

## **THE CHALLENGES IN IMPLEMENTING BUILDING INFORMATION MODEL (BIM) FOR SME'S CONTRACTOR IN THE CONSTRUCTION INDUSTRY**

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### **ABSTRACT**

Building Information Modelling (BIM) is a technology that is currently gaining momentum within the construction industry as interoperability issue is becoming more and more important in relative to the quality and productivity of the industry. BIM is defined as a modelling technology and associated set of processes to produce, communicate, and analyse building models throughout the entire project's lifecycle. Although there is bound of benefits that gained from the BIM application, the SME's contractor still reluctant to deploy the technology in delivering its services. The objectives set out in this research are to examine issues and challenges faced by SME's in adopting BIM in construction industry; to determine the potential solution in implementing BIM for SME's contractor; and to identify the advantages of how BIM can give a good impact on productivity in the construction industry. The methodology adopted for this research was quantitative method using the questionnaire survey. Convenience sampling was used where the respondents were recommended by experts and SME's contractor company/firm. The results concluded that: for the issues and challenges, the cost to implement BIM in a company where the highest rank scored, and for the potential solution, the government should provide awareness and motivation programme has been chosen by the respondents to be a top solution. And last for the advantages, the respondents agree that improved cost estimating at each project stage was the best advantages. It was found that BIM can be made an optional or a compulsory subject in the architecture, engineering and construction education curriculum for all undergraduate architecture, engineering and construction students before they go abroad into the world of the construction industry.

### **Keywords:**

*Building Information Model (BIM), Issues and Challenges, Potential Solution, Advantages, Construction Industry.*

### **INTRODUCTION**

Building Information Modelling (BIM) is one of the new technologies that in the developing process, it is applied to design, construction and management. It is like all the construction data will be in digital format. This technology is actually has been utilized in many advanced countries to guarantee their construction industries efficiently receive the utilization of the BIM as the construction work devices in the construction process. (Harris M. I, 2014). The important features of BIM are that it provides an object-oriented database that is made up of intelligent objects, the 3D representation of integrated information, and a relational database that is interconnected (CIDB, n.d). BIM is the practice of the methodology which conveys the principles to stand the view of accessibility in data about the cycle of the construction process. BIM has created to meet the client needs by view the visual of building design and building estimation before the

construction starts. The advancement of BIM in Malaysia only generated by private sectors since 2009 and the National cancer institute (NCI) is the first government project using BIM in the year of 2010. According to CIDB Malaysia (2014) stated that by knowing the importance of BIM in construction industry, that board will give and supply the knowledge about to manage the BIM so that it can survive and flourish. Early steps that CIDB was make is the provide awareness program and workshops to get the feedback and remark went to graphing path for big and bigger implementation of BIM.

## **LITERATURE REVIEW**

The construction industry is one of the mainstays of a country's economic growth. It is not wrong to state that a country's construction zone can be used as an indicator to estimate that country's economic performance. Different people may hold different views, but when a country's economic statistics are heading downwards, the government's 'stimulus package' for the economy frequently comprises extensive allocation for the construction industry (Richard, 2003). As stated by Michel et. Al (2000), the role of IT in most industrial areas has changed impressively in the course of recent year. Building practitioners use IT to reproduce, break down and assess the expected execution of the luxury plan, the outline of the pleasantries' conveyance procedure and the configuration of associations in completing the procedures. Computer vision is a technology that spotlights on giving computers the qualities of the capacity of human vision. It can be utilized as a part of the definition of 3D objects from 2D images. An image is consequently checked and work in advancement can be measured. Case in point, it is conceivable to outwardly quantify the construction process of a superstructure, while some different parts of measuring advancement can't be completely mechanized. Along these lines, the utilization of a computer vision system is to help the task of project management to some degree (Zhang et al., 2009). This study characterizes SMEs uniquely in contrast to prior investigations of construction or different industries. Typically, researchers characterize SMEs by the quantity of workers or aggregate resources (Norris, 1984). In any case, this definition is not practical in the Malaysian construction industry. Therefore, construction companies once in a while have the quantity of workers and resources that match their task volume. As revealed by CIDB (n.d), BIM reduces risks of cost and time over-runs, enhances safety and improves competitiveness for contractors. Risk of rework is significantly reduced, thus resulting in increased profit.

