Level of Awareness of Building Information Modeling (BIM) In Malaysia Construction Industry

by

Mohd Amiruddin Bin Mat Rifin

Dissertation submitted in partial fulfillment of

the requirements for the

Bachelor of Engineering (Hons)

(Civil Engineering)

SEPT 2011

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

Level of Awareness of Building Information Modeling (BIM) In Malaysia Construction Industry

by

Mohd Amiruddin Bin Mat Rifin

A project dissertation submitted to the

Civil Engineering Programme

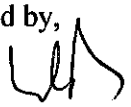
Universiti Teknologi PETRONAS

in partial fulfillment of the requirements for the

BACHELOR OF ENGINEERING (Hons)

(CIVIL ENGINEERING)

Approved by,



Assoc. Prof. Ir. Dr. Arazi Idrus

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

SEPT 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Mohd Amiruddin Mat Rifin

ABSTRACT

Building Information Modeling (BIM) is a new emerging approach to design, construction, and facility management in which a digital representation of the building process is being created to facilitate the exchange and interoperability of information in digital format. Despite the advantages derived from this paradigm, local construction industry is reluctant to deploy the technology in its service delivery. The objectives of the study were to investigate the level of awareness and perception of BIM among Engineers and Architects in Malaysia. To realize the objectives, structured questionnaires were administered to 30 key players in the field of Architecture and Engineering randomly selected from PAM and ACEM database. In addition to that, interviews were also conducted to some key players in design and construction industry to elicit BIM awareness among them. Qualitative analysis was used to analyze the result from interview while quantitative analysis was used to analyze the result of the questionnaires. From the research, 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.

ACKNOWLEDGEMENT

In the name of ALLAH S.W.T, the most merciful and compassionate, praise to ALLAH, he is the almighty, eternal blessing and peace upon the Glory of the Universe, our beloved Prophet Muhammad (S.A.W), and his family and companions.

Upon completing one year of final year project, the author is greatly indebted to personnel namely below.

First and foremost **Assoc. Prof. Ir. Dr. Arazi Idrus (Supervisor)** who found time in a very busy schedule to give author new functional scope tasks, monitors progression and answer questions. Author feels grateful for being placed under his supervision and also deeply grateful for his advices, encouragements and patience throughout the duration of the project. The support he has given to the author as a student in civil scope of work has been greatly appreciated too.

Author also would like to thanks to the Graduate Assistances; Mr.Hammad Dabo Baba and Mr Umar for their assistance in completing this project. It would not be possible for the author to conduct the interviews without the countless help and support from both of them and thus completing the final year project.

Last but not least, author's sincere appreciation also extends to all fellow colleagues and others who provided assistance at various occasions.

TABLE OF CONTENTS

CERTIFICATE OF APPROVAL ..... **i**

CERTIFICATE OF ORIGINALITY ..... **ii**

ABSTRACT ..... **iii**

ACKNOWLEDGEMENT ..... **iv**

LIST OF FIGURES ..... **vi**

LIST OF TABLES ..... **vi**

CHAPTER 1 ..... **1**

INTRODUCTION **1**

1.1 BACKGROUND STUDY 1

1.2 PROBLEM STATEMENT 2

1.3 OBJECTIVES 3

1.4 SCOPE OF WORK 3

CHAPTER 2 ..... **4**

LITERATURE REVIEW **4**

2.1 GENERAL 4

2.2 BIM AND TECHNOLOGIES 5

2.2.1 Autodesk Revit 5

2.2.2 Bentley Solutions 6

2.2.3 Graphisoft Archi CAD 6

2.3 BIM AND APPLICATIONS 6

2.3.1 Design Visualization.....7

2.3.2 Constructability Review 7

2.3.3 Site Planning and Utilization 7

2.3.4 "5D" Cost Estimation.....7

2.3.5 System Coordination 7

2.3.6 Prefabrication.....8

2.3.7 Operations and Maintenance..... 8

2.4 BIM AND BENEFITS.....8

2.4.1 Visualization 8

2.4.2 Collaboration 9

2.4.3 Elimination 9

2.5 BIM AND SUSTAINABLE DESIGN 9

2.6 BIM AND BARRIERS.....10

2.6.1 Interoperability..... 10

2.6.2 Scalability..... 10

2.6.3 Change of Mindset 11

2.6.4 Legal Issues..... 11

Tools and Duty of Care: Model Authorship and Ownership 13

Obligations and Considerations 13

Jurisdiction and Cyber Security 14

CHAPTER 3 15

METHODOLOGY 15

3.1 INTRODUCTION.....15

3.2 RESEARCH METHODOLOGY.....15

3.3 LITERATURE REVIEW 17

3.4 RESEARCH DESIGN AND DATA COLLECTION.....17

3.5 PILOT SURVEY INTERVIEW..... 18

3.6 SAMPLING METHOD 18

3.7 ANALYSIS OF RESULT 18

GANTT CHART.....19

CHAPTER 4 20

RESULT AND DISCUSSION 20

4.1 RESULT 20

4.1.1 Qualitative 20

4.1.2 Quantitative 22

CHAPTER 5 34

CONCLUSION AND RECOMMENDATION 34

5.1 CONCLUSION 34

5.2 RECOMMENDATION 35

REFERENCES 36

APPENDIX 38

LIST OF FIGURE

Figure 2.1: Teicholz Construction Productivity Index Graph

Figure 1.2: A taxonomy of legal limitation in BIM

Figure 3.1: A Flowchart showing how the study were conducted

Figure 4.1: Qualification of Respondents

Figure 4.2: Experience of Respondents

Figure 4.3: Awareness of BIM

Figure 4.4: Use of Autodesk AutoCAD

Figure 4.5: Use of Autodesk 3D Studio Max

Figure 4.6: Use of Tekla Structure

Figure 4.7: Autodesk Revit MEP

Figure 4.8: Autodesk Revit Architecture

Figure 4.9: Autodesk Revit Structure

Figure 4.10: ArchiCAD

Figure 4.11: Bentley Micro Station

Figure 4.12: Bentley Structure

Figure 4.13: Sketch up

Figure 4.14: Not Required by Client

Figure 4.15: Lack of Legal Backing from Authority

Figure 4.16: Never Required by Other Team Members

Figure 4.17: Expensive Software

Figure 4.18: Not Ready To Disturb Normal Operational Structure

Figure 4.19: Difficult To Learn

Figure 4.20: Non Availability of Parametric Library

Figure 4.21: Takes Longer Time to Develop a Model

Figure 4.22: Problems of Interoperability

Figure 4.23: Lack of Competent Staff to Operate the Software

LIST OF TABLE

Table 3.1: Gantt chart for FYP 11

CHAPTER 1

INTRODUCTION

1.1 Background study

Information and communication (ICT) technology holds tremendous promise and potential to bring greater integration in the construction industry. Significant benefits can be realized by developing appropriate ICT solutions. That is why a new technology is developed for the purpose of managing information about the life cycle of a building which are called Building Information System (BIS) and Building Information Modeling (BIM).

BIS was developed in order to fulfill the needs of managing information within the organization. The functions of this system are to help the management to process the drawing approval for a building, supervise the construction project, process the permit for a project and etc. in other words, it eases the management to obtain information regarding the project within a short period. Apart from BIS, there is another technology which is widely used in order to ease the works in construction industry. It is called Building Information Modeling.

According to (Succar, 2009) BIM is an emerging technological and procedural shift within the Architecture, Engineering, Construction, and Operations (AECO) industry. In its simple's concept, BIM is a methodology for organizing, storing, and maintaining information about the physical nature of a building. Apart from BIM, it is also known with different names, such as Single Building Model (SBM), Integrated Building Model (IBM), Generic Building Model (GBM) or Virtual Building Model (VBM), Graph soft

and so on. (Baoping, Wei, & Xin, 2010). Regardless of the various names, they have the same objective which is to ease the works in the construction industry.

Since building projects are often large and complex, to plan, design, construct, and maintain them may require many specialized persons. The need for efficiency and the profitability of owners, designers, and contractors are being challenged as our buildings and business processes become increasingly complex. (Kymmell, 2008). Fortunately with the help of BIM technology, construction process had become a lot easier. According to (Campbell, 2007) there is currently a dramatic shift in the Architecture, Engineering, and Construction (AEC) industry to embrace BIM as a tool that can assist in integrating the fragmented industry by eliminating inefficiencies and redundancies, improving collaboration and communication, and enhancing overall productivity.

1.2 Problem Statement

Despite the wide adoption of BIM in leading countries like US, Canada, United Kingdom (UK) and France to optimize works in their construction industry, in Malaysia this seem to be otherwise. BIM is still in infant stage, even though there are local resellers representing the company's marketing BIM solutions like Autodesk, Tekla, Bentley, Grafisoft etc. It is apparently clear that, civil engineering consultancy firms are still using the legacy method of performing calculation, designing and analysing data manually and producing 2-D drawings. This method is great in the early stage of design. However it may cause problems when there is change in design, which may lead repetition of the entire work and this is time consuming.

Literatures have indicated that, these problems can be overcome using Building Information Modelling (BIM). With BIM, projects can be delivered faster, more economically and with reduce environmental impact.

1.3 Objectives

The overall aim of this research is to determine level of awareness among the engineers and architects about the practice of BIM in construction industry in Malaysia. Therefore, the fundamental questions to be addressed are;

i. What is the level of awareness of BIM in Malaysia among the construction professionals?
ii. What is the perception of construction professional in Malaysia regarding BIM?

In order to fulfil the aim and above research questions, the objectives of this research will be:

i. To investigate level of awareness of BIM among the construction professionals in Malaysia.
ii. To investigate level of perception of BIM among the construction professionals in Malaysia.

1.4 Scope of Work

The research focused on architects and consulting engineers who registered with "Persatuan Arkitek Malaysia (PAM) and Association of consulting Engineers (ACEM). The reason for choosing these categories is because of their eminent roles in the construction industry starting from planning phase until maintenance phase of a building.

CHAPTER 2

LITERATURE REVIEW

2.1 General

For several decades, the architecture, engineering, and construction (AEC) industry has suffered from gross inefficiencies and redundancies, due in part to the relatively slow pace at which designers and builders adapt to and exploit information technology. While computers, generally speaking, have aided in increased productivity for nearly all sectors of manufacturing, construction productivity has flat-lined, and in some cases has declined. Below is the graph of labor productivity for construction and non-farm industries, 1964-2004 taken from (Smith & Tardif, 2009).

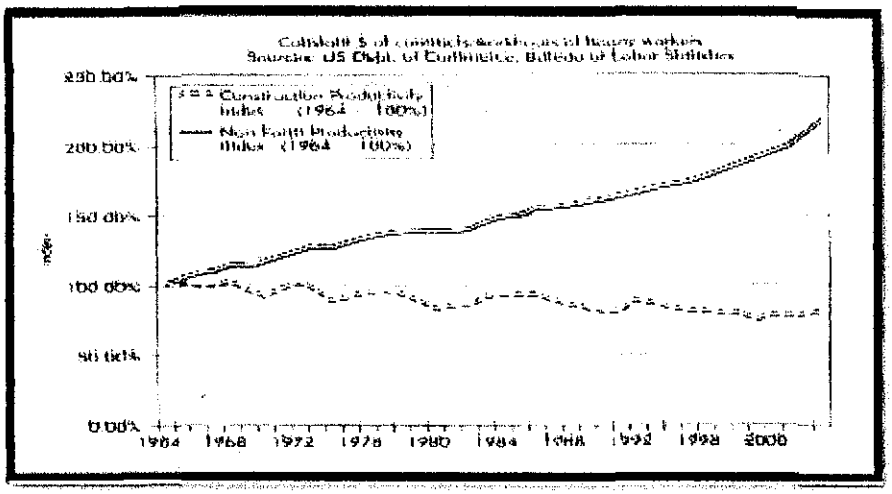


Figure 2.1: Teicholz Construction Productivity Index Graph

To overcome this problem in construction industry, many responsible personnel have come forward with new technologies. One of them is called "Building Information Modeling" According to the General Services Administration (GSA):

> *(BIM) Building information modeling is the development and use of a multi faceted computer software data model to not only documents a building design, but to simulate the construction and operation of a new capital facility or a recapitalized (modernized) facility. The resulting building information model is a data rich, object based intelligent and parametric digital representation of the facility, from which views appropriate to various users needs can be extracted and analyzed to generate feedback and improvement of the design GSA 2007*

With BIM technology, an accurate virtual model of a building is constructed digitally. It accommodates many of the functions needed to model the life cycle of a building, providing the basis for new construction capabilities and changes in the roles and relationships among a project team. It will also facilitate a more integrated design and construction process that result in better quality buildings at lower cost and reduced project duration. (Eastman et al. 2008).

