

ADOPTION OF BUILDING INFORMATION MODELLING (BIM) TOOLS  
DURING PRE-CONSTRUCTION STAGE IN MALAYSIAN  
CONSTRUCTION INDUSTRY

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## **DEDICATION**

Especially for My beloved parents who gave me endless love, trust, constant encouragement over the years, and for their prayers.

Course mates, Friends, Supervisor,

For their encouragement throughout the course.

You know who you are.

This project report is dedicated to them.

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## **Abstract**

The construction industry believes that Building Information Modelling (BIM) is a platform that has the potential to promote an intensive construction activity especially in reducing the time and productivity towards the evolution of industry 4.0. The goal of this study is to explore the process and the level of BIM tools implemented in the Malaysian. Lack of government involvement worsens the current situation besides having the resistance to change from construction players. To reduce the resistance for adopting BIM, most of the companies came out with own strategy such as developing new BIM unit, developing training and education program, changing management style and developing new roles and responsibilities. These activities could facilitate the organisations in adopting BIM tools. BIM is not only a technology, but it is also involved in changing the current practices and processes including changing managerial function and hierarchy, including roles and responsibilities. This study also identified that the adoption BIM Level in the Malaysian is between Level 0 and 2. However, the number will increase as Construction Industry Development Board (CIDB) has enhanced a lot of seminar, talks and conferences regarding BIM adoption. Thus, the identification of BIM tools adoption factor is essential to assist the companies to continue adopting BIM in real practices. Hence, the objective of this research is to explicate the BIM adoption factors from various literature and distributing questionnaires to gather data, as a basis to develop a research framework for analyse the data obtained, and (1)to study the extent of construction players in adopting BIM during pre-construction stage.(2) to identify the effects of BIM implementation during pre-construction stage.(3) to determine the best solutions of BIM implementation during pre-construction stage.

## Abstrak

Industri pembinaan percaya bahawa Pemodelan Maklumat Bangunan (BIM) berpotensi untuk mempromosikan aktiviti kerjasama dalam industri pembinaan. Matlamat kajian ini adalah untuk meneroka proses dan tahap pelaksanaan alat BIM di Malaysia. Khususnya semasa peringkat pra-pembinaan kerana pihak yang berkepentingan tidak tahu di mana, kapan dan bagaimana untuk memulakan kerana tidak ada piawai dan garis panduan BIM nasional untuk mereka ikuti. Kekurangan penglibatan kerajaan dan penentangan terhadap perubahan daripada orang. Untuk mengurangkan rintangan daripada orang, kebanyakan syarikat keluar dengan strategi mereka sendiri seperti membangunkan unit BIM baru, membangunkan program latihan dan pendidikan, mengubah gaya pengurusan dan membangunkan peranan dan tanggungjawab baru. Aktiviti ini dapat memudahkan orang ramai dan organisasi dalam mengadaptasi alat BIM kerana BIM bukan hanya teknologi, tetapi juga terlibat dalam mengubah amalan dan proses semasa termasuk mengubah fungsi pengurusan dan hierarki, peranan dan tanggungjawab. Kajian ini juga telah mengenal pasti bahawa penggunaan BIM Level dalam industri pembinaan Malaysia adalah di antara Tahap 0 dan 2. Walau bagaimana pun, bilangan ini akan bertambah apabila Lembaga Pembangunan Industri Pembinaan (CIDB) telah meningkatkan banyak seminar, ceramah dan persidangan mengenai penggunaan BIM. Objektif penyelidikan ini adalah untuk menerangkan faktor-faktor adopsi BIM dari pelbagai kesusasteraan dan pengumpulan soal selidik untuk mengumpulkan data, sebagai asas untuk membangunkan rangka kerja penyelidikan untuk menganalisis data yang diperolehi, dan (1) untuk mengkaji sejauh mana pemain pembinaan dalam mengamalkan BIM (2) untuk mengenal pasti kesan pelaksanaan BIM semasa peringkat pra-pembinaan (3) untuk menentukan penyelesaian terbaik pelaksanaan BIM semasa peringkat pra-pembinaan.

