

# Construction Waste Management: A Review of Recycled Product Marketability

JANNATUN NAEMAH ISMAM, NOR AZIZAH TALKIS

Centre of Studies for Construction  
University Universiti Teknologi MARA  
Perak Branch, 32610, Perak, Malaysia  
MALAYSIA

*Abstract:* - The construction industry has been challenged to minimise the large volumes of waste generated throughout construction activities. In terms of 3R's (Reduce, Reuse, Recycle) practice, construction waste recycling is perceived as one of the waste management strategies that is more environmentally friendly and preferred than reduce, reuse and waste disposal. Furthermore, recycling approaches will transform construction waste into new materials. It was considered an excellent approach to achieve construction sustainability and overwhelm future economic growth. Recycling of construction waste has been tremendously promoted by the government. Nonetheless, a few issues arose, such as a lack of market demand for recycled construction waste material due to low quality standards, ineffective management, a lack of expertise to operate the material waste, and financial constraints. Thus, issues related to the marketability of recycled construction waste products were reviewed in this paper. An intensive literature review was conducted based on the objectives identified. It compares and contrasts the marketability of recycled construction waste products from developed and developing countries. Both the government and the private sector are potential market drivers for recycled construction waste products. It is followed by a few aspects such as training, technology development, product quality, and marketability, all of which require consistent investment and incentives. As a result, special consideration should be given to the identified market drivers and aspects. The limitations of this study are the implementation and practitioners' acceptance to overview the real situation and mitigate the issues descriptively.

*Key-Words:* - Construction Waste, Waste Management, Recycled Product, Marketability, Market Demand

Received: June 9, 2021. Revised: July 12, 2022. Accepted: August 11, 2022. Published: September 27, 2022.

## 1 Introduction

Construction waste is well defined as waste that is generated throughout the construction process and improper handling will result in landfill disposal. The negative impact of construction waste on the global environment has become increasingly complex, with estimates ranging from 16 to 60% of global landfills [1][2][3]. Most developed countries have seen an increase in construction waste production and improper management issues because of population growth, rapid development, and limited landfill disposal. As a result, authorities have made their best endeavors to promote the 3Rs (Reduce, Recycle, Reuse) principle to reduce the environmental impact that would be detrimental to health and well-being [4].

In Malaysia, there is a lack of data on the amount of construction waste that is reused or recycled. The low rate of waste reuse and recycling is due to a variety of issues and challenges. Contamination, waste quality, collection and transportation challenges, and

difficulties in sorting, transforming, and disposing of waste are the most pressing issues [5]. In contrast to other developed countries, Germany and some western countries pioneered the recycling of construction waste and have attained positive outcomes through a variety of policy planning and technology promotion strategies. In Europe, Germany is one of the most successful countries, recycling 87 percent of construction waste using the waste hierarchy theory as a foundation, a comprehensive legal system of construction waste treatment, and an advanced waste management system [6].

In China, construction waste accounts for 30–40% of total waste. Construction waste is typically dumped or disposed of in landfills at random, and the average recycling rate of construction waste in China is only about 5% [7][8]. However, [7] conducted an intensive literature review and identified several of the challenges related to recycling construction waste. The studies provide a holistic view that starts

from the waste generated, recycling process until the recycled product is ready to market.

## 2 LITERATURE REVIEW

### 2.1 Recycling Management

According to [9], from a sustainability standpoint, the effectiveness of CWD management is dependent on some indexes such as waste generation rate and life cycle assessment. In terms of waste generation, the issue arose when the waste generated was of poor quality and contaminants were discovered in some types of waste [5]. Moreover, [10] and [11] agreed with [9] that some waste generated was forced to be disposed of due to unsanitary waste or dumpsite. In addition, there are no standard methods to collect and segregate the material waste generated during construction activities. It allows contractors, particularly those from SMEs, to illegally dispose of construction waste [12]. Meanwhile, large companies spend a large amount of time and money on manually sorting unsegregated waste.

management system is dependent on how the project is managed at each phase of construction.