2.2 BIM Technologies

There are many different technologies and software behind BIM itself. Some of the international construction software business has developed some solution based on the building information model. The paragraphs below are the summary of what being discuss by (Baoping et al. 2010) about the technologies behind BIM.

2.1.1 Autodesk REVIT

Revit is a solution of architect industry, which is based on BIM. It is promoted by Autodesk Corporation after they purchase the Revit science and technology company in 2002. Among its solutions are Autodesk Revit Building, Structure, and Mechanical, Electrical, and Plumping (MEP). It has a central project database that contains

representations of all building elements. Design revisions are immediately reflected throughout the whole project and errors can be detected easily.

2.1.2 Bentley Solutions

Bentley Solutions is an integrated project model-based on a number of related application modules and accesses project data by means of DWG and IFC file formats. It includes Bentley Architecture, Bentley Structural, Bentley Building Mechanical System and many more. Bentley implementation program is developed by the company's own set of modules, the definitions of data operations, which share the same building information model to achieve the purpose of BIM.

2.1.3 Graphisoft Archi CAD

Graphsoft Archi CAD is based on a virtual building model, and was designed as a BIM system in 1980s. It behaves as an application peripheral to the model instead of containing all the building data itself. But this term is different from others. It is called "virtual construction" instead of BIM. (Lachmi, 2003). The solution of BIM in Graphisoft is based on a series of products. Graphisoft proposed Constructor series product according to construction in 2004. Then in 2005, Graphisoft produced Graphisoft Constructor 2005 and Graphisoft Estimator 2005.

2.3 BIM and Applications

The application of BIM is not restricted only during the design phase. BIM is essential to be used throughout all phases in construction industry starting from planning, designing, constructing and maintaining. According to (Campbell, 2007), the application of BIM can be summarized as follow:

2.3.1 Design Visualization

BIM are often used by the designers and also contractors as a way to visualize and communicate design intentions. This will enable them to make right decision which at the end can have huge impact on costs of the construction.

2.3.2 Constructability Review

Beyond visualization, contractors use BIM as a way to provide assistance to the design team and to provide a "constructability review" in which various means and methods are analyzed and tested to ensure the design can be built to meet a targeted schedule and cost. Often, BIM exposes errors and omissions in the design, and can help us recommend alternate solutions while preserving design intent.

2.3.3 Site Planning and Utilization

BIM can be use not only to analyze the proposed building but also to study about the site condition. The study can included the existing and proposed underground utilities, site excess, safety issues, excavation, shoring, dewatering, position of cranes, booms, hoist, and temporary "lay down" storage zones.

2.3.4 "5D" Cost Estimating

BIM also can be integrated with another factor, cost to generated a "5D" simulation. It is used to facilitate a quantity survey of building materials and components, and these quantities are linked directly to cost databases. With this information, the building design can be modify and understand the implication of the costs in real time.

2.3.5 System Coordination

After all building systems are detailed in 3D and incorporated into BIM, these systems then can be coordinated. All equipment, fixtures, pipes, ducts, conduits, structural members, and other building components are checked through "clash detection" tools to discover and resolve conflicts before systems are installed in the field. We have found

that in some cases, there is much as an 80% reduction in field-related questions and conflicts due to this use of BIM.

2.3.6 Prefabrication

BIM can also be used in prefabrication work in order to save time during the field assembly of the building. This is a result of integration of many of the other uses. For example, full contribution by subcontractors, full integration and coordination of geometry, and accurate registration and field installation.

2.3.7 Operations and Maintenance

BIM can be updated during the construction of the facility to create an "as-build" record of construction conditions. Once this is complete, the geometry in BIM can be linked with non-graphic information found in equipments and facilities operations manuals. In other word, BIM now is a complete and living record to support the facilities management.

2.4 BIM and Benefits

There are two types of benefits that can be achieved by using BIM. They are direct benefits and indirect benefits. Direct benefits mean qualities such as the improved visualization and the centralization of building information for a project. While indirect benefits include the necessity for collaboration and the resulting better project understanding, and the reduction of project risk. However the benefits of BIM according to (Kymmell, 2008) can be divided into three parts which are visualization, collaboration and elimination. The paragraphs below will discuss in details about these benefits.

2.4.1 Visualization

The clearest benefit from a 3D model is the improved ability to visualize what is being represented. Many people have difficulty to understand 2D drawings. A 3D model however, clearly represents the project and allows the visualization of many features,

even with only few details. Model views will allow people to share one's another concerns in any given area and communicate about their collaborative approach to solve any conflicts. In other word, visualization is at the root of the communication necessary to collaborate and coordinate.

2.4.2 Collaboration

The necessity to collaborate to employ simulation techniques in the construction industry is without doubt its greatest benefit. Early collaboration will give a large benefit for planning and construction of a project. Thus, it is very important to have early and in-deep collaboration of the project team on planning, design, and construction issues. With collaboration, better information can be collected causing better design model, lower in cost and also less time to finish a project.

2.4.3 Elimination

By virtue of the increased ability to visualize, communicate, evaluate, and coordinate through the use of BIM, it becomes possible to speed up and improve understanding, coordination, material use and others in the management of building project. The BIM process helps to reduce construction conflicts, construction waste, and project cost.

Conflicts can be identified easily through the centralization of access to all information regarding the project. Construction waste reduction is another use of model analysis. By analysing the construction simulation, it may help to improve the efficiency of construction procedures, the use of materials, time and energy. When all these are improved, the cost of the project may be reduced.

2.5 BIM and Sustainable Design

Recent studies indicate that the demand for sustainable building facilities with minimal environmental impact is increasing. (Azhar S. , 2010). No wonder many countries and international organisations have initiated rating system for sustainable construction. For

example, a project pursuing LEED's certification, designers have to conduct in-depth sustainability analysis based on building's form, materials, context and mechanical-electrical-plumbing (MEP) systems. Since BIM allows for multi-disciplinary information to be superimposed within one model, it will conduct these analysis accurately and efficiently compared to the traditional method. (Azhar et al. 2011)

2.6 BIM and Barriers

Before BIM technology can be successfully implemented by the professionals in construction industry, there are 2 types of barriers that they have to overcome which are technical barriers and human barriers. Technical barriers consist of interoperability and scalability while human barriers include change of mindset and legal issues. All of these will be discuss further in paragraphs below.

2.6.1 Interoperability

Interoperability can be defined as "The ability of two or more systems or components to exchange information and to use the information that has been exchange". Interoperability is achieved by mapping parts of each participating application's internal data structure to a universal data model and vice versa. It eliminates the costly process of integrating every application with other applications.

Today, there are many available proposals to represent data models and services for the main business and manufacturing activities, and thus sustain interoperability. Some are releases with international standards (e.g., ISO, UN), some are developed at the regional or national level (e.g., CEN, DIN) and the rest are developed by independent project teams and groups (e.g., OMG, W3C, IAI, ebXML). (Grillo & Jardim-Goncalves, 2009). Most of the standards based models that are available have been developed in closed contact with industry, following an established methodology.

2.6.2 Scalability

In traditional method, a building may have more than 5 drawings related to it such as structural drawing, architecture drawing, mechanical drawing, electrical drawing and

etc. If all these drawing are converted into softcopies, the size of them will be very big in terms of memory. An individual needs to have a large storage device in order to keep all softcopy drawing. Unfortunately, this problem is not associated with the traditional way only. The same problem will occur with the implementation of BIM.

The basic concept of BIM is all information regarding to a building will be stored in one place. In other word, a drawing for a building in BIM will consist of all elements (e.g: structural, architecture, MEP and etc.). Imagine if a designer want to pass the information of a building to a contractor using email. Most probably the transaction will fail due to very large size of the document. When the flow of information is disturbed, problems such as misunderstanding, delay of project, increases in cost and etc. will occur. So, for the sake of successfully implementation of BIM, this problem must be tackle wisely.

2.6.3 Change of Mindset

When a person get used to something, it may not be easy for him or her to change it. The same goes with the implementation of BIM. When professionals are already comfortable with the legacy method of performing works in construction industry, they may not want to adapt to something new, as for this case, a change for BIM. They cannot just simply accept BIM and forget about the current method of performing calculation, designing, and producing 2-D drawing. Even though BIM has a lot of advantages compared to current method, but professionals still need times to change their mindset in order to accept BIM. As said by (Eastman et al. 2008), this transformation will require time and education, as is true of all significant changes in technology and work processes.

2.6.4 Legal Issues

Much effort is being invest into BIM adoption by many industry stakeholders. However, the overarching question is: can BIM deliver its technical benefits without adapting existing legal instruments, or possibly formulate new one? Related to this, (Holzer, 2007) suggest that BIM may not facilitate lasting solutions to the limitations of conventional fragmented processes unless apparent issues which are complicated by

gaps in its legal frameworks and e-business models are addressed. According to (Alfred & OLATUNJI, 2011), some of these challenges are identified in Figure 2.2 below, and reviewed subsequently.

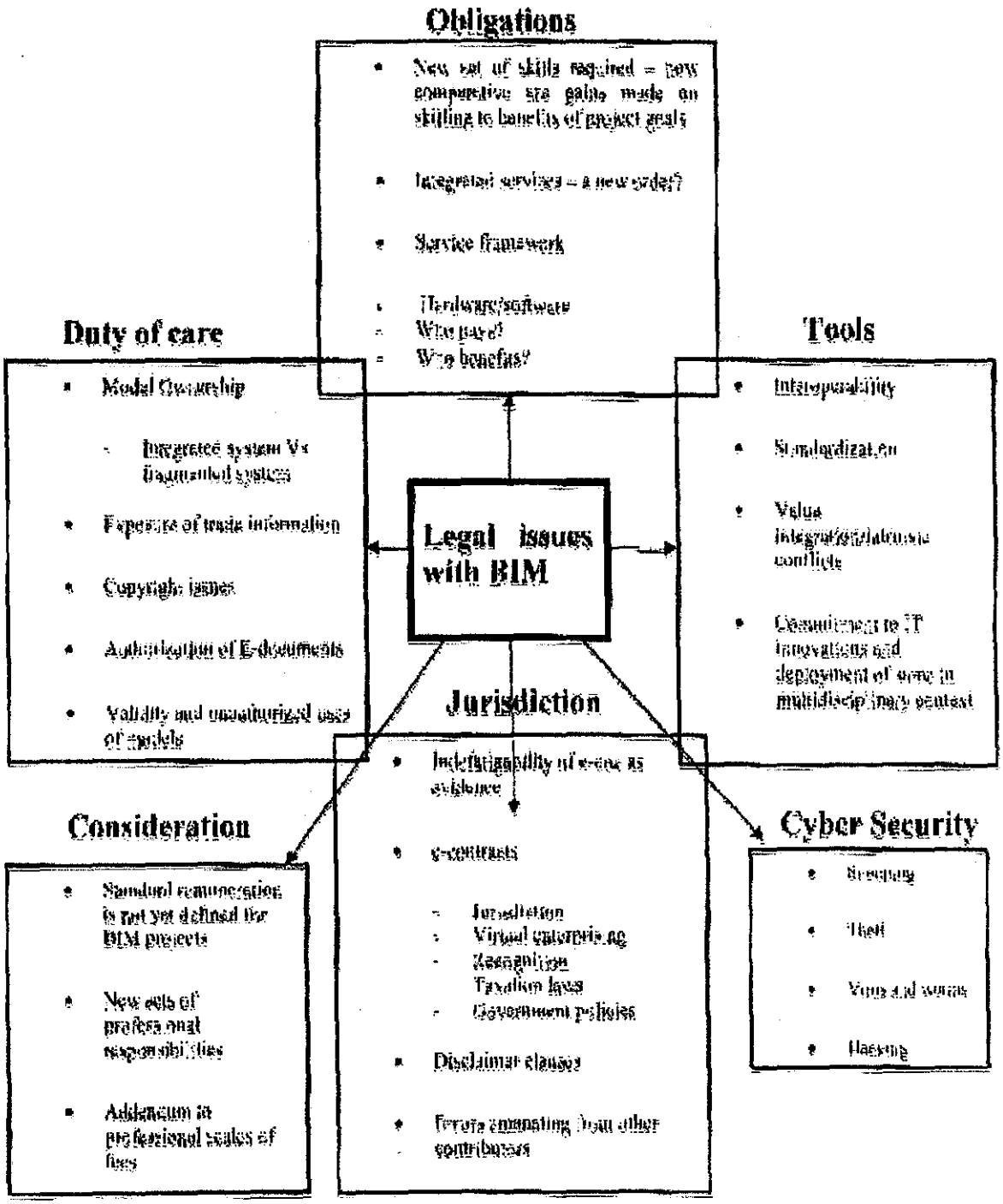


Figure 1.2: A taxonomy of legal limitation in BIM

↓ *Tools and Duty of care: Model Authorship and Ownership*

Inputs in conventional design systems are fragmented, and existing regulations regarding responsibilities and management of professional services are made to support this. Consequently, the focus of existing legal provisions on this is that input authors reserve most rights to issue, protect and be answerable to all issues arising from their services. According to (Moses et al. 2008), there are significant empirical evidence regarding how client involvement in design and construction processes may improve project performance. (Dean & Ryan, 2009) said that the designers no longer want to bear to the risks of design errors and used an excuse to transfer risks due to them to clients, who are the ultimate owners of the project model. Therefore, model ownership as a legal challenge is multifaceted.

