
Environmental Study on Methods of Handling Construction Waste for Achieving Sustainability in Malaysian Construction Projects

Mohd Nasrun Mohd Nawi ^{1*}, Nur Najihah Osman ¹, Wan Nadzri Osman ¹,
Faisal Zulhumadi ¹, Salman Riazi Mehdi Riazi ²

¹ School of Technology Management and Logistics, Universiti Utara Malaysia,
06010 Sintok, Kedah, MALAYSIA

² School of Housing, Building and Planning, Universiti Sains Malaysia, 11800 USM, Pulau
Pinang, MALAYSIA

* Corresponding author: mohdnasrun@gmail.com

Abstract

All stakeholders should participate in striving towards sustainable construction in order to embark upon the environmental impact issues. Construction industry has been recognised as a major contributor of economic growth and sustainability of a country, however, it could have a negative impact for the economy, quality of environment as well as social contexts, if this industry is not managed properly. This research would like to address the issue of the increasing use of natural resources that leads to increasing construction waste. This subject is not only a major issue debated in Malaysia, but it has also become a major issue globally. It occurs due to the lack of awareness of good construction waste management practices among stakeholders. Accordingly, this research paper will discuss the issue of waste management in more detail that including stakeholders' awareness, future's impact and also the best practices of waste management in improving the sustainability of construction.

Keywords: waste management, construction industry, sustainability, environmental practice

Mohd Nawi MN, Osman NN, Osman WN, Zulhumadi F, Mehdi Riazi SR (2018) Environmental study on Methods of Handling Construction Waste for Achieving Sustainability in Malaysian Construction Projects. Ekoloji 27(106): 1041-1046.

INTRODUCTION

Construction industry is a major contributor to the economy of a country (Bakar 2015). This can be seen through the involvement of the construction industry in a variety of industries, covering various fields. Sectors in the construction industry include residential, industrial, commercial, infrastructure, and others, that involves several phases of work, namely the pre-construction, construction, and post-construction stages. According to a report issued by the Economic Planning Unit (EPU) of Statistics (Unit Perancang Ekonomi 2015), GDP for the construction sector in 2014 had increase to RM32,984 million, compared to, 2013 which was RM29,554 million. Under the 10th Malaysia Plan, the target for average annual growth rate was 3.7%, covering 2014 to 2015. This would contribute positively to the employment rate in Malaysia. Based on the 10th Malaysia Plan, the percentage of total employment in the construction sector was expected to increase to 0.3%, compared to 0.2% in the 9th Malaysia Plan. There are various stakeholders involved in the

construction industry who have different responsibilities and expertise in each lifecycle stage of construction covering the pre-construction, construction, and post-construction phases. Examples of stakeholders in the construction industry include consultants, customers, and contractors (Ahn et al. 2013).

STRATEGY FOR SUSTAINABLE DEVELOPMENT IN MALAYSIA

Sustainability in the built environment will directly drive the construction industry to achieve a positive impact on social and environmental aspects of any country (Ahn et al. 2013), especially in developing countries. Various initiatives have been taken by the government to improve practices in the preservation and conservation of the environment.

This was evident in 1999, when the Construction Industry Development Board (CIDB) Malaysia had introduced a Green Technology programme through the establishment of Technical Committee of Good

Table 1. CITP Strategic Thrust

Strategic Thrust	Description
Quality, Safety, & Professionalism	Quality, safety, and professionalism are to be ingrained in the culture of the industry.
Environmental Sustainability	Malaysia's sustainable infrastructure is to be a model for the emerging world.
Productivity	Doubling productivity will be equally matched by higher wages within the construction industry.
Internationalisation	Provide avenue for Malaysian companies to capture growth beyond the domestic market.

Environmental Practice. With the continuation of the initiative, in 2010 CIDB had established Technical Committee of Best Practices in the Construction Industry Green Technology that includes government departments, professional bodies, academia, and associations related to the construction industry. Implementation of this practice is to help CIDB in identifying, preparing, and developing the Construction Industry Standard (CIS), manuals, guidelines, technical reports, training modules, and etc., related to green technology in the construction industry.

