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THE CHALLENGES OF CONSTRUCTION WASTE MANAGEMENT IN KUALA LUMPUR

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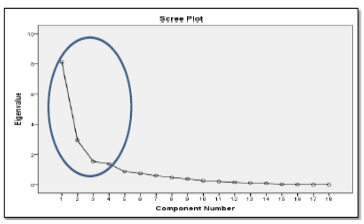
Graphical abstract



Abstract

Rapid growth in construction activities in Kuala Lumpur resulted in increasing of construction waste problems. Construction waste gives a negative impact to the environment, cost, time, productivity and social of the country. This paper studies the challenges of construction waste management faced by the contractors undertake projects in Kuala Lumpur. Eighty five (85) numbers of questionnaires were distributed to various groups of respondents which include main contractors, registered contractor for collection of waste, Kuala Lumpur City Hall (DBKL) officers and Solid Waste Corporation (SWCorp) officers. Spearman's rank correlation coefficient analysis, mean ranking analysis, Kruskal-Wallis test, and factor analysis are among the analysis used in this study. In addition correlation test were also conducted to establish the correlation between the factors. The result shows that the factor influenced in successful implementation of Construction waste management (CWM) for DBKL projects are internal factor, management factors, local authority factor and law regulation. The findings also show that the barrier in implementing CWM in DBKL projects is due to the lack of authority to monitor the management of construction waste on site. The findings of this study highlight the scenario of the current CWM for projects in Kuala Lumpur and thus, provide the recommendation in improving the CWM in Kuala Lumpur.

Keywords: Construction waste management (CWM), suitable method of CWM, factor influence CW, implementing CWM

1.0 INTRODUCTION

In 2008, 23,000 tons of waste is produced each day in Malaysia, with less than 5% of the waste is being recycled. In Kuala Lumpur, the capital of Malaysia, waste generation is about 3,000 tons a day and forecasts show that this will increase further in the coming years whereas in Selangor, waste generated in 1997 was over 3000t/day and the amount of waste is expected to rise up to 5700t/day in the year 2017[1]. This resulted to an alarming 19% of waste ends up in our drains, which then causes flash floods and drainage blockage. This situation has been and will be reducing our environmental capacity to sustain life [2]. Construction industries used up significant quantities of raw materials in their process, in order to produce the output such as their product and the waste materials from that construction development. As a result, construction industries sectors tend to be well-known among the worst type of environmental polluter [3]. Apart from that, construction waste management issues become a global problem. Every year about 3000 million tonnes of waste was produced in Europe [4]. Major categories of the solid waste are waste from construction, industry, mining and agriculture and 30% of the solid waste from construction and demolition of the structure [4]. Besides that, based on the predicted result of total solid waste generated (per day and per year) in Kuala Lumpur, trend indicate continue increasing 2% of total solid waste every year [5]. Solid waste from construction and industry contributed about 4% from the predicted result of the study [5]. In realising this issue, the government under Solid Waste and Public Cleansing Management Act 2007 [6] was gazette on 30th August 2007 and were enforced on 1st September 2011. The Act 672 was enforced to implement an efficient solid waste treatment, interim treatment and final disposal of solid waste. It also covers the controlling of solid waste generators and persons in possession of controlled solid waste, enforcement and reduction and recovery of controlled solid waste [7]. SWCorp was developed to manage and handle all the construction waste produce in Kuala Lumpur due to the fact that DBKL facing financial issues and insufficient of construction waste collector [7]. Currently, all the construction waste produce in construction site in Kuala Lumpur are collected by registered construction waste contractor and are sent to the dumping area at Sungai Kertas, Gombak. Twenty four (24) registered contractors were registered with PPSPPA for collection of construction waste in Kuala Lumpur. In ensuring the competency of the contractor, these contractors were required to attend training and seminars provided by SWCorp prior in obtaining the certificate for collection of construction waste in Kuala Lumpur [7]. These registered contractors were then appointed by the Project Manager of the respective construction company whom require their services. The objective of the paper is to identify the suitable method of construction waste management practices for construction project in DBKL project; to identify the factor influence in the successful implementation of construction waste management in DBKL project; and to identify the difficulties in implementing construction waste management in DBKL project.