Foremost, contributors to BIM models may depend on inputs from other members of the project team. All parties are bound by relative responsibilities to industry standards on duty of care in a new world of innovation and virtual enterprise where data generation is quick and external resources are not necessarily verified or guaranteed. (Haynes, 2009). However, different professionals may provide different aspects of services at every stage as they become necessary. It is a possibility that when models are enshrined exclusively to clients, inputs can be put to unauthorized uses that are not constructive to originators' goals. Futhermore, as there is not yet provision on all feasible right and obligations of all parties involved in BIM, there could be several legal consiquences wherever existing legal provisions are silent or could deserve futher interpretations.

↓ *Obligations and Consideration*

Existing provisions for remunerations of professional services in the industry are largely driven by conventional fragmented concepts. (Sher et al. 2009) suggested that new processes and skills are required in BIM to achieved improved project outcomes. Since there are no proper protocols regarding professional services involved in BIM are institutionalized, it is difficult to ascertain comparative fairness in how these protocols are valued and remunerated.

In addition, there is little empirical evidence upon which to conclude on how the cost of BIM compares, in terms of direct costs and effectiveness, with other design tools. Based on (Aranda-Mena et al. 2009), cost of BIM is not depends on size of firms, nature of projects, strategizing model and implementation instruments or similar. However, different situations are applied in different parts of the world. The best way to address this situation is to standardize service procedures and formulate workable legal instruments to service BIM deliverables and allied innovations.

- ***Jurisdiction and Cyber Security***

Jurisdiction is a substantial issue in electronic transactions. For example, (De Groote, 2009) raises questions that urge discussions on internet tort jurisdictions and how effected parties are treated in specific damages, especially across trans-border operations where there are different legal standpoints in the various territories involved. Most design documentations are non parametric and paper-based, and participants are often expected to sign off documentation with definite instruments. However, the concept of electronic design is totally different. Eventhough many companies created e-enovative tools to service process and product improvement, legal framework for transacting universally are apparently grossly inadequate in the industry. According to (Ren & Hassan, 2007) issues regarding legal liabilities in electronic mediums are effective formulation of e-contracting, acceptibility of authorization style, repudiation, jurisdiction and acceptability of electronic documents as inexorable evidence in many law courts, taxation laws and cyber snooping problems. In order to overcome this problems, BIM adoption and implemetation frameworks must be comprehensive and objective, involving all stakeholders.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter elaborates on the methodologies being used for the purpose of data collection, discussion and analysis and reporting of findings and result of the study.

3.1 Research Methodology

In order to derive a logical result, the study has adopted three (4) approaches, these are:

a) Literature Review
b) Data Collection
c) Data Analysis
d) Presentation of results and conclusion.

In pursuance of the study, the following items were clearly identified as defined:

a) Problem Statement
b) Aims and Objectives
c) Scope of the study
d) Significance of the study

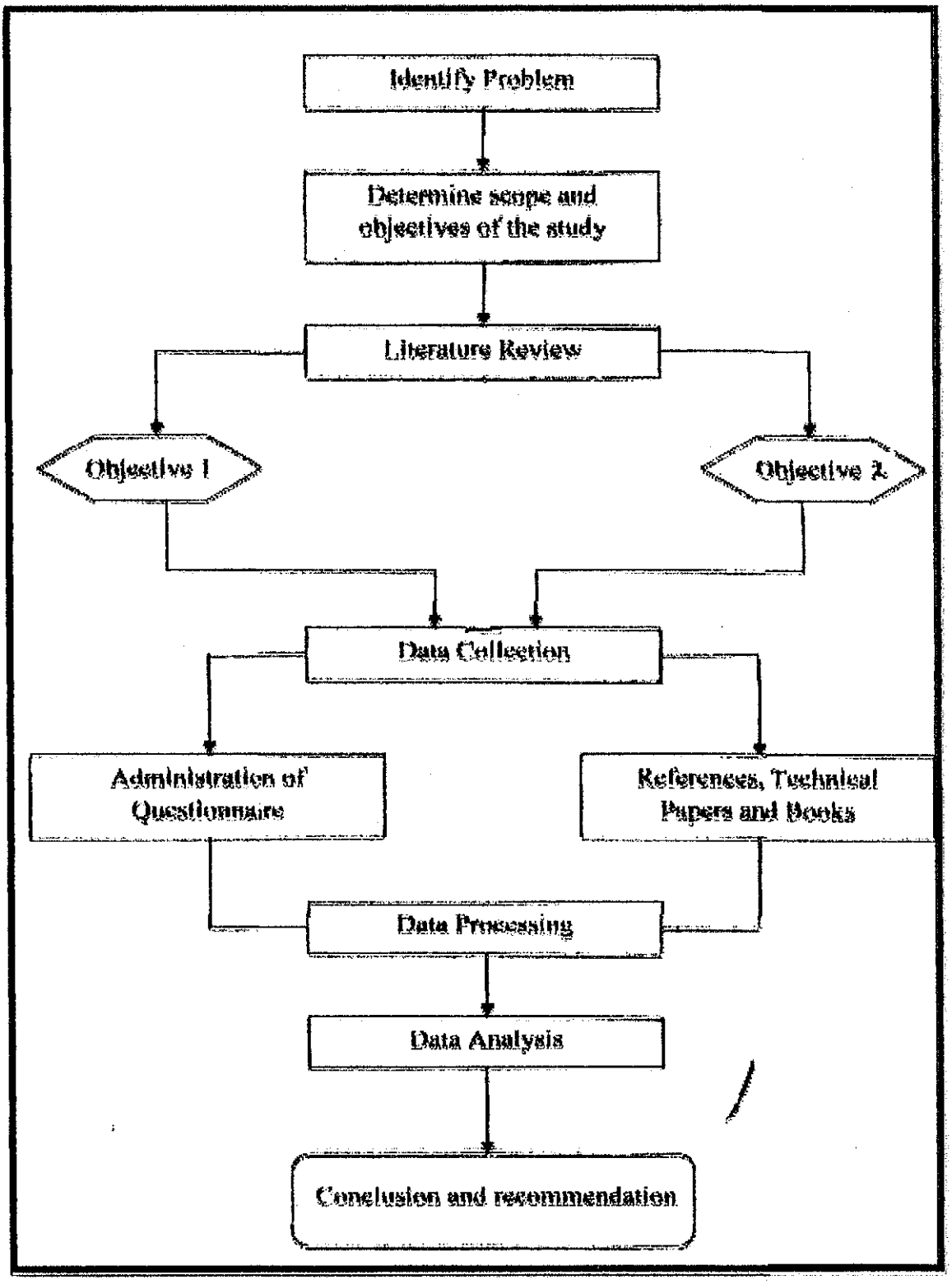


Figure 3.1 A Flowchart showing how the study were conducted

3.2. Literature Review

This is an exercise in which the researcher tried to identify, locate read and evaluate previous studies, observations, opinions and comments related to Building Information Modeling. Under this exercise, concept, applications and the barriers to implementation of Building Information Modeling (BIM) in local construction industry were discussed and critically analyzed.

3.4 Research Design and Data Collection

Survey research design was adopted for the study; where by the instrument for data collection was a set of questionnaire. The questionnaire was divided into Three Sections (A – C). All questions were structured so as to enable a logical quantitative analysis of the result. Moreover, each question is ranked on 5 points Likert rating scales. Below is the detailed description of the questionnaire.

a. **Section A**: This section covered the demographic background of the firms, eg , Name of the Firm, Area of Expertise, qualification, experience of the respondent and a question either the respondents are aware of BIM or not.

b. **Section B**: This section will cover the frequently used of software among the construction professionals in Malaysia.

c. **Section C**: This section will seek to identify the perception of the professionals on the concept of BIM by definition and by application.

3.5 Pilot Survey Interview

The purposes of pilot survey is to identify clearly about the research area, scope, needs, and focus before the next stage of research can be carried out. According to (Foddy, 1993), piloting questions on a small sample of respondents is useful for uncovering aspect of question that will cause interviewee to have difficulty in interpreting the question as intended. As for this research, the pilot surveys were conducted among selected lecturers from Universiti Teknologi Petronas (UTP) and two architects in Ipoh, Perak. Based on the result, the questionnaire was validated to affirm the integrity of its contents and coverage.

3.5 Sampling Method

There were 1637 architects registered with PAM and 723 engineers registered with ACEM. From the list only 60 architects and 40 engineers were selected to answer the questionnaire. In order to avoid bias, the respondents were selected by using "Systematic Random Sampling" method.

The advantages of using Systematic Random Sampling are:

a) It allows the author to add a degree of system or process into the random selection of subjects

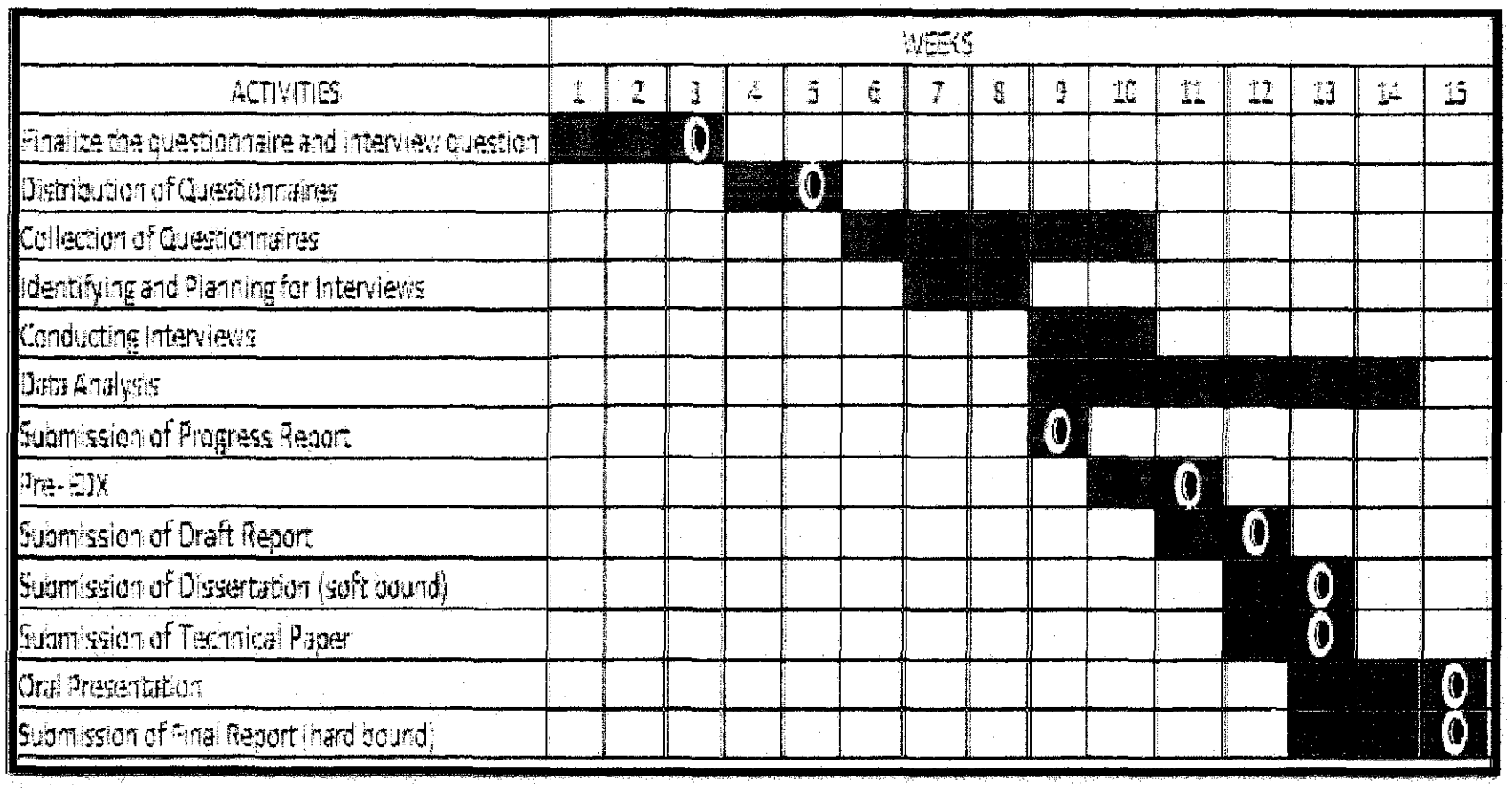
b) It makes sure that the population will be evenly sampled.

c) It eliminates the chance of creating a clustered selection of subjects.

