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Appraisal of Waste Minimization and Management in the Context of Malaysian Construction Industry

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Abstract

These days, the building and construction industry is a main provider to the source of national economy in most countries. Though, incorrect construction waste management lead to numerous difficulties such as prohibited dumping along the roadsides, demolition waste and disposal of construction at landfills as Malaysia is facing severe deficiency of landfill space and lately the matter has developed more serious through the country, which these have caused major government sources and environmental problem. Sustainable waste management aids construction key players to diminish and making better use of material on their construction project. The waste minimization strategy is not only implemented during the construction stage, but it record and estimates the use materials through whole project delivery process. This paper will discuss and elaborate on waste minimization and management in the context of Malaysian construction sector. Waste minimization plan is necessary to reduce present and future risks to human health and the environment which presents guidelines that can be used by professional personnel and organizations to decrease the amount and perniciousness of wastes generated.

Keywords: waste management, waste minimization, construction industry, project delivery.

1. Introduction

It should be pointed out that the construction industry is a major contributor to the source of national economy in most countries all over the world. However, inappropriate construction waste management lead to various problems such as illegal dumping along the roadsides, demolition waste and disposal of construction at landfills that Malaysia is facing serious shortage of landfill space and recently the issue has become more serious throughout the country, which these have caused major government sources and environmental issue (CIDB, 2015). Waste minimization plan is an effective and efficient method to assists clients, developers, designers, practitioners, contractors, sub-contractors and competent authorities achieve zero waste on construction projects. The collaboration of waste minimization and management practitioners involved with appropriate skill or method used that it is necessary required to achieve the sustainable waste management (Tey et al., 2013).

Waste minimization is necessary implemented by all developed countries. During construction and remodeling, the recoverable waste materials generated could be converted to recycled contents (Ismam, Ismail, 2014). The waste issue and problem had to be managing through various solutions. For example, the local companies can choose using technology such as

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incinerators, composting, sanitary landfill and etc. or using management method (Waste Minimization Plan) depending on their own requirements. The proposed waste minimization plan is determined through which it can function properly on the projects and the identification of the sources of construction waste is important to solve the current problem. Researchers found that eight waste sources were deemed to be sufficiently significant. These were waiting due to staff interference; insufficient equipment, and setup of equipment; waiting for instruction and inspection; rework due to design efficient; waiting due to stock problem and material supply delay (Nagapan, et al, 2012). The related information will help to carry out waste minimization and management practice successfully.

Sustainable waste management helps construction key players to reduce and making better use of material on their construction project. The waste minimization strategy is not only implemented during the construction stage, but it record and estimates the use materials through whole project delivery process (Mahayuddin, Wan Zaharuddin, 2013), in order to decrease the amount of waste requiring disposal at landfill and as a consequence, fully mitigate the interrelated cost, strengthen competitive advantage and environmental benefits. The implementation of waste minimizing plan method is an opportunity to increase profit of construction company through identification of valuable waste and invaluable waste to gain profit (Augustine, 2011). Businesses can create value through the return of construction wastes back to recycling and manufacturing processes into new products.

1.1 Waste Minimization Plan

Waste minimization plan is necessary to reduce present and future risks to human health and the environment which presents guidelines that can be used by professional personnel and organizations to decrease the amount and perniciousness of wastes generated. They defined that every members of the community to be conscious of the environment and financial impacts related to the disposal of construction wastes and materials and also to help minimize the waste generated quantity.

1.2 Construction Waste

Construction waste is defined as wastes generated by the construction, refitting, and repairing of individual residences, commercial buildings, infrastructural, facility and other structures. They point out that the building material can be divided into four categories during construction process which are material used, surplus, use again and material wasted (Johari et al., 2014). However, surplus material can also be considered as construction waste because contractors always think that the selling and storage of these materials are not required due to less profit. In the construction industry, the waste is not only concentrated on the building material but also focus on several activities such as storage, time and etc. For example, the waste also can be defined as any losses produced by activities that generate direct or indirect costs but do not add any value to the product from the point of view of the client (Mallak et al., 2014). As research indicates, various activities during construction process that can produce direct or indirect cost in these activities are required human resources, need more time, more facility or equipment but do not generate interest to the product.