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## LIST OF SYMBOLS

$\alpha$  - Cronbach's alpha

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# CHAPTER 1

## INTRODUCTION

### 1.0 Research Background

Adaptation of technology in the construction industry is moving rapidly towards the era of modernisation and globalisation. ICT has played a significant role in this transformation. The use of ICT permeates in various industries including in the construction industry and it is seen as a major driver for improving performance of the industry (CIDB, 2007).

In the pre-construction stage of project, the adoption of Building Information Modelling (BIM) tools can increase accuracy in preparing cost estimating, project scheduling, site analysis, and project productivity (Fallon and Palmer, 2007; Eastman et al., 2011). The ability of BIM in visualising project design and detect design clashes during design stage can reduce request for information (RFI), design changes and incomplete design specification during construction stage. The possibilities of those problems occur during construction stage can be avoided earlier in pre-construction stage (Kymmell, 2008; NCCER, 2008).

The main importance of BIM implementation in project pre-construction stage lies on the use of three dimensional (3D) parametric authoring tools as object-based modelling software (Mohamad Kamar, 2012).

There are several types of modelling software or also known as BIM tools are used to manage project design in construction projects. These tools are such as Revit (architecture, structural, mechanical and electrical (M&E)), Bentley System (architecture, structural and M&E) and Tekla structure. The tools are capable to visualise project model, preview design clashes and generate fabrication drawing for various building systems (Azhar, 2011; Eastman et al., 2011; Ahmad Latiffi et al., 2013; Monteiro and Martins, 2013; PWD, 2013).

Utilising BIM technology allows effective and better plan for construction projects activities, which can overcome the potential errors in design, disputes among construction stakeholders, construction cost overrun and project delay (Eastman et al., 2011). BIM also has ability to improve communication, collaboration between construction stakeholders, reducing cost at every stage in construction projects and minimise safety issues in construction projects (Smith and Tardif, 2009; Cheng and Ma, 2012; Sunindijo and Zou, 2013).

## **1.1 Problem Statement**

Currently, the implementation of BIM during pre-construction stage is seen as one of the effective ways to minimise construction problems. Even though BIM implementation gives positive effects to construction projects, most of the design team is facing difficulty to implement BIM.

Meanwhile, possessing of relevant skill on BIM will also guide construction stakeholders on how to manage project design, cost estimating, project scheduling, site coordination and facilities management by using BIM tools such as Revit families (Azhar, 2011; Newman, 2013).

The hindrance of BIM adoption in construction projects is due to cost of implementing BIM tools (revit families), new hardware (computer) and BIM training. The cost for these tools is expensive and it could be a barrier for small and medium construction companies to implement BIM in their work (Furneaux and Kivvits, 2008; Eastman et al., 2011; Forbes and Ahmed, 2011).

The lack of effective strategy of implementing BIM in an organisation also contributed to the slow adoption of BIM among construction stake holders (Arayici et al., 2012); for instance: the absence of a comprehensive BIM standard guideline (Zakaria et al., 2013; CREAM, 2014) and adoption model to implement BIM (Zakaria et al., 2013). Literally, there is no clear consensus on how to implement BIM in construction projects (Azhar, 2013)

## **1.2 Research Questions**

The research questions are as follows:

- (i) To what extent did construction players use BIM in project Pre-construction stage?
- (ii) How BIM implementation in project Pre-construction stage gives effect to construction players?
- (iii) What are the benefits of BIM implementation in project Pre-construction stage?
- (iv) How to assist construction players to implement BIM in project pre-construction stage?

## **1.3 Research Aim and Objectives**

The aim of this research is to assist construction players to implement BIM in project pre-construction stage.

To be able to attempt the aim, the following research objectives are established:

- (i) To study the extent of construction players adopting BIM during pre-construction stage.
- (ii) To identify the effects of BIM implementation during pre-construction stage to construction players.
- (iii) To determine the best solutions of BIM implementation during pre-construction stage.

#### **1.4 Scope of Research**

The scope of this research is focused on construction projects in Malaysia, which have used and currently using BIM. The projects are residential and commercial projects. Therefore, all information regarding implementing BIM in pre-construction stage were obtained from design team, which are client, architect, structural engineer, Mechanical, Electrical and Plumbing (MEP) engineers as well as contractors. The contractors are involved in this research because most of the projects using BIM in Malaysia is using design and build (D&B) as project delivery method. According to Chappell (2007), most contractors that are involved in managing project design are in design and build project scheme.

