To assess BIM practices in the West Bank, respondents were asked to rate potential practices on a five-point scale, with 5 being applied “very much” and 1 being “never” as according to the degree of their agreement about to what extent their company implement BIM with each element of ADKAR model. The weighted average of the sample answers on the different study dimensions was calculated using Likert scale in order to know the direction of the opinions of the sample members and the work of the various comparisons. The Likert scale is considered to be the best measure of trends tool method (Aiken, 2000; Cohen and Swerdlik, 2001; Gregory, 2003) as sited in Chomeya (2010). Table (4.5) shows the intervals and their represented degrees of implementation:

Table 4.5: Proposed interval and degree of implementation

Interval	Degree of Implementation
≤ 20%	Very low (VL)
>%20 & ≤ %40	Low (L)
>%40 & ≤ %60	Moderate (M)
>%60 & ≤ %80	High (H)
>80%	Very High (VH)

There are many factors that could affect the implementation of BIM practices, either by support or by hindrance.

Therefore, one of the objectives of this research aims to provide a clear picture of variables helping or stopping BIM implementation from the viewpoint of engineering specialties based on ADKAR model.

The implementation of ADKAR in Palestinian engineering and contracting companies with all their specializations was analyzed by using descriptive analysis. As shown below, Relative weight (R.W), and standard deviation (S.D) were used to identify the application degree for each practice. Also, “One Way ANOVA” test was used to compare the respondents’ rate according to their field.

4.4.1 The First Dimension: The Level of Awareness of BIM

Table 4.6: Orientations of the sample of Awareness dimension

No.	Paragraph	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation	Sig.
1	Do you think in your work that BIM technology will help in sustainable environment and will reach a positive impact?	**Civil**	80.2	76.0	1.040	C & A (H) M & E (M)	0.000 *
		Architect	84.4				
		Mechanic or Electric	61.6				
2	Do you think in your work that BIM technology will help in improving the construction design & management field?	**Civil**	81.0	76.0	1.063	All (H)	0.000 *
		Architect	83.0				
		Mechanic or Electric	61.4				
3	How do you see in your work the level of need to use BIM technology?	**Civil**	76.0	71.0	1.117	C & A (H) M & E (M)	0.000 *
		Architect	79.2				
		Mechanic or Electric	58.0				
4	Do you agree in your work that BIM is the "Future of project information management"?	**Civil**	78.4	74.0	1.136	C & A (VH) M & E (M)	0.000 *
		Architect	82.0				
		Mechanic or Electric	60.0				
5	Do you believe that the engineers do not yet know enough of what BIM actually is?	**Civil**	81.8	76.4	1.133	C & A (VH) M & E (H)	0.000 *
		Architect	81.8				

		Mechanic or Electric	64.2				
6	Do you believe in your work that using BIM allows companies to win more works?	**Civil**	73.8	70.4	1.079	C & A (H) M & E (M)	0.000 *
		Architect	77.6				
		Mechanic or Electric	57.0				
7	Do you believe that adopting BIM workflow will lead to better works in your job?	**Civil**	78.0	74.0	1.118	C & A (VH) M & E (M)	0.000 *
		Architect	83.0				
		Mechanic or Electric	59.0				
8	Are you aware of BIM and its benefits?	**Civil**	73.6	68.4	1.217	C & A (H) M & E (M)	0.000 *
		Architect	76.8				
		Mechanic or Electric	51.8				

*** Statistically significance at 0.05 level**

The results of the table (4.6) show that the Relative weights ranged from 68.4 % to 76.4 %. The values of standard deviations indicate that there is a difference in respondents' answers in general to the above-mentioned paragraphs on the level of Awareness. The fifth paragraph which refers to “I believe that the engineers do not yet know enough what BIM actually is considered the strongest paragraph with "high" degree.

Furthermore, the eighth paragraph which refers to “I am aware of BIM and its benefits “considered the weakest paragraph in Awareness level with "high" degree.

Table (4.6) also shows that there is a statistically difference in mean average in respondents' answers in all paragraphs. In order to determine the source of the resulting difference, Least Square Difference (L.S.D.) test is chosen which is one of the many varied post hoc tests.

The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who work in the field of Mechanic or Electric and the answers of respondents of other fields.

Here, the largest gap was in the eighth paragraph and the smallest gap was in the fifth paragraph. These differences were higher in adoption for the respondents working in the field of civil and architectural engineering.

4.4.2 The Second Dimension: The Level of Desire of BIM

Table 4.7: Orientations of the sample of Desire dimension

No.	Paragraph	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation	Sig.
1	Do you see in your work that BIM improves cost estimating at each project stage	**Civil**	81.0	76.0	0.986	C & A (VH) M & E (H)	0.000 *
		Architect	83.0				
		Mechanic or Electric	62.0				
2	Do you see in your work that BIM improves productivity of estimator in quantity take-off?	**Civil**	81.2	75.8	1.081	C & A (VH) M & E (H)	0.000 *
		Architect	83.2				
		Mechanic or Electric	61.0				
3	Do you see in your work that BIM helps in facilitating quantity take -off for construction projects?	**Civil**	81.4	76.2	1.069	C & A (VH) M & E (H)	0.000 *
		Architect	83.8				
		Mechanic or Electric	61.0				
4	Do you see in your work that BIM reduces cost from health and safety issues in construction projects?	**Civil**	69.4	68.6	1.077	C & A (H) M & E (M)	0.000 *
		Architect	77.4				
		Mechanic or Electric	58.4				
5	Do you see in your work that BIM reduces an overall project cost?	**Civil**	72.6	70.4	1.071	C & A (H) M & E (M)	0.000 *
		Architect	78.0				
		Mechanic or Electric	58.6				
6	Do you see in your work that BIM increases speed of delivering construction projects?	**Civil**	75.2	70.8	1.116	C & A (H) M & E (M)	0.000 *
		Architect	77.6				
		Mechanic or Electric	56.8				

7	Do you see in your work that BIM reduces overall project duration?	**Civil**	73.8	70.0	1.090	C & A (H) M & E (M)	0.000 *
		Architect	75.8				
		Mechanic or Electric	58.4				
8	Do you see in your work that BIM improves maintenance scheduling?	**Civil**	76.4	72.4	1.088	C & A (H) M & E (M)	0.000 *
		Architect	80.2				
		Mechanic or Electric	58.6				
9	Do you see in your work that BIM supports the use of 4D BIM (integrating schedule dimension with the 3D)?	**Civil**	73.2	70.8	1.051	C & A (H) M & E (M)	0.000 *
		Architect	80.6				
		Mechanic or Electric	57.0				
10	Do you see in your work that BIM improves management of project schedule milestones?	**Civil**	78.4	73.8	1.038	C & A (H) M & E (M)	0.000 *
		Architect	81.2				
		Mechanic or Electric	59.6				
11	Do you see in your work that BIM Improves construction design quality?	**Civil**	75.2	72.4	1.072	C & A (H) M & E (M)	0.000 *
		Architect	80.8				
		Mechanic or Electric	59.4				
12	Do you see in your work that BIM improves efficiencies from reusing the data (enter once use many)?	**Civil**	79.8	73.8	1.066	C & A (H) M & E (M)	0.000 *
		Architect	79.8				
		Mechanic or Electric	58.6				
13	Do you see in your work that BIM enhances energy efficiency and sustainability of the construction projects?	**Civil**	73.4	70.6	1.059	C & A (H) M & E (M)	0.000 *
		Architect	78.2				
		Mechanic or Electric	58.4				
14	Do you see in your work that BIM improves energy analysis of the construction projects?	**Civil**	73.6	70.4	1.035	C & A (H) M & E (M)	0.000 *
		Architect	78.0				
		Mechanic or Electric	58.0				

15	Do you see in your work that BIM reduces safety risks in construction projects?	**Civil**	70.2	67.6	1.041	C & A (H) M & E (M)	0.000 *
		Architect	73.0				
		Mechanic or Electric	58.6				
16	Do you see in your work that BIM reduces redesign issues?	**Civil**	76.4	72.4	1.057	C & A (H) M & E (M)	0.000 *
		Architect	79.2				
		Mechanic or Electric	60.0				
17	Do you see in your work that BIM reduces waste in construction projects?	**Civil**	76.4	72.0	1.054	C & A (H) M & E (M)	0.000 *
		Architect	79.2				
		Mechanic or Electric	58.4				
18	Do you see in your work that BIM decreases changes at the execution stage of construction projects?	**Civil**	79.2	74.4	1.086	C & A (VH) M & E (H)	0.000 *
		Architect	81.2				
		Mechanic or Electric	61.0				
19	Do you see in your work that BIM helps in earlier and more accurate design visualization?	**Civil**	80.8	75.0	1.110	C & A (VH) M & E (H)	0.000 *
		Architect	81.2				
		Mechanic or Electric	61.0				
20	Do you see in your work that BIM associates in generating accurate and compatible 2D drawings at any stage of construction projects?	**Civil**	80.6	75.6	1.041	C & A (VH) M & E (H)	0.000 *
		Architect	82.6				
		Mechanic or Electric	61.6				
21	Do you see in your work that BIM improves site analysis of construction projects?	**Civil**	78.2	73.4	1.030	C & A (H) M & E (M)	0.000 *
		Architect	80.6				
		Mechanic or Electric	58.6				
22	Do you see in your work that BIM improves communication between project stakeholders?	**Civil**	78.4	74.4	1.067	C & A (VH) M & E (H)	0.000 *
		Architect	82.6				
		Mechanic or Electric	60.4				

23	Do you see in your work that BIM improves documents management of construction projects?	**Civil**	77.8	73.4	1.054	C & A (H) M & E (M)	0.000 *
		Architect	80.8				
		Mechanic or Electric	59.0				
24	Do you see in your work that BIM improves asset management of whole project life cycle?	**Civil**	76.0	72.4	1.060	C & A (H) M & E (M)	0.000 *
		Architect	81.2				
		Mechanic or Electric	58.4				
25	Do you see in your work that BIM enhances management of security and safety information of construction projects?	**Civil**	75.4	71.4	1.065	C & A (H) M & E (M)	0.000 *
		Architect	78.2				
		Mechanic or Electric	58.4				
26	Do you see in your work that BIM improves maintenance due to building automation system?	**Civil**	74.8	72.2	1.050	C & A (H) M & E (H)	0.000 *
		Architect	79.8				
		Mechanic or Electric	60.6				
27	Do you see in your work that BIM enhances team collaboration in construction projects?	**Civil**	78.8	73.8	1.090	C & A (H) M & E (M)	0.000 *
		Architect	80.8				
		Mechanic or Electric	59.0				
28	Do you see in your work that BIM improves human resources management in construction projects?	**Civil**	75.6	72.4	1.045	C & A (H) M & E (M)	0.000 *
		Architect	79.8				
		Mechanic or Electric	60.0				
29	Do you see in your work that BIM develops conflict detection in construction projects?	**Civil**	81.4	76.4	1.119	C & A (VH) M & E (H)	0.000 *
		Architect	85.0				
		Mechanic or Electric	61.0				
30	Do you see in your work that BIM helps in increasing productivity due to easy recovery of information?	**Civil**	79.0	74.2	1.077	C & A (VH) M & E (M)	0.000 *
		Architect	81.4				
		Mechanic or Electric	60.0				

31	Do you see in your work that BIM helps in predicting project time and cost?	**Civil**	78.4	73.8	1.077	C & A (H) M & E (M)	0.000 *
		Architect	81.4				
		Mechanic or Electric	59.6				
32	Do you see in your work that BIM improves coordination in the construction phase of construction projects?	**Civil**	80.2	75.0	1.009	C & A (VH) M & E (H)	0.000 *
		Architect	82.0				
		Mechanic or Electric	60.6				
33	Do you see in your work that BIM enhances work coordination with subcontractors or suppliers in construction projects?	**Civil**	76.8	72.6	1.040	C & A (H) M & E (M)	0.000 *
		Architect	80.0				
		Mechanic or Electric	59.0				
34	Do you see in your work that BIM improves maintenance of construction projects due to the as-built model?	**Civil**	76.2	72.4	1.021	C & A (H) M & E (M)	0.000 *
		Architect	79.8				
		Mechanic or Electric	59.6				

*** Statistically significance at 0.05 levels**

The results of the table (4.7) show that the Relative weights ranged from 67.6 % to 76.4 %. The values of standard deviations indicate that there is difference in respondents' answers in general to the above-mentioned paragraphs on the level of Desire. The twenty-ninth paragraph which refers to “BIM develops conflict detection in construction projects" is considered the strongest paragraph with "high" degree, followed by the third paragraph which refers to “BIM helps in facilitating quantity take -off for construction projects with "high" degree.

As for the fourth paragraph which refers to “BIM reduces cost from health and safety issues in construction projects “it is considered to be the weakest paragraph on the level of Desire with “high" degree.

Table (4.7) also shows that, there is a statistically difference in mean average in the respondents' answers in all paragraphs. In order to determine the source of the resulting difference, L.S.D. test was performed.

The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who work in the field of Mechanic or Electric and the answers of respondents of the other fields. Here, the largest gap was in the twenty-ninth paragraph and the smallest gap was in the fourth and fifteenth paragraphs as shown on appendix A.5.

These differences were higher in adoption for the respondents working in the field of civil and architectural engineering.

4.4.3 The Third Dimension: The Level of Knowledge of BIM

Table 4.8: Orientations of the sample of Knowledge dimension

No.	Paragraph	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation	Sig.
1	Do you know in your work that BIM provides three-dimensional (3D) modeling and visualization of construction projects?	**Civil**	82.2	76.2	1.042	C & A (VH) M & E (M)	0.000 *
		Architect	83.0				
		Mechanic or Electric	59.6				
2	Do you know in your work that BIM improves realization of the design idea by the owner via a 3D model of the building?	**Civil**	81.4	75.6	1.041	C & A (VH) M & E (M)	0.000 *
		Architect	83.0				
		Mechanic or Electric	59.4				
3	Do you know in your work that BIM provides four dimensional (4D) visualized scheduling and simulation for construction sequence?	**Civil**	78.8	74.0	1.025	C & A (H) M & E (M)	0.000 *
		Architect	80.8				
		Mechanic or Electric	59.6				
4	Do you know in your work that BIM provides five-dimensional (5D) model - based cost estimation?	**Civil**	73.0	70.6	0.994	C & A (H) M & E (M)	0.000 *
		Architect	78.0				
		Mechanic or Electric	58.4				
5	Do you know in your work that BIM improves design quality of construction projects?	**Civil**	78.2	73.8	1.047	C & A (H) M & E (H)	0.000 *
		Architect	78.8				
		Mechanic or Electric	61.4				
6	Do you know in your work that BIM provides functional simulation for construction projects to choose the best solution?	**Civil**	78.8	74.4	1.063	C & A (VH) M & E (M)	0.000 *
		Architect	81.8				
		Mechanic or Electric	60.0				

7	Do you know in your work that BIM promotes the safety planning and monitoring risk?	**Civil**	73.6	70.2	1.059	C & A (H) M & E (M)	0.000 *
		Architect	77.6				
		Mechanic or Electric	57.0				
8	Do you know in your work that BIM enhances energy optimization of the building?	**Civil**	74.6	70.8	1.043	C & A (H) M & E (M)	0.000 *
		Architect	77.0				
		Mechanic or Electric	58.4				
9	Do you know in your work that BIM improves emergency management of construction projects?	**Civil**	71.6	69.6	1.090	C & A (H) M & E (M)	0.000 *
		Architect	77.4				
		Mechanic or Electric	58.6				

*** Statistically significance at 0.05 levels**

The results of the table (4.8) show that, the Relative weights ranged from 69.6 % to 76.2 %. The values of standard deviations indicate that there is difference in respondents' answers in general to the above-mentioned paragraphs on the level of Knowledge. The first paragraph which refers to “BIM technology provides three-dimensional (3D) modeling and visualization is considered the strongest paragraph with “high" degree.

This is followed by the second paragraph which refers to “BIM technology improves realization of the idea for a design by the owner via a 3D model of the building” with "high" degree.

While the ninth paragraph which refers to “BIM improves emergency management of construction projects “is considered to be the weakest paragraph in the level of Knowledge with "high" degree.

Table (4.8) also shows that, there is a statistically difference in mean average in respondents' answers in all paragraphs. In order to determine the source of the resulting difference, L.S.D. test was performed.

The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who work in the field of Mechanic or Electric and the answers of those of other fields.

Here, the largest gap was in the first and second paragraphs and the smallest gap was in the fifth and ninth paragraphs. These differences were higher in adoption for the respondents working in the field of civil and architectural engineering.

4.4.4 The Fourth Dimension: The Level of Ability of BIM

Table 4.9: Orientations of the sample of Ability dimension

No.	Paragraph	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation	Sig.
1	In your experience, awareness of BIM can bring benefits to engineering and contracting companies	**Civil**	80.2	76.6	1.006	C & A (VH) M & E (H)	0.000*
		Architect	85.2				
		Mechanic or Electric	62.2				
2	In your experience, awareness of BIM can bring benefits to construction projects	**Civil**	81.6	76.6	0.995	C & A (VH) M & E (H)	0.000 *
		Architect	84.2				
		Mechanic or Electric	61.0				
3	In your experience, there is a low learning curve with those unfamiliar with technology	**Civil**	74.2	73.8	0.989	C & A (H) M & E (H)	0.004 *
		Architect	78.8				
		Mechanic or Electric	67.2				
4	In your experience, there is a need for well-defined commercial business process models to build the project	**Civil**	78.8	76.0	0.930	C & A (H) M & E (H)	0.000 *
		Architect	80.6				
		Mechanic or Electric	67.6				
5	In your experience, there is a lack of clear boundary of responsibilities between parties if BIM is not used	**Civil**	74.0	73.6	0.931	C & A (H) M & E (H)	0.037 *
		Architect	77.4				
		Mechanic or Electric	68.8				
6	In your experience, there is a need to draft BIM specific contracts	**Civil**	78.0	77.2	0.862	C & A (H) M & E (H)	0.052
		Architect	80.0				
		Mechanic or Electric	72.8				

7	In your experience, there is enough skilled personnel to use BIM in construction projects	**Civil**	39.4	39.6	0.869	C & A (L) M & E (M)	0.001 *
		Architect	33.8				
		Mechanic or Electric	45.0				
8	In your experience, there is adequate information available to use BIM in construction projects	**Civil**	40.0	39.6	0.864	C & A (L) M & E (M)	0.262
		Architect	36.8				
		Mechanic or Electric	41.6				
9	In your experience, there is adequate support available to use BIM in construction projects	**Civil**	40.8	40.0	0.869	C & A (L) M & E (M)	0.178
		Architect	36.4				
		Mechanic or Electric	41.6				
10	In your experience, people accept to learn BIM in construction projects	**Civil**	50.4	47.8	0.984	C & A (M) M & E (M)	0.312
		Architect	45.8				
		Mechanic or Electric	46.6				
11	In your experience, most construction projects are suitable to use BIM	**Civil**	46.8	45.8	0.925	C & A (M) M & E (M)	0.478
		Architect	43.8				
		Mechanic or Electric	47.6				
12	In your experience, most clients accept BIM if they know its benefits	**Civil**	46.0	43.8	0.903	C & A (M) M & E (M)	0.079
		Architect	39.8				
		Mechanic or Electric	45.2				
13	In your experience, most clients accept BIM even if it costs them more design fees	**Civil**	44.4	44.4	0.924	C & A (M) M & E (M)	0.592
		Architect	43.2				
		Mechanic or Electric	46.6				
14	In your experience, most clients accept BIM even if it costs them employing additional costs	**Civil**	41.6	42.4	0.876	C & A (M) M & E (M)	0.604
		Architect	41.4				
		Mechanic or Electric	44.2				

15	In your experience, most engineering and contracting companies accept BIM even if it costs them more in training existing staff	**Civil**	42.6	43.4	0.931	C & A (M) M & E (M)	0.803
		Architect	44.2				
		Mechanic or Electric	44.6				
16	In your experience, most engineering and contracting companies will accept BIM even if it costs them more in buying new software and updates	**Civil**	43.8	43.6	0.976	C & A (M) M & E (M)	0.993
		Architect	43.6				
		Mechanic or Electric	44.0				
17	In your experience, most engineering and contracting companies accept BIM even if it takes more time to produce the models	**Civil**	44.8	44.8	0.993	C & A (M) M & E (M)	0.993
		Architect	45.0				
		Mechanic or Electric	44.6				
18	In your experience, most engineering and contracting companies accept BIM even if it takes efforts to train existing staff	**Civil**	42.8	43.6	0.905	C & A (M) M & E (M)	0.724
		Architect	43.2				
		Mechanic or Electric	45.2				
19	In your experience, most engineering and contracting companies accept BIM even if it requires changing the culture towards fully collaborative working environment	**Civil**	43.2	43.6	0.910	C & A (M) M & E (M)	0.714
		Architect	42.6				
		Mechanic or Electric	45.2				
20	In your experience, most engineering and contracting companies accept BIM to improve the way of contracting documentation	**Civil**	44.4	44.2	0.885	C & A (M) M & E (M)	0.766
		Architect	43.2				
		Mechanic or Electric	45.6				

*** Statistically significance at 0.05 levels**

The results of the table (4.9) show that the Relative weights ranged from 39.6 % to 77.2 %. The values of standard deviations indicate that there is difference in respondents' answers in general to the above-mentioned paragraphs on the level of Ability. The sixth paragraph which refers to “There is a need to draft BIM specific contracts "is considered the strongest paragraphs with "high" degree. This is followed by the first paragraph which refers to “Awareness of BIM can bring benefits to engineering and contracting companies” and the second paragraph which refers to “Awareness of BIM can bring benefits to construction projects with “high" degree for each.

The seventh paragraph which refers to " There is enough skilled personnel to use BIM in construction projects" and the eighth paragraph which refers to" There is adequate information available to use BIM in construction projects" are both considered the weakest paragraphs in the level of Ability with "low" degree for each.