3.6 Analysis of Result

For this research, both qualitative and quantitative method was used to analyze the result. Qualitative method was used to analyze the interview which is to answer the 1st objective. While qualitative method was used to analyze the questionnaire which is to answer the 2nd objective

Table 3.1: Gantt chart for FYP 11



● Key milestones

CHAPTER 4

RESULT AND DISCUSSION

4.1 Result

Qualitative method was used to analyze the interviews while quantitative method was used to analyze the questionnaires.

4.1.1 Qualitative

From the interviews, the author can conclude that architects and consulting engineers in Malaysia are aware about BIM. In fact, some of the firms have already implemented BIM in their organization. Unfortunately, the rest of architects and engineers still do not implement BIM because of curtain issues. Despite the wide use of BIM in Europe, Australia, and even Singapore, BIM is still in infant stage in Malaysia.

However, the construction stakeholders are currently discussing on how to implement BIM in Malaysia construction industry. This is because they believe that BIM has many advantages as compared to current construction delivery method. As being mentioned by the Principal of Integrated Project Management Solution (IPMS), traditional method are use in isolation, but BIM process uses technology in collaboration. With BIM, the physical and functional characteristics of a project can be explored digitally before it is built. It also can be use to visualize, simulate and analyze real world appearance, performance and cost for any projects. Furthermore, the project will be delivered faster, more economically and with reduced environmental impact by using BIM.

As for the challenges, architects agreed that there are 4 challenges to implement BIM. They are process, people, technology and policy. The right process can differentiate between the successes of the failure of a BIM implementation. Therefore, BIM process must be define clearly and monitored wisely by the expert. People in this context refer to all construction stakeholders. Firstly, they must change their mindset and be ready to implement BIM. Then, they must establish new roles and responsibilities and improve collaboration between them.

The 3rd challenge is technology. It requires certified hardware and software to secure all the data and to make it a user friendly system. Lastly is about the policy. Government should come out with a specific guideline and standard for BIM so that all construction stakeholders can follow. For the beginning, government may take the guideline and standard from other countries who already establish their own. Then few changes should be made from the guideline in order to make it suitable for construction industry in this country.

While for engineers, they believe that the readiness for the people to change is one of the challenges to implement BIM. It is not easy for someone who is comfortable with the traditional method to suddenly change to new method. They are going to need knowledge, training and time before they can be expert with BIM. For that purpose, a lot of money must be invested.

Besides that, both architects and engineers faced the same problems with the current construction delivery method which are delays due to variation orders (VO) and clashes of structural elements. When delays happen, the cost for overall project will be increased and sometimes the quality will be lower. However, they believe with the help of BIM, the delays and VO's in construction can be reduced or eliminated which at the end will result in completing project within the schedule with lower cost and higher quality.

Architects and engineers also agree that if BIM is implemented by all stakeholders and work together as a team for a project, all of them will receive the same benefits. Even though different stakeholders have different interest in a project but, they may achieve all of their interest by working together. Architect will be able to improve the

quality of their design, engineer will manage to design better within a shorter time, quantity surveyor will estimate and calculate the cost more accurately, contractor can proceed with the works on site with less problems and most importantly, the client will satisfied with the project.

4.1.2 Quantitative

Result from the questionnaires are being analyze in bar chart in order to fulfill the 2nd objective which is level of perception of BIM among architects and consulting engineers in Malaysia. For this research, the author had send 150 questionnaires to architects and consulting engineers. However, the author only received back 32 sets of the questionnaires. Out of that number, 17 of them are from architects while another 15 are from consulting engineers. The results of the questionnaire are shown in figures below.

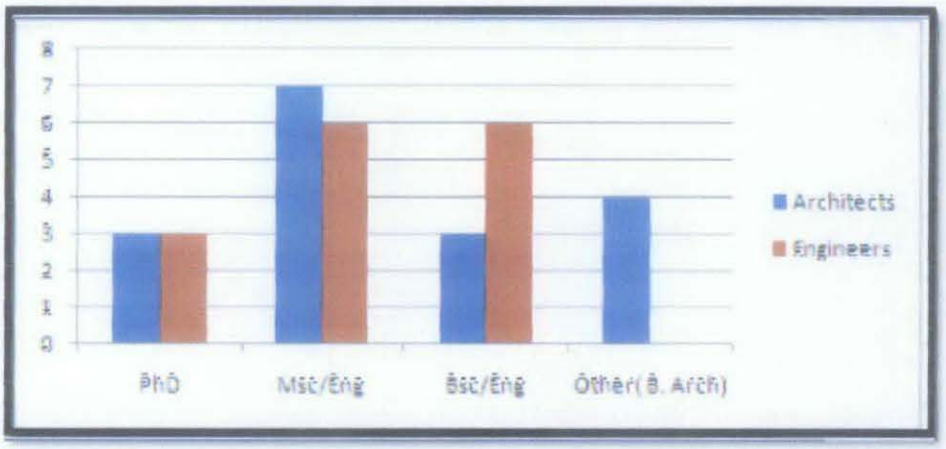


Figure 4.1: Qualification of Respondents

Based on Figure 4.1 above, 41.2% of architects are having Master in Architecture as their qualification while 40% of engineers had Master in Engineering and Bachelor in Engineering.

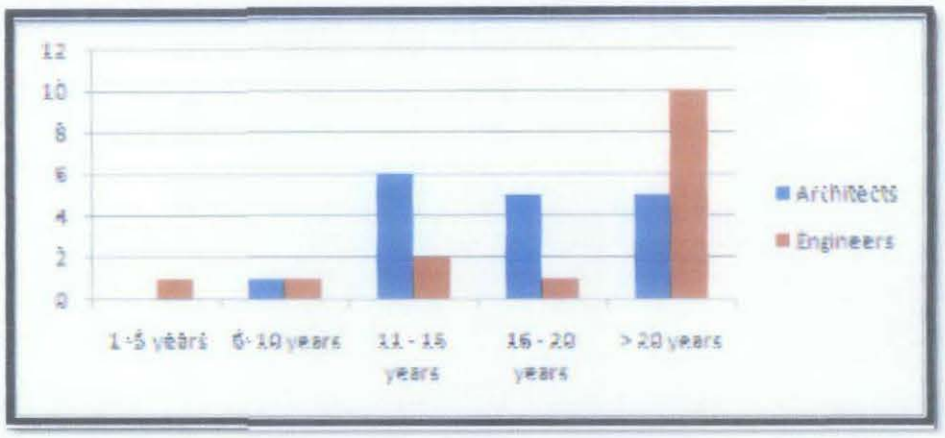


Figure 4.2: Experience of Respondents

From Figure 4.2 above, 94.1% of the architects are having experience more than 11 years in architecture while for engineers, 66.7% of them are having experience of more than 20 years.

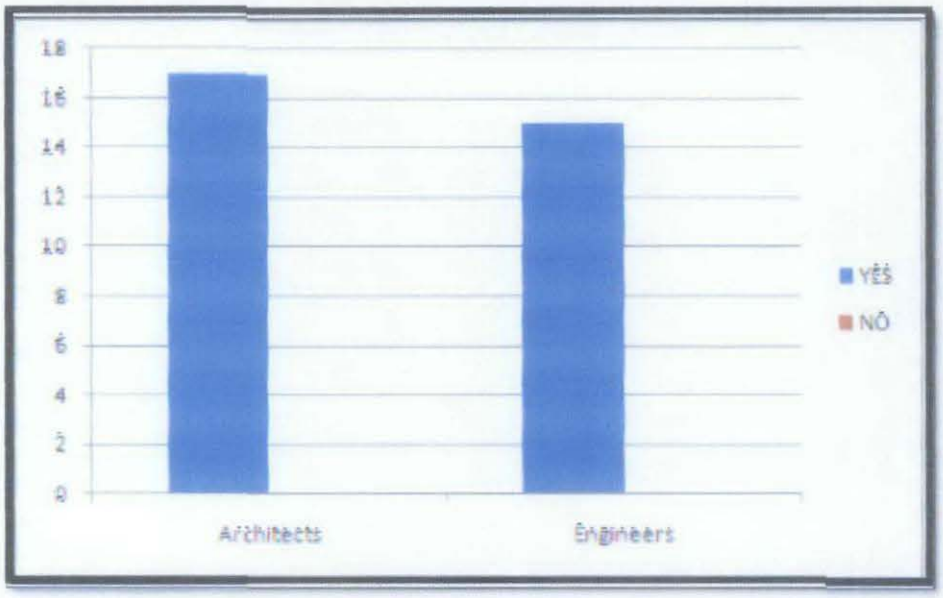


Figure 4.3: Awareness of BIM

According to Figure 3 above, 100% of Architects and Engineers in Malaysia are aware about BIM.

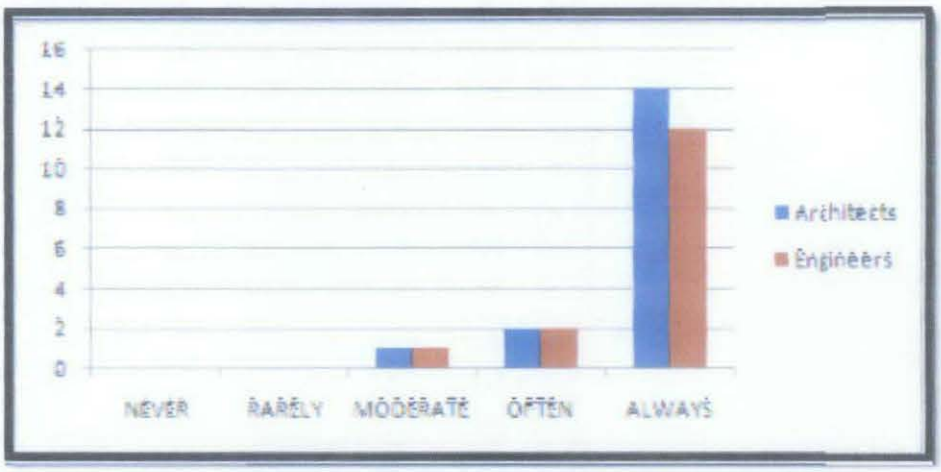


Figure 4.4: Use of Autodesk AutoCAD

From Figure 4.4 above, 82.4% of architects always used AutoCAD for their design while for engineers, 80% of them always used AutoCAD to produce their design.

