Towards Systematic Implementation of Waste Management in Construction Industry

Wan Nadzri Osman
School of Technology Management and Logistics
Universiti Utara Malaysia
wannadzri@uum.edu.my

Mohd Nasrun Mohd Nawi
School of Technology Management and Logistics
Universiti Utara Malaysia
nasrun@uum.edu.my

Rohaizah Saad
School of Technology Management and Logistics
Universiti Utara Malaysia
rohaizah@uum.edu.my

Abstract

Most stakeholders involved in the construction industry, particularly from developing countries have less emphasis on environmental care primarily involves the reuse and recycle of building materials in their construction projects. Previous studies prove environmental aspects have been neglected by the major stakeholders of the construction industry compared with issues related to cost and time. This study focuses on identifying the current adoption level of reuse and recycle practice among Malaysian contractors, the factors that are required for the successful implementation of systematic reuse and recycle and to identify the relationship between the selected factors and systematic implementation of reuse and recycle. The questionnaires were distributed to grade A contractors that registered with the Contractor Service Centre. Currently, most of the contractors are concerned about waste management of the construction materials.

Keywords

Waste Management, Construction Industry

1. Introduction

Infrastructures development and construction industry are usually cannot be separated and they are both actually linked together. Currently, the construction industry faces increasingly restrictive environmental conservation and protection laws and regulations in order to improve the image of this industry. Due to this reason, the emergence of international standards to address environmental quality and performance such as ISO 14,000 and substantial pressures from civic and private environmental groups seems to be crucial in order to improve the current practices. One of the matter concern in the construction industry are involves the issues of waste which resulted from the activities of the construction work. Tam and Tam (2008), mentioned that Construction and Demolition (C&D) waste is often seen as the major contributor to the solid waste stream that is going to landfill, hence, making it the area of focus for improvement . According to Construction Industry Research and Information Association (CIRIA) (2001), construction industry still lags behind in performing the key area of sustainability theme especially on the environmental theme. The implications of these issues heightened the pressure to consider greener practices as part of the culture in the construction projects (Kibert, 2008).

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Previously, most of the construction stakeholders around the world especially in developing countries did not really aware on the environmental aspect of their construction projects. Previous survey reported that any environmental issues received less attention from the construction industry practitioners compared to construction costs and time related issues (Shen and Tam, 2002). However, this kind of trend has changed due to the depletion of non-renewable resources, green house gas emissions and global warming. Regarding to this issues, construction stakeholders worldwide have gain wider attention on the environmental issues in the construction projects. Many efforts are being directed to build greener construction projects through the entire stages from the planning stage until the termination of the project. These efforts include lean construction approach and efficiency improvement through regulatory compliance.

2. Reduce and Reuse Implementation In the Construction Industry

Resource reduction of the building materials nowadays still viewed as very new and this effort is seen as capable to generate benefits in terms of the environment and the economy. There are many benefits from the resource reduction process. These benefits can be summarized as, reduce the use of virgin materials, divert materials from landfills, reduce energy consumption, reduce emissions and decrease costs in construction projects (Wilburn, 1998). Currently, the existence of regional and national policies, laws and regulations governing reduce and reuse principles for C&D waste is minimal in Asia. According to Coventry (1999), C&D wastes including demolished concrete, bricks and masonry, wood and other materials such as dry wall, glass, insulation, roofing, wire, pipe, and rocks. Without proper reuse and recycle policies, these C&D wastes would quickly fill all the remaining landfill space, which has already been growing in scarce around this region. Therefore, this study aimed to identify the important aspects to address this problem of C&D waste. Systematic construction waste management look important. Several approaches have been taken by the authorities involved:

i. Government Support
ii. Policy Implementation and Legislation enforcement
iii. Waste Management Effectiveness
iv. Stakeholders Awareness
v. Technology and Techniques

This study aims to examine the effectiveness of these 5 methods of execution towards systematic C & D waste management.

