The Potential of Implementing Building Information Modelling (BIM) in Malaysian Construction Industry: An Exploratory Study

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ABSTRACT

In Malaysia, we cannot deny the widespread of Information and Communication Technology (ICT) and the influence of ICT to speed up the working process. Lots of benefits can be gained from utilisation of ICT, especially in construction industry. For decade, construction industry can be considered as a fragmented industry because of lacking of sharing information through its life cycle and with other parties. ICT can be a tool for integrating and collaborating among parties in the construction projects, and Building Information Modelling (BIM) is one of the platforms that can be used to promote the collaboration between parties in the construction projects. Eastman et al., 2011, interpreted BIM *as "a digital representation of the building process to aid in exchanging and interoperability information in a digital format."* Basically, BIM will act like a respiratory system with full of information to share with for construction projects. Even though there are lots of benefits can be gained by utilisation of BIM, it is a difficult task to convince the construction companies to embrace and implementing it due to some reasons. Since there is a short of understanding of BIM by the construction companies in Malaysia, this paper is intended to review the strategy and action plan from Singapore and Hong Kong in adopting and implement BIM, which could be used in supporting the implementation of BIM in Malaysian Construction Industry. As a summary, this paper revealed that involvement from government, collaboration between government, private sector and universities and awareness program are the most of the important criteria that must be taken into consideration once to developing BIM implementation strategy plan for Malaysian construction industry.

Keyword: Information and Communication Technology (ICT), Malaysian Construction Industry, Building Information Modelling (BIM), Strategic Plan

1. Introduction

Many researchers like Kaner et al. (2008); Khanzode et al. (2008) and Staub-French and Fischer (2001) regard Building Information Modelling (BIM) as a combination of Information and Communication Technology (ICT) product and process that can improve the construction process by improving the information exchange between parties in the construction projects. BIM can be considered as important tools to enhance the process of collaboration between parties in the construction projects by sharing all the information, whether in digital forms or vice versa. For decades, construction regards as fragmented industry due to its nature, which is to complete a construction project it involves a combination of various parties. In Malaysia, according to Mastura et al. (2007), the government of Malaysia has been kept promoting and pushing the industry to adopt and utilised ICT in order to achieve the developed country status by the year 2020. Unfortunately, Stewart and Mohamed (2003) found that the construction industry in Malaysia still behind with other industries in terms of implementing ICT. Li et al. (2000) added there are many factors contribute to lag in adopting and implement ICT in the construction industry and mostly are some organisations reluctant to change their business process and not support in implementing ICT and majority of companies adopt and implement ICT in ad-hoc manner and without planning and evaluation. Same goes when promoting the benefits of BIM and despite lots of benefits can be gained by utilisation of BIM, Aouad et al. (2006) found that one of the obstacles in implementation of BIM is short of understanding of BIM's function and business value between parties in construction projects.

Therefore, this paper is intended to review the strategy and action plan from Singapore and Hong Kong in adopting and implement BIM, which could be used in supporting the implementation of BIM in Malaysian

Construction Industry. This paper will start with general discussion of BIM, Malaysian construction industry in general and followed by reviewing the strategy and action plan from Singapore and Hong Kong in adopting and implementing BIM and finally; a recommendation will be highlighted at the end of this paper. Malaysia could learn from these countries because they can be classified as a new comer in implementing BIM compared to other's countries such as United State of America, United Kingdom, Finland, Denmark, Australia and Norway, which are more advance in implemented BIM.

2. Building Information Modelling (BIM): An Overview

Now days, construction projects become more sophisticated and unique due to demand and need by the clients. Lots of information needs to be gathered, stored and distribute evenly among different parties in the construction projects. In addition, the project teams faced others pressure in order to complete the projects such as regulatory restriction imposed by the authorities, shorter completion time of projects and new project delivery standard. Without proper planning between parties in the construction projects will jeopardise the successfully of the projects. Therefore, Nuntasunti et al. (2006); Waleed et al. (2003) and Hervas et al. (2007) believed that there is the need a collaborative effort between parties in the construction projects to streamline communication and coordination in order to avoid the communication breakdowns between different parties. Traditionally, 2D drawings commonly use as communication between different parties in the construction projects. However, Eastman et al. (2011) found that the main problem with this approach is when there is any amended needed to be done in each separate 2D drawing; there is a possibility of inconsistencies and discrepancy in the plan because architect, civil and structure engineer, mechanical and electrical engineer will produce their own 2D drawing. As a result, the possibility of any team in the construction projects received outdated plans are inevitably since it updated and creates separately. These conflicts become a main problem in the construction projects because it's consume time, energy and costs to resolve it when dispute among different parties happen. To cater for these issues, Rashid (2009); Nawi et al. (2009); Waleed et al. (2003) and Hervas et al. (2007) viewed Building Information Modelling (BIM) have a potential platform to increase the collaboration of information between different parties in the construction projects and can resolve some problems, especially in coordination of information.