## **METHODOLOGY**

### ***Methodology Flowchart***

This study provides the essentials of what are the challenges in implementing building information modelling (BIM) for SME's contractor in the construction industry. The first chapter is the introduction of the research, which includes the problem statement, aim and objectives, scope of the study and research methodology used for this study. The second and third chapter is based on secondary data. A literature review was used and it focuses on the overview of BIM application, SME's classification and construction industry in Malaysia. The third chapter continues with the literature review, but this chapter focuses on efforts made to improve the participation of SME's contractor with the BIM. The Research Methodology lays down the methods used for this research.

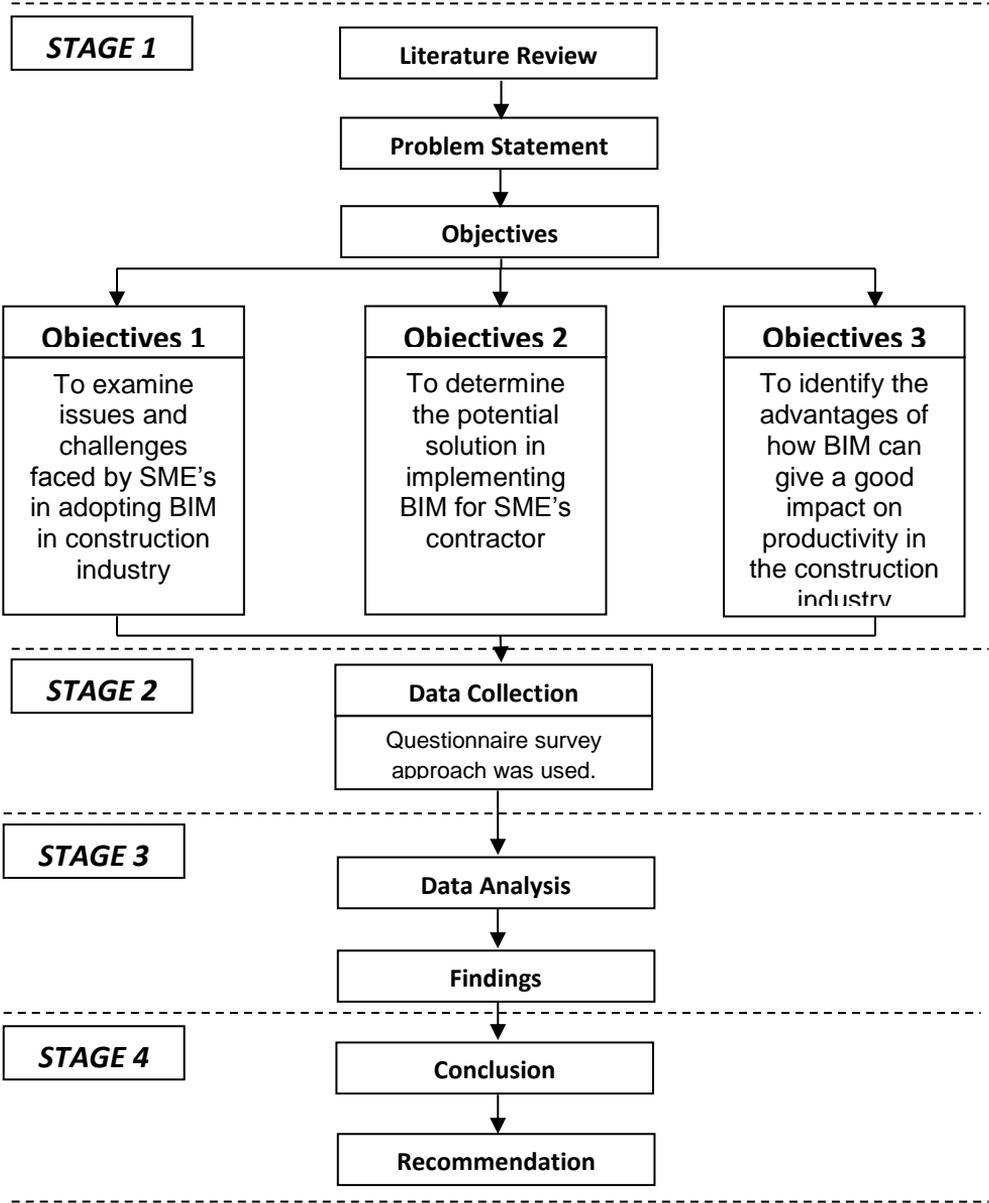


Figure 1: Research Process

*Literature Review*

The literature review is used as a secondary resource for gathering information about past research that has been done to identify what are the what are the challenges in implementing Building Information Modelling (BIM) for SME's contractor in the construction industry,

*Questionnaires*

The survey was conducted in December 2015 and convenience samplings were used due to limited time and sources of funding. In total 60 sets of questionnaires were distributed to the relevant party of construction project participants. The target respondents were based on recommendation from experts and industry players. In total 60 sets of questionnaire survey were distributed. Only 48 sets of replies and returned to complete questionnaire form by the respondents. From the survey, 48 responses were successfully obtained a giving rate of 80%.