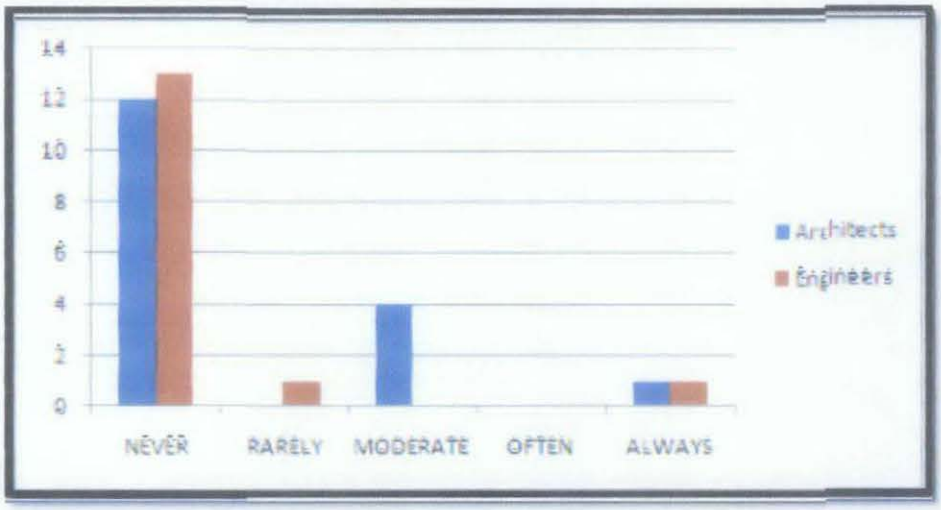


Figure 4.5: Use of Autodesk 3D Studio Max

Based on Figure 4.5 above, 70.6% of architects never used Autodesk 3D Studio MAX in their operation. As for engineers, 86.7% of them never used Autodesk 3D Studio MAX to produce their design. Only 5.9% of architects and 6.7% of engineers who's always used Autodesk 3D Studio MAX for their design.

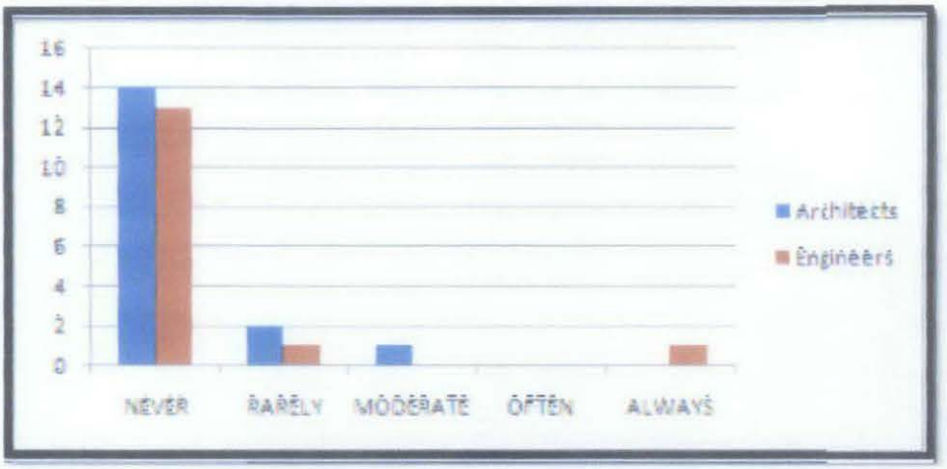


Figure 4.6: Use of Tekla Structure

According to Figure 4.6 above, 82.4% of architects never used, 11.8% rarely use and 5.8% of them moderately use Tekla Structure software to design. As for engineers, 86.7% never used 6.7% rarely use and another 6.7% always used Tekla Structure software to design for structural element.

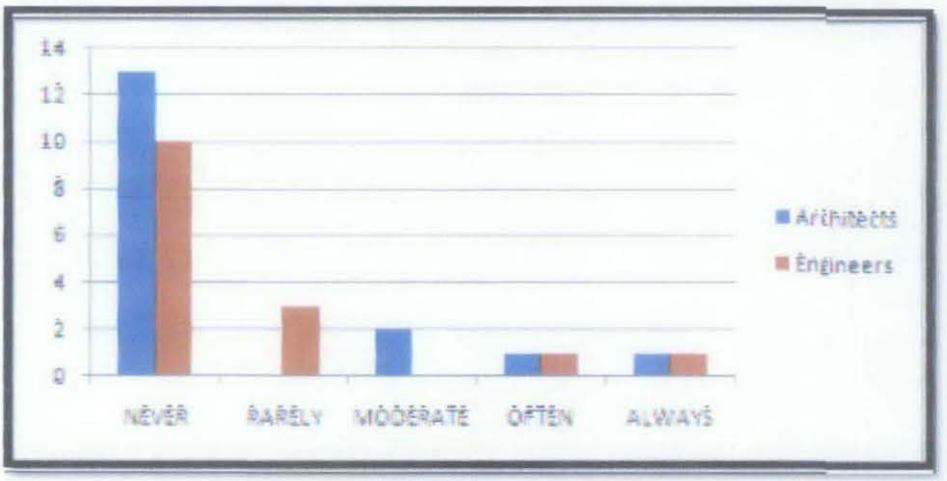


Figure 4.7: Autodesk Revit MEP

Based on Figure 4.7 above, 76.5% of architects never use Autodesk Revit MEP, 11.8% moderately used and the rest are often and always use this software to design. As for engineers, 66.7% of them never used, 20% rarely used while another 13.3% are often and always use Autodesk Revit MEP to produce their design.

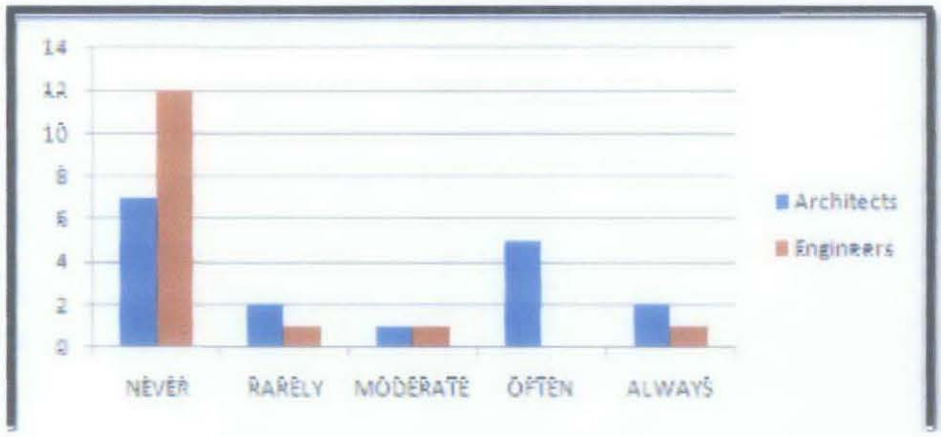


Figure 4.8: Autodesk Revit Architecture

From Figure 4.8 above, 41.2% of architects never use Autodesk Revit Architecture, 11.8% rarely and always used while 29.4% of them often use this software to produce their design. As for engineers, 80% of them never use Autodesk Revit Architecture before.

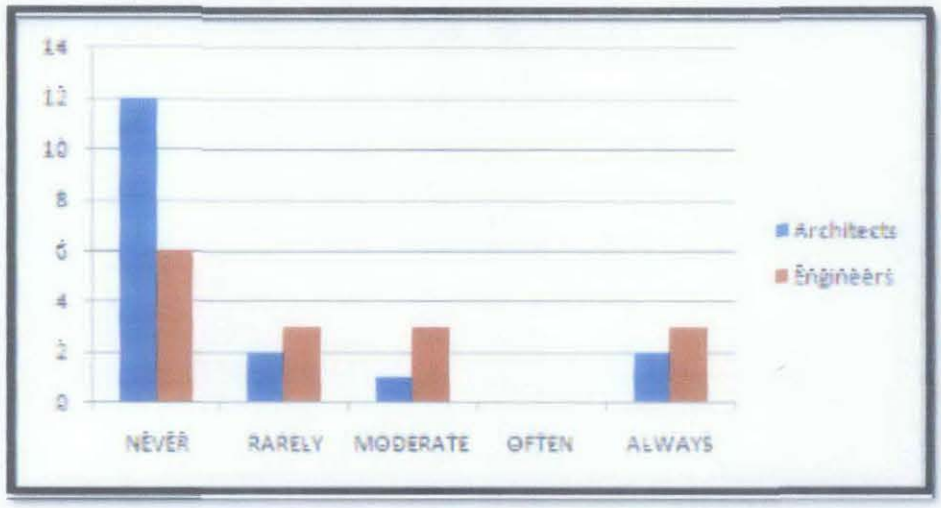


Figure 4.9: Autodesk Revit Structure

Based on Figure 4.9 above, 70.6% architects never use Autodesk Revit Structure, while 11.8% of them rarely and always used it. For engineers, 40% of them never use Autodesk Revit Structure while the rest are rarely, moderately and always use it to design.

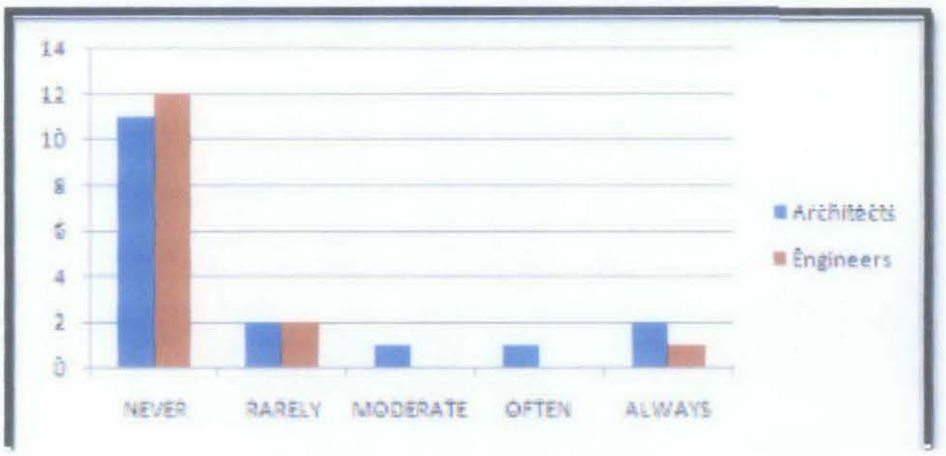


Figure 4.10: ArchiCAD

According to Figure 4.10 above, 64.7% of architects never use ArchiCAD. 11.8% of them rarely and always use ArchiCAD while the rest of 11.8% moderately and often used this software. As for engineers, 80% of them never use, 13.3% rarely use and 6.7% always used ArchiCAD.

Figure 4.11: Bentley Micro Station

From Figure 4.11 above, 94.1% of architects never use Bentley Micro Station and the rest rarely used to produce their design. For engineers, all 100% of them never use Bentley Micro Station before.

Figure 4.12: Bentley Structure

According to Figure 4.12 above, 94.1% of architects never use Bentley Structure while another 5.9% rarely use this software to produce their design. 100 % of engineers also never use Bentley Structure before.

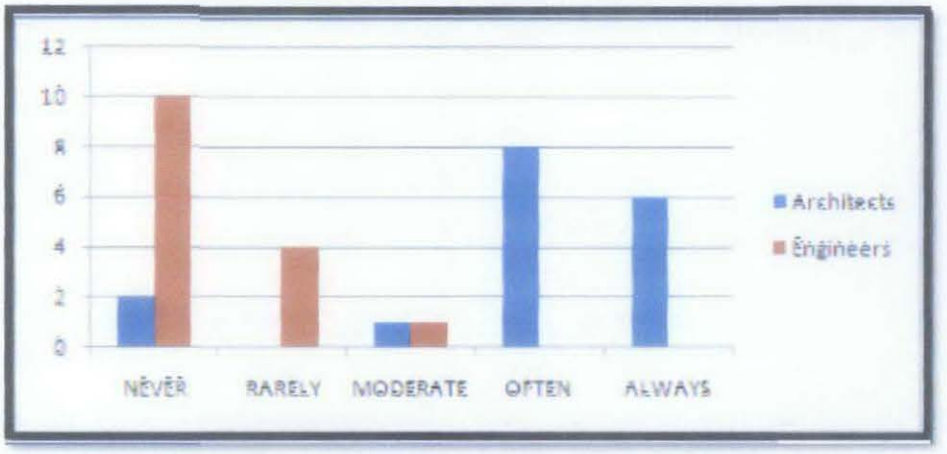


Figure 4.13: Sketch up

Figure 4.13 above shows that 47.1% of architects often use Sketch up and 35.3% of them always use it to design. Only 11.8% of architects never use this software while for engineers, 66.7% never used, 26.7% rarely use and 6.7% moderately use Sketch up.

