AWARENESS OF IMPLEMENTATION BUILDING INFORMATION MODELLING (BIM) IN CONSTRUCTION INDUSTRIES

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Report submitted in fulfillment of the requirements for the award of the degree of Bachelor of Project Management with (Hons)

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I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledge. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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This Degree dissertation is dedicated to my parents

Kahapah Bin Daud and Rahani Binti Ibrahim

Success is in my stride, because I have parents in my side that give full supportive from birth until now.

Thanks for being perfect.

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ABSTRACT

Building Information Modeling (BIM) is a technology that is currently emerging in the construction industry. BIM is defined as a modeling technology and associated set of process to produce communicate, and analyse building models throughout the projects lifecycle. Nevertheless, in Malaysia show that the adoption of BIM is still early stage because only a few companies that implementing BIM in their organization. Therefore, the purpose of this study is to identify the level awareness of implementation BIM among project manager, and to identify the barrier of BIM implementation in construction industry. Questionnaire have been used to obtain the data. There are 65 sets of questionnaire have been collected back. Consequently, result of this study stated that most of the project manager in Kelantan are aware on the implementation of BIM in construction industry. The main barriers for implementing the BIM are lack of training and respondents also said that BIM is expensive to implement in their organization.

ABSTRAK

Permodelan Bangunan Bermaklumat (BIM) merupakan teknologi yang kini sedang pesat membangun dalam industri pembinaan. BIM ditakrifkan sebagai teknologi pemodelan dan berkaitan set proses untuk menghasilkan berkomunikasi, dan menganalisis model bangunan di sepanjang kitaran hayat projek. Namun begitu, di Malaysia menunjukkan bahawa penggunaan BIM masih peringkat awal kerana hanya beberapa syarikat-syarikat yang melaksanakan BIM dalam organisasi mereka. Oleh itu, tujuan kajian ini adalah untuk mengenalpasti tahap kesedaran BIM pelaksanaan di kalangan pengurus projek, dan untuk mengenal pasti halangan pelaksanaan BIM dalam industri pembinaan. Soal selidik telah digunakan untuk mendapatkan data. Terdapat 65 set soal selidik telah dikumpulkan kembali. Oleh itu, hasil kajian ini menyatakan bahawa kebanyakan pengurus projek di Kelantan sedar mengenai pelaksanaan BIM dalam industri pembinaan. Halangan utama untuk melaksanakan BIM adalah kekurangan latihan dan responden juga berkata BIM adalah mahal untuk dilaksanakan dalam organisasi mereka.

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BIM	Building Information Modelling

CHAPTER 1

INTRODUCTION

1.1 Introduction

This study is describe about implementation of Building Information Modelling in construction industry. Some basic information of the study including background of study, problem statement, research objective, research question, scope of the study, significant of the study, expected outcome and definition of term.

1.2 Background of Study

The Malaysian construction industry is productive and generates wealth for the country by addressing social and economic needs through the provision of infrastructures and buildings that constantly contribute to the growth of the economy Hamid (2010). Explained that the Malaysian construction industry is separated into two areas, which are construction and special works. At present, the construction industry is continuously expanding towards economic growth as stated in Ibrahim et al. (2010). Therefore, the construction industry plays an important role in the economic development of the country in the world.

In construction, getting the right information to the right place means overcoming the challenges of the organizational problem of the industry and the site-based location of much of its work according to Davies & Harty (2013). Thus, Information Technology (IT) can be defined as the use of electronic machines and programmes for the processing, storage, transfer and presentation of information as stated in Kasim (2011). He also emphasize the communication technology (ICT) today an important part of IT. Malaysia seem to be developing countries because the demand for founding infrastructure is highly increasing. Thus, the information technology is a very essential for the construction industries in Malaysia to avoid any issues that need to face. Generally, the construction industry in Malaysia has lagged behind other industries in embracing ICT said by Kasim (2011). It was found that although the professionals are quick to use the computerization into their construction processes, but the contractor, worker and builders are still far from the adoption of ICT. The level performance of the ICT still not satisfied among user. This is cause of different software that use such as the types of software and the application which it might cause the information of the project will not accurate.

However, regarding to the problem construction industry has introduced a Building Information Modeling (BIM). BIM implementation is expected to upgrade the design and construction through 3D visualization simulation, composite and production drawings automatically, documentation and retrieving information, data and consistent information, conflict detection and automatic calculation of building materials (Haron, 2013).

Malaysia encourage the implementation of BIM in construction industry. Construction industry must upgrade the current construction approach, practice, management and technologies as stated in Ali, Haron, & Marshall-ponting (2014). This is because the Malaysian construction industry faces a major challenge to improve productivity, quality and value to the construction industry for the construction industry in Malaysia is an industry that is often faced with the problem of delay, the production of medium productivity, labor intensive and are still using technology long Zahrizan et al.(2013). The issue happens because in the construction industry construction process is complex and involves many

parties that require collaborative communication and coordination as well as the construction of an effective team member (Antonio et al., 2012).

BIM as an approach to building design and construction distinguishes it from other technologies. This is not only because of 3D model, but also the structured information that organized, defined, and exchangeable. The structured information is more opened and the most effective communication and collaboration during project lifecycle. However, for this study focus more about the adoption of BIM for construction industries in Malaysia.

1.3 Problem Statement of Study

Today, construction industry in Malaysia is facing huge challenge from the communities to increase their productivity, quality, and value. This is because, construction industry has been seen as the most problem in industry in Malaysia such as cost overrun, delay, the production of low quality product, intensive labor as well as still using old technology said by Zakaria et al. (2013). This is happen because in dealing with complex project and involves many parties. Then, in construction industry involved a lot exchange among them mostly involve a lot of documentation and drawing.

In Malaysia, the adoption of BIM is still in early stage because only a few companies or organizations that are implementing BIM software in their organization and construction projects such as Sime Darby Berhad, Brundsfield, Sunway Putra Perdana and UEM as stated in CREAM (2014). In comparison to the USA and the Nordic European countries which this company implement the BIM in every project. However, in Malaysia all those companies have involved in construct the complex, unique, and high cost project. This is because there are some challenges or obstacles that must be faced by the project team members in the construction industry, particularly small and medium enterprises (SME's) as a high cost in implementing BIM in construction projects to replace the old construction method (CREAM, 2014). However, this is also supported by Ir Ahmad Asri Abdul Hamid which is Senior General Manager Development Sector said three main things that seen barriers BIM

implementation at the moment is the cost of the software and training were a little high, the time taken to train experts in BIM and the need for new hardware to implement BIM (Metro, 2015)

Besides that, the Construction Industry Development Board Malaysia (CIDB) had approximately twenty (20) projects using BIM in Malaysia according to CIDB (2014). This shows that the use of BIM implementation is not yet widespread in the construction industry and in civil engineering in Malaysia said by Abdullah et al. (2013). This is supported by Chief Executive of CIDB, Datuk Seri Ir. Judin Abdul Karim said "only about 10 per cent of the country's construction industry using this technology even though it has introduced over 20 years ago and is used in most developed countries, including Singapore" (Utusan Online, 2014).

Therefore, the benefits of BIM should use by the construction industry, which helps them to enhance and improve the construction process view from Hussin (2009). The construction industry has a history of slow improvement in productivity compared with other industries. As said by Datuk Seri Ir Judin Abdul Karim said "It is not a problem of knowledge and information on the usage of ICT but it is always about the cost." Although there is awareness of using the ICT but the cost of investment prohibited companies from adopting the technology. Big companies can afford ICT investment while most of the small companies find its adoption unaffordable (Star, 2009).

However, despite the use of BIM has increased every year, the rate of acceptance of this system is still in the stage of unfavorable.Thus, it will be difficult for the Malaysian government to immediately set standards as mandatory, since the use of BIM in Malaysia is still at its early stage. Hence, this study to determine the extent of awareness of the implementation of BIM in the construction industry and the obstacles that cause BIM is not used in the construction.

1.4 Research Objective

The main goal of this study is to know the awareness implementation Building Information Modeling (BIM) in construction industry. In achieving the following objectives are identified to facilitate the execution of the study and researches goals can be focused between the objectives outlined are:

i. To determine the level awareness of implementation BIM among project manager.

ii. To identify the barriers of BIM implementation in construction industry.

1.5 Research Question

i. What are different level of awareness in implementation of BIM among project manager?

ii. What are the barriers in implementing BIM in construction industry?

1.6 Scope of Study

This study is focuses on implementation of Building Information Modelling (BIM) in Malaysia construction industry. Therefore, the scope of this study is only limited in Kelantan state. Kelantan is one of the developing state which focused on construction project such as building, infrastructure, tunnel, and others. The scope of study is:

i. The respondent comprised of company registering in Grade 7 that registered in Construction Industry Development of Board (CIDB). Grade 7 of contractors is regarded as big companies with large- size project. As a result of this, to make sure the data obtained could be reliable and as a large project in this company have a project manager as a research respondent.

ii. This study is focus of level awareness about Building Information Modelling from project manager in construction industries in Kelantan. Then, their barrier in implementation of BIM.