However, the waste can also be the investment opportunity for the construction industry through proper management. McDonald and Smithers (1998) suggest that the local contractors should reassess the value of construction waste as a new source of profit which the waste should be control and manage with appropriate ways such as recycled, reused or disposed. This is because the construction waste may turn into resource through process of add-value to the waste which it creates use-value for another project.

Management is defined as cooperate with team members or other people to complete the mission and vision of a project within organization. The “management” concept can be adopted and employed in the construction industry which explained as the necessity of construction waste management. It is necessary required to plan and monitor the process work on site with participation of construction professional whether government or private in order to minimize the waste generation and stabilization of building material used (Saadi, Ismail, 2015).

Through the above viewpoints, any substances is abandoned due to they cannot increase the quality of the product and add the value to the project which can be classified as construction waste. Poor waste management may cause the negative impact on our environment.

2. Types of construction waste

In construction industry, the construction waste can be divided into two types which are material waste and time waste

2.1 Material waste

Waste in material can be defined as any physical material that required to be shipped somewhere else from the construction site or operate within the construction site. The material waste is defined when the material is damage, broken, over ordering or not compliance the requirement and specification during the construction process, and departing from the intended specific objective of the project. The cost saving of building material transported somewhere else is deducted due to the difference in between the price of materials transferred and established on construction site, these building material is used as specified and exactly measured in the process which may indirectly increase cost or extension of time by the material wastage.

2.2 Time waste

Time of construction process measured by value adding activity due to the duration of construction projects which consists of various tasks such as redesign, reconstruct, inspection work, transportation time, waiting time. The research explained any activity that exchanges materials and information that is required by the client which it is always defined as value adding activity. When the company activity that takes cost, human resources, equipment and time but does not add value to the product, it is known as time waste or non-value adding activity. Non value adding activity can be divided into contributory activities and unproductive activities such as redesign, work carried out using the wrong equipment or the wrong procedures, correct mistakes and so on.

Contributory activities are work elements that do not directly add to product but are generally required and sometimes essential in implementing an operation. However, unproductive activities are those that are not required such as being unwanted or doing something that is unrelated to the process being carried out or that is in no way necessary to carry out the operation

3. Classification of Waste

As been mentioned by As Memon (2013), there are six types of construction waste material have been produced in 30 construction site which are concrete (12.32 %), metals (9.62 %), bricks (6.54 %), plastics (0.43 %), woods (69.10 %) and others waste. These waste materials are disposed to landfill or few of them are sent to recycling which indirectly increase the construction cost of contractors. Construction wastes on site can be divided into two categories which are direct waste and indirect waste. The indirect waste is more related to cost increased and time delay. When the building material is damaged, broken or cannot be used, it can be defined as direct/physical waste. There are focused on five primary physical waste on the sites which are concrete waste, timber waste, packaging waste, steel waste and brick waste.

In New Zealand, a standard set of categories is prepared by Waste Analysis Protocol which the process of breakdown of different material waste can be carried out easily. Recently, the government is started to focus on how to reduce the quantity of construction waste on site such as encourages the usage of Industrialized Building System (Memon, 2013). Malaysia still do not have strong enough enforcement policy, standard and guidelines to effectively deal with the classification of construction waste.

4. Construction Waste Generation

There are several factors for the generation of the physical and nan-physical waste in the construction project (Taha, 2015). They have identified that most of the causes contributed to the wastes are due to mechanical problem and human resources during the life cycle of construction activities. Many researchers made the same points of view with above. For example, In Hong Kong,

the reasons of construction waste on site can be divided into two parts which are delivery of materials and onsite management (Poon et al., 2001).

Construction site waste always created during design, operational, procurement and material handling problems to influence the effectiveness of project. Besides that, the causes of waste as design, procurement, handling of materials, operational, residual waste and others. They have observed that it occurs a lot of extravagant activities within the construction process, especially during design and procurement, due to lack of systematic of waste management plan.

Taha (2015) identify that “Design” is related error in drawing and specification, “Procurement” includes incorrect detail information and unclear procurement process, “Material handling” and “Operational” are always related to human error and lack of awareness such as incomplete record and careless attitude of workers.

