Strategic on Planning of Building Information Modelling (BIM) In Malaysia

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***Abstract*—Building Information Modeling (BIM) is currently being used by the architecture, engineering and construction (AEC) industry in Malaysia. It has been introduced by the Director of Public Works Department (PWD) in 2007 to enhance performances and quality in planning, design, construction, operation and maintenance stage. The main aim of this research is to study the implementation of BIM in Malaysian construction industry. A literature review was done to explore previous BIM studies on definitions of BIM, necessity of BIM implementation, concept and application of BIM, BIM tools, differences between traditional and BIM method, benefits of BIM, challenges in implementing BIM as well as ways to improve BIM implementation. The data came from various sources such as books, journal, articles and material available on the internet which related to BIM. Furthermore, questionnaire survey had been carried out where 100 sets of questionnaire were sent out to the developer, consultant, contractor, architectural and engineering companies as well as government sector in Malaysia and 55 sets completed forms received back were analyzed. Findings of the study revealed that the rate of BIM implementation in construction industry is very low. Major benefits of BIM are clash detection, accurate quantity take off as well as efficient project delivery process. However, major challenges to low level of BIM implementation are high cost of implementation, lack of training and lack of expert. Provide training program, include BIM course in higher education teaching syllabus and acquirement of new skills by staffs are very effective ways in enhancing the implementation of BIM.**

***Index Terms*— Building Information Modeling (BIM), Strategic Planning, Cost of implementation, and benefits of BIM**

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1. INTRODUCTION

The construction industry in Malaysia is one of the important industries that contribute to the economy of our country. However, recently, there are many problems occurred in construction projects which caused negative impact to the construction industry as well as to economy [1]. The problems are delay of projects, dirty construction sites, dangerous site conditions, poor quality of workmanship, accidents on construction sites, over budget of construction cost, disputes among construction players and so on[2]. Therefore, Malaysian Government implements BIM as they aware that BIM may reduce construction problems. BIM is implemented as a useful tool for construction players during planning, design and construction stage because it is able to plan and manage construction projects effectively. Effective construction planning and managing can prevent problems from occurring [4]. Nevertheless, even though the implementing of BIM can overcome problems in construction projects, it is not popularly used in the construction industry as many construction players do not know its benefits to their organization and look upon BIM as new software which require a high cost to adopt. Thus, in order to successfully implement on strategic planning of BIM in Malaysia, it is very important for construction players understand the benefits and challenges in implementing BIM in order to find ways to improve BIM in construction industry [5].

This study is to determine the benefits of BIM that contributes to the construction industry in Malaysia [6]. Since BIM is a new technology which is not widely used in AEC industries, many construction players still do not know the benefits of BIM to their organization. Besides, this study is also to investigate the main challenges to implement BIM as well as ways to improve BIM in construction industry of Malaysia [5]. As it was introduced to reduce the construction problems as well as to manage the construction project more effectively, construction players have to know the challenges faced so that they are able to cope with it by improving the BIM for their organization [7].

Since BIM not so familiar to the current AEC industries, there might have some problems while getting information from them. In order to get enough information to support and complete this research, foreign article and journal will be used as references for further discussion. Besides, questionnaire will also be distributed as to get information to complete this study. The respondents of questionnaire will include those companies registered under the Construction Industry Development Board (CIDB), Board of Quantity Surveyors Malaysia (BQSM), Board of Architects Malaysia (BAM) and Board of Engineer Malaysia (BEM) [9].

2. METHODOLOGY

Research Methodology is a method to come out the result of a given issue on a particular subject or issue that is also referred to the research problem. In Methodology, the researcher uses distinct criterion to solve or search for the given research problem. In this study, the main focus is to examine the potential of Malaysian construction industry organizations in adopting the BIM that has been implemented since year 2007. In order to prove the theories that have been done in the previous chapter, which is a literature review, a survey is carried out. The purpose of survey is to collect all the relevant information in order to support or confront the literature review and also to achieve the aim and objectives of this study.