1.7 Significant of the Study

The important of understanding of the use of BIM for a projects in the construction industry as a whole is of interest in this study. This research is important to get the level of awareness about the implementation of BIM for a projects in the construction industry. Also, this study will be undertaken to find out barrier in implementation of Building Information Modeling in order to foster the construction industry towards broader adoption of BIM. It can be beneficial and contribute to: -

i. Academics

Academics can make this study as a source of reference on the level of use of BIM and the barrier for using BIM in the construction industry. Thus, it can be expected to help carry out a study on the future of academic references related to the topic of this study.

ii. Construction industry

Contractors and developers are more concerned about the use of BIM in the construction industry. Construction industry can use BIM to improve project quality, reduce cost and time to complete a project.

iii. Project manager

Furthermore, implementing BIM in construction project can make project team clear information about the project. Project manager easy to manage project team when using BIM in construction. It is can avoid lack of information, lack of communication among project manager and team members and the most importantly reduce overall cost of construction.

1.8 Definition of Term

Operationalizing or operationally defining, a concept to render it measureable is achieved by looking at the behavioral dimensions, facets, or properties denoted by concept.

1.7.1 Building Information Modeling (BIM)

The process and technology of digitally constructing an accurate virtual model of a building is known as Building Information Modeling. When completed, the computer-generated model contains precise geometry, spatial relationships, geographic information, quantities and properties of building component needed to support the construction, fabrication, and procurement activities needed to realize the building.

1.7.2 Information Technology

Information technology is defined to include all kinds of technology used for the storage, transfer and manipulation of information, thus also including devices such as copying machines, faxes and mobile phones.

1.7.3 Information and Communication Technology (ICT)

ICT in construction can be broken down into different segments for its better understanding and its role in construction. The word Information communication and technology can be understood from different perspectives as well as towards an ICT view, as a whole new meaning of its own

1.7.4 Construction Industry

Sector of national economy engaged in preparation of land and construction, alteration, and repair of buildings, structures, and other real property.

1.8 Expected result

In conclusion, this chapter about general information relate to Building Information Modeling (BIM) in the construction industry. Hence, the researcher can understand it briefly and overall about the studies that have been done. As a result in this study will be to determine the level awareness of use BIM for construction projects in the construction industry and also the barrier in implementation it.

CHAPTER 2

LITERETURE REVIEW

2.1 Introduction

According to Kasim (2011), Construction materials usually constitute a major portion of the total cost in a building construction project. Despite the potential benefit of ICT, convincing construction organizations to embrace its use and implementation has proved a difficult task. Information and Communication Technology (ICT) is a wide-ranging term that includes all technologies for the manipulation and communication of information. For instance, the internet is widely used for electronic mail (email) and electronic commerce (e-commerce) including electronic invoicing, payments and receipt of materials process (Salman Azhar, 2011)

This chapter will provide the review from previous research that is related to this final year project. Also, in this chapter will covers the basis information about Building Information Modelling (BIM) which includes the concept, benefit, implementation of BIM in construction industry. Next, the barrier of implementation BIM are also discussed in this chapter.

2.2 Nature of Construction Industry

The construction industry continues to occupy an important position in the nation economy as stated in Aibinu & Jagboro (2002). However, according to Coates et al. (2010) construction industry is facing trouble with a demand to simultaneously reducing cost, increasing quality, and improving efficiency. A major construction process demands heavy exchange of data and information between project participants on a daily basis based on previous researcher Oladapo (2006). However, the use of Information Communication Technology can impact on the problem of exchange data or information between key players in project. According to Onyegiri & Nwachukwu (2011), the goal of ICT in construction is provide stakeholders with information and analytical tool for best control of the construction delivery process. Hence, ICT in construction is very essential due to connection among key players in construction such as contractor, designer, subcontractor, architect and others that often inhibited communications and teamwork. In construction failure to communicate with the player will cause a project to be halted, delayed, and it also will might the project fail as stated in Hamid Z. (2004).

2.2.1 Information and Communication Technology (ICT) in Malaysian Construction Industry

Through globalization, there a lot of information, knowledge and technology can be shared and transferred easily across countries. Technology enabled people to do their job and daily activities more effectively and efficiently. Hence, construction industry is one of the industries need modern technology for them to increase their productivity and to achieve a better quality of the project. Information Communication and Technology (ICT) used in construction is one of the most important to increase the efficiency of their project. ICT can defined as the application of decision support tools, which uses electronic machines and program for processing, storage, analysis, control, transfer, and presentation of construction information data during the whole life cycle of a construction (Kasim, 2011).

In Malaysia the role of ICT in construction industry in Malaysia has become more crucial. However, construction industry in Malaysia show that rather slowly adopting ICT (Antonio et al., 2012). There are many software and hardware which have been developed to help planning, designing and executing of projects. Hence, in Malaysia Building Information Modeling (BIM) is one of the effort is identified as a key technology and process to improve productivity and increase integration the ICT in construction industry as stated in CIDB (2014). The important features of Building Information Modeling (BIM) are provide an object-oriented database that made up of intelligent objects, the 3D representation of integrated information, and a relational database that interconnected as stated in thesis A. T. Haron(2013). He also said, BIM is could possibly provide a better solution of the problem in construction industry.

2.3 Fundamental of Building Information Modelling (BIM)

2.3.1 Definition of Building Information Modeling (BIM)

It is very essential to know and understand the definition of the Building Information Model and Building Information Modelling. According to Haron, Marshall-Ponting, & Aouad (2010) Building Information Model is represent of building, potentially containing all the information need to construct the building by using the computer and software. Generally, it is refer both models which are representation the physical of the project and also the information contained and attached to the component of model which may include any or all the 2D, 3D, 4D, 5D and nD to achieve the goal of project. Then, the definition of Building Information Modelling is the more explained as a tool that help the project team achieve the final goal. In the other word, it is defined as the act of creating or using a BIM. However, to more clarify of BIM table 2.1 shows the list of definitions of BIM that have been made by individual or organizations through the sequence of years:

Individuals/ Organizations	Definition of Building Information Modeling (BIM)
Autodesk (2008)	BIM is an integrated process built on coordinated, reliable information about a project from design through construction and into operations. It is digital design information and documentation of use accurately visualize, simulate, and analyze performance of project.
Wong, A.K.D., Wong, F.K.W., and Nadeem (2009)	Building Information modelling (BIM) is also defined as a digital system for facilitating a data-rich, object-oriented, intelligent and parametric of a construction project.
Salman Azhar (2011)	BIM is simulate the construction project in a virtual environment. BIM is technology with an accurate virtual model of building by digital constructed.
Whyte (2012)	BIM is the connections between digital technologies and sustainability while the carbon is a motivation for policy of BIM. It also, lifecycle use of BIM with particular focus on areas such as managing waste.
The Journal of Building Information Modeling (JBIM) (2012)	BIM can be viewed as a combination of advanced process and technology that offers a platform for collaboration between different parties in the construction project by exploiting the uses of Information Technology (IT).

Latif A.A., Mohd S., Kasim N. and Fath M.S (2013)	BIM is a set of digital tools that can manage construction projects effectiveness. BIM is a collaborative tool used by architectural, engineering and construction (AEC) industries based on a number of software solutions.
Ahmad Tarmizi Haron (2013)	Is defined as an approach to building design and construction through modeling technology, associated sets of process and people to produce, communicate and analyze building information models.
Jabatan Kerja Raya (JKR) (2013)	BIM is a digital model of the building physical and visualized in 3D contain a variety of information geometry, function, features or parameter produced by some software related.
National Building Information Modeling Standards (NBIMS) (2014)	It is simply the means by which everyone can understand a building through the use of a digital model. Modelling an asset in digital form enables those who interact with the building to optimize their actions, resulting in a greater whole life value for the asset.
Construction Research Institute of Malaysia (CREAM)	The new emerging technologies to be deployed in the design, construction, and facility management in which a digital representation of the building is being created to facilitate the exchange and interoperability of information in digital format

Table 2.1: Definition of BIM from Individual/Organizations

Based on the definitions mentioned that, it can be conclude that BIM is not only technology, but it also a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle as said by Lahdou & Zetterman (2011). They also said, it is important to keep in mind that BIM is something that cannot replace with human (people) but BIM reduces repetitive of work task and easy to post the information. It is still conducted by people who gather and put information into the model.

2.4 The Concept of Building Information Modeling (BIM)

Building Information Modeling (BIM) is about the process of development and use of the computer that generated model to simulate the planning, design, construction and operation of a facility. The concept of BIM as digitalization which the next trend of development in construction industry, by increase more information being digital in nature as stated in C.M.Tang el. (2013). They also said, the important of the inter-dependent cooperation within BIM and the construction industry is information.