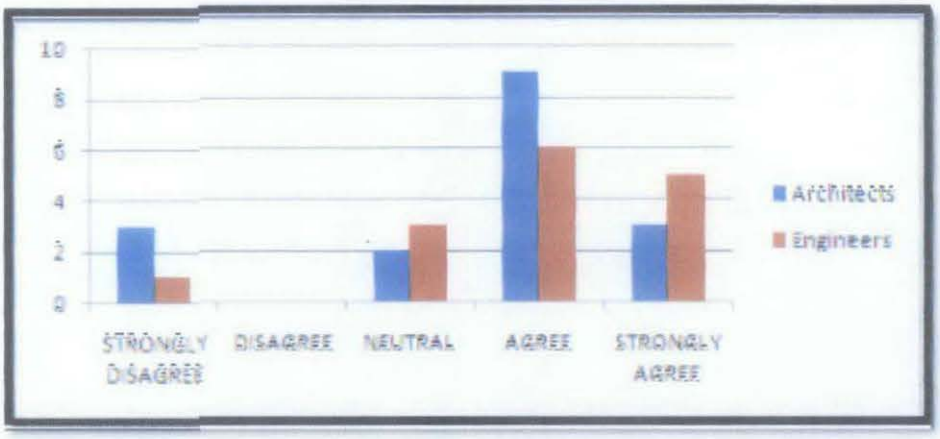


Figure 4.14: Not Required by Client

Figure 4.14 above indicates 70.6% of architects believe that BIM was never required by client. Only 17.6% of them strongly disagree and another 11.7% feel neutral about this perception. While for engineers, 73.3% of them also believe that BIM was never required by client and only 6.7% of them strongly disagree on this..

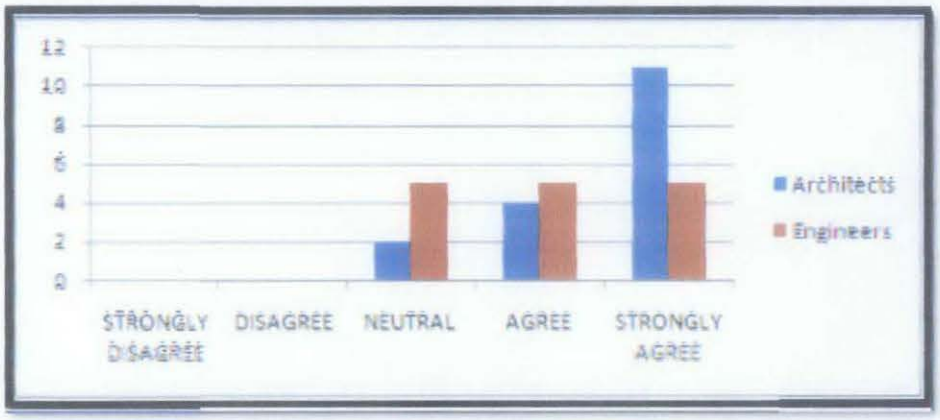


Figure 4.15: Lack of Legal Backing from Authority

Based on Figure 4.15 above, 88.2% of architects and 66.7% of engineers think that lack of legal backing from authority is the reason why BIM is slowly adopted in Malaysia. While another11.7% of architect and 33.3% of engineers fell neutral about this perception.

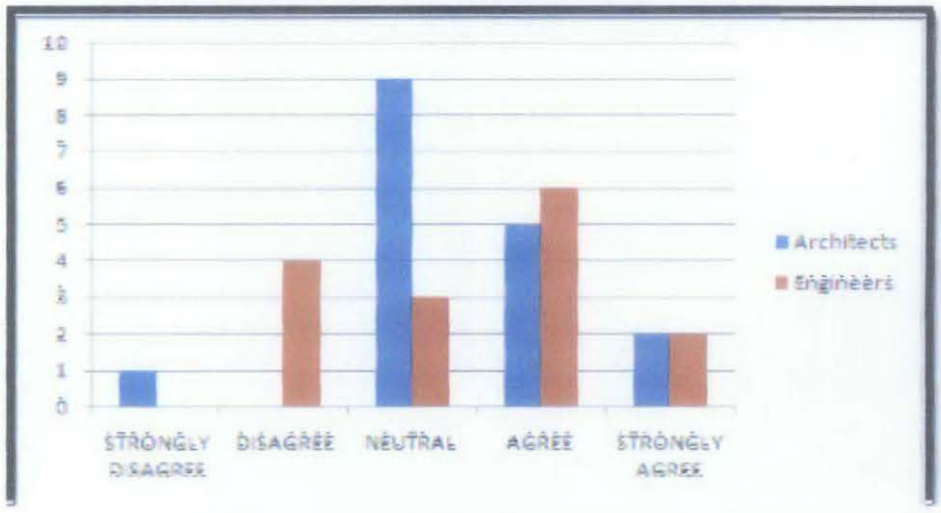


Figure 4.16: Never Required by Other Team Members

From Figure 4.16 above, 41.2% of architects believe that adoption of BIM in Malaysia is slow because it is never required by other team member. 52.9% of them fell neutral while the rest strongly disagree on this. As for engineers, 53.3% of them believe on this perception that. While 26.7% disagree and another 20% fell neutral about this.

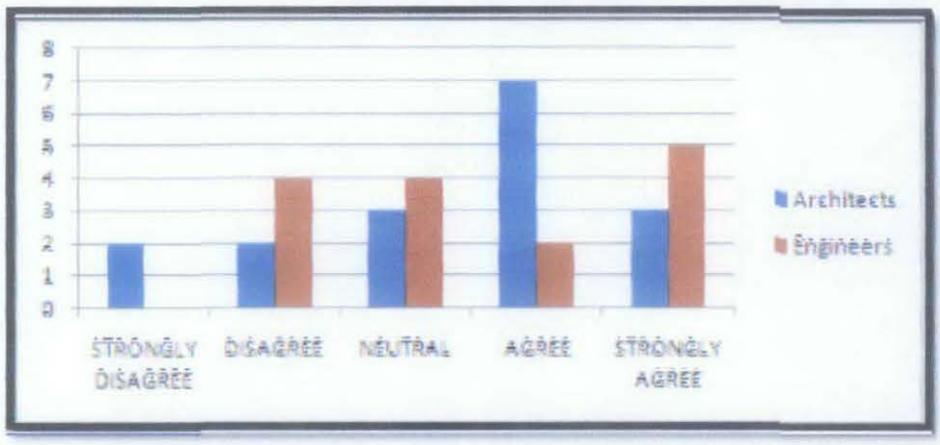


Figure 4.17: Expensive Software

According to Figure 4.17 above, 58.8% of architects think that BIM software are expensive, 23.5% of them do not think so while the rest fell neutral about this. As for for engineers, 46.7% of them think that BIM software are expensive while another 26.7% disagree and fell neutral about that.

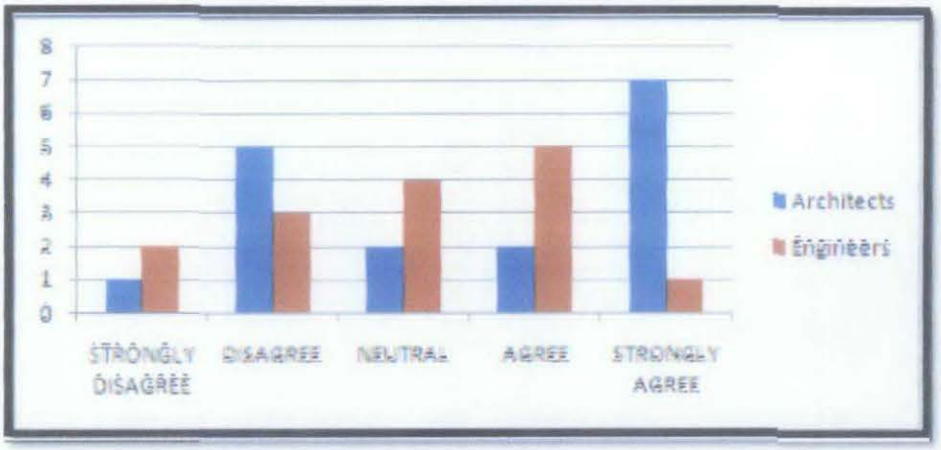


Figure 4.18: Not Ready To Disturb Normal Operational Structure

From Figure 4.18 above, 52.9% of architects believe that BIM is slowly adopted in Malaysia because they are not ready to disturb the normal operational structure. However, 35.3% of them do not believe on that and the rest of them fell neutral about this perception. As for engineers, 40% of them believe, 33.3% do not think so while another 26.7% fell neutral on that.

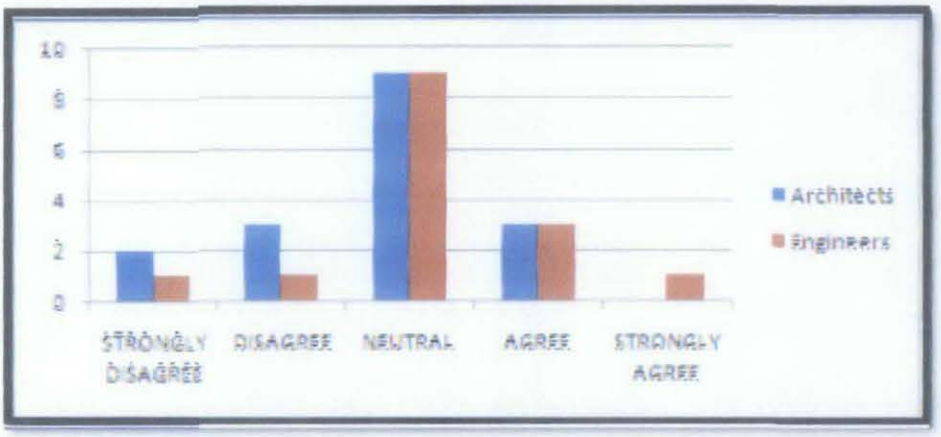


Figure 4.19: Difficult To Learn

Figure 4.19 above indicates 52.9% of architects and 60% of engineers felt neutral about perception of difficult to learn BIM software. Only 17.6% of architects and 26.7% of engineers think that it is difficult to learn BIM.

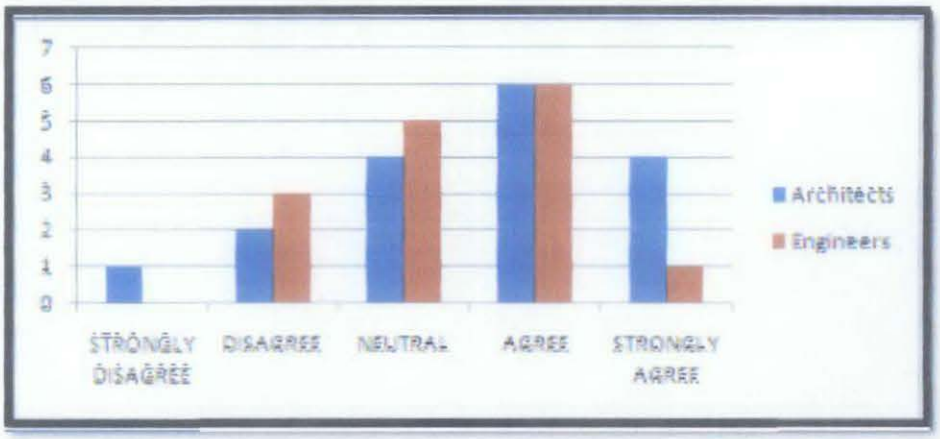


Figure 4.20: Non Availability of Parametric Library

Based on Figure 4.20 above, 58.8% of architects believe that BIM is slowly adopted in Malaysia because of non availability of parametric library. Only 17.6% of them think otherwise and the rest fell neutral about this perception. While for engineers, 66.7% of them agreed about that perception, 20% of them disagree and another 13.3% fell neutral about this.