The method of survey as well as the method used to collect data such as questionnaire survey and secondary data will be discussed in detail in this chapter. Every part mentioned above plays a fundamental role during the research process.

2.1. Method of Survey

A survey is a process by which the information is obtained directly from a person who is knowledgeable and expertise in the subject of the study. In this study, a questionnaire survey form was sent out by post and e-mail to the targeted respondent in order to find out the respondents' level of understanding toward BIM that being implemented in Malaysian construction industry. In addition, it is also to obtain some feedback on the use of BIM in Malaysian construction industry. A questionnaire is the most popular method used in carrying out a survey because it is considered as most economical method of survey which provides relatively high validity of results due to their wide geographic coverage. Besides, it is also a fast method of conducting a survey where only short period is required as compared to interview which required much longer period to obtain the number of respondents needed for the survey.

Yet, there are some limitations when conduct a survey by using a questionnaire. One of the limitations is the questionnaire must contain simple questions. Besides, the answers provided by respondents are final and there is no opportunity to make clear of uncertainty which afterward may cause inaccuracy to the results. Moreover, respondents may also answer the questionnaire generally according to what they think it is about instead of based on their understanding and knowledge towards the current industry. There is also no guarantee that the questionnaire survey is completed by a right person even though it has been stated in the questionnaire survey form. Lastly, for many organizations and individuals students' questionnaires are of less priority.

2.2. Concept of BIM

Building Information Modeling (BIM) may refer to as a process to create the development of the project from by using the numerical models in order to facilitate the planning, design, construction, operation and management of a facility before the project is built [11]. Moreover, BIM is an intelligent model during the design stage as it increases the value of the project across its life-cycle. It also provides all the information required under the project as to create suitable construction documents for the construction of buildings [2]. It is also a shared knowledge resource for information about a facility which afterward can be used to make decisions throughout its life-cycle.

BIM's concept can be illustrated based on three aspects which are Building, Information and Modelling. Building can be defined as a project such as residential, commercial, healthcare, institutional project and etcetera [10]. Meanwhile, information aspect can include all those locations, size, shape, specifications, quantities, elements, schedule, and systems and so on which means all this information required in a project must be included in the modeling [8]. Modelling would be able to control the objects and imitate the performance and thus it is known as a visual component. The BIM models and the information shall be linked together which connected with project planning, design, construction, operation and demolition as shown in Figure 1.

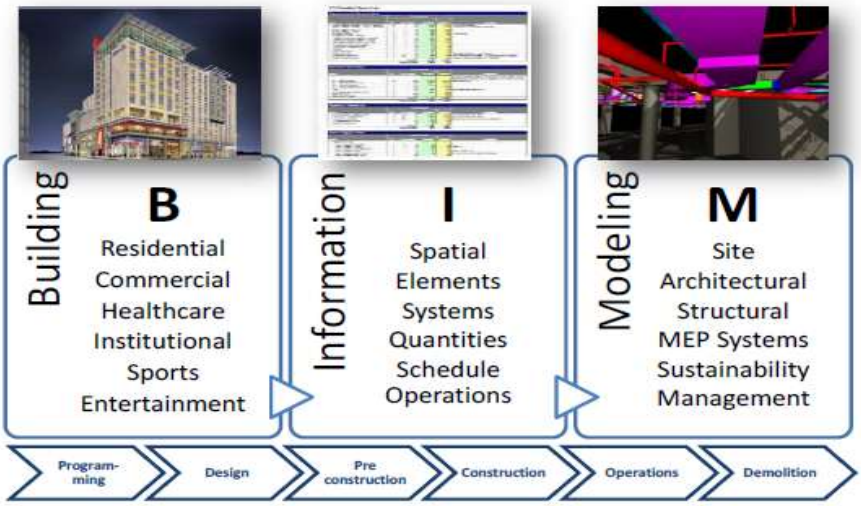

Figure 1: A visual representation of BIM concept (Source: Salman Azhar et al., 2012)

2.3. Data Collection

In order to achieve the aim and objectives of this research, primary source and secondary source were used to obtain the information. The primary source of data was from questionnaire survey. It was distributed to the experts in the construction industry. These experts include developers, consultants, contractors, architects, engineers and government officials. Meanwhile, articles, journals, books, thesis or dissertation and internet resources were secondary source where the information related to the research obtained from.