BIM can be defined in many ways and interpretations. Revit (2008) defined BIM as *"an integrated process built on coordinated, reliable information about a project from design through construction and into operation."* Eastman et al. (2011) interpret BIM as *"a digital representation of the building process to aid in exchanging and interoperability information in a digital format."* BIM SmartMarket Report by McGraw-Hill (2008) defines BIM as "*the process of creating and using digital models for design, construction and/or operations of projects,"* while Taylor and Bernstein (2008) define BIM as *"a new industry term referring to parametric three-dimensional computer aided design (CAD) technologies and processes in the architecture, engineering, and construction (AEC) industry."* From these definitions, information, coordination and integration can be considered as key functions in BIM, and BIM can be viewed as a single respiratory system that supplies and received any information in digital form related with construction projects. How BIM can update any changes? Amine and Nathaniel, (2011) further explain that, in BIM, any objects will carry their own geometry and attributes, when any authorised parties made any changes to an object, the system will change to all relevant views and documents of the project with no further modification, and the updated object can be shared with other's parties in the construction projects. The most important is the creation and contributions of information are from collaboration between different parties in the construction projects. The used of BIM allows us to interact and communicate effectively between parties in the construction projects. These activities show how BIM can be an enabler for collaborative activities in the construction projects.

The construction industry can be benefited from utilisation of BIM and can reduce the issues on fragmented because of sharing and transmitted of information among various parties in the construction industry more reliable and efficient. In addition, these activities are done by integrating the work from different parties in the construction projects. In addition, by having a right and accurate information its can reduce errors during design and construction stage resulting less cost and fewer claims and dispute due to efficiencies in the design, detailing and construction processes. Resulting from design documentation error free it shortened lead times and reducing requests for Information (RFI), the productivity of the

construction project significantly will be increased (Kaner et al., 2008; Khanzode et al., 2008 and Staub-French and Fischer, 2001). Taylor and Bernstein (2008) call these advantages referred as coordination benefits.

Kymmell (2008) and Taylor and Bernstein (2008) believed that visualisation is one of the benefits can be gained by exploitation of BIM. Visualisation could help parties that involved in the construction projects to gain better understanding of what they construct by creating the detailed of 3D view. Kymmell (2008) added, in Mechanical, Electrical and Plumbing (MEP) design one of the critical task is clash detection and without having good visualisation tools this task will consume time, because traditionally in 2D drawing to do a clash detection process is by overlaying 2D plan drawings to visualize the location of the system components in 3D space. However, by exploits 3D modelling between architect and structural engineer this task can be done within short of time and more accurate compare traditional method. Other's benefits can be gained by utilisation of BIM in terms of cost estimating and planning and scheduling when the information in BIM incorporated with time and cost. In terms of cost estimating, BIM can facilitate quantity surveyor quantified the cost and the material of the projects in shorter time which time can be reduced up to 80% in generating the cost estimation compare to traditional methods (Azhar et al., 2008). In terms of facilitating in site planning and utilisation and scheduling and planning, BIM can be utilised to analyse and configure the right location for machineries, temporary access point and the same time it can identify the safety measurements for the construction projects (Khanzode et al., 2008). In addition, scheduling and planning will be become more accurate and reliable due to the capabilities of BIM to simulate and analyse the construction activities and able to optimise the sequence of construction activities and by doing this approach project time can be reduced up to 7% (Laiserin, 2008 and Azhar et al., 2008). The most important contribution of BIM if BIM is fully implemented is during the Maintenance and Operation phase in the project's life cycle. As we know that, in the stage of design and construction phases, lots of information will be gained and used, and the new information will be updated during these phases and all these data that stored will become a real as built information of construction and all these information will facilitate owner to maintain their assets by having an accurate information in hand.