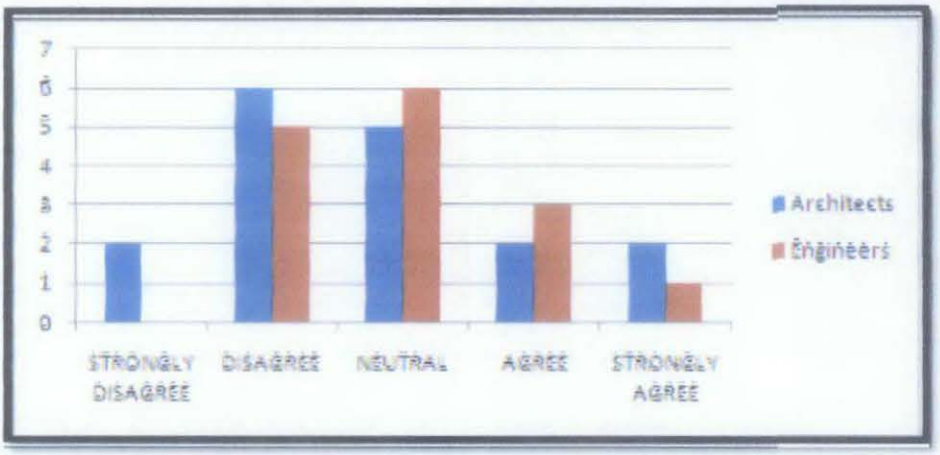


Figure 4.21: Takes Longer Time to Develop a Model

According to Figure 4.21 above, 47.1% of architects do not think that it will take longer time to develop a model by using BIM. Only 23.5% of them agree on this perception and the rest fell neutral. While for engineers, 33.3% of them disagree, 26.7% think so and another 60% fell neutral about that perception.

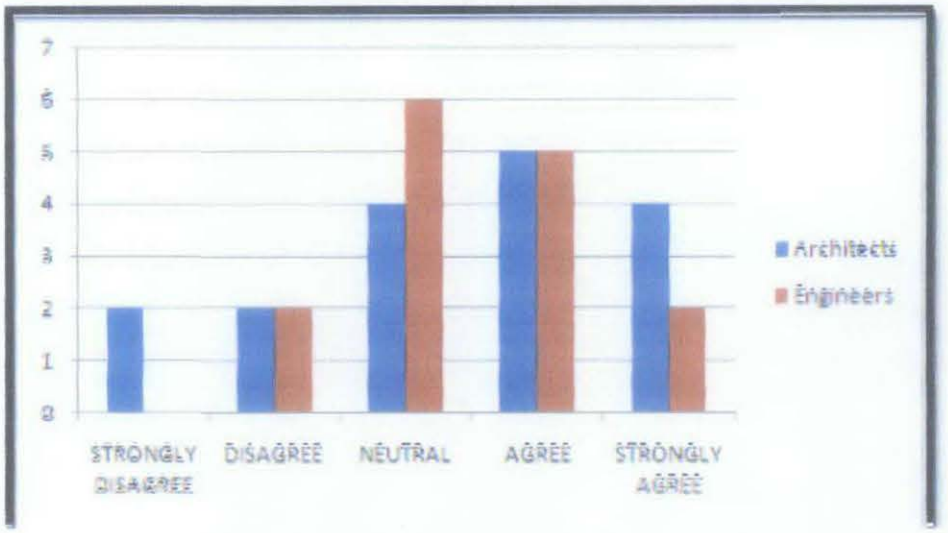


Figure 4.22: Problems of Interoperability

From Figure 4.22 above, 52.9% of architects and 46.7% of engineers think that problem of interoperability as the factor why adoption of BIM is slow in Malaysia. However, 23.5% of architects and 13.3% of engineers think otherwise. While another 23.5% of architects and 40% of engineers fell neutral about this perception.

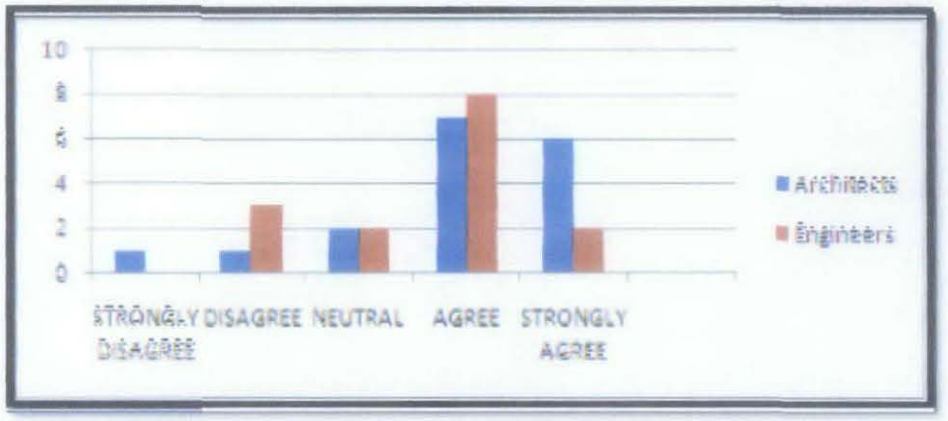


Figure 4.23: Lack of Competent Staff to Operate the Software

Figure 4.23 above shows that 76.5% of architects and 66.7% of engineers believe that BIM is slowly adopted in Malaysia because of lack of competent staff to operate the software. Only 11.8% of architects and 20% of engineers do not believe on this. The rest of architects and engineers fell neutral about this.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the result, the author can conclude that both architects and engineers are aware about BIM. However not all of them are adopting BIM into their operational structure. Most of them (82.4% of architects and 80% for engineers) are still using Autodesk AutoCAD to produce their design. None of them have use Bentley software before. They do not adopt BIM in the first place because of their perceptions towards BIM. Both architects and engineers have their own perception for not adopting BIM. Below are what they claim to be the barriers for them not to use BIM.

88.2% of the architects claim that lack of backing from authority as the main barrier for them to start using BIM. They believe that this barrier must be taken care of first before they could implement BIM. That is why they as architects are still with the conventional method and do not implement BIM into their business just yet.

While for engineers, 73.3% of them believe that BIM was never required by their client. That is why they do not implement BIM in the first place. They think that why would they bother to use BIM when their client never ask them to. Furthermore, they are still comfortable with the current conventional method of designing. And most importantly their client still satisfied with the conventional method.

For the conclusion, the author realizes that there are different perceptions between architect and engineer regarding barriers of BIM. No matter what their perceptions are, all of these must be solved first if we want to see a wide use of BIM in Malaysia construction industry.

5.2 Recommendation

In order to successfully implement BIM in Malaysia construction industry, the author had come out with the following recommendations.

i. Further study should be done to tackle the barriers of BIM implementation. From this research, the author realized that lack of legal backing from authority was the main barrier agreed by both architects and engineers. One way to improve the legal aspect of BIM is by establishing a standard and guideline for BIM implementation. For this purpose, both government and private sector must work together in order to discuss and produce the guideline for BIM. For the 1st step, Malaysia could take the guideline from other countries which had implemented BIM likes U.S, U.K, Australia and Singapore. However, the guidelines must then being change and modified in order to suite the culture in Malaysia construction industry.

ii. Besides that, the government also should take the 1st step in BIM implementation. Government could start using BIM for government projects to prove that the quality and efficiency of works in construction will be far better by using BIM. Apart from that, the government also should recommended or assist the public sector to use BIM. In U.K, it is a mandate by the government to use BIM in any construction projects. While in Australia, the government recommended the private sector to use BIM. Lastly in Singapore, the government is assisting the private sector in using BIM. So in Malaysia, where do we stand? Before Malaysia could mandate the use of BIM, at least the government should try to assist the use of BIM in private sector first.

REFERENCES

Alfred, O., & OLATUNJI. (2011). A Preliminary Review On The Legal Implications of BIM And Model Ownership. *Journal of Information Technology in Construction Vol 16* , 687-695.

Aranda-Mena, G., John, C., Chevez, A., & Froese, T. (2009). building Information Modeling Demystified: Does It Make Business Sense To Adopt Bim? *International Journal of Managing projects, 2* , 419-433.

Azhar, S. (2010). BIM for sustainable design: results of an industry survey. *Journal of Building Information Modeling 4 (1)* , 27–28.

Azhar, S., Carlton, W. A., Olsen, D., & Ahmad, I. (2011). Building information modeling for sustainable design and LEED® rating analysis. *Automation in Construction 20* , 217–224.

Baoping, C., Wei, W., & Xin, H. (2010). *A Research on Construction Project Based on BIM.* China: Wuhan University of Science and Technology.

Campbell, D. A. (2007). The Web3D Application for AEC . *Building Information Modeling* , 173-219.

De Groote, B. (2009). Jurisdiction Problems Regarding Internet Torts: Critical Remarks. *Computer Law & Security Review, 25* , 447-454.

Dean, T., & Ryan, G. (2009). Building Information Modeling: Contractual Risks Are Changing With Technology.

Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2008). *BIM Handbook : A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors.* New Jersey: John Wiley & Sons, Inc.

Foddy, W. (1993). *Constructing Questions for Interviews and Questionnaires: Theory and Practice in Social Research.* Cambridge University Press.

Grillo, A., & Jardim-Goncalves, R. (2009). Value proposition of interoperability on BIM and collaborative working environments. *Automation in Construction* .

Haynes, D. (2009). *Reflection On Some Legal And Contraction Implications of Building Information Modeling (BIM).* Pepe & Hazard Llp.

Holzer, D. (2007). Are You Talking To Me? Bim Alone Is Not The Answer. *Associate of Architecture Schools Australasia Conference.* Australia: University of Technology Sydney.

Kymmell, W. (2008). *Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulation.*

Lachmi, K. (2003, November 20). *BIM Goes Mainstream.* Retrieved June 13 , 2011, from Graphisoft's New Virtual Construction Solutions: http://www.aecbytes.com

Moses, S., El-Hamalawi, A., & Hassan, T. M. (2008). The Practicabilities of Transfering Data Between Project Collaboration Systems Used By The Construction Industry, 17. *Automation In Construction* , 824-830.

Ren, Z., & Hassan, T. M. (2007). Legal Requirements And Challenges For E-Business Within The Single Electronic Europian Markets. *Journal of Profesional Issues In Enginering Education And Practice, 133* , 246-254.

Sher, W., Sheratt, S., Williams, A., & Gameson, R. (2009). Heading Into New Virtual Environment: What Skills Do Design Team Members Need? *Journal of Information Technology In Construction, 18* , 17-29.

Smith, D. K., & Tardif, M. (2009). *Building Information Modeling : A Strategic Implementation Guide.* New Jersey: John Wiley & Sons, Inc.

Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders . *Automation in Construction 18* , 357-375.

APPENDIX A: 1st draft

Date: .....

Project Director,

Dear Sir, Madam,

Level of awareness of Building Information Modeling (BIM) in Malaysian construction industry.

We seek your help in a university research survey on level of awareness of BIM in Malaysian construction industry.

Building Information Modeling (BIM) is a new emerging approach to design, construction, and facility management in which a digital representation of the building process is being created to facilitate the exchange and interoperability of information in digital format. However, local construction industry is reluctant to deploy this technology in its service delivery.

Therefore, the objectives of the study include identifying the level of awareness about this technology among Engineers and Architects, Identifying the barriers for the implementation of Building information modeling (BIM) in the local construction industry. Hopefully, this research will contribute to improve works in Malaysian construction industry from designing phase up to maintenance phase of a building.

So, we would like you to complete and return the questionnaire which will only take less than 15 minutes of your time. It would be very helpful if you could complete and return the questionnaire before 26th September 2011. As an enclosure to this letter, please find a self-addressed and stamped envelope to return the questionnaire. Alternatively, you could also return it by fax on 05-3656716 (Attn: Assoc. Prof. Ir. Dr. Arazi Idrus). Kindly contact Mr. Mohd Amiruddin Mat Rifin, (019-5941560) or email cmen912@gmail.com if you have any question.

Yours faithfully,

.....

(Assoc. Prof. Ir. Dr. Arazi Idrus)
Head of Structure and Construction Cluster of Civil Engineering Department
Universiti Teknologi PETRONAS

Cc: Mr. Mohd Amiruddin Mat Rifin

SURVEY QUESTIONAIRE

Level of Awareness of Building Information Modeling (BIM) in Malaysian Construction Industry.

The need for efficiency and the profitability of owners, designers, and contractors are being challenged as buildings and business processes become increasingly complex. Even though BIM technology can ease the construction processes, but local construction industry is reluctant to deploy this technology in its service delivery. Therefore, a research is conducted to investigate level of awareness of BIM in Malaysian construction industry.