2.2.1. Questionnaires

A set of questionnaire which consists of three 3 sections was designed and distributed out to the local construction industry company. All questions were structured to serve the intended purpose in order to obtain a logical quantitative analysis of the result.

i. Section A was about the general information about the respondent and the company which included name of company, designation in the company, age of respondent, level of education, professional background, working experience in the construction industry, type of company and company years of operation. The first part was to show the validity of the respondents and consistency of the results collected.

ii. Section B of the questionnaire contained the questions on the company adoption of digital information software. There were only 3 questions were asked. The first question was about whether the company has experience using any digital information or modeling software application for some purposes. This question was asked in the form of 5 Likert scale of 1-Never to 5-Always. Then, followed by the questions of how the company estimates the output of using digital information or modelling software application in their development project and how digital information or modelling software application does are managed in their company. The respondent did not require answering these 2 questions and require proceeding to Section C if their company did not experience in using any digital information or modelling software application.

iii. Section C consisted of 6 questions which were about the company readiness in BIM implementation in order to fulfill the objectives of this study. The questions required the respondents to answer whether they have heard about BIM implementation in Malaysian construction industry, is their company implements BIM and is their company willing to invest in BIM to manage their future projects. For those respondents where their company did not implement BIM, they were not required to answer this question. In addition, benefits derived from the implementation of BIM, the challenges in implementing BIM and ways to improve BIM implementation also been asked in this section. For these 3 questions, the respondents were required to identify how much they agree or disagree with them based on their opinion by using the 5 Likert scale of 1-Strongly disagree to 5-Strongly agree.

3. RESULTS AND DISCUSSION

In this chapter, the result of questionnaires which are completed by the respondents will be analyzed and discussed further. Furthermore, the aim of research is going to be examined in this chapter. A questionnaire survey had been conducted to collect the data in order to complete this research. A total of 100 sets of questionnaire survey have been sent out by post and e-mail to the developer, consultant, contractor, architectural and engineering companies as well as government sector in Malaysia. However, only 55 sets of questionnaire survey being received. The purpose of the questionnaire is to review on the implementation of BIM in Malaysia's construction industry. For analyzing purpose, charts and tables are used to tabulate the results of the questionnaire survey.

Table 1: Benefits derived from the implementation of BIM

Benefits	Frequency					Total	Mean	Rank
	1	2	3	4	5			
	SD	D	N	A	SA			
Improved construction site safety	1	6	12	31	5	55	3.60	6
Accurate quantity take-off	1	2	6	34	12	55	3.98	2
3D/4D clash detections	1	2	7	31	14	55	4.00	1
Efficient project delivery process	2	0	14	27	12	55	3.85	3
Better quality control of project	2	0	13	31	9	55	3.82	4
Better cost control of project	2	2	9	33	9	55	3.82	4

Note: SD=Strongly Disagree, D=Disagree, N=Neither Agree or Disagree, A=Agree, SA=Strongly Agree

This question was set to find out the benefits derived from the implementation of BIM in the Malaysian construction company. Table 1 showed six (6) benefits of implementing BIM in the company. Among these benefits, the highest ranked is the 3D or 4D clash detection with mean value of 4.00. As 3D or 4D clashes can be detected by design team members during design reviews and before the construction works start on site, it can result in time saving and cost efficiency as the cost of improving and resolving the clashes off-site are relatively low than on-site. This is because once the structure being built on site and clashes found, it required changes of design drawing of other elements or structures which cause extra time and cost. Furthermore, instead of conducting clash detection only one-time upon completion of design work for coordination, it is also used continuously during the construction process as project audit.

