[CON 6] CONSTRUCTION CONTRACTOR'S PERCEPTION ON EFFECTIVE 3R IMPLEMENTATION FOR SOLID WASTE REDUCTION IN PERAK

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ABSTRACT

Construction industry produces large volume of construction waste that occupies the landfills. Construction contractors must play active role to reduce the construction waste by implementing the 3R concept. Weak action towards the 3R implementation among the construction contractors will directly lead to the non-sustainable issues. Perak has largest landfill in Peninsular Malaysia should manage well their landfill in order to avoid environmental issues and to ensure their landfill can operate in a long terms. More disposals from the construction activities will decrease the space at the landfills. Construction contractors should implemented 3R towards the solid waste management as it is more sustainable. This paper aims to study the perception of construction contractors in Perak regarding their 3R implementation for solid waste reduction. This paper also aims to assess the difference on the statement in elements of effective 3R implementation based on the construction contractor's grades in Perak that has been registered under CIDB. This study used the quantitative method. A questionnaire survey has been conducted among 194 selected contractors registered under CIDB that located in Perak, Malaysia. However, respondent that answering the questionnaire survey was 92 respondents only. The results show that the entire respondents have been agreed towards the elements that have been suggested in the implementation of 3R concept to reduce the construction waste.

Keywords: *construction waste, solid waste, 3R, Perak*

INTRODUCTION

The construction and demolition of waste can be defines as the waste that produce from the construction industry with the civil construction and building, construction activities, renovation for the building, road construction and demolition activities, soil excavation include construction site cleaning (Shen et al., 2004). According to the Solid Waste Management and the Public Cleansing Act 2007 (Act 672) that passes by the Parliament on July 17.2007 and has been gazetted this Act on August 30, 2007 (Begun et al., 2007a). These 3R concepts were officially launched at 3R Ministerial Conference that has been hosted by the Government of Japan in April 2005, in order to expose the global action towards 3R. Senior Officials Meeting were arranged on March, 2006 regarding the 3R approach was organized in Japan was aim to gain the strong commitment of governments and other stakeholders to implement 3R at local, national, and regional level. Some 3R initiatives such as Circular Economy in China, the 5Rs policy in Indonesia and the Zero Waste Society in Japan and Singapore have been

implemented. According to the Ministry of Urban Wellbeing, Housing and Local Government of Malaysia on 2015 shown some list towards the number of operating site in Perak that are contain 17 operating site which is the largest in Peninsular Malaysia (Sh et al., 1970a). In order to ensure all the landfills in Perak are well managed, the 3R concept is implemented that follow based on one of the thrust of National Solid Waste Management Policy. This 3R represent the concept of reduce, reuse and recycle. Recyclable material around 70% to 80% are found in the landfill in Malaysia (Moh et al., 2014a). This kind of data is more accessible in developed countries due to their well-established policies together with the proper waste management systems (Sh et al., 1970b).

STATEMENT OF THE PROBLEM

Effective maximization of 3R implementation towards construction waste reduction contributes to minimization of quantity waste dispose at landfill (Augustine, 2011). However, disposals are selected by most of people or company because the cheap and easy method is used in order to manage construction waste compare to the sustainable approaches. Most firms do not take serious action regarding these issues that are being the biggest problem towards their profit objective. Apart from that, the higher volume amount of waste that come from construction site will increase the negative impact to the human health, environment and reduce the lifetime of landfill. It is very important in order to maintain the landfill lifetime. The selected contractors need to answer the questionnaire that has been given to them. Most of the question in this questionnaire survey is related with 3R concept about the solid waste reduction. Therefore, the purpose of this research is:

1. To study the perception of contractors in Perak regarding their 3R implementation for solid waste reduction.
2. To assess the difference on the statement in elements of effective 3R implementation based on contractors grades which are G1, G2, G3, G4, G5, G6 and G7 under CIDB.

