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RESEARCH ARTICLE

Identifying the Initiatives of Construction Waste Management in Malaysia towards Achieving Sustainable Construction

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ABSTRACT - Construction waste management is not a new topic in the construction industry. It involves the management of waste material arising from construction, renovation, and demolition activities as such concrete, timber, steel, and plastics products. The poor construction waste management practice has led to failure to ensure sustainability in construction by increasing environmental impacts and illegal dumping. Hence, with proper construction waste management techniques and processes, the notion of sustainable construction can easily be achieved. The aim of this study is to identify the initiatives for construction waste management toward sustainable construction. The study adopted a quantitative method of questionnaires survey distributed to 118 numbers of Grade 7 Contractors in Pahang. The professional teams in the company provide their responses in regard to waste management initiatives taken by them. The findings revealed several initiatives taken by contractors in helping to move towards sustainable construction in Pahang as such strengthening the policies in government agencies regarding waste management and compliance with the law to the general legislative structure. This study contributes to increasing the effectiveness of managing construction waste, particularly for contractor companies who are major involved during the construction process.

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1.0 INTRODUCTION

In any developing country, the construction sector is very important because it is an economic investment, and its association with economic growth is well known [1]. [2] stated that the construction industry is essential for economic growth because it raises the standard of living and provides employment opportunities. Unfortunately, the rise in developments in Malaysia has caused environmental damage and affected the ecosystem. This damage has become a major problem in recent years. Urbanization has developed globally and an extraordinary rate over the last few years. The rise in the management of urban solid waste has become one of Malaysia's biggest environmental problems. According to [3] population growth has led to an increase in solid waste generation in Malaysia and has become a critical problem to be solved. Because of all these problems, solid waste management plays an important role in preserving a sustainable environment, and each country has different ways of managing its solid waste caused by construction. Environmental problems have become more severe over the last two decades and should be curbed in Malaysia. To achieve sustainability in waste management, the cooperation of every party involved in waste management handling with the suitable method is required. All industries must be integrated to apply a sustainable waste management system. For some time, solid waste management has been a problem in Malaysia due to inadequate management and handling activities that impact both environment and the public [2].

2.0 LITERATURE REVIEW

2.1 Construction Waste Management Definition

Waste management has been recognized as an effective technique for construction project management because of the growing awareness of the environmental implications of construction waste. [4] defined waste management as the process of generating, storing, collecting, transporting, processing, and disposing of solid waste while considering environmental, economic, aesthetic, and public considerations. Construction waste management also is one of the techniques for achieving sustainable development by reducing waste and avoiding negative environmental consequences [5]. However [2] defined construction waste differently as a tool for identifying acceptable waste sources, waste production targets, and processes to ensure that best practices are achieved. In addition, it includes collection, monitoring, collection, transportation, processing, and trash disposal, all of which are part of waste management.

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2.2 Types of Construction Waste Management

The construction industry consumes many natural resources and generates a substantial amount of waste. Based on [6], they suggested implementing the concept of 3Rs for construction and demolition waste management, which are reduced, reuse, and recycle. According to [7], construction waste minimization is a design technique that helps to avoid, remove, or reduce waste at its source. Next, [8] explained that re-use is attempted to restore a portion of a product's waste stream to be used for the same purpose repeatedly. According to [9], the on-site recycling method separates the construction waste and is used as a raw material in other construction processes such as concrete waste can be used as hardcore. Landfill disposal is the last alternative and the lowest criterion for sustainable construction waste management. Based on [10], the Department of National Solid Waste Management indicated that Malaysia had around 289 landfills in the country. [11] mentioned that construction waste should be treated according to the proper construction waste management hierarchy. In waste management, there are 3R concepts that must be filled before wastage is disposed of in landfills. Hence, as a result, it is critical to make optimum use of construction resources to reduce waste generation.

2.3 Construction Waste Management Initiatives towards Sustainable Construction

The government has taken several initiatives to handle construction waste management in Malaysia. The initiative applied was defined as varying plans or strategies to improve the management or any system required to solve a problem regarding construction waste. The policy is one of the government initiatives and is important for achieving sustainable construction. [12] have stated that relevant legislation and laws need to be added to the waste management policy to ensure that the parties involved will bear the issues. Currently, policy development is important to offer clearer aims and priorities to the government in the sectors of construction waste management and environmental protection through the establishment of appropriate laws, legislation, regulations, and standards [13]. As a potential initiative in resolving the issues, Malaysia has been considering incorporating Building Information Modelling (BIM) tools, and technologies into all construction practices and stages as an industry standard. One of the most important reasons for introducing BIM into present construction industry practices due to extremely unsustainable nature, especially in terms of waste and unsuitable construction materials management. Based on [14], BIM systems are important because they will provide advanced features to detect and reduce waste-related costs and materials in construction projects.