Table (4.9) also shows that, there is a statistically difference in mean average in respondents' answers in paragraphs (1, 2, 3, 4, 5). In order to determine the source of the resulting difference, L.S.D. test was performed.

The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who work in the field of Mechanical or Electrical engineering and the answers of the respondents of other fields, and these differences were higher for the respondents working in the field of Civil and Architectural engineering.

In addition, table (4.9) shows that there is a statistically difference in mean average in respondents' answers (paragraph 7) between the answers of respondents who work in the field of Mechanical or Electrical engineering and the answers of the respondents of other fields, and these differences were higher for the respondents working in the field of Mechanical or Electrical engineering. Also, there is a statistically difference between the answers of respondents who work in the field of Civil and the answers of the respondents who work in the field of Architectural. The Civil field was higher in adoption than other engineering specialties.

4.4.5 The Fifth Dimension: The Level of Reinforcement of BIM

Table 4.10: Orientations of the sample of Reinforcement dimension

No.	Paragraph	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation	Sig.
1	Do you agree to using BIM technologies mandatory by the Engineers Association during design phase?	**Civil**	69.0	67.6	1.197	C & A (H) M & E (H)	0.000 *
		Architect	75.0				
		Mechanic or Electric	57.0				
2	Do you agree to using BIM technologies mandatory by contractors' union during execution phase?	**Civil**	68.0	66.6	1.208	C & A (H) M & E (M)	0.000 *
		Architect	74.4				
		Mechanic or Electric	55.4				
3	Do you agree to increase the trainings for BIM technologies by private or governmental sectors?	**Civil**	79.0	73.6	1.157	C & A (VH) M & E (M)	0.000 *
		Architect	81.8				
		Mechanic or Electric	57.4				
4	Do you agree to refuse Engineers Association receiving and accepting all drawings not made using BIM?	**Civil**	61.2	61.2	1.232	C & A (H) M & E (M)	0.005 *
		Architect	67.6				
		Mechanic or Electric	53.4				
5	Do you agree with studying of BIM technologies mandatory at universities for undergraduate students?	**Civil**	76.4	73.0	1.210	C & A (H) M & E (M)	0.000 *
		Architect	81.8				
		Mechanic or Electric	59.6				
6	Do you agree and recommend implementing BIM within construction projects?	**Civil**	74.8	72.0	1.156	C & A (H) M & E (M)	0.000 *
		Architect	79.4				
		Mechanic or Electric	60.0				

7	Do you agree with the statement: "The biggest opportunity with construction technology is the BIM"?	**Civil**	74.6	72.0	1.031	C & A (H) M & E (H)	0.000 *
		Architect	78.2				
		Mechanic or Electric	62.0				

*** Statistically significance at 0.05 levels**

The results of the table (4.10) show that the Relative weights range from 61.2 % to 73.6 %. The values of standard deviations indicate that there is difference in respondents' answers in general to the above-mentioned paragraphs on the level of Reinforcement.

The third paragraph which refers to “I agree to increase the trainings for BIM technologies by private or governmental sectors" is considered the strongest paragraph with "high" degree, followed by the fifth paragraph which refers to “I agree with making studying of BIM technologies mandatory at the universities for undergraduate students with "high" degree.

In comparison, the fourth paragraph which refers to “I agree to refuse Engineers Association receiving and accepting all drawings not made using BIM “is considered the weakest paragraph in the level of Reinforcement with "high" degree.

Table (4.10) also shows that there is a statistically difference in mean average in respondents' answers in all paragraphs. In order to determine the source of the resulting difference, L.S.D. test was performed.

The results of L.S.D test show that there is a statistically difference between the answers of respondents who work in the field of Mechanic or Electric and the answers of the respondents of the other fields. Here, the largest gap was in the third paragraph and the smallest gap was in the fourth paragraph. These differences were higher in degrees of adoption for the respondents working in the field of Civil and Architect.

4.4.6 The Summary of Current Level of ADKAR Implementation in the West Bank Engineering and Contracting Companies.

Table 4.11: Orientations of the sample of ADKAR factors

No.	The Dimension	Field	R. W. (%)	Tot. R.W. (%)	S.D.	Degree of implementation
1	**Awareness**	**Civil**	77.9	73.4	0.968	C&A (H) M&E (M)
		Architect	81.0			
		Mechanic or Electric	59.1			
2	**Desire**	**Civil**	76.9	72.9	0.942	C&A (H) M&E (M)
		Architect	80.2			
		Mechanic or Electric	59.4			
3	**Knowledge**	**Civil**	76.9	72.8	0.944	C&A (H) M&E (M)
		Architect	79.7			
		Mechanic or Electric	59.2			
4	**Ability**	**Civil**	53.9	53.0	0.408	All (M)
		Architect	53.5			
		Mechanic or Electric	51.4			
5	**Reinforcement**	**Civil**	71.9	69.4	1.020	C&A (H) M&E (M)
		Architect	76.9			
		Mechanic or Electric	57.8			
Total		**Civil**	71.5	68.3	0.750	C&A (H) M&E (M)
		Architect	74.2			
		Mechanic or Electric	57.4			

*** Statistically significance at 0.05 levels**

The results of the table (4.11) show that the Relative weights range for the five ADKAR elements from 53.0 % to 73.4 %.

The values of standard deviations indicate that there is a convergence in respondents' answers in the five ADKAR levels.

The total implementation of the five ADKAR levels is "high", where the level of Awareness is considered the strongest level with "high" degree, followed by a lesser level of Desire and level of Knowledge with "high" degree for each.

The least which is the level of Ability is considered to be the weakest level with “Moderate " degree.

4.5 Correlation between ADKAR Change Model Components.

In this section, Pearson correlation was used to test if there is any statistically significant correlation, at the significance level ($\alpha \leq 0.05$), between each of ADKAR change model components.

Table (4.12) shows the correlations among five groups of ADKAR change model. The table shows the test results which represent the correlation among five ADKAR model levels: (1) level of Awareness, (2) level of Desire, (3) level of Knowledge, (4) level of Ability, and (5) level of Reinforcement.

Table 4.12: Correlation coefficient among ADKAR practices.

ADKAR Practices		Awareness	Desire	Knowledge	Ability	Reinforcement
Awareness	Pearson Correlation	———	0.909**	0.861**	0.143*	0.835**
	Sig. (2-tailed)	———	0.000	0.000	0.031	0.000
Desire	Pearson Correlation	0.909**	———	0.926**	0.110	0.826**
	Sig. (2-tailed)	0.000	———	0.000	0.098	0.000
Knowledge	Pearson Correlation	0.861**	0.926**	———	0.072	0.821**
	Sig. (2-tailed)	0.000	0.000	———	0.280	0.000
Ability	Pearson Correlation	0.143*	0.110	0.072	———	0.133*
	Sig. (2-tailed)	0.031	0.098	0.280	———	0.047
Reinforcement	Pearson Correlation	0.835**	0.826**	0.821**	0.133*	———
	Sig. (2-tailed)	0.000	0.000	0.000	0.047	———

****. Correlation is significant at the 0.01 level (2-tailed).**

***. Correlation is significant at the 0.05 level (2-tailed).**

The results of Pearson's correlation coefficient test of the hypotheses show that four of ADKAR practices have a significant and strong correlations with each other which are Awareness, Desire, Knowledge, and Reinforcement since all of the P-values for these four practices are less than 0.01. These correlations can be described as positively strong since all of the Pearson correlation coefficients is above $\rho=0.5$. The strongest relation is between the level of Desire and the level of Knowledge ($\rho=0.926$), followed by the relation between the level of Awareness and the level of Desire ($\rho=0.909$).

On the other hand, the results of Pearson's correlation coefficient test indicate that there is no correlation between the Ability practices and any of the other ADKAR practices (There is a very little correlation between Awareness and Ability)**.**

4.6 Inferential Statistics (Hypotheses Testing)

This section outlines the statistical difference between participants in this study. Independent Samples Test (T-Test for Equality of Means) and one-way ANOVA test are used to explain these differences. These two tests are used because correlations between qualitative and quantitative factors will be tested as well as the need to highlight whether the means of several variables are equal or not.

T-test method compares means of qualitative independent variable which has two levels; where one-way ANOVA compares means of qualitative independent variable which has more than two levels. In this case, the dependent variables are quantitative. The summary of these tests is shown below:

4.6.1 Gender impact on ADKAR change management model development

The first hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance ($\alpha \leq 0.05$) in the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) due to the gender of the respondents.

To examine the hypothesis, independent samples T-test was used as table (4.12) shows.

Table 4.13: **Independent Samples T-test Results for Hypothesis One.**

	Gender	N	Mean	R.W. %	S. D.	T- Value	Sig.
Awareness	Male	186	3.62	72.4	1.029	- 1.426	0.155
	Female	56	3.83	76.6	0.716		
Desire	Male	186	3.61	72.2	0.999	- 1.112	0.267
	Female	56	3.77	75.4	0.719		
Knowledge	Male	186	3.60	72.0	1.013	- 1.120	0.264
	Female	56	3.76	75.2	0.660		
Ability	Male	186	2.62	52.4	0.405	- 2.061	0.040 *
	Female	56	2.75	55.0	0.406		
Reinforcement	Male	186	3.40	68.0	1.083	- 1.874	0.062
	Female	56	3.69	73.8	0.742		
Total	Male	186	3.37	67.4	0.808	- 1.665	0.097
	Female	56	3.56	71.2	0.490		

*** Statistically significance at 0.05 levels**

The results of the table (4.13) show that there is no statistically significant difference between mean averages of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components due to the gender of the respondents in total degree, where T-value is (- 1.665) with significant value (0.097), which is statistically significant at ($\alpha \leq 0.05$) level. Also, the results show no statistically significant difference in four of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement since all of the sig-values for these levels are above than 0.05. While the results show a significant difference in mean average with regard to the gender in Ability level. The female won the benefit. Based on what was mentioned, that in spite of gender differences, responses agreed in the paragraphs cited in the questionnaire in the ADKAR change model components. Therefore, there is no impact for gender in the answers. This is consistent and it confirms the first hypothesis and led the study to accept it.

4.6.2 Education degree influence on ADKAR change management model development

The second hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) owing to the education degree of the respondents.

To examine this hypothesis, "One Way ANOVA" test was used as table (4.13) shows.

Table 4.14: One Way ANOVA Test Results for Hypothesis Two.

Source of Variation		Sum of Squares	Df.	Mean Square	F-value	Sig.
Awareness	Between Groups	27.539	4	6.885	8.225	0.000 *
	Within Groups	198.385	237	0.837		
Desire	Between Groups	18.515	4	4.629	5.612	0.000 *
	Within Groups	195.462	237	0.825		
Knowledge	Between Groups	20.910	4	5.228	6.285	0.000 *
	Within Groups	192.029	237	0.819		
Ability	Between Groups	1.620	4	0.405	2.496	0.044 *
	Within Groups	38.465	237	0.162		
Reinforcement	Between Groups	21.306	4	5.326	5.502	0.000 *
	Within Groups	229.441	237	0.968		
Total	Between Groups	15.570	4	3.892	7.694	0.000 *
	Within Groups	119.905	237	0.506		

*** Statistically significance at 0.05 levels**

The results of the table (4.14) show that there is a statistically significant difference between mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components with regard to the education degree of the respondents in total degree: F-value is (7.694) with significant value of (0.000), which is a statistically significant at ($\alpha \leq 0.05$) level. Moreover, the results show a statistically significant difference in all levels of the five ADKAR component levels. These are shown in all of the sig-values which are less than 0.05. In order to determine the source of the resulting difference. The L.S.D. test was chosen to be used.

The results of L.S.D tests shown on Appendix A.5 in the sample show that there is a difference between the answers of respondents who have a diploma degree and the answers of all the respondents of the various scientific degrees. These differences were higher in adoption for the respondents with higher scientific degrees than a diploma. In addition, the results of L.S.D tests in the sample show that there is difference between the answers of respondents who have a Bachelor's degree and the answers of the respondents with higher scientific degrees. These differences were higher in adoption for the respondents with higher scientific degrees namely M.A, and Ph.D. certificates.

All differences that were mentioned above, especially in the total degree, contradict the hypothesis, and led the study to reject the second hypothesis.

4.6.3 Field of study effect on ADKAR change management model development

The third hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) due to the field of study of the respondents.

To examine this hypothesis, "One Way ANOVA" test was used as table (4.15) shows.

Table 4.15: One Way ANOVA Test Results for Hypothesis Three.

Source of variation		Sum of Squares	Df.	Mean Square	F-value	Sig.
Awareness	Between Groups	46.592	3	15.531	20.612	0.000 *
	Within Groups	179.332	238	0.753		
Desire	Between Groups	41.649	3	13.883	17.174	0.000 *
	Within Groups	172.328	238	0.724		
Knowledge	Between Groups	40.764	3	13.558	18.567	0.000 *
	Within Groups	174.176	238	0.732		
Ability	Between Groups	0.671	3	0.224	1.350	0.259
	Within Groups	39.414	238	0.166		
Reinforcement	Between Groups	31.687	3	10.562	11.476	0.000 *
	Within Groups	219.059	238	0.920		
Total	Between Groups	27.043	3	9.014	19.786	0.000 *
	Within Groups	108.431	238	0.456		

*** Statistically significance at 0.05 levels**

The results of the table (4.15) show that, there is a statistically significant difference between mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components regarding the field of study of the respondents in total degree, where F-value is (19.786) with significant value of (0.000), is statistically significant at ($\alpha \leq 0.05$) level. Moreover, the results show a statistically significant difference in four levels of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement, since all of the sig-values for these levels are less than 0.05.

In order to determine the source of the resulting difference. The L.S.D. test was used. The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who work in civil field and the answers of the respondents who work in Mechanic or Electric field, and these differences were higher in adoption for the respondents who work in civil field. Also, there is a statistical difference between the answers of respondents who work in Architect field and the answers of the respondents who work in Mechanic or Electric field, and these differences were higher in adoption for the respondents who work in Architect field.

On the other hand, table (4.15) also shows that there is no statistically significant difference between mean averages of the respondents in Ability level, where F-value is (1.350) with significant value of (0.259), which is statistically significant at ($\alpha \leq 0.05$) level.

All the differences that were mentioned above, especially in the total degree, contradict the third hypothesis and led the study to reject it.

4.6.4 Experience impact on ADKAR change management model development

The fourth hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) due to the years of experience.

To examine this hypothesis, “One Way ANOVA” test was used as table (4.16) shows.

Table 4.16: One Way ANOVA Test Results for Hypothesis Four.

Source of variation		Sum of Squares	Df.	Mean Square	F-value	Sig.
Awareness	Between Groups	12.989	4	3.247	3.614	0.007 *
	Within Groups	212.935	237	0.898		
Desire	Between Groups	10.317	4	2.579	3.001	0.019 *
	Within Groups	203.660	237	0.859		
Knowledge	Between Groups	11.031	4	2.758	3.205	0.014 *
	Within Groups	203.908	237	0.860		
Ability	Between Groups	1.178	4	0.295	1.794	0.131
	Within Groups	38.907	237	0.164		
Reinforce ment	Between Groups	15.927	4	3.982	4.019	0.004 *
	Within Groups	234.820	237	0.991		
Total	Between Groups	8.631	4	2.158	4.032	0.004 *
	Within Groups	126.843	237	0.535		

*** Statistically significance at 0.05 levels**

The results of the table (4.16) show that there is a statistically significant difference between mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components with regard to the years of experience of the respondents in total degree, where F-value is (4.032) with significant value of (0.004), which is a statistically significant at ($\alpha \leq 0.05$) level. Moreover, the results show a statistically significant difference in four levels of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement, since all of the sig-values for these levels are less than 0.05.

In order to determine the source of the resulting difference. The L.S.D. test was used. The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents who have less than 5 years of experience and the answers of the other respondents, especially those who have from 5 to 15 years of experience or those who have more than 20 years' experience. These differences were higher in adoption for the respondents who have less than 5 years of experience. In general, L.S.D. test show that the difference in mean answer is higher in adoption for the lower years of experience.

On the other hand, table (4.16) shows explicitly that there is no statistically significant difference between mean averages of the respondents in Ability level, where F-value is (1.794) with a significant value of (0.131), which is statistically significant at ($\alpha \leq 0.05$) level.

All of the differences that were mentioned, especially in the total degree, contradict the fourth hypothesis. Therefore, it is rejected.

4.6.5 Position influence on ADKAR change management model development

The fifth hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) due to the current position of the respondents.

To examine this hypothesis, independent samples T-test was used as table (4.16) shows.

Table 4.17: **Independent samples T-test Results for Hypothesis Five.**

	position	N	Mean	R.W. %	S. D.	T- Value	Sig.
Awareness	Contractor	99	3.59	71.8	1.127	- 1.077	0.283
	Engineering	143	3.72	74.4	0.841		
Desire	Contractor	99	3.58	71.6	1.069	- 0.827	0.409
	Engineering	143	3.68	73.6	0.845		
Knowledge	Contractor	99	3.60	72.0	1.063	- 0.573	0.567
	Engineering	143	3.67	73.4	0.856		
Ability	Contractor	99	2.56	51.2	0.402	- 2.826	0.005 *
	Engineering	143	2.71	54.2	0.402		
Reinforcement	Contractor	99	3.53	70.6	1.152	0.778	0.437
	Engineering	143	3.43	68.6	0.920		
Total	Contractor	99	3.37	67.4	0.881	- 0.721	0.472
	Engineering	143	3.44	68.8	0.645		

*** Statistically significance at 0.05 levels**

The results of the table (4.17) show that, there is no statistically significant difference between mean averages of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components due to the current position of the respondents in total degree, where T-value is (- 721) with a significant value (0.472), which is statistically significant at ($\alpha \leq 0.05$) level. Also, the results show no statistically significant difference in four of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement since all of the sig-values for these levels are above than 0.05.

However, the results show a significant difference in mean averages due to the current position in Ability level for engineering firms. Based on what was mentioned, that despite the difference in the current position, responses agreed in the paragraphs cited in the questionnaire about the ADKAR change model components. Therefore, there is no impact for the current position on the answers. This is consistent and it confirms the fifth hypothesis and led the study to accept it.

4.6.6 Size of company effect on ADKAR change management model development

The sixth hypothesis states that there is no statistically significant difference between the mean average of the respondents at the level of significance (α ≤ 0.05) about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) due to the size of company of the respondents.

To examine this hypothesis, "One Way ANOVA" test was used as table (4.17) shows.

Table 4.18: One Way ANOVA Test Results for Hypothesis Six.

Source of Variation		Sum of Squares	Df.	Mean Square	F-value	Sig.
Awareness	Between Groups	10.023	4	2.506	2.751	0.029 *
	Within Groups	215.901	237	0.911		
Desire	Between Groups	9.545	4	2.386	2.766	0.028 *
	Within Groups	204.432	237	0.863		
Knowledge	Between Groups	8.206	4	2.052	2.352	0.055
	Within Groups	206.733	237	0.872		
Ability	Between Groups	0.351	4	0.088	0.532	0.719
	Within Groups	39.734	237	0.168		
Reinforcement	Between Groups	7.740	4	1.935	1.887	0.113
	Within Groups	243.006	237	1.025		
Total	Between Groups	6.034	4	1.508	2.762	0.028 *
	Within Groups	129.440	237	0.546		

*** Statistically significance at 0.05 levels**

The results of the table (4.18) show that there is a statistically significant difference between mean averages of the respondents at the level of significance ($\alpha \leq 0.05$) about the ADKAR change model components due to the size of company of the respondents in total degree. The F-value is (2.762) with significant value of (0.028), which is statistically significant at ($\alpha \leq 0.05$) level.

Moreover, the results show a statistically significant difference in two levels of the five ADKAR component levels which are Awareness, and Desire since the sig-values for these two levels are less than 0.05. In order to determine the source of the resulting difference, the L.S.D. test was performed.

The results of L.S.D tests shown on Appendix A.5 show that there is difference between the answers of respondents whose companies contain from 20 to 50 workers and the answers of the other respondents, especially those whose companies contain more than 50 workers. These differences were higher in adoption for the respondents whose companies contain from 20 to 50 workers. In general, L.S.D test shows that the difference in mean answer is higher in adoption for the lower size companies.

On the other hand, table (4.18) shows too that there is no statistically significant difference between mean averages of the respondents in the three levels of ADKAR components, which are Knowledge, Ability, and Reinforcement, since the sig-values for those levels are more than 0.05 which is statistically significant at ($\alpha \leq 0.05$) level.

All the differences that were mentioned above, especially in the total degree, contradict the sixth hypothesis, and led the study to reject it.

Chapter Five

Discussion and Model Development

5.1 An Overview

This Chapter includes the hypotheses testing results and a discussion for the outcomes with reference to the analysis for both interviews and questionnaires. The objectives and research questions are reviewed once again to ensure that the purposes of the study have been achieved and discussed.

5.2 Hypotheses Testing Results

This section discusses the results of hypotheses based on the participants in this study. Independent Samples Test (T-Test for Equality of Means) and one- way ANOVA tests were used as mentioned in the previous chapter. The summary of these hypotheses is shown in sections below:

5.2.1 The First Hypothesis: Gender Differences

The first hypothesis states that there is **no** statistically significant difference between the mean average of the respondents in the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) concerning the Gender of the respondents.

The outcomes of the Table (4.13) prove the hypothesis that there is ***no*** statistically significant difference between mean average of the respondents about the ADKAR change model components regarding the Gender of the respondents in total degree. Furthermore, the outputs show ***no*** statistically significant difference in four of the five ADKAR levels that are Awareness, Desire, Knowledge, and Reinforcement.

But the results show a significant difference in mean averages with regard to the gender in Ability level. The females implement more than males. But, for the overall result, there is **no** impact for Gender in the answers. So, the first hypothesis is accepted.

This result emphasizes the outputs of Khatatbeh (2015) in Jordan for this independent variable. The look for both genders towards BIM in construction projects is the same for the West Bank and Jordan as they work inside same identical countries with almost similar visions. However, the result contradicts with the outcome of Carlos et al. (2017), which observes that most women emphasized do not use BIM in their field and in Educational institutions. Additionally, it disagrees with the results of Ali (2013), that the awareness of females is more than males for the feasibility, and the design stages as females are more involved in the inside design stage than males that offers more time in implementing BIM.

