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CAPABILITY OF BIM APPLICATION IN IMPROVING THE EFFECIENCY OF GREEN BUILDING PROJECT IN KLANG VALLEY - A LITERATURE REVIEW

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Abstract:
There are countless issues regarding unsustainability activities from irresponsible bodies, where, sustainable development is needed in the event of global climate changes, air pollution, water pollution and others. Due to that, construction industry has taken this issue seriously and has come out with an idea of "green building". Along with the existence of modern technologies, it is true that technological innovation does play an important role in both short and long term in societal, economic and also environment. In order to enhance the performance of Green Building construction, the construction industry can apply Building Information Modeling (BIM) in their project. The aim of this paper is to enhance the existing knowledge towards green building. For this paper there are about 15 research papers published within the past 7 years which are used in abstracting all the relevant literature, analyzing and coming out with the findings on what are the indicators in identifying the benefits and factors of BIM application towards green building project.

Keywords: Building Information Modelling (BIM), Green Building, benefits

1.0   INTRODUCTION

In recent years, environmental issues have been raised especially on consumption of energy and resources in the building sector. Green buildings or sustainable developments are the examples of environmental concerns. Green Buildings should be designed and operated to reduce the overall impact of the built environment on its surroundings (Green Building Index, 2017) while according to Sood et al. (2011), sustainable development is 'development which meets the needs of the present without compromising the ability of future generations in order to meet their needs'. By having an understanding of what is construction industry all about, this could provide better knowledge on how to implement the building itself. Thus, these buildings are qualified for certification by one of the foreign rating systems tool or nothing else than Malaysia's which is Green Building Index (GBI). But, what are the relations between Green Building and Green Building Index (GBI) as it is mentioned previously? As a result, the government had introduced a specific green building assessment tool in 2009, known as the Green Building Index (GBI), which follows similar methodological approach tools such as Building Research Establishment Environmental Assessment Leadership in Energy and Environmental Design.

In order to enhance the performance of Green Building construction, the construction industry can implement Building Information Modelling (BIM) application in their project to produce data-rich models of buildings and structures since it started in the 1970s and its development in the 1980s and 1990s (Wong & Fan, 2013).In Malaysia, BIM's role is well-defined as a modelling technology and associated set of processes to analyze, communicate, produce and use digital information models throughout the construction project life cycle ("BIM", 2017). According to Succar and Kassem (2015), BIM has been considered as one of the most effective technological and organizational innovations in architecture, engineering and construction (AEC) industry.

Therefore, by having little knowledge about what Green Building is and how it is related to BIM the developer, consultant, contractor and other connected bodies would not be able to have sufficient ideas on how BIM technology can facilitate producing green building. In Malaysia green building concept

is still new even though it is already exposed to the other countries for a long time. By hiring more expertise on green building in terms of materials, technology, designing and also financial stability it will help to ensure the effectiveness of green building implementation.

2.0   LITERATURE REVIEW

Malaysia has started implementing green building practices even though it is still slow due to the level of awareness towards sustainability in construction industry is at minimum stage. According to Sood et al., (2011), there are several countries that had implemented green building sustainable development. It started with BREEM in UK in 1990 and followed by LEED in US in 1996. In 2009, Malaysia had launched National Green Technology Policy (NGTP) where the government's manifesto emphasizes in applying 'green' for the country. Apart from that, Sim and Putuhena (2015) stated that NGTP promotes the practicality of green management in many projects such as Kuala Lumpur International Airport Terminal II (KLIA2) and Sunway Resort City Development. In order, for green building to be well-executed, the construction industry can apply BIM throughout the project instead of using traditional method as BIM is capable to enhance the communication and coordination between different parties. In Malaysia, most of the construction players are not familiar with BIM as a technology due to not widely used in the construction project. But, there are only few companies in Malaysia that implement BIM in the construction project by providing BIM tools, consultancy services and training. For example, Sunway Berhad, Petaling Jaya, Selangor, and Precision Design Solution Sdn. Bhd. (PDSSB), Petaling Jaya, Selangor (Aryani, 2013). Hence, it indicates that by implementing BIM in green building construction project, the efficiency of the project not only can be enhanced but also provide support in advancing the construction activities.