According to S. Russell-Smith (2011) the concept of BIM is develop data rich product models and facilitates the realization of integrated benefits. He also said BIM is represent the real world element of a facility such as a walls, doors, windows, and beams become in a three dimensional digital model. Also, BIM become more flexible in order to respond to the highly dynamic computing environment, more autonomous to incorporate the rationale of professionals- in particular on how the professionals filter and process information by using the software solution of BIM according to C.M.Tang el. (2013)

Building Information Modeling (BIM) is rapidly gaining acceptance as the preferred method of communicating the design professional's intent to the owner and project builders according to Bruce. A (2009). He also said that, all the data-rich models can be used by other members of the design team to coordinate a building's various systems (such as electrical or mechanical systems) or identify interferences (Figure 2.1). In addition, members of the build team can use these models as input for preparing fabrication drawings, ordering materials, developing construction schedules or preparing erection sequences

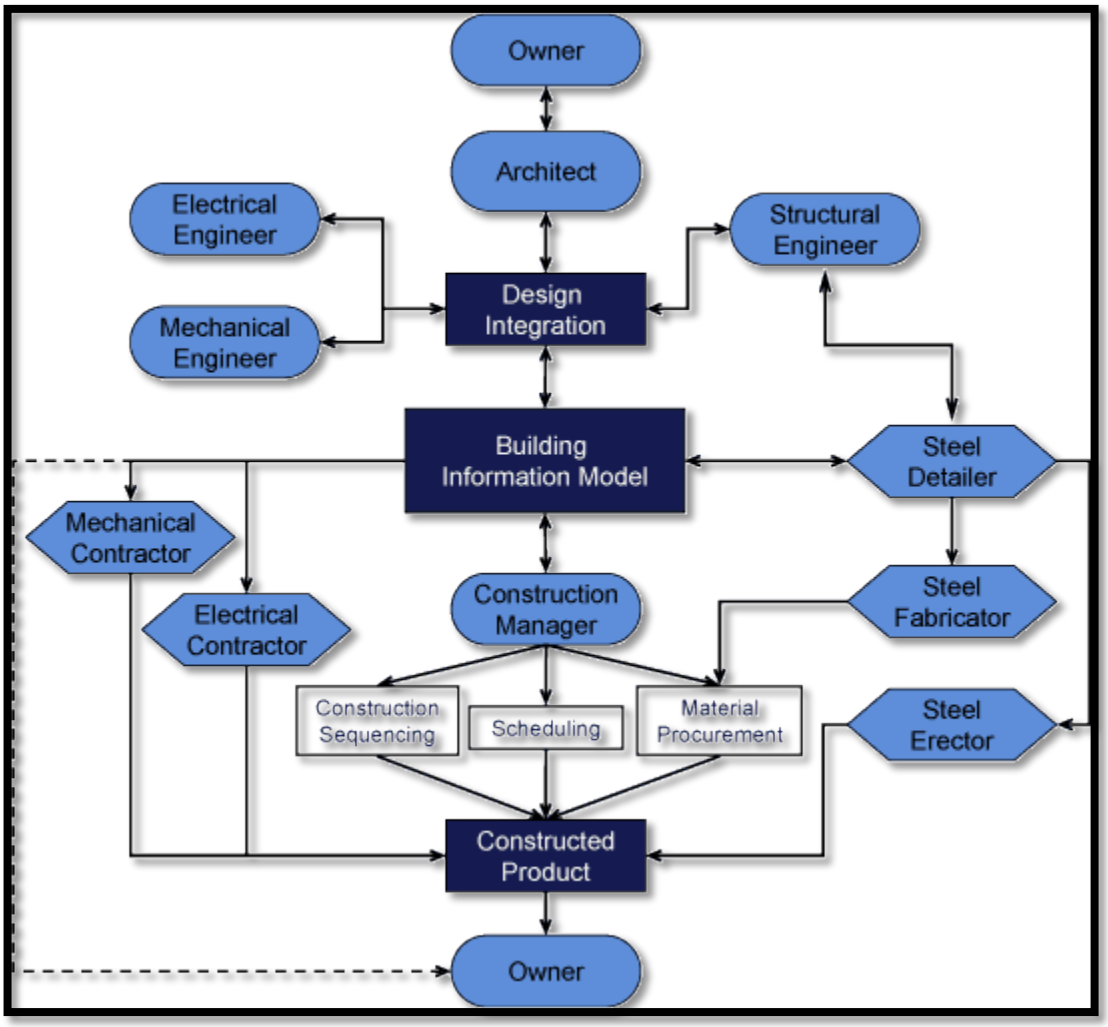


Figure 2.1: The Concept of BIM

(Source: Bruce. A, 2009)

2.4.1 The Importance of Building Information Modeling (BIM)

Building Information Modelling is not the only tool that a digital of physical but also a facility that link with database of project information. BIM as a partnership of architecture, engineering, and construction industry to improve constructability of design and also to avoid project delay, cost overrun and conflict among construction player CREAM (2014). This supported by other researcher which is Fernando (2014), he said BIM offers the better in improvements when it comes to saving costs and time, accuracy in estimation, rework, alterations and the avoidance of error due to the loss of information.

2.5 BIM Tools

Building Information Modeling (BIM) is one of these 3-D modeling tools being used in the construction industry. It is provide opportunities for project members to control the variable of project such as cost, time and quality in more efficient (Porwal & Hewage, 2013). It will become a national modeling standard, which will soon replace the 2D drawings from CAD, and has also been pushing the construction toward green technology, filled with improvements in engineering efficiency according to Grilo & Goncalves J. (2010). Hence, Building Information Modeling is involve into one of the most advance technologies in construction industries. It is require more software to develop it. According to (Wang, 2011) the vendor provide some corresponding BIM solution for Building and site design such as Autodesk, Bentley and Graphisoft.

2.5.1 Autodesk

One of the tool that use in BIM which is software for specializes in strictly clash detection, which is identifying conflicts where structural, mechanical, electrical and architectural drawings do not match up, (Rosen, Knight, & Ross 2010). This software is called Navisworks, developed by Autodesk. Autodesk collaboration and data management software is part of BIM solution to help the project data consistency and to support the getting

the right information to the right time (Autodesk, 2014). Others, Revit for building modeling and civil 3D for site modeling for example Revit Architecture building design software and it could help the architects and designers to develop high quality designs, to get better capture and analyze concepts (Autodesk, 2010).

2.5.2 Bentley

Bentley is another major software company that offers products for architecture, engineering and construction. Bentley, use for manage federated manner and shares thought the entire lifecycle as stated in Bentley (2012). Also, this software provide the civil engineers and designers a flexible 2D/3D tool for land development and site model suitable for commercial building site, campuses as well as drainage project.

2.5.3 Graphisoft

ArchiCAD is mainly developed for Architectural and structural design. However, this BIM tool does have some features that would enable some simple site design.

2.6 The Benefit of BIM

According to Shen XU (2013) stated that Building Information Modelling is about the management information and the difficulty relationship between the social and technical resources in construction industry. In other words BIM is a set of software, 3D models, processes, and databases. All the software application that control the model in order to obtain the objective in construction. In this study the benefits of BIM divided by two part which in overall and benefit in project life cycle.

2.6.1 Benefits of BIM in Three Major Phase in Construction Industry

Building Information Modelling is not just a technology but it also the complete of process by using product of the right software. Also, adoption of BIM it can connects all parties in construction to works together on common information system according to Azhar (2011). In addition, he also added used of BIM wisely since the beginning of the project, BIM can assist the contractors in variety of work problem. However, BIM a technology that can reduce cost, time, material that usage in construction and also misunderstanding among key players. There are benefit for three major phase in construction which are design phase, construction phase, and management phase.

2.6.1.1 Design Phase

During the course of a building project, an architect must balance the project scope, schedule and cost. By using BIM, all of the critical information such as design- and geometry-information is immediately available, so that project-related decisions can be made more quickly and effectively. Furthermore, BIM allows a project team to make changes to the project at any time during the design or documentation process without laborious, low-value re-coordination and manual checking work. In addition, all of the building design and documentation work can be done concurrently instead of serially, because design thinking is captured at the point of creation and embedded in the documentation as the work proceeds (C. Hungu, 2013). Lastly, the automatic coordination of changes offered by BIM would eliminate coordination mistakes, improves the overall quality of the work and helps companies win more repeat business (Autodesk, 2008).

2.6.1.2 Construction Phase

During the construction phase, BIM makes available concurrent information on building quality, schedule and cost. The builder can accelerate the quantification of the building for estimating and value-engineering purposes and for production of updated

estimates and construction planning. The consequences of proposed or procured products can be studied and understood easily and the builder can quickly prepare plans showing site use or renovation phasing for the owner, thereby communicating and minimizing the impact of construction operations on the owner's operations and personnel. The result is that, less time and money are spent on process and administration issues but goes into the building (Autodesk, 2003).

2.6.1.3 Management Phase

In the management phase of the building lifecycle, BIM makes available concurrent information on the use or performance of the building, its occupants and contents, the life of the building over time and the financial aspects of the building. Moreover, the provided digital record of renovations accelerates the adaption of standard building prototypes to site conditions for businesses of similar buildings in different locations. Furthermore, BIM also provide the physical information about the building such as finishes, furniture and equipment's or financially important data about leasable areas and rental income or departmental cost allocations are all more easily managed and available. Generally, it can conclude that the consistent access to these types of information improves both revenue and cost management in the operation of the building (Manning R., 2014).