The Ministry of Works and the Economic Planning Unit (EPU) (JKR 2015, Unit Perancang Ekonomi 2015) had initiated the framework of sustainable consumption and production based on the 11th Malaysia Plan (MP-11), which included activities to strengthen existing policies, reduce the use of natural resources, and reduce emissions, waste, and other pollution, thus improving the quality of life. The strategies taken by the Ministry of Works is to ensure that new government buildings will have green design and features using environmentally friendly construction materials based on the Green Rating Scheme, while existing buildings are to be retrofitted in stages. Benefits of these strategies are to ensure the durability of the building from threat of climate change and extreme weather.

In addition, CIDB in collaboration with the construction industry stakeholders had produced the Construction Industry Transformation Programme (CITP) 2016-2020 as a continuation of the Construction Industry Master Plan (CIMP) 2006-2015. There are four strategic thrusts in the CITP, as described in **Table 1**.

ISSUES IN CONSTRUCTION INDUSTRY

The construction industry has a significant impact on the environment, economy, and society (Alzahrani et al. 2013, Doloi 2009). According to (Nagapan et al. 2012), although the construction industry is a major stimulant to the economy, if construction activities are

Table 2. Waste generated during construction work (Parsanejad et al. 2011)

Activities at Construction Sites	Examples of Waste
Site Preparation	Soil, wood, plant
Excavation	Soil, contaminated soil
Foundation work	Wood, steel, concrete
Framing	Wood
Iron work, wiring	Iron
Plumbing Work	Iron, plastics, waste of solvents
Insulation	Iron, plastic, rubber
Drywall	Gypsum, wallboard, cardboard, boxes
External finishes	Wood, brick, masonry, vinyl, mortar
Roof finishing	Asphalt shingles, cedar shakes, tiles

not well managed, it will have a negative impact on the environment, economy and society. Through the report of the Financial and Private Sector Development, the construction industry is a major contributor to the pollution of the environment. This is based on the level of energy consumption and greenhouse gas emissions. (Li et al. 2014) stated that pollution that occurs currently is not a major challenge only in Malaysia, but also becoming a global issue. It is also linked to the issue of the construction industry, which is one of the major contributors to the problem due to the large energy consumption and pollution emissions. This issue covers the works during from the construction stage to building occupancy (Hoornweg and Bhada-Tata 2012). **Table 2** lists some examples of the wasted generated from activities at the construction site.

CONSTRUCTION WASTE MANAGEMENT

Global Review of Solid Waste Management has reported that, solid waste management at the global level is approximately 1.3 billion tons per year (World Bank 2012). This amount is expected to be increased to 2.2 billion by 2025.

Based on the Solid Waste Management Act and Public Cleansing Act 2007 (Act 672) (Undang-undang Malaysia 2007), solid waste includes:

- i. any scrap material or other unwanted surplus substance or rejected products arising from the application of any process,
- ii. any substance required to be disposed of as being broken, worn out, contaminated, or otherwise spoiled, and
- iii. any other material that according to this Act or any other written law is required by the authority to be disposed.

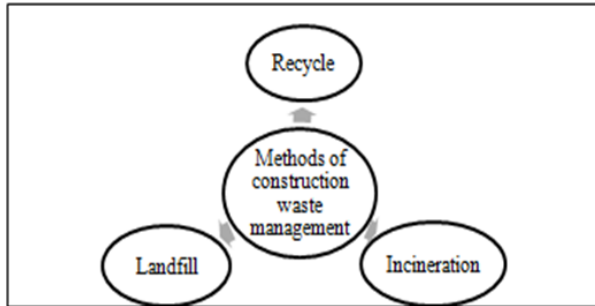


Fig. 1. Methods of Waste Management

In general, the generation of solid waste in Malaysia has been increasing (Kementerian Perumahan dan Kerajaan Tempatan 2015). Solid waste generated in Peninsular Malaysia in 2012 was 25,000 tons in a day. This fact is considerably worse when only 5% of the waste was recycled.