**4.0 RESULTS AND DISCUSSION**

The first part of the analysis concentrates on analysing the data obtained by questionnaires. From the result of the questionnaires, the construction industry is dominated by male workers rather than female workers. This is a norm for the construction industry. The majority of the respondents has not more than 5 years' experience. The majority of the respondents work for a contractor firm and mostly involved in public projects. Sixty six (66%) of the respondent strongly agrees that the cost to implement BIM in the company is too high. Based on the percentage done on the first section that is to determine the cause of challenge in implementing BIM in company for SME's contractor. The remaining variables are rated neutral from the respondents. The highest ranked challenge is that the cost to implement BIM in the company is too high. And the lowest ranked challenge is readiness to change from traditional to BIM requires high cost of investment, clear Consensus as how to implement and use BIM. Moving on to the second objective that is to identify potential solution in implementing BIM for SME's contractor, the percentage shows that respondents agreed all the solutions are important. The highest ranked is important that the government should provide awareness and motivation programme. On the other hand the lowest ranked is the development of a CIDB portal to gain information about the BIM. Lastly, the third objective is to identify the advantages of how BIM can give a good impact on productivity in the construction industry the highest ranked for advantages of BIM is improved cost estimating at each project stage and the lowest ranked is increased speed of delivering projects.

**4.1 Issues and Challenges Faced by SME's in Adopting BIM in Construction Industry**

Tables 4.1 display the overall results of the survey on issues and challenges faced by SME's in adopting BIM in construction industry.

Table 4.1: Issues and Challenges faces with SME's (by ranking)

| Issues and Challenges  | Frequency |   |   |    |    |       | Mean | Level of agree | Ranking |
|--|-----------|---|---|----|----|-------|------|----------------|---------|
|  | 1         | 2 | 3 | 4  | 5  | Total |      |                |         |
| The cost to implement BIM in the company is too high.                        | 0         | 0 | 2 | 14 | 32 | 48    | 4.63 | Strongly Agree | 1       |
| The SME's contractors do not have the technology (hardware and software) and | 0         | 0 | 4 | 18 | 26 | 48    | 4.46 | Agree          | 2       |

|  |   |   |   |    |    |    |      |       |   |
|--|---|---|---|----|----|----|------|-------|---|
| capability to implement BIM.   |   |   |   |    |    |    |      |       |   |
| BIM is a new tool that many have little or no knowledge about it.  | 0 | 0 | 0 | 28 | 20 | 48 | 4.42 | Agree | 3 |
| The in-house technical staff are not ready to be trained   | 0 | 0 | 4 | 20 | 24 | 48 | 4.42 | Agree | 4 |
| Readiness to change from traditional to BIM requires high cost of investment, clear Consensus as how to implement and use BIM. | 0 | 0 | 3 | 26 | 19 | 48 | 4.33 | Agree | 5 |

According to the table 4.1 above, shows the cost to implement BIM in the company is too high scored highest mean (4.63) followed by the SME’s contractors do not have the technology (hardware and software) and capability to implement BIM scored second highest mean (4.46), BIM is a new tool or process that many have little or no knowledge about it and the in-house technical staff are not ready to be trained scored third highest mean (4.42). Readiness to change from traditional to BIM requires high cost of investment, and the clear consensus as how to implement and use BIM (mean 4.33) were found with a lower mean score.

Therefore, to implement BIM among SME’s contractor, were found that, all issues and challenges listed based on strongly agree to strongly disagree it able to become the issues and challenges to against in implement BIM, to provide understanding for construction players regarding BIM knowledge and to explore the potential solution regarding the issues and challenges.

All results obtained, it able to describe that, the issues and challenges to implement BIM among SME’s contractor indicated the government and CIDB should help and assist the SME’s contractor to understand the BIM. Financial problem also was vital to become the biggest challenges to implement BIM. Therefore, all issues and challenges to implement BIM among SME’s in the construction industry, it able to identify what are the solution to make. It also shows that all issues and challenges are important towards achieving aimed in order to improve and enhance implementation of BIM among SME’s contractor in the construction industry.

