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Relationship between Construction Waste Triggers and Bim-Ibs Activities in The Construction

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Abstract

Construction waste is another serious problem in the construction industry. Large and various types of construction waste with different characteristics are created at all the stages of construction. Managing construction waste is also an issue if not properly handled as it will give a negative impact on the environment, society and finally economy. Malaysia needs to embark towards a waste management hierarchy by enacting specific construction waste regulation. Implementing of BIM-IBS system in all stages as a solution to reducing Malaysia construction. As this study seeks to identify the acceptance level of BIM-IBS activities in the construction industry and analyse whether the use of BIM-IBS activities helps to reduce construction waste. In other words, a survey consisting of a thorough questionnaire was developed to obtain the required information from the contractors in Klang Valley Area and also other area. A literature review and questionnaire survey were conducted to identify the objective of the research. The data have been analyzed using the SPSS Software to identify the value needed such as Cronbach alpha, mean value, standard deviation, and correlation. The results shows that all contractor company knowledge the acceptance level of BIM-IBS activities that consists of organizational category, technology quality category, behaviour control category and personal competency category in the construction industry. More than half of company willing to use BIM-IBS activities in the future which can help to reduce construction waste. The result shows strong relationship between all acceptance level category studied with variables in IBS activities and variables in BIM activities to reduce construction waste in construction industry.

Keywords: Building Information Modeling, Industrialised Building System, Acceptance Level, Construction Waste, Waste Reduction.

Introduction

Since Malaysia's independence in 1957, the building sector has continued to expand. Malaysia's construction industry has progressed from a low-tech, labour-intensive, craft-based business to one that employs advanced technologies. The Industrialized Structure System (IBS) appears to be an excellent way to improve the quality and performance of a building. Inaccurate strategic judgments in the IBS workflow, on the other hand, have resulted in a large cost overrun. As a result, Building Information Modelling (BIM) is implemented to improve IBS performance in terms of time, cost, and quality. BIM is one of the technologies that can help with design, digital representation, project scheduling, and cost and time management (Saar et al., 2019). Furthermore, BIM provides a platform for improving communication between stakeholders, allowing for easier interaction between them at various phases of the design, manufacturing, shipping, assembling, and operational processes (Kocakaya et al., 2019). The Construction Industry Development Board (CIDB) in Malaysia has advocated that BIM be integrated into every construction project and made BIM mandatory for projects worth more than RM10 million. Similarly, to the IBS industry, BIM is intended to be integrated into the IBS workflow since it has the ability to increase support for prefabrication element standardization (Wai, 2020). In addition, BIM can manage many resources and information at the same time. The lack of communication between the production and construction industries contributes to the complexity of IBS construction. As a result, proper technology such as BIM can help bridge the gap between industries. The purpose of this study is to assess the deployment of BIM in the Malaysian IBS sector. In conclusion, the purpose of this research will be to determine the IBS work method in line with BIM functions (Jaffar & Lee, 2020). An additional problem in the construction industry is construction waste. Construction waste has a wide range of characteristics and is created at all stages of construction (Gulghane & Khandve, 2015). In Malaysia, we must embark on enacting specific regulations with regard to construction waste in order to engage towards a waste management hierarchy. Managing construction waste presents a challenge if it is not handled correctly. In the construction industry, waste generation has not been well managed to reduce waste generation. Many construction practitioners lack a proper waste management strategy. As reported by CIDB in 2017 Malaysia's construction projects have been reflected in the projects reported for 2017 in terms of new construction works. According to estimates, RM138.0 billion will be spent on construction projects in 2017 versus RM 131.0 billion in 2016. Malaysia's construction industry is poised to implement huge megastructure projects as a good investment, based on this projection and development of projects. Considering the discussion above, construction waste generation increases due to the growing number of new developments and remodelled buildings. Construction projects have contributed to environmental problems caused by the development of infrastructure, especially in terms of the disposal of construction waste (Negash et al., 2021). The increased demand for infrastructure in Malaysia was also directly contributing to the growth of the construction sector in the country (Rahim et al., 2017). The construction waste in Malaysia could be reduced by implementing the BIM-IBS system in all stages of construction. BIM-IBS could improve project schedules, detect any clashes during construction and decrease construction costs. BIM-IBS system increases efficiency and reduces waste by making better decisions based on information. Different scenarios can be simulated beforehand to test different approaches. Waste management can be improved by the BIM-IBS system by reducing waste during design and production, improving collaboration on-site, and gaining access to new sustainable opportunities.