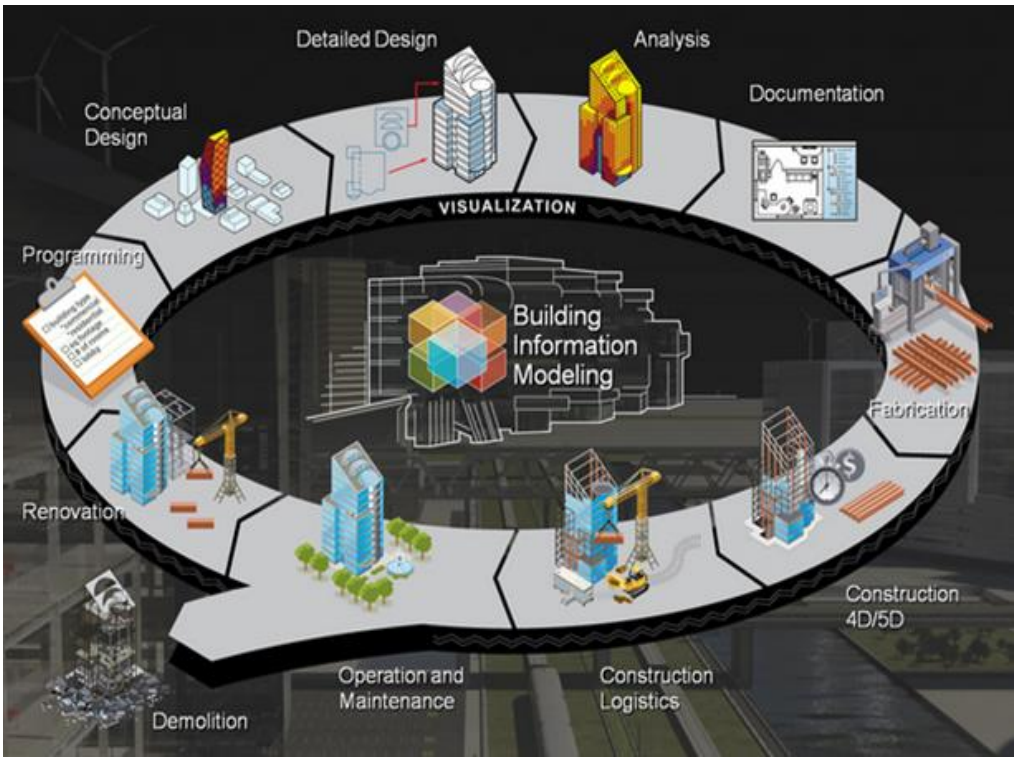


Figure 2.2: Entire Building Life Circle through BIM Technique

(**Source:** K. Dispenza / Buildpedia.com)

Refer to the figure above, the Building Information Modeling carries out the project from start to the end of demolition phase which visually present details on the construction phase. However, according to Mehmet F. (2011) during the design phase, the use of BIM can maximize its impact on a project since the ability to influence cost is the highest. The team can creatively come up with ideas and provide solutions to issues before problems become high cost impacts to the project. This can be realized through the cooperation and coordination of the entire project staff. Therefore, it is extremely important to have a good collaboration.

2.6.2 Advantage of BIM

There are several advantage of using Building Information Modelling for communication, collaboration, coordination, clash detection, and risk management.

2.6.2.1 Communication

BIM is one of the solution that enable for share the understanding and successful communication more effective especially during design development in project. It is achieved by creation of virtual preconstruction models so that the keys player in the project can drive the direction of the client need. Coates, Arayici, Koskela, and Usher (2010) said the design review is not prescribed with predetermined image and views taken from preset perspectives. Another benefit is most project use a different set of consultant and the task of assembling each new project team should focus on quality work, so by using BIM project team have more potential work opportunities because it is easier to forward the data. According to Epstein. E. (2012) the potential communication problem is when only use individual technology and disparate applications

2.6.2.2 Collaboration

BIM is the combination of advanced process and technology that will provide a platform for collaboration between different parties in the construction project by utilize the Information Technology (IT) as stated Zakaria et al. (2013). BIM has set new collaborative and quality standard Epstein. E. (2012). Collaboration using BIM is encourage by innovations such as web-based application to quicken meeting via cell phones and the internet. This can directly reduce the cost and time by allowing this to take place via web meetings and web-based conversation Integrated project collaboration (IPC) software has taken the BIM process to making possible real time collaboration and exchange of data between project teams.

2.6.2.3 Coordination and Clash Detection

The advantage of BIM for coordination process is easy to determine field conflicts by using 3D model of building as stated in Mohd and Latiffi (2013). The ability of BIM in avoiding design clashes that can the quality of project design improved. Other than that, every stage in construction have conflict, BIM is provide for detect potential problem as early as in pre-construction. So, it can avoid the potential problem in construction for the next stage according to Zheng (2013). For the conventional approach, usually in 2D drawing, clash detection process is done by overlaying 2D plan drawings to visualize the location of the system components in 3D space. However, by the exploitations of 3D parametric modelling between architect and structural engineer, this task can be done within a short time and is more accurate compared to traditional method (Zakaria et al., 2013)

2.6.2.4 Risk Management and Quality Control

In the construction project, there is a lot of risk in every phase. According to Tang (2007) the most important risks happen in project are poor quality of work, premature failure of the facility, safety, and financial, and also incorrect design risk. However, risk is about managing what might go wrong. BIM is use to reducing the potential risk in construction as stated in Epstein. E. (2012). Risk management in BIM is about the impact of quality of work produced affected the quality of a project. The advantage of BIM is the important about quality control. A major errors of construction project is the duplication of data such as the time worker work, the cost or duration of project. However, BIM is use for each team works separate database, the problem of that is eliminated.

2.7 Implementation of BIM in Construction Industry

Building Information Modelling is Building information modeling (BIM) is becoming more and more important to manage complex communication and information sharing processes in collaborative building projects (Sebatian and Léon, 2010). BIM is now increasingly used as an emerging technology to assist in conceiving, designing, constructing and operating the buildings in many countries, notably in the United States. Other countries including Finland, Singapore, Denmark and Norway have also adopted BIM (Wong et al, 2009)

2.8 Awareness and Use of BIM

According to National BIM report (2013), stated that the awareness of implementation of BIM is increase especially in UK. In figure 2.3 show that the awareness of construction in UK. According to Macgough D. (2013) government in UK will mandatory in 2016 all project use BIM. Hence, when compared to traditional 2D CAD systems, BIM is a more efficient way of handling information connected to the project or the building. Adoption of BIM enables changes in work processes that can streamline the performance in construction projects. Adoption of BIM is not only a change in technology there is a need for substantial changes in work processes in order to make improvements to productivity. BIM is a tool to improve processes in order to reach certain goals.

According to Tan (2011) from his thesis which is only limited in scope Quantity Surveying discipline, the level of awareness of BIM in the quantity surveying profession is low in Malaysia. Hence, the usage of BIM within the Malaysian Construction Industry only received seventy responses from quantity surveyors as stated in his thesis. While the other researchers understand the usage of BIM it was found out that Architects and Engineers in

Malaysia are aware of BIM but not many of them are implementing this technology due to some barriers according to Rifin. M (2011).

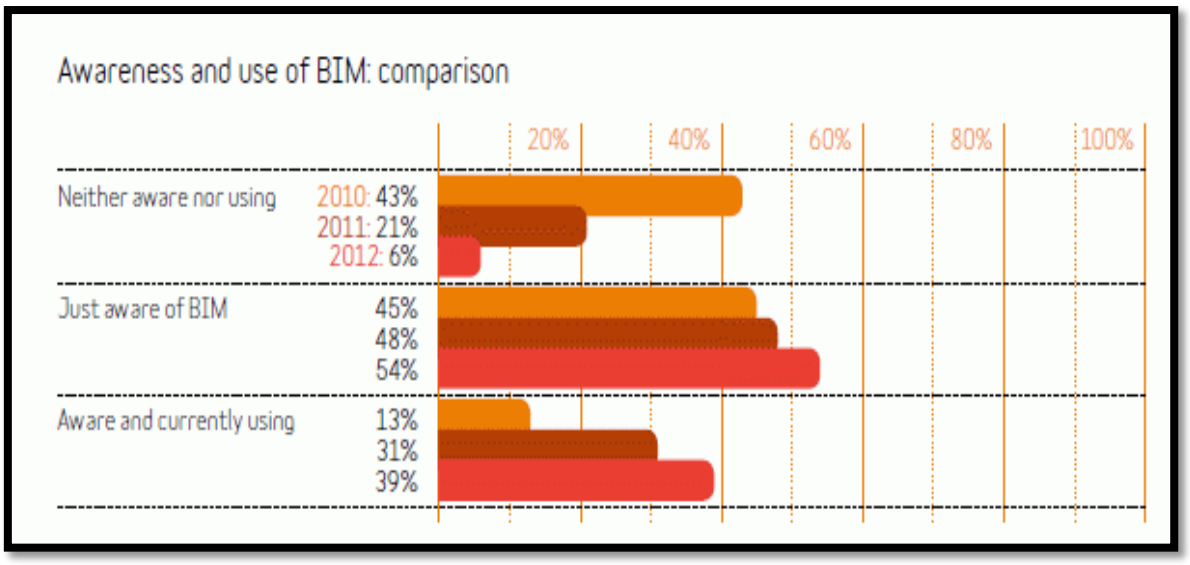


Figure2.3: Level awareness in UK in year

(Source: National BIM Report, 2013)

2.9 Barrier in Implementation of Building Information Modeling (BIM)

According to Zakaria et al. (2013) Building Information Modeling is able to help a clear communication between client, consultant, and contractor in construction project by providing a system for exchanging digital information in one or more agreed format. It is can reduce the inconsistency in construction. The challenge of adoption BIM can be divide by two which are non-technical and technical (Salleh & Fung, 2014). Usually, non-technical is the challenge are related with the people and organizational culture. Then, for the technical the show that resistance in upgrading the technology, compatibility and the complexity. The table 2.2 show the summarized of the research related with barrier or challenge in implementation of BIM among construction industries.

Author	Focus area	The main barrier of implementation of BIM
Haris M., Ani I. C. A., Haron A. T., and Husain A.H. (2009)	The way forward for building information modeling (BIM) for contractors in Malaysia.	Two critical issue which is people and technology. Technology regards the application requirement, technology system risk, and financial risk.
Z.Zahrizan, N. Ali, A. Haron, A. Marshall-Ponting, and Z. A. Hamid (2013)	Exploring the Barriers and Driving Factors in Implementing Building Information Modeling (BIM) in the Malaysian Construction Industry : A Preliminary Study	The finding in this study the lack of government involvement worsens the situation besides having the resistance to change from people.
H. Salleh and W. Fung (2014)	BIM application: focus-group discussion.	This study ascertains critical barriers and appropriate strategies for the application of BIM through qualitative approach via focus group discussions. The findings reveal that the cost of implementation is not indicated as a critical barrier, and that the lack of expertise, training, and awareness, is more critical in that respect.