Mallak et al. (2014) emphasis same opinion which different construction stages; design, procurement, materials handling, construction and demolition that contributes to the site wastes. However, project manager cannot really determined the reasons of waste due to the construction process and its activities varies according to the that projects that differ in size, amount, degree, or nature from something else of the same general class based on the client’s requirement and financial capability.

5. Waste Management Hierarchy

In 1997, The European Commission’s Program is proposed concept that using the options of waste management hierarchy which is the integration of sustainable and integrated waste management in order to take advantage of management’s principle. The construction waste should be carefully processing through various steps rather than take discarded or cremation.

According to Taha (2015), the construction waste should be treated through six stages, which are reduce, reuse, recycle, compost, incinerate and landfill, the hierarchy is take aim to help reduce the impact on environment. So, these components are arranged from least beneficial to most beneficial action to the surrounding. Figure 1 shows the hierarchy which is introduced by Peng et.al. However, Ismam, Ismail (2014) defines an effective waste management should include avoid, reuse, recycle, waste to energy and dispose of waste. as shown in Figure 2. He believes that “avoid” should be adopted within the management plan in order to strengthen the process of waste minimization, through avoiding all unnecessary waste and the quantities should be reduced during construction project.

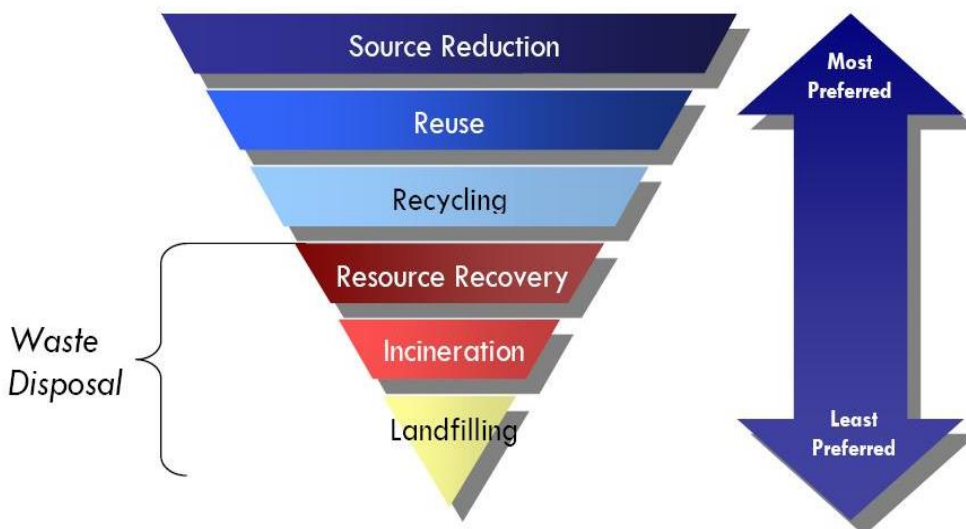


Fig. 1. Solid waste management hierarchy (Ismam, Ismail, 2014)



Fig. 2. Waste management hierarchy (Taha, 2015)

Utilization of 3R concept; reuse, recycle and reduction and these component can effectively minimized construction waste which was created onsite. It required the cooperation of all parties during design and construction stages. Thus, the components of different hierarchy may be different, but the 3R concept is necessary. However, Malaysia is still ineffective in the implementing of the construction waste management hierarchy which led to land disposal site.

6. Waste Management in Construction Industry in Malaysia

The construction industry in Malaysia continues to grow to achieve approximately 10.3 % in 2015 compared to 11.8 % in 2014. It grew 18.1 % in 2012 and 10.6 % in 2013; the number of project has achieved double-digit growth for three consecutive years. The Department of Statistics Malaysia reported the contribution of the construction industry to the GDP has increased dramatically as shown in Figure 3. From Figure 3, GDP from construction industry in Malaysia increased to 13398 MYR Million in the first quarter of 2017 from 12582 MYR Million in the fourth quarter of 2016. GDP From Construction in Malaysia averaged 9808.72 MYR Million from 2010 until 2017, reaching an all-time high of 13398 MYR Million in the first quarter of 2017 and a record low of 6464 MYR Million in the first quarter of 2010.