Literature Review

Construction Waste Management and Initiatives in Malaysia

Construction of infrastructures affects numerous aspects of the living environment, including conditions of living, social well-being and the health of citizens (Song et al., 2021). In the event of new development, waste generation may also increase as a result of higher demand. For the purpose of the current study, civil engineering and construction projects can be viewed as part of the construction industry. Additionally, the authors suggested that construction is an especially risky and dangerous industry. Economic growth depends on the construction industry. The recent growth of Malaysia has, however, caused ecological disruption and environmental damage. As a result, it has become a major problem. The construction industry generates significant amounts of waste. Nevertheless, it is well established that construction activities, such as construction research, renovation and demolition, lead to the generation of inert and non-inert materials that are generally referred to as construction waste. Furthermore, the statistics confirm that the majority of construction and demolition wastes are generated on the construction and demolition sites (Saadi et al., 2016). The Malaysian government has taken many steps to minimize the generation of waste (Ibrahim et al., 2021). In contrast, many contractors mismanaged construction waste as a result of poor waste management. The construction waste management problem can be approached in various ways (Yazdani et al., 2021). It is important to understand that construction waste management involves more than just waste disposal. Construction resource utilization comprises a number of strategies aimed at reducing the amount of waste generated as well as utilizing generated waste in a more effective manner (Lu et al., 2021). The most common method of reusing construction wastes in Malaysia is to send them to landfills. The waste materials are thought to have somewhat a higher value in Malaysia, thus contractors choose this method. However, the practices will no longer be applicable in the long term since the construction industry had generated a significant amount of waste and there is an upward trend in construction waste generation that will further clog the already overflowing landfills (Hasmori et al., 2020).

Industrialised Building System (IBS)

Since the 1960s, IBS has been developed in Malaysia in order to deal with the shortage of housing. The IBS, however, was just starting out and was not a widely-adopted technology yet. In the 1960s and 1970s, several international IBS systems were introduced; however, these systems were not compatible with Malaysia's climate, which halted the production of precast concrete due to the time-consuming process of applying the conventional method (Rahim & Qureshi, 2018). There is a need for more intensive training programs like integrating or assembling systems in order to enhance IBS skills. It requires more time and attention to meet these special needs. Contractors who are involved in IBS projects are no longer builders but rather assemblers. Contractors must possess IBS knowledge and skills in order to perform this work. A contractor's IBS products must be marketed and the industry must be competitive for the contractors to make the needs more imperative (Mohamed et al., 2021). During the period of July to September 2002, many talented foreign workers were automatically displaced when there was a sudden crackdown on illegal foreign workers. There were two large groups of foreign workers called the 'new batches', who were retrained since they did not possess the needed skills. The Industrialized Building System (IBS) is a type of building system that is mass-produced and of high quality (Mohamed et al., 2021). IBS has therefore become an indispensable component in meeting the ever-increasing demand for houses by offering advantages such as speed, quality, and cost. Mass-produced houses require the use of Malaysian building systems and materials which are compatible with the world's most advanced construction systems and building materials (Mohd Amin et al., 2017). By reducing labour intensity and standardizing construction, the IBS, which allows factories to fabricate and cast components for on-site assembly, will save costs and improve quality. In addition to that, it reduces waste, materials, and building costs, and creates a more controlled and cleaner environment. The Malaysian building construction industry is still quite low when compared to conventional methods when it comes to IBS implementation. This appears to be part of a general consensus among all stakeholders in Malaysia.

Building Information Modeling (BIM)

Building Information Modeling (BIM) is a technique for integrating data acquisition, exchange, visualization, and analysis during the life cycle of a construction project (Hannan et al., 2015). BIM enhances the quality of design and construction by providing managers and engineers with support. All information is stored in a unique model and it is simplified to capture and visualize data. Research has shown that BIM-based design validation increases the productivity of engineers by reducing errors and rework by allowing design review and clash detection. This in turn reduces the generation of waste by 15% (Won & Cheng, 2017). Zero waste goals could be achieved through BIM implementation in the construction project. In order to reduce the number of errors, rework, and collisions in design performance, the potential functionality of BIM on waste generation by analyzing the reasons for waste generation (Saka et al., 2020).