The questionnaire below is divided into four sections (A, B, C, D). Kindly answer the questionnaire by referring to every section's instructions.

SECTION A: GENERAL/ BACKGROUND INFORMATION

Please tick in ◯ provided and fill in the blank.

Gender

◯ Male ◯ Female

Profession

◯ Engineer ◯ Architect ◯ Others (please specify)

Company's name

.....

Age

◯ 20- 23 yrs ◯ 24- 26 yrs ◯ 27- 30 yrs ◯ Above 30 yrs

Level of education

◯ Ph.D ◯ Ms.C ◯ Bachelor Degree ◯ Others

Past experiences in construction industry

◯ < 5 ◯ 5-10 ◯ 11-20 ◯ > 20

SECTION B: AWARENESS OF BIM

Please tick in ◯ provided and fill in the blank.

Do you know what BIM is?

Yes ◯ No ◯

How do you know about BIM?

◯ Internet ◯ Newspaper/ Magazines/ Book ◯ People

◯ Other (please specify) .....

What do you know about BIM?

◯ The software ◯ The applications ◯ The benefits

◯ Others (please specify).....

1. How much do you know about BIM's software?

No significant	1	2	3	4	5	Very significant

SECTION C: PERCEPTION OF BIM

Kindly rate the questions on perception of BIM in Malaysian construction industry using 5-point Lickert scale where; 1=strongly disagree, 2= disagree, 3= average, 4= agree, 5= strongly agree.

No.	Criteria	Scale 1	2	3	4	5
1	Productivity in construction industry has not rapidly grow					
2.	BIM's software are very expensive					
3.	BIM's software are very difficult to learn					
4.	BIM's software has more applications compare to current used software.					
5.	BIM is very beneficial to be applied into construction industry.					

SECTION D: FEEDBACK

1. If there is any additional information regarding BIM that you want to add, feel free to write them here.

   .....

   .....

   .....

   .....

   .....

   .....

   .....

2. How do you prefer to know the result of the research?

   ◯ Via email ◯ Via mail ◯ No, thank you

3. Would you willing to be contacted to provide additional information to support this research?

   ◯ Yes, my contact telephone number is ..... Ext: .....

   ◯ No.

Thank you for your time and cooperation in completing the questionnaire. It would be appreciated if you could return this questionnaire as soon as possible, latest by 26th September 2011 using self-addressed envelope.

APPENDIX A: 2nd draft

To:

_____

_____

_____

_____

Date: 18 Oct 2011

Dear Sir,

Level of awareness of Building Information Modeling (BIM) in Malaysian construction industry.

We seek your help in a university research survey on level of awareness of BIM in Malaysian construction industry.

Building Information Modeling (BIM) is a new emerging approach to design, construction, and facility management in which a digital representation of the building process is being created to facilitate the exchange and interoperability of information in digital format. However, local construction industry is reluctant to deploy this technology in its service delivery.

Therefore, the objectives of the study are to investigate level of awareness and perception of BIM among Engineers and Architects in local construction industry. Hopefully, this research will contribute to improve the works in Malaysian construction industry from designing phase up to maintenance phase of a building.

This questionnaire will only take less than 15 minutes of your time. It would be very helpful if you could complete and return the questionnaire before **15th November 2011**. As an enclosure to this letter, please find a self-addressed and stamped envelope to return the questionnaire. Alternatively, you could also return it by fax on 05-3656716 (Attn: Assoc. Prof. Ir. Dr. Arazi Idrus). Kindly contact Mr. Mohd Amiruddin Mat Rifin, (019-5941560) or email amir.rifin@gmail.com if you have any question.

Yours faithfully,

(Assoc. Prof. Ir. Dr. Arazi Idrus)
Head of Structure and Construction Cluster of Civil Engineering Department
Universiti Teknologi PETRONAS

Cc: Mr. Mohd Amiruddin Mat Rifin

SURVEY QUESTIONAIRE

Level of Awareness of Building Information Modeling (BIM) in Malaysian Construction Industry.

The need for efficiency and the profitability of shareholders in construction are being challenged as buildings and business processes become increasingly complex. Even though BIM technology can ease the construction processes, but local construction industry is reluctant to deploy this technology in its service delivery. Therefore, a research is conducted to investigate level of awareness of BIM in Malaysian construction industry.

The questionnaire below is divided into four sections (A, B, C, D). Kindly answer the questionnaire by referring to every section's instructions.

SECTION A – RESPONDENT PARTICULAR

Name of Firm : _____

Area of Expertise : _____

Qualification: PhD [ ] Msc/MEng [ ] Bsc/BEng [ ] Diploma [ ] Others [ ]

Years of Experience: 1- 5 [ ] 6 -10 [ ] 11 -15 [ ] 16 – 20 [ ] >20 [ ]

Number of Staff: 1-5 [ ] 6-10 [ ] 11-15 [ ] 16 – 20 [ ] > 20 [ ]

SECTION B – FREQUENCY OF BIM TOOLS UTILIZATION

Please circle at the appropriate box alongside each statement given to show your frequency of using the under listed software (On the scale: 1 to 5).

1	2	3	4	5
Never	Very Rarely	Rarely	Occasionally	Frequently

No.	Software in use	FREQUENCY LEVEL				
1	Autodesk AutoCAD					
2	Autodesk 3D Studio MAX					
3	Tekla Structure					
4	Autodesk Revit MEP					
5	Autodesk Revit Architecture					
6	Autodesk Revit Structure					
7	ArchiCAD					
8	Bentley Micro station					
9	Bentley Structure					
10	Sketch up					

SECTION C – PERCEPTION TOWARDS IMPLEMENTATION OF BIM

Please circle at the appropriate box alongside each statement given to show your level of agreement on the factors you think are responsible for slow adoption of BIM (On the scale: 1 to 5).

1	2	3	4	5
Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree

NO.	Perception Towards BIM	AGREEMENT LEVEL				
1.	Not required by client	1	2	3	4	5
2.	Lack of legal backing from Authority. eg: who the owner of the model	1	2	3	4	5
3.	Never required by other team members	1	2	3	4	5
4.	Expensive Software	1	2	3	4	5
5.	Not ready to distort the normal operational structure.	1	2	3	4	5
6.	Difficult to learn	1	2	3	4	5
7.	Non availability of parametric library	1	2	3	4	5
8.	Takes longer time to develop a model	1	2	3	4	5
9	Problems of interoperability	1	2	3	4	5
10.	Lack of competent staff to operate the software	1	2	3	4	5

SECTION D: FEEDBACK

1. How do you prefer to know the result of the research?

   Via email [ ] Via mail [ ] No, thank you [ ]

2. Would you willing to be contacted to provide additional information to support this research?

   [ ] Yes, my contact telephone number is _____ ext: _____

   [ ] No.

Thank you for your time and cooperation in completing the questionnaire. It would be appreciated if you could return this questionnaire as soon as possible, latest by **15th November 2011** using self-addressed envelope or fax them to 05-3656716 (Attn: Assoc. Prof. Ir. Dr. Arazi Idrus).

APPENDIX A: Final questionnaire

TO: _____

_____

_____

_____

Date: 18 Oct 2011

Dear Sir,

Level of awareness of Building Information Modeling (BIM) in Malaysian construction industry.

We seek your help in a university research survey on level of awareness of BIM in Malaysian construction industry.

Building Information Modeling (BIM) is a new emerging approach to design, construction, and facility management in which a digital representation of the building process is being created to facilitate the exchange and interoperability of information in digital format. However, local construction industry is reluctant to deploy this technology in its service delivery.

Therefore, the objectives of the study are to investigate level of awareness and perception of BIM among Engineers and Architects in local construction industry. Hopefully, this research will contribute to improve design process in Malaysian construction industry from designing phase up to maintenance phase of a building.

This questionnaire will only take less than 15 minutes of your time. It would be very helpful if you could complete and return the questionnaire before **15th November 2011**. As an enclosure to this letter, please find a self-addressed and stamped envelope to return the questionnaire. Alternatively, you could also return it by fax on 05-3656716 (Attn: Assoc. Prof. Ir. Dr. Arazi Idrus). Kindly contact Mr. Mohd Amiruddin Mat Rifin, (019-5941560) or email amir.rifin@gmail.com if you have any question.

Yours faithfully,

(Assoc. Prof. Ir. Dr. Arazi Idrus)
Head of Structure and Construction Cluster of Civil Engineering Department
Universiti Teknologi PETRONAS

Cc: Mr. Mohd Amiruddin Mat Rifin

SURVEY QUESTIONAIRE

Level of Awareness of Building Information Modeling (BIM) in Malaysian Construction Industry.

The need for efficiency and the profitability of shareholders in construction are being challenged as buildings and business processes become increasingly complex. Even though BIM technology can ease the construction processes, but local construction industry is reluctant to deploy this technology in its service delivery. Therefore, a research is conducted to investigate level of awareness of BIM in Malaysian construction industry.

The questionnaire below is divided into four sections (A, B, C, D). Kindly answer the questionnaire by referring to every section's instructions.

SECTION A – RESPONDENT PARTICULAR

Name of employer : _____

Area of Expertise : _____

Qualification: PhD [ ] Msc/MEng [ ] Bsc/BEng [ ] Diploma [ ] Others [ ]

Years of Experience: 1- 5 [ ] 6 -10 [ ] 11 -15 [ ] 16 – 20 [ ] >20 [ ]

Are you aware of Building Information Modeling (BIM)?

Yes [ ] No [ ]

(Kindly proceed to the questions on the next sections)

SECTION B – FREQUENCY OF BIM TOOLS UTILIZATION

Please circle at the appropriate box alongside each statement given to show your frequency of using the under listed software (On the scale: 1 to 5).

1	2	3	4	5
Never	**Rarely**	**Moderate**	**Often**	**Always**

No	Software in use	FREQUENCY LEVEL				
1	Autodesk AutoCAD	1	2	3	4	5
2	Autodesk 3D Studio MAX	1	2	3	4	5
3	Tekla Structure	1	2	3	4	5
4	Autodesk Revit MEP	1	2	3	4	5
5	Autodesk Revit Architecture	1	2	3	4	5
6	Autodesk Revit Structure	1	2	3	4	5
7	ArchiCAD	1	2	3	4	5
8	Bentley Micro station	1	2	3	4	5
9	Bentley Structure	1	2	3	4	5
10	Sketch up	1	2	3	4	5

SECTION C – PERCEPTION TOWARDS IMPLEMENTATION OF BIM

Please circle at the appropriate box alongside each statement given to show your level of agreement on the factors you think are responsible for slow adoption of BIM (On the scale: 1 to 5).

1	2	3	4	5
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**

NO.	Perception Towards BIM	AGREEMENT LEVEL				
1.	Not required by client	1	2	3	4	5
2.	Lack of legal backing from Authority. eg: who the owner of the model	1	2	3	4	5
3.	Never required by other team members	1	2	3	4	5

4.	Expensive Software	1	2	3	4	5
5.	Not ready to distort the normal operational structure.	1	2	3	4	5
6.	Difficult to learn	1	2	3	4	5
7.	Non availability of parametric library	1	2	3	4	5
8.	Takes longer time to develop a model	1	2	3	4	5
9	Problems of interoperability	1	2	3	4	5
10.	Lack of competent staff to operate the software	1	2	3	4	5

SECTION D: FEEDBACK

3. How do you prefer to know the result of the research?

   Via email [ ] Via mail [ ] No, thank you [ ]

4. Would you willing to be contacted to provide additional information to support this research?

   [ ] Yes, my contact telephone number is _____ ext: _____

   [ ] No.

Thank you for your time and cooperation in completing the questionnaire. It would be appreciated if you could return this questionnaire as soon as possible, latest by **15th November 2011** using self-addressed envelope or fax them to 05-3656716 (Attn: Assoc. Prof. Ir. Dr. Arazi Idrus).

APPENDIX B: Interview Questions

INTERVIEW QUESTIONS

Awareness of Building Information Modeling Among Professional in Malaysia Construction Industry

ORGANIZATION:

POSITION :

1. Do you know what is Building information Modeling?

2. How would explain this emerging technology?

3. What is your general perception of the technology

4. What are the possible challenges you think, this technology will create.

5. What are the major professional problems that you are facing with the current construction delivery methods

6. Who do you think will benefit most among the construction stakeholders?

7. What are the risks of using this technology to construction professionals?