LITERATURE REVIEW

Examining the concept of solid waste reduction and 3R concept

These solid waste reductions are refers from the 3R that are known as the thrusts in the National Solid Waste Management Policy. This 3R shown the approach of reduce, reuse and recycle (Ng et al., 2015a). Based on the Ministry of Urban Wellbeing, Housing and Local Government (UHLG) 2015, have list the report of UHLG that selected statistics until March 2015 has shown that currently there only 2 operating landfill in Penang (Shan et al., 2014). First classification of 3R is reduction. Reduction means to reduce something. Reuse action are the reuse of the materials that have the same function on the same site or on other sites that use a product more than once. This situation includes the conventional for reuse that it will be used again that has the same function or use of the new functionality (Kajornboon, 2005).

Examining the concept of solid waste reduction by 3R implementation in Malaysia

Malaysia was the country that now is facing the largest of waste generation and the negative impacts of disposal (Begun et al., 2007b). Construction waste are sent the

waste to the landfills without any reused or recycle action might cause its anaerobic degradation that effects to air pollution or contamination of the ground water and soil (Lu et al., 2015). The recycling rate of Malaysia for about 5% rather than the recycling rate in Japan that an about 40% (Moh et al., 2014b). The major challenge to implement the 3R concept in terms of solid waste reduction is at the low of stage, contractor's attitude and low recyclable together with reusable construction waste (Ng et al., 2015b). Meanwhile, the Municipal Council is involved in providing the landfill together with the disposal services but it does not include in the process of construction waste management at site (Ng et al., 2015c).

RESEARCH METHODOLOGY

Sampling and data collection

In this study, the focus population is the contractor under CIDB that operated in Perak. This study used a quantitative method. As shown in the study, questionnaire surveys are conducted among contractors. According to the sample size at the table that has been presented by Israel random sampling, a sample size of 194 persons was required when the population is 4000 persons. In this research, the total contractors in Perak is 4960 persons, however, 194 respondents were selected randomly among the contractors that have been registered as G1, G2, G3, G4, G5, G6, and G7 grades under CIDB located in 9 regions in Perak. However, only 92 respondents have been answering the questionnaire surveys that were sent to them through e-mail that need for them to fill out the Google Form. Before the questionnaire being sent to the respondents, the pre-test have been conducts in order to ensure the question that were write in the questionnaire are still in the contractors field.

Measurement scale and data analysis

The data questionnaire were analysed by using Statistical Packages for Social Science (SPSS). According to the TABLE I have been shown the level of agreement towards the elements in effective implementation for 3R to reduce the solid waste in the construction sector. Apart from that, a mean score analysis represented based on the 5 points in the Likert scale a shown in Figure 1. This Likert score are used to help the respondent to indicate their level of agreement about the effective implementation of solid waste reduction in 3R. The mean score 4.05 for the role of government shown that the respondent agree with the encouragements or supports from the governments in order to implements the 3R approach in solid waste reduction for construction industry. Next the mean score for the legislation and enforcement are 4.10 among respondents. This legislation and enforcement includes with government encourage of 3R in construction waste must be more specific in order to specify their own accountability and responsibility in waste management. In addition, the mean score for the 3R implementation among contractors are 4.16 which at the agree level in the Likert scale. Survey also shown that, the awareness elements is the most important stage in order to implement 3R approach in solid waste reduction for construction industry. Likert scale shown awareness at the agree level which is contain mean score 4.27 respondents. Most of the respondents agree with the government activities to conduct educational program about 3R in construction industry, meanwhile, for legislation of 3R in this awareness to be formulated only has small mean scale because the new introduce of this 3R for construction sector. From the survey for the technology and techniques shown that the mean score is 4.04 respondents which is at the agree level in

Likert scale. However, these elements are the elements that get small mean score rather than other elements in the questionnaire. However, some of this technology or techniques need the higher expert to handle it. This situation might the reason for the contractors to put it as the lowest agree towards these elements.