3.0 METHODOLOGY

3.1 Research Design

The most suitable method for data collecting for this research was the quantitative method, where the data comes from numbering and mathematical statistics. The questionnaires were used with a combination of multiple-choice questions and Likert-scale questions because it appears to be the most effective way. After that, the Likert scale is given in the form of agreement according to the variables provided. The questionnaires were developed and validated before being distributed to the G7 construction company in Pahang. The targeted respondents were limited to the Project Manager, Site Supervisor, Contractor, Engineer, and Quantity Surveyor who have experience in handling small or huge projects in contractors' companies around Pahang. Thus, all information gathered from the questionnaires was to measure their interest in sharing experiences dealing with construction waste management.

3.2 Population and Sampling Size

As mentioned above, the targeted respondents were coming from professionals in the contractor company. Accordingly, the respondents were chosen based on a registered company from the Centralized Information Management System (CIMS) by the Construction Industry Development Board (CIDB) website. Based on the data gathered, there are about 168 populations of G7 construction companies located in Pahang. Therefore, referring to Krejcie and Morgan's sample size table, the population of this study is 168, hence the minimum sample size needed is 118. The questionnaires were distributed to reach a possible number of 118 respondents. The medium of distribution to the targeted respondents was using company emails, WhatsApp applications, and company corporate social media platforms for every construction company located in Pahang.

3.3 Data Analysis

The data collected were analyzed using Statistical Package of Social Science (SPSS) Version 26, where descriptive statistical analysis, mean rank, and reliability analysis were used for this study. The data is cleaned and screened accordingly to the scope of targeted respondents only before being analyzed by using the SPSS software. Ideally, the questionnaires were divided into four sections namely respondents' profiles, types of construction waste, initiative of construction management waste, and lastly the best construction waste management towards sustainable construction.

4.0 ANALYSIS AND FINDINGS

4.1 Demographic Information

The background and demographic details of the respondents for this study were described in Section A. Although 118 surveys were returned, only 103 questionnaires are used to be analyzed in this study. The breakdown of respondents was tabulated in Table 1 below.

Table 1. Respondents' distribution based on profession

Profession	Frequency	Percentage (%)
Contractor	39	38
Quantity Surveyor	25	24
Project Manager	17	16
Site Supervisor	14	14
Engineer	8	8
Total	103	100

4.2 Types of Construction Waste On-Site

According to Fig. 1, the highest contribution of waste on-site in this study was coming from the waste of concrete with 3.63 means. Then followed by the waste of bricks (3.40) and wastage of wood and timber (3.23) and continued the wastage of metal and steel. [15] his research also agreed that construction waste is majorly contributed by excess from the construction process or residual from demolition which is concrete, bricks and blocks, and timber strutting. On top of that, this study only listed construction waste into six categories as shown below while The European Union divides the construction waste categories into eight categories and England has divided construction waste into ten categories [16].