Females and males in the West Bank engineering and contracting companies are almost the same in Awareness, Desire, Knowledge, and Reinforcement levels as shown on Table 4.13. This is particularly because the technology reaches most of them with almost similar background as the study targeted mostly engineers. However, both genders lack the Ability to implement BIM in real construction projects.

Working males in the public civil works are more than females (PCBS, 2018). Most males in the West Bank construction projects work internally and externally with more time in supervision or execution than females. Hence, they use their traditional tools more because they lack the Ability to connect with BIM in design and execution phases.

5.2.2 The Second Hypothesis: Education Differences

The second hypothesis states that there is ***no*** statistically significant difference between the mean average of the respondents about the overall ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) relating to the Education Degree of the respondents.

The outputs of the table (4.14) contradict with the hypothesis that ***there is*** a statistically significant difference between mean averages of the respondents about the ADKAR change model levels with regard to the education degree of the respondents in total degree. Moreover, the outcomes show a statistically significant difference in all levels of the five ADKAR components.

Our results show that there is difference between the answers of respondents who have a diploma degree and those of various scientific degrees. These differences were higher in adoption for the respondents with higher scientific degrees than a diploma. In addition, the results also show that there is difference between the answers of respondents who have a Bachelor’s degree and those with higher scientific degrees. These differences were higher in adoption for the respondents with higher scientific degrees namely M.A, and Ph.D. certificates. Therefore, the second hypothesis is rejected.

However, this contradicts with the outcomes of AbuHamra (2015) for this independent variable. In her study, no significant difference for educational qualifications and BIM application was shown in the AEC industry of Gaza Strip. The result is different than this study as the awareness and application of BIM in Gaza Strip is very low for the overall respondent results with all their educational qualifications.

However, in the study, there is an awareness and low application of BIM in the West Bank construction projects which makes it more reasonable to differentiate between various educational levels.

Our result also conforms with Zakaria et al. (2013) and Hatem et al. (2018) that higher education helps in increasing BIM acceptance of people if the Educational institutions are interested in technology. Lower knowledge in Iraqi Educational institutions is one of the main barriers that prevent using the BIM system (Hatem et al., 2018). This is fundamentally applicable as more educational qualification in contemporary Educational institutions leads to a better adoption of BIM.

Hence, this is similar to this study that more educational qualification leads to a better acceptance of BIM in the West Bank construction projects.

Unfortunately, BIM is mainly used in Palestine individually, and not on the level of companies (AbuHamra, 2015). Higher education individuals are more interested in modern technology as clearly shown on Table 4.14. They look for new techniques to facilitate their work. Definitely, BIM is a major up-to-date engineering process and software to establish the construction project virtually before physically constructing it. Therefore, most individuals of high education degrees have more Awareness, Desire, Knowledge, Ability, and Reinforcement levels than those with low educational certificates.

5.2.3 The Third Hypothesis: Field of Study

The third hypothesis states that there is ***no*** statistically significant difference between the mean average of the respondents about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) in the Field of Study of the respondents.

The outcomes of the table (4.15) contradict the hypothesis and proves that ***there is*** a statistically significant difference between the mean averages of the respondents about the ADKAR change model components in the field of study of the respondents in total degree. Plainly, the outputs show a statistically significant difference in four of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement except Ability. Therefore, the hypothesis is rejected.

As for Ability, table (4.15) shows that there is no statistically significant difference between the mean average of the respondents concerning the

Ability level. The probable explanation for this reason is that all fields in the West Bank construction projects lack the Ability to fully implement integrated BIM. However, most of them claim to have Awareness, Desire, Knowledge, and support the Reinforcement ideas.

The respondents confirm that BIM improves the engineering work without actually having the Ability to actually implement it. They are satisfied with the system and the way for change, and encourage the ways for making it last. However, they do not implement it well with the fact that most of the community do not really use it with the current situation and price.

The results show that there is difference between the answers of respondents who work in Civil field and the answers of the respondents who work in Mechanical or Electrical fields. The credit goes to the respondents who work in the Civil field.

Also, there is a statistically difference between the answers of respondents who work in Architectural field and the answers of the respondents who work in Mechanical or Electrical fields, and the approval goes to the respondents who work in Architectural field.

This is also shown in the results of Aranda-Mena et al. (2009) that BIM starts in enhancing the confidence of architectural design outcomes. Additionally, it improves the ability to understand clients' needs and complete more design projects. It also supports the architects to focus widely on design development.

The prospect of BIM adoption is optimistic by architects and civil engineers. BIM changes the way of communication between them (YAN et al., 2008). It also conforms with Sarah Berwald (2008), that bringing BIM into Educational institutions helps primarily architects to become better designers and work efficiently with other fields. Furthermore, implementing BIM for civil engineers will increase the total productivity and facilitate their work process (Nowak et al., 2016). This is especially applicable for decision makers and engineers with high responsibilities of Architectural and Civil engineers.

The architect is the lead designer to guide the adoption of BIM (Rogers et al., 2015). Additionally, adopting BIM in civil specialization for large size projects will be more efficient (Gu et al., 2007). However, these contradict with the outputs of AbuHamra (2015) as it shows no significant difference in the Field of Study and BIM adoption in the AEC industry of Gaza Strip.

The result is different than this study, for the knowledge and implementation of BIM in Gaza Strip is very low for most respondent results with all their specializations. Therefore, the differentiation between various specialties in AbuHamra survey was not obvious.

Architectural and Civil engineers are the main parties that define the concept of the project with the client. The use of 3D programs in designing purposes for the construction projects is usually done by the architects for exterior or interior building design (AbuHamra, 2015). This confirms the study results that Architectural and Civil engineers adopt BIM partially in their work for mostly preparing 3D shots more than Mechanical or Electrical fields.

Furthermore, the Architectural or Civil engineering specialties are always the contractual fields that decide the work process with the client during the concept, design, and tender phases (PALENG, 2006). They also control the price of design requirements. They constitute the main parties that may convince the client to work with BIM or not. The Mechanical and Electrical fields usually follow the process of Architectural and Civil specializations.

Therefore, and particularly if the architect mainly uses traditional engineering methods for design like 2D CAD drawings, the Mechanical and Electrical fields will generally follow the same way. However, if the architect uses BIM for design purposes, the Mechanical and Electrical specialties may or may not use BIM.

There is no doubt that the Mechanical and Electrical design using BIM costs much more than traditional methods and with a longer design period of time as it uses 3-D building models with detailed information about all components of the Mechanical, Electrical, Plumbing (MEP) systems. Therefore, it is more complex and not feasible for current minimum PALENG design prices of MEP fields to implement BIM as they also usually do not get involved in the execution phase.

5.2.4 The Fourth Hypothesis: Years of Experience

The fourth hypothesis states that there is ***no*** statistically significant difference between the mean average of the respondents about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) concerning the Years of Experience of the respondents.

The outputs of the table (4.16) contradict with the hypothesis and prove that ***there is*** a statistically significant difference between mean averages of the respondents about the ADKAR change model components with regard to the years of experience of the respondents in total degree. Therefore, the hypothesis is rejected.

In general, the difference in mean answer for the study is for the lower years of experience. On one hand, fresh experiences are usually motivated by modern technology methods. Therefore, the focus for changing to BIM should be done before those of old experiences that may resist the change. The focus must also include the decision makers of the engineering company.

On the other hand, table (4.16) shows explicitly that there is no statistically significant difference between mean averages of the respondents in Ability level. The possible explanation based on the study results is because all experiences lack the Ability to implement BIM in their own work. They are mostly not ready to implement it in real projects. Furthermore, lack of large-size projects may also be a reason for this low Ability of using BIM as they don’t consider it feasible for small size projects.

This result is similar to the conclusions of Ku and Taiebat (2011) in the survey with 31 contracting companies in the United States. It showed that the main barrier to BIM implementation is the education curve and the lack of skilled employees. However, this result is different from AbuHamra (2015) as it shows no significant difference in the years of experience and BIM application in the AEC industry of Gaza Strip. The result is unlike this study as the awareness and implementation of BIM in Gaza Strip is very low for all respondent results with all their experiences. Therefore, it was not obvious to distinguish between different experiences in the study.

Our outcomes verify differences between the answers of respondents who have lower than 5 years of experience and the answers of other respondents. These differences were particularly for the respondents who have less than 5 years of experience. The result also conforms with Zakaria et al. (2013), that recruiting new employees with lesser experiences will motivate knowledge sharing behavior and encourage BIM adoption. However, the top two purposes for not applying BIM on projects are “Lack of expertise within the project team, and lack of expertise within the organizations” (Eadie et al., 2013).

Additionally, BIM adoption for project managers needs high knowledge and experience (Rokooei, 2015). The reason for this different outcome is because the experience meaning in this study is general in the number of years working in construction projects. However, the meaning of experience in the mentioned contradicted studies is the experience of using

BIM. Therefore, more experienced workers in BIM leads to better convincing other employees inside the organization to adopt it.

5.2.5 The Fifth Hypothesis: Current Position

The fifth hypothesis states that there is ***no*** statistically significant difference between the mean average of the respondents about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) concerning the Current Position of the Respondents.

The results of the table (4.17) prove the hypothesis that there is ***no*** statistically significant difference between mean averages of the respondents about the ADKAR change model components with regard to the current position of the respondents in total degree. Therefore, the hypothesis is accepted. Additionally, the results show no statistically significant difference in four of the five ADKAR component levels which are Awareness, Desire, Knowledge, and Reinforcement.

Employees who work in engineering consulting firms or contracting companies are mainly those who have similar backgrounds. Therefore, they are expected to have similar Awareness, Desire, Knowledge, and support the sustainability of engineering improvement.

However, the results show a significant difference in mean averages due to the current position in Ability level for engineering firms. Engineering firms are mainly the initiators for the project with the client. If they use BIM, they usually adhere to no one. They are mainly the decision makers with the client. However, the contracting companies commonly follow the engineering firms' tools for preparing the outputs. They generally cannot implement BIM in the execution phase if the design phase is not based on BIM. They usually find the execution easier if they build on the Issued for Construction (IFC) drawings that are available from the engineering office. Otherwise, they adopt BIM partially by changing all the previous design drawings into BIM system.

The result is compatible with the outputs of AbuHamra (2015) for this independent variable. However, on one hand, it contradicts with the outputs of Azhar et al. (2008), that the general contractors of the United States are the early adopters of BIM among all parties. The contractors use it more effectively than designers to achieve higher profitability, better client service, cost and time control, better quality, more precise decision making, and greater management. BIM is very useful in construction industry for designers and contractors. BIM in design phase reduces mistakes before execution. It also helps contractors in reducing cost and time in field (Fazli et al., 2014).

Furthermore, in Malaysia, big contracting companies pay fees to designers in order to motivate adoption of BIM as a competitive advantage in construction projects (Rogers, et al., 2015). Therefore, American and Malaysian big contractors use BIM more usefully. On other hand, BIM is mainly used in design and pre-construction phases with a lower extent in the construction phase (Robert Eadie, 2013).

Hence, it is compatible with this study and AbuHamra (2015), that the designers adopt BIM more widely in the design stage, and the contractors use it with a lesser range in the construction period. This is because the West Bank and Gaza Strip lack large contracting companies that might be interested in BIM support and adoption.

5.2.6 The Sixth Hypothesis: Size of Company

The sixth hypothesis states that there is ***no*** statistically significant difference between the mean average of the respondents about the ADKAR change model components (Awareness, Desire, Knowledge, Ability and Reinforcement) concerning the Size of Company of the respondents.

The results of the Table (4.18) show that ***there is*** a statistically significant difference between mean averages of the respondents about the ADKAR change model components with regard to the size of company of the respondents in total degree. Moreover, the results show a statistically significant difference in two of the five ADKAR component levels which are Awareness, and Desire.

The results show that there is a difference between the answers of respondents whose companies contain from 20 to 50 workers and the answers of the other respondents, especially those whose companies contain more than 50 workers. These differences were higher in adoption for the respondents whose companies contain from 20 to 50 workers. In general, the test shows that the difference in mean answer is higher in adoption for the lower size companies. Therefore, the hypothesis is rejected.

Large companies might have more resources to adopt BIM (Ainsworth, 2016). Additionally, the big construction projects and the big clients are the main adopters of BIM. Government, as the biggest client can successfully lead to better BIM adoption (Rogers et al., 2015).

Additionally, when there are large amounts of resources in construction projects, the cooperation support at design and execution stages will motivate more incentives for BIM adoption (Gu et al., 2007).

The beginning costs for adopting BIM system is essential, particularly, for small size companies (Bryde et al., 2012). However, in this study, low number of employees inside the engineering firms or contracting companies with different specializations may have more chance to adopt BIM in total degree. This might be because controlling a small number of individuals is easier than those of a higher number.

Clearly, small to medium scale projects as a pilot trial is ideal to adopt BIM at the first time (Zakaria et al., 2013). Luckily, most engineering and contracting companies in the West Bank have a small number of workers as the West Bank lacks large size projects. Furthermore, the unstable political situation is a major factor that inhibits engineering and contracting companies from taking the risk of development.

5.3 Model Development

The qualitative analysis shown in Table 4.1 explains that BIM improves the productivity of construction projects. However, its adoption limitations must be fixed in order to successfully implement it for different engineering fields. Furthermore, and based on the quantitative analysis, working with Architectural and Civil specialties for BIM adoption is different from working with Mechanical and Electrical fields. Therefore, a framework will be designed in order to be implemented towards BIM adoption for various fields.

It can be clearly elicited in Table 4.11 that Architectural and Civil fields basically lack the Ability to implement BIM in actual work projects. However, Mechanical and Electrical specialties lack all Awareness, Desire, Knowledge, Ability, and Reinforcement. The designer and the contractor with different specialties, in addition to the client, are the main parties to be involved in BIM adoption with the help of government. Government can move construction projects towards BIM by the PALENG, PCU, ministries, and financers as major factors of change.

The following is the proposed framework that is supposed to be implemented on the West Bank engineering and contracting companies with different fields, in addition to the clients, for ensuring successfully adoption of BIM:

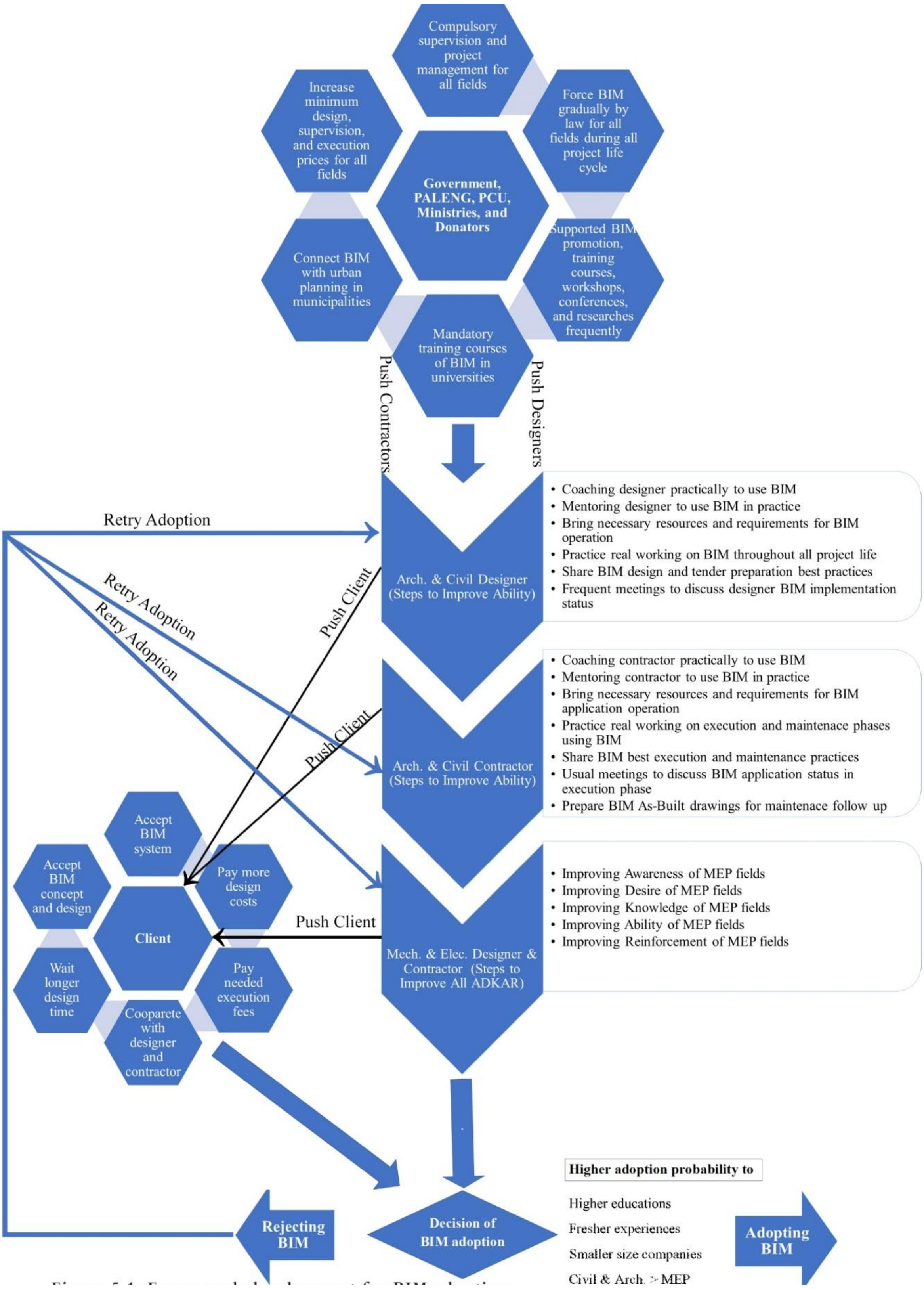

Figure 5.1: Framework development for BIM adoption in the West Bank construction projects.

The first element of figure 5.1 starts with the government, PALENG, PCU, ministries, and financers as the main contributors that can push towards BIM adoption in the West Bank construction projects by the following steps:

1. Oblige the engineering firms to supervise the project with all specialties. Each field should have its private contract for design and supervision services for all project stages.

2. Work to increase the minimum engineering work prices for all fields. The focus should be done on Mechanical and Electrical fields that don’t contact directly with the client to request a raise in their fees, as they can’t become a contractual office like the Architectural and Civil fields in the PALENG.

3. Impose BIM progressively in law by rejecting traditional working methods for all engineering works.

4. Link BIM with urban planning in municipalities to require using BIM in formal license.

5. Propped BIM promotion and training courses, workshops, conferences, and researches frequently with BIM professionals to ensure that the change will last in a right way.

6. Compulsory training courses of BIM in universities to prepare the engineering students for all fields to work on BIM system after graduation.

All the six previous factors will help in converting the traditional system of work in engineering and contracting companies into BIM if they fix their deficiencies and empower their strengths. Architectural and civil designer and contractor should work on supporting their Ability to overcome traditional engineering methods and change to BIM by some methods as in the following:

- Coaching practically to use BIM.
- Mentoring to use BIM in practice.
- Bring necessary resources and requirements for BIM application operation.
- Practice real working on execution and maintenance phases using BIM.
- Share BIM best design, tender, execution, and maintenance phases.
- Frequent meetings to discuss BIM throughout project life cycle.
- Using BIM overall project phases.

After that, the Mechanical and Electrical designer and contractor must work on Awareness, Desire, Knowledge, Ability, and Reinforcement in order to overcome conventional engineering working procedures. Every mentioned ADKAR component level has to be improved. Developing previous level is needed prior to proceeding to the next level. For example, overcoming Awareness level totally is needed in order to continue to the next level which is Desire.

The needed steps for ADKAR component levels developments with Mechanical and Electrical fields start with improving the Awareness in the following steps:

- Meetings with the board of directors to have their consciousness of changing to BIM.
- Contacting directly or by social media with MEP designers and contractors to make them aware of the importance of changing to BIM.
- Distributing educational brochures and literatures about BIM in MEP throughout all project lifecycle for designers and contractors.

Furthermore, to improve the desire of MEP fields, the following steps are required:

- Highlighting BIM benefits for MEP designers and contractors.
- Preparing job advancement and compensation opportunities to use BIM in MEP overall project stages for contractors and designers.
- Supporting job security for BIM users in MEP.
- Motivating MEP users by role model leaders.
- Hearing employees’ complaints and suggestions for a better changing to BIM.
- Accepting the best suggestions with the majority of users.

- Ensuring shared decision making for designers and contractors to be involved.

Additionally, for developing the knowledge of MEP specialties, the next procedures are recommended:

- Training & Teaching BIM inside or outside the company for MEP specialties.
- Preparing workshops to explain how to change.
- Hiring Social networks to increase knowledge of BIM in MEP fields.
- Preparing MEP helpful learning resources.
- Determining implementation barriers to overcome them.
- Understanding compensation programs.
- Ensuring access to BIM information.
- Setting BIM implementation checklist and monthly limestones distributed.

Moreover, the following methods are recommended for empowering the ability of MEP specializations:

- Coaching the use of BIM practically for MEP designers and contractors.
- Mentoring the use of BIM for MEP designers and contractors in practice.

- Bringing necessary resources and requirements for BIM operation in MEP.

- Practicing real working on MEP throughout all project stages.

- Sharing best BIM practices in MEP throughout project lifecycle.

- Conducting frequent meetings to discuss BIM implementation status for MEP designers and contractors throughout all project phases.

Finally, to empower the reinforcement of BIM in MEP fields, the next stages are required:

- Promoting the best practices of BIM for MEP designers and contractors and sharing them.

- Fostering the collaboration relationship of using BIM in MEP specializations.

- Presenting BIM best practices overall project stages.

- Holding ongoing meetings discussing improvement ways for MEP designers and contractors.

