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Causes of Construction Wastes and Capabilities of Building Information Modelling (BIM) in Minimizing the Wastes

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Abstract

Recently the amount of Construction and Demolition (C&D) wastes generated in Malaysia is enormous due to the rapid development. Malaysian Government carried out many efforts to reduce the generation of construction wastes by implementing policy for the contractor to comply. Regrettably, it does not reach the level of effectiveness required in reducing the construction wastes. The generation of C&D wastes not only affect the cost of a project but also lead to many environmental impacts such as air and water pollution. BIM is a 3D model-based process to create and manage information on a construction project on a project throughout the entire project lifecycle. It allows the project participates working together in the planning, design and construction of a building in one 3D model thereby manage and minimize C&D wastes efficiently. The aim of this research is to explore the causes of construction wastes and the capabilities of BIM in minimizing the wastes. This research is targeted to the Quantity Surveyors in Kuala Lumpur and the method used to collect primary data is quantitative questionnaire. The collected primary data is then analysed by using Relative Importance Index (RII) and Mean Score (MS) method. The results revealed that poor planning and low rate of reuse and recycling of wastes is the most significant causes of construction wastes while accurate quantity take-off is the most effective capability of BIM in minimizing these wastes.

Keywords

BIM, construction, wastes

Introduction

Building Information Modelling (BIM) is becoming a crucial process to ensure the planning, design and construction is much efficient and collaborative in a construction project across the world. With the adoption of BIM, it is believed that BIM have the capabilities in minimizing Construction and Demolition wastes. BIM is a 3D model-based process for creating and managing information on a construction project throughout the entire project lifecycle. It enables AEC professionals and multiple stakeholders work together on the planning, design and construction of a building in one 3D model (Sarah, 2018). From the construction of a building to its physical construction, the entire process can be visualized using BIM. The contractors' understanding of what is being built can be improve by the 3D visualization of the final condition. As this visualization happens before the construction

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commence, any re-work due to misunderstanding or clashing can be significantly reduced (Autodesk.com, 2016).

There are some causes of Construction and Demolition (C&D) wastes include frequent changes in design, mistake of workers, wrong material storage, poor planning, low rates of reuse and recycling of wastes as well as errors in material ordering. BIM has the capabilities to prevent these causes of C&D wastes which are accurate quantity take-off, phase planning to improve construction sequencing, 3D coordination to prevent errors and omissions, provide design review for project participants and improve site utilization.

Over the decades, there are substantially large volume of wastes generated during construction, demolition and renovation activities across the globe. In Malaysia, the generation of Construction and Demolition (C&D) wastes is becoming a pressing issue. There are many C&D wastes generated due to the rapid development in construction industry (Asitharan, N. et al, 2012). The percentage of total solid wastes generated in construction industry is approximately 41% in Malaysia (Chooi Mei and Takeshi, 2016). The generation of C&D wastes was estimated at 161.19 tons per day in 2009, raising to 299.69 tons per day in 2015, and is forecasted to reach 368.31 tons per day by 2023. The origins of the amount of Construction and Demolition (C&D) wastes in construction industry is enormous due to inefficient material handling, inadequate work schedules, weather, unexpected building design changes and improper design (Walmikey and Kulkarni, 2016).

C&D wastes generated during a project increased the cost of project as the construction wastes must be disposal at the stated landfill. The cost incurred during landfill disposal process of construction wastes are cost of collection, transportation and storage of wastes on site, sorting materials, wastes transportation to the landfill, weighting and admission of wastes into landfill and tax of landfill. Therefore, additional cost is generated (Liu and Wang, 2013).

On the other hand, C&D wastes not only affect the cost of a project but also lead to environmental impact which can be categorized into air pollution, noise pollution and water pollution. The C&D wastes generated on site might pollute the land and air if wastes management is not carried out properly. Other than that, improper wastes management in wastes disposal will cause environmental degradation, destruction of the ecosystem and affects the public health. Therefore, it is important to comply the right protocols and dispose wastes to the proper areas such as recycling centre and landfill site during construction and demolition projects. Consequently, it will minimize the impact to the environment (Demolition, 2018).

Apart from that, some contractors carried out illegal dumping activities due to the distance of the landfill site is far from the location of the construction project which lead the contractors resist to dispose wastes in the gazetted landfill. Furthermore, the contractor will dispose the wastes in illegal dumping site to avoid cost of transportation and payment for landfill charge so that their profit can be maximized. As a result, it will cause major negative impact to the environment (Nurzalikha et al., 2016).

This research aimed to identify the level of adopting Building Information Modelling in Malaysia's construction company, to identify the causes of Construction and Demolition (C&D) wastes, and to determine the capabilities of Building Information Modelling (BIM) application for C&D wastes minimization.

Capabilities of BIM in Minimizing C&D Wastes

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There are several causes of construction wastes produced during a construction project which are:

i. frequent design changes
ii. mistake of the workers
iii. wrong material storage
iv. poor planning
v. low rate of reuse and recycling of wastes
vi. errors in material ordering

After reviewing the past literature, the capabilities of Building Information Modelling (BIM) to avoid the main causes of C&D wastes are:

i. accurate quantity take-off
ii. phase planning to improve construction sequencing and planning
iii. 3D coordination to prevent errors and omissions
iv. provide design review for project participants
v. improve site utilization planning

Research Methodology

For this research, the method of primary data collection is conducted in quantitative approach. Survey method related to the questionnaires survey is carried out in order to collect primary data for this research. Besides, secondary data is obtained from articles, online journal, books or news to analyse literature review. Questionnaire was sent out to 72 Quantity Surveyors in Kuala Lumpur that are registered under Board of Quantity Surveyors Malaysia (BQSM). There were 32 responses out of 72 where the response rate is 44.4%. The methods used for data analysis are Relative Importance Index (RII) and Mean Score method.

Data Analysis

The adoption level of BIM in Malaysia's construction company is identified based on the responses received from the questionnaires survey and thus this objective is successfully accomplished. After analysed the data collected, it shows that there were 81.3% of respondents are aware of BIM and 18.8% of respondents are not aware of BIM. Although most of the respondents are aware of BIM but there were only 35.5% of respondents have adopted BIM in their company while 62.5% of respondents have not adopt BIM. As a result, the adoption level of BIM in Malaysia's construction company is considered relatively low.

The causes of construction waste are stated in Table 1. The capabilities of Building Information Modelling (BIM) application for C&D wastes minimization are stated in table 2.

Table 1. Ranking of causes of construction wastes

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CAUSES OF CONSTRUCTION WASTE	RII	RANKING
Low Rates of Reuse and Recycling of Waste	0.750	1
Poor Planning	0.750	1
Frequent Changes in Design	0.688	3
Mistake of Workers	0.669	4
Wrong Material Storage	0.663	5
Errors in Material Ordering	0.575	6

Table 2. Ranking of capabilities of BIM in minimizing the wastes

CAPABILITIES OF BIM IN MINIMIZING WASTE	MEAN SCORE	RANKING
Accurate Quantity Take-off	3.938	1
Improvement of Construction Sequence and Plan by 4D simulation	3.781	2
Prevention of Errors by 3D Coordination	3.750	3
Enhancement of Communication and Coordination Between Project Participant by Design Review	3.563	4
Analyze Site Layout for Space and Time Conflict by Site Utilization Planning	3.188	5

Conclusions

In conclusion, the low rates of reuse and recycling of wastes as well as poor planning are the most significant causes of C&D wastes while accurate quantity take-off provided by BIM in minimizing the wastes is the most effective capability of BIM among the others to minimize the wastes.

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