MANAGING WASTE IN REFURBISHMENT PROJECTS IN KLANG VALLEY

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Abstract
Waste has been a major problem in the construction industry. Not only waste has an impact on the efficiency of construction industry but it also causing negative impact to the environment and moreover the total project cost. There are a lot of researches on sustainable construction industry but not they are not related it with refurbishment project in details. Parties involve in refurbishment project encounter numerous causes of waste generation and uncertainty in managing waste. This papers aims to identify variable that contribute to waste in refurbishment projects and implementation of effective waste management in construction industry. A questionnaire survey to 172 respondents has conducted to several professions in refurbishment projects. The methodologies used are by survey. Through survey and analysis processes, all the collected data were analyzed using quantitative statistical analysis package software. The correlation tests between the dependent, intervening and independent variables would determine the relationships among of the group of variables shown in theoretical framework. Once the survey revealed waste contribution factors and the effectiveness of waste, a set of findings and recommendations are proposed for better handling waste management in refurbishment projects. The recommendation listed out and discussed will enhance the waste minimization for the construction industry and hopefully the readers of this research could find something useful information for their own ongoing or future refurbishment projects.

Key words: Refurbishment waste, waste causes, waste management.

INTRODUCTION

Waste produced in construction sector has become a critical issue in cost performances and also causing negative impact to the natural. This is because of waste occurs in lifecycle of buildings, construction stage, maintenance, renovation, refurbishment, restoration and demolition phases. It has become a serious environmental problem in both developed and developing country. For an example in United Kingdom, Esin and Cosgun (2007) has reported that, typical landfill in UK could be over 50% of construction waste. Pollution occurred in most of the construction activities carried out that required electricity, especially during the operation. Mainly waste transportation and waste composition time contributed to air and water pollution in landfill area. Firstly, typical wastage of material in UK construction industry is recorded as being around 10 to 15 percent (McGrath & Anderson, 2000). Similarly study by DETR (2000) estimated at around 70 million tons of construction waste produced per annum due to many varieties of materials used in construction sector. The entire researcher also founded up the evidence shows that landfill around the world were caused by large portion of material due to underutilized materials in construction industry even proving the problem were exists. This can relate to the awareness of waste minimization for construction project is a key success factor in cost efficiency and creating environmental friendly development.

Besides that, Li et al. (2010) have reported that the materials and components dismantled from the building are highly potential to be reused or recycled. With appropriate handling and managing of these wastes, sustainable environment and cost efficiency for the project could be achieved. Egan (1998) stated the only way of achieving better quality and efficiency in construction industry is reducing the waste generation in all stage of construction industry (procurement, material handling, storage, site management and etc.). As the result, lower construction cost driven by importance of construction waste management and material utilization.

Material waste not only negative impact to environment but also added cost to construction project. The addition cost of waste is rather difficult to estimate due to different groups define waste in their own way. The material waste causes impact to environment will indirectly increase the cost of construction too due to the government impose taxes to pollution and waste. In Malaysia the government taxes is least significance.

The cost of waste then transfer to end user and finished product end up selling at higher price with least profit is hard to compete with others in such competitive environment (Macozoma, 2002). Teo and Loosemore (2001) estimated contractors with 10 percent or higher of waste are disadvantage in tendering. This is because the cost for wastage is part of the cost in overall tendered sum. Additional materials, delays, extra work in cleaning and clearing the debris left over and head count costs will reduce the profits for the contractors. Managing waste can increase competitiveness

of the contractor via lower cost and better publicity of the company. However, most of the contractors do not put much attention into the waste or implementation of it (Lam, 1997). This is because of their opinion is to finish or complete the project earlier is a better cost saving rather than managing of waste (Poon et al., 2001).

Statement from Formoso et al., (1999), waste is classified as *"any losses produced by activities that generate direct or indirect costs but do not add any value to the product".* Whereas, Koskela (1992) stated that the construction waste is *"relation to time delays, quality costs, lack of safety, rework, unnecessary transportation trips, long distance, improper choice of management, methods or equipment and poor constructability*". Hassan et al. (1998) has further derived on analysis of wastage of material referring to data for Central region and Southern region in Malaysia. They are 36.73% from household waste, 28.34% from industrial and construction waste, the remaining of 34.93% is others sources like market, commercial waste, institutional waste, landscaping waste and street sweeping waste. From the statistic, it shows Malaysia has large number of construction waste disposed to the landfills despite taking the timing of the sources acquired.