Level of acceptance for BIM-IBS activities

The rising demand for housing and commercial buildings has encouraged Malaysian builders to recognise the advantages of the Industrialised Building System (IBS). Despite its benefits, they are afflicted in Malaysia, in part due to a poor implementation strategy and a lack of understanding among practitioners (Saar et al., 2019). If more strict regulations are created to safeguard the health of labourers brought into the country, foreign labour for construction and property development may be harder to come by (Wai, 2020). In addition, the author reported that the IBS will help the country as a whole according to the government. The author added that since 2008, all public projects worth more than RM10 million have been required to employ IBS and attain a minimum IBS score of 70. Private projects, on the other hand, must utilise IBS with a minimum score of 50 for projects worth more than RM50 million. He also reported that in 2019, 35% of private projects achieved ratings of 80 or higher. In IBS acceptance for the private sector, however, is still modest. According to Rafee (Rafee, 2021), the retired chief judge of Sabah and Sarawak, Tan Sri David Wong Dak Wah revealed that the level of BIM acceptance in Malaysia is the lowest which is only 17% compared to the United States which acceptance level of 71%, United Kingdom has acceptance level of 38% and Singapore with 65% of acceptance level. She also noted that Tan Sri David Wong Dak Wah had reasoned why there are barriers to embracing more advanced technology because of human factors which are the acceptance of technology, lack of knowledge and the hesitancy of individuals. In Bernama article (Bernama, 2019), it was reported that The Construction Industry Development Board (CIDB) has proposed that certain private sector projects employ Building Information Modelling (BIM) as of 2020. In addition, the author reported that Chief Executive Datuk Ahmad Asri Abdul Hamid explained that while only a few private companies use BIM, for the public sector was mandatory to use the BIM system for a project costing more than RM100 million. The government had expected that Malaysian building industry to implement BIM technology within the next five years (Rashid, 2020). Based on the same article, Works Minister, Datuk Seri Fadillah Yusof has set the acceptance of the technology to reach 50% by 2021 and 80% by 2025 through the Public Works Department (JKR) Strategic Plan 2021-2025 (Rashid, 2020).

BIM-IBS Activities Reduce Construction Waste

Increasingly, information technology is used to reduce construction waste, especially Building Information Modelling (BIM) (Watfa et al., 2021). In addition to helping detect design errors and collusion early, it also facilitates life-cycle estimations and the identification of alternative designs. The use of BIM enables an individual to use big data architecture, a BIM-based simulation tool designed to assist in the reduction of waste through design (Akinade et al., 2018). It provides data for design exploration and optimization, the detection of causal factors and sources, hidden patterns, estimation and quantification, and unknown correlations, as well as an effective strategy for waste minimization and effectiveness based on supply chain planning and construction material (Saka et al., 2020). In addition to showing the generation rate of waste, BIM can also be used to develop construction and demolition waste (CDW) management plans, select the most efficient disposal sites, and even assess the environmental impact of disassembling and reusing building components (Xu et al., 2018). The BIM model integrates geometry, material resources, and work schedule data with cost and schedule information to organize just-in-time deliveries of equipment, materials and labour (Won & Cheng, 2017). BIM minimizes wasteful processes across the lifecycle of a project, adding to it a positive impact (Pärn et al., 2017). BIM-only integration would reduce CDW by up to 2% if conducted during the design phase only (Banihashemi et al., 2018).