Subsequently, and after controlling all ADKAR component levels for engineering and contracting companies and all their specialties with the help of government, PALENG, PCU, ministries, and financers as external factors, the client may then be convinced to accept BIM with all its requirements as follows:

a) Accepting BIM system, concept, and design from the designer.

b) Spending more design costs as it is much more expensive than traditional working methods during the design and tender stages.

c) Waiting for more design time and not rushing the designer during the BIM work as it takes longer time than conventional ways. However, BIM ensures much more accuracy to minimize the execution time and cost in addition to improving the project quality.

d) Paying the required execution fees, or other needed fees.

e) Collaborating with designer and contractor to deliver what is required to guarantee the success of BIM work flow for all project life cycle.

Furthermore, the probability of adopting BIM by engineering and contracting companies in order to convince the client to accept it is for higher education, newer experiences, smaller size companies, and Civil and Architectural fields as resulted from hypotheses testing. Otherwise, the engineering and contracting companies must try again to overcome their deficiencies in BIM adoption using ADKAR stages and then convince the client with a next trial.

Chapter Six
Conclusions and Recommendations

6.1 An Overview

In this chapter, the conclusions have been extracted from the previous discussion of the results in chapter 5 and will be presented herein. In addition to the recommendations beyond those results and conclusions, contributions to this research and future studies based on this study will be presented.

6.2 Conclusions

Based on the outputs of the research, the main results concluded are:

- The in-depth interviews affirm that although the benefits of BIM are well-known, the West Bank construction projects still lack the Ability to use it for many limitations in different engineering disciplines, especially in the Mechanical and Electrical fields.

- The survey shows that the majority of Palestinian engineering firms and contracting companies are educated. Hence, focusing to enhance their Ability of using BIM may be easier.

- The survey shows that the majority of the engineering fields involved in BIM are Civil followed by Architectural then Mechanical and Electrical specialties.

- Based on the results of the distributed questionnaires for the five component titles of ADKAR model, the following can be concluded:

➢ For the Awareness level, it is high for Civil and Architectural engineers and moderate for Mechanical or Electrical engineers.

These results appear in the questionnaires which show that the Civil and Architectural fields are more engaged in design and execution stages. Consequently, this will increase the probability of hearing about BIM.

➢ As for the Desire level, it is high for Civil and Architectural engineers and moderate for Mechanical or Electrical engineers. This indicates that the engineering and contracting companies with their different specialties have somehow motivations to know the importance of BIM and how it could affect in enhancing the performance of construction sector.

Additionally, Architectural and Civil engineers had always more incentives to adopt BIM as they work more during the design phase and usually supervise or execute the work on site. However, working traditionally in the Mechanical and Electrical design drawings generally does not consume long time when compared to other specialties.

In comparison, working on MEP drawings using BIM usually consumes longer time and higher efforts. Therefore, Mechanical and Electrical engineers mostly lack the high Desire to adopt BIM compared to other fields.

- As for the level of Knowledge, it is high for Civil and Architectural engineers and moderate for Mechanical or Electrical engineers. Therefore, Architectural and Civil engineers have more information to adopt BIM.

They understand the technology more than other fields as they have more Awareness and Desire to use it. They are more engaged in 3-D designing, scheduling and cost estimating as they are generally concerned with the execution phase of the West Bank construction projects.

Truly, Architectural and Civil fields commonly own good Knowledge on BIM technology as to build an integrated model that covers all concerns and information of the project throughout its full life.

- With regard to the Ability level, it is moderate for all fields. All engineering fields lack the Ability to fully implement BIM in their work. They emphasize that BIM develops the engineering work but without actually having the Ability to use it.

This deficiency results from a few reasons such as resisting the change by sticking to the old methods; especially old decision making, lack of supervision and lack of large size projects to implement BIM sufficiently. This is in addition to the weak authority that still cannot convince the clients and the engineering firms to adopt the system and increase the minimum prices.

- Based on the results of Reinforcement level, it is high for Civil and Architectural engineers and moderate for Mechanical or Electrical engineers. Civil and Architectural specialties support the sustainability of the technology more than other fields as they have more Awareness, Desire, and Knowledge to use it. They have no objection to continue using the new technology after getting the needed practice.

6.3 Recommendations

The following are practical recommendations to all project stakeholders; owners, designers and contractors which could lead to better practices in BIM system in the West Bank when they are carried out:

- Convincing the government to support BIM technology in the West Bank.

- Support and public promotions from Government to convince the clients to adopt BIM with all its requirements.

- Encouraging the PALENG to convince the engineering firms to use BIM progressively in their work during the IFC drawings in addition to force the mandatory supervision and project management of construction projects. Also, encourage them to raise the minimum engineering work prices to be fair with the new technology in design, tender, schedule, cost estimate, and other work activities.

- Motivate the PCU to promote the implementation of BIM for contracting companies during their shop drawing, scheduling, cost estimating, preparing the As-Built drawing, and the maintenance works.

- Connect the BIM with the urban planning in municipalities.

- Ensure top Leaders BIM support by clarifying the advantages of this technology. Leaders are recommended to be Aware of the benefits of BIM and actively participate in its implementation rather than resisting it.

- Encourage Educational institutions to teach BIM for undergraduate students especially for teaching BIM concept and its practical use in construction projects throughout the project life for architectural, civil, MEP, and other engineering fields.

- Motivate employees to use BIM by supporting or free training courses, workshops, conferences, and researches.

- Increase employees' commitment by empowering and involving them in decision-making process.

- Focus more on employees with higher education, fresher experiences, smaller size groups, and architectural and civil fields in training and using BIM. This will strengthen their high Ability to learn the new system and make them the initiators to be imitated by other low ability employees.

- Change the attitude towards the importance of all engineering fields to get involved in all project life.

6.4 The Research Contributions

For the first time in literature, this research adds a contribution to the engineering and contracting companies with various fields by the application of ADKAR as a change management model in the BIM adoption process. The research discovers the current status of BIM case in construction projects and its implementation with their different specializations.

After revising the literature, eight interviews were made with organizations, companies and unions in addition to distributing questionnaires with engineering and contracting firms to assess the current state of BIM in the West Bank construction projects using ADKAR model. The interviews discovered their strengths and weaknesses that inhibit the adoption of this new trend. They also examined BIM adoption in terms of different hypotheses applied in the West Bank construction projects.

They also checked BIM adoption with different genders, education, fields of study, years of experience, current positions, and size of company for all ADKAR components in addition to comparing the results with outcomes of other researches.

The study also proposes a framework to facilitate the implementation of different engineering specialties with various positions for the project life cycle with the goal of BIM adoption. The framework aims to convince the engineering and contracting companies with all specialties to adopt BIM, then persuade the client to try the new technology with the help of the government, PALENG, PCU, ministries, and donators. This framework can be applied to help the West Bank engineering and contracting companies adopt BIM for different engineering fields to be modified clearly by ADKAR change management model.

6.5 Suggested Future Researches Based on This Study

In the recent decade, the West Bank has seen real positive improvements in some sectors aspects. However, it showed a setback in the construction sector. In order to meet future demands and encourage fruitful projects, one of the significant methods to achieve a detectable change is the BIM system which has revealed successful application in the global world.

The data gained from the study propose that BIM is efficient in developing construction projects. Cost, time, quality, coordination, and communication will be influenced in engineering and contracting companies. In terms of additional research, this study refers to several studies that wrote about BIM adoption. Additionally, and according to the results and conclusions that have been presented, it is worth to mention a number of future studies that could be based on this study in order to enrich the engineering field with wide range of BIM modern technology.

As suggestions for future studies that could be conducted about BIM and its adoption, the researcher proposes such insights which could be helpful for the construction field such as:

BIM implementation within large and small construction projects with maximum benefits of time, cost, and quality.

The plans, relations, partnerships, and responsibilities that are needed to be established by all involved stakeholders towards BIM adoption in the West Bank construction projects among all engineering fields throughout the project life-cycle.

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Appendices

A.1 Appendix A: Interviews

Dear Sir,

This is an interview that will be undertaken with major organizations in the West Bank region as a tool for a master's degree in Engineering Management to study the BIM status in the West Bank construction projects for different fields. The information in the interview will be only applied for academic research objectives to help in developing the questionnaire that will be distributed, with a complete commitment to absolute confidence.

Regards.

Interview

First Question: Have you heard about the Building Information Modeling (BIM)?

Second Question: If yes, do you know the benefits of this model towards the construction industry in Palestine?

Third Question: Do you know how much the engineering offices and contracting companies in the West Bank are aware of the BIM system?

Fourth Question: Do you think that there will be a Desire and Ability to implement BIM in Palestine among the engineering and contracting companies?

Fifth Question: Do you think that it is possible to implement the BIM system in the West Bank? And what are the challenges of its adoption process?

Sixth Question: What suggestions do you provide in order to facilitate the adoption and implementation of BIM in the West Bank construction projects?

A.2 Appendix B: List of Interviewees

No.	Name	Position	Place
1	Eng. Bilal Al-Howwary	Head of Engineering Department	Rawabi City - Ramallah
2	Eng. Jamal Numan	Head of GIS Department	Palestinian Ministry of Local Government - Ramallah
3	Eng. Husam Ibrahim	Head of Engineering Department	Bethlehem Municipality – Bethlehem
4	Eng. Moayyad Zboun	Head of BIM Division	Consolidated Contractors Company (CCC) - Ramallah
5	Eng. Mohammad Asawdeh	Head of Structural Department	PALENG - Ramallah
6	Eng. Osama Aslan	Architect	Al-Khatib & Alami Office - Ramallah
7	Eng. Sana' Hamdan	Head of Building Department	Bedya Municipality – Nablus

A.3 Appendix C: The Questionnaire

Subject: Questionnaire survey about “Adopting BIM in the West Bank Construction Projects Using ADKAR as an Integrative Model of Change Management; a thesis submitted in partial fulfillment of requirements for Master’s degree in Engineering Management, Structural Engineering.

Research aim: To spread a clear understanding for BIM technology and address the barriers hindering the construction firms to decide working with BIM in order to build a framework for implementing it in the West Bank construction projects.

Target group: The West Bank engineering consulting and contracting companies.

Gender	☐	Male
	☐	Female
Education Degree	☐	Diploma
	☐	Bachelor
	☐	Master
	☐	PhD
	☐	Other (please specify)
Field of Study	☐	Civil
	☐	Architect
	☐	Electrical
	☐	Mechanical
	☐	Other (Please specify)
Years of experience	☐	Less than 5 years
	☐	5-10 years
	☐	11-15 years
	☐	16-20 years
	☐	More than 20 years
Current position	☐	Project Manager
	☐	Designer
	☐	Supervisor
	☐	Projects Engineer
	☐	Projects Planner
	☐	Other (Please specify)
What is the size of your organization?	☐	5 or less persons
	☐	6- 20 persons
	☐	20- 50 persons

	☐	50 – 100 persons
	☐	More than 100 persons
What type of projects do you most often work on?	☐	Residential & commercial buildings
	☐	Interior architecture or design
	☐	Urban design
	☐	Public buildings
	☐	Others (Please specify)
Do you know BIM technology?	☐	I haven't heard about BIM technology before
	☐	I heard about BIM technology but I don't exactly know it well
	☐	I have an idea about the concept of BIM technology
	☐	I have a high level of information about BIM technology
	☐	I know it well and use it at my work
Did you have BIM training courses?	☐	Yes
	☐	No

Part 2: This section is to measure the level of **Awareness** of BIM by the consultant engineering and contracting companies.

Please rate the following factors on an important scale of 1-5 where 1= Strongly agree, 2 = Agree, 3 = Somewhat agree, 4 = Disagree, 5 = Strongly disagree

Tick (X) in front of the number that reflects your point of view

No	Question:	Strongly agree	Agree	Somewhat agree	Agree	Strongly disagree
1	Do you think in your work that BIM technology will help in sustainable environment and will reach a positive impact?					
2	Do you think in your work that BIM technology will help in improving the construction design & management field?					
3	How do you see in your work the level of need to use BIM technology?					
4	Do you agree in your work that BIM is the "Future of project information management"?					

5	Do you believe that the engineers do not yet know enough of what BIM actually is?					
6	Do you believe in your work that using BIM allows companies to win more works?					
7	Do you believe that adopting BIM workflow will lead to better works in your job?					
8	Are you aware of BIM and its benefits?					

Part 3: This section is to measure the level of **Desire** of BIM by the consultant engineering and contracting companies.
Please rate the following factors on an important scale of 1-5 where 1= Strongly agree, 2 = Agree, 3 = Somewhat agree, 4 = Disagree, 5 = Strongly disagree

Tick (X) in front of the number that reflects your point of view

No	Question:	Strongly Agree	Agree	Don't know	Disagree	Strongly Disagree
1	Do you see in your work that BIM improves cost estimating at each project stage					
2	Do you see in your work that BIM improves productivity of estimator in quantity take-off?					
3	Do you see in your work that BIM helps in facilitating quantity take - off for construction projects?					
4	Do you see in your work that BIM reduces cost from health and safety issues in construction projects?					
5	Do you see in your work that BIM reduces an overall project cost?					
6	Do you see in your work that BIM increases speed of delivering construction projects?					
7	Do you see in your work that BIM reduces overall project duration?					

8	Do you see in your work that BIM improves maintenance scheduling?					
9	Do you see in your work that BIM supports the use of 4D BIM (integrating schedule dimension with the 3D)?					
10	Do you see in your work that BIM improves management of project schedule milestones?					
11	Do you see in your work that BIM Improves construction design quality?					
12	Do you see in your work that BIM improves efficiencies from reusing the data (enter once use many)?					
13	Do you see in your work that BIM enhances energy efficiency and sustainability of the construction projects?					
14	Do you see in your work that BIM improves energy analysis of the construction projects?					
15	Do you see in your work that BIM reduces safety risks in construction projects?					
16	Do you see in your work that BIM reduces redesign issues?					
17	Do you see in your work that BIM reduces waste in construction projects?					
18	Do you see in your work that BIM decreases changes at the execution stage of construction projects?					
19	Do you see in your work that BIM helps in earlier and more accurate design visualization?					
20	Do you see in your work that BIM associates in generating accurate and compatible 2D drawings at any stage of construction projects?					
21	Do you see in your work that BIM improves site					

	analysis of construction projects?					
22	Do you see in your work that BIM improves communication between project stakeholders?					
23	Do you see in your work that BIM improves documents management of construction projects?					
24	Do you see in your work that BIM improves asset management of whole project life cycle?					
25	Do you see in your work that BIM enhances management of security and safety information of construction projects?					
26	Do you see in your work that BIM improves maintenance due to building automation system?					
27	Do you see in your work that BIM enhances team collaboration in construction projects?					
28	Do you see in your work that BIM improves human resources management in construction projects?					
29	Do you see in your work that BIM develops conflict detection in construction projects?					
30	Do you see in your work that BIM helps in increasing productivity due to easy recovery of information?					
31	Do you see in your work that BIM helps in predicting project time and cost?					
32	Do you see in your work that BIM improves coordination in the construction phase of construction projects?					
33	Do you see in your work that BIM enhances work coordination with subcontractors or suppliers in construction projects?					

34	Do you see in your work that BIM improves maintenance of construction projects due to the as-built model?					

Part 4: This section is to measure the level of **Knowledge** of BIM by the consultant engineering and contracting companies.
Please rate the following factors on an important scale of 1-5 where 1= Strongly agree, 2 = Agree, 3 = Somewhat agree, 4 = Disagree, 5 = Strongly disagree
Tick (X) in front of the number that reflects your point of view

No	Question:	Strongly Agree (1)	Agree (2)	Don't know (3)	Disagree (4)	Strongly Disagree (5)
1	Do you know in your work that BIM provides three-dimensional (3D) modeling and visualization of construction projects?					
2	Do you know in your work that BIM improves realization of the design idea by the owner via a 3D model of the building?					
3	Do you know in your work that BIM provides four dimensional (4D) visualized scheduling and simulation for construction sequence?					
4	Do you know in your work that BIM provides five-dimensional (5D) model -based cost estimation?					
5	Do you know in your work that BIM improves design quality of construction projects?					
6	Do you know in your work that BIM provides functional simulation for construction projects to choose the best solution?					
7	Do you know in your work that BIM promotes the safety planning and monitoring risk?					
8	Do you know in your work that BIM enhances energy optimization of the building?					
9	Do you know in your work that BIM improves emergency management of construction projects?					

Part 5: This section is to measure the level of **Ability** of using BIM by the consultant engineering and contracting companies.
Please rate the following factors on an important scale of 1-5 where 1= Strongly agree, 2 = Agree, 3 = Somewhat agree, 4 = Disagree, 5 = Strongly disagree
Tick (X) in front of the number that reflects your point of view

No	Question:	Strongly Agree (1)	Agree (2)	Don't know (3)	Disagree (4)	Strongly Disagree (5)
1	In your experience, applying BIM can bring benefits to engineering and contracting companies					
2	In your experience, applying BIM can bring benefits to construction projects					
3	In your experience, there is a low learning curve with those unfamiliar with BIM technology					
4	In your experience, there is a need for well-defined commercial business process models to build the project					
5	In your experience, there is a lack of clear boundary of responsibilities between parties if BIM is not used					
6	In your experience, there is a need to draft BIM specific contracts					
7	In your experience, there is enough skilled personnel to use BIM in construction projects					
8	In your experience, there is adequate information available to use BIM in construction projects					
9	In your experience, there is adequate support available to use BIM in construction projects					
10	In your experience, people accept to use BIM in construction projects					
11	In your experience, most construction projects are suitable to use BIM					

12	In your experience, most clients accept BIM if they know its benefits					
13	In your experience, most clients accept BIM even if it costs them more design fees					
14	In your experience, most clients accept BIM even if it costs them employing additional costs					
15	In your experience, most engineering and contracting companies accept BIM even if it costs them more in training existing staff					
16	In your experience, most engineering and contracting companies will accept BIM even if it costs them more in buying new software and updates					
17	In your experience, most engineering and contracting companies accept BIM even if it takes more time to produce the models					
18	In your experience, most engineering and contracting companies accept BIM even if it takes efforts to train existing staff					
19	In your experience, most engineering and contracting companies accept BIM even if it requires changing the culture towards fully collaborative working environment					
20	In your experience, most engineering and contracting companies accept BIM to improve the way of contracting documentation					

Part 6: This section is to measure the level of **Reinforcement** and sustainability of using BIM after the adoption process by the consultant engineering and contracting companies.
Please rate the following factors on an important scale of 1-5 where 1= Strongly agree, 2 = Agree, 3 = Somewhat agree, 4 = Disagree, 5 = Strongly disagree
Tick (X) in front of the number that reflects your point of view

No	Question:	Strongly Agree (1)	Agree (2)	Don't know (3)	Disagree (4)	Strongly Disagree (5)
1	Do you agree to using BIM technologies mandatory by the Engineers Association during design phase?					
2	Do you agree to using BIM technologies mandatory by contractors' union during execution phase?					
3	Do you agree to increase the trainings for BIM technologies by private or governmental sectors?					
4	Do you agree to refuse Engineers Association receiving and accepting all drawings not made using BIM?					
5	Do you agree with studying of BIM technologies mandatory at universities for undergraduate students?					
6	Do you agree and recommend implementing BIM within construction projects?					
7	Do you agree with the statement: "The biggest opportunity with construction technology is the BIM"?					

A.4 Appendix D الاستبيان

اعتماد البيم (نمذجة أنظمة معلومات البناء) في مشاريع البناء في الضفة الغربية باستخدام أدكار كنموذج تكاملي لإدارة التغيير.

الموضوع: استبيان حول "اعتماد البيم في مشاريع البناء في الضفة الغربية باستخدام أدكار كنموذج تكاملي لإدارة التغيير؛ هذه الاطروحة المقدمة هي جزء مهم لاستكمال متطلبات الحصول على درجة الماجستير في إدارة المشاريع الهندسية، الهندسة الإنشائية.

البيم هو مصطلح اختصاراً لنمذجة أنظمة معلومات البناء، بمعنى أن تعمل جميع تخصصات المكتب الهندسي بما فيها هندسة عمارة الأبنية، والإنشاءات، والكهرباء، والميكانيك على نفس النموذج المبني باستخدام عناصر مع معلوماتها الكاملة، أي يكون هنالك مكتبة عناصر نختار منها لبناء المشروع بعناصره، ومعلوماته المتكاملة بكل تخصصاته من مرحلة الفكرة الأولية للمشروع، وتمتد ما بعد التسليم، أي أنها تشمل مرحلة التنفيذ من قبل المنفذ الذي يكمل مخططاته التنفيذية، وجدوله الزمني، وحساب تكلفة المشروع وغيرها باستخدام نفس النموذج، أي أن جميع أطراف المشروع الإنشائي بما فيها المالك، والمصمم، والمنفذ يشتركون بنفس النموذج للوصول لنفس الهدف، وهو إنجاح المشروع، مما يقلل أخطاء تضارب معلومات المشروع، أو إعادة نفس الأنشطة، أو غيرها من الفوائد التي لا يمكن تحقيقها بالأنظمة التقليدية المتبعة حالياً.

هدف البحث: نشر فهم واضح لتكنولوجيا البيم، ومعالجة العوائق التي تعرقل شركات البناء لاتخاذ قرار العمل على نظام البيم من أجل بناء إطار لتنفيذها في مشاريع البناء في الضفة الغربية.

الفئة المستهدفة: المكاتب، والشركات الهندسية، وشركات المقاولات في الضفة الغربية.