Even existing process of construction debris flow from the category of generation, category of waste, transitional and dumping and the quantum of waste minimization, reuse or recycle data is not readily in Malaysian construction industry, but as common and referring to local authorities in the said regions, waste generated is increasing rapidly annually in Kuala Lumpur, a proper waste management should be implemented in order to reduce the waste. Moreover, construction sector has to responsible in producing different types of waste from construction especially in major infrastructure, commercial, housing and others highly demanded construction activities. The numbers of variety waste is determine by characteristics, such as phases in construction, different types construction work and practice on site has to be managed accordingly to regulations. Failing in doing would lead to abused by some parties in dumping debris into lakes, jungle, rivers, ravines and vacant land. As the result, erosion, contaminates of water, engage pests, produce fire hazards and imperil of aesthetic view of natural.

Resulting of pollution occurred when excessive of waste produced by construction industry is faster than bio decomposed rate. Thus, waste minimization in construction sector in Malaysia is crucial to keeping the natural of environment in the good shape. In one of the development way is implementing refurbishment projects instead of new construction and demolition. The researcher will focus on investigating the relations exist between waste minimization with the total cost of refurbishment projects. Besides that, it will also focus on factors that influence the waste variable in refurbishment works. As the result, from the implementation the waste in refurbishment could be reducing and hence, the total cost of construction will be reduced. This paper is based on a questionnaire that involved refurbishment projects that has carried out in Klang Valley, Malaysia from year 2012 to 2014. The research also includes the economic feasibility of waste minimization by recycling the construction waste materials.

Waste generation from construction industry in Malaysia relative contribute to the overall national waste burden. Thus, the awareness towards waste minimization for construction has become a vital issue in the sector (Begum et al., 2007).

REFURBISHMENT PROJECTS

Refurbishment waste can be divided into three major categories: material, labor and machinery waste. However material wastage is one of the most concerns because most of the raw materials from construction are derived from non-renewable resources. For an example, timber formwork derived from wood, which is a non-renewable resource.

According to Mansfield (2001) quoted that there are more than 20 descriptions that are currently used to describe attempts to redress the effects of depreciation for refurbishment. Generally refurbishment is located toward the end of a property's life cycle. Overall purpose of refurbishment is to extend the beneficial use of an existing building by providing a cost-effective alternative to redevelopment (Markus, 1979) and improving the aesthetics of the existing buildings (Adair et al., 2003).

Recent studies in the UK have demonstrated the sustainability benefits of office refurbishment when compared to demolish and rebuild (Anderson and Mills, 2002). In many areas of the world the desire for more sustainable building practice is one of the factors driving the trend towards renovation and refitting of existing building premises rather than new construction (Balaras 2002).

In addition to the environmental imperative, property values and planning restrictions are combining to make renovation an economically attractive alternative to demolition and rebuild, especially on Central Business District (CBD) sites. All refurbishment, however, generates some

amount of solid waste and generally this is at a higher rate than new construction for a given floor area.

According to Hamilton (2003), there are many buildings are wrongly used in Malaysia. These phenomenon will results the building to become dilapidated. In additional of improper maintenance carried out which lead to building deterioration and the rate of wear and tear also increased.

In the other hand, the new constructed buildings for the past four decades has created a situation that there are many buildings available to refurbish and reuse (Shah and Kumar, 2005). Furthermore, high land prices in city center or developed area has resulted limitation of land for new development. These strategic areas normally have been occupied by people and difficult to acquire. As the result, refurbishment works has considered as the best option compared to the others alternatives.

EFFECTIVE WASTE MINIMISATION IN REFURBISHMENT PROJECT

The excessive wastage of raw materials, improper waste management and low awareness of the need for waste reduction are common in the local construction sites. Coffey (1999) has proposed several waste management strategies. He stated that construction solid waste management is generally seen as a low priority when financial constraints are present. He added that, considerable waste reduction can be achieved if waste management is implemented as part of project management functions. Here the waste implementation in waste management plan will be study and discuss the efficiency several types of waste implementations.