However, it was believed that the data produce by respondents in line with the issues and challenges faces by the SME’s contractor to implement BIM in construction industry where quality data that able to provide and grant indication on issues and challenges faces by SME’s accordingly.

**4.2 Potential Solution in Implementing BIM for SME’s Contractor**

Table 4.2 displays the results of the survey on the level of potential solution in implementing BIM for SME’s contractor.

Table 4.2: Rank order of importance: Potential Solution in Implementing BIM

| Potential Solution  | Frequency |   |   |    |    |       | Mean | Level of Important | Ranking |
|---|-----------|---|---|----|----|-------|------|--------------------|---------|
|   | 1         | 2 | 3 | 4  | 5  | Total |      |                    |         |
| Is it important that the government should provide awareness and motivation programme?                    | 0         | 0 | 5 | 15 | 28 | 48    | 4.48 | Important          | 1       |
| Provide additional training necessary to use BIM tools  | 0         | 2 | 4 | 12 | 30 | 48    | 4.46 | Important          | 2       |
| The system of certification and accreditation of qualified BIM contractors that have undertaken training. | 0         | 0 | 6 | 20 | 22 | 48    | 4.33 | Important          | 3       |
| Providing initial support in the form of establishing ‘One Stop BIM Technology Centre’ for SMEs           | 2         | 1 | 7 | 14 | 24 | 48    | 4.13 | Important          | 4       |
| The development of the CIDB portal to gain information about the BIM.                                     | 0         | 3 | 5 | 25 | 15 | 48    | 4.08 | Important          | 5       |
| BIM should have a standard code of practices and guideline  | 0         | 8 | 5 | 17 | 18 | 48    | 3.94 | Important          | 6       |

Based on this table above, the results indicate that the government should provide awareness and motivation programme scored highest mean (4.48). The government must play a role as a party that’s responsible to make sure all the SME’s contractors aware and motivated regarding BIM. Without this awareness and motivation, SME’s contractors would ignore about the BIM, and this getting worse since the government itself wants all the projects in Malaysia have to use BIM by the year 2016.

Followed by providing additional training necessary to use BIM tools (mean 4.46), definitely, this approach is considered as important for SME’s contractors to familiar with the BIM. With the training SME’s contractors easily to understand how to operate BIM, since BIM consists 5D systems, they’re so many tools have to practice and study. It also indicated System of

certification and accreditation of qualified BIM contractors that have undertaken training (mean 4.33); Providing initial support in the form of establishing ‘One Stop BIM Technology Centre’ for SMEs (mean 4.13); the development of a CIDB portal to gain information about the BIM (mean 4.08); and BIM should have a standard code of practices and guideline scored lowest mean (3.94). On the other hands, all the potential solutions are important to encouraging SME’s contractors to use BIM for their projects.

**4.3 The Advantages of How BIM Can Give a Good Impact on Productivity in the Construction Industry**

Table 4.3 illustrates the overall results on the advantages of the advantages of how BIM can give a good impact on productivity in the construction industry.

Table 4.3: Advantages of BIM (by ranking)

| The Advantages  | Frequency |   |   |    |    |       | Mean | Level of Important | Ranking |
|---|-----------|---|---|----|----|-------|------|--------------------|---------|
|   | 1         | 2 | 3 | 4  | 5  | Total |      |                    |         |
| Improved cost estimating at each project stage              | 0         | 0 | 6 | 10 | 32 | 48    | 4.54 | Agree              | 1       |
| Improved productivity of the estimator in quantity take-off | 0         | 2 | 6 | 17 | 25 | 48    | 4.48 | Agree              | 2       |
| Reduced overall project duration                            | 0         | 0 | 4 | 18 | 26 | 48    | 4.46 | Agree              | 3       |
| Improved management of project schedule milestones          | 0         | 0 | 3 | 21 | 24 | 48    | 4.44 | Agree              | 4       |
| Reduced overall project cost                                | 0         | 4 | 3 | 19 | 22 | 48    | 4.23 | Agree              | 5       |
| Improved design quality                                     | 0         | 0 | 9 | 20 | 19 | 48    | 4.21 | Agree              | 6       |
| Reduced redesign issues                                     | 0         | 3 | 5 | 25 | 15 | 48    | 4.08 | Agree              | 7       |
| Increased speed of delivering projects                      | 2         | 3 | 5 | 19 | 19 | 48    | 4.04 | Agree              | 8       |

According to table 4.3 above, result highlights, eight (8) variables on this advantage were classified in high level band (range mean value 4.04 to 4.54). Improved cost estimating at each project stage scored the highest mean (4.54), this followed by the second highest mean (4.48) which is improved productivity of the estimator in quantity take-off. While, reduced overall project duration scored the third highest mean (4.46). By using BIM overall project duration can be reduced when it has all in one system.