2.1 Government Support

Government support is one of the contributing factors towards the improvement of reuse and recycles practices in the construction industry. One of the supports that could be carried out is through the financial incentives. Financial incentives will attract interest of contractors to practice reuse and recycle. In addition, local authority could also provide financial incentive in term of subsidies or loans on credit for the contractors to acquire an equipment or machineries that could be used for the recycling process. In effort to promote reuse and recycle, for example, in Hong Kong, the government has implemented the Construction Waste Disposal Charging Scheme in 2005 to provide financial incentives for organization that reduce waste and promote reuse and recycle and charging of construction and demolition waste to landfills . This scheme is part of the policies that most influence contractors in controlling the generation of construction waste. In addition, government could also provide guideline to contractors on how to practice waste reduction (Begum et al., 2006).

2.2 Policy Implementation and Legislation Enforcement

Legislation plays an important role in policy implementation. In term of the importance of Policy implementation of reuse and recycle, Japan and South Korea for example have enforced laws in recycling construction and demolition waste. This enforcement encourage and promote reduction of construction waste (Nitivattananon & Borongan, 2008). Top down approach could be implemented to the contractors to ensure that reuse and recycle is mandatory among contractors. For example, Singapore government applied top down approach by using legislations and regulations to enforce the policy in solid waste management. Hong Kong is also promote the construction waste management reduction through the top down approach.

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2.3 Waste Management Effectiveness

Construction waste management effectiveness is very important to overcome many issues created from the construction sector. Current waste management methods are not sustainable. Through effective waste management approaches, it could reduce the negative impact of construction industry on the environment. In addition, the construction stakeholders should practice reuse and recycle before they decided to dispose the wastes to landfills (Nagapan et al., 2012). The concept of integrated waste management is paramount where waste must been given a priority to go through reuse and recycle process before been dispose (Ngoc & Schnitzer, 2009).

2.4 Stakeholders Awareness

Stakeholders awareness are very important to reduce waste among contractors in construction industry. Education and training programs will encourage contractors to practice reuse and recycle in construction industry (Begum et al., 2006). Another good example from Hong Kong: where the government promote some steps of waste management planning, reduction and recycling construction waste by providing the internal training on environmental management (Nitivattananon & Borongan, 2008).

2.5 Technology and Techniques

Industrialised Building System (IBS) is a construction process that utilizes techniques, products, components or building systems which involve prefabricated components and installation at the construction site. This prefabricated components could reduce the amount of waste on site through proper planning and implementation. IBS usage guarantee many advantages such as reduction of unskilled workers, construction waste reduction or materials wastage, reduction in the building material and construction sites cleanliness (CIDB, 2012).

3.0 Research Objectives

i. To measure the current adoption level of reuse and recycle practice among Malaysian contractors.
ii. To identify the factors that are required for the successful implementation of systematic reuse and recycle implementation among Malaysian contractors.
iii. To identify the relationship between the selected factors and systematic implementation of reuse and recycle.

4.0 Research Methodology

This proposed research aims to appraise Malaysian contractors' view of the implementation of reuse and recycle of construction materials.

i. **Phase 1** : Literature review on the concept of Malaysian construction industry, reuse and recycle issues and the concept of sustainable construction in the construction industry.
ii. **Phase 2** : Literature review on the concept of Waste Management specifically on reuse and recycle implementation in the construction industry – to understand those concepts, principles, challenges and advantages of their application in construction industry and identification of research framework and research hypothesis.
iii. **Phase 3** : Postal survey - investigate the factors that affecting the systematic implementation of reuse and recycle among Malaysian contractors.
iv. **Phase 4** : Investigate the factors / causes based - investigate the problems and challenges of application, factors affecting application, explain reasons for current level of practices and recommend ways for improvement.

This research involved collecting the respondents perception based on their experiences in construction industry. This study is hypothesis testing and tries to discover the factors affecting the implementation of systematic reuse and recycle technic by Malaysia construction stakeholders. A survey method was employed. For this study, the unit of analysis is the contractors' organization. Each respondent is chosen to represent his or her organization. Therefore, the targeted respondent is someone who is involved in the operation of the

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organization. The respondents consist of project managers, engineers, quantity surveyors and other relevant individuals, who responded on behalf of the contractor. The companies that had been selected are only companies located in Peninsular of Malaysia. Sabah and Sarawak would be excluded because of the geographical scope of the study. To be more representative, it was decided that the samples come from northern, central, southern and eastern regions of Peninsular Malaysia.

