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Preliminary Study on Construction Waste Management in Malaysia: A Qualitative Approach

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Abstract
Throughout the years, the construction industry had made an important contribution in the lives of the society in Malaysia. Moreover, the Ninth Malaysia Plan RMK9 (2006-2010) had also played a significant role in the demands of executing major residential housing project developments where it has been observed that the construction wastes was one of the priority waste streams. Due to the increasing number of population that is actively involved in economic activities and the modernisation of the country, the types of construction wastes that are being produced are becoming more complex and identifying the sources is complicated. Therefore, appropriate action needs to be taken with respect to its effective management in handling the situation. The aim of this preliminary study is to investigate the existing process of the construction waste management currently practised in Malaysia. The interview method was chosen to obtain data from ten contractors and the data were processed using the NVivo 9 software before being analysed. Throughout this study, useful information and better understanding of the existing process of construction waste management were identified. The detailed description of the existing process of the construction waste management was achieved to assist in improving the quality and awareness of the construction waste management practiced.

Keywords
Construction Industry, Construction Waste Management

1. Introduction

The construction industry plays a significant role in helping the nation to achieve sustainable development. Moreover, in achieving the quality of a better life among residents, the Ninth Malaysia Plan (RMK9) had concentrated in executing sufficient major residential housing project developments. Based on the RMK9 (2006-2010), the demand of the residential housing project development was approximately around 709,400 units with the highest proportion in Selangor (19.2%), followed by in Johor (12.9%), Sarawak (9.4%) and Perak (28.2%) (EPU, 2010). This RMK9 target on the residential housing project was less than the completed residential housing project in the RMK8 (2001-2005) which was 844,043 units. Although, the demand of the residential housing project development in the RMK9 decreased, the achievement of the development did increase in the RMK8 (2001-2005) whereby, the target was 615,000 units but 844,043 units were developed (EPU, 2010).

With the demand in the implementation of the residential housing development, this shows that the construction sector is being expanded and developed. Due to the factors of the construction stage, type of construction work and practices on site, the construction sector would produce types of waste (Begum, 2007). The highest quantity of waste generated is from waste material or construction waste material. Based on the Solid Waste and Public Cleaning Management Act 2007 (Act 672), construction solid waste is "any type of solid waste that is produced from any construction activities or demolition or including accomplishment, arrangement, renovation or modification". Therefore, in order to construct the housing residential development, this construction waste generated will have an impact on the environment. The effect on the environment include an unbalanced ecology, change of living environment, potential sewage, depletion of natural sources, energy consumption and generation wastes (Yip, 2000). After some decades of an extensive "use and throw away" philosophy, it has now been recognised that this uninhibited use of natural resources and resultant pollution levels are unsustainable (Chong et al., 2001). Therefore, it is essential to raise the awareness and revise the previous common practices within the construction industry.

The generation of construction waste from the construction activities will continuously give a negative impact to the environment. From a survey done in Hong Kong, it was discovered that the housing project had generated the highest wastage level compared to the other types of projects. The reason may be due to the fact that the private projects are normally of non-standardised building structures which include the different sizes and shapes of building components such as formwork, reinforcement and brickwork (Shen et al., 2000). In addition, the generation of waste will produce a negative impact on the environment, public image, and resources, raise time and cost for the building process and disposal of landfills site (Shen et al., 2000). Normally the conventional method is practised when the extra waste material and construction wastes are finally disposed of in the landfill (Symonds, 1999).Currently in Malaysia, the common practice of the construction waste is to dump it at illegal dumping sites but there are no statistics available for the quantities of the solid waste dumped recorded (MHLG, 2005). Based on this situation, it shows that Malaysia still implements an improper method in managing the construction waste and there is a lack of a controlling system for construction waste. Most of the landfills are not properly managed and there are also no regulations that control the collection together with the provision that requires a certain percentage of the waste collected to be diverted from landfills for reuse, recovery and

recycling of recyclable material. Thus, all of the construction waste will be collected and directly disposed of in landfills without the separation and recovery process (MHLG, 2005). Due to the current situation and the effects of the construction waste generated to the environment, the description of the current existing process or framework needs to be early redefined in order to define the gaps that occur. Therefore, the systematic framework approaches can suit the current existing process of construction waste management.