2.0 RESEARCH METHOD

In this research, questionnaire survey and discussion with subject matter experts were conducted. Questionnaire were distributed to the respondents which includes of forty one (41) number of main contractors whom construction project in Kuala Lumpur; twenty four (24) numbers of registered waste contractor; fifteen (15) numbers of DBKL officers from department of planning and control project whom directly involve in construction project; and five (5) numbers of SWCorp officers from department of construction waste. The questionnaires were distributed to the respondent using various method which includes by hand, email and online survey. The questionnaire consists of five sections namely section A (demographic profile), section B (suitable method of CWM practices), section C (factor influence in successful implementation of CWM for DBKL projects), section D (difficulties in implementation of CWM for DBKL projects) and section E (recommendation for improvement). Likert scale of five ordinal measures of agreement were used towards each questions which includes from Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. Pilot Study was conducted with seven (7) subject matter experts in order to ensure the reliability and validity of the tools. Using Reliability test, Cronbach Alpha is 0.856 (>0.7). This shows that the questionnaire is reliable and consistent [8].

3.0 RESULTS AND DISCUSSION

Forty four (44) numbers of questionnaires were successfully collected and representing respond rate is 52%. For construction industry it is norm to obtain questionnaire surveys of 20% to 30% [9]. Thus, the respond rate of 52% is considered reliable.

3.1 Method of CWM Practices

Table 1 shows the type of construction waste and its ranking. This indicates that the highest construction waste is concrete & aggregate followed by soil & sand and timber material.

Table 1 Ranking on Construction Waste Generation at Construction Project

Type of Construction Waste	Mean	Rank
Concrete and Aggregate	4.3409	1
Soil and Sand	4.1591	2
Timber Material	4.0455	3
Brick and Block	3.6136	4
Steel and Metal	3.3409	5
Plastic and Wrapping Construction Material	3.3182	6
Tile and Ceramic	3.2045	7
Glass	3.0000	8

Table 2 The Highest Contribution of Construction Waste with the CWM Practices

	C&A		S&S		TM	
	Mean	Rank	Mean	Rank	Mean	Rank
Reduce	4.48	1	4.66	2	4.70	2
Reuse	3.54	3	4.79	1	4.71	1
Recycle	4.30	2	1.09	4	4.23	3
Disposal	2.93	4	1.59	3	2.02	4

C&A - Concrete and Aggregate
S&S – Soil and Sand
TM – Timber material

Table 2 shows the mean and ranking for the three (3) most generated wastes for construction project based on the four (4) type of waste disposal method includes reduce, reuse, recycle and disposal. Based on Table 2, the best method for minimising the generation of C&A waste at the construction project is to reduce the usage of concrete and aggregate with mean value of 4.48. The planning of construction material is essential during the design stage that can avoid the wastage of construction material [10]. Thus, proper planning on the design project should be finalised prior project commencement. In addition, all parties should be in consensus on the design and no changes to be made at the last minute that could affect the project. Due to no design change during the construction phase has significantly reduced the construction waste at the construction site in Hong Kong[11]. Recycle C&A received the second best method in minimising construction waste at site, mean value of 4.40.The purpose of recycle method is to convert the unneeded things into useful and marketable recycled products [7]. For example, excess of concrete from concreting work can be recycled that will give another value such as concrete block. Concrete can be recycled by crushing as partial replacement for natural aggregate [12].

Table 2 also shows that reduce method is the best method in minimising the generating of S&S waste at construction project. The generation of S&S waste can be minimised by proper monitor and control of the S&S procurement to avoid from purchasing the unnecessary quantity [18]. As discussed with the subject matter experts, SWCorp engineer, usually the remaining of S&S will be reused for other works such as landscaping activities for the same construction project. On the other hand, the best ways to minimize the generation of timber material construction waste is by adopting the 3R's method (Reuse, Reduce and Recycle) in the construction waste management hierarchy [13]. TM can be reduced by a proper storage, proper handling of TM such as do not cutting the timber without know the actual dimension needed and adequately ordering of TM [7].

3.2 Factor Influence in Successful Implementation of CWM

Table 3 shows four (4) major factors which influence the successful implementation of CWM according to its ranking. This includes Internal Factor, Management, Local Authority Law and Regulation.

Table 3 Major Factor Influence in Successful Implementation of CWM

	Law and Regulation	Local Authority	Management	Internal Factor
Mean	4.0455	4.1455	4.2023	4.2818
Ranking	4	3	2	1

The Internal factors consist of awareness of CWM implementation; financial resources for CWM implementation; communication amongst project participants; research and development in CWM; and training needs in CWM. The internal factor is one of the important elements to successful in management of construction waste [14].

The management factor consists of stakeholders role in implementing successful CWM; stakeholders provide training/seminar to staff on CWM best practice; site construction and demolition waste supervision system; site construction and demolition waste sorting; fewer design change; implementation of waste recycling and reuse; improving conventional construction process; proper storage system and usage of material; consider CWM in bidding and tendering of the construction project.

