Building Information Modeling Adaptation for Industrialized Building Construction Projects: A Review

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ABSTRACT

Adoption of BIM will play a major role in the construction industry's revolutionary growth in terms of project delivery process productivity and efficiency. Industrialised Building System (IBS) has been considered a construction method to accelerate the development of the construction industry in attempt to boost the economic growth of Malaysia. Therefore, the goals of this article is to ascertain the BIM adaptation for IBS Projects. Full adoption of IBS is not an easy journey. In addition, the implementation of BIM technology into IBS system will put the client's expectation at risk as it is difficult to understand the complex software.

Keywords: Building information modeling industrialized building system, adaptation.

1. INTRODUCTION

Many issues and mistakes arise during the construction phase as a result of poor coordination, communication, and standardization. The adoption of Building Information Modeling (BIM) can help with this interoperability problem. BIM, or Building Information Modeling, is thought to be a technology-driven change to provide the construction industry with the greatest impact (Hardin and McCool, 2015).

BIM offers a substitute for the conventional project design on paper and administration, where the project performance is quantifiable. It is a creation of an intelligent virtual integrates the project data from a model from conception to construction and use. It involves engineering, architecture, and professionals in construction (AEC) and provide insight to more effectively plan when designing, building, running a building, and buildings' corresponding infrastructure practically throughout the entire life cycle as semantically enhanced, reliable, and digital creating models (Abanda, F. H. *et al*., 2015).

However, Industrialize Building System (IBS) is one of the technologies that can be referred to as the inventive manufacturing of construction technique ideas that are mass-produced in factories and further observation of minimal site work (Rahim *et al*., 2018). The development of IBS includes prefabricated installation components that are applied systematically aligning our planning accordingly. The IBS is produced with certain elements in an either a controlled environment on-site or off-site similar to a factory. According to The Malaysian Reserve (2019), once finished the components will be moved and positioned and built with the least amount of materials site work for assembly and erection.

The Malaysian government has made numerous attempts to accelerate the use of BIM in IBS construction projects, however the progress has been slow and unfavourable. Therefore, this article will provide a review on the adaptation of BIM in IBS construction projects focusing on Malaysia.

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2. A REVIEW

2.1 Building Information Modeling (BIM)

Building Information Modeling (BIM) is a technology that describes an engineering project that contains intellectual objects with their unique data possessions and consideration instructions, allowing for the presentation of each object's representation as well as its internal components and characteristics (K. Hannele, M *et al*., 2012). There are five main aspects of BIM, which are visualization, coordination, modeling, optimization, and plotting skills. The digital simulation and modeling are the key benefit of BIM modeling of the project to become a real one that is generated earlier from the first task in the project. As a result, BIM reduces planning errors, offers quick calculations, estimates additional costs, and shows replacements (M.S. Liew *et al*., 2016). Hence, the work ability of the construction industry can be significantly improved by BIM and its various digital tools and practices.

In accordance with Fourth Industrial Revolution (IR 4.0), there is a tremendous opportunity to advance and set new benchmarks for digital data and what is possible. By attempting to create a central repository for digital information about a project or asset, BIM will hasten this development. As a result of processing the finished, accurate data through all project life cycle stages, changing from flaws could be corrected, and design to construction and conservation, schedule and budget effectiveness should be increased (S. Azhar, 2011). By implementing BIM in the project's early stages, the benefits of digital data may be obtained. In order to prepare for the industrialization of construction, BIM technology is used.

BIM creates a 6D model based on the three-dimensional visualization dimensions and adds time, cost, and sustainability considerations to it to help with decision-making regarding the selection and use of assembled parts. As a result, not only time and quality are decreased waste, while also ensuring an improvement in the overall project performance. During the building stage, BIM technology assisted by Augmented Reality (AR) could be combined to give physical parts access to digital data. Additionally, BIM technology combined with digital processing that is compatible and values well-organized formation, advanced information management and distribution.

With the help of BIM technology, manufacturers of prefabricated parts can better integrate their design, fabrication, construction, and preservation processes. The information from the BIM simulation makes it very appropriate to use prefabricated parts during the construction process. The electronic records size of the resulting data for each part will increase due to the BIM requirements. Construction stakeholders must be aware of this in order to capable of handling the resulting data overflow. The processing of this data and its commercial application will enable the stakeholders to realize this improvement's full potential, which will result in novel business in a digitalize world (W.S. Alaloul *et al*., 2017).