In the construction industry, the construction and demolition waste can be defined as waste generated from the construction industry. This waste results from construction activities, renovation of buildings, civil and building construction, clearing of construction sites, road construction, and demolition and excavation work (Kucukvar and Tatari 2013). Various methods are used in the management of construction waste, which are shown in **Fig. 1**.

Proper waste management methods are important in promoting sustainability. These methods are:

- i. recycle,
- ii. incineration, and
- iii. landfill

RECYCLE. In Malaysia, various initiatives have been taken to minimise waste. One such action was through the implementation of National Recycle Campaign. The objective of this campaign is to promote the reuse, reduction, and recycling (3Rs) of solid waste. However, according to (Musa et al. 2009), lack of recycling methods occurs to hamper this movement in Malaysia. Because of this, a proposal to introduce the 7Rs approach was presented. This method involves the entire life-cycle of a project, where 7Rs cover regulation, reducing, reusing, recycling, recovery, rethinking, and renovation. The main purpose of the 7Rs approach is to reduce the use of building materials. This is because this approach to sustainability is good practice and at the same time the waste can be used in other building projects.

INCINERATION. This method involves burning at high temperatures of about 500 to 600 degrees Celsius. Ash produced by the combustion method is 99% safe for cultivation in the existing landfills. According to (World Bank 2012), waste incineration with energy recovery can reduce the amount of waste disposed of up to 90%. Advantages through this method is that it is able to destroy pathogens that are contained in the waste which can cause disease. In addition, this method can reduce space in landfills, which is due to the drastic reduction of the volume of waste that has been burnt. This method is also the best way to eliminate hazardous organic waste (Mohd et al. 2013). In Malaysia, the method of waste incineration is seen as one viable way to overcome the problem of waste disposal. However, open burning causes negative effects, which is air pollution due to the combustion temperature (World Bank 2012).

LANDFILL. There is quite a number of solid waste disposal sites in Malaysia. However, the disposal site is not sufficient to cover the amount of waste generated by the construction industry. This issue become more serious when this method can cause high risk to the environment and people in surrounding the area (Sobian 2015).

STAKEHOLDERS AWARENESS

Although, the concept of construction waste management had been introduced for many years ago, however, stakeholders' efforts in the implementation of waste management is still lacking (Osman et al. 2015). This concept was observed without any action taken or implemented by construction industry stakeholders (Mydin et al. 2014). This opinion is further supported by (Tey et al. 2013), whereby, construction waste management in Malaysia at present is not being practised entirely. Most of the construction stakeholders in Malaysia do not apply proper waste management. In 2013, the rapid development taking place in Malaysia can give a serious impact on the quality of the environment (Kementerian Perumahan dan Kerajaan Tempatan 2015). This is because if the waste generated by the construction industry is poorly managed, it will increase the production of total waste. In Kuala Lumpur alone, nearly 400 illegal waste dump sites have been identified, where 80% of these illegal waste dump sites were detected to contain mainly construction industry waste.

Table 3. Percentage of Construction Waste Disposal Method (Kadis and Badruddin 2007)

Type of construction waste	Methods of disposing construction waste		
	Burnt at construction site	Delivered to landfill	Reuse and recycle
Brick	0	42.9	57.1
Concrete	0	46.7	53.3
Iron	0	20	80
Aggregates	0	31.3	68.8
Ceramic	7.7	76.9	15.4
Glass	7.7	84.6	7.7
Wood	0	60	40
Aluminium	0	23.1	76.9
Paper	6.7	86.7	6.7
Zinc	0	46.2	53.8
Paint cans	0	64.3	35.7
Mortar	0	60	40
Soil	0	31.3	68.8
Premix	0	40	60