Moreover, all respondents involved in this research must have been involved and currently involved in projects using BIM. This is important to gain their understanding and experiences in managing projects using BIM. Furthermore, the information also vital to discover current BIM practices in Malaysian construction projects. The information is very useful to identify level of BIM implementation in Malaysian construction projects.

## **1.5 Significance of Research**

This research is expected to contribute to design team and the construction industry with:

(i) giving recommendation to design team on how to implement BIM in project pre-construction stage in a construction project. This could increase BIM implementation in construction projects.

(ii) producing the best solutions that could assist design team to implement BIM and get benefits of using BIM in managing construction projects.

## **1.6 Research Methodology**

Research methodology is one of the approaches in doing research. It is an approach to plan, to review and to control research process (Fellows and Liu, 2008). Figure 1.1 shows research methodology process for this research to be able to achieve research aim and objectives.

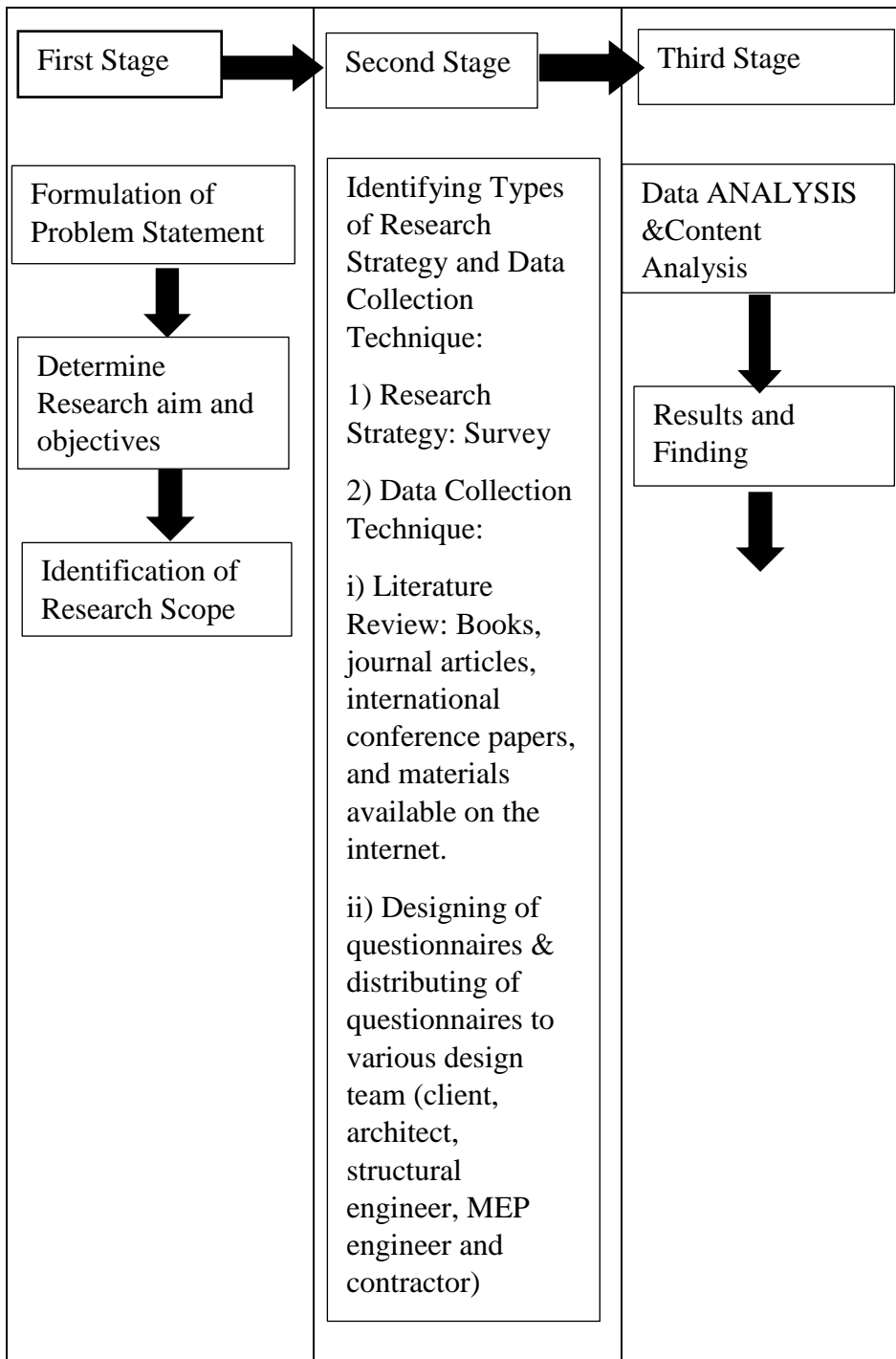


Figure 1.1: Research Methodology Process

Based on Figure 1.1, the research methodology process is divided into three (3) stages.



The first stage is the process to identify research issues, topic selection problem statement and research objectives. The researcher had brainstormed for research topic and had identified current issues on BIM implementation in construction projects. Moreover, the researcher has identified which construction projects in Malaysia are using BIM for the purpose of data collection.

The second stage shows types of research strategy and data collection technique used in this research. Survey is adopted in this study as the research strategy. Meanwhile, literature review and questionnaires were used in this study as data collection technique. The literature review is made to gain information on BIM implementation in project pre-construction stage and types of model, which related to BIM and construction field. All information on BIM and project pre-construction stage was gathered from books, journal articles, international conference papers, and materials available on the internet. Moreover, questionnaires are used to collect data in this study to gain information from the design team on current BIM implementation in project design stage.

The final stage, or the third stage is divided into three (3), which are data analysis, results and findings, conclusion and recommendations. All data gained from questionnaires with the design team are analysed using content analysis. Both data from literature review and questionnaires were used for the purpose of model development. The content analysis view data representation through texts, images and expressions (Krippendorff, 2012). Utilising Statistical Package for Social science (SPSS) software to assist researchers in analysing all the data. Conclusion and recommendation are the last chapter in this thesis.

The conclusion summarised all chapters in this thesis. Meanwhile, recommendations are produced based on limitation to fulfil this study and recommendations made by the researcher to improve this research in the future.