It is clear that the construction industry is aware of the significant shift toward digitization and IR 4.0. The stakeholders have access to methods through digitization to increase efficiency. Construction industry still lags behind even though other industries have historically benefited along the entire value chain. There are a few stakeholders have not yet adopted digitalization potential as a strategy to improve their performance and productivity. Figure 1 below shows the BIM adoption rate reported in BIM Report 2016.

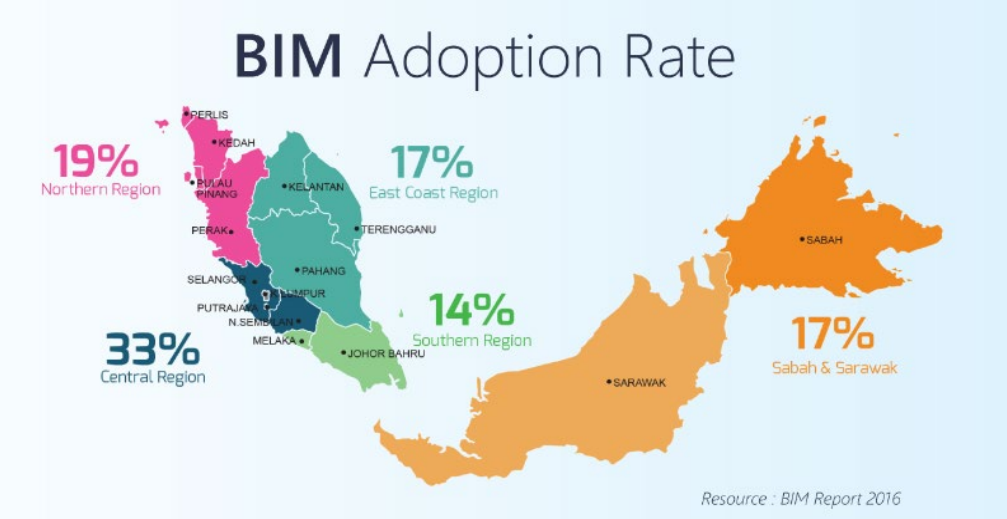

Figure 1. BIM Adoption Rate (Resource BIM Report 2016).

2.2 IBS

Industrialized Building System (IBS) is a system method of construction components which are produced in controlled conditions (at the factory / on-site building) and transported, installed in construction' work using minimal labor requirements (Ministry of Finance, Malaysia, 2003). There are five types of IBS have been identified, namely, System Pre-Cast Concrete, Steel Frame System, System Molds, Timber Frame System and System Block.

The idea of the IBS was first introduced in the construction industry in 1624, when wood panel houses from England were brought to North America. The IBS concept, in which blocks are divided into smaller and more manageable sizes, was used to construct the Egyptian pyramids for convenience in transport (H.R. Thomas *et al*., 1994). Construction projects using the IBS began to take off in the United, especially in the 1851 construction of the Crystal Palace (Figure 2), the Kingdom made significant contributions. The combination of glass, wood, and steel windows were used as frame elements. The construction of the building was finished in just four months (C.H. Oglesby *et al*., 1989).

Public Works Department (PWD) architects were sent by the Malaysian government in 1963 to several European nations in order to further examine the ideas behind development. The Ministry of Housing and Local Government concentrated on housing development projects at the same time to raise the standard of living. Additionally, Malaysian representatives travelled to Western countries like Germany, Denmark, and France to learn more about the construction industry (P.F. Kaming, P.O *et al*., 1997).

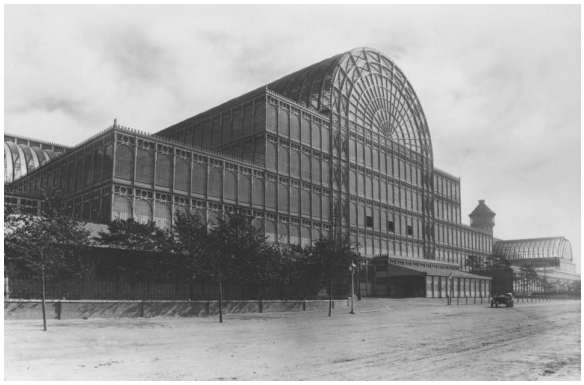

Figure 2. The Crystal Palace, London.