Haris M., Ani A. I. C., Haron A.T., and Husain H. A (2014)	The Way Forward for Building Information Modeling (BIM) for contractors in Malaysia	In this study discuss about the barriers of adoption BIM because of contractor which is the initial expenditure such as purchase of software, conduct BIM training and use of BIM time consuming. Next, the barrier from consultant which is the cost for BIM is high.

Table 2.2. The summarized of the research related with barrier or challenge in implementation of BIM

In addition, the challenge for adoption of Building Information Modeling is because people need to change the way of their current working process, changing in staffing needs, and organization. They also need change the managerial function and hierarchy such as the roles and responsibilities in organization. (Zakaria et al., 2013). The adoption of BIM has difficult because lack of BIM expertise in construction industry as stated in Salleh & Fung (2014). They also said in process implementing BIM it is difficult because BIM is not a straightforward. The process to implement BIM is would only be limited to purchase and installation of the new BIM software into the working environment. Hence, it is require practices, skill and information technology (IT) to help organization implement the BIM. Then, another barrier that to implement the BIM is when companies faced to manage resource and information, after complete implementation of BIM and network based integration (Autenrieth & Lipsey, 2011).

2.10 Summary

This chapter had review literature cover all the objectives of research such as level awareness and barrier in implementation of BIM. Hence, the research topic also defining the BIM concept, the use of BIM and also the barriers of implementing and conclude with the review of some identified strategies to promoting BIM adoption. Thus, it is essential to have ICT in construction to avoid project failure and information is conveyed successfully.

CHAPTER 3

RESEARCH METHODLOGY

3.1 Introduction

This chapter describes the methods used in carrying out the study. Research methodology will conduct to achieve the objectives and scope of this study. It also will be explain about the population and sampling techniques, unit of analysis, data collection techniques, questionnaires and instrument design and lastly about statistical analysis techniques.

3.2 Research Design

In research, it is important for us to determine the respondents that we are going to do research on. In this research, the respondents are mostly the project managers. The project manager is one of the highest percentage in the distribution because they were thought to be the key players in industry who handle Building Information Modelling (BIM) in the overall of the project because project manager is a leader to make sure the project team is conducted. To have a better research design, flowchart is importance in order to help researchers conducting the research in more organize way. Figure 3.1 illustrated the flowchart of methodology regard to this research.

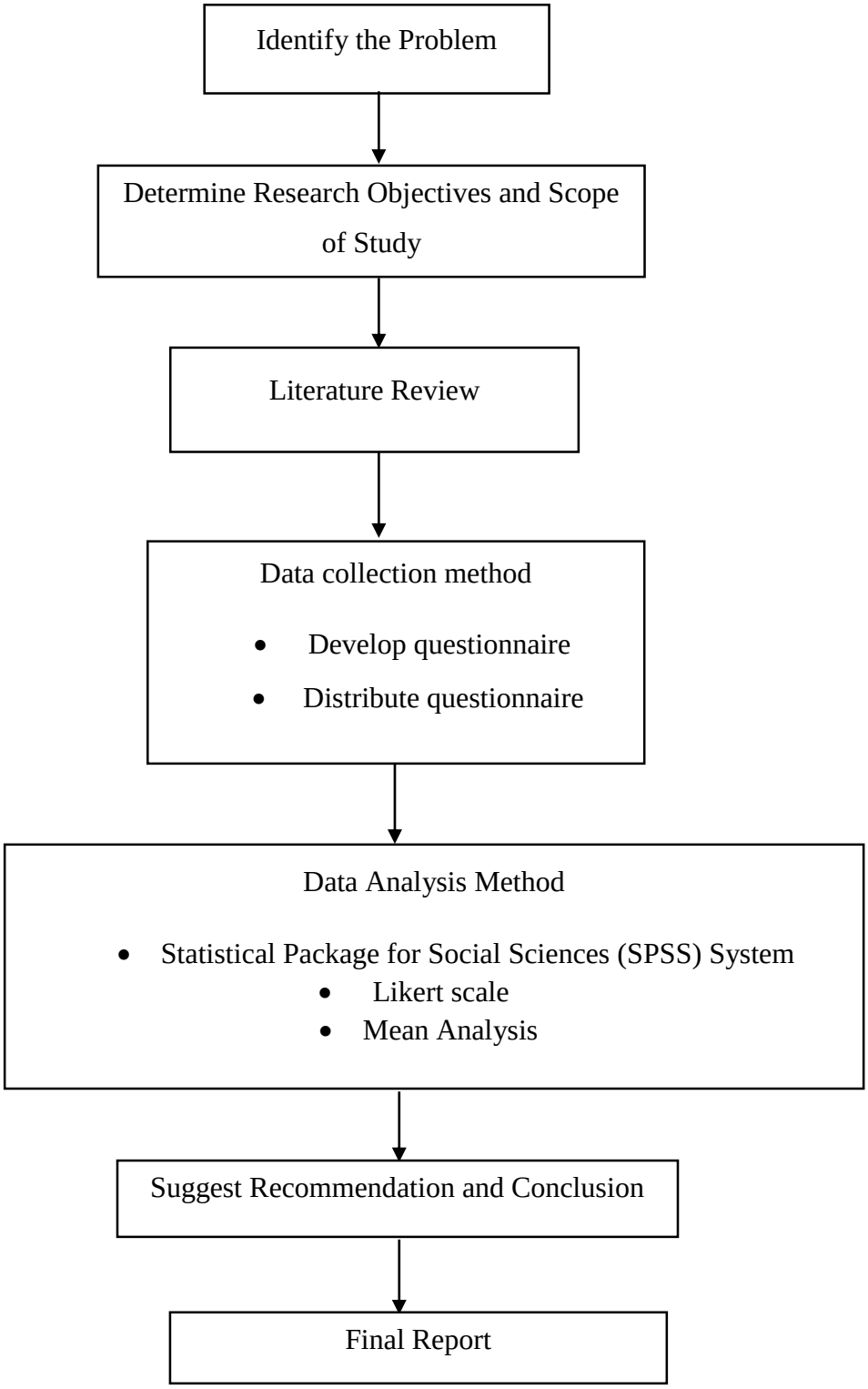


Figure 3.1: Flowchart of methodology

3.3 Research Method

In this research study, the quantitative method which is descriptive design of survey by using questionnaires for obtaining primary data to find out the implementation of BIM in construction industry. Primary data is a survey of questionnaires being deliver to the respondent from chosen contractor. By using this method this method in this study because it can generate the information from a large group of sample in the same industry. Secondary data also used in this study to obtain more information from analysis and research done by people. Then, scondary data can be obtain from journals, books, articles, conferences, newspaper articles and internet as well. This data is very important in order to identify the knowledge of BIM concept. Besides, the barrier in implementation of BIM can be determine that proposed by various researcher around the world.

The survey questionnaire is also designed based on the subtopics in the literature review. Survey-based methods were used to gain better understanding about the benefit of implementation Building Information Modelling (BIM) among project managers and it also used to collect detailed information. This questionnaire were used because of many factors such as ease for respondents to complete the questionnaires without taking a long time, more respondents were selected as the sample for this research and save time and cost when compared with other data collection methods.

3.3.1 Questionnaires and Instrument Design

The questionnaires for this study will be in close ended question to ensure respondent make quick decision and help me as a researcher in coding the information for analysis the collected data. Instead of using open ended question, this research will use close ended questions format in which the respondents only need to select their answer by choosing in the scale lists provided.

The quantitative data collection will be used by using questionnaires. Web based questionnaire will be used. It is a new and inevitably growing by utilizing internet based. The questionnaires are sending by email to the respondents which are works in construction industry in Kelantan.

Meanwhile, using the mail approach there is some time that might be taken some period for respondent answer the questionnaire. There is also a possibility that respondent do not give their respond to the questionnaire. The respondent will give a specific time to respond which is one week. After one week, the response from email questionnaire will be collected and count. The questionnaires will distribute and sent to the respondent which G7 construction companies in Kelantan based on web based questionnaire and paper-pencil-questionnaires.

3.3.2 Development of Instrument

The questionnaire is design according to the objective of this research. According to (Leung, 2001), the design decision are depend on the purpose of the study, the nature of problem and the alternative appropriate for its investigation. Also, to obtain accurate relevant information for our survey in study.

Hence, the questionnaire consists of three main parts which are part A, part B and part C. Part A is the questions that are in nominal scale which is used for the developing which focus on respondents demographic. The demographic criteria are consists of 5 question of respondents background which is about the respondents' age, education level, experience in construction, numbers of project involve and current use of Information technology. This is very essential part because we need to know the detail about respondent to make the researcher easy to analyze and measure the data that gathered from respondent. Then, part B will contain about the objective one which to study about level awareness in implementation of BIM. Last, part C which is this part will obtain the objective two which the barrier in implementation of BIM in construction industry. All the questionnaire of this

research indicator based on the Likert scale. Usually, this Likert scale have the indicator 1 to 5 and it can categorize as strongly agree, agree, neutral, disagree and strongly disagree.

The questionnaire is design according to the objective of this research. The questionnaire categorized and divided into three (3) part. All the questionnaire this study was adopt and adapt from other previous study. The questionnaire will be modified to match with the objectives in this study. It is begin with questions with general in part A, and questions which are designed according to objectives in part B and C. The detail about each part of the questionnaire are below.