The medium ranked is implementation of BIM would result in efficient project delivery process with mean value of 3.85. The relatively new technology of BIM has helped the designers and contractors to develop the way to look at entire building process which is from developing the design brief through the construction documentation stage into actual construction management stage and finally the facilities management stage. Besides, the reviews of every part of the building design are possible which afterward can results in delivered of project to the client efficiently. Furthermore, as BIM enables testing of design solutions, a more responsive building design can be produced as well as provide better coordination of all project information. The adoption of BIM practices has alsochanged the design workflow where more technical design is produced.
Lastly, the lowest ranked is improved construction site safety with mean value of 3.60. Today, BIM in the Malaysian construction industry is considered as a potential tool which may help to improve construction site safety as it help designers to implement the design for construction safety knowledge. In this regard, BIM provide three-dimensional building models for competent collaborating team works and make the designing for construction site safety suggestions available to the designers as well as contractors]. Not only that, the contractors are also able assess to the conditions of the construction site and identify the danger through the demonstrative site layout plan and safety plan provided through use of BIM technology.

Table 2: Challenges to implement BIM

Challenges	Frequency					Total	Mean	Rank
	1	2	3	4	5			
	SD	D	N	A	SA			
Lack of training	1	3	6	32	13	55	3.96	2
Lack of awareness	3	4	8	28	12	55	3.76	4
High cost of implementation	2	0	7	28	18	55	4.09	1
Lack of expert	1	3	8	31	12	55	3.91	3
Poor interoperability among BIM software	1	0	21	24	9	55	3.73	5
Ownership issue	1	4	21	20	9	55	3.58	6

Note: SD=Strongly Disagree, D=Disagree, N=Neither Agree or Disagree, A=Agree, SA=Strongly Agree

This question was set to find out the challenges faced in implementing BIM in Malaysian Construction Company. Based on Table 2, the main challenge to implement BIM is due to high cost of implementation with mean of 4.09. These costs include cost of software and hardware and cost of training. Current trends show that the costs of BIM software packages are more expensive than CAD software packages which are available on the market at a fraction of the cost of BIM software. Furthermore, the price to keep the software updated is relatively high as it needs updated periodically. Besides, with the introduction of BIM software, the requirements on hardware have increased drastically as high specification workstations are required. Other than that, due to changes of work processes and workflows, training of staffs is also needed as the professionals with CAD proficiency will not be able to learn new BIM software quickly or without specialized training.
The medium ranked which is the third highest is lack of expert with means of 3.91. Since BIM is such a new concept and considered to be a complex and delicate system, not many construction companies can claim to have BIM experts in their company. In other words, most construction companies lack of employees that have expertise and knowledge in BIM techniques and principles to fully put this new concept into the practice. Because of this constraint, the construction companies need external expert to deal with integration issues and others BIM problem in order to incorporate BIM which afterward make the implementation of BIM techniques expensive.

The lowest ranked is focus on ownership issue with mean of 3.58. The project owner who is paying for the design may feel entitle to own the model by claiming ownership of the data and documents. Conversely, other project team members might have contributed information and such information need to be protected as well. For example, designers will say that their design remains their own intellectual property. Because of these issues, discussions regarding licensing can arise when project team members other than the owner or the design team contribute information which is combined in the model. Hence, ownership of the model must be solved uniquely in every project due to different circumstances.