3. The Application of Building Information Modelling (BIM) in Project's Life Cycle

The application of BIM in construction projects can be applied throughout project's life cycle and all parties able to exploit the benefits from BIM. Normally project's life cycle consists of four phases started with plan, design, construct and ended with operate. BIM Project Execution Planning Guide by The Pennsylvania State University revealed that there are twenty five uses of BIM for consideration (Figure 1). During the planning and design stage, owners can fully utilised the function of 3D modelling to experience and understanding of the end product and able to modify it. In these stages, the team which consists of multiple parties be able to come out with ideas and solution to any problems arises like cost, clash, design, etc. before these problems become a liability to the construction projects. In order to do this approach, cooperation, collaboration and coordination of the entire project staff is a must. Failing to do so, will make BIM lost of its main functions, which are sharing all the information throughout project's life cycle and promoting collaboration between different parties in the construction projects. Besides that, the main contractor is able to start making coordination between subcontractors and suppliers in these stages. During the construction phase, BIM can give constructability, sequencing, value and engineering reports to the main contractor. During the operation phase, actual information recorded in BIM can help owners to maintain the building throughout its life cycle. These processes can be achieved if BIM is fully implemented, and all parties in the construction projects collaborate with each other's. This is the vision of BIM, but some reasons it is do not makes this practicable. Therefore according to guide, it is not appropriate to implement all the applications of BIM. Because, not everybody know how to implement BIM in a right way and there are some obstacles to implementing fully BIM in construction industry, especially in Malaysia.

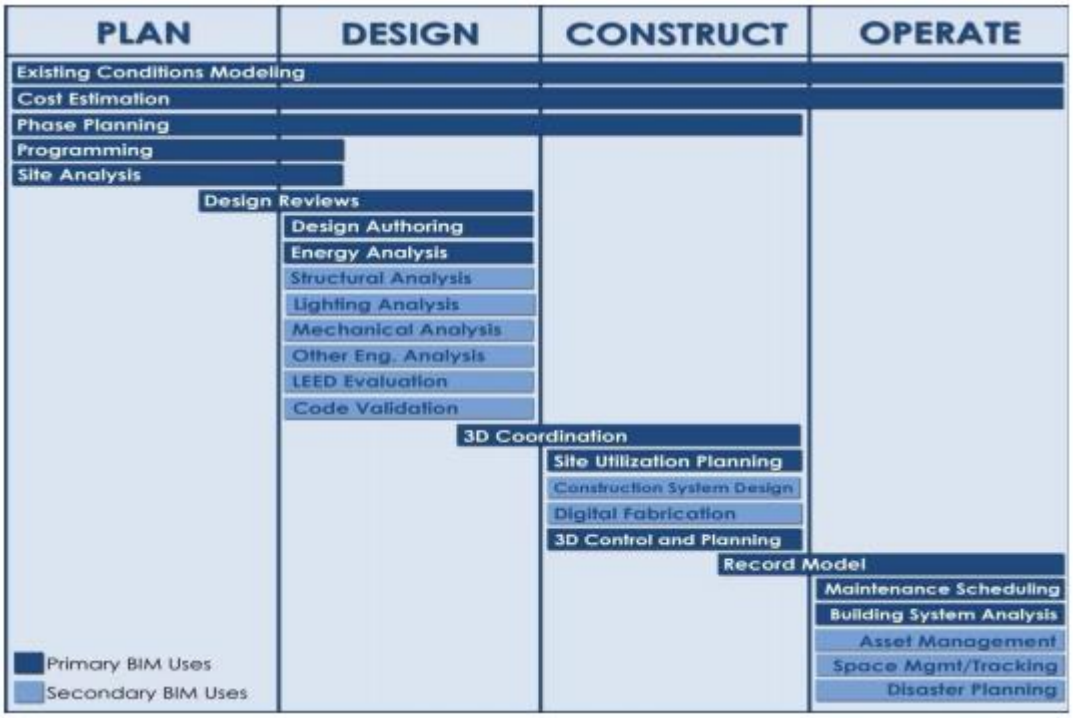

Figure 1: BIM application in project's lifecycle (BIM Project Execution Guide, 2009)

4. Malaysian's Construction Industry: Backgrounds and Issues

In Malaysia, construction industry is one of the economic sectors after manufacturing and agriculture in contributing to Malaysian economic (CIDB, 2008). Shari (2000), reported that since seventies until eighty's construction industry in Malaysia has expended from 6% to 15%, this shows how importance construction industry to the growth of Malaysian economic. During the economic downturn from mid of 2007 until 2008 because of global financial crisis, construction industry in Malaysia enjoyed an additional budget amounting to RM60 billion (about 13 billion Euros) under government driven stimulus package to spur the construction activities in Malaysia (Market Watch Malaysia, 2010). Despite having a strong support from the Malaysian government, in reality, Malaysian construction industry facing a serious problem such as too depending on unskilled and foreign labour, low productivity and lack of innovation in construction (CIDB, 2008). Cost and time overrun is most commonly problems occur in the construction projects. Cost overrun can be defined as extra cost beyond the planned cost agreed during signing the contract, while time overrun can be interpreted as extension of time beyond planned completion dates as agreed by both party's client and contractor (Intan et al., 2005). Abdul Rahman et al. (2006), revealed that in Malaysia's delays in the completion dates during construction phase is almost 45.9%, while Murali, S. and Soon, Y. W. (2007) added about 17.3%, government contract projects in Malaysia were considered sick because of delay more than three months or abandoned due to various causes in year 2005. Intan et al. (2005) found that in Malaysia for public sector projects, only 46.8% projects completed within budget while for private sector about 37.2% projects completed within budget. These figures show how serious the problems of Malaysian construction industry are facing and delay in completing the construction projects will contribute in increasing cost and time overrun. We know that time, and cost overrun has an implication to the construction project performance and to the client especially projects that involved public fund. According to Abdul Rahman et al. (2006) one of the factors that contribute to clients' satisfaction is complete the construction projects within time and cost given and performance of the contractor mostly judged by these factors.