The principal incentive for waste minimization on construction sites remains an economic one. However studies have shown that there other driver of waste minimization initiatives and that the workforce can take ownership of these issues and actively participate in waste management (Lingard *et al*. 2001). One of these is site safety. A well organized, controlled and monitored construction site where materials inflows and outflows are carefully tracked is likely to have fewer problems with accident and injury due to trips and falls. Also a frugal attitude towards materials can encourage the whole workforce on site to look for efficiencies and savings and to consequently avoid waste. The desire to minimize the environmental damage done by construction waste has led to the development of systems for assessing, tracking and managing such waste (Cheung *et al.* 2004). This trend has been observed in several countries and appears likely to continue (Lockwood 2006).

Techniques or factors of waste minimization are known as variable in this research. Variables are then will be further investigate in relation between the project performances which is the cost of the project.

From the study, the researcher finalize that Tam (2008), the effective measures in implementing waste management variables are closest to the objective for this research. As the result, the researcher took the following variables into this research.

i. Use of prefabricated building components
ii. Purchase management
iii. Education and training
iv. Proper site layout planning
v. On-site waste recycling operation
vi. Implementation of environment management systems
vii. High level management commitment
viii. Install underground mechanical wheel washing machines
ix. Identification of available recycling facilitate
x. Use of metal formwork

There is a survey done in the report from Tam (2008) by relating the relative importance index for effective measures in implementing waste management plan method. The result is shown in Table 1.

Table 1: Relative importance index for effective implementation

Effective measures in implementing a WMP Method	Σ_w	Relative importance index	Ranking
Use of prefabricated building components	306	0.805	1
Purchase management	294	0.774	2
Education and training	294	0.774	2
Proper site layout planning	290	0.763	4
On-site waste recycling operation	288	0.758	5
Implementation of environmental management systems	280	0.737	6
High level management commitment	278	0.732	7
Install underground mechanical wheel washing machines	256	0.674	8
Identification of available recycling facilitate	254	0.668	9
Use of metal formwork	244	0.642	10

(Source: Tam, 2008)

According to Tam, (2008), 15 variables in encouraging the adoption of the waste implementation method are identified as shown in Table 1, ranked by the relative importance index. By using the relative importance index, ‘‘Use of prefabricated building components’’ is considered as the major effective measure to implement the method. After that, it comes to “Purchased management” and “Education and training” in second places. “Proper site layout planning” is in fourth place and the following is by “On-site waste recycling operation” in fifth place. As show in table 1, “Implementation of environmental management system” is in sixth place and “Install underground mechanical wheel washing machines” is in eighth place, but these two measures were not popular in the field of this research, so as the result, “High level of commitment” and “Identification of available recycling facilities” is take into the variable for this research. At last but not least, “Use metal formwork” consider as variable in this research due to the existing condition of refurbishment projects. This is due to in Malaysia’s construction content is still using timber formwork and only large scale project used metal formworks. Therefore, is significant to figure out the two differences of these formworks.

RESEARCH METHODOLOGY & DATA ANALYSIS

The general data collection techniques for quantitative research are secondary date sources, objectives measures or test, semi-structured interview questions and structured survey questionnaires. The data collection techniques adopted for this study were secondary data source and surveys. There are two general types of data – primary and secondary.

Measurement on the different variables that contribute to waste in refurbishment projects are identified and developed. This research is involves questionnaires as a tool for gather the required data in the study. All the collected data were analyzed using quantitative statistical analysis package software. The correlation tests between the dependent, intervening and independent variables would determine the relationships among of the group of variables shown in theoretical framework. The study also provides an understanding on the factors that contribute to waste in refurbishment projects.

From 191 questionnaires, 10 sets return without answers are the contractor refuse participate due to certain reason and another 9 respondents were rejected because did not follow the instruction given and some questionnaires had incomplete answers.

Table 2: The Portion of Questionnaire Surveys

Description	Frequencies
Number of questionnaire distributed	191
Questionnaire sets return without answers	10
Questionnaire answered, but were rejected	9