5.0 Data Analysis

The questionnaires were distributed to grade A contractors that registered with the Contractor Service Centre. The respondents consist of engineer, technician, technician assistant, resident engineer, project manager, site supervisor and administration division. Most respondents involved in this study are engineers that represent 25.6% of total respondents, while the second highest is the technician (24%) and the least is the project manager which represent 5% of the total respondents. Site supervisors are also involved (19%), the administration represent 9.9%, assistant technicians (9.0%), and resident engineer (7.4%).

5.1 Demographic

From the data collection, 5% of the total respondents had worked for less than 5 years and another 38.8% of respondents had worked in the industry for about 6 to 10 years. Other percentages are respectively 18.2% for respondents who had worked for 11 to 20 years, and 4.1% of respondents who had worked for more than 20 years. In term of company establishment, 53.7% of the companies had been established for more than 20 years. The second highest are the companies that has been established between 11-20 years, which represent 23.1%. While 14% of the companies involved in this study were established under 5 years and 9.1% were established around 6 to 10 years. More than half of the respondents which represent 62.8% mentioned that their company has specific policy on reuse and recycle. While 37.2% of the contractors do not have a policy in term of reuse and recycle waste at the construction site. However, based on the data that had been analysed, almost 76% of the respondents mentioned that the company that they represent had an objective to implement reuse and recycle method although they do not have a policy on this method. Only 24% of the respondents mentioned that their company do not have an objective in implementing waste management (reuse and recycle). The percentage of companies that adopted a procedure of reuse and recycle of waste building materials according to the respondents are 66.9%. The remaining 33.1% of the companies according to the respondents mentioned that they did not have procedures in implementing reuse and recycle of construction waste material.

5.2 Reuse and Recycle Implementation at Construction Site

Almost of the respondents involved in this research understand the concept of reuse and practice it on construction sites although the company that they represent do not have a clear policy and procedure on reuse and recycle. 92.6% of respondents practice the reuse of waste materials to eliminate waste, save costs, and others. While only 7.4% of respondents failed to implement the concept of reusing waste materials. From the data analysis, this research found that 53.7% of the companies are practising the concept of recycle while 46.3% failed to implement the recycle concept. This result might be due to lack of exposure on the concept of recycling among respondents. There are various obstacles which led respondents do not practice the concept of recycling at the construction sites.

5.3 Mean Analysis

For the descriptive analysis, based on the data collected from the questionnaire, the mean score are between 2.50 to 3.49. Description below shows the interpretation of overall mean score.

Table 5.1 : Mean Value Description

Mean Value	Description
1.00 to 1.49	Practitioners do not agree with the application of reuse and recycle in local construction industry
1.50 to 2.49	Practitioners neutral with the application of reuse and recycle in local construction industry
2.50 to 3.49	Practitioners agreed with the application of reuse and recycle in local construction industry
3.50 to 4.00	Practitioners strongly agreed with the application of reuse and recycle in local construction industry

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Table 5.2 : Mean Value

Section	Independent Variables	Mean
B	Waste Management (Reuse and Recycle) Effectiveness	3.877
C	Reduce and reuse application level in the organization	2.977
D	Reduce and reuse relevant policy	3.845
E	Technology and techniques that are being used	3.676
F	Awareness of other relevant stakeholders related to reduce and reuse	3.004
G	Reuse and reduce Systematic Implementation	2.620

In terms of reuse and recycle in companies, the mean value recorded was 2.977. This shows the mean value of reuse and recycle is still at a moderate level.Respondents further agree that the existing policy regarding reuse and recycle is compatible with the encouragement given by the authorities and the mean value recorded was 3.845.Currently, for respondents who practiced reuse and recycle, they stated that the techniques and technology used are effective and mean value recorded was 3.676.However, overall, respondents representing contractors still have a level of awareness on the medium level with average mean score of 3.004.Based on the mean value specified above , respondents overall mentioned that at present, systematic approach of reuse and recycle by contractors is still at a low level with a mean value of 2.60.

5.4 Correlation Analysis

Correlation analysis was used to describe the strength and direction of the linear between the relationships of the two variables.