Details of research methodology process were discussed in Chapter 3.

## **1.7 Research Organisation**

The research consists of six (6) main chapters. The chapters are as follows:

### **(i) Chapter 1: Introduction**

This chapter consisted of introduction to research, background of research, problem statement, research questions, research objectives, scope of research, significance of research, research methodology, research organisation and summary of the chapter.

### **(ii) Chapter 2: Literature Review**

Chapter 2 contained of literature reviews on construction project design stage and BIM. All information in this chapter consisted of introduction to construction project design stage; construction players in project design stage and issues on project design. This chapter also discussed on BIM in construction projects; definitions of BIM; implementation of BIM in the Malaysia construction industry; application of BIM in project design; tools; benefits; challenges to implementing BIM; future development of BIM in the construction industry and BIM adaptation in project design stage. Apart from that, this chapter also discussed about model development technique, which are related to BIM and construction field. The discussion contained of examples of model related to research model, similarities between the model and selection of maturity level for the research model. This chapter end with explanations on theoretical framework and summary.

### **(iv) Chapter 3: Research Methodology**

Chapter 3 discussed on research approaches, research strategies and data collection method. This is followed by methodology adopted for the research and discussion on each adopted approach, methods used for data collection and data analysis.

(iv) Chapter 4: Results and Findings

This chapter consisted of findings from questionnaires that distributed to the design teams. Furthermore, this chapter focused on current BIM practices in project design stage among design teams. The trends of BIM implementation in project design stage are explored, which include BIM implementation in project design stage, effects of BIM implementation in project design stage, challenges of BIM implementation in project design stage and potential improvements of BIM implementation in project design stage.

(v) Chapter 5: Conclusion and Recommendations

The main conclusion is drawn out in this chapter and the limitations of the research are highlighted. It revealed the finding and suggested recommendations for future research and it ended with a concluding remark.

## **1.8 Summary**

This chapter has presented the main issues of BIM implementation in project pre-construction stage and justification for the need of research on BIM in project re-construction stage. The aim and objectives of the research are stated in this chapter. This chapter also explored about the research planning and methodology used in this study. The structure of this study is presented at the end of the chapter. The next chapter focused on literature review related to project pre-construction stage, BIM tools and model related to BIM and construction field.

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