Fig. 3. The Contribution of the Construction Industry to the GDP

However, rapid development in local construction industry lead to higher generation to construction waste which end up in the landfill that it may occurs land shortage in Malaysia. The problems occurred increasingly was illegal disposal waste and illegal dumping site. So, the

government has proposed several related policy to address waste issues in order to improve the condition of environment, economic and social (Tey et al., 2013).

There are few regulations and policy for managing waste generation in Malaysia, which most of them focuses on solid waste. For example, there are four consortiums responsible for processing waste management which are Urban Solid Waste Management, Funded Public information campaigns, Action Plan for a Beautiful and Clean Malaysia and Recycling campaigns. According to the Solid Waste and Public Cleansing Management Act 2007 (Act 672), which is the federal agency; Solid Waste Management and Public Cleansing Corporation will cooperate with others department. They have the power to control and manage the solid waste and public cleansing from the Local Authorities throughout Peninsular Malaysia and the Federal Territories of Kuala Lumpur, Putrajaya and Labuan. However, Construction Industry Development Board (CIDB) is concerned on the impact of construction waste management on the environment pollution, it is responsible to execute the Pembinaan Malaysia Act 1994 (Tey et al., 2013). The Construction Industry Master Plan also introduced by CIDB to local construction industries in order to increase the awareness of contractors of environmental protection through effective waste management.

The Ministry of work is liable to govern and administer the Standard Specification for Building Works (SBW) that is applied into all construction projects. The SBW produced a standard to local contractors consist of guidelines on the materials, equipments, transport, lighting and others necessary items from the construction to the completion.

Today, the government is actively promoting the utilization of effective waste management such as the introduction of the 3R concept- reduce, reuse and recycle to sort and collect the solid waste (Tey et al. 2013). They also recommended the use of new technology, Industrialized Building Construction (IBS) to replace the traditional construction method in order to minimize the waste of construction project (Begum et al., 2006).

7. Waste Minimization Strategy

3R Program as the suitable and economical option that understands the concept of “cause and effect relationship”. It is three essential waste minimization strategies which are reduce, recycle and reuse. However, the waste reduction is the most desired plan by many countries due to its efficient and effective solution that decrease most problems related to waste generated. Based on Taha (2015), it is possible to manage 90 % of the construction and demolition waste with using recycles. Nowadays, 3R Programs always considered as the best waste minimization strategies due to its effectiveness in developing countries in the aspect of environment. For example, an advantage of 2.5 % of total construction cost is produced by reuse and recycled activity.

Just-in-time strategy is one of the reduction options that transport and manage storage levels to apart from over ordering. It required controlling the design to avoid wrong specification in order to enhance off site prefabrication quality through offer supplier agility in bring about reduction quantity of materials (Dainty, Brooke, 2004). This strategy is included how to manage the supply chain and material controlling practices, it is one of the most attractive planning methods. Also, workers training and developing waste awareness among professional can be calculated.

Global Positioning System and Geographical Information System technology can orbit the flow of building material to the construction site, and these is considered as bar code system applications. Based on the quantity of materials onsite needed, the application can measure the performance of the workers. As they indicated, the Global Positioning System and Geographical Information System technology can operate combine with bar code system to quantify the materials used and get the latest information about its delivery time. There are six waste minimization strategies which are recycle, reuse, avoid, compost, burn and dispose at landfills. They are more focuses on the three types for reduction of construction and demolition waste which are avoiding waste; re-using materials; and recycling waste. This is because avoiding waste refers to any fulfilling that avoids or decrease amount waste at source.

The re-using and recycling of waste materials, and thus, minimizing the volume of waste needed to be disposed to the landfills considered as re-using and recycling waste due to composting construction and demolition waste requires widespread use of land. Many type of construction and demolition waste are not combustible, composting waste also cause to the emission of toxic gases. In Malaysia, the land supply is too hard to found, thus it is not feasible in Malaysia, so compositing

waste would cause the emission of toxic gases and many type of construction and demolition waste are not combustible.