Table 5.3: Correlation Strength

Range r	Level of Correlation Strength
1.0	Very Good
0.9 – 0.7	Good
0.6 – 0.4	Moderate
0.3 – 0.1	Weak
0.0 Zero	(No)

Table 1.4 : Significant Strength

Range p	Level of Significance Strength
Less than 0.050	Significant
Higher than 0.050	No Significant

A. Waste Management Effectiveness

Table 5.5 shows the management correlation value is 0.525 and sig. (P – value) is 0.000. Results showed that this correlation is moderated and the relationship is significant. Thus the study accepted the null hypothesis (H0), and reject the alternative hypothesis (HA).

Table 5.5 : **. Correlation is significant at the 0.01 level (2 - tailed)

		Reuse and reduce Systematic Implementation	Waste Management (Reuse and Recycle) Effectiveness
Reuse and reduce	Pearson Correlation Sig.	1	.525**

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Systematic Implementation	(2-tailed) N	 121	.000 121
Waste Management (Reuse and Recycle) Effectiveness	Pearson Correlation Sig. (2-tailed) N	.525** .000 121	1 121

B. Reduce and Reuse Application Level In the Organization

From Table 5.6 shows the correlation value is 0.368 and sig. (P - value) is 0.000. The results show the strength of this correlation is weak and the relationship is significant. Thus the study accepted the null hypothesis (H0), and the alternative hypothesis is rejected (HA).

Table 5.6 : **. Correlation is significant at the 0.01 level (2 - tailed)

		Reuse and reduce Systematic Implementation	**Reduce and Reuse Application Level In the Organization**
Reuse and reduce Systematic Implementation	Pearson Correlation Sig. (2-tailed) N	1 121	.368** .000 121
Reduce and Reuse Application Level In the Organization	Pearson Correlation Sig. (2-tailed) N	.368** .000 121	1 121

C. Reduce and Reuse Relevant Policy

Table 5.7 shows the correlation is 0.634 and sig. (P - value) is 0.000. The results show the strength of the correlation is good and the relationship is significant. Thus the study accepted the null hypothesis (H0), and the alternative hypothesis (HA) is rejected.

Table 5.7 : **. Correlation is significant at the 0.01 level (2 - tailed)

		Reuse and reduce Systematic Implementation	**Reduce and Reuse Relevant Policy**
Reuse and reduce Systematic Implementation	Pearson Correlation Sig. (2-tailed) N	1 121	.634** .000 121
Reduce and Reuse Relevant Policy	Pearson Correlation Sig. (2-tailed) N	.634** .000 121	1 121

D. Technique and Technology

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Table 5.8 shows the correlation is 0.670 and sig. (P - value) is 0.001. The results show the strength of the correlation is good and the relationship is significant. Thus the study accepted the null hypothesis (H0), and the alternative hypothesis (HA) is rejected.

Table 5.8 : **. Correlation is significant at the 0.01 level (2 - tailed)

		Reuse and reduce Systematic Implementation	**Technique and Technology**
Reuse and reduce Systematic Implementation	Pearson Correlation Sig. (2-tailed) N	1 121	.670** .000 121
Technic and Technology	Pearson Correlation Sig. (2-tailed) N	.670** .000 121	1 121

E. Stakeholders Awareness

Table of 5.9 shows the correlation is 0.907 and sig. (P - value) is 0.001. The results show the strength of the correlation is good and the relationship is significant. Thus the study accepted the null hypothesis (H0), and the alternative hypothesis (HA) is rejected.

Table 5.9 : **. Correlation is significant at the 0.01 level (2 - tailed)

		Reuse and reduce Systematic Implementation	**Stakeholders Awareness**
Reuse and reduce Systematic Implementation	Pearson Correlation Sig. (2-tailed) N	1 121	.907** .000 121
Stakeholders Awareness	Pearson Correlation Sig. (2-tailed) N	.907** .000 121	1 121

6. Conclusion and Recommendation

There are some findings found from this research. From the correlation analysis, the result could be concluded that the entire hypotheses are positively associated with the implementation of systematic implementation of reuse and recycle practices in the construction industry. Based on overall results, found stakeholders awareness variable have very strong relationship with 0.907 value. The table shows a list of hypotheses with 'r-value' and 'p-value':

Table 6.1 : List of the Hypothesis with the Values of r and p

	Alternative Hypothesis	**r**	**p**	**Result**
HA 3(1)	There is a positive relationship between Waste Management (Reuse and Recycle) Effectiveness and Reuse and reduce Systematic Implementation	0.525	0.000	Significant
HA 3(2)	There is a positive relationship between Reduce and Reuse Application Level In the Organization and Reuse	0.368	0.000	Significant