Table 3: Ways to improve BIM implementation

Ways	Frequency					Total	Mean	Rank
	1	2	3	4	5			
	SD	D	N	A	SA			
Improve awareness and conduct motivation programs	1	1	8	36	9	55	3.93	4
Provide training programs	1	1	3	35	15	55	4.13	1
Setting out a BIM technology	1	0	17	30	7	55	3.76	5

center								
Acquirement of new skills by staffs	1	2	9	27	16	55	4.00	3
Include BIM course in higher education teaching syllabus	1	1	7	32	14	55	4.04	2

Note: SD=Strongly Disagree, D=Disagree, N=Neither Agree or Disagree, A=Agree, SA=Strongly Agree

The question above was set to identify the various ways to improve BIM implementation in Malaysian Construction Company. According to Table 3, the various ways are improve awareness and conduct motivation programs, provide training programs, setting out a BIM technology center, acquirement of new skills by staffs and lastly include BIM course in higher education teaching syllabus.

It showed that the highest ranked is to provide training programs which have mean value of 4.13. In order to have skillful and knowledgeable staff in BIM, training is required. Subsequently, the training for BIM is to be provided for construction players in the AEC industry, particular in small and medium organization (SMEs). A proper systematic BIM training program for construction players would provide required knowledge for BIM implementation. However, most of the construction players are concerned about the training period and cost which is long duration with expensive. Thus, in order to relieve the burden and motivate the construction players, subsidies from respective bodies such as CIDB and PWD are suggested for the comprehensive trainings of BIM.

Besides, the medium ranked is acquirement of new skills by staff which have mean value of 4.00. Changing the work workflow and practices from traditional to BIM requires changes in roles of project team members as well as in the skills necessary for modelling. This means project team members especially designers have to acquire the needed skills in order to change from designing to modelling and working in the new concepts well as developing new project roles to efficiently assimilating the new way of working. These new skills are eventually reflected in a change on the organizational culture regarding the methods it uses to create its products.

The lowest ranked is by setting out a BIM technology center which have mean value of 3.76.As the implementation of BIM brings benefits to the construction industry, BIM Technology Centre shall be established by government through the cooperation with CIDB and PWD. Aim of setting out the center is to provide initial support to SMEs in adopting BIM in their organization. Setting out of the Centre could help the SMEs to be confident in implementing BIM for their projects. Even though with the full understanding on the usefulness of BIM, the SMEs need to have easy access and 'ease-of-use' on the use of BIM for their projects. Hence, the concept of pay-per-use or periodical license should put into practice to support the implementation of BIM. In addition, free consultation by BIM modelers' software and system could also be part of the services provided at the BIM technology center.

5. CONCLUSION

BIM is not only a technology but it is a methodology of practice that relates to changing the way of thinking and working process. It can be used for the entire of construction project stages which are pre-construction, construction and post construction. It also has been used in construction projects to manage the construction project activities such as visualization, scheduling, cost estimating, clash detection, facilities management and others.

Furthermore, it is undeniable that BIM can enhance construction performance as well as quality but the rate of implementation of BIM in the Malaysian construction industry has been at a slow pace. The adoption of BIM software has proven to be beneficial to the construction organization in terms of design, construction, operation and data management. However, a number of factors that contributes to slow implementation are identified which are lack of training, lack of awareness, high cost of implementation, lack of expert, poor interoperability among BIM software and ownership issue.

The possible approaches to address these issues include improve awareness and conduct motivation programs, provide training programs, setting out a technology center, acquirement of new skills by staffs and lastly include BIM course in higher education teaching syllabus. Therefore, it can be concluded that the construction industry in Malaysia needs to be evolve by upgrading the current construction industry approach, whether in terms of practice, management or technology in order to meet the global standard.

For future study, semi-structured interview can be carried out with several construction players which are clients, architects, engineers and contractors who had experienced in using BIM software. The data obtained from those interviewees will be more detail and accurate as the interviewees had knowledge and understanding about what the BIM software actually is. The purpose of interview is to gain information on BIM practices in Malaysian construction projects and to propose a framework on how to

implement BIM in construction planning. Besides, case studies can also be carried out as BIM have been used in several projects in Malaysia. The purpose of case studies is to investigate the benefits, challenges as well as strategies to improve BIM implementation in more detail.

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