Abdul Rahman et al. (2006) identify in Malaysia the construction phase regard as a phase that contributes a higher percentage of delay in a project's life cycle. Is it faulted from contractor, consultant, or client? If we look into statement by Abdul Rahman et al. (2006) we can assume that the main cause for delay in

Malaysia is came from contractor side because during the construction phase, the contractor plays a major role to complete the task given by the client and consultant. How true our assumption? There are lots of factors that contribute to cost and time overrun occur resulting from delay in Malaysian construction industry. Mainly these factors are inter-related within client, consultant and contractor (Murali, S. and Soon, Y. W., 2007) and this shows that not only contractor contribute to delay in construction projects, the client and consultant also contribute to these issues. Various researchers revealed that, late payment received from client, inadequate client's finance, late of decision making done by the client to any amended, and interferences from client are the elements that contribute to delay in construction projects (Abdul Rahman et al. 2006; Murali, S. and Soon, Y. W., 2007 and Hamzaha et al., 2011) and its effect the capability of contractors in completing his tasks. While, Abdul Rahman and Berawi (2001) classified delays caused by the consultants can be classified into four main items: problems in detail design, slow correction of design problems and late inform and distribute the new design details, late review of shop drawings, and delay in tests and inspections. These factors can lead to delay in construction phase where the consultants fail to give appropriate and complete details to the contractor to perform the work in time, and the consequence is the contractor can be interpreting wrong detail designs. A survey done by Abdul Rahman et al. (2006) reported that satisfaction indexed of the contractor towards a consultant are low, where only 10.1% was satisfied with the consultants who submitted a complete set of final drawings at the right time. This survey revealed that, consultants in Malaysia still lacking in providing good services to the contractors and need an innovation approach to cater for this issue.

The factors of delay's causes by the contractor mostly related with incompetent in managing the construction projects. Various researchers revealed that, the most prominent factor why delay starting to evolve during the construction phase is improper managing the construction projects. These resulting delays during construction phase such fails to estimate the construction activities and duration resulting difficulty in planning, monitoring and controlling the construction projects, under estimate the project cost and fail to distribute the cost accordingly and misinterpret the design details (Naief, 2002; Chan and Park, 2005 and Long et al., 2008). Although there are external factors that could contribute to delays such as late approval from local authorities to commence the construction projects and "act of god," but the main issues are most of the contractors always underestimate the constructions' activities and duration and underestimate the project's cost. Failing to tackle or improved these issues resulting planning, scheduling and sequence activities in chaos and underestimate the project's cost that will end up with the cost will burst or the quality of the end product will be low due to budget constraint. Intan et al. (2005) believed that these scenarios happened because the majority of planners or estimators in Malaysian construction industry used their experience and intuitions. Unavailable of the detailed model of the construction projects can be one of the elements that contribute to why most of the planner or estimator used that approach in Malaysia (Naief, 2002).

As summary, there is a hiccup in terms of communication and transmitting the information between parties in the construction project in Malaysia. The consultant fails to deliver or updated the current detail design to the contractor because majority of them are complacent with the current process or they are not aware of the availability of technology that could speed up their works. While the contractor fails to plan the construction activities and estimate the right cost due to incapable or miss interpret the detail designs or drawing accordingly. Currently, most of the construction project more complex and sophisticated, and the contractors are unable to predict how the building look like due to lack of visualisation tools or lack of experience using visualisation tools to simulate the construction projects. With the reliable technology and knowledge, now days the contractors are able to simulate the sequence of construction works in the shorter time and able to predict the completion of construction project more accurate compare using traditional approach. On the client part, involvement in the early stage of the construction is not enough to feed the information to the other parties, and there is a need to establish an innovation approach to ensure all the information can be distributed equally among different parties in the construction projects through its life cycle. Therefore, each parties need a platform that can enhance the way of communication and the same time to share and to disseminate the information effectively and efficient.