The objective of this paper is to investigate the existing process for construction waste management which is currently put into practice in Malaysia. While the current belief is that there is no clear picture shown on the current existing process for the construction waste management, the research posits that there are several methods that had been practiced in managing waste at the construction site. To operationalise the research, a qualitative research approach through a semi structured interview is adopted.

2. Research Methodology

The methodology used is based on the qualitative research technique. Qualitative methods provide more details for exploring viewpoints, allow the researchers to gain a better initial understanding of the problem and identify attitudes, phenomenon and influences (Denan, 2008; Maxwell, 1996; Healy and Perry, 2000). The initial method of data collection is by the means of a semi-structured interview of ten respective contractors involved in the construction industry. The face-to-face interview is designed to gain a common situation of the existing process in managing construction waste. The interviews were recorded and transcribed verbatim for content analysis. In this research content analysis was useful in revealing the significant differences of the information from the main contractors. This research is a preliminary study for the qualitative research approach to explore the little areas before conducting the detailed investigation (Kumar, 2005). This type of research is focused on the four districts in the Klang Valley area in Selangor which consist of Klang, Gombak, Hulu Selangor and Petaling Jaya. The representative sample consists of class A contractors. An encouraging response from the 10 respondents in this research study is achieved over a period of two months of data collection.

Table 1 shows some details of the respondent's experience with the position level. Based on the designation, professional background and work experiences of the respondents, it is reasonable to infer that the majority of the respondents have a sound knowledge of the activities associated with construction waste management in the Selangor area of the Klang Valley.

Table 1: Profile of Respondents and Their Experiences

	Sample	**Experience in the Construction Industry (Years)**
No. of Company	**Types of Respondent**	**No of Years**
A	Senior Site Supervisor	3
B	Safety & Health Supervisor	5
C	Project Manager	4
D	Assistant Project Manager	12
E	Project Manager	15
F	Assistant Project Manager	7
G	Assistant Project Engineer	10
H	Project Manager	4
I	QA/QC Engineer	4

3. Key Research Findings

A combination of the literature review and analysis of the results are used to derive at the findings. The texts were systematically categorised into different themes, and a number of occurrences of quotes were counted for each individual question. The detailed interview brought together all the contractors who had an experience in this construction field. Table 2 presents the categories, codes and frequency of the references of the coded text in the interviews.

Table 2: Interview Areas, Descriptive Codes and Source of Reference Data

Area of Discussion	Descriptive Codes	Frequency of Coded Text
Types of Process	Segregation	10
	Combination	7
Methods of Handling	Disposed	10
	Burnt (On Site)	2
	Bury (On Site)	1
Types of Place Disposed	Unknown	2
	Landfill	3
	Private Land	7
Types of Recovery Practiced	Reuse (On Site)	10
	Recycle (Out Site)	9

3.1. Types of Waste Process

Table 3 presents the different types of process for construction waste. All the 10 respondents admitted that they had used the segregation process, while 70% (7 out of 10) of the respondents asserted that they preferred to utilise the combination process in order to collect waste at the construction site. The results supported the opinions of Poon et.al (2001), Chen et.al (2005) and Couto (2002) that regarded that most of the main contractors had cleared wastes like timber, metal, packages, aggregates and granular materials manually by collecting and then separating them into certain portions before reusing or recycling them. Meanwhile, the study done by the Lau et al. (2008) claims that not all of the waste collected could be measured and quantified directly at the site as they were mixed together. In addition, Couto (2002) stated that wastes that were segregated needed to be stored in the containers or bins and labeled before being transported and disposed of.

According to Table 3, there were several opinions from the interviews. Based on the interviews, companies D, E, F, I and J stated that most of the wastes were generated during the structure and architecture phases. These wastes could be reused or recycled and placed at specific places before being disposed of from the construction site if early segregation was done. Most of the wastes were usually separated manually at the site by hand, excavator and bulldozer and they included wood, steel, bricks and tiles. Normally, bins were not used to store the waste; instead their own lorry or private transportations were used in collecting these wastes because the contractors wanted to minimise cost for bin fees which have become higher than before.