In Malaysia, the best endeavour from the Construction Industry Development Board (CIDB) is the establishment of the Malaysia Carbon Reduction and Environmental Sustainability Tool (MYCREST), which aims to reduce carbon emissions and environmental impact [14]. It examines 11 critical elements in a three-stage scorecard that includes the design stage, construction, and operation and maintenance stages (Figure 2) [15].

Nonetheless, how serious the government is about enforcing the law, policy, tools, and other measures will determine how much waste is successfully recycled. It is based on the previous research where most of the results highlighted the government as the driving force behind the implementation of construction waste management [7][16][12][13][17].



Fig 1

Instead of the environment, this recycling process deals with cost, quality, duration, and safety automatically [9]. Thus, [7] and [13] opine that the issue of contaminants in material waste generated during construction activities could be avoided by numerous factors (Figure 1). From the factors, it has shown that an effective construction waste recycling



Fig 2

## 2.2 Recycling Technology

Equipment used in China to produce recycled construction waste materials is imported from Western countries, significantly raising the market price of recycled materials. As a result, the higher price discourages stakeholders from using it in projects [10]. According to [18], technologies play an important role in waste recovery that is both safe and effective. It will drive improvements in waste diversion from landfills and, in some ways, a shift toward energy generation and material recycling.

Recent waste recycling issues, on the other hand, have shown that limited technological advances, and associated high capital costs have historically hampered the manufacture of commercially competitive products. Machine learning, robotics, and automation are expected to be a long-term solution to recycling waste management issues [19]. Thus, various research related to transforming material waste into several products and numerous approaches and technologies has been conducted. For instance, [20] proposed that recycled glass waste be used to make building components and thus create a market opportunity as a recyclable material.

Next, the viability of recycled inert construction waste material in the substrate mixes such as plastic waste and fillers [19][21]. [21] have come up with research to address the efficiency of marble waste for material development and it has the possibility of developing some long-lasting green composite materials. Therefore, these constructive research findings have proved that recycling construction waste is an excellent way and one of the best efforts to preserve the environment, reduce waste disposal, and be considered as a viable material in the construction industry for future applications.

However, due to several technological constraints, the researchers' recommended approach may be impossible to implement in Malaysia. If the technology approach is applied and enforced comprehensively throughout the construction process, it will represent a huge investment in waste management technologies to achieve proper waste recycling management and reduce environmental impact. Not only does technology influence the use of recycled construction waste products, but education and incentives for private investment in technology are also important factors in the success of recycled construction waste products.

## 2.3 Recycled Products Marketability

Government incentives are critical in emerging markets for the development of CW recycling and their economic strategy, which is necessary to ensure feasibility and revenue for investors [22]. However, [7] opine based on consequences turned out in China, where in terms of price, most of the recycled construction waste products are perceived as incomparable to the original products. It is turning to the large-scale technological investment in the construction waste recycling process as the reason why the market for recycled construction waste products has less opportunity for growth. Contractors are generally ready to carry out construction waste recycling, but an imperfect market is one of the barriers that prevents them from doing so [23]. It is inextricably linked to the issue of market demand and the specific quality standard of recycled products which requires supportive incentives to reduce raw material demand [24][18]. [25] viewed a few aspects such as incentive policies, tax relief and subsidies as longer-term balancing strategies in the market. [7] added that collaboration between government and private local partnerships could result in the development of a new market strategy.

Construction companies in Malaysia have started recycling construction waste to save money on disposal. It is also proven in most developing countries, where economic goals take precedence over environmental concerns [26]. As agreed by [27], the market for recycled waste is not able to minimise the waste problem and create a healthy environment for human beings, but it has opened opportunities for several entrepreneurs to gain money for themselves as well as for the country. Referring to [26], it found that the situation is contrary to what has been done in developed countries. There is a high market demand for recycled construction waste products due to the scarcity of raw materials and landfill constraints.

Thus, people are willing to use recycled and reused materials.

Currently, approximately 453 enterprises and firms in Malaysia are authorised to collect waste from construction activities [28]. Thus, a beneficial recycling system for construction waste requires widespread exposure among these groups, particularly in terms of profitable business operations. Furthermore, recycled product quality standards, innovation development, intensive promotion and public-private collaboration are viewed as forces that will increase market demand for recycled products.