5. What Building Information Modelling (BIM) can offer to Malaysian Construction Industry

To enhance the image of construction industry in Malaysia as one of the most sectors contributing to the Malaysia's economic and having a full support from the government of Malaysia, there is the urgency to shift the paradigm from using the traditional approach into more innovative approach and the same time able to increase the operational performance of construction projects. The construction industry in Malaysia needs to evolve by upgrading the current construction approach, whether in terms of practice, management or technology in order to meet the global standard. Zaini Omar ex-Director General Public Work Department Malaysia, which currently is C.E.O of Construction Industry Development Board (CIDB) during his key note address delivered in 3rd Annual Convention of Malaysian Structural Steel Association 2000, said that, *"since the 1960 Malaysian construction industry has not much transformed in terms of technology or construction approach and still depends on the traditional approach. And, the local construction players need to be more innovative to become more competitive globally and locally."*

In order to inline with the vision 2020, the government of Malaysia has launched Construction Industry Master Plan (CIMP) 2006-2015 to overcome the weakness in the current construction industry. The vision and the mission of CIMP are *"The Malaysian construction industry shall be a world class, innovative and knowledgeable global solution provider"* and *"To be a dynamic, productive and resilient enabling sector, supporting sustainable wealth creation and value creation, driven by technologically-pervasive, creative and cohesive construction community"* (CIMP, 2007).

In CIMP, there are seven strategic thrusts. Seven Strategic Thrusts were identified as follow:

1. Integrate the construction industry value chain to enhance productivity and efficiency.
2. Strengthen the construction industry's image.
3. Strive for the highest standard quality, occupational safety and health, and environmental practices.
4. Develop human resource capabilities and capacities in the construction industry.
5. Innovate through research and development and adopt new construction methods.
6. Leverage on information and communication technology in the construction industry.
7. Benefit from globalization including the export of construction products and services.

(CIMP, 2007)

Integrate, innovative and information and communication technology (ICT), are the key elements in the strategic thrust number 1, 5 and 6 that CIMP believed, by utilisation of these elements its can reduce the setback in Malaysian construction industry. Integrated or collaborative approach can be used to reduce the fragmented issue that hampered the efficiency of transmitting the information on the construction projects. By applying an innovative approach which is bringing a fresh idea whether a new process, services, technology or management likes Industrial Building System (IBS), the government of Malaysia believed construction players in Malaysia will become more competitive and ready to adopt and adapt any changes in a near future. ICT can be exploited to develop a new technology that can offer a platform for integrating between different parties in the construction industry in an innovative way. So, now is a perfect time to implement BIM in Malaysian construction industry, which is in line with the need of CIMP and government of Malaysia to strengthen the construction industry's image.

BIM can be classified as an innovative approach which is come with advance process and technology that offering a platform for collaborating between different parties in the construction project by exploiting the used of ICT. In a traditional design process 2D detail designs are passed between consultants and manually checked, but current trend show that building become more complex and sophisticated, in 2D process manually checking will consume time and effort and error cannot be avoided. The utilisation of BIM which is content the intelligent models of building that can be combined into single model and checked with clash-detection software to ensure coordination (Kymmell, 2008). This model can be passed digitally between consultants in the construction projects. This approach not only faster but can reduces the chance of human error into minimum. This model can be passed to the contractor for estimating and planning the construction projects.

There are lots of benefits that BIM can offer to Malaysian construction industry, especially in enhancing the communication between different parties in construction projects. BIM able to streamline and aids clear communication between client, consultant and contractor in construction projects by providing a single respiratory system for exchanging digital information in one or more agreed format. Khanzode and Fisher (2000) and Azhar et al. (2008) believed that, this approach can reduce errors associated with inconsistent and uncoordinated project documents because BIM capable of carry all information related to the building, including its physical and functional characteristics and project life cycle information, in a series of "smart objects." Figure 2 shows the vision of BIM to promote the collaborative approach between parties in construction projects. Other benefits that BIM can offers besides enhancing the collaboration between different parties are having better design and drawing coordination, constructability conflict resolutions, automated cost estimating and simulation of project planning (Atkin, 1999 and Staub-French and Khanzode, 2007).