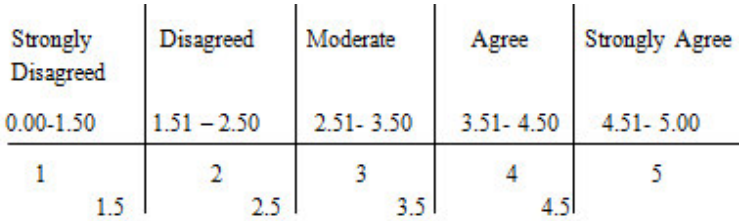

Figure 1
Mean score analysis for Likert scale (Razzaly et al., 2012)

Table 1
Level of agreement on elements of effective 3R implementation in solid waste reduction (Ng et al., 2015d)

Elements	Mean Score	Level of agreement
Role of government	4.05	Agree
Legislation and enforcement	4.10	Agree
3R implementation among contractors	4.16	Agree
Awareness	4.27	Agree
Technology and technique to practice 3R	4.04	Agree

RESULTS

The one-way analysis of variance (ANOVA) had been done to analyse the effective of implementation for solid waste reduction in construction sector among G1, G2, G3, G4, G5, G6, and G7 grades for the contractors. ANOVA are the statistical method in order to comparing and analysing the mean score for the respondents that are more than one group. Based on this study, if the significance level of the $p < 0.05$, the null for the hypothesis is rejected.

Hypothesis: There is significantly different perception on the statement in elements among different grades of contractors.

Null hypothesis: There is no different perception on the statement in elements among G1, G2, G3, G4, G5, G6 and G7 grades contractors.

Based on the ANOVA result has been shown that the null hypothesis of statement in some 19 elements are rejected (Table II). There are significantly statements elements in roles of government or authority regarding local authorities that should established variety recycling company where has shown that $F = 2.350$, significant level = 0.038, $p < 0.05$. There are also some statements on legislation that are important in implementing 3R policies in managing construction waste, with $F = 2.298$, significant level = 0.042, $p < 0.05$. These ANOVA test also shown the legislation and enforcement that need to established law and regulation to prescribe contractors obligations to

reduce, classify, segregate, reuse and recycle construction wastes, where F = 2.158, significant level = 0.12 , $p < 0.05$. Apart from that the legislation and enforcement improve existing standards and quality control for reuse and recycling construction waste management among contractors, F = 2.692, significant level = 0.19, $p < 0.05$. For the next difference perception are focus on the contractors apply waste management hierarchy in construction waste management, which is F = 2.772, significant level = 0.16, $p < 0.05$. ANOVA test has shown the contractors apply integrated waste management concept to reduce construction waste where wastes should be separated into waste streams, where F = 2.298, significant level = 0.042, $p < 0.05$. In addition, ANOVA list the F = 2.526, significant level = 0.027, $p < 0.05$ in the statements for the contractors should practice reduction, reuse and recycling of construction waste before waste is dispose to landfill. In the statements of construction waste generated must be recovered through reuse and recycling, with F = 3.604, significant level = 0.003, $p < 0.05$. The on-site separation of construction wastes is an effective way to increase the recycling rate of construction wastes, with the F = 2.594, significant level = 0.023, $p < 0.05$. ANOVA also has list statements for contractors in reduction of construction waste can be practiced during stages of design, material quantity calculations for procurement, handling, and storage, which is F = 3.536, significant level = 0.004, $p < 0.05$. These statements through ANOVA test shown F = 2.513, significant level = 0.027, $p < 0.05$ for the difference of government should conduct educational programs and training on environmental management to provide knowledge and awareness on 3R implementation. Furthermore, statement of government should conduct awareness campaigns to encourage and motivate contractors with, F = 3.250, significant level = 0.006, $p < 0.05$. The cooperation of public, private sectors, and non-governmental organisations in 3R activities are encouraged to reduce the amount of wastes in landfill also has been listed by ANOVA test, with F = 2.929, significant level = 0.012, $p < 0.05$. ANOVA has been shown the legislation of 3R should be formulated and introduced in construction waste management to increase awareness of the importance of 3R among contractors, which is F = 2.251, significant level = 0.046, $p < 0.05$. Next, ANOVA test shows that F = 2.498, significant level = 0.028, $p < 0.05$ which in statements for application of Industrialised Building Systems (IBS) to reduce construction waste. The inert waste such as sand, bricks and concrete can be used for land reclamation also has been test by ANOVA, with F = 3.138, significant level = 0.008, $p< 0.05$. ANOVA also test the statement of grinded rock and concrete can be used as the base for new concrete or filling hole, with F = 2.495, significant level = 0.028, $p < 0.05$. The recycled asphalt can be used in base layers for road construction also has been test by the ANOVA with F = 2.282, significant level = 0.043, $p < 0.05$. The statements of wooden wastes are easy to be reused and recycled together with the wooden formworks that can be reused for several times, with F = 2.866, significant level = 0.014, $p < 0.05$.