The Petronas Twin Towers (Figure 3), the Malaysian Light Rail Transit (Figure 4) and the Bukit Jalil Sports Complex (Figure 5), are just a few of the past mega-projects that use the Industrialized Building System. It was developed in Malaysia decades ago, but the usage is still very low upgrades to the infrastructure.

Figure 3. Petronas Twin Tower.

Figure 4. Light Rail Transit.

Figure 5. Bukit Jalil Sports Complex.

Following the success of their visits, in 1964, the government began using the IBS system for significant projects. In addition to being able to build high-quality, affordable housing units, their main goal was to expedite the projects' timely completion initiatives along Jalan Pekeliling in Kuala Lumpur, which spans 22.7 acres, seven 17-storey apartment blocks have been built. 40 shop lots and 3,000 affordable flats are housed on each floor (Figure 6). The construction took two years, three months, and a total of RM 2.5 million for casting to complete (P.F. Kaming et al., 1998).

Figure 6. Jalan Pekeliling Flat, Kuala Lumpur.

The system is only applicable to straightforward and easy-to-design buildings. The IBS is being used in construction more and more effectively every day. According to reports, at least 21 different suppliers and manufacturers are advertising their components in Malaysia. Additionally, an IBS Center has been established in Kuala Lumpur's Jalan Chan Sow Lin in Cheras. These are the government agencies in charge of putting strategies into practice and introducing innovations in IBS technology to enhance the construction sector's productivity and quality while reducing reliance on foreign avoiding the influx of foreign labor into the local construction market.

2.3 BIM Adaptation in IBS Projects

According to Peniel Ang Soon Ern *et al*., (2022), in the case of the IBS project, BIM has the ability to improve the design process. The building industry in Malaysia, on the other hand, is not progressing as predicted, contributing the least to economic productivity. In relation, BIM adoption would be a key factor of the breakthrough development of construction industry in term of the productivity and efficiency of the project delivery process.

IBS and BIM are two distinct viewpoints that have been viewed as having the potential to both significantly revolutionize the construction industry and address long-standing issues, like decreased efficiency and productivity. There is a growing body of research being done in this field because BIM application in IBS projects has so many advantages. The implementation of BIM in IBS projects is recognized as a method for maximizing each party's advantages while minimizing their disadvantages. The construction industry benefits greatly from the use of BIM in IBS projects.

Despite BIM's advanced level of technology, there are still challenges and barriers to its wide adaptation in Malaysia's construction sector in term of IBS. Therefore, a study related to exploring the integration of BIM in IBS projects is perceived necessary. The outcome of study would contribute to the body of knowledge especially for civil engineering and construction management areas.

3. CONCLUSION

The construction sector in Malaysia has lagged behind in terms of technology. As a result, there is a problem with productivity, quality, and value (Zahrizan *et al*., 2013). The construction industry is a very complicated one that involves numerous parties. A significant amount of document and drawing exchange between the parties could result in a final product defect. Implementing BIM in an IBS Projects can aid in streamlining processes and enhancing data exchange. Even after changes, the data between the parties remains consistent and organized for viewing by all parties.

Although BIM has the potential to increase efficiency, its adaptation in the IBS industry is still at a low level, which raises concerns because only some is known about its capabilities in the IBS industry work process. The results of this study have allowed IBS practitioners to understand how BIM are used in all work processes. This result is necessary in order to creating a strategy to persuade IBS industry participants to adopt BIM in their projects must be proven to be effective.

This study may serve as proof of the advantages BIM may offer an organization in achieving its objectives following an investment in this technology. The IBS-BIM practitioner's success story may be of interest to other IBS professionals. This study can serve as a performance metric for BIM adaptation in IBS each step of the work process is industry. The data from this study can be used by CIDB as a manual to hasten Malaysia's adoption of BIM. The structure could be used by the BIM Committee to determine how to approach and use IBS practitioners BIM in all work processes.

ACKNOWLEDGEMENT

The author would like to acknowledge the support from the Ministry of Higher Education (MoHE) Malaysia through the Fundamental Research Grant Scheme (FRGS) under a grant number of FRGS/1/2023/SSI02/UNIMAP/02/1).

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