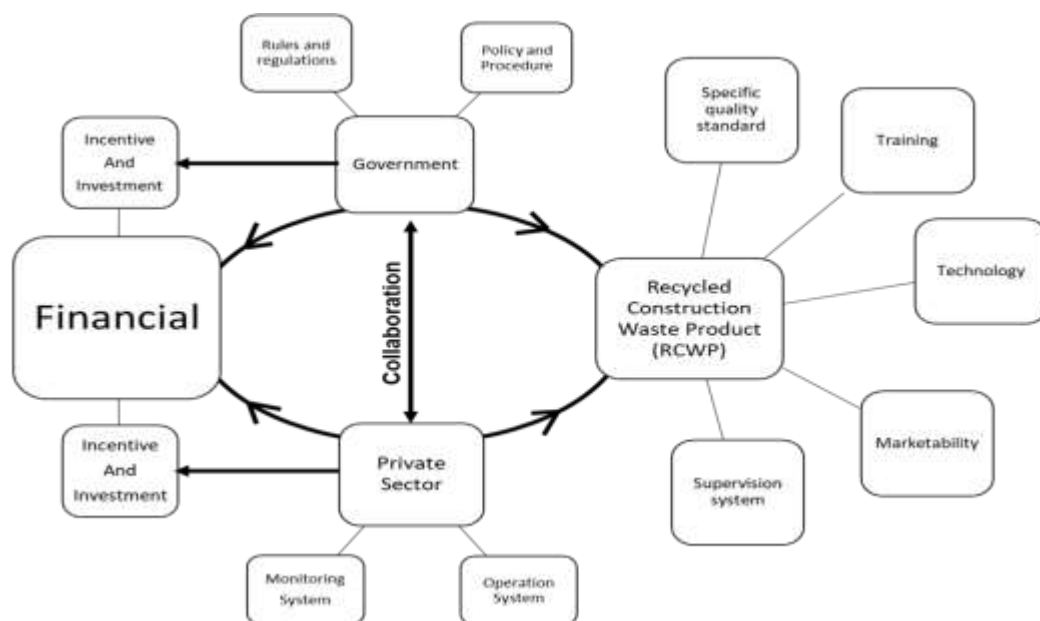
### 3 Research Methodology

This research begins with an intensive literature review of previous research. It focused on the current issues concerning construction waste recycling. Comparative studies are conducted to identify issues related to the marketability of recycled construction waste products. These studies were carried out between developed and developing countries. Through research, the disparities and similarities in viewpoints have been discovered. From the literature review, the potential market drivers and several significant aspects have been discovered. It has the potential to facilitate the marketability of recycled construction waste.

Based on the differences and similarities of viewpoints, a few aspects and market drivers must be considered in order to ensure the success of recycled construction waste products on the market. The government and the private sector are the market's drivers, and both require collaboration. It was found that financial resources, whether in the form of investments or incentives, are important in operating and monitoring the marketing process. While rules, legislation, and business policies are required to serve as guidelines for practitioners, particularly for those participating in marketing recycled products.

As in Figure 3, it has highlighted important aspects that give an opportunity for expanding recycling of construction waste products through market drivers' interventions (public and private sector). It was discovered that the marketability of recycled construction waste products must be assessed in several ways. Training, technology development, specific quality standards, marketability, and supervision systems are all aspects that require incentives and investment. As a result, financial interventions from the government and private sector are critical. In addition, continuous incentives and investment support are required for those who participate in marketing recycled products. These initiatives may have the potential to scale up construction waste recycling.

A comprehensive roadmap appears to be required for effective CW recycling management.



### 4 Conclusion

Fig 3 It must be viewed holistically, from the generation of construction waste to the conversion of waste into a

marketable product. Furthermore, due to the limitations of overviews, the presented findings are not conclusive. It is recommended to conduct a larger scale of respondents. Furthermore, more research is needed to examine recycled construction waste holistically.

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