2.1   *Building Information Modelling (BIM)*

BIM application has captured the attention among construction players in Malaysia and most of them already started implementing BIM throughout their project. According to Fathoni et al.,(2015), the projects that has been implementing BIM application are Proposed Hotel Ancasa (involving consultation on applying BIM modeler, 4D Project Planning Consultant by using BIM and Microsoft Project Planning Tools), Multi-purpose Hall, Universiti Tun Hussein Onn Malaysia (utilizing Integrated Project Delivery and BIM) and Proposed Educity Sports Complex (by using BIM 4D Project Planning Consultant by adopting BIM and Microsoft Project Planning Tools),

The benefits of implementing Building Information Modeling (BIM) can be divided by three aspects which is environmental, social and economic aspects. Firstly, environmental aspects is designers are able to enhance the designs in terms of shading design, determine mechanical heating and cooling and adjust the location for vegetation and garden layouts. For example, by using software Autodesk ECOTECT, it is capable to estimate the percentage of reflection and shading along with amount of the solar radiation dropping on the object where it is tremendous in determining the setting and orientation for solar panels. Hence, the features of ECOTECT like 'solar analysis' will help towards the optimization of total energy consumption of the building and it easy to calculate the energy production thru the year (Wong & Fan, 2013). While, based on the case studies at Savannah State University in Georgia, the owner and the architect coordinate with contractor in preparing BIM at the pre-design stage before producing the three different design options. Therefore, the owner is capable to choose the best option that fit the needs of the building (Azhar, 2011).

Secondly is a social aspect. Wong and Fan, (2013) found that the teamwork and communication between team members that are developed by implementing the Integrated Project Delivery (IPD) where it could reduce the risk in a construction project. Not only that, IPD also helps in improving the safety by expecting the problems in the early stage of the project. For example, by combining the architectural and MEP models in Naviswork, function of clash detection is identified. Apart from that, the number of job opportunities in professional BIM consultancy increased as the popularity of BIM rising, while, Azhar

(2011) stated that the implementation of BIM in the project could improve the communication and beliefs between the parties and accelerate the process of decision making.

The last benefit for BIM is economic aspect. The reduction of undesirable wastage is to reduce the cost of project and to improve the construction management. This can be done by implementing IPD. By having a better quality of material and energy efficiency in the construction industry, it could help in reducing the capital and costs as well (Wong & Fan, 2013). According to Azhar (2011), the usage of BIM application has resulted in cost and time savings in AEC industry. Hence, several case studies were conducted by using BIM application in planning, design, pre-construction and construction phase for the project of Aquarium Hilton Garden that was based in Atlanta, Georgia. Even though at the beginning of the project, it did not initially design using BIM application but during completion, it had exceeded the expectations of the owner and also the team members. This can be shown by the unknown costs avoided and the cost benefits to the owner were sufficiently better. Azhar (2011) stated that BIM application is capable to prepare cost estimate for all virtual models that are prepared by the architect, while, Soltani (2016) concluded that the implementation of BIM application does influence economic efficiency for instance reducing wastage, decreasing the costs and also saving time of the project.

2.2 *Green Building*
In 2009, Sood et al., (2011) found that the Association of Consulting Engineers Malaysia (ACEM) together with Malaysia Institute of Architects (PAM) had launched Green Building Index (GBI) to allow green grading and certification of Malaysia buildings. GBI was formulated based on six criteria namely; indoor environment quality, energy efficiency, sustainable site and management, materials and resources, innovation and water efficiency. For example, green building project that entitled platinum in GBI rating for Non-Residential New Construction (NRNC) are Bangunan Suruhanjaya Tenaga, SP Setia Berhad HQ and Menara Kerja Raya.