Part A: Demography

The questions are about the personal detail of respondent that work in construction industries in Kelantan which is project manager. The respondents will be ask about age, education level, year of experience in construction, numbers of project involve and current use of information technology in construction. All the question in this part is very important to make this research is reliable.

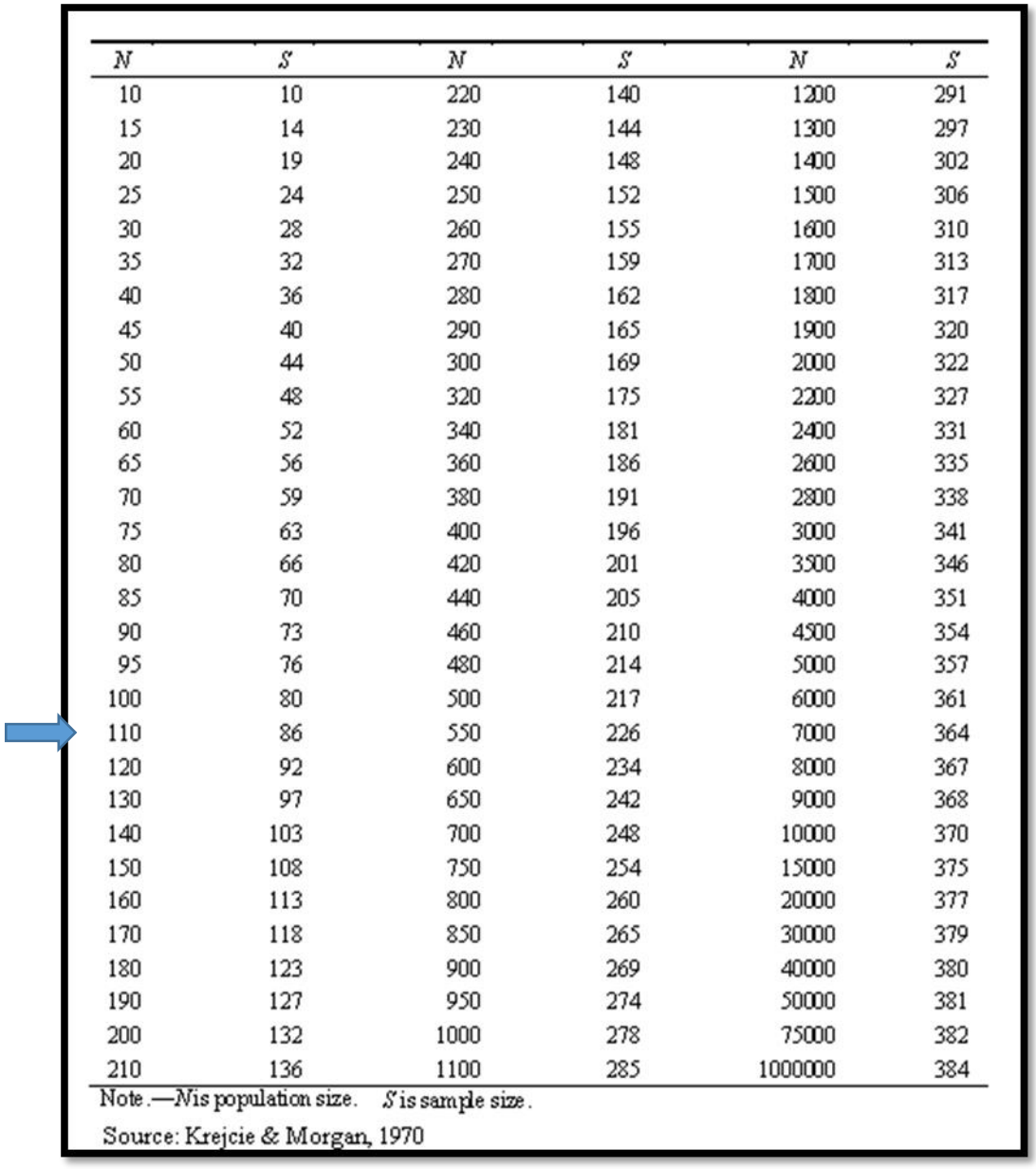
Part B: Level awareness in implementation of Building Information Modeling (BIM).
This part is more focus on the knowledge of respondent about Building Information Modeling (BIM). The statements are in relation to BIM in construction such as the benefit of BIM, management, effectiveness and other that related with BIM. The questionnaire for this objective adapted from Rogers J.P. (2013) and guideline BIM published by CIDB.

Part C: Barrier in implementation of Building Information Modelling (BIM)
The questions is will be identified about objective of this study related with the barrier in implementation of BIM in construction. The questionnaire for this objective is self-administered which take from the literature review and based on the past review from others study. The source of this questionnaire is Park K. S & Kim K.P. (2014), Yan H and Damian P (2008)

3.4 Population and Sampling

The important things before start the survey is to select the respondent who will participate in this study. The respondents in this study are all project manager in East region of Malaysia which is in Kelantan states. Generally, this study will discuss about the awareness of implementation Building Information Modelling (BIM) in construction. The method used in this study to obtain the data of the companies in construction industries that operate in Kelantan which companies who registered in Construction Industry Development Board (CIDB). To be more specific, the companies chosen to be the sample for this research is companies who registered in G7 only.

The total population for this research is 110 respondents and according to Morgan table below, the sample of respondent for this research is 86 it is enough to get the research valid and reliable. This research uses simple random sampling because every element in the population has a known and equal chance of being selected as a subject. By this selection, it will provide more information for a given sample size and all the same time provides some might on the usage BIM among project manager in construction industry. This research uses non- probability sampling because every element in this population has known and equal chance of being picked as a subject. Moreover, non-probability sampling is more accurate to research for a big size of sample. Despite this research only needs six months which is difficult to gain data in short time. Non-probability sampling help to gain data in a very short time



N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Table 3.1: Table for determining sample size

Source: Krejcie and Morgan, 1970

3.5 Data Analysis

Analyzing the data is the further step in conducting this study. The data that have been collect from the sample need to analyze by using a specific methods and tools as stated (Sabine Landau, 2004). The collected data were analyzed using the Statistical Package for the Social Science (SPSS Version 21) software. This technique used to calculate and determine the information according to answer from respondents in survey questionnaires. The question which used Likert scale and numbered as 1, 2, 3, 4, and 5. Each of the questions in questionnaire was label as V1, V2 and others. It is will make easier in identify it. They were keyed in into the SPSS for the statistical technique.

3.5.1 Likert Scale

Originally developed by Rensis Likert (1932), this type of rating is the most widely used attitude scaling technique. Likert rating scales are used in various settings, including clinical, educational, administrative, and organizational contexts. The reasons for its popularity including relatively easy to construct, yields reliable scores and flexibility in its ability to measure many types of affective characteristics.

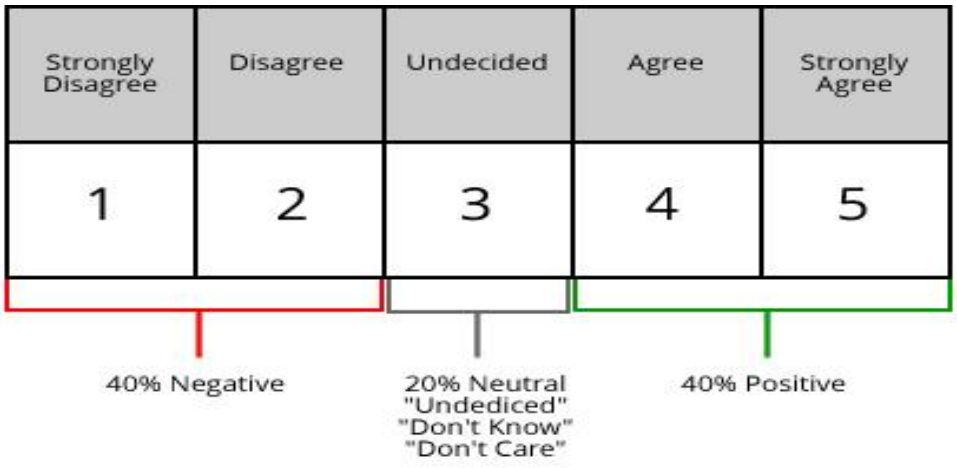


Figure 3.2: Table of Likert scale

3.5.2 Mean Score

The finding of the questionnaires will be analyzed to determine the mean and percentage. As stated to Mohd Najib Abdul Ghafar (2003), he said the range and mean analysis to interpret the overall analysis of questionnaires based on the table below.

Mean Score	Level
1.00-2.33	Poor
2.34-3.66	Moderate
3.67-5.00	Good

Table 3.2: Interpretation of mean value range

3.6 Summary

The important of research to be carried smoothly, a proper framework of research methodology must be first prepared. This is because the research methodology is very essential process to achieve the research objectives. This research methods show the sampling technique is non-probability sampling which is use simple random method. It also describe the data analysis in this research for gathering data. Thus, the overall elements in methodology an important to researcher conduct the research. That is because, the data analysis and the finding clarification that are according to the fulfilment of the objective of the research as stated in Chapter 1 before drawing up a conclusion.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter shows analyses of the data which were collected through questionnaires as described in the chapter three. The findings of the research are related to the research questions include a demographic section, question in section B and question in section C which this section are related with Building Information Modeling (BIM). The finding data from demographic section will be structured by showing the profiles of the respondents through descriptive statistic and followed by the result of descriptive analysis for level awareness and barrier of implementation of Building Information Modeling.