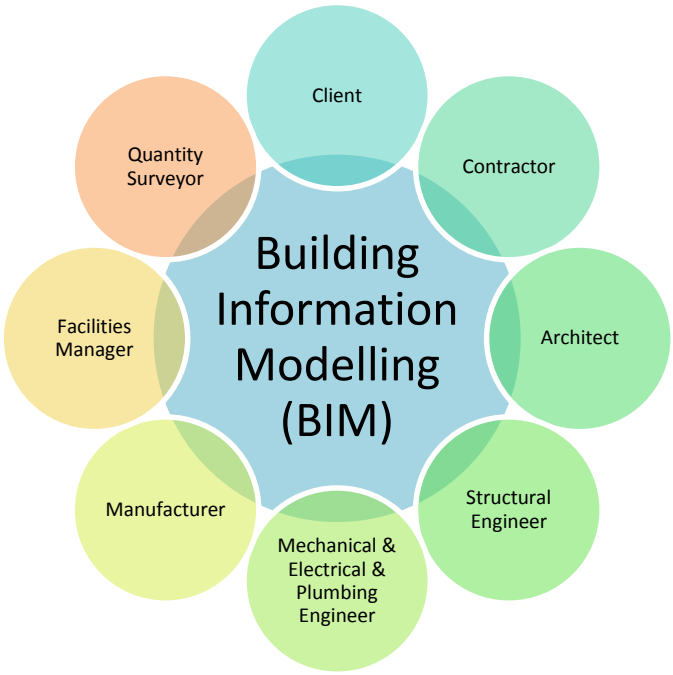

Figure 2: The vision of BIM in integrating the different parties through BIM

In summary, BIM could offer the Malaysian construction industry as an innovative way that could improve the design process by providing improved and continuous assessment of the design and easier design amendment, improved communication through a project's life cycle, enhanced coordination, planning, scheduling and monitoring of construction projects and able to provide a real information of "as built" construction projects. However, despite a lot of benefits gained from BIM, implementing BIM in Malaysian construction industry need a good and clear roadmap or strategy that can assist Malaysian construction players to successfully adopting BIM. Smith and Tardif (2009); Succar (2009) and Eastman et al. (2011), agreed that the implementation of BIM requires a strategic implementation plan to gain the fully benefit from BIM, otherwise the construction industry will benefit from a small subset of what BIM has to offer.

6. Implementing Building Information Modelling (BIM)

Information and Communication Technology (ICT) can be viewed as the usage of technologies as a tool for the manipulation and communication of information (Narimah, 2011). In Malaysian construction industry, the widespread of ICT and the influence of ICT to speed up the working process cannot be deniable, however according to Steward et al. (2002); majorities of construction industry players are still unable to gain the benefits from it. In Malayisa, Mui at al. (2002) believed there are many factors

contribute to this situation many of the companies invest in technology advancement because they simply followed the others companies that successfully implement ICT without doing feasibility studies. They are not aware of the problems might be arisen, what is the right strategies and why they need that technology, while Yusuf and Othman (2008) added that lacking in training and limited of expert users in area of ICT in construction industry worsen the current situation. Meanwhile, Wade and Hulland (2004) viewed that some of the organisation failed to adopt and adapt the rapid changing of ICT technologies, practices, process and expertise into their organisational processes. Alshawi et al. (2003) and Peppard et al. (2007) believed that benefits from utilisation of ICT don't come automatically because some of the benefit required more time to mature and the process of evolving from current practise into 'unknown environment', therefore, there is a time gap between the early investment and income. To avoid these pitfalls, a thoroughly study needed to be carried out to identify the right approach or strategic in adopting BIM in construction industry.

BIM Implementation by Singapore

In Singapore, CORENET (COnstruction and Real Estate NETwork) was launched in 1995 with its goal to *'to reengineer and streamline the fragmented work processes in the construction industry, so as to achieve quantum improvements in turnaround time, quality and productivity.'* CORENET which is lead by the Ministry of National Development and driven by the Building and Construction Authority (BSA) and currently the main organisation involved in the development and implementation of BIM for government projects (www.corenet.gov.sg). A study conducted by Khemlani (2005) revealed that Singapore promoting the usage of BIM since 1997. Approval for building plans and fire safety certification mostly through e-submission system called e-PlanCheck. Any submission for approvals must used of BIM as one of their conditions. Currently CORENET already completed the development of BIM Guideline to support the implementation of BIM called 'Integrated Plan Checking'.

It is not easy to shift the paradigm from traditional approach into innovation approach. According to Evelyn and Fatt (2006), first approach done by CORENET in order to achieve its goal is gained a support from the BSA and Singapore chapter of International Alliance for Interoperability (IAI). A development of e-PlanCheck must comply with Industry Foundation Classes (IFC) standards. It is one of the critical success factors for smoothing the pace of adoption of the system. Another factor is building owner and CAD users required that all the CAD software must IFC-compliant to tender any projects under BSA. This to ensure that any software that be used by the construction players able to communicate with e-PlanCheck.