FINDINGS AND DISCUSSION

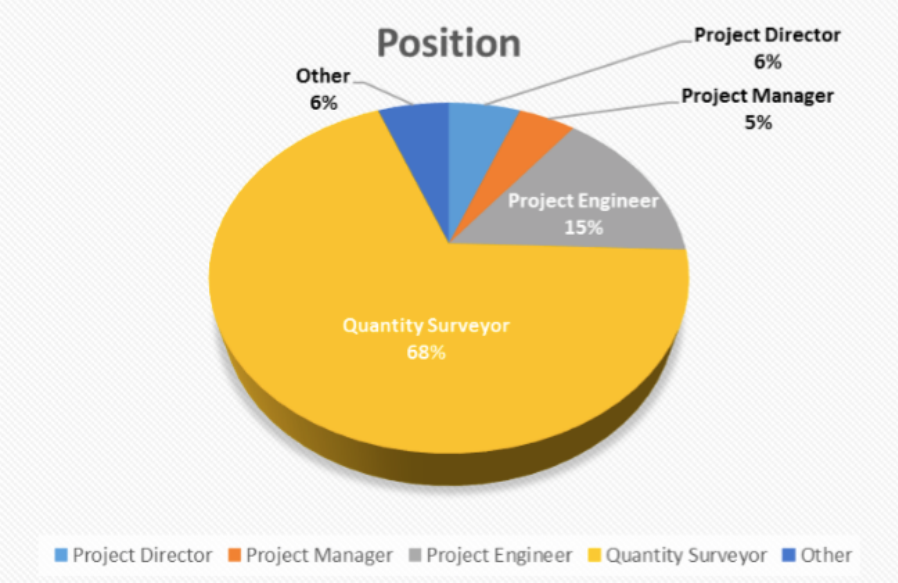

Figure 1: Position/designation in the refurbishment project.

From Figure 1, majority of 68% out of 172 respondents are from quantity survey position, second biggest group are project engineer where contributed 15%. The third is project director and project manager where consist of 6%. Others position like supervisor, safety officer and others are

consist of 6% as well. The last is project manager where only 5% out of 172 respondents only. Quantity surveyors are the major position in this survey; this is a good sign for this survey due to the performance in this survey is measure by cost. Quantity survey is the contract people in the project, and this particular group of people having the most reliable outgoing cost data in the project. Besides that, quantity survey have better knowledge in the waste affected the cost of project. In this mixture of questionnaire respondents, the researcher believes it would produce out a reliable result for this research.

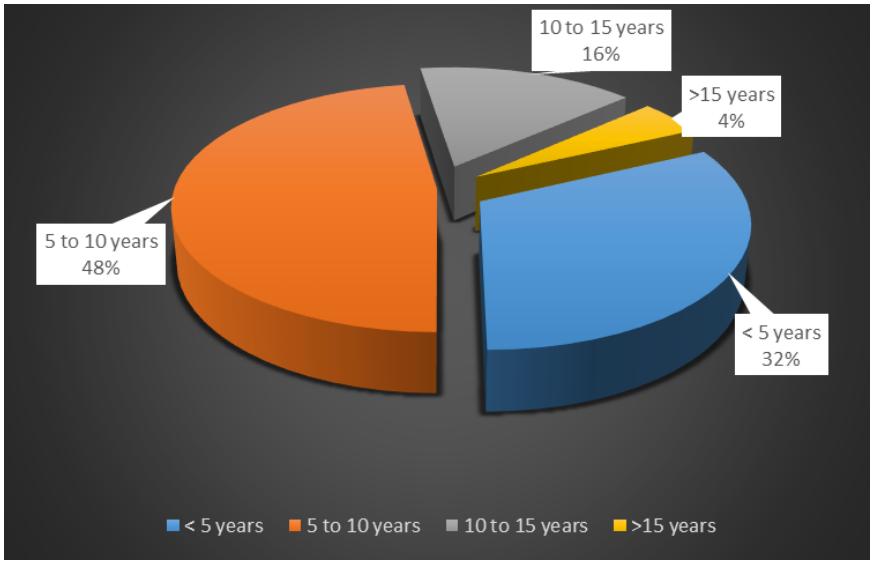

Figure 2: Experiences in refurbishment project

Figure 2 presents baseline estimation of differences of the 172 respondents of contractors in experiences in refurbishment projects. Majority in total of 48% respondents are 5 to 10 years experiences, 32% with less than 5 years experiences, 16% is in between 10 to 15 years experiences and 4% with more than 15 years of experiences in refurbishment projects.