The local authority factors consist of local authority role in implementing successful of CWM; local authorities regularly monitoring the construction site; and imposing penalty to company that breech the regulation.

The law and regulation factors include implementation and enforcement of ACT 627 (Solid Waste and Public Cleansing Management Act 2007); establish systematic CWM; impose of penalty for CWM; and government policies in CWM.

3.3 Difficulties in Implementing CWM

Two statistical measures namely Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy while Bartlett's test of sphericity [15]. Table 4 shows that validity test for difficulties in implementing CWM for DBKL projects. The KMO index ranges from 0 to 1, with more than 0.5 suggested for a good factor analysis while Bartleett's test of sphericity should be significant ($p < .05$) [15]. In Table 4, gives the Bartlett's test of sphericity and KMO values to test validity on the factors of difficulties. From the tables, the index KMO by Kaiser Meyer Olkin is 0.772 which is more than 0.5 and is significant due to the range indicated. As a result, it satisfied and acceptance for the next step to conduct and undergoing of factor analysis. The number of factors of difficulties can be determined using the Scree Plot. Referring to Figure 1, the suitable number of components is considered before the linear plateau.

Table 4 KMO and Barlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.772
Bartlett's Test of Sphericity	Approx. Chi-Square	905.954
	df	253
	Sig.	.000

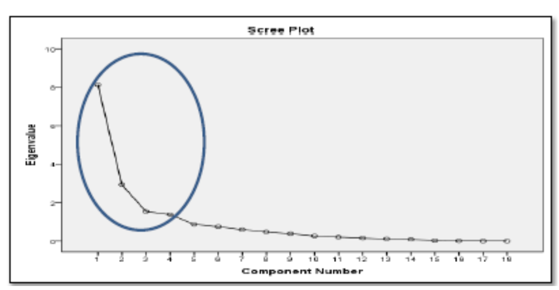


Figure 1 Scree Plot

Factor analysis was conducted to determine the inter correlations of a set of variables in which the data may reduce or summarized using smaller set of factor or components [15]. Table 5 shows that the component matrix after rotation with value of factor loadings more than 0.5 [16]. Based on the factor analysis in Table 6, it indicates that the factors which influence difficulties in implementing CWM for DBKL projects can be classified into four (4) groups of factors namely behaviour and skill; construction waste management system; law and regulation; and authority.

Table 5 Rotated Factor Matrix for the Difficulties in Implementing CWM

Difficulty	Component			
	1	2	3	4
Lack of proper training and education	.910			
Lack of well-known effective waste management methods	.894			
Lack of consideration given to waste reduction during planning and design stage	.848			
Construction culture and behavior	.834			
Disposed in landfill without being separated into constituent's parts	.827			
Limited site space	.794			
Design change during construction progress	.762			
Not practicing source separation, reduction, reuse and recycling in construction site	.750			
Complicated subcontracting system	.656			
Lack of skilled personal in operating an efficient waste collection and disposal practice	.634			
High cost of transportation and disposal waste		.902		
Low financial incentive/ budgetary allocation for CWM were also insufficient		.858		
No recovery process/mechanism for reusing and recycling		.783		
Lack markets for construction waste recycling		.773		
Lack of promotion of waste minimization measures		.656		
Legal enforcement and existing legislation is inadequate to facilitate CWM effectively			.893	
No specific regulation and guidelines			.597	
Lack of authority to monitor the management of construction waste on site				.949

4.0 CONCLUSION

Based on the findings, the major factors that influence the difficulties in implementing CWM (behaviour and skill; construction waste management system; law and regulation; and authority) need to be considered by the authorities in making CWM a success. This includes:

i. All construction projects requires approval from DBKL of the disposal landfill area to avoid from illegal dumping by the main contractor.
ii. Instil CWM awareness and its importance in responsible parties.
iii. SWCorp plays important role to ensure that the main contractor adhere and abide to the Act 627. Thus, sufficient numbers of staffs to handle and monitor the construction project in Kuala Lumpur.
iv. The authorities should establish a specific act on construction waste with all the requirements. Currently, there is only Act 627 refers to the requirement of construction waste and municipal waste.

DBKL to establish waste control system as part of the requirement of site management that indicates the waste construction generation data, identify the major areas of waste generation, analyse the causes for the waste generation, produce solutions for mitigation waste and deliver the decision making by the management to the site staff who work on those key areas.

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