Table 3: Types of Waste Process (Segregation)

Company	Types of Waste Process (Segregation)
Company D	- *"Normally, we collect and place at one area in front of every unit house, block by block. We will gather them together based on different types of wastes such as timber waste will be gathered with timber waste, after collecting them at certain places, then we will dispose them out from site using private transporter".*
Company E	- *"Normally, we will clean up and collect waste that had been separated such as steel, timber formwork, bricks and locate them at one area before disposing out from site".* - *"The waste will be separated first and then we will define either to reuse, recycle or dispose.. Commonly, we will minimize not to dispose waste out from landfills".*
Company F	- *"Besides, in here all wastes will be segregated firstly, before disposed such as steel or reinforcement, timber, tiling or mosaic and after the quantity of waste are more than usual therefore we will ask the private transporter to dispose it. Usually, the transporter will charge us, for one trip we need to pay about RM30 to RM40".*
Company I	- *"For wood and steel waste we just prepare an area to collect and keep it because of the limited space in construction site. Here, steel and wood waste will be segregated first before disposed".*
Company J	- *"Commonly, waste will be segregated first. Wastes are such as wood, bricks, steel and after collect it, we will decide if the waste can or can't be used again".* - *"But the waste that can't be used will be collected, segregated and disposed out from this site using our own lorry. Such as wood will be processed into manufacturer bricks, broken bricks will be used as road excess. We will control the trip for transportation; in here there are not more 10 trips that transported waste from this site.*

Table 4 presents the opinions of respondents in terms of the combination process which is one of the existing processes after the wastes had been collected from the construction site. Companies A, B, E and H admitted that commonly, most of the small pieces of wastes like broken bricks, wood, plastic and other materials had been mixed together with the other wastes before being disposed, burnt or buried. However, in company D the mixed waste filled up the space at the construction sites as road access.

Table 4: Types of Waste Process (Combination)

Company	Types of Waste Process (Combination)

Company A	- *"When the waste had been combined together, we need to excavate and fill with original soil and compact it. Another waste is concrete; we will crush and make it as road access".*
Company B	- *"They are two ways to dispose waste. Firstly, we can appoint someone or private transporter that had roro, they will provide large roro bins which are used to dispose waste. Wastes will be collected and transported by using the bins provided. Common wastes like timber usually we will mix them together with a small size of other wastes like broken bricks, harden concrete and etc".*
Company E	- *"Wastes that are disposed out from site, majority contain small pieces of waste. All wastes will be gathered and collected together to burn it in our site. Now, timber has higher demand because people outside will come to our site and take it to their manufacturer and process it. Normally, they always recycle back waste. Such at Rawang there are manufacturers that recycle waste. It's same like steel, they also recycle steel to produce new product".*
Company H	- *"In this site, all the waste is mixed together and we don't segregate it on site".*

3.2. Methods of Handling Waste

According to the Begum et al. (2009), majority of (65%) the contractors in the Selangor area reported that they had disposed mixed wastes and wastes that could not be reused or recycled at landfills, while 9% of the contractors disposed wastes at illegal dumpsites. Based on the survey done by the Lau et al. (2008) in Sarawak, it is shown that 50% of the construction wastes did not leave the site, and they were either used for open burning, land filled on private land, dumped illegally in rural areas, prepared for site works or left on site.

Table 5 presents the methods of handling wastes including dispose, burn and bury. 10 of the respondents responded that after the method of collection had been made, most of the mixed wastes generated would be disposed through private transportation. While, 20% (2 out of 10) of the contractors had defined that they did open burning at construction sites. Based on the interviews, the contractors burnt only small pieces of wastes like wood. In addition, 10% (1 out of 10) of the respondents had buried wastes in a specific place at the construction site.