DISSCUSSION AND IMPLICATIONS

In addition from these 19 statements, the other null hypothesis is accepted. These test shows that there have different in perception among the G1, G2, G3, G4, G5, G6, and G7 grades for the contractors as shown in TABLE II. Mostly, all the contractors that came from different grades are represent as the respondents have different perception towards the effective for the 3R implementation to reduce the solid waste from the construction industry. There are about 19 statements based on four elements in this

paper contain different perception in implementation of 3R for solid waste reduction among contractor as a respondents. This situation happen may be due to the personal towards the 3R implementation for reduction of solid waste. However, this study has shown that several of the contractors have the similar perception maybe due to the various experiences, financial limit or the project cost and their personal view between different grades of contractors that registered under CIDB Malaysia. This study has shown different result from the study that has been conduct by Ng et al., 2015 at the Penang, Malaysia in the same topic which is about 3R implementation for reduction of solid waste in construction sector. This study that has been done in Perak has shown different perception of contractors rather than different perception among contractors. The different kinds of project might generate different amount of construction waste. For example, higher cost of development for the project might contain higher amount of construction waste rather than the moderate or smaller project that only produce small amount of construction waste. Based on this semi-structural questionnaire, several respondents have been writing down some opinion about the 3R implementation in construction industry. Some respondents think that this 3R must be completed by all party, 3R is not bad activities to be conducted, 3R activities is needed the higher cost to conduct it, 3R is widely been used, 3R also the good work to being used.

Table 2

Reliability statistics environmental

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.719	.721	5

TABLE 3

ANOVA test result on the elements of 3R implementation (Ng et al., 2015e)

Elements of effective 3R implementation in construction solid waste reduction		Sum of Squares	df	Mean Square	F	Sig.
Roles of government/ authority						
Government/authority provides subsidies to contractors who reduce construction waste through 3R to improve construction waste management.	Between Groups	3.793	6	.632	1.030	.412
	Within Groups	52.163	85	.614		
	Total	55.957	91			
Government/authority provides financial incentives to promote 3R practices among contractors.	Between Groups	5.352	6	.892	2.019	.072
	Within Groups	37.550	85	.442		
	Total	42.902	91			
Local authorities can provide credit loans for contractors who need buy equipment or machinery used in recycling process.	Between Groups	5.609	6	.935	1.582	.162
	Within Groups	50.217	85	.591		
	Total	55.826	91			
Construction Waste Disposal Charging Scheme charge cost of disposal based on the quantity of construction waste sent to landfills.	Between Groups	4.152	6	.692	1.207	.311
	Within Groups	48.750	85	.574		
	Total	52.902	91			
Government/authority high charges on contractors who send in construction wastes which are reusable and recyclable to landfill.	Between Groups	4.109	6	.685	.926	.481
	Within Groups	62.880	85	.740		
	Total	66.989	91			
Government/authority prepare guidelines with government act for contractors to implement construction waste reduction through 3R.	Between Groups	5.408	6	.901	1.535	.176
	Within Groups	49.897	85	.587		
	Total	55.304	91			
Local authorities should establish recycling company that are effective in recycling various types of material wastes.	Between Groups	5.758	6	.960	2.350	.038
	Within Groups	34.720	85	.408		
	Total	40.478	91			
Legislation and Enforcement						