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	and reduce Systematic Implementation			
HA 3(3)	There is a positive relationship between Reduce and Reuse Relevant Policy and Reuse and reduce Systematic Implementation	0.634	0.000	Significant
HA 3(4)	There is a positive relationship between Technic and Technology and Reuse and reduce Systematic Implementation	0.670	0.010	Significant
HA 3(5)	There is a positive relationship between Stakeholders Awareness and Reuse and reduce Systematic Implementation	0.907	0.000	Significant

7. Suggestions and Improvements

Based on the research findings, among the suggestions and views obtained are including unskilled workers and professional in the construction projects should have knowledge and skills to handle construction materials and must practice waste management especially when they are at the construction site. The respondents also suggested that the waste management approach of construction materials are included in the contractual obligations towards more efficient waste management. At the same time, the local authorities are encourage to increase the numbers of Recycling Site specifically on construction waste materials. Other suggestions towards improving the waste management approaches are include :

i. Makes reuse and recycling more simple and easy to practice.
ii. Provide appropriate disclosure to the parties involved on reuse and recycle.
iii. Providing guidelines, criteria, methods of work, checklists, and related training.
iv. Increase agency/organization to monitor the reuse and recycle management at the construction sites.

Based on respondents' views, they are concerned of the basic knowledge related to the implementation of the reuse and recycle approaches at the construction sites.

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Biography

Wan Nadzri Osman obtained a Bachelor of Science in Housing Building and Planning (HBP) from Universiti Sains Malaysia (USM) in Construction Management in 2006 and subsequently obtained a Master of Science in Project Management in 2007 also from the same university. After graduation, he started to work as a Research Assistant in the School of Housing, Building and Planning. Subsequently served as Corporate and Logistics Manager in Kolej Teknologi dan Antarabangsa (KTP) before joining Universiti Utara Malaysia (UUM) in the School of Technology Management and Logistics (STML) and subsequently completed a PhD in 2013 in the field of Technology Management. Currently a senior lecturer in STML and seconded to the Centre for University-Industry Collaboration (CUIC) in 2014 as Chairperson for Innovative-Industrial Collaboration Division. In 2011, research grants with the title of Supply Chain Management In Construction Industry has won the best research in UUM. Have a keen interest in research primarily involves the construction field, including Sustainability in construction, Green Technology Practices in the construction, Waste Management in the construction industry as well as Value Management in construction projects.

Mohd Nasrun Mohd Nawi is an Associate Professor and he is a specializes in the area of integrated design and construction management. He holds a PhD the field of Construction Project Management from the University of Salford, UK. As an academician and a fully qualified Building Surveyor, he has been active in research and consultation works relating to the areas of Industrialised (offsite) and Modern Method of Construction, Integrated Design Delivery Solution (i.e. Integrated Project Delivery, Lean Construction, Building Information Modelling), Sustainable (green) Construction, Life cycle costing & Value Management, Building Performance (i.e. Energy Management and Audit) and Management of Technology. Besides being involved actively in various academic activities, he is also an active author with various publications especially in the area of Construction and Technology Management.

Rohaizah Saad is a Senior Lecturer in School of Technology Management and Logistics (STML). She obtained her PhD in management at UUM and specialized in Quality Management, Quality Tools and Continuous Improvement activities. She joined UUM in May 2006 and lectured for undergraduates, postgraduates and supervises the Phd and DBA candidates. Besides her academic achivements, Dr Rohaizah is also a Member of Malaysia Institute of Management (MIM). Currently, she is appointed as Malaysian Qualifications Agency (MQA) Assessment Panel for Management and Operation Management Programs. Her main research area and publications are in Quality Management Continuous Improvement activities. Prior joining UUM as academician, Dr Rohaizah was with the industries for 20 years started as an Assistant Accountant, Accountant, Finance and Admin Manager and Quality Manager in various industry among all manufacturing, financial and distribution organization. Her working experience also include as key senior staff of the ISO 9001 team. She help organization to be certified with ISO 9001. After that she become ISO 9001 consultant to few of organization such as Gah Manufacturing Sdn Bhd.

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