4.2 Return Rate of Questionnaire

Questionnaires have been email and personally distributed by the researcher to respondents. In this study, the respondents are 110 companies which register in Grade 7 in Kelantan. However, the respondents would be needed in this study are only 86 respondent that represent as a population in this study. 42(38.5%) questionnaires were not returned by the respondents and 67(61.5%) questionnaires were successfully collected. From the collected questionnaires (61.5%), the usable questionnaires were 65(59.7%) and unusable is 2(1.8%). The return rate is (61.5%) is acceptable where if there is at least 60% response rate to survey therefore the researcher had obtained enough response from the population (Johnson, 2010).

	N	Percent (%)
Total Questionnaires	110	100
Number of Usable Questionnaires	65	59.7
Number of Unusable Questionnaires	2	1.8
Number of Uncollected Questionnaires	42	38.5

Table 4.1: Survey Return Rate

4.3 Demographic Profile of Respondents

This section discusses the result of analysis on the demographic of respondents. The descriptive data reported in this study were based on 65 respondents who are in the construction companies in Kelantan.

4.3.1 Highest academic qualification

	Frequency	Percent
PhD	1	1.5
Master	24	36.9
Bachelor Degree	26	40.0
Diploma	14	21.5
Total	**65**	**100.0**

Table 4.2: Respondents of Highest Academic Qualification

Based on the table 4.2 shows the respondent's profile on academic level. Academic qualification is very essential to know which level is the respondent from. It was found that most of the respondents have the highest qualification are bachelor degree which 40.0 percent. Then, master is the second highest qualification of respondents with 36.9 percent

and followed by diploma which 21.5 percent. The data analyze that the respondent's education levels from PhD is the least with 1.5 percent.

4.3.2 Experience in Construction Project

	Frequency	Percent
Under 5 years	11	16.9
6 to 10 years	27	41.5
11 to 15 years	21	32.3
16 to 20 years	6	9.2
Total	**65**	**100.0**

Table 4.3: Respondents of Experience in Construction

The table 4.3 show about the data of years of experience respondents in construction. The output of this data show that, the most of respondent are working with organization for 6 to 10 years that represent 41.5 percent and followed by 11 to 15 years with 32.3 percent. Then followed by respondents who under 5 years in construction with 16.9 percent. The data also shown the less data are from the respondents that 16 to 20 years of working experience in construction.

4.3.3 Types of Projects

	Frequency	Percent
Building	35	53.8
Industrial	18	27.7
Highway	9	13.8
Tunneling	3	4.6
Total	**65**	**100.0**

Table 4.4: Respondent's Type of Projects

Based on the above table that illustrates the respondent's frequency about the project type on which project that the respondent involved. Majority of the respondents with 53.8 percent worked in building construction projects, followed by industrial with 27.7 percent. Then, 13.8 percent represent the project from highway. The lowest is from tunneling with 4.6 percent. The result shows the target respondents are well chosen relevant to the scope of study.

4.3.4 Heard of Building Information Modeling (BIM) Solution and Application

	Frequency	Percent
Yes	37	56.9
No	28	43.1
Total	**65**	**100.0**

Table 4.5: Respondents Known about BIM Solution and Application

Based on the table above show that majority of the respondent are heard about Building Information Modeling represent 56.9 percent. However, 43.1 percent represent the respondent do not heard about BIM. It is show that more respondent already heard about BIM in the construction.

4.3.5 The Company Applying BIM in Construction Project

	Frequency	Percent
Yes	8	12.3
No	53	87.7
Total	**65**	**100.0**

Table 4.6: Respondents of the Company Applying BIM in Construction

The table 4.6 show that more than a half of the contractors do not applying Building Information Modeling in their project. The total of frequency of company do not applying BIM in their project which 87.7 percent. Then, remaining of respondent with 12.3 percent with represent the company applied BIM in their project.

4.4 Descriptive Analysis

Descriptive statistic was used to measure the level awareness of implementation Building Information Modeling (BIM) and the barriers of BIM implementation in construction industry and discuss about mean for all variables.

4.4.1 The level awareness of implementation BIM in construction

The table below shows about the data have been analyze by using descriptive analysis for question section b. The data below explaining the answers the objective of the level awareness of implementation BIM. The objective are listed in the questions are have been rate using likert scale technique.

Item No.	Items	N	Mean	Std. Deviation
1	Familiar on the term BIM	65	3.92	1.04
2	Aware on various short courses to support BIM implementation	65	3.43	1.12
3	Aware on government enforcement of using BIM	65	3.94	.81
4	Knows various types of software to implement BIM	65	3.31	1.07
5	BIM allows better understanding for design	65	3.42	.89
6	BIM's ability to capture specifications in the model	65	3.57	.88

7	BIM's built-in and accurate scheduling capabilities	65	3.84	.93
8	BIM allows better documentation with less errors	65	3.85	.75
9	BIM reduce the overall project cost	65	3.77	.96
10	BIM shortness the overall project timescale	65	3.83	.87
	Total Mean		**36.87**	
	Average Mean		**3.69**	

Table 4.7: Statistic of the level awareness of implementation BIM in construction

The table 4.7 above shows that, there are some of the result show the highest mean in this section is 3.94 which respondents are aware on government enforcement of using BIM in their project. Then, the second higher is the respondents are familiar on the term of BIM it is represent mean score with 3.92. It is show the respondents know about the BIM because it show some of the respondent already familiar with the term of BIM in their project. The third higher mean score in this section is respondent with 3.85 shows that respondent agree BIM allow better documentation with less error. This is one of the essential function of BIM where the model itself contains a lot of information regarding the project.

There are also shows the result that mean score with the least agree from respondents. Firstly, knows various type of statement to implement BIM which is a 3.31. It is might be the respondent think that BIM is only have a software or BIM only can change 2D paper drawings in 3D model. Secondly, the least mean score is about BIM allows better understanding for design with represent 3.42. The third least means score in this section is the level of aware on various short course to support BIM implementation with represent 3.43. It is shows that the respondent not aware on various short course to enhance BIM implementation in a project.

From the findings, indicate that the level awareness of implementation BIM among project manager in construction industries is good with the average mean is 3.69. This contradicts with the past researcher in chapter 2(literature review). According to N.Kasim (2011), he explain that limited usage of ICT tools it might be the low awareness to benefits in ICT implementation in construction industries, this statement might related with implementation of BIM is quite low. However, the finding of result from this research it show that the respondents are ready to adopt BIM in their company to increase the quality and performance in work. It shows the respondents already know about benefit of BIM in construction.

4.4.2 The barriers of BIM implementation in construction industry

This section describe about the barrier of BIM implementation in construction industries in Kelantan. The table below have been analyzed the data of the respondent in this section c.

Item No.	Items	N	Mean	Std. Deviation
1	Lack of knowlegde about BIM	65	3.60	.99
2	Existing CAD system fulfils our need to design and draft	65	3.54	.81
3	BIM is too expensive	65	3.97	.81
4	Lack of training on BIM software	65	4.01	0.86
5	Current technology is enough	65	3.15	1.06
6	BIM lacks features or flexibility to create a building model/ drawing	65	3.48	2.56
7	Waste time and human resource	65	2.75	.88
8	Application of BIM will effect the current process practice	65	3.12	.86

9	Application of BIM will effect the current productivity	65	3.03	.97
10	Legal or contract issue	65	3.03	.90
11	Unsuitable for the project	65	2.60	.92
12	Reluctance from client, contractors or consultant to implement BIM	65	3.14	.58
13	Lack of data on return on Investment of BIM	65	3.28	.89
14	Software related	65	3.91	.76
	Total Mean		**46.61**	
	Average Mean		**3.33**	

Table 4.8: Statistic the barriers of BIM implementation in construction industry

The table 4.8 above indicates that respondent answering the questionnaires about barriers of implementation of BIM. It shows that, the highest mean score in this section is 4.01 which is represent lack of training. This is might the respondents agree when there is no clear guidance or best practice to learn and build up their capacity for BIM use in their company. Mostly, the respondents agree that the primary identified as a barriers. Then, the second higher mean score in this section is 3.97 which is represent that BIM is expensive. Followed by, the software related with 3.91. The software related such as high software cost to implement BIM in company.

In addition, the least mean in this section is unsuitable for the project. The results of these questions is 2.60 shows that the respondent not totally agree on the barriers in BIM. Next, the result for the statement waste time and human resource is also least which is 2.75. the least mean score shows that also respondent do not agree with the barrier of BIM implementation in construction industries in Kelantan. Followed by, application of BIM will effect the current productivity and legal or contract issue which are both statement are represent the mean score is 3.03. It shows that the both barriers of implementation BIM is not the challenging of barriers.

From the findings the table above shown the entire 65 respondent had managed to identify the barrier of BIM implementation in construction industry. As the result of the average mean indicate that 3.33 which consider as in moderate. It is show the respondents are knowledgeable about the barrier by implementing BIM in their company. However, the barrier that had been listed in questionnaire may not the critical barrier to implement BIM in their organization because of that the result of average mean show it is moderate. Respondents of this study might have another barrier that the most critical among them. In the other hand, the respondent agree the most barrier is lack of training and BIM is expensive. This result was supported with Zahrizan, Z., Ali, N. M., Haron, A. T and Hamid A.(2013). In their study BIM technology is difficult and it may increase the cost of the project. This also include the barriers may face in term of cost for the trainnig worker to handling this technlogy.