Legislation is important in implementing 3R policies in managing construction waste in order to encourage, promote, and ensure preservation of environment.	Between Groups	7.007	6	1.168	2.298	.042
	Within Groups	43.200	85	.508		
	Total	50.207	91			
Top-down approach should be mandatory among contractors by enforcing 3R policy legislation and regulations in construction waste management.	Between Groups	3.769	6	.628	1.238	.295
	Within Groups	43.133	85	.507		
	Total	46.902	91			
Legislation and enforcement establish and promote related legislation's to ensure contractors manage construction wastes through 3R practices.	Between Groups	6.292	6	1.049	1.572	.165
	Within Groups	56.697	85	.667		
	Total	62.989	91			
Legislation and enforcement establish specific 3R policies for waste management in construction industry.	Between Groups	6.099	6	1.016	1.701	.131
	Within Groups	50.803	85	.598		
	Total	56.902	91			
Legislation and enforcement establish law and regulations to prescribe contractors obligations to reduce, classify, segregate, reuse and recycle construction wastes.	Between Groups	9.171	6	1.529	2.944	.012
	Within Groups	44.133	85	.519		
	Total	53.304	91			
Legislation and enforcement establish law and regulations to prescribe reuse of certain recycling construction wastes such as aggregate, concrete and wood.	Between Groups	6.138	6	1.023	2.158	.055
	Within Groups	40.297	85	.474		
	Total	46.435	91			
Legislation and enforcement improve existing standards and quality control for reuse and recycling construction waste management among contractors.	Between Groups	7.962	6	1.327	2.692	.019
	Within Groups	41.897	85	.493		
	Total	49.859	91			
Legislation of 3R practices should be specified in construction contract.	Between Groups	7.021	6	1.170	1.862	.097
	Within Groups	53.413	85	.628		
	Total	60.435	91			
Perception on Effective 3R Implementation Among Contractors						
Contractors apply waste management hierarchy in construction waste management.	Between Groups	9.683	6	1.614	2.772	.016
	Within Groups	49.480	85	.582		
	Total	59.163	91			
Contractors apply integrated waste management concept to reduce construction waste where wastes should be separated into waste streams.	Between Groups	7.007	6	1.168	2.298	.042
	Within Groups	43.200	85	.508		
	Total	50.207	91			
Contractors should practice reduction, reuse and recycling of construction waste before waste is dispose to landfill.	Between Groups	9.192	6	1.532	2.526	.027
	Within Groups	51.547	85	.606		
	Total	60.739	91			
Construction waste generated must be recovered through reuse and recycling.	Between Groups	10.326	6	1.721	3.604	.003
	Within Groups	40.587	85	.477		
	Total	50.913	91			
On-site separation of construction wastes is an effective way to increase the recycling rate of construction wastes.	Between Groups	7.071	6	1.179	2.594	.023
	Within Groups	38.613	85	.454		
	Total	45.685	91			
Reduction of construction waste can be practiced during stages of design, material quantity calculations for procurement, handling, and storage.	Between Groups	12.721	6	2.120	3.536	.004
	Within Groups	50.963	85	.600		
	Total	63.685	91			
Only un-recyclable and non-reusable construction wastes can be sent to landfill.	Between Groups	7.150	6	1.192	2.201	.051
	Within Groups	46.013	85	.541		
	Total	53.163	91			
Awareness on 3R Implementation						