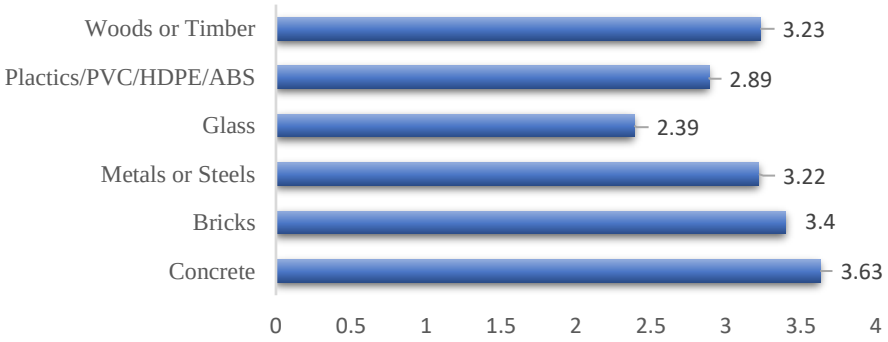

Figure 1. Breakdown of construction waste on-site

4.3 Initiatives of the 3Rs concept in Construction Waste Management

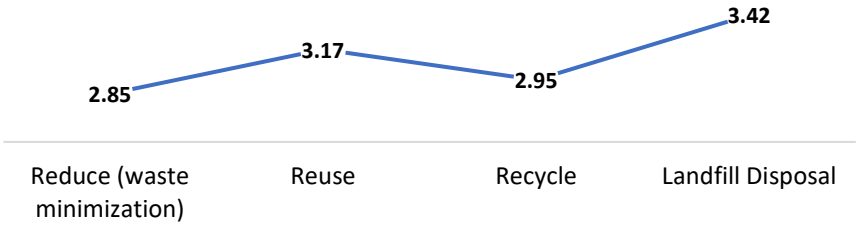

Figure 2. Reduce, reuse, and recycle initiatives

In this study, findings show that most of the contractors in Pahang are preferably to choose landfill disposal (mean of 3.42) instead of implementing the 3R Principle. 3.17 means score showing that some of the contractors agreed to reuse which reduced the use of raw materials, reduced the environmental impact from raw material extraction, and reduced the new material production process by re-using some of the construction materials again. However, recycling and reduction initiatives are less preferred by the contractors. According to [17], there are several reasons contractors are reluctant to recycle construction waste quantity of waste, quality of waste, contamination, and logistic issues on site. Meanwhile, minimizing construction waste (reduction) is sometimes difficult to control due to client changes, errors by tradesmen, and materials compliance towards specification [18].

4.4 Initiatives in Construction Waste Management towards the Sustainable Construction

The means score of initiatives in construction waste management towards sustainable construction is shown in Table 2 accordingly to their rank. All the items are tabulated in order which are from highest mean score to lowest mean score. All these variables are using the Likert scale method in the questionnaires and finally were calculated based on the mean score for each item.

Table 2. Summary of initiatives by mean rank

Initiatives	Mean score	Ranking
Government agencies need to strengthen the policy in managing construction waste	3.72	1
Effective laws and regulations must be applied to the general legislative structure of the waste management policy	3.71	2
The contractor is responsible to manage the construction waste wisely to achieve sustainable construction	3.69	3
A proper plan must be implemented in conducting the construction waste management	3.64	4
Improve the facilities and procedure of construction waste management	3.62	5
Use suitable type of construction waste management for each construction waste on-site	3.60	6
Enhancing the level of awareness on minimizing construction waste	3.59	7
Sustainable construction will improve the quality of life and provide social satisfaction	3.57	8

Accordingly, most respondents agreed that government agencies need to strengthen the policy in managing construction waste with a mean of 3.72. [19] also emphasized that the existing regulations and policies in Malaysia are not clear in terms of construction waste management. Following that, respondents also agreed that effective laws and regulations must be applied to the general legislative structure of the waste management policy with the means of 3.7. The existing regulation needs to be fully enforced and become mandatory to follow so that other sectors than the construction sector also will follow the same initiatives. On top of that, the contractor is also responsible to manage the construction waste wisely on their site in ensuring sustainability can be achieved. Monitoring and compliance checking need to be taken by responsible parties to ensure the contractor takes their own initiative to manage their construction waste properly on site. However, interestingly, most of the respondents were less likely to agree that sustainable construction will improve the quality of life and provide social satisfaction. This is due to a lack of awareness of the social benefits of sustainable construction among the respondents, hence they believe that sustainable construction is not related to their quality of life. [20] revealed that only 40% of the developers/contractors have a good understanding of sustainable construction. Hence, the data obtained in this research seems to be in line with the research by [20].

5.0 CONCLUSION

In conclusion, the government and all key players in the construction industry should work together to ensure that contractors always tried to use proper waste management in their construction projects and practices. This could be clearly seen that there is a lack of waste management practices and a lack of enforcement and regulations applied during the process of managing construction waste in the construction industry. Both parties need to be responsible for their roles in providing the initiatives of construction waste to ensure sustainability in construction can be achieved. Solving this problem, it will lead to achieving sustainable construction in the Pahang region and in Malaysia as a whole.

6.0 AUTHOR CONTRIBUTIONS

Siti Nur Aishah Mohd Noor: Conceptualization, Supervision, Writing- Original draft preparation.

Muhammad Shazwan Holelkusairi: Data curation, Investigation.

Lilawati Ab Wahab: Visualization, Validation.

Izatul Farrita Mohd Kamar: Methodology, Validation.

Mohd Khairul Amri Ramly: Writing- Reviewing and Editing.

7.0 DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are included in the article.

8.0 CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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