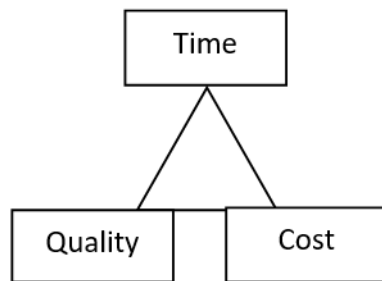


Fig. 2. Golden Triangle

WASTE MANAGEMENT AND PROJECT PERFORMANCE

The successful implementation of a construction project is an important issue to the government, users, and communities. This is because the construction industry is important in the development of a country and physical development, such as buildings, roads, and bridges, is illustrative of a country’s blooming economic growth (Ye et al. 2009). Therefore, construction projects become a major challenge to both sides, namely the contractor and client, to ensure that all projects are resounding successes (Doloi 2009). Factors such as revenue/turnover history, quality of policy, adequacy of labour and plant resources, waste disposal, size of completed project, and the company’s image and reputation will affect the success of a project (Alzahrani et al. 2013).

Basic criteria that are used in measuring the project performance include cost, time, and quality, which is known as the “golden triangle” (Fig. 2) and has been traditionally used as a criterion for the success of a project.

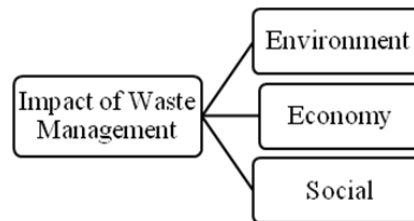


Fig. 3. Impact of Construction Waste Management (Nagapan et al. 2012)

IMPACT OF CONSTRUCTION WASTE MANAGEMENT

If construction waste is not managed properly, it will not only influence the construction process but also the environment, economy, and society (Fig. 3).

Environment

Impact of poor construction waste management to the environment will cause contamination to the environment, lack of usable land, increase in illegal waste dumping, and serious ecological damage (Nagapan et al. 2012).

Economy

Use of efficient building materials, lightweight design, and responding well on site can reduce the amount of waste at construction sites. At the same time, this can save the cost of construction. This is because, the building would have such long-term operating costs, which can be lowered. Identifying waste that may arise initially at the stage of the design process will reduce the waste generated during the construction stage (Couto and Couto 2010).

Society

According to the Integrated Environmental Health Impact Assessment System report, exposure to contaminants such as airborne nitrogen dioxide, dioxin, bioaerosols, biogas, and occupational accidents resulting from the transport of waste, landfill, mechanical, and biological treatment (MBT) and combustion will have a detrimental effect on a person’s health, such as disruption of breathing, and can even cause death (Osmanet al. 2016).

CONCLUSION

In a way forward in sustainable construction, the obstacle for the government to deal with rapid development especially in construction that continuously comes out with the issues related to the environmental condition. This study concludes that it is crucial to improve the level of construction waste management practices among industry stakeholders

especially in Malaysia in ensuring the industry continues to remain relevant. Unfortunately, developing countries including Malaysia are still suffering from a lack of awareness of the importance of good waste management practices due to the issue of monetary profit that becomes the main objective of the industry stakeholders. Therefore, increasing awareness of the construction stakeholders involved such as developers, consultants, and contractors, is seen important in order to minimise these issue. It is also

important to determine the appropriate action that can be taken by stakeholders in managing construction waste and at the same time preserving the environment.

ACKNOWLEDGEMENT

Authors of this paper acknowledge the research funding from the University's Grant (*Geran Penjanaan*), Managed by RIMC, Universiti Utara Malaysia (S/O code 13909).