الجزء الاول: معلومات عامة

1) الجنس

☐ ذكر ☐ أنثى

2) مستوى المؤهل العلمي

☐ دبلوم ☐ بكالوريوس ☐ ماجستير ☐ دكتوراه ☐ أخرى

3) مجال الدراسة

☐ هندسة معمارية ☐ هندسة مدنية ☐ هندسة كهربائية ☐ هندسة ميكانيكية ☐ أخرى

4) عدد سنوات الخبرة

☐ أقل من 5 سنوات ☐ من 5 – 10 سنوات ☐ من 10 – 15 سنة ☐ من 15 – 20 سنة ☐ أكثر من 20 سنة

5) المسمى الوظيفي

☐ مدير مشروع ☐ مهندس مصمم ☐ مهندس مشرف ☐ مهندس تخطيط مشاريع ☐ أخرى

6) حجم المؤسسة التي تعمل بها (عدد العاملين بالمؤسسة)

☐ أقل من 5 ☐ من 5 – 20 ☐ من 20 – 50 ☐ من 50 – 100 ☐ أكثر من 100

7) نوعية المشاريع التي تعمل بها

☐ مبانٍ سكنية ومبانٍ تجارية

☐ مشاريع هندسة التخطيط العمراني

☐ الهندسة المعمارية الداخلية أو مشاريع التصميم

☐ مشاريع التصميم الحضري ☐ مباني عامه او حكومية

8) هل سمعت عن تكنولوجيا البيم

☐ لا، لم أسمع عن تقنية البيم من قبل

☐ نعم، سمعت عن تقنية البيم ولكن لا أعرفها تماما جيدا

☐ نعم، لدي فكرة عن مفهوم تقنية البيم

☐ نعم، لدي مستوى عال من المعلومات حول تقنية البيم

☐ نعم، أنا أعرف ذلك جيدا وأنا استخدمه في عملي

9) هل حصلت على دورات تدريبية في مجال البيم

☐ نعم ☐ لا

الجزء الثاني: قياس الوعي

هذا الجزء سوف يقيس مستوى **الوعي** بتكنولوجيا البيم عند المكاتب، والشركات الهندسية، وشركات المقاولات. يرجى تقييم العوامل التالية على حسب أهمية الدرجة من 1−5 حيث:

1 = موافق وبشدة 2 = موافق 3= محايد 4 = معارض 5= موافق بشدة

اختر الاجابة التي تعكس وجهة نظرك

الاستفسار	1	2	3	4	5
هل تعتقد أن تكنولوجيا البيم ستدعم نجاح البيئة المستدامة وتساعد في الوصول الى تأثير إيجابي بالمشاريع الإنشائية	☐	☐	☐	☐	☐
تعتقد أن تكنولوجيا البيم سوف تساعد في تحسين تصميم البناء والحقل الإداري للمشاريع الإنشائية	☐	☐	☐	☐	☐
على حسب رأيك هنالك حاجة لاستخدام تكنولوجيا البيم في شركتك	☐	☐	☐	☐	☐
هل توافق أن البيم هو مستقبل إدارة المعلومات للمشاريع الإنشائية	☐	☐	☐	☐	☐
هل تعتقد أن المهندسين بفلسطين ليسوا بعد ملمين بما هو البيم فعلا	☐	☐	☐	☐	☐
هل تعتقد أن استخدام البيم يسمح للشركات أن تربح أعمالاً أكثر	☐	☐	☐	☐	☐
هل تعتقد أن تبني البيم كاملا سوف يقود إلى تحسين العمل الهندسي بالمشاريع الإنشائية	☐	☐	☐	☐	☐
هل أنت على وعي بالبيم ومنافعه	☐	☐	☐	☐	☐

الجزء الثالث: قياس الرغبة

هذا الجزء سوف يقيس مستوى **الرغبة** بتكنولوجيا البيم عند المكاتب، والشركات الهندسية، وشركات المقاولات. يرجى تقييم العوامل التالية على حسب أهمية الدرجة من 1−5 حيث:

1 = موافق وبشدة   2 = موافق   3= محايد   4 = معارض   5= موافق بشدة

اختر الاجابة التي تعكس وجهة نظرك

الاستفسار	1	2	3	4	5
البيم يحسن تقدير التكاليف في كل مراحل المشروع الإنشائي					
البيم يحسن الإنتاجية في حساب كميات المشروع الإنشائي					
البيم يسهل عملية حساب كميات المشروع الإنشائي					
البيم يقلل تكاليف الأمان والسلامة والعامة للمشاريع الإنشائية					
البيم يقلل تكلفة المشروع الإنشائي بصورة شاملة					
البيم يساهم بزيادة سرعة تسليم المشاريع الإنشائية					
البيم يقلل مدة المشروع الإنشائي بصورة شاملة					
البيم يحسن برنامج أعمال صيانة المشاريع الإنشائية					
البيم يدعم استخدام خاصية رباعي الأبعاد (دمج البعد الزمني الرابع للثلاثي الأبعاد) للمشاريع الإنشائية					
البيم يحسن إدارة جدولة مراحل المشروع الإنشائي					
البيم يحسن جودة تصميم المشاريع الإنشائية					
لبيم يحسن كفاءة إعادة استخدام بيانات المشروع الإنشائي (إدخال معلومة لنموذج المشروع مرة واستخدامها مرات)					
البيم يحسن فعالية الطاقة والديمومة للمشاريع الإنشائية					
البيم يحسن تحليل الطاقة للمشاريع الإنشائية					
البيم يقلل مخاطر السلامة العامة للمشاريع الإنشائية					
البيم يقلل مشكلات إعادة تصميم المشاريع الإنشائية					
البيم يقلل هدر مصادر المكاتب والشركات الهندسية والمقاولات					
البيم يقلل التعديلات في مرحلة تنفيذ المشروع الإنشائي					
البيم يساهم برؤية التصميم التصوري للمشروع الإنشائي بشكل أدق وأسرع					
يم يدعم إخراج مخططات ثنائية الأبعاد بشكل دقيق ومطابق في أي مرحلة من مراحل المشروع					
البيم يحسن تحليل موقع المشروع الإنشائي					
البيم يحسن الاتصال بين أطراف المشروع الإنشائي					

البيم يحسن إدارة مستندات المشروع الإنشائي	☐	☐	☐	☐	☐
البيم يحسن إدارة أصول المشروع الإنشائي طيلة فترة حياته	☐	☐	☐	☐	☐
البيم يحسن الإدارة في أمن وأمان معلومات المشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحسن أعمال صيانة المشاريع الإنشائية بفضل نظام أتمتة البناء	☐	☐	☐	☐	☐
البيم يحفز التعاون بين فريق العمل	☐	☐	☐	☐	☐
البيم يحسن إدارة الموارد البشرية للمشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحسن اكتشاف التضارب بالمخططات الهندسية للمشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يساهم بانتاجية عالية للمشاريع الإنشائية بفضل سهولة استرجاع المعلومات	☐	☐	☐	☐	☐
البيم يساعد على التنبؤ بوقت وتكلفة المشروع الإنشائي	☐	☐	☐	☐	☐
البيم يحسن التنسيق في مراحل بناء المشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحفز تنسيق العمل مع مقاولي الباطن والموردين للمشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحسن أعمال الصيانة للمشروع الإنشائي بفضل النموذج المبني حسب الواقع	☐	☐	☐	☐	☐

الجزء الرابع: قياس المعرفة

هذا الجزء سوف يقيس مستوى **المعرفة** بتكنولوجيا البيم عند المكاتب، والشركات الهندسية، وشركات المقاولات. يرجى تقييم العوامل التالية على حسب أهمية الدرجة من 1−5 حيث:

1 = موافق وبشدة   2 = موافق   3= محايد   4 = معارض   5= موافق بشدة

اختر الاجابة التي تعكس وجهة نظرك

الاستفسار	**1**	**2**	**3**	**4**	**5**
م يزود نموذج وتصور ثلاثي الأبعاد للمشروع الإنشائي	☐	☐	☐	☐	☐
بيم يحسن تحقيق فكرة تصميم المشروع الإنشائي من قبل المالك بمساعدة التصميم ثلاثي الأبعاد للبناء	☐	☐	☐	☐	☐
بيم يزود تصور جدول زمني متسلسل بمراحل بناء المشروع (محاكاة زمنية لمراحل المشروع) بخاصية رباعي الأبعاد	☐	☐	☐	☐	☐
يم يزود نموذج خماسي الأبعاد عند ربط زمن وتكلفة المشروع الإنشائي مع النموذج ثلاثي الأبعاد	☐	☐	☐	☐	☐
البيم يحسن جودة تصميم المشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يزود محاكاة وظيفية للمشاريع الإنشائية لاختيار افضل حل	☐	☐	☐	☐	☐
البيم يحث على تخطيط السلامة ورصد المخاطر للمشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحفز تحسين طاقة البناء المثلى للمشاريع الإنشائية	☐	☐	☐	☐	☐
البيم يحسن إدارة الطوارىء للمشاريع الإنشائية	☐	☐	☐	☐	☐

الجزء الخامس: قياس القدرة

هذا الجزء سوف يقيس مستوى **القدرة** على تطبيق تكنولوجيا البيم عند المكاتب، والشركات الهندسية، وشركات المقاولات.

يرجى تقييم العوامل التالية على حسب أهمية الدرجة من 1–5 حيث:

1 = موافق وبشدة 2 = موافق 3= محايد 4 = معارض 5= موافق بشدة

اختر الاجابة التي تعكس وجهة نظرك

الاستفسار	1	2	3	4	5
القدرة على تطبيق البيم يمكن أن يجلب فوائد إلى المكاتب والشركات الهندسية والمقاولات	☐	☐	☐	☐	☐
القدرة على تطبيق البيم يمكن أن يجلب فوائد إلى المشروع الإنشائي	☐	☐	☐	☐	☐
هنالك انحدار في منحنى التعلم مع هؤلاء غير الملمين بتكنولوجيا المشاريع الإنشائية	☐	☐	☐	☐	☐
هنالك حاجة إلى معرفة جيدة بنماذج عمل تجارية لبناء المشروع الإنشائي	☐	☐	☐	☐	☐
الك نقص بوضوح حدود المسؤولية بين الأطراف في حال عدم استخدام البيم بالمشاريع الإنشائية	☐	☐	☐	☐	☐
هنالك حاجة إلى صياغة عقود بيم محددة	☐	☐	☐	☐	☐
هنالك مهارة كافية للموظفين لاستخدام البيم للمشاريع الإنشائية	☐	☐	☐	☐	☐
هنالك معلومات كافية متاحة للتزويد بتطبيق البيم للمشاريع الإنشائية من حيث الاستخدام	☐	☐	☐	☐	☐
هنالك دعم متاح كافي للتزويد بتطبيق البيم للمشاريع الإنشائية من حيث الاستخدام	☐	☐	☐	☐	☐
هنالك قبول من قبل الأشخاص لاستخدام البيم في المشاريع الإنشائية	☐	☐	☐	☐	☐
استخدام البيم ملائم لمعظم المشاريع الإنشائية	☐	☐	☐	☐	☐
هنالك قبول لملاك المشاريع الإنشائية تبني البيم بسبب وعيهم بفوائده مما يزيد الاستخدام	☐	☐	☐	☐	☐
لك قبول لملاك المشاريع الإنشائية تبني البيم حتى مع التكلفة العالية للتصميم مما يزيد الاستخدام	☐	☐	☐	☐	☐
هنالك قبول لملاك المشاريع الإنشائية تبني البيم حتى مع توظيف تكاليف إضافية	☐	☐	☐	☐	☐
الك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع تكلفة تدريب الطاقم الموجود	☐	☐	☐	☐	☐
هنالك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع تكلفة برمجيات جديدة وتحديثات للاستخدام	☐	☐	☐	☐	☐
نالك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع طول الوقت لإنتاج نموذج البيم	☐	☐	☐	☐	☐
نالك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع طول الوقت اللازم لتدريب الفريق الموجود	☐	☐	☐	☐	☐
هنالك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع تغيير الثقافة نحو العمل التعاوني	☐	☐	☐	☐	☐
هنالك قبول للمكاتب والشركات الهندسية والمقاولات تبني البيم حتى مع النقص في وجود وثائق تعاقدية	☐	☐	☐	☐	☐

الجزء السادس: قياس التمكين

هذا الجزء سوف يقيس مستوى **تمكين**، وتعزيز، وديمومة الأفكار المطروحة للحفاظ على تكنولوجيا البيم مع الوقت بعد تبنيه لدى المكاتب، والشركات الهندسية، وشركات المقاولات. يرجى تقييم العوامل التالية على حسب أهمية الدرجة من 1−5 حيث:

1 = موافق وبشدة   2 = موافق   3= محايد   4 = معارض   5= موافق بشدة

اختر الاجابة التي تعكس وجهة نظرك

الاستفسار	1	2	3	4	5
توافق على إلزام استخدام تكنولوجيات البيم من قبل نقابة المهندسين خلال مرحلة تصميم اريع الإنشائية	☐	☐	☐	☐	☐
توافق على إلزام استخدام تكنولوجيات البيم من قبل اتحاد المقاولين خلال مرحلة تنفيذ المشاريع الإنشائية	☐	☐	☐	☐	☐
هل توافق على تزويد التدريبات لتكنولوجيا البيم بالمشاريع الإنشائية من قبل شركات ومكاتب خاصة أو حكومية	☐	☐	☐	☐	☐
توافق على رفض نقابة المهندسين قبول أية رسومات غير معمولة باستخدام برمجيات البيم للمشاريع الإنشائية	☐	☐	☐	☐	☐
ل توافق على جعل دراسة تكنولوجيات البيم إلزامية في الجامعات لدراسة الطلاب في المرحلة الجامعية	☐	☐	☐	☐	☐
هل توافق وتوصي على تنفيذ البيم ضمن المشاريع الإنشائية	☐	☐	☐	☐	☐
ل توافق مع المقولة "الفرصة الأكبر لتكنولوجيا إنشاءات المباني هي تكنولوجيا البيم"	☐	☐	☐	☐	☐

A.5 L.S.D Results:

The First Dimension: The Level of Awareness of BIM

Multiple Comparisons					
LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
a1	Civil	Architect	-.210	.148	.157
		Mechanic or Electric	.928*	.153	.000
	Architect	Civil	.210	.148	.157
		Mechanic or Electric	1.139*	.165	.000
	Mechanic or Electric	Civil	-.928*	.153	.000
		Architect	-1.139*	.165	.000
a2	Civil	Architect	-.096	.152	.531
		Mechanic or Electric	.986*	.157	.000
	Architect	Civil	.096	.152	.531
		Mechanic or Electric	1.081*	.170	.000
	Mechanic or Electric	Civil	-.986*	.157	.000
		Architect	-1.081*	.170	.000
a3	Civil	Architect	-.152	.164	.356
		Mechanic or Electric	.902*	.169	.000
	Architect	Civil	.152	.164	.356
		Mechanic or Electric	1.054*	.183	.000
	Mechanic or Electric	Civil	-.902*	.169	.000
		Architect	-1.054*	.183	.000
a4	Civil	Architect	-.185	.165	.263
		Mechanic or Electric	.918*	.171	.000
	Architect	Civil	.185	.165	.263
		Mechanic or Electric	1.103*	.184	.000
	Mechanic or Electric	Civil	-.918*	.171	.000
		Architect	-1.103*	.184	.000
a5	Civil	Architect	.005	.169	.979

Multiple Comparisons				
LSD				
Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
a1	Civil	Architect	-.50	.08
		Mechanic or Electric	.63*	1.23
	Architect	Civil	-.08	.50
		Mechanic or Electric	.81*	1.46
	Mechanic or Electric	Civil	-1.23*	-.63
		Architect	-1.46*	-.81
a2	Civil	Architect	-.40	.20
		Mechanic or Electric	.68*	1.30
	Architect	Civil	-.20	.40
		Mechanic or Electric	.75*	1.42
	Mechanic or Electric	Civil	-1.30*	-.68
		Architect	-1.42*	-.75
a3	Civil	Architect	-.47	.17
		Mechanic or Electric	.57*	1.24
	Architect	Civil	-.17	.47
		Mechanic or Electric	.69*	1.41

	Mechanic or Electric	Civil	-1.24*	-.57
		Architect	-1.41*	-.69
a4	Civil	Architect	-.51	.14
		Mechanic or Electric	.58*	1.25
	Architect	Civil	-.14	.51
		Mechanic or Electric	.74*	1.47
	Mechanic or Electric	Civil	-1.25*	-.58
		Architect	-1.47*	-.74
a5	Civil	Architect	-.33	.34

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
a5	Civil	Mechanic or Electric	.880	.174	.000
	Architect	Civil	-.005*	.169	.979
		Mechanic or Electric	.875	.188	.000
	Mechanic or Electric	Civil	-.880*	.174	.000
		Architect	-.875*	.188	.000
a6	Civil	Architect	-.192*	.159	.229
		Mechanic or Electric	.838	.164	.000
	Architect	Civil	.192*	.159	.229
		Mechanic or Electric	1.030	.177	.000
	Mechanic or Electric	Civil	-.838*	.164	.000
		Architect	-1.030*	.177	.000
a7	Civil	Architect	-.250*	.159	.118
		Mechanic or Electric	.946	.165	.000
	Architect	Civil	.250*	.159	.118
		Mechanic or Electric	1.196	.178	.000
	Mechanic or Electric	Civil	-.946*	.165	.000
		Architect	-1.196*	.178	.000
a8	Civil	Architect	-.158*	.178	.375
		Mechanic or Electric	1.090	.183	.000
	Architect	Civil	.158*	.178	.375
		Mechanic or Electric	1.248	.198	.000
	Mechanic or Electric	Civil	-1.090*	.183	.000
		Architect	-1.248*	.198	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
a5	Civil	Mechanic or Electric	.54	1.22
	Architect	Civil	-.34*	.33
		Mechanic or Electric	.50	1.25
	Mechanic or Electric	Civil	-1.22*	-.54
		Architect	-1.25*	-.50
a6	Civil	Architect	-.51*	.12
		Mechanic or Electric	.51	1.16
	Architect	Civil	-.12*	.51
		Mechanic or Electric	.68	1.38
	Mechanic or Electric	Civil	-1.16*	-.51
		Architect	-1.38*	-.68

a7	Civil	Architect	-.56[*]	.06
		Mechanic or Electric	.62	1.27
	Architect	Civil	-.06[*]	.56
		Mechanic or Electric	.85	1.55
	Mechanic or Electric	Civil	-1.27[*]	-.62
		Architect	-1.55[*]	-.85
a8	Civil	Architect	-.51[*]	.19
		Mechanic or Electric	.73	1.45
	Architect	Civil	-.19[*]	.51
		Mechanic or Electric	.86	1.64
	Mechanic or Electric	Civil	-1.45[*]	-.73
		Architect	-1.64[*]	-.86

*. The mean difference is significant at the 0.05 level.

The Second Dimension: The Level of Desire of BIM

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b1	Civil	Architect	-.096	.140	.496
		Mechanic or Electric	.953[*]	.145	.000
	Architect	Civil	.096	.140	.496
		Mechanic or Electric	1.049[*]	.156	.000
	Mechanic or Electric	Civil	-.953[*]	.145	.000
		Architect	-1.049[*]	.156	.000
b2	Civil	Architect	-.100	.156	.521
		Mechanic or Electric	1.013[*]	.161	.000
	Architect	Civil	.100	.156	.521
		Mechanic or Electric	1.113[*]	.173	.000
	Mechanic or Electric	Civil	-1.013[*]	.161	.000
		Architect	-1.113[*]	.173	.000
b3	Civil	Architect	-.119	.153	.437
		Mechanic or Electric	1.023[*]	.158	.000
	Architect	Civil	.119	.153	.437
		Mechanic or Electric	1.142[*]	.170	.000
	Mechanic or Electric	Civil	-1.023[*]	.158	.000
		Architect	-1.142[*]	.170	.000
b4	Civil	Architect	-.393[*]	.159	.014
		Mechanic or Electric	.556[*]	.165	.001
	Architect	Civil	.393[*]	.159	.014
		Mechanic or Electric	.950[*]	.178	.000
	Mechanic or Electric	Civil	-.556[*]	.165	.001
		Architect	-.950[*]	.178	.000
b5	Civil	Architect	-.268	.159	.093

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b1	Civil	Architect	-.37	.18
		Mechanic or Electric	.67*	1.24
	Architect	Civil	-.18	.37
		Mechanic or Electric	.74*	1.36
	Mechanic or Electric	Civil	-1.24*	-.67
		Architect	-1.36*	-.74
b2	Civil	Architect	-.41	.21
		Mechanic or Electric	.70*	1.33
	Architect	Civil	-.21	.41
		Mechanic or Electric	.77*	1.45
	Mechanic or Electric	Civil	-1.33*	-.70
		Architect	-1.45*	-.77
b3	Civil	Architect	-.42	.18
		Mechanic or Electric	.71*	1.33
	Architect	Civil	-.18	.42
		Mechanic or Electric	.81*	1.48
	Mechanic or Electric	Civil	-1.33*	-.71
		Architect	-1.48*	-.81
b4	Civil	Architect	-.71*	-.08
		Mechanic or Electric	.23*	.88
	Architect	Civil	.08*	.71
		Mechanic or Electric	.60*	1.30
	Mechanic or Electric	Civil	-.88*	-.23
		Architect	-1.30*	-.60
b5	Civil	Architect	-.58	.04

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b5	Civil	Mechanic or Electric	.694	.164	.000
	Architect	Civil	.268*	.159	.093
		Mechanic or Electric	.963	.177	.000
	Mechanic or Electric	Civil	-.694*	.164	.000
		Architect	-.963*	.177	.000
b6	Civil	Architect	-.119*	.164	.468
		Mechanic or Electric	.927	.170	.000
	Architect	Civil	.119*	.164	.468
		Mechanic or Electric	1.046	.183	.000
	Mechanic or Electric	Civil	-.927*	.170	.000
		Architect	-1.046*	.183	.000
b7	Civil	Architect	-.103*	.164	.528
		Mechanic or Electric	.773	.169	.000
	Architect	Civil	.103*	.164	.528
		Mechanic or Electric	.876	.182	.000
	Mechanic or Electric	Civil	-.773*	.169	.000
		Architect	-.876*	.182	.000
b8	Civil	Architect	-.190*	.157	.229
		Mechanic or Electric	.890*	.163	.000
	Architect	Civil	.190*	.157	.229