Table 5: Methods of Handling Wastes including Disposed, Burnt and Buried

Company	**Methods of Handling Wastes (Disposed, Burnt and Buried)**
Company C	- *"For cement bags, once we open and use, we will directly use until finish all the content of the cement and if the cement had harden, therefore we can't use it anymore. Such as timber, reinforcement, bricks will be separated first, after collecting all of the wastes it will be disposed using bins or lorry under private transporter that we hired on our own. And before hiring them, we will ensure that they dispose wastes in the legal dumpsite".*

Company A	- *"For major wastes such as timber, we had burned it such as small pieces of timber. This is not open burning. Besides, we also will bury waste on site at one specific area that had the permit from the client".*
Company E	- *"Actually, the private transporter will collect only for steel waste and the other wastes will be disposed out at the private owned space area or burnt on site".*
Company C	- *"For major wastes such as timber, we had burned it such as small pieces of timber. This is not open burning. Besides, we also will bury wastes on site at one specific area that had the permit from the client".*

3.3. Types of Places for Waste Disposal

Table 6 presents the different types of disposal in managing wastes among contractor group A which consist of legal landfill, private land and unknown places. 70% (7 out of 10) of the respondents agreed that one of the disposal places that had been chosen was Private Land, followed by the 30% (3 out of 10) who disposed waste at legal landfills. While, 20% (2 out of 10) of the respondents didn't know the specific place that they usually disposed their wastes. However, these findings contradicted with those of the study done by Begum et al. (2009) in the Klang Valley among the contractors of groups A, B and C (G1 until G7), which showed that 65% of the contractors reported that they disposed waste at landfills, while 9% disposed of their waste at illegal dumpsites, nearby construction sites and other locations.

Meanwhile, the findings in the survey done by Nittvattananon and Borongan (2007) which referred to the scenario in Asia of the current practices focused in Hong Kong supported the argument of the findings above of this study in which 21% of the wastes were disposed at landfills while the other 79% were disposed at public filling areas.

Table 6: Types of Places for Waste Disposal

Company	**Types of Places Waste Disposed (Legal Landfill, Private Land and Unknown Place)**
Company I	- *"For wood and steel waste we just prepare an area to collect and keep it because of the limited space in construction site. Here, steel and wood waste will be segregated first before disposed. For bricks we use for road excess, and if the quantity become more, then we will dispose out at landfills that are under local authority".*
Company E	- *"All wastes are valuable. Such as soil, after excavate it, people will ask us to fill up the soil at their space area. They volunteer to take it. Actually, the private transporter will collect only for steel waste and the others wastes will be disposed out at private owned space area or burnt on the site".*
Company A	- *"We just think about profit, we don't care either the transporter want to dispose waste in the illegal or legal dumpsite. The parties that give permit need to ensure that the transporter will dispose waste in proper way with monitoring it in perfect way. The local*

	authorities maybe know about the illegal dumpsite but they don't care about it".

Due to these opinions, it is shown that most of the wastes are disposed at legal landfills and private lands that are registered by the local authorities. The contractors usually appointed private transporters that had licensed from the local authorities. However, there were also a few contractors who were not concerned and know of the places that the private transporters chose to dispose their wastes.

3.4. Types of Recovery Practised

According to Begum et al. (2006) in the Klang Valley area, it is shown that commonly 73% of waste materials at project sites were reused and recycled. The reused and recycled were practised and had been promoted in order to protect the environment and reduce wastes (Begum et al., 2008). Table 7 presents the types of recovery that had been practised during the construction activities based on ten respondents. They admitted that they usually reused wastes at the construction site. These results were supported by the statement of Laquatra and Pierce (2004), in which most of the wastes like wood would be used in composite wood products,mulsching on site and collection for others uses. While, usually contractors liked to reuse materials like wood within the project as many times as possible to avoid the cost of collection and disposal (Kofoworola and Gheewala, 2009).

The results show that, 70% (7 out of 10) of the respondents agreed that most of the wastes that were collected by the private transporters normally would be recycled at the manufacturing sites to produce raw products or materials. These results were supported by the statement of Wilson (1997), in which there were wastes that were suitable for recycling including concrete, timber, metal, plaster board and masonry. In addition, in the Portugal scenario there are the recycling plants called TRIANOVO that are used to collect, separate, crush and sell separated materials to other recyclers (wood, metal, glass) and suppliers of graded fill aggregate which mainly composed of crushed concrete, brick and mixed fines (Coelho, 2006). Besides,a study done by Tand and Larsen (2004) in Sarawak highlighted that due to the high resell value at the present date, scrap metal wastes were usually collected for recycling.