Methodology

This research considers using a quantitative method which is by using the questionnaire. The researcher will distribute the questionnaire to the required contractor in higher and lower grades in the Klang Valley area and also other zone area including Northern, Southern, Eastern, Sabah and Sarawak. There are a few parts of questions that will be asked of them. The first part is about detail about themselves regarding their race, age, occupation, marital status and education level. This question will be asked because it is not considered a sensitive question and is very general for everyone. The second part concerns their knowledge or information about the level of acceptance of IBM-IBS activities in the construction industry. The question for respondents on an awareness that the BIM-IBS activities benefit the construction industry, whether time been using IBS and BIM in the construction industry, whether either company implement the use of IBM and IBS in the construction project, the construction phase of BIM element being used within the organisation, the present and potential use of BIM in the organisation. This question can be a key point question where it can determine the level of acceptance (organizational category, technology quality category, personal competency category and behaviour control category) of BIM-IBS activities in the construction industry. The third part is about analysing whether the use of BIM-IBS activities helps to reduce construction waste. The question for respondents on aware whether waste produced by the construction industry increased every year, evaluate whether BIM-IBS activities can reduce waste produced by the construction industry and whether the percentage of construction waste will be reduced. The questionnaire is divided into three main sections which are section A for general information, section B for evaluating the level of acceptance of BIM-IBS activities in the construction industry, and section C for analysing whether the use of BIM-IBS activities helps to reduce construction waste.

Result and Discussion

Table 4.1

Demographics Profiles of the Respondents

Demographics Group	Descriptions	Percentage(%)
Gender	Male	60%
	Female	40%
Zone	Northern (Perlis,Kedah, Penang)	4%
	Central (Perak,WP, Selangor)	88%
	Southern (N9,Melaka,Johor)	1%
	Eastern (Kelantan,Terengganu,Pahang)	6%
	Borneo (Sabah, Sarawak)	1%
Company	Consultant	35%
	Contractor	59%
	Others	6%
Sector	Public sector	7%
	Private sector	93%
Qualification	Certificate/Diploma	7%
	Degree	68%
	Master/PHD	25%
Designation	PM/Architect	4%
	Engineer/QS	94%
	Supervisor	2%
Years of Experience	<3 years	7%
	3 – 5 years	78%
	5 - 10 years	15%
Involvement in BIM-IBS project	Never	23%
	< 3 years	48%
	3 – 6 years	28%
Organization size	< 20 employees	5%
	20 - 50 employees	63%
	50 - 200 employees	26%
	> 200 employees	6%

Table 4.1 showed the respondent's demographic profiles. The highest respondents was from central zone with 88%. Contractor section contributed 59%, consultant section contributed 35% and others section contributed 6% of the respondent in company section. Most of the respondents are working in Private Sector with 93% followed by Public Sector with 7%. The result of respondent's qualification are mostly Degree level which is 68%, followed by Master/PhD level which is 25%, and Certificate/Diploma level stated 7. Most of the respondent consist Degree level certificate as the percentage of it almost half of the total respondents. Based on the years of experience in construction industry involvement in BIM-IBS project group most of the respondents were at between range 3 to 5 years is 78%, 15% at between range 5 to 10 years, 7 less than 3 years and none from the respondents more than 10 years. It can be presumed that respondents are have an experienced and knowledge involvement in BIM-IBS project.

Table 4.2
Descriptive analysis of Respondent Exposure Level

Exposure group on	Exposure level	Percentage (%)
Aware on BIM-IBS benefits	Yes	100%
	No	0%
Years of using IBS in construction	Never	20%
	< 1 year	9%
	1 - 2 years	41%
	2 - 3 years	1%
	3 - 5 years	27%
	> 5 years	2%
Percentage of using IBS in construction	1% - 25% of projects	28%
	26% - 50% of projects	67%
	51% - 75% of projects	4%
	> 75% of projects	1%
Years of using BIM in construction	Never	22%
	< 1 year	7%
	1 - 2 years	41%
	2 - 3 years	1%
	3 - 5 years	27%
	> 5 years	1%
Percentage of using BIM in construction	1% - 25% of projects	30%
	26% - 50% of projects	65%
	51% - 75% of projects	5%
Which construction phase of BIM element(s) are being used within your organization?	Planning phase	5%
	Execution phase	1%
	Construction phase	91%
	O&M phase	2%
How will you explain the present and potential use of BIM in your organisation?	We currently use BIM	56%
	In one year's time we will use BIM	36%
	In three years' time we will use BIM	6%
	In five years' time we will use BIM	2%

Referring to table 4.2, the majority of the respondents are aware of the benefits of using BIM and IBS in the construction industry. The distribution of respondents' knowledge exposure to the use of IBS and BIM in the construction industry is mixed, where the majority of respondents only have 1-2 years of experience (41%), 3-5 years (27%) and the remaining 20% have no exposure to IBS and BIM at all. The respondents' involvement in the use of IBS in construction stated as much as 67% stated the use of IBS as much as 26%-50% of projects while 65% stated the use of BIM as much as 26% - 50% of projects involved. BIM is widely used in the construction phase, with 91% of respondents choosing it. When asked about the level of BIM use in the respondent's organization, the majority stated that their company is currently and towards using BIM in the planning and design process.