		Mechanic or Electric	1.080*	.175	.000
	Mechanic or Electric	Civil	-.890*	.163	.000
		Architect	-1.080*	.175	.000
b9	Civil	Architect	-.370*	.150	.014
		Mechanic or Electric	.807	.155	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b5	Civil	Mechanic or Electric	.37	1.02
	Architect	Civil	-.04*	.58
		Mechanic or Electric	.61	1.31
	Mechanic or Electric	Civil	-1.02*	-.37
		Architect	-1.31*	-.61
b6	Civil	Architect	-.44*	.20
		Mechanic or Electric	.59	1.26
	Architect	Civil	-.20*	.44
		Mechanic or Electric	.69	1.41
	Mechanic or Electric	Civil	-1.26*	-.59
		Architect	-1.41*	-.69
b7	Civil	Architect	-.43*	.22
		Mechanic or Electric	.44	1.11
	Architect	Civil	-.22*	.43
		Mechanic or Electric	.52	1.24
	Mechanic or Electric	Civil	-1.11*	-.44
		Architect	-1.24*	-.52
b8	Civil	Architect	-.50*	.12
		Mechanic or Electric	.57*	1.21
	Architect	Civil	-.12*	.50
		Mechanic or Electric	.73*	1.43
	Mechanic or Electric	Civil	-1.21*	-.57
		Architect	-1.43*	-.73
b9	Civil	Architect	-.66*	-.07
		Mechanic or Electric	.50	1.11

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b9	Architect	Civil	.370	.150	.014
		Mechanic or Electric	1.177*	.167	.000
	Mechanic or Electric	Civil	-.807	.155	.000
		Architect	-1.177*	.167	.000
b10	Civil	Architect	-.141*	.148	.342
		Mechanic or Electric	.934*	.153	.000
	Architect	Civil	.141	.148	.342
		Mechanic or Electric	1.075*	.165	.000
	Mechanic or Electric	Civil	-.934	.153	.000
		Architect	-1.075*	.165	.000
b11	Civil	Architect	-.281*	.157	.074
		Mechanic or Electric	.796*	.162	.000
	Architect	Civil	.281	.157	.074
		Mechanic or Electric	1.077*	.175	.000

	Mechanic or Electric	Civil	-.796	.162	.000
		Architect	-1.077*	.175	.000
b12	Civil	Architect	.004*	.149	.976
		Mechanic or Electric	1.055*	.154	.000
	Architect	Civil	-.004*	.149	.976
		Mechanic or Electric	1.051*	.166	.000
	Mechanic or Electric	Civil	-1.055*	.154	.000
		Architect	-1.051*	.166	.000
b13	Civil	Architect	-.242*	.156	.123
		Mechanic or Electric	.752*	.161	.000
	Architect	Civil	.242	.156	.123

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b9	Architect	Civil	.07	.66
		Mechanic or Electric	.85*	1.51
	Mechanic or Electric	Civil	-1.11	-.50
		Architect	-1.51*	-.85
b10	Civil	Architect	-.43*	.15
		Mechanic or Electric	.63*	1.24
	Architect	Civil	-.15	.43
		Mechanic or Electric	.75*	1.40
	Mechanic or Electric	Civil	-1.24	-.63
		Architect	-1.40*	-.75
b11	Civil	Architect	-.59*	.03
		Mechanic or Electric	.48*	1.11
	Architect	Civil	-.03	.59
		Mechanic or Electric	.73*	1.42
	Mechanic or Electric	Civil	-1.11	-.48
		Architect	-1.42*	-.73
b12	Civil	Architect	-.29*	.30
		Mechanic or Electric	.75*	1.36
	Architect	Civil	-.30*	.29
		Mechanic or Electric	.72*	1.38
	Mechanic or Electric	Civil	-1.36*	-.75
		Architect	-1.38*	-.72
b13	Civil	Architect	-.55*	.07
		Mechanic or Electric	.43*	1.07
	Architect	Civil	-.07	.55

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b13	Architect	Mechanic or Electric	.994	.174	.000
	Mechanic or Electric	Civil	-.752*	.161	.000
		Architect	-.994	.174	.000
b14	Civil	Architect	-.217*	.152	.156
		Mechanic or Electric	.779*	.157	.000
	Architect	Civil	.217*	.152	.156
		Mechanic or Electric	.995	.170	.000
	Mechanic or Electric	Civil	-.779*	.157	.000
		Architect	-.995	.170	.000

b15	Civil	Architect	-.142*	.160	.375
		Mechanic or Electric	.571*	.165	.001
	Architect	Civil	.142*	.160	.375
		Mechanic or Electric	.713	.178	.000
	Mechanic or Electric	Civil	-.571*	.165	.001
		Architect	-.713	.178	.000
b16	Civil	Architect	-.131*	.154	.395
		Mechanic or Electric	.825*	.159	.000
	Architect	Civil	.131*	.154	.395
		Mechanic or Electric	.956*	.171	.000
	Mechanic or Electric	Civil	-.825*	.159	.000
		Architect	-.956*	.171	.000
b17	Civil	Architect	-.131*	.151	.386
		Mechanic or Electric	.907*	.156	.000
	Architect	Civil	.131*	.151	.386
		Mechanic or Electric	1.038	.168	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b13	Architect	Mechanic or Electric	.65	1.34
	Mechanic or Electric	Civil	-1.07*	-.43
		Architect	-1.34	-.65
b14	Civil	Architect	-.52*	.08
		Mechanic or Electric	.47*	1.09
	Architect	Civil	-.08*	.52
		Mechanic or Electric	.66	1.33
	Mechanic or Electric	Civil	-1.09*	-.47
		Architect	-1.33	-.66
b15	Civil	Architect	-.46*	.17
		Mechanic or Electric	.25*	.90
	Architect	Civil	-.17*	.46
		Mechanic or Electric	.36	1.06
	Mechanic or Electric	Civil	-.90*	-.25
		Architect	-1.06	-.36
b16	Civil	Architect	-.43*	.17
		Mechanic or Electric	.51*	1.14
	Architect	Civil	-.17*	.43
		Mechanic or Electric	.62*	1.29
	Mechanic or Electric	Civil	-1.14*	-.51
		Architect	-1.29*	-.62
b17	Civil	Architect	-.43*	.17
		Mechanic or Electric	.60*	1.21
	Architect	Civil	-.17*	.43
		Mechanic or Electric	.71	1.37

Multiple Comparisons

LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b17	Mechanic or Electric	Civil	-.907	.156	.000
		Architect	-1.038*	.168	.000
b18	Civil	Architect	-.100	.159	.529
		Mechanic or Electric	.910*	.164	.000
	Architect	Civil	.100*	.159	.529
		Mechanic or Electric	1.010*	.177	.000
	Mechanic or Electric	Civil	-.910	.164	.000
		Architect	-1.010*	.177	.000
b19	Civil	Architect	-.018	.160	.913
		Mechanic or Electric	.992*	.165	.000
	Architect	Civil	.018*	.160	.913
		Mechanic or Electric	1.010*	.178	.000
	Mechanic or Electric	Civil	-.992	.165	.000
		Architect	-1.010*	.178	.000
b20	Civil	Architect	-.101	.148	.494
		Mechanic or Electric	.949*	.153	.000
	Architect	Civil	.101*	.148	.494
		Mechanic or Electric	1.050*	.165	.000
	Mechanic or Electric	Civil	-.949*	.153	.000
		Architect	-1.050*	.165	.000
b21	Civil	Architect	-.122*	.146	.403
		Mechanic or Electric	.973*	.151	.000
	Architect	Civil	.122*	.146	.403
		Mechanic or Electric	1.095*	.163	.000
	Mechanic or Electric	Civil	-.973	.151	.000
		Architect	-1.095*	.163	.000

Multiple Comparisons

LSD				
Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b17	Mechanic or Electric	Civil	-1.21	-.60
		Architect	-1.37*	-.71
b18	Civil	Architect	-.41	.21
		Mechanic or Electric	.59*	1.23
	Architect	Civil	-.21*	.41
		Mechanic or Electric	.66*	1.36
	Mechanic or Electric	Civil	-1.23	-.59
		Architect	-1.36*	-.66
b19	Civil	Architect	-.33	.30
		Mechanic or Electric	.67*	1.32
	Architect	Civil	-.30*	.33
		Mechanic or Electric	.66*	1.36
	Mechanic or Electric	Civil	-1.32	-.67
		Architect	-1.36*	-.66
b20	Civil	Architect	-.39	.19
		Mechanic or Electric	.65*	1.25
	Architect	Civil	-.19*	.39
		Mechanic or Electric	.73*	1.38
	Mechanic or Electric	Civil	-1.25*	-.65
		Architect	-1.38*	-.73
b21	Civil	Architect	-.41*	.17

		Mechanic or Electric	.68*	1.27
	Architect	Civil	-.17*	.41
		Mechanic or Electric	.77*	1.42
	Mechanic or Electric	Civil	-1.27	-.68
		Architect	-1.42*	-.77

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b22	Civil	Architect	-.215	.153	.161
		Mechanic or Electric	.901*	.158	.000
	Architect	Civil	.215	.153	.161
		Mechanic or Electric	1.116*	.170	.000
	Mechanic or Electric	Civil	-.901*	.158	.000
		Architect	-1.116*	.170	.000
b23	Civil	Architect	-.158	.151	.298
		Mechanic or Electric	.936*	.156	.000
	Architect	Civil	.158	.151	.298
		Mechanic or Electric	1.093*	.168	.000
	Mechanic or Electric	Civil	-.936*	.156	.000
		Architect	-1.093*	.168	.000
b24	Civil	Architect	-.255	.152	.095
		Mechanic or Electric	.886*	.157	.000
	Architect	Civil	.255	.152	.095
		Mechanic or Electric	1.141*	.169	.000
	Mechanic or Electric	Civil	-.886*	.157	.000
		Architect	-1.141*	.169	.000
b25	Civil	Architect	-.139*	.157	.378
		Mechanic or Electric	.855*	.162	.000
	Architect	Civil	.139*	.157	.378
		Mechanic or Electric	.994*	.175	.000
	Mechanic or Electric	Civil	-.855*	.162	.000
		Architect	-.994*	.175	.000
b26	Civil	Architect	-.243	.154	.116

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b22	Civil	Architect	-.52	.09
		Mechanic or Electric	.59*	1.21
	Architect	Civil	-.09	.52
		Mechanic or Electric	.78*	1.45
	Mechanic or Electric	Civil	-1.21*	-.59
		Architect	-1.45*	-.78
b23	Civil	Architect	-.46	.14
		Mechanic or Electric	.63*	1.24
	Architect	Civil	-.14	.46
		Mechanic or Electric	.76*	1.43
	Mechanic or Electric	Civil	-1.24*	-.63
		Architect	-1.43*	-.76
b24	Civil	Architect	-.55	.04

		Mechanic or Electric	.58*	1.20
	Architect	Civil	-.04	.55
		Mechanic or Electric	.81*	1.47
	Mechanic or Electric	Civil	-1.20*	-.58
		Architect	-1.47*	-.81
b25	Civil	Architect	-.45*	.17
		Mechanic or Electric	.54*	1.17
	Architect	Civil	-.17*	.45
		Mechanic or Electric	.65*	1.34
	Mechanic or Electric	Civil	-1.17*	-.54
		Architect	-1.34*	-.65
b26	Civil	Architect	-.55	.06

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b26	Civil	Mechanic or Electric	.709	.159	.000
	Architect	Civil	.243*	.154	.116
		Mechanic or Electric	.953	.172	.000
	Mechanic or Electric	Civil	-.709*	.159	.000
		Architect	-.953*	.172	.000
b27	Civil	Architect	-.106*	.157	.500
		Mechanic or Electric	.987	.162	.000
	Architect	Civil	.106*	.157	.500
		Mechanic or Electric	1.093	.175	.000
	Mechanic or Electric	Civil	-.987*	.162	.000
		Architect	-1.093*	.175	.000
b28	Civil	Architect	-.202*	.155	.194
		Mechanic or Electric	.784	.160	.000
	Architect	Civil	.202*	.155	.194
		Mechanic or Electric	.985	.173	.000
	Mechanic or Electric	Civil	-.784*	.160	.000
		Architect	-.985*	.173	.000
b29	Civil	Architect	-.178*	.158	.261
		Mechanic or Electric	1.023*	.163	.000
	Architect	Civil	.178*	.158	.261
		Mechanic or Electric	1.201*	.176	.000
	Mechanic or Electric	Civil	-1.023*	.163	.000
		Architect	-1.201*	.176	.000
b30	Civil	Architect	-.125*	.155	.422
		Mechanic or Electric	.948	.161	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b26	Civil	Mechanic or Electric	.40	1.02
	Architect	Civil	-.06*	.55
		Mechanic or Electric	.61	1.29
	Mechanic or Electric	Civil	-1.02*	-.40
		Architect	-1.29*	-.61
b27	Civil	Architect	-.42*	.20
		Mechanic or Electric	.67	1.31
	Architect	Civil	-.20*	.42
		Mechanic or Electric	.75	1.44
	Mechanic or Electric	Civil	-1.31*	-.67
		Architect	-1.44*	-.75
b28	Civil	Architect	-.51*	.10
		Mechanic or Electric	.47	1.10
	Architect	Civil	-.10*	.51
		Mechanic or Electric	.65	1.33
	Mechanic or Electric	Civil	-1.10*	-.47
		Architect	-1.33*	-.65
b29	Civil	Architect	-.49*	.13
		Mechanic or Electric	.70*	1.34
	Architect	Civil	-.13*	.49
		Mechanic or Electric	.85*	1.55
	Mechanic or Electric	Civil	-1.34*	-.70
		Architect	-1.55*	-.85
b30	Civil	Architect	-.43*	.18
		Mechanic or Electric	.63	1.26

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b30	Architect	Civil	.125	.155	.422
		Mechanic or Electric	1.074*	.173	.000
	Mechanic or Electric	Civil	-.948	.161	.000
		Architect	-1.074*	.173	.000
b31	Civil	Architect	-.156*	.155	.316
		Mechanic or Electric	.934*	.160	.000
	Architect	Civil	.156	.155	.316
		Mechanic or Electric	1.090*	.173	.000
	Mechanic or Electric	Civil	-.934	.160	.000
		Architect	-1.090*	.173	.000
b32	Civil	Architect	-.093*	.146	.526
		Mechanic or Electric	.978*	.151	.000
	Architect	Civil	.093	.146	.526
		Mechanic or Electric	1.070*	.162	.000
	Mechanic or Electric	Civil	-.978	.151	.000
		Architect	-1.070*	.162	.000
b33	Civil	Architect	-.165*	.153	.282
		Mechanic or Electric	.884*	.158	.000
	Architect	Civil	.165*	.153	.282
		Mechanic or Electric	1.049*	.170	.000

	Mechanic or Electric	Civil	-.884*	.158	.000
		Architect	-1.049*	.170	.000
b34	Civil	Architect	-.171*	.149	.254
		Mechanic or Electric	.831*	.154	.000
	Architect	Civil	.171	.149	.254

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b30	Architect	Civil	-.18	.43
		Mechanic or Electric	.73*	1.42
	Mechanic or Electric	Civil	-1.26	-.63
		Architect	-1.42*	-.73
b31	Civil	Architect	-.46*	.15
		Mechanic or Electric	.62*	1.25
	Architect	Civil	-.15	.46
		Mechanic or Electric	.75*	1.43
	Mechanic or Electric	Civil	-1.25	-.62
		Architect	-1.43*	-.75
b32	Civil	Architect	-.38*	.19
		Mechanic or Electric	.68*	1.27
	Architect	Civil	-.19	.38
		Mechanic or Electric	.75*	1.39
	Mechanic or Electric	Civil	-1.27	-.68
		Architect	-1.39*	-.75
b33	Civil	Architect	-.47*	.14
		Mechanic or Electric	.57*	1.20
	Architect	Civil	-.14*	.47
		Mechanic or Electric	.71*	1.38
	Mechanic or Electric	Civil	-1.20*	-.57
		Architect	-1.38*	-.71
b34	Civil	Architect	-.47*	.12
		Mechanic or Electric	.53*	1.13
	Architect	Civil	-.12	.47

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
b34	Architect	Mechanic or Electric	1.002	.166	.000
	Mechanic or Electric	Civil	-.831*	.154	.000
		Architect	-1.002	.166	.000

Multiple Comparisons				
LSD				
Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
b34	Architect	Mechanic or Electric	.67	1.33
	Mechanic or Electric	Civil	-1.13*	-.53
		Architect	-1.33	-.67

*. The mean difference is significant at the 0.05 level.

The Third Dimension: The Level of Knowledge of BIM

Multiple Comparisons					
LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
c1	Civil	Architect	-.034	.144	.816
		Mechanic or Electric	1.130*	.149	.000
	Architect	Civil	.034	.144	.816
		Mechanic or Electric	1.163*	.161	.000
	Mechanic or Electric	Civil	-1.130*	.149	.000
		Architect	-1.163*	.161	.000
c2	Civil	Architect	-.075	.145	.606
		Mechanic or Electric	1.105*	.150	.000
	Architect	Civil	.075	.145	.606
		Mechanic or Electric	1.180*	.161	.000
	Mechanic or Electric	Civil	-1.105*	.150	.000
		Architect	-1.180*	.161	.000
c3	Civil	Architect	-.106	.147	.473
		Mechanic or Electric	.955*	.152	.000
	Architect	Civil	.106	.147	.473
		Mechanic or Electric	1.061*	.164	.000
	Mechanic or Electric	Civil	-.955*	.152	.000
		Architect	-1.061*	.164	.000
c4	Civil	Architect	-.248	.147	.094
		Mechanic or Electric	.731*	.152	.000
	Architect	Civil	.248	.147	.094
		Mechanic or Electric	.979*	.164	.000
	Mechanic or Electric	Civil	-.731*	.152	.000
		Architect	-.979*	.164	.000
c5	Civil	Architect	-.034	.156	.828

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
c1	Civil	Architect	-.32	.25
		Mechanic or Electric	.84*	1.42
	Architect	Civil	-.25	.32
		Mechanic or Electric	.85*	1.48
	Mechanic or Electric	Civil	-1.42*	-.84
		Architect	-1.48*	-.85
c2	Civil	Architect	-.36	.21
		Mechanic or Electric	.81*	1.40
	Architect	Civil	-.21	.36
		Mechanic or Electric	.86*	1.50
	Mechanic or Electric	Civil	-1.40*	-.81
		Architect	-1.50*	-.86
c3	Civil	Architect	-.40	.18
		Mechanic or Electric	.65*	1.25
	Architect	Civil	-.18	.40
		Mechanic or Electric	.74*	1.38
	Mechanic or Electric	Civil	-1.25*	-.65
		Architect	-1.38*	-.74
c4	Civil	Architect	-.54	.04
		Mechanic or Electric	.43*	1.03
	Architect	Civil	-.04	.54
		Mechanic or Electric	.66*	1.30
	Mechanic or Electric	Civil	-1.03*	-.43
		Architect	-1.30*	-.66
c5	Civil	Architect	-.34	.27

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
c5	Civil	Mechanic or Electric	.842	.161	.000
	Architect	Civil	.034*	.156	.828
		Mechanic or Electric	.876	.174	.000
	Mechanic or Electric	Civil	-.842*	.161	.000
		Architect	-.876*	.174	.000
c6	Civil	Architect	-.150*	.155	.333
		Mechanic or Electric	.938	.160	.000
	Architect	Civil	.150*	.155	.333
		Mechanic or Electric	1.088	.172	.000
	Mechanic or Electric	Civil	-.938*	.160	.000
		Architect	-1.088*	.172	.000
c7	Civil	Architect	-.202*	.157	.200
		Mechanic or Electric	.828	.162	.000
	Architect	Civil	.202*	.157	.200
		Mechanic or Electric	1.030	.175	.000
	Mechanic or Electric	Civil	-.828*	.162	.000
		Architect	-1.030*	.175	.000
c8	Civil	Architect	-.121*	.156	.438
		Mechanic or Electric	.814	.161	.000
	Architect	Civil	.121*	.156	.438
		Mechanic or Electric	.935	.174	.000

	Mechanic or Electric	Civil	-.814*	.161	.000
		Architect	-.935*	.174	.000
c9	Civil	Architect	-.290*	.166	.081
		Mechanic or Electric	.643	.171	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
c5	Civil	Mechanic or Electric	.52	1.16
	Architect	Civil	-.27*	.34
		Mechanic or Electric	.53	1.22
	Mechanic or Electric	Civil	-1.16*	-.52
		Architect	-1.22*	-.53
c6	Civil	Architect	-.45*	.15
		Mechanic or Electric	.62	1.25
	Architect	Civil	-.15*	.45
		Mechanic or Electric	.75	1.43
	Mechanic or Electric	Civil	-1.25*	-.62
		Architect	-1.43*	-.75
c7	Civil	Architect	-.51*	.11
		Mechanic or Electric	.51	1.15
	Architect	Civil	-.11*	.51
		Mechanic or Electric	.68	1.37
	Mechanic or Electric	Civil	-1.15*	-.51
		Architect	-1.37*	-.68
c8	Civil	Architect	-.43*	.19
		Mechanic or Electric	.50	1.13
	Architect	Civil	-.19*	.43
		Mechanic or Electric	.59	1.28
	Mechanic or Electric	Civil	-1.13*	-.50
		Architect	-1.28*	-.59
c9	Civil	Architect	-.62*	.04
		Mechanic or Electric	.31	.98

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
c9	Architect	Civil	.290	.166	.081
		Mechanic or Electric	.933*	.185	.000
	Mechanic or Electric	Civil	-.643	.171	.000
		Architect	-.933*	.185	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
c9	Architect	Civil	-.04	.62
		Mechanic or Electric	.57*	1.30
	Mechanic or Electric	Civil	-.98	-.31
		Architect	-1.30*	-.57

*. The mean difference is significant at the 0.05 level.