4.5 Summary

This chapter described the results and findings of the study in describing and answering all research questions that were idenfield from Chapter One. The findings of the study included demoghraphic information of the respondnets such as their highest academic qualification, length of experience in construction, the type of project involvement, heard of BIM as solution and applications and as about the company applying BIM in construction project. The next section discussed the findings of the study which answered all the research questions and analyzed it. The result obtained hoped to increase the understanding of about BIM in construction industries.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter focused on the discussions about the results of the findings presented in Chapter Four. It includes the analysis of demographic background, the level awareness of implementation BIM among project manager and the barriers of implementation of BIM in construction industries in Kelantan. It will answered all the research questions of the study. In addition, some recommendations are proposed for those who have willingness towards conducting similar researches in this ares in the future.

5.2 Recapitulation of This Study

The first objective for this is to study the level awareness of implementation BIM among project manager. Second objective is to identified the barriers of implementation BIM in construction in Kelantan. Both of these research objectives had beend mentioned in chapter one with the problem statement, research questions and expected result.

Next, in the chapter two discussing about the statement that carried out from the literature review that related with this study. Based on the literature review, researcher develop questionnaire to survey whether the statement from the journal is trus or not and indentified the level awareness and the barriers of implementation BIM in contruction industry in Kelantan.

Then, in the chapter three is discussed on the research methodology that will be used in order to collect the data. Besides, in this chapter also discussing about how the researcher construct the questionnaire. The researcher refer to the journal in order to develop a questionnaire then after the example of questionnaire from the past rearcher is being identified, researcher modified the questionnaire by following the design questionnaire. Meanwhile, chapter three also discuss about the total population fo the respondent for the research.

In the chapter four, it is discuss about the data analysis that being used such as desricptive analysis and find the means score for the questionnaire. In this chapter also, the researcher analyse the data by using SPSS. However, for the final chapter which conclusion and recommendation are will provide some ideas and give suggestions for the future study and develop improvement as well.

5.3 Limitation

In this research, there are several limitation In this research, there are several limitation involved during conducting this research includes in collecting data analysis. First is because of the timing, regarding the time given is limited due to other commitment with other subjects and activities. In term of questionnaire, some of respondents not answered the questionnaires completely. Besides, some of them not give feedback at the questionnaires given because of they not have enough time to spend for answered the questionnaires. So, the double effort needed to make sure this research will complete within the time given. Furthermore, some of contractor are not in the office during the questionnaires was distributes because they are out due to other commitment at the site and cannot be reached.

Other constraints for this research is also faced problem with the literature is limited to address the scope of this research. With solicited literature, not many are relevant to the scope of this research. Although the articles and journals are available, not all of them can be used.

5.4 Conclusion

The purpose of this research is to study the implementation of Building Information Modeling in construction industry in Kelantan as mentioned in chapter one. The result of this study related with two objectives are showed below to fulfil the aim of the research.

For the first objective is to study the level awareness of implementation BIM among project manager.From the finding that have been discussed in Chapter Four (4), the level awareness of implementation BIM among project manager is aware. From the average mean have been done to answer research question the result show the level awareness of implementation BIM among project manager is good.

Next, second objective is to identify the barriers of BIM implementation in construction industry in Kelantan. It is analyse which part of the barrier are the critical. From the finding it can conclude that the most difficulties of implementation of BIM in construction industry are lack of training and the respondents agreed that BIM is expensive.

5.5 Recommendation

It is recommended that a lot of research about Building Information Modeling (BIM) should be established so that the effectiveness of BIM implementation in construction industry will be increase.

Other than that, the government needs to give an incentive to the company especially the key player in the construction to promote the implementation of BIM in construction industry. Also, the appropriate party must take action in establishing a lot of courses on BIM in order to train the workers on how to use BIM. Hence, it will be a lot easier for the company to become skillful using the BIM in a company.

Then, advertisement, campaign and brochure can be used to promote BIM to the contractors in Malaysia. Hence they will be able to knows various types of BIM and also understand the procedure on how to implement BIM. So, they will not hesitate anymore to implement BIM in their construction project.

5.6 Chapter Summary

This chapter represented the discussion of the final chapter of the study which covers conclusions and recommendations. This section also provided the summary of findings in answering each and every research questions.

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Appendix A

Questionnaire

Questionnaire on Implementation of Building Information Moedling (BIM)

in construction Industry

This questionnaire are to collect data for the fulfilment of the final year project.

The objectives of this questionnaire are:

i. To study the level awareness of implementation Building Information Modeling in construction industries in Kelantan

ii. To identify the barrier of implementation BIM

All data will be kept confidential and used anonymously for research purpose only.

Section A: Demographic

Please TICK (/) on the appropriate box as provided below.
Respondent particulars

1) Your highest academic qualification?

☐ PhD ☐ Diploma

☐ Master ☐ Certificate

☐ Bachelor Degree ☐ Other, please specify _____

2) How long experience do you have in construction project?

☐ Under 5 years
☐ 6 to 10 years
☐ 11 to 15 years
☐ 16 to 20 years
☐ Above 21 years

3) What type of project your company involved?

☐ Building ☐ Industrial ☐ Highway ☐ Tunnelling

☐ Others, please specify _____

4) Have you heard of Building Information Modeling (BIM) solutions and applications?

Yes ☐ No ☐

5) Did your company applying BIM in construction project?

Yes ☐ No ☐

Section B: The level awareness of implementation of Building Information Modeling(BIM)
Please tick (/) in the appropriate box. Answer given according to the scale below.
(1=Not at all aware, 5=Extremely aware)

	Statement	Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
1	Familiar on the term BIM	1	2	3	4	5
2	Aware on various short courses to support BIM implementation	1	2	3	4	5
3	Aware on government enforcement of using BIM	1	2	3	4	5
4	Knows various types of software to implement BIM	1	2	3	4	5
5	BIM allows better understanding for design	1	2	3	4	5
6	BIM's ability to capture specifications in the model	1	2	3	4	5
7	BIM's built-in and accurate scheduling capabilities	1	2	3	4	5
8	BIM allows better documentation with less errors	1	2	3	4	5
9	BIM reduce the overall project cost	1	2	3	4	5
10	BIM shortness the overall project timescale	1	2	3	4	5

Section C: The barriers of BIM implementation in construction industry

Please tick (/) in the appropriate box. Answer given according to the scale below. (1=strongly disagree, 5=strongly agree)

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
A Lack of knowlegde about BIM	1	2	3	4	5
B Existing CAD system fulfils our need to design and draft	1	2	3	4	5
C BIM is too expensive	1	2	3	4	5
D Lack of training on BIM software	1	2	3	4	5
E Current technology is enough	1	2	3	4	5
F BIM lacks features or flexibility to create a building model/ drawing	1	2	3	4	5
G Waste time and human resource	1	2	3	4	5
H Application of BIM will effect the current process practice	1	2	3	4	5
I Application of BIM will effect the current productivity	1	2	3	4	5
J Legal or contract issue	1	2	3	4	5
K Unsuitable for the project	1	2	3	4	5
L Reluctance from client, contractors or consultant to implement BIM	1	2	3	4	5
M Lack of data on return on Investment of BIM	1	2	3	4	5
N Software related	1	2	3	4	5

Appendix B

Gantt Chart for Final Year Project 1

Year	February 2015				March 2015				April 2015				May 2015			
Activities	**W 1**	**W 2**	**W 3**	**W 4**	**W 1**	**W 2**	**W 3**	**W 4**	**W 1**	**W 2**	**W 3**	**W 4**	**W 1**	**W 2**	**W 3**	**W 4**
i. Introduction																
Submit to supervisors for review																
Correction																
ii. Literature review																
Submit to supervisors for review																
Correction																
iii. Research methodology																
Submit to supervisors for review																
Correction																
iv. Questionnaire Development																
Submit to supervisors for review																
Correction																
v. Initial Contact with Respondents																
vi. PSM I Presentation																
Correction																

Gantt Chart for Final Year Project 2

NO	RESEARCH ACTIVITY	MONTH					
		JUL	AUG	SEPT	OCT	NOV	DIS
1	Correction						
2	Distribute the questionnaires						
3	Collecting the questionnaires from the respondent						
4	Conduct data analysis						
5	Start the Chapter 4 and 5						
6	Add on information of data analysis						
7	Submitting draft of the full report						
8	Correcting and editing of full report						
9	Submitting full report of FYP 2						
10	Present the FYP 2						
11	Correction and binding the report						

Appendix C

Statistical Package for Social Science (SPSS) Original Data

Highest Academics Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	phd	1	1.5	1.5	1.5
	master	24	35.8	36.9	38.5
	degree	26	38.8	40.0	78.5
	diploma	14	20.9	21.5	100.0
	Total	65	97.0	100.0	
Total		67	100.0		

How long experience do you have in construction project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 5 years	11	16.4	16.9	16.9
	6 to 10 years	27	40.3	41.5	58.5
	11 to 15 years	21	31.3	32.3	90.8
	16 to 2o years	6	9.0	9.2	100.0
	Total	65	97.0	100.0	
Total		67	100.0		

What type of project your company involved?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Building	35	52.2	53.8	53.8
	Industrial	18	26.9	27.7	81.5
	Highway	9	13.4	13.8	95.4
	Tunneling	3	4.5	4.6	100.0
	Total	65	97.0	100.0	
Total		67	100.0		

Have you heard of Building Information Modeling (BIM) solutions and applications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	37	55.2	56.9	56.9
	no	28	41.8	43.1	100.0
	Total	65	97.0	100.0	
Total		67	100.0		

Did your company applying BIM in construction project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	12	17.9	18.5	18.5
	no	53	79.1	81.5	100.0
	Total	65	97.0	100.0	
Total		67	100.0		