Table 7: Types of Recovery Practiced

Company	Types of Recovery Practiced
Company A	*- "The highest waste is timber because we just used it usually 4 times only and after 4 times we do not allow for construction because of quality of wood".* *-"Even there is exist very minimum waste, we will use the concrete waste for road access".* *- "When the waste had been combined together, we need to excavate and fill with original soil and compact it. Another waste is concrete; we will crush and make it as road access. The balance of the piles, we will use back to build as temporary bridge for water trench. The piles also will be reused as road access and then will cover by crusher run. Besides, timber wastes that can't be reused, will keep in store and transport to another site that can be used again which depend on condition".*

Company I	- *"Steel will be recycled again and for wood will reuse 3 times and after that wood will be transported to bricks manufacture. In overseas, they will keep wood, steel, bricks wastes and collect them for recycle again to produce new product. Such as wood waste will be crushed and used for the landscape work especially for landscaping. While, concrete waste in overseas commonly used as crusher run for road pavement".*
Company E	-*"Normally for big wastes, we will use bins but now the wastes that are generated are very minimum. Actually, this timber wastes can be recycled to produce colorful chipboard for landscaping. Sometimes, the private companies that do landscaping will collect timber wastes at site spaces to recycle it back. Besides, plywood wastes also will be bought from contractors and chipped to the company that used timber for production of renewable product. Along time ago, timber did not have higher demand but now it is more expensive.*

4. Discussion

As listed in Tables 3 to Table 7, most of the contractors practised segregation of wastes at the construction site. However, there were a few of them who mixed wastes together before disposing them either in landfills, private lands or unknown places. In addition, after the segregation process had been done using the excavator, private transporter or bulldozer,all of the separated wastes would be stored in the containers or bins before being taken by recycling companies. Besides, there were fewer contractors who burnt and buried their wastes on site without concerns of the environment and community; they were more concerned about their own profits.

Based on the findings also, generally the contractors had exposed the wastes for reuse and recycle practised on site. Many of the contractors had reused wastes in order to minimise the cost of collection and disposal. For instance, they usually reused wood wasted a few times, crushed the concrete and bricks to be used as road access and etc. Interestingly, the recycle activity had been practised during the construction stage among private transporters who collected and processed them into a new product. A study done by Jantan et al. (2004) found that wood could normally be recycled to produce woodchips,wood briquettes and dry coloured woodchips which could be used in landscaping and barbequing activities. However, there were no facilities provided in order to support and encourage them. This was also supported by the statement by Lau et al. (2008), who found that there were no specific facilities provided for collection, recovery and recycling of construction wastes.

Finally, most of the contractors didn't have a specific flowing process in managing wastes; therefore, several of them didn't know of the specific place to dispose their wastes. Moreover, there were a few of them who liked to burn and bury their wastes eventhough they knew that this was the wrong way in managing wastes. Besides, ,there were no specific

regulations or procedures that enforced the contractors to relate to a specific flow process in managing wastes.

5. Conclusion

Overall, this paper presented the findings of the detailed description of the existing process that had been practised in managing construction wastes which included the collection, segregation and combination processes. Then, this was followed by the process of disposing the wastes at Legal Landfill, Private Land and Unknown Place. Most of contractors practised the recovery process including reusing and recycling the waste on site. However, there were a few of them who still conducted open burning and buried their wastes at the construction site.

In addition, there were many contractors who had exposed the wastes to the recycle and reuse practise at the constuction site. However, based on the findings shown, there was no proper and systematic flow or process in managing wastes. Therefore, there is a need of a systematic flow that will highlight the improvement in managing the process of wastes from the time the wastes are generated until they are disposed of.

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7. References

Begum, et.al (2006), Implemetation of Waste Management and Minimization in the Construction Industry of Malaysia, Universiti Kebangsaan Malaysia, Bangi.

Begum, R.A., Siwar, C., Pereira, J.J., Jaafar, A.H., (2007). Implementation of Waste Management and Minimisation in the Construction Industry of Malaysia. *Resources, Conservation and Recycling* 53, pp321-328.

Begum, R.A., Pereira, J.J., 2008. Environmental Problems in Malaysia : A View of Contractors' Perception. Journal of Applied Sources 8 (22), 4230-4233 pp.

Begum, R.A., Siwar, C., Pereira, J.J., Jaafar, A.H., (2009). Attitude and Behavioral Factors in Waste Management in the Construction Industry of Malaysiar. *Resouces, Conservation and Recycling* 51, 190-202.