The Fourth Dimension: The Level of Ability of BIM

Multiple Comparisons					
LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
d1	Civil	Architect	-.254	.145	.082
		Mechanic or Electric	.896*	.150	.000
	Architect	Civil	.254	.145	.082
		Mechanic or Electric	1.150*	.162	.000
	Mechanic or Electric	Civil	-.896*	.150	.000
		Architect	-1.150*	.162	.000
d2	Civil	Architect	-.123	.141	.382
		Mechanic or Electric	1.033*	.146	.000
	Architect	Civil	.123	.141	.382
		Mechanic or Electric	1.157*	.157	.000
	Mechanic or Electric	Civil	-1.033*	.146	.000
		Architect	-1.157*	.157	.000
d3	Civil	Architect	-.230	.155	.139
		Mechanic or Electric	.351*	.160	.029
	Architect	Civil	.230	.155	.139
		Mechanic or Electric	.581*	.173	.001
	Mechanic or Electric	Civil	-.351*	.160	.029
		Architect	-.581*	.173	.001
d4	Civil	Architect	-.091	.144	.528
		Mechanic or Electric	.561*	.149	.000
	Architect	Civil	.091	.144	.528
		Mechanic or Electric	.652*	.161	.000
	Mechanic or Electric	Civil	-.561*	.149	.000
		Architect	-.652*	.161	.000
d5	Civil	Architect	-.167	.148	.261

Multiple Comparisons				
LSD				
Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
d1	Civil	Architect	-.54	.03
		Mechanic or Electric	.60*	1.19
	Architect	Civil	-.03	.54
		Mechanic or Electric	.83*	1.47
	Mechanic or Electric	Civil	-1.19*	-.60
		Architect	-1.47*	-.83
d2	Civil	Architect	-.40	.15
		Mechanic or Electric	.75*	1.32
	Architect	Civil	-.15	.40
		Mechanic or Electric	.85*	1.47
	Mechanic or Electric	Civil	-1.32*	-.75
		Architect	-1.47*	-.85
d3	Civil	Architect	-.53	.08
		Mechanic or Electric	.04*	.67
	Architect	Civil	-.08	.53
		Mechanic or Electric	.24*	.92
	Mechanic or Electric	Civil	-.67*	-.04
		Architect	-.92*	-.24
d4	Civil	Architect	-.38	.19

		Mechanic or Electric	.27*	.86
	Architect	Civil	-.19	.38
		Mechanic or Electric	.34*	.97
	Mechanic or Electric	Civil	-.86*	-.27
		Architect	-.97*	-.34
d5	Civil	Architect	-.46	.12

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
d5	Civil	Mechanic or Electric	.258	.153	.092
	Architect	Civil	.167*	.148	.261
		Mechanic or Electric	.425	.165	.011
	Mechanic or Electric	Civil	-.258*	.153	.092
		Architect	-.425*	.165	.011
d7	Civil	Architect	.278*	.135	.041
		Mechanic or Electric	-.277	.140	.049
	Architect	Civil	-.278*	.135	.041
		Mechanic or Electric	-.555	.151	.000
	Mechanic or Electric	Civil	.277*	.140	.049
		Architect	.555*	.151	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
d5	Civil	Mechanic or Electric	-.04	.56
	Architect	Civil	-.12*	.46
		Mechanic or Electric	.10	.75
	Mechanic or Electric	Civil	-.56*	.04
		Architect	-.75*	-.10
d7	Civil	Architect	.01*	.54
		Mechanic or Electric	-.55	.00
	Architect	Civil	-.54*	-.01
		Mechanic or Electric	-.85	-.26
	Mechanic or Electric	Civil	.00*	.55
		Architect	.26*	.85

*. The mean difference is significant at the 0.05 level.

The Fifth Dimension: The Level of Reinforcement of BIM

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
e1	Civil	Architect	-.296	.185	.110
		Mechanic or Electric	.601*	.191	.002
	Architect	Civil	.296	.185	.110
		Mechanic or Electric	.898*	.206	.000
	Mechanic or Electric	Civil	-.601*	.191	.002
		Architect	-.898*	.206	.000
e2	Civil	Architect	-.319	.186	.089
		Mechanic or Electric	.632*	.193	.001
	Architect	Civil	.319	.186	.089
		Mechanic or Electric	.950*	.208	.000
	Mechanic or Electric	Civil	-.632*	.193	.001
		Architect	-.950*	.208	.000
e3	Civil	Architect	-.140	.164	.396
		Mechanic or Electric	1.080*	.170	.000
	Architect	Civil	.140	.164	.396
		Mechanic or Electric	1.219*	.183	.000
	Mechanic or Electric	Civil	-1.080*	.170	.000
		Architect	-1.219*	.183	.000
e4	Civil	Architect	-.320	.193	.098
		Mechanic or Electric	.390	.199	.052
	Architect	Civil	.320	.193	.098
		Mechanic or Electric	.710*	.215	.001
	Mechanic or Electric	Civil	-.390	.199	.052
		Architect	-.710*	.215	.001
e5	Civil	Architect	-.263	.180	.144

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
e1	Civil	Architect	-.66	.07
		Mechanic or Electric	.22*	.98
	Architect	Civil	-.07	.66
		Mechanic or Electric	.49*	1.30
	Mechanic or Electric	Civil	-.98*	-.22
		Architect	-1.30*	-.49
e2	Civil	Architect	-.69	.05
		Mechanic or Electric	.25*	1.01
	Architect	Civil	-.05	.69
		Mechanic or Electric	.54*	1.36
	Mechanic or Electric	Civil	-1.01*	-.25
		Architect	-1.36*	-.54
e3	Civil	Architect	-.46	.18
		Mechanic or Electric	.74*	1.41
	Architect	Civil	-.18	.46
		Mechanic or Electric	.86*	1.58
	Mechanic or Electric	Civil	-1.41*	-.74
		Architect	-1.58*	-.86
e4	Civil	Architect	-.70	.06

		Mechanic or Electric	.00	.78
	Architect	Civil	-.06	.70
		Mechanic or Electric	.29*	1.13
	Mechanic or Electric	Civil	-.78	.00
		Architect	-1.13*	-.29
e5	Civil	Architect	-.62	.09

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
e5	Civil	Mechanic or Electric	.841	.186	.000
	Architect	Civil	.263*	.180	.144
		Mechanic or Electric	1.105	.201	.000
	Mechanic or Electric	Civil	-.841*	.186	.000
		Architect	-1.105*	.201	.000
e6	Civil	Architect	-.228*	.175	.193
		Mechanic or Electric	.742	.181	.000
	Architect	Civil	.228*	.175	.193
		Mechanic or Electric	.971	.195	.000
	Mechanic or Electric	Civil	-.742*	.181	.000
		Architect	-.971*	.195	.000
e7	Civil	Architect	-.180*	.156	.251
		Mechanic or Electric	.634	.162	.000
	Architect	Civil	.180*	.156	.251
		Mechanic or Electric	.813	.174	.000
	Mechanic or Electric	Civil	-.634*	.162	.000
		Architect	-.813*	.174	.000

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
e5	Civil	Mechanic or Electric	.47	1.21
	Architect	Civil	-.09*	.62
		Mechanic or Electric	.71	1.50
	Mechanic or Electric	Civil	-1.21*	-.47
		Architect	-1.50*	-.71
e6	Civil	Architect	-.57*	.12
		Mechanic or Electric	.39	1.10
	Architect	Civil	-.12*	.57
		Mechanic or Electric	.59	1.35
	Mechanic or Electric	Civil	-1.10*	-.39
		Architect	-1.35*	-.59
e7	Civil	Architect	-.49*	.13
		Mechanic or Electric	.32	.95
	Architect	Civil	-.13*	.49
		Mechanic or Electric	.47	1.16
	Mechanic or Electric	Civil	-.95*	-.32
		Architect	-1.16*	-.47

*. The mean difference is significant at the 0.05 level.

The Second Hypothesis

Multiple Comparisons							
LSD							
Dependent Variable	(I) Qualifi	(J) Qualifi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
ta	Diploma	B.A	-1.19686*	.27292	.000	-1.7345	-.6592
		M.A	-1.61965*	.30394	.000	-2.2184	-1.0209
		pH.D	-2.07708*	.48700	.000	-3.0365	-1.1177
		others	-1.21117*	.38191	.002	-1.9635	-.4588
	B.A	Diploma	1.19686*	.27292	.000	.6592	1.7345
		M.A	-.42279*	.16539	.011	-.7486	-.0970
		pH.D	-.88023*	.41490	.035	-1.6976	-.0629
		others	-.01432	.28430	.960	-.5744	.5458
	M.A	Diploma	1.61965*	.30394	.000	1.0209	2.2184
		B.A	.42279*	.16539	.011	.0970	.7486
		pH.D	-.45743	.43593	.295	-1.3162	.4014
		others	.40848	.31420	.195	-.2105	1.0275
	pH.D	Diploma	2.07708*	.48700	.000	1.1177	3.0365
		B.A	.88023*	.41490	.035	.0629	1.6976
		M.A	.45743	.43593	.295	-.4014	1.3162
		others	.86591	.49347	.081	-.1062	1.8381
	others	Diploma	1.21117*	.38191	.002	.4588	1.9635
		B.A	.01432	.28430	.960	-.5458	.5744
		M.A	-.40848	.31420	.195	-1.0275	.2105
		pH.D	-.86591	.49347	.081	-1.8381	.1062
tb	Diploma	B.A	-1.01566*	.27090	.000	-1.5493	-.4820
		M.A	-1.27100*	.30169	.000	-1.8653	-.6767
		pH.D	-1.87990*	.48340	.000	-2.8322	-.9276
		others	-1.02161*	.37908	.008	-1.7684	-.2748
	B.A	Diploma	1.01566*	.27090	.000	.4820	1.5493
		M.A	-.25534	.16416	.121	-.5787	.0681
		pH.D	-.86424*	.41183	.037	-1.6756	-.0529
		others	-.00595	.28220	.983	-.5619	.5500
	M.A	Diploma	1.27100*	.30169	.000	.6767	1.8653
		B.A	.25534	.16416	.121	-.0681	.5787
		pH.D	-.60890	.43271	.161	-1.4614	.2435
		others	.24939	.31187	.425	-.3650	.8638

Multiple Comparisons							
LSD							
Dependent Variable	(I) Qualifi	(J) Qualifi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
tb	pH.D	Diploma	1.87990*	.48340	.000	.9276	2.8322
		B.A	.86424*	.41183	.037	.0529	1.6756
		M.A	.60890*	.43271	.161	-.2435	1.4614
		others	.85829*	.48982	.081	-.1067	1.8232
	others	Diploma	1.02161*	.37908	.008	.2748	1.7684
		B.A	.00595*	.28220	.983	-.5500	.5619
		M.A	-.24939*	.31187	.425	-.8638	.3650
		pH.D	-.85829	.48982	.081	-1.8232	.1067
tc	Diploma	B.A	-1.02448*	.26991	.000	-1.5562	-.4928
		M.A	-1.35035*	.30058	.000	-1.9425	-.7582
		pH.D	-1.96296	.48162	.000	-2.9118	-1.0142
		others	-1.12458	.37769	.003	-1.8686	-.3805
	B.A	Diploma	1.02448*	.26991	.000	.4928	1.5562

		M.A	-.32587*	.16356	.047	-.6481	-.0036
		pH.D	-.93848	.41032	.023	-1.7468	-.1301
		others	-.10010	.28116	.722	-.6540	.4538
	M.A	Diploma	1.35035*	.30058	.000	.7582	1.9425
		B.A	.32587	.16356	.047	.0036	.6481
		pH.D	-.61261	.43112	.157	-1.4619	.2367
		others	.22577	.31073	.468	-.3864	.8379
	pH.D	Diploma	1.96296*	.48162	.000	1.0142	2.9118
		B.A	.93848*	.41032	.023	.1301	1.7468
		M.A	.61261*	.43112	.157	-.2367	1.4619
		others	.83838*	.48802	.087	-.1230	1.7998
	others	Diploma	1.12458*	.37769	.003	.3805	1.8686
		B.A	.10010	.28116	.722	-.4538	.6540
		M.A	-.22577*	.31073	.468	-.8379	.3864
		pH.D	-.83838	.48802	.087	-1.7998	.1230
td	Diploma	B.A	-.37027*	.12017	.002	-.6070	-.1335
		M.A	-.39200	.13383	.004	-.6557	-.1283
		pH.D	-.31417	.21444	.144	-.7366	.1083
		others	-.38144	.16816	.024	-.7127	-.0502

Multiple Comparisons

LSD

Dependent Variable	(I) Qualifi	(J) Qualifi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
td	B.A	Diploma	.37027*	.12017	.002	.1335	.6070
		M.A	-.02174*	.07282	.766	-.1652	.1217
		pH.D	.05610*	.18269	.759	-.3038	.4160
		others	-.01117*	.12519	.929	-.2578	.2354
	M.A	Diploma	.39200*	.13383	.004	.1283	.6557
		B.A	.02174*	.07282	.766	-.1217	.1652
		pH.D	.07784*	.19195	.685	-.3003	.4560
		others	.01057	.13835	.939	-.2620	.2831
	pH.D	Diploma	.31417*	.21444	.144	-.1083	.7366
		B.A	-.05610*	.18269	.759	-.4160	.3038
		M.A	-.07784	.19195	.685	-.4560	.3003
		others	-.06727	.21729	.757	-.4953	.3608
	others	Diploma	.38144*	.16816	.024	.0502	.7127
		B.A	.01117*	.12519	.929	-.2354	.2578
		M.A	-.01057	.13835	.939	-.2831	.2620
		pH.D	.06727	.21729	.757	-.3608	.4953
te	Diploma	B.A	-1.03511*	.29350	.001	-1.6133	-.4569
		M.A	-1.40605	.32686	.000	-2.0500	-.7621
		pH.D	-1.82381	.52373	.001	-2.8556	-.7920
		others	-1.24459	.41071	.003	-2.0537	-.4355
	B.A	Diploma	1.03511*	.29350	.001	.4569	1.6133
		M.A	-.37094*	.17786	.038	-.7213	-.0205
		pH.D	-.78870*	.44620	.078	-1.6677	.0903
		others	-.20948*	.30574	.494	-.8118	.3928
	M.A	Diploma	1.40605*	.32686	.000	.7621	2.0500
		B.A	.37094	.17786	.038	.0205	.7213
		pH.D	-.41776*	.46881	.374	-1.3413	.5058
		others	.16146	.33790	.633	-.5042	.8271
	pH.D	Diploma	1.82381*	.52373	.001	.7920	2.8556
		B.A	.78870	.44620	.078	-.0903	1.6677
		M.A	.41776	.46881	.374	-.5058	1.3413
		others	.57922	.53069	.276	-.4662	1.6247

Multiple Comparisons							
LSD							
Dependent Variable	(I) Qualifi	(J) Qualifi	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
te	others	Diploma	1.24459*	.41071	.003	.4355	2.0537
		B.A	.20948*	.30574	.494	-.3928	.8118
		M.A	-.16146*	.33790	.633	-.8271	.5042
		pH.D	-.57922*	.53069	.276	-1.6247	.4662
total	Diploma	B.A	-.92848*	.21218	.000	-1.3465	-.5105
		M.A	-1.20781*	.23629	.000	-1.6733	-.7423
		pH.D	-1.61158*	.37861	.000	-2.3575	-.8657
		others	-.99668	.29691	.001	-1.5816	-.4118
	B.A	Diploma	.92848*	.21218	.000	.5105	1.3465
		M.A	-.27934*	.12858	.031	-.5326	-.0260
		pH.D	-.68311	.32256	.035	-1.3186	-.0477
		others	-.06820	.22102	.758	-.5036	.3672
	M.A	Diploma	1.20781*	.23629	.000	.7423	1.6733
		B.A	.27934*	.12858	.031	.0260	.5326
		pH.D	-.40377	.33891	.235	-1.0714	.2639
		others	.21113	.24427	.388	-.2701	.6923
	pH.D	Diploma	1.61158*	.37861	.000	.8657	2.3575
		B.A	.68311	.32256	.035	.0477	1.3186
		M.A	.40377	.33891	.235	-.2639	1.0714
		others	.61491	.38364	.110	-.1409	1.3707
	others	Diploma	.99668*	.29691	.001	.4118	1.5816
		B.A	.06820*	.22102	.758	-.3672	.5036
		M.A	-.21113*	.24427	.388	-.6923	.2701
		pH.D	-.61491*	.38364	.110	-1.3707	.1409

*. The mean difference is significant at the 0.05 level.

The Third Hypothesis

Multiple Comparisons					
LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
ta	Civil	Architect	-.15475	.13729	.261
		Mechanic or Electric	.93607*	.14185	.000
		Others	.47898*	.23423	.042
	Architect	Civil	.15475	.13729	.261
		Mechanic or Electric	1.09083*	.15308	.000
		Others	.63373*	.24119	.009
	Mechanic or Electric	Civil	-.93607*	.14185	.000
		Architect	-1.09083*	.15308	.000
		Others	-.45710	.24382	.062
	Others	Civil	-.47898*	.23423	.042
		Architect	-.63373*	.24119	.009
		Mechanic or Electric	.45710	.24382	.062
tb	Civil	Architect	-.16424	.13458	.224
		Mechanic or Electric	.87454*	.13905	.000
		Others	.44951	.22961	.051
	Architect	Civil	.16424	.13458	.224
		Mechanic or Electric	1.03878*	.15006	.000

		Others	.61375*	.23644	.010
	Mechanic or Electric	Civil	-.87454*	.13905	.000
		Architect	-1.03878*	.15006	.000
		Others	-.42502	.23901	.077
	Others	Civil	-.44951	.22961	.051
		Architect	-.61375*	.23644	.010
		Mechanic or Electric	.42502	.23901	.077
tc	Civil	Architect	-.13993	.13530	.302
		Mechanic or Electric	.88726*	.13979	.000
		Others	.31758	.23083	.170

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
ta	Civil	Architect	-.4252	.1157
		Mechanic or Electric	.6566*	1.2155
		Others	.0176*	.9404
	Architect	Civil	-.1157	.4252
		Mechanic or Electric	.7893*	1.3924
		Others	.1586*	1.1089
	Mechanic or Electric	Civil	-1.2155*	-.6566
		Architect	-1.3924*	-.7893
		Others	-.9374	.0232
	Others	Civil	-.9404*	-.0176
		Architect	-1.1089*	-.1586
		Mechanic or Electric	-.0232	.9374
tb	Civil	Architect	-.4294	.1009
		Mechanic or Electric	.6006*	1.1485
		Others	-.0028	.9018
	Architect	Civil	-.1009	.4294
		Mechanic or Electric	.7432*	1.3344
		Others	.1480*	1.0795
	Mechanic or Electric	Civil	-1.1485*	-.6006
		Architect	-1.3344*	-.7432
		Others	-.8959	.0458
	Others	Civil	-.9018	.0028
		Architect	-1.0795*	-.1480
		Mechanic or Electric	-.0458	.8959
tc	Civil	Architect	-.4065	.1266
		Mechanic or Electric	.6119*	1.1626
		Others	-.1372	.7723

Multiple Comparisons

LSD					
Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
tc	Architect	Civil	.13993	.13530	.302
		Mechanic or Electric	1.02719*	.15086	.000
		Others	.45752*	.23770	.055
	Mechanic or Electric	Civil	-.88726	.13979	.000
		Architect	-1.02719*	.15086	.000
		Others	-.56967*	.24028	.019
	Others	Civil	-.31758*	.23083	.170
		Architect	-.45752*	.23770	.055
		Mechanic or Electric	.56967	.24028	.019
te	Civil	Architect	-.24955*	.15174	.101
		Mechanic or Electric	.70272*	.15677	.000
		Others	.25571	.25887	.324
	Architect	Civil	.24955	.15174	.101
		Mechanic or Electric	.95227*	.16919	.000
		Others	.50525	.26657	.059
	Mechanic or Electric	Civil	-.70272	.15677	.000
		Architect	-.95227*	.16919	.000
		Others	-.44701*	.26947	.098
	Others	Civil	-.25571*	.25887	.324
		Architect	-.50525*	.26657	.059
		Mechanic or Electric	.44701	.26947	.098
total	Civil	Architect	-.13739	.10676	.199
		Mechanic or Electric	.70538*	.11030	.000
		Others	.31860	.18213	.082
	Architect	Civil	.13739	.10676	.199
		Mechanic or Electric	.84276*	.11903	.000
		Others	.45598	.18755	.016

Multiple Comparisons

LSD				
Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
tc	Architect	Civil	-.1266	.4065
		Mechanic or Electric	.7300*	1.3244
		Others	-.0107*	.9258
	Mechanic or Electric	Civil	-1.1626	-.6119
		Architect	-1.3244*	-.7300
		Others	-1.0430*	-.0963
	Others	Civil	-.7723*	.1372
		Architect	-.9258*	.0107
		Mechanic or Electric	.0963	1.0430
te	Civil	Architect	-.5485*	.0494
		Mechanic or Electric	.3939*	1.0116
		Others	-.2543	.7657
	Architect	Civil	-.0494	.5485
		Mechanic or Electric	.6190*	1.2856
		Others	-.0199	1.0304
	Mechanic or Electric	Civil	-1.0116	-.3939
		Architect	-1.2856*	-.6190
		Others	-.9779*	.0838
	Others	Civil	-.7657*	.2543
		Architect	-1.0304*	.0199

		Mechanic or Electric	-.0838	.9779
total	Civil	Architect	-.3477	.0729
		Mechanic or Electric	.4881*	.9227
		Others	-.0402	.6774
	Architect	Civil	-.0729	.3477
		Mechanic or Electric	.6083*	1.0773
		Others	.0865	.8255

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
total	Mechanic or Electric	Civil	-.70538	.11030	.000
		Architect	-.84276*	.11903	.000
		Others	-.38678*	.18959	.042
	Others	Civil	-.31860	.18213	.082
		Architect	-.45598*	.18755	.016
		Mechanic or Electric	.38678*	.18959	.042

Multiple Comparisons

LSD

Dependent Variable	(I) Field	(J) Field	95% Confidence Interval	
			Lower Bound	Upper Bound
total	Mechanic or Electric	Civil	-.9227	-.4881
		Architect	-1.0773*	-.6083
		Others	-.7603*	-.0133
	Others	Civil	-.6774	.0402
		Architect	-.8255*	-.0865
		Mechanic or Electric	.0133*	.7603

*. The mean difference is significant at the 0.05 level.