Table 4.3
Analysis of Acceptance Level of BIM and IBS in construction.

Acceptance level according to category	Mean	Std. Deviation
Organization category	4.4156	.68488
Technology quality category	4.4630	.65683
Personal competency category	4.4911	.63047
Behaviour control category	4.3786	.77863

In organization category, the highest rank was the organization does not have psychological resistance to using new IT Inertia causes companies to lose flexibility, preventing them from adapting to environmental and internal changes. An organization exhibiting organizational inertia may have internal power struggles, poorly developed decision-making processes and bureaucratic organizational structures. Organization that had technical capability of using new information technology. While the lowest mean value in organization category was that the organization did not provides proper education/training for BIM utilization. Most construction players are directly concerned with cost in order for BIM to be adopted. Several costs are associated with the initial investment, such as implementing new software, updating hardware and training employees. The construction industry must allocate resources for the hiring of new staff with BIM expertise. BIM training also takes time, and in the short term, will reduce the productivity of workers and incur additional expenditure. In BIM, information contained in a Building Information Model is used for controlling and organizing construction projects so that information about assets can be exchanged throughout the life of the project.

The highest score of acceptance level in technical quality category was that the information acquired by using BIM can be used throughout the course of the project. In BIM, buildings can be modelled from conception to demolition, from inception to design to recycling. Next, which is enough information can be gathered using BIM. Third, the information acquired by using BIM is accurate and detailed and those who use BIM can also expect to notice an improvement in the quality of the construction process, which typically occurs during the design and construction process. A better structure results from more accurate calculations and models made with BIM. The respondent also claims that BIM utilization improves information accessibility. BIM may also enhance the aesthetic appeal of a structure, since it provides multiple visualization tools. In addition to improving communications among architects, clients, contractors, and other stakeholders. BIM also facilitates as collaborative engineering. As a result of BIM, all of the relevant information is collected from one central location, like models, estimates, and design notes. The information can be seen by all participants and they can make suggestions as well. Through this collaboration, architects find a better way to solve problems based on data analytics and eliminate information silos (Li et al., 2021).

Acceptance level for Personal competency category shows, the highest score mean weree shown by the item of the technical capability of using a new information technology and overall, find BIM useful in job in this project. Most of the respondent claims that do not have any resistance to using BIM, do not have psychological resistance to using a new information technology, aggressive about using a new information technology, using BIM enhances my effectiveness on the job in this project. The lowest mean value in this category was claims that familiar with BIM tools understand the benefits of using BIM. Malaysia lacks BIM guidelines based on national standards, adding to the challenge. Construction players are uncertain about how, when, and what to start implementing BIM due to their lack of knowledge regarding the process. A national guideline on BIM deployment is absent, so users must formulate their own guidelines without seeking BIM experts' advice (Wai, 2020).

Acceptance level for Behaviour control category shows, the highest score for mean are shown by the first item where respondents claims that interaction with BIM to support work is clear and understandable in this project, followed by requirement to adopt BIM by cooperative companies and cooperative relations' and required to adopt BIM to satisfy owner's requirement. Next, the requirement to adopt BIM by project delivery or contract method. Lastly, that the organization forces to use BIM by setting up policies and regulations and required to use BIM by superiors and colleagues. The respondents had an interaction with BIM based on behaviour control to support their work become clear and understandable. Despite the variations in awareness, knowledge, and interest in BIM across the construction industry disciplines, engineers, architects, project managers, and others clearly agree that the main factors affecting its implementation are predictable (Durdyev et al., 2021).