## **5.0 CONCLUSION**

The research was conducted with the aim to identify what are the issues and challenges in implementing BIM for SME's contractor in the construction industry. Three objectives were outlined in order to achieve aim of the research.

### **5.1 *To examine issues and challenges faced by SME's in adopting BIM in construction industry.***

The following are the issues and challenges faced by SME's in adopting BIM in construction industry.

#### Issues and Challenges

- a) The cost to implement BIM in the company is too high (4.63)
- b) The SME's contractors do not have the technology (hardware and software) and capability to implement BIM (4.46)
- c) BIM is a new tool that many have little or no knowledge about it. (4.42)
- d) The in-house technical staff are not ready to be trained (4.42)
- e) Readiness to change from traditional to BIM requires high cost of investment, clear Consensus as how to implement and use BIM (4.33)
- f) Do you agree that BIM is the "future of project information management"? (4.08)

It is believed that the results from findings on issues and challenges were able to provide an indication and backbone on this research.

### **5.2 *To determine the potential solution in implementing BIM for SME's contractor.***

The potential solution is important to ensure SME's contractor do not leave behind from this new technology, with these solutions they can be guided and monitored how to use and implement BIM to their company without having issues. As a result, the government should play an important role to achieve what their wants for the construction industry in the future.

The following are the important solution in descending order:

#### Potential Solution

- a) Government should provide awareness and motivation programme (4.48)
- b) Provide additional training necessary to use BIM tools (4.46)
- c) The system of certification and accreditation of qualified BIM contractors that have undertaken training (4.33)

- d) Providing initial support in the form of establishing ‘One Stop BIM Technology Centre’ for SME’s (4.13)
- e) The development of the CIDB portal to gain information about the BIM (4.08)
- f) BIM should have a standard code of practices and guideline (3.94)

**5.3** *To identify the advantages of how BIM can give a good impact on productivity in the construction industry.*

Based on literature review, BIM is also known as an emerging technologies to be deployed in the planning, design and facility management and which can be used to improve performances and productivities of construction players, which are client, consultants, and contractor in designing projects, construction, operation and maintenance process. BIM has improved design management tools in the AEC industry from 2-dimensional (2D) to 3-dimensional (3D), 4-dimensional (4D) and 5-dimensional (5D) in order to increase accuracy of project design and detect design clashes. The ability of BIM in managing construction projects has reduced construction problems, project delay, construction cost overrun, and disputes among construction players. It believes there are the advantages in BIM that can change the traditional system of the construction process.

The following are the advantages of BIM in descending order:

- a) Improved cost estimating at each project stage (4.54)
- b) Improved productivity of the estimator in quantity take-off (4.48)
- c) Reduced overall project duration (4.46)
- d) Improved management of project schedule milestones (4.44)
- e) Reduced overall project cost (4.23)
- f) Improved design quality (4.21)
- g) Reduced redesign issues (4.08)
- h) Increased speed of delivering projects (4.04)

## **6.0 RECOMMENDATIONS**

The research has identified recommendations to improve and enhance the participation of SME’s contractor using BIM in construction industry. The following are recommendations to improve the participation of SME’s contractor using BIM.

1. It is recommended BIM be made an optional or a compulsory subject in the architecture, engineering and construction, education curriculum for all undergraduate architecture, engineering and construction students before they go abroad into the world of the construction industry.
2. The biggest issues and challenges is the cost to implement BIM in company, because of that government should provide some funding to lend only for SME’s to implement BIM in their company, with the terms and conditions for example SME’s should provide the letter about their project, beside, government also may control and monitor all the SME’s under the fund loan.
3. Provide conferences, forum and publish information relating the advantages of how BIM can give a good impact on productivity in the construction industry.

### **6.1 Recommendations for Future Research**

The subject of Building Information Modelling (BIM) is continuously under study. Based on this study, the following could be possible area for further research that may also be beneficial to the industry:

1. To propose alternatives based on the identified benefits and advantages in promoting adoption of BIM.
2. To evaluate the differences between BIM based Project and Non BIM based project through some solid case studies.
3. To conduct a similar research towards the reason and perception of top and middle level management on BIM.
4. To develop a more appropriate system in solving interoperability issue in the context of the local construction industry.

As a final point, it is hoped that this research will advantageous to all parties involved in the construction industry and would stand as a good foundation for future research.

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