Chong, T.T., Tang, H.H and Larsen, I.B. (2001), Environmental Performance : Articles on waste and river management, Sarawak Government/DANCED Sustainable Urban Development Project, Sarawak.

Chen, M.C., Ruijs, A and Wessler, J. (2005). Solid Waste Management on Small Islands: The Caseof Green Island, Taiwan. *Resources, Conservation and Recycling*. Vol 45,pp 31-47.

Coelho. A.D (2006) Construction and Demolition Waste Management in Portugal, Instituto Superior Tecnico, Universidade Technica de Lisbone, Portugal.

Couto, J.P and Couto, A.M. (2002). Constrcution Sites Environment Management: Establishing Measures to Mitigate the Noise and Waste Impact, *Unpublished Msc dissertation, University of Minho.*

Denan, Z. (2008). The Relationship between Absorptive Capacity and Firm's Performance: The Case of Manufacturing SMEs in Malaysia, in Norzaidi et.al (2008), *Selection of Research Papers in Social Sciences and Management.* Malaysia: University Publication Centre UiTM, Shah Alam.

EPU, the Economic Planning Unit, (2006-2010). Ninth Malaysia Plan, RMK9, Prime Minister, D. (Ed.), The Economic Planning Unit Putrajaya, http://www.utusan.com.my/utusan/SpecialCoverage/RMK9/english/Chapter21.pdf.

Healy, M. and Perry, C. (2000). Comprhensive Criteria to Judge validity and realibility of qualitative research within the realism paradigm. *Qualitative Market Research: An International Journal,* 3(3) pp. 118-126.

Jantan, M.H., Pereira, J.J., Midon, M.S and Zain, M.Z. (2004). Development of Wood Based Products from Construction Waste, *Proceedings of the Construction Industry Research Achievement Seminar (CIRAS).*

Kofoworola, O. F. and Gheewala, S. H. (2009) Estimation of Construction Waste Generation and Management in Thailand. *Waste Management,* 29**,** 731-738.

Kumar, R., 2005. Research Methodology-A step by step guide for beginners, 1 st Edition edn. SAGE Publication Inc.

Laquartra, J. and M. Pierce (2004). Managing Waste at the Resiedential Construction Site, *The Journal of Solid Waste Technology and Management, in press.*

Lau, H.H., Whyte, A and Law, P.L. (2008), Composition and Characteristics of Construction Waste Generated by Residential Housing Project, *Int. j. Environ. Res., 2(3):* pp261-268.

Maxwell, J.A. (1996). *Qualitative Research Design.* Beverly Hills, CA: Sage Publication.

Ministry of Housing and Local Government (MHLG). (2005) National Strategic Plan for Sloid Waste Management. http://www.kpkt.gov.my/kpkt/

Nittvattananon, V and Borongan, G. (2007). Construction and Demolition Waste Management: Current Practices in Asia, *Proceedings of the International Conference on Sustainable Solid Waste Management, Chennai, India,* pp 97-104.

Poon, C.S., Ann, T.W., Ng, L.H. (2001). On-site Sorting of construction and demolition waste in Hong Kong, *Resources, Conservation and Recycling* 32, 157-172pp.

Solid Waste and Public Cleaning Department, (Act 672), (2007). Laws of Malaysia.

Shen, L.Y., Tam, V.W.Y., Tam, C.M., Ho, S., (2000). Material Wastage in Construction Activities-A Hong Kong Survey. *In: Proceedings of the 1 st CIB-W107 International Conference-Creating a Sustanable Construction Industry in Developing Countries,* 125-131.

Symonds, (1999). Construction and Demolition Waste Management Practices and their Economic Impacts. In: report to DGXI.

Wilson, O.D., Skitmore, R.M and Seydel, A. (1997). Waste Management in the Cnstruction Industry, *Proceedings Symposium A: Materials and Technolgies for Sustainable Construction, Vol 2, The International Council for Building Research Studies and Documentation (CIB) World Congress: Construction and the Environment2, Gavle, Sweden,* pp 879-886.

Yip, J.L, J., 2000. New directions of environmental management in construction: accepted levels of pollution. *Structural Survey* Vol 18 (2), 89-98pp.