CORENET has developed its own strategy and action plan to ensure this system well accepted and can be fully used in the real environment. There are five actions in CORENET's strategy and action plan (Figure 2) which are;

a) Conducting seminar to disseminate the capabilities of BIM technology through seminars, forums and discussion among industry and academia.
b) Pilot testing with the industry to identify if there any setback of the system and to gain the feedback from the users to enhance the capability of the system.
c) Collaborating with Institute Higher Learning in order to assist the industry on the use of 3D BIM in their works and conduct research related with BIM technologies and process.
d) Provide the training grants to enhance the knowledge of the works in the use of IFC-BIM based tools.
e) Collaborate with the government bodies and developers to stipulate the requirement of 3D IFC CAD model in the building contract as mandatory.

(Evelyn and Fatt, 2006)

Figure 3: Strategy and Action Plan for Implementing BIM in Singapore (Evelyn and Fatt, 2006)

BIM Implementation in Hong Kong

In Hong Kong BIM known as Object Oriented Computer-Aided Design (OOCAD) and the government of Hong Kong through one of its agencies Hong Kong Development Bureau realised that, the current Computer-Aided Design (CAD) which is widely used in the construction industry cannot be directly applied into BIM. In order to increase the usage of OOCAD, a working group named The Works Project Information Standard (WPIS) was established under the policy agenda for the 2005 policy. The WPIS working group will be worked closely with the other working group which monitoring and controlling the existing CAD software named The CAD Standard for Works Projects (CSWP) working group. One of the tasks for WPIS working group is to come out with any recommendation for the requirements of OOCAD before a new standard to support BIM can be issued (Andy et al., 2011).

In 2007, discussion between WPIS working group, CSWP working group, the construction players and the vendors of software realised that in private sectors projects, there is a growing trend to utilise the BIM in their projects. During the discussion session, there are few recommendations have been given for the adoption of BIM in Hong Kong, which is;

a) WPIS and CWSP working group will study and analyse the impacts and barriers when migrate from CAD standard and OOCAD standard and the future trend of BIM software.
b) Come out with a clear road map to indicate the time frame for implementing BIM and provide a strategic plan to assist the industry players in implementing BIM.

(DevB, 2007)

Efforts from Hong Kong Development Bureau to migrate from using traditional CAD into OOCAD attract the attention from other's government of Hong Kong agencies, which is Hong Kong Housing Authority, which intended to implement OOCAD in their housing development. Few pilot projects have been selected and used BIM and Geographical Planning Information System in 2008. After several investigations, analysis and study, in 2009 Hong Kong Housing Authority decided to deploy BIM in the development of standard modular apartments and design libraries in selected projects. Since 2009, the awareness of BIM in Hong Kong is well amazing where the government of Hong Kong fully utilise the function of their agencies to spread the benefit of using BIM in construction industry (Andy et al., 2011).

The widespread of the BIM in Hong Kong is very fast since 2007, when discussion among WPIS working group, CSWP working group, the construction players and the vendors of software to implement OOCAD was held, resulting in another agency comes out to implement BIM, which is Hong Kong Housing Authority. The government of Hong Kong is very fortunate because, the migration from traditional CAD into OOCAD got a strong support from private sectors. In order to support the inspiration of the government of Hong Kong in implementing BIM and the same time to optimise the benefit from utilisation of BIM, in 2009, Hong Kong Institute of Building Information Modelling (HKIBIM) was established. This effort is come from a group of Hong Kong corporations, stakeholders and experts in BIM application. In general, the objectives of HKIBIM are to promote and create awareness of BIM, to enhance the utilisation of BIM, to develop and establish the standard of BIM practices, conduct a research for improvement and to establish BIM Guideline for Hong Kong.

(www.hkibim.org)

HKIBIM provides a platform to industry players, including the government of Hong Kong agencies to gather and to discuss on how to improve the implementation of BIM in Hong Kong. HKIBIM viewing that there is a possibility of increasing the usage of BIM in Hong Kong. Therefore, HKIBIM recommends some strategy action for the government to take for regulating the utilisation of BIM solution as followed (Figure 4);

a) To ensure the smooth of implementation of BIM in Hong Kong, there are the needs to establish a new policy and program that can assist the construction players in implementing BIM and the same time it could give a clearer picture where BIM in Hong Kong heading to.
b) Pilot testing is one of the strategies, especially for a newcomer who had the intention to implement BIM, and the government should encourage any construction companies that secure any contract to adopt and implement the partial part of BIM components.
c) Seminars, colloquiums, workshops and forum are the platforms that can be used to share the knowledge, experiences, expertise and discussion that can promote the implementation of BIM. Besides that, collaboration with global professional bodies is highly recommended to exchange information and expertise that can improve the current situation. Incentives can be given to any construction players who implement BIM in their construction projects.
d) Since the implementation of BIM new in Hong Kong, the government of Hong Kong should establish a new department in any agencies that could monitor the process of adopting and implement BIM in construction industry. At the same time, this department able to monitor and evaluate whether the implementation of the government's BIM policy success or not.
e) The BIM policy should recommend that the design information be open and made available to partners so that the design intent can be easily understood and evaluated. To promote the use of open standard software, there are the needs in continues development to achieve open standard. Research and development between industry and academic is one of the approaches to achieve this goal.