REFERENCES

- Ahn YH, Pearce AR, Wang Y, Wang G (2013) Drivers and barriers of sustainable design and construction: The perception of green building experience. *International Journal of Sustainable Building Technology and Urban Development*, 4(1): 35-45.
- Alzahrani JI, Emsley MW (2013) The impact of contractors' attributes on construction project success: A post construction evaluation. *International Journal of Project Management*, 31(2): 313-322.
- Bakar AHA (2015) Industri binaan Malaysia: satu tinjauan. Retrieved from <http://www.hbp.usm.my/abuhassan/const%20industry.htm>
- Couto A, Couto JP (2010) Guidelines to Improve Construction and Demolition Waste Management in Portugal. INTECH Open Access Publisher.
- Doloi H (2009) Analysis of pre-qualification criteria in contractor selection and their impacts on project success. *Construction Management and Economics* 27: 1245-1263.
- Hoornweg D, Bhada-Tata P (2012) What a waste: a global review of solid waste management.
- JKR (2015) RMK 11: lima projek pembangunan infrastruktur jadi cabaran buat Kementerian Kerja Raya. Retrieved from <http://www.astroawani.com/berita-malaysia/rmk11-lima-projek-pembangunan-infrastruktur-jadi-cabaran-buat-kkr-60453>
- Kadis R, Badruddin M (2007) Pengurusan Sisa Binaan Dari Pelbagai Aktiviti Pembinaan. PSM thesis, Universiti Teknologi Malaysia .
- Kementerian Perumahan dan Kerajaan Tempatan (2015) Lab pengurusan sisa pepejal. Retrieved from http://jpspn.kpkt.gov.my/resources/index/user_1/Sumber_Rujukan/kajian/lab_sisa_pepejal.pdf
- Kucukvar M, Tatari O (2013) Towards a triple bottom-line sustainability assessment of the US construction industry. *The International Journal of Life Cycle Assessment*, 18(5): 958-972.
- Li Y, Yang L, He B, Zhao D (2014) Green building in China: Needs great promotion. *Sustainable Cities and Society*, 11: 1-6.
- Ministry of International Trade and Industry (2015) Pembinaan dan perkhidmatan berkaitan kejuruteraan. Retrieved from <http://myservices.miti.gov.my/ms/web/guest/construction-and-related-engineering>
- Mohd F, Salleh A, Mahmood S, Hajar S, Sarip M, Ubaidah T (2013) *Jurnal Teknologi Green Technology Management in the Muslim World*, 1: 107-115.
- Musa SMS, Shafii H, Zubir SNSM (2009) Potensi kitar semula dalam industri pembinaan: kajian kes daerah Batu Pahat, Johor. He 3rd Malaysian Technical Universities Conference on Engineering and Technology (MUCEET2009), 20-22 June 2009, Kuantan, Pahang: 553-559.
- Mydin MO, Khor JC, Sani NM (2014) Approaches to Construction Waste Management in Malaysia. In MATEC Web of Conferences (Vol. 17, p. 01014). EDP Sciences.
- Nagapan S, Abdul Rahman I, Ade Asmi AA (2012) Construction waste management: Malaysian perspective. *The International Conference on Civil and Environmental Engineering Sustainability IConCEES 2012*, 2.
- Osman NN, Nawawi MNM, Osman WN (2016) The effectiveness of construction waste management and its relationship with project performance, *Proceedings of the International Conference on Applied Science and Technology 2016 (ICAST'16)*, AIP Conf. Proc. 1761, 020084-1-020084-6.
- Osman WN, Nawawi MNM, Yaakob M, Radzuan K, Osman NN (2015) Critical success factors for the implementation of environmental management practices: a study on the Malaysian construction stakeholders. *International Academic Research Journal of Business and Technology*, 1(2): 175-180.

- Parsanejad MR, Momeni M, Mohaghar A (2011) Impact of sources on waste production in activities across supply chain: A new approach, 9(1): 20–28.
- Sobian A (2015) Pengurusan sisa pepejal di Malaysia dan masalahnya. Retrieved from <http://www.ikim.gov.my/index.php/en/artikel/7193-pengurusan-sisa-pepejal-di-malaysia-dan-masalahnya>
- Tey JS, Goh KC, Kek SL, Goh HH (2013) Current practice of waste management system in Malaysia: towards sustainable waste management
- Undang-undang Malaysia (2007) Akta Pengurusan SisaPepejal Dan Pembersihan Awam.
- Unit Perancang Ekonomi (2015) Rancangan Malaysia kesepuluh 2011-2015. Retrieved from http://www.pmo.gov.my/dokumenattached/RMK/RMK10_Mds.pdf
- World Bank (2012) A global review of solid waste management. Retrieved from http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf
- Ye J, Hassan TM, Carter CD, Kemp L (2009) Stakeholders requirements analysis for a demand-driven construction industry. Retrieved from <http://www.itcon.org>