Post Hoc Tests-

The Fourth Hypothesis

Multiple Comparisons					
LSD					
Dependent Variable	(I) Experience	(J) Experience	Mean Difference (I-J)	Std. Error	Sig.
ta	Less than5 years	5- 10 years	.35915*	.16224	.028
		10- 15 years	.50665*	.19006	.008
		15 - 20 years	.39619	.22620	.081
		More than 20 years	.71972*	.20409	.001
	5- 10 years	Less than5 years	-.35915*	.16224	.028
		10- 15 years	.14750	.17885	.410
		15 - 20 years	.03704	.21687	.865
		More than 20 years	.36057	.19369	.064
	10- 15 years	Less than5 years	-.50665*	.19006	.008
		5- 10 years	-.14750	.17885	.410
		15 - 20 years	-.11047	.23840	.644
		More than 20 years	.21306	.21753	.328
	15 - 20 years	Less than5 years	-.39619	.22620	.081
		5- 10 years	-.03704	.21687	.865
		10- 15 years	.11047	.23840	.644
		More than 20 years	.32353	.24973	.196
	More than 20 years	Less than5 years	-.71972*	.20409	.001
		5- 10 years	-.36057	.19369	.064
		10- 15 years	-.21306	.21753	.328
		15 - 20 years	-.32353	.24973	.196
tb	Less than5 years	5- 10 years	.33837*	.15866	.034
		10- 15 years	.47798*	.18587	.011
		15 - 20 years	.40203	.22122	.070
		More than 20 years	.61788*	.19960	.002
	5- 10 years	Less than5 years	-.33837*	.15866	.034
		10- 15 years	.13961	.17491	.426
		15 - 20 years	.06366	.21209	.764

Multiple Comparisons				
LSD				
Dependent Variable	(I) Experience	(J) Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
ta	Less than5 years	5- 10 years	.0395*	.6788
		10- 15 years	.1322*	.8811
		15 - 20 years	-.0494	.8418
		More than 20 years	.3177*	1.1218
	5- 10 years	Less than5 years	-.6788*	-.0395
		10- 15 years	-.2048	.4998
		15 - 20 years	-.3902	.4643
		More than 20 years	-.0210	.7421
	10- 15 years	Less than5 years	-.8811*	-.1322
		5- 10 years	-.4998	.2048
		15 - 20 years	-.5801	.3592
		More than 20 years	-.2155	.6416

	15 - 20 years	Less than5 years	-.8418	.0494
		5- 10 years	-.4643	.3902
		10- 15 years	-.3592	.5801
		More than 20 years	-.1684	.8155
	More than 20 years	Less than5 years	-1.1218*	-.3177
		5- 10 years	-.7421	.0210
		10- 15 years	-.6416	.2155
		15 - 20 years	-.8155	.1684
tb	Less than5 years	5- 10 years	.0258*	.6509
		10- 15 years	.1118*	.8442
		15 - 20 years	-.0338	.8378
		More than 20 years	.2247*	1.0111
	5- 10 years	Less than5 years	-.6509*	-.0258
		10- 15 years	-.2050	.4842
		15 - 20 years	-.3542	.4815

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	Mean Difference (I-J)	Std. Error	Sig.
tb	5- 10 years	More than 20 years	.27951*	.18943	.141
	10- 15 years	Less than5 years	-.47798*	.18587	.011
		5- 10 years	-.13961	.17491	.426
		15 - 20 years	-.07595*	.23315	.745
		More than 20 years	.13990*	.21274	.511
	15 - 20 years	Less than5 years	-.40203	.22122	.070
		5- 10 years	-.06366	.21209	.764
		10- 15 years	.07595	.23315	.745
		More than 20 years	.21585*	.24423	.378
	More than 20 years	Less than5 years	-.61788	.19960	.002
		5- 10 years	-.27951	.18943	.141
		10- 15 years	-.13990	.21274	.511
		15 - 20 years	-.21585	.24423	.378
tc	Less than5 years	5- 10 years	.24805	.15876	.120
		10- 15 years	.33412	.18599	.074
		15 - 20 years	.52844	.22135	.018
		More than 20 years	.65066*	.19972	.001
	5- 10 years	Less than5 years	-.24805	.15876	.120
		10- 15 years	.08607	.17502	.623
		15 - 20 years	.28038	.21222	.188
		More than 20 years	.40261*	.18954	.035
	10- 15 years	Less than5 years	-.33412*	.18599	.074
		5- 10 years	-.08607	.17502	.623
		15 - 20 years	.19432*	.23329	.406
		More than 20 years	.31654*	.21287	.138
	15 - 20 years	Less than5 years	-.52844	.22135	.018
		5- 10 years	-.28038	.21222	.188

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
tb	5- 10 years	More than 20 years	-.0937*	.6527
	10- 15 years	Less than5 years	-.8442*	-.1118
		5- 10 years	-.4842	.2050
		15 - 20 years	-.5353*	.3834
		More than 20 years	-.2792*	.5590
	15 - 20 years	Less than5 years	-.8378	.0338
		5- 10 years	-.4815	.3542
		10- 15 years	-.3834	.5353
		More than 20 years	-.2653*	.6970
	More than 20 years	Less than5 years	-1.0111	-.2247
		5- 10 years	-.6527	.0937
		10- 15 years	-.5590	.2792
		15 - 20 years	-.6970	.2653
tc	Less than5 years	5- 10 years	-.0647	.5608
		10- 15 years	-.0323	.7005
		15 - 20 years	.0924	.9645
		More than 20 years	.2572*	1.0441
	5- 10 years	Less than5 years	-.5608	.0647
		10- 15 years	-.2587	.4309
		15 - 20 years	-.1377	.6985
		More than 20 years	.0292*	.7760
	10- 15 years	Less than5 years	-.7005*	.0323
		5- 10 years	-.4309	.2587
		15 - 20 years	-.2653*	.6539
		More than 20 years	-.1028*	.7359
	15 - 20 years	Less than5 years	-.9645	-.0924
		5- 10 years	-.6985	.1377

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	Mean Difference (I-J)	Std. Error	Sig.
tc	15 - 20 years	10- 15 years	-.19432*	.23329	.406
		More than 20 years	.12222*	.24438	.617
	More than 20 years	Less than5 years	-.65066	.19972	.001
		5- 10 years	-.40261*	.18954	.035
		10- 15 years	-.31654*	.21287	.138
		15 - 20 years	-.12222	.24438	.617
te	Less than5 years	5- 10 years	.36272	.17037	.034
		10- 15 years	.32096	.19959	.109
		15 - 20 years	.46169*	.23754	.053
		More than 20 years	.84539	.21432	.000
	5- 10 years	Less than5 years	-.36272	.17037	.034
		10- 15 years	-.04175	.18781	.824
		15 - 20 years	.09898	.22774	.664
		More than 20 years	.48267	.20340	.018
	10- 15 years	Less than5 years	-.32096	.19959	.109
		5- 10 years	.04175	.18781	.824
		15 - 20 years	.14073*	.25035	.575
		More than 20 years	.52443	.22844	.023

	15 - 20 years	Less than5 years	-.46169	.23754	.053
		5- 10 years	-.09898	.22774	.664
		10- 15 years	-.14073*	.25035	.575
		More than 20 years	.38370*	.26225	.145
	More than 20 years	Less than5 years	-.84539	.21432	.000
		5- 10 years	-.48267*	.20340	.018
		10- 15 years	-.52443*	.22844	.023
		15 - 20 years	-.38370	.26225	.145
total	Less than5 years	5- 10 years	.27609	.12521	.028
		10- 15 years	.36333	.14669	.014

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
tc	15 - 20 years	10- 15 years	-.6539*	.2653
		More than 20 years	-.3592*	.6037
	More than 20 years	Less than5 years	-1.0441	-.2572
		5- 10 years	-.7760*	-.0292
		10- 15 years	-.7359*	.1028
		15 - 20 years	-.6037	.3592
te	Less than5 years	5- 10 years	.0271	.6983
		10- 15 years	-.0722	.7142
		15 - 20 years	-.0063*	.9297
		More than 20 years	.4232	1.2676
	5- 10 years	Less than5 years	-.6983	-.0271
		10- 15 years	-.4118	.3282
		15 - 20 years	-.3497	.5476
		More than 20 years	.0820	.8834
	10- 15 years	Less than5 years	-.7142	.0722
		5- 10 years	-.3282	.4118
		15 - 20 years	-.3525*	.6339
		More than 20 years	.0744	.9745
	15 - 20 years	Less than5 years	-.9297	.0063
		5- 10 years	-.5476	.3497
		10- 15 years	-.6339*	.3525
		More than 20 years	-.1329*	.9003
	More than 20 years	Less than5 years	-1.2676	-.4232
		5- 10 years	-.8834*	-.0820
		10- 15 years	-.9745*	-.0744
		15 - 20 years	-.9003	.1329
total	Less than5 years	5- 10 years	.0294	.5228
		10- 15 years	.0743	.6523

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	Mean Difference (I-J)	Std. Error	Sig.
total	Less than5 years	15 - 20 years	.36325*	.17458	.039
		More than 20 years	.60233*	.15752	.000
	5- 10 years	Less than5 years	-.27609	.12521	.028
		10- 15 years	.08724*	.13804	.528
		15 - 20 years	.08716*	.16738	.603
		More than 20 years	.32624	.14949	.030
	10- 15 years	Less than5 years	-.36333	.14669	.014
		5- 10 years	-.08724	.13804	.528
		15 - 20 years	-.00008*	.18400	1.000
		More than 20 years	.23900	.16789	.156
	15 - 20 years	Less than5 years	-.36325	.17458	.039
		5- 10 years	-.08716	.16738	.603
		10- 15 years	.00008	.18400	1.000
		More than 20 years	.23908	.19274	.216
	More than 20 years	Less than5 years	-.60233	.15752	.000
		5- 10 years	-.32624	.14949	.030
		10- 15 years	-.23900*	.16789	.156
		15 - 20 years	-.23908	.19274	.216

Multiple Comparisons

LSD

Dependent Variable	(I) Experience	(J) Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
total	Less than5 years	15 - 20 years	.0193*	.7072
		More than 20 years	.2920*	.9127
	5- 10 years	Less than5 years	-.5228	-.0294
		10- 15 years	-.1847*	.3592
		15 - 20 years	-.2426*	.4169
		More than 20 years	.0317	.6207
	10- 15 years	Less than5 years	-.6523	-.0743
		5- 10 years	-.3592	.1847
		15 - 20 years	-.3626*	.3624
		More than 20 years	-.0917	.5698
	15 - 20 years	Less than5 years	-.7072	-.0193
		5- 10 years	-.4169	.2426
		10- 15 years	-.3624	.3626
		More than 20 years	-.1406	.6188
	More than 20 years	Less than5 years	-.9127	-.2920
		5- 10 years	-.6207	-.0317
		10- 15 years	-.5698*	.0917
		15 - 20 years	-.6188	.1406

*. The mean difference is significant at the 0.05 level.

Post Hoc Tests-

The Sixth Hypothesis

Multiple Comparisons

LSD

Dependent Variable	(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Sig.
ta	Less than 5 persons	5 - 20 persons	.06412	.15330	.676
		20 - 50 persons	.30866	.20954	.142
		50 - 100 persons	-.51165	.28374	.073
		More than 100	-.34499	.23108	.137
	5 - 20 persons	Less than 5 persons	-.06412	.15330	.676
		20 - 50 persons	.24454	.19113	.202
		50 - 100 persons	-.57577*	.27043	.034
		More than 100	-.40911	.21452	.058
	20 - 50 persons	Less than 5 persons	-.30866	.20954	.142
		5 - 20 persons	-.24454	.19113	.202
		50 - 100 persons	-.82031*	.30584	.008
		More than 100	-.65365*	.25773	.012
	50 - 100 persons	Less than 5 persons	.51165	.28374	.073
		5 - 20 persons	.57577*	.27043	.034
		20 - 50 persons	.82031*	.30584	.008
		More than 100	.16667	.32098	.604
	More than 100	Less than 5 persons	.34499	.23108	.137
		5 - 20 persons	.40911	.21452	.058
		20 - 50 persons	.65365*	.25773	.012
		50 - 100 persons	-.16667	.32098	.604
tb	Less than 5 persons	5 - 20 persons	.13161	.14918	.379
		20 - 50 persons	.41423*	.20390	.043
		50 - 100 persons	-.38488	.27610	.165
		More than 100	-.22854	.22486	.310
	5 - 20 persons	Less than 5 persons	-.13161	.14918	.379
		20 - 50 persons	.28262	.18598	.130
		50 - 100 persons	-.51649	.26315	.051
		More than 100	-.36015	.20874	.086

Multiple Comparisons				
LSD				
Dependent Variable	(I) Size	(J) Size	95% Confidence Interval	
			Lower Bound	Upper Bound
ta	Less than 5 persons	5 - 20 persons	-.2379	.3661
		20 - 50 persons	-.1041	.7215
		50 - 100 persons	-1.0706	.0473
		More than 100	-.8002	.1102
	5 - 20 persons	Less than 5 persons	-.3661	.2379
		20 - 50 persons	-.1320	.6211
		50 - 100 persons	-1.1085*	-.0430
		More than 100	-.8317	.0135
	20 - 50 persons	Less than 5 persons	-.7215	.1041
		5 - 20 persons	-.6211	.1320
		50 - 100 persons	-1.4228*	-.2178
		More than 100	-1.1614*	-.1459
	50 - 100 persons	Less than 5 persons	-.0473	1.0706
		5 - 20 persons	.0430*	1.1085
		20 - 50 persons	.2178*	1.4228
		More than 100	-.4657	.7990
	More than 100	Less than 5 persons	-.1102	.8002
		5 - 20 persons	-.0135	.8317
		20 - 50 persons	.1459*	1.1614
		50 - 100 persons	-.7990	.4657
tb	Less than 5 persons	5 - 20 persons	-.1623	.4255
		20 - 50 persons	.0125*	.8159
		50 - 100 persons	-.9288	.1590
		More than 100	-.6715	.2144
	5 - 20 persons	Less than 5 persons	-.4255	.1623
		20 - 50 persons	-.0838	.6490
		50 - 100 persons	-1.0349	.0019
		More than 100	-.7714	.0511

Multiple Comparisons					
LSD					
Dependent Variable	(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Sig.
tb	20 - 50 persons	Less than 5 persons	-.41423	.20390	.043
		5 - 20 persons	-.28262	.18598	.130
		50 - 100 persons	-.79911	.29760	.008
		More than 100	-.64277	.25079	.011
	50 - 100 persons	Less than 5 persons	.38488	.27610	.165
		5 - 20 persons	.51649	.26315	.051
		20 - 50 persons	.79911*	.29760	.008
		More than 100	.15634	.31234	.617
	More than 100	Less than 5 persons	.22854	.22486	.310
		5 - 20 persons	.36015	.20874	.086
		20 - 50 persons	.64277*	.25079	.011
		50 - 100 persons	-.15634*	.31234	.617
total	Less than 5 persons	5 - 20 persons	.07977	.11870	.502
		20 - 50 persons	.28151*	.16225	.084
		50 - 100 persons	-.36089*	.21970	.102
		More than 100	-.22313	.17892	.214
	5 - 20 persons	Less than 5 persons	-.07977	.11870	.502
		20 - 50 persons	.20175	.14799	.174

		50 - 100 persons	-.44066*	.20939	.036
		More than 100	-.30290	.16610	.069
	20 - 50 persons	Less than 5 persons	-.28151	.16225	.084
		5 - 20 persons	-.20175*	.14799	.174
		50 - 100 persons	-.64240	.23681	.007
		More than 100	-.50465	.19956	.012
	50 - 100 persons	Less than 5 persons	.36089	.21970	.102
		5 - 20 persons	.44066	.20939	.036
		20 - 50 persons	.64240	.23681	.007

Multiple Comparisons

LSD

Dependent Variable	(I) Size	(J) Size	95% Confidence Interval	
			Lower Bound	Upper Bound
tb	20 - 50 persons	Less than 5 persons	-.8159	-.0125
		5 - 20 persons	-.6490	.0838
		50 - 100 persons	-1.3854	-.2128
		More than 100	-1.1368	-.1487
	50 - 100 persons	Less than 5 persons	-.1590	.9288
		5 - 20 persons	-.0019	1.0349
		20 - 50 persons	.2128*	1.3854
		More than 100	-.4590	.7716
	More than 100	Less than 5 persons	-.2144	.6715
		5 - 20 persons	-.0511	.7714
		20 - 50 persons	.1487*	1.1368
		50 - 100 persons	-.7716*	.4590
total	Less than 5 persons	5 - 20 persons	-.1541	.3136
		20 - 50 persons	-.0381*	.6011
		50 - 100 persons	-.7937*	.0719
		More than 100	-.5756	.1294
	5 - 20 persons	Less than 5 persons	-.3136	.1541
		20 - 50 persons	-.0898	.4933
		50 - 100 persons	-.8532*	-.0282
		More than 100	-.6301	.0243
	20 - 50 persons	Less than 5 persons	-.6011	.0381
		5 - 20 persons	-.4933*	.0898
		50 - 100 persons	-1.1089	-.1759
		More than 100	-.8978	-.1115
	50 - 100 persons	Less than 5 persons	-.0719	.7937
		5 - 20 persons	.0282	.8532
		20 - 50 persons	.1759	1.1089

Multiple Comparisons

LSD

Dependent Variable	(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Sig.
total	50 - 100 persons	More than 100	.13776	.24853	.580
	More than 100	Less than 5 persons	.22313	.17892	.214
		5 - 20 persons	.30290	.16610	.069
		20 - 50 persons	.50465	.19956	.012
		50 - 100 persons	-.13776	.24853	.580

Multiple Comparisons

LSD

Dependent Variable	(I) Size	(J) Size	95% Confidence Interval	
			Lower Bound	Upper Bound
total	50 - 100 persons	More than 100	-.3519	.6274
	More than 100	Less than 5 persons	-.1294	.5756
		5 - 20 persons	-.0243	.6301
		20 - 50 persons	.1115	.8978
		50 - 100 persons	-.6274	.3519

*. The mean difference is significant at the 0.05 level.

A.5 List of Arbitrators and Experts:

Name	Position
Dr. Ayham Jaaron	Associate Professor – An-Najah National University
Dr. Ehab Hjaze	Associate Professor – An-Najah National University
Dr. Mohammed Othman	Assistant Professor – An-Najah National University
Dr. Yahya Saleh	Assistant Professor – An-Najah National University
Miss Samia Ata	Master's in Linguistics – Holy Bible College

جامعة النجاح الوطنية

كلية الدراسات العليا

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قدمت هذه الاطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الإدارة الهندسية، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين

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الملخص

هدف الدراسة هو فحص مستوى البيم في مشاريع الضفة الغربية الإنشائية بعد استعراض فوائد استخدامه، بالإضافة لاستغلال إدارة التغيير، وفحص بعض الفرضيات لزيادة تبني البيم باستخدام نموذج أدكار للتغيير كإطار عمل لاستبدال طرق العمل الهندسية التقليدية بأخرى حديثة للمجالات الهندسية المختلفة.

يعد قطاع المباني من أهم فروع صناعة الإنشاءات، والتي تمثل جزءاً اقتصادياً رئيسياً داخل أي دولة. لذلك فإن تطوير هذا القطاع بالتأكيد سينشأ عنه تطوير الدولة بالكامل. إن إحدى الطرق الأساسية الهندسية لتعزيز تقدم قطاع الأبنية، والإنشاءات هي تقنية البيم المستخدمة عالمياً. إن عملية تبني البيم ستطور إجراءات العمل الهندسية للمشاريع الإنشائية لبنائها بالجودة المطلوبة، وبأدنى تكلفة، وبأقل مدة زمنية لازمة.

لقد اطلع الباحث على العديد من الكتب والدراسات ذات العلاقة لتوسيع مداركه، وثقافته، ومعلوماته لإنجاز هذه الرسالة بنجاح. أضف إلى ذلك، المقابلات التي أجراها مع ثماني مؤسسات كبرى و242 ردود استمارة تعبئة لشركات هندسية استشارية، وشركات مقاولات مما ساعد بتحقيق أهداف الدراسة المرجوة بوضوح أكبر.

لقد تم التوصل إلى أن عناصر نموذج أدكار، وهي: الوعي، والرغبة، والمعرفة، والتمكين باستثناء عنصر القدرة على تبني البيم من قبل المهندسين بتخصصي عمارة الأبنية، والإنشاءات كانت أعلى من تخصصي الميكانيك، والكهرباء. لقد كان ملحوظاً أن جميع الميادين افتقرت عنصر القدرة على

تطبيق البيم في المشاريع الإنشائية. كذلك فقد تبين أن تبني البيم في مشاريع البناء في الضفة الغربية كان أكثر فاعلية لأولئك الحاصلين على شهادات جامعية عليا، أو ذوي الخبرات القليلة، أو للشركات الصغيرة، أو لمهندسي تخصص عمارة الأبنية، والإنشاءات.

ومن حسن الحظ، وبعد جمع المعلومات اللازمة، وتحليل النتائج الكمية، والنوعية تم تأسيس إطار عمل للمهندسين العاملين في التخصصات المختلفة من عمارة الأبنية، وإنشاء المباني، والميكانيك، والكهرباء. هذا الإطار يدعم تطبيق البيم، وذلك بمساعدة الحكومة ومؤسساتها لإشراك جميع الأطراف بما فيهم مالك المشروع لضمان نجاح تبني تقنية البيم داخل مشاريع البناء.

هذه الدراسة تضيف إسهاماً لقطاع الأبنية عن طريق تطبيق النموذج الإداري التغييري، أدكار، في عملية تبني البيم، وهذه هي المرة الأولى التي تستكشف بالدراسات.

بالخلاصة، فإن الباحث يوصي بتبني البيم من قبل الدول النامية إلى جانب أية مناطق أخرى ممكنة في مشاريعهم الإنشائية.