8. Waste Minimisation Technique

Waste minimisation techniques are plays an important role in decreasing the quantity of hazardous waste generated at the construction industry. The waste generators are encouraged to actively look into waste minimisation techniques and include these techniques as an essential component of the education and investigation procedures, as shown in [Figure 4](#).

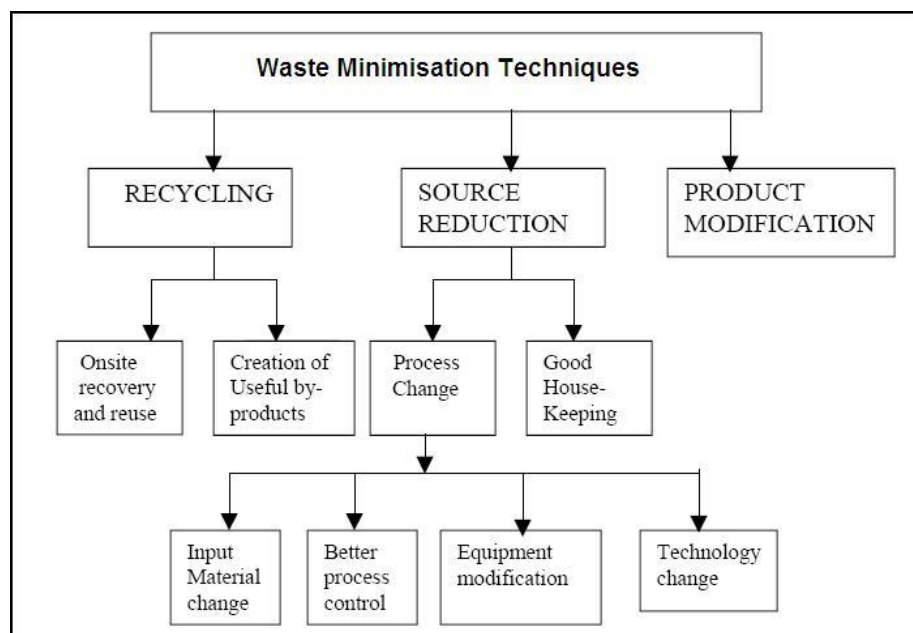


Fig. 4. Waste minimisation techniques

9. Waste Management Plan

9.1. Issues Addressed by Waste Management System

According to Ismam, Ismail (2014), there are various issues should be addressed during the development of the initial stages of the waste management plan. This is because they have many options for waste minimization or reduction such as salvaging, land filling and waste technology, so it is very important to resolve the options of alternatives for waste minimization. External issues to addressed different factors such as worker cost to gather and process the building waste material, delivery cost, tool and equipment cost and waste disposal cost, all of these must be analysed during planning the management.

9.2. Educating Labour about Waste Management System

When investigating the waste management resources, educated human resources involved in the construction process is very important. This is because the worker must be able to analysis which type of materials can be reuse or recycled, which technique of gathering are used on a project for onsite or off site. The field labours need be actively taking part for nearly any kind of waste management plan to be achieve the outcome, so the education and knowledge about construction and demolition wastes and others alternatives to manage and disposal waste is necessary. For example, the strategy plan allows the workers on site necessary to view the types and amount of building waste being thrown away

9.3. Waste Management Plan Overview

Waste management plan is obtained to protecting the social, environment and economics. Construction waste always arise various conflict due to the environmental problems which are troublesome to quantify, while problems of the economic can be measured with mathematic and several decimal places. Construction industry develop waste management plan for these aspects and

reasons, but the plan in all probability, it will be operate by economics. A closed loop system always consider within the waste management process which there are various flexible inputs. These input need analysis with accurate information due to these input that need be to periodically updated.

10. Conclusion

The construction industry has its trends and developments that required to be systematized for the purpose of environment and bonanza. Therefore, materials waste management is an essential part of construction project, which contribute a primary portion of time and cost related activities. The functions of material waste management plan need to be determined in more detail and particular. The management plan will comprehend how the system operates in construction projects due to it is increase the value to company. It will also be advantageous to relate materials management system to supply chain management and waste management systems. It is probable to state the following provision in general as major functions of materials management.

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