The benefits of Green Building are divided into three aspects which are environmental, social and economic aspects. Firstly, the environmental aspect is the construction industry. This aspect is knowingly tied to the environmental issues. Through reducing waste, improvement of air-water quality, secure the ecosystem and preserve natural resources. All of these could bring benefit to green building especially in the environmental aspects (Turcotte et al., 2011). Gonchar et al., (2011) also found that green building could bring the advantage to the environment in reducing the waste.

Next is social aspect. By referring to the benefits of social aspects of green building, it does not only enrich the occupants' comfort and health but it also able to improve the aesthetic and quality of life (Turcotte et al., 2011). Besides that, green design may possibly increase the workers' productivity and health benefits via green materials in the construction project. Moreover, green building competent can increase the efficiency, prolong the life of buildings and enhance the occupant well-being (Gonchar et al., 2011). Due to that, most of the people nowadays are concerned to buy property that meets the criteria in green building. Birkenfeld et al., (2011) found that green building helps consequential health welfares to occupants that associated with LEED credits by enhancing the indoor air quality.

Then, the third benefit of green building is economic aspects. According to Turcotte et al., (2011), as green building becomes widely known among developers and owners, the financial benefits are becoming clearer. For example, maintenance and utility costs help increase savings in green building. Apart from that, green building could increase green products and services in the market place. Gonchar et al., (2011) stated that green building construction can reduce operating and maintenance costs. The existing green building helps to minimize negative effects towards the environment through the use of natural resources, energy and water. Birkenfeld et al., (2011) concluded that any organizations that have implemented green building would find improvement that measure economic, environment and social aspects performance for example like saving the cost in the construction project.

Last but not least, in order for Malaysia to become a country that is widely implementing BIM application in green building project especially buildings in Klang Valley area, the construction industry should be more exposed about the benefits of green building. According to Mohd Adnan et al. (2017),

since information and awareness can be learned and improved, it will be one of the strong factors in implementing green building in Klang Valley even though, Malaysia is not well exposed on green building if compared to the other Asian countries. But, this is not the reasons why Malaysia could not become a well-known country which contributed most in producing sustainable building. The awareness can be taught consistently and it moves reasonably well with learning. The more information individuals have on green building the more awareness can be produced.

3.0   METHODOLOGY

15 selected papers publications were chosen from Scopus and Google Scholar platform to justify and analyze the obtained information on the benefits of implementing BIM in green building project. The publications of 15 relevant research papers were selected within the timeline from 2011 until 2017. From the 15 papers, only six authors were considered to be analysed based on the benefits of BIM and green building. In addition, the chosen criteria were also based on the detailed explanation of green building as well as the citation.

4.0   ANALYSIS AND FINDINGS

This section represents the findings from the analysis and reviewing process of relevant literature the benefits of BIM application towards green building construction project. The publications of 15 relevant research papers were selected within the timeline from 2011 until 2017. The contribution shows from years to numbers of publication as shown in Figure 1.
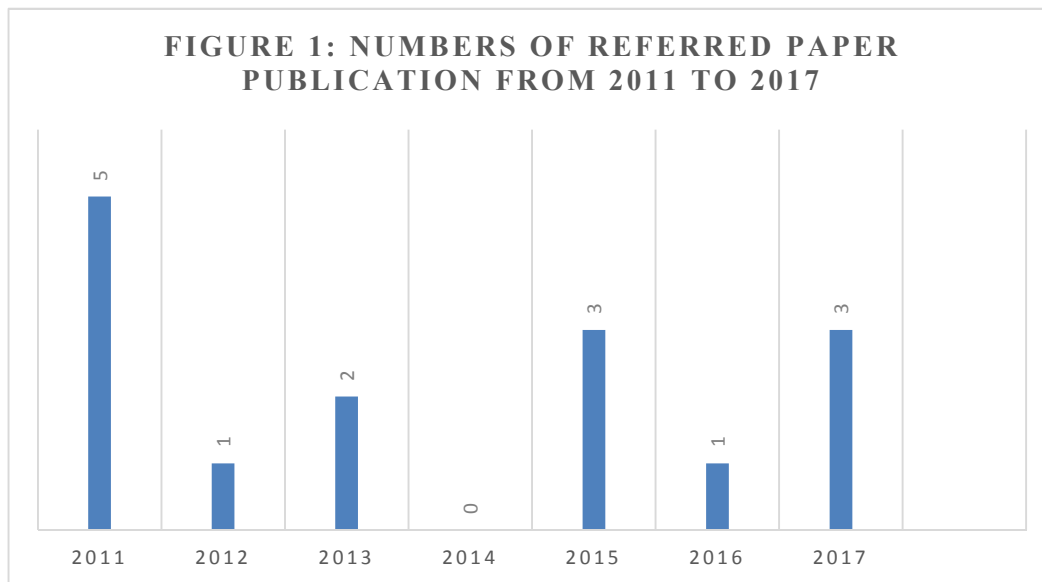