(Andy et al., 2011)

Figure 4: Strategy and Action Plan for Implementing BIM in Hong Kong (Andy et al., 2011)

7. Lesson Learnt from Singapore and Hong Kong

Singapore and Hong Kong seemly enjoyed the strong support from their government to push Building Information Modelling (BIM) into their construction industry in terms of policy and contract. Involvements from private sector also play a significant role in speed up the process of adoption and implementation of BIM in their construction industry. Willingness of Private sector to take part in the pilot project gives a huge significant impact to the pace of implementing BIM, where the feedback from the pilot project will be used as a continuous quality improvement to improve the current practice. Series of awareness was conducted by both countries to disseminate the knowledge of BIM and the same time; it can convey the benefit that can be gained by implementing BIM to the construction players. Involvements from local universities are inevitable because, by doing this research and developments in BIM by the universities become more valuable due to input given by the industry. To increase the participants from the industry in implementing BIM incentives are given whether for training purpose to enhance the worker's knowledge or tax reduction. The only different approach between Singapore and Hong Kong is Singapore more toward doing collaboration between government agencies and private sector whereas Hong Kong intended to establish a new role for government agencies to monitor the implementation of BIM. The collaboration between government agencies and private sector in Singapore is to ensure and encourage the private sector to specify the requirement of IFC 3D model in their contract and for government project there is no issues because requirement of IFC 3D model is already stated in the contract. Contrary in Hong Kong, the establishment of department of BIM is more to monitor the implementation of the government's BIM policy and as entrusted with the task of overseeing BIM initiatives.

In Malaysia implementation of BIM demands the involvement from the government, and this can be the driving force towards higher utilisation of BIM in Malaysia. To gain the trust or involvement from the government, forming a BIM working group is one way like Hong Kong, which is forming the Works Project Information Standard (WPIS) working group in their early stage adopting BIM. In Malaysia, Construction Research Institute of Malaysia (CREAM) under Construction Industry Development Board (CIDB) can

play a significant role to gather all parties in Malaysian construction industry to discuss the direction of BIM in Malaysia. Collaboration with local universities in research and development can be done through research grants, which are provided by the government such as Exploratory Research Grant (ERGS) or Science Fund. On top of that, collaboration with the local universities will enhance the knowledge of the academia in BIM and the same time the local universities are able to modify their curriculum to meet the demand from the industry by offering the course that can be produced the students who ready with 3D model or parametric model. Seminars, colloquiums and workshops can be conducted between the industry and the local universities. Incentives can be used to promote the use of BIM, such as tax redemption to accelerate the pace of adoption of BIM. CIDB has implemented this approach for contractors who implement Industrial Building System (IBS) in their construction projects and this approach also can be used for those who are implementing BIM.

8. Conclusion

Implementation of Building Information Modelling (BIM) in Malaysian construction industry is not impossible, and it is achievable. Hong Kong and Singapore already showed the possibilities of implementing BIM in their construction industry. Roles of government to be a driven factor of implementation of BIM in Malaysia cannot be denied, but the government cannot be alone in promoting and spreading the importance of implementing BIM. All industry players have to play their own role to ensure the successful in implementing BIM in Malaysia. Therefore, in Malaysia, forming BIM working group could be a starting point to spark the pace of adoption and implementation of BIM. This working group can start to;

a) Evaluate, study and testing the available BIM technologies in the markets.
b) Identify and choose any construction projects as a pilot project.
c) Documented all the processes from the beginning of the pilot project.
d) Documented the entire lesson learnt from the pilot project.
e) Road Tour to disseminate the lesson learnt gained from the pilot project.

These steps just a kick starts to spark the intention of the government of Malaysia to instil the concept of innovation in construction industry.

Further research needs to carry out especially to identify the evaluation criteria for selecting the right BIM technologies, criteria for selecting the appropriate pilot project, analyse the worker's knowledge, analyse the suitable project delivery method and analyse and identify the strategy plan that can fit into any organisation who wants to implement BIM.

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