Government should conduct educational programs and training on environmental management to provide knowledge and awareness on 3R implementation.	Between Groups	6.674	6	1.112	2.513	.027
	Within Groups	37.630	85	.443		
	Total	44.304	91			
Contractors should provide 3R education and training programs for workers to reduce construction waste generated at construction sites.	Between Groups	5.336	6	.889	1.871	.095
	Within Groups	40.403	85	.475		
	Total	45.739	91			
Government should conduct awareness campaigns to encourage and motivate contractors to practice 3R in construction industry.	Between Groups	8.332	6	1.389	3.250	.006
	Within Groups	36.320	85	.427		
	Total	44.652	91			
Government should conduct awareness campaign as one of the channels to show the importance of 3R implementation among contractors.	Between Groups	5.569	6	.928	2.186	.052
	Within Groups	36.083	85	.425		
	Total	41.652	91			
Cooperation of public, private sectors, and non-governmental organisations in 3R activities are encouraged to reduce the amount of wastes in landfill.	Between Groups	8.260	6	1.377	2.929	.012
	Within Groups	39.947	85	.470		
	Total	48.207	91			
Legislation of 3R should be formulated and introduced in construction waste management to increase awareness of the importance of 3R among contractors.	Between Groups	7.297	6	1.216	2.251	.046
	Within Groups	45.920	85	.540		
	Total	53.217	91			
Technology and Techniques to Practice 3R						
Application of Industrialised Building Systems (IBS) to reduce construction waste.	Between Groups	6.756	6	1.126	2.498	.028
	Within Groups	38.320	85	.451		
	Total	45.076	91			
Inert waste such as sand, bricks and concrete can be used for land reclamation.	Between Groups	7.491	6	1.249	3.138	.008
	Within Groups	33.813	85	.398		
	Total	41.304	91			
Grinded rock and concrete can be used as the base for new concrete or filling hole.	Between Groups	7.336	6	1.223	2.495	.028
	Within Groups	41.653	85	.490		
	Total	48.989	91			
Major steel structural components can be reused and recycled in renovation project.	Between Groups	5.610	6	.935	1.970	.079
	Within Groups	40.347	85	.475		
	Total	45.957	91			
Recycled asphalt can be used in base layers for road construction.	Between Groups	8.449	6	1.408	2.282	.043
	Within Groups	52.453	85	.617		
	Total	60.902	91			
Wooden wastes are easy to be reused and recycled. Wooden formworks can be reused for several times.	Between Groups	8.242	6	1.374	2.866	.014
	Within Groups	40.747	85	.479		
	Total	48.989	91			
Ceramic, terrazzo and marble can be patched, cleaned, and polished to be reused in other projects.	Between Groups	6.728	6	1.121	1.765	.116
	Within Groups	54.000	85	.635		
	Total	60.728	91			
Grinded glass can be used as substitute for sand and pozzolan in the production of various concrete products and cement.	Between Groups	5.782	6	.964	1.542	.174
	Within Groups	53.120	85	.625		
	Total	58.902	91			

If the significant level of $p < 0.05$, the null hypothesis are rejected

CONCLUSION

Perak might be known as the state that have largest landfill in Peninsular Malaysia but if this landfill does not organize very well or construction waste are produce in largest amount without any option to control it, this situation will directly support to the problem in the landfill. The landfill might not be able to accommodate all the waste for a long term situation. Contractors should focuses on the 3R approach in order to ensure the waste from construction activities can be disposal from landfill. Most of the studies has been shown that the construction waste have the suitable characteristic for reuse and recycle it rather than thrown that waste to the landfill. The sustainable construction waste management can be easily achieved by conducting the solid waste reduction activities among the contractors. According to this survey that has been conducted, most of the respondents are agree towards the elements of 3R implementation in reducing the construction waste. All the parties, include government, private sector must take serious action to ensure the 3R implementation for solid waste reduction in construction industry can be manage clearly.

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