Figure 1: Numbers of referred paper from 2011 to 2017

Figure 1 shows the benefits of Building Information Modelling (BIM). There are six factors listed and cited as well as analyzed in term of environmental, social and economic aspects based on three authors from the year interval of 2011 to 2017. By referring to Table 1 below, the highest times referred to is the factor on benefits of BIM which goes to economic aspects that is cost savings. This factor can be considered as the highest main factors which contribute to the benefits of BIM in the construction project. The number of times referred to on this factor is 3.

While, Table 2 shows the benefits of green building project. There are 12 number of factors listed and cited as well as analyzed in term of environmental, social and economic aspects based on the three authors within the year interval of 2011 to 2017. By referring to the Table 2 below, the highest number

referred to for benefit of green building goes to social aspects which is to enhance occupant's comfort and health. These factors can be considered as the highest main factors which contribute to the benefits of green building in the construction project. The number of times referred to for this factor is 3 times. Then, it is followed by environmental aspect which reduces the wastage.

Hence, these two concepts can be implemented. In addition, the construction industry should have a sound knowledge in BIM application towards green building project in order to create the efficiency in construction activities.

Table 1: Factors Benefits of Building Information Modelling (BIM)

No	Benefits of BIM	Wong & Fan, (2013)	Azhar, (2011)	(Soltani, 2016)	Times referred
1.	**Environmental aspects:** - Enhance the designs	✓	✓		2
2.	**Social aspects:** - Teamwork and communication improved - Job opportunities increased	✓ ✓	✓		2 1
3.	**Economic aspects:** - Reduction of wastage - Costs savings - Time Savings	✓ ✓	✓ ✓	✓ ✓ ✓	2 3 2

Table 2: Factors Benefits of Green Building

No	Benefits of Green Building	Turcotte, Villareal&Bermin gham, (2011)	A.G. Gonchar& H. Akhtar, (2011)	Birkenfeld, Brown, Kresse, Sullivan &Thiam, (2011)	Times referred
1.	**Environmental aspects:** - Protect biodiversity and ecosystems - Reduce waste - Conserve and restore natural resources	✓ ✓ ✓	✓		1 2 1
2.	**Social aspects:** - Enhance occupant comfort and health - Improve aesthetic - Improve quality of life - Increase efficiency - Prolong the life of building	✓ ✓ ✓	✓ ✓ ✓	✓	3 1 1 1 1
3.	**Economic aspects:** - Increase markets for green products and services - Enhance life-cycle economic performance - Lower operational costs - Lower maintenance costs	✓ ✓	 ✓ ✓	 ✓	1 1 1 1

5.0   CONCLUSION

This research is conducted to identify the implementation of BIM application in enhancing the efficiency of green building construction project in Klang Valley. These recent years the issue of sustainability across many restraints has increased. Particularly, in the implementation of BIM application in green buildings that will bring benefit to the environment which response to the building users' need, lifestyles and also preservation of nature. However, the BIM application in green building initiative needs strong support from all the stakeholders as to meet the aim and objectives. It can be done by improving the level of awareness among team members in construction industry. It is hoped that in the future, Malaysia is able to implement BIM application in green building project extensively.

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