Table 4.4
IBS and BIM activities towards waste reduction

Category	Mean	Std. Deviation
IBS activities toward construction waste reduction	4.5782	.54968
BIM activities toward construction waste reduction	4.5714	.56829

IBS activities towards waste reduction shows in Table 4.4, the highest score mean were contibuted by the first item where the IBS design with the concept of precast panels has set the dimensions of the panels (Standardized the design) that will be used in the construction of the factory outside the construction site, followed by item which is the preparation of each module to be used in a separate plant from the construction site can avoid congestion and the possibility of waste at the construction site. Malaysian government was prioritizing IBS, a construction method that makes use of prefabricated elements, over most other construction technologies. IBS encourages sustainability by reducing waste, recycling, or reusing certain materials on-site (Khudzari et al., 2021). While, BIM activities towards waste reduction shows, the highest score for mean were contributed by element benefit of BIM in maximised productivity that building projects would have a shorter life cycle and are thus more efficient. It becomes easier to handle and complete all aspects of the pre-construction and planning processes. Design team can use BIM software to build designs faster, and estimators can use BIM models to make more reliable estimates. Using BIM platform could enhance construction processes through improved design, the selection of appropriate materials, increased collaboration between stakeholders, the provision of well-designed and timely services, and the reduction of waste generation (Lu et al., 2021).

Table 4.4
Correlations analysis of IBS and BIM related category towards waste reduction

Correlations

			C1	C2	C3	C4	C5	C6	C7	C8
C1	Organization category	Pearson Correlation	1	.955**	.861**	.819**	.731**	.735**	.626**	.652**
		Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	Technology quality category	Pearson Correlation	.955**	1	.883**	.818**	.784**	.810**	.633**	.657**
		Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000	0.000
C3	Personal competency category	Pearson Correlation	.861**	.883**	1	.872**	.860**	.873**	.690**	.730**
		Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000	0.000
C4	Behaviour category	Pearson Correlation	.819**	.818**	.872**	1	.865**	.860**	.684**	.709**
		Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.000
C5	Benefits of IBS	Pearson Correlation	.731**	.784**	.860**	.865**	1	.928**	.698**	.705**
		Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.000
C6	Benefits of BIM	Pearson Correlation	.735**	.810**	.873**	.860**	.928**	1	.703**	.715**
		Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000
C7	IBS activities toward construction waste reduction	Pearson Correlation	.626**	.633**	.690**	.684**	.698**	.703**	1	.970**
		Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000		0.000
C8	BIM activities toward construction waste reduction	Pearson Correlation	.652**	.657**	.730**	.709**	.705**	.715**	.970**	1
		Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.4 shows the correlation between acceptance level of organization category (r=0.626), technical quality category (r=0.633), personal competency category(r=0.690) and human behaviour category (r=0.684) toward IBS activities in ruducing construction waste. The result show significant relationship with significant value less than 0.01. While, correlation between acceptance level of organization category (r=0.652), technical quality category (r=0.657), personal competency category(r=0.730) and human behaviour category (r=0.709) toward BIM activities in ruducing construction waste. The result show significant relationship with significant value less than 0.01. These indicate that organization category, technical quality category, personal competency category and human behaviour category variables showed that there was a strong positive linear relationship. This indicator shows that the acceptance level of all these category affecting the BIM-IBS activities towards construction waste reduction.

Conclusion

The research explores the relationship between construction waste triggers and all BIM-IBS activities at all stages of construction. Finally, a prediction model based on the mean value and regression was developed to assess the extent of BIM-IBS acceptance in the construction industry, as well as how BIM-IBS activities contribute to waste reduction. As a result of the present study, the following implications have been made regarding the proposed research objectives. A large segment of Malaysians was unaware of and unprepared for BIM-based e-submission, even though they perceived the benefits, such as improved communication efficiency, higher quality information exchange, innovative design, and new business opportunities, that can be created through BIM. The industry is unwilling to change existing procedures and learn new concepts and technology, as evidenced by the wait-and-see approach taken by most companies in organizational preparation. The Malaysian construction industry should improve its waste construction management in order to reduce waste construction. At an early stage, reducing construction waste can be achieved through the implementation of the BIM system at all stages. Malaysian practices in the construction industry are not well adapted to the BIM-IBS system. Thus, this type of method for waste management can help in reducing construction waste in Malaysia

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