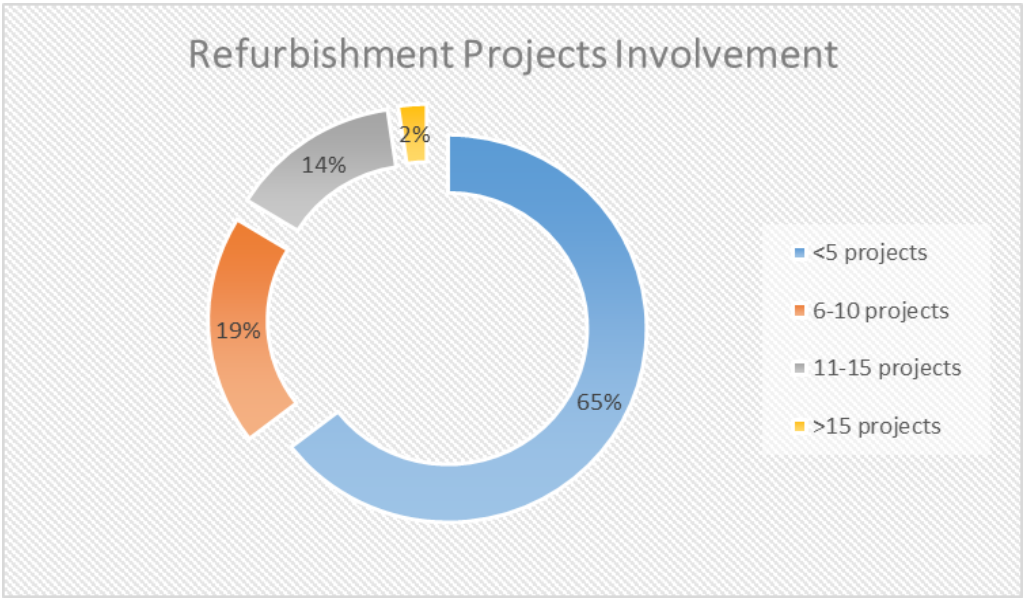

Figure 3: Refurbishment Projects Involvement

Figure 3 shows the different numbers group of refurbishment projects that the respondents have involved. Majority total of 65% respondents are less than 5 projects. This indicates that average of each refurbishment project is 2 years if comparing with the majority of respondents refurbishment

experience. 19% as second major in between 6 to 10 projects, then followed by 11 to 15 projects consist of total 14% and last but not least 2% respondents have more than 15 projects.

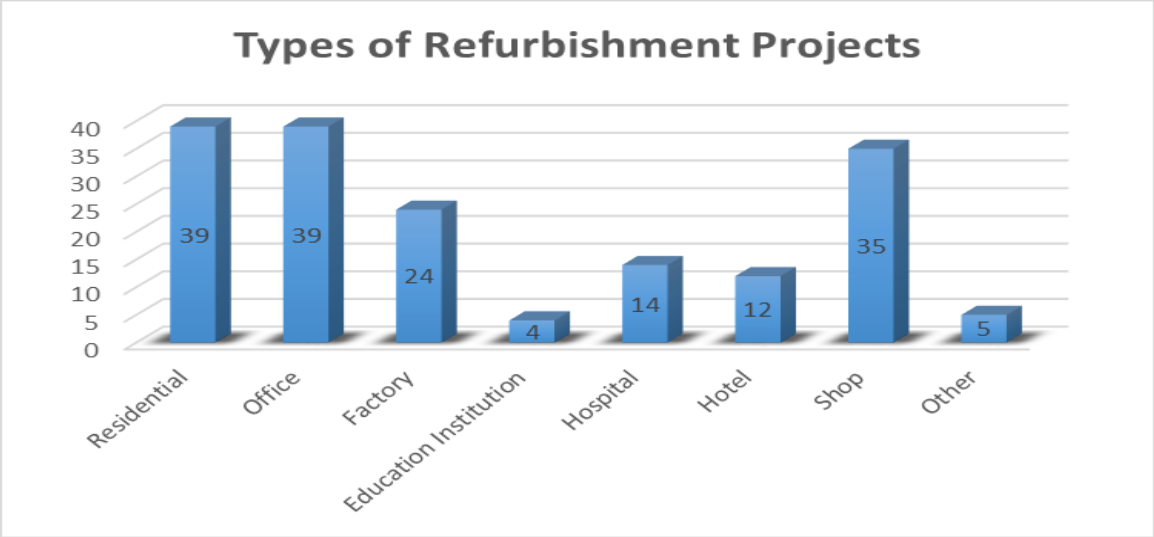

Figure 4: Types of Refurbishment Projects

Figure 4 shows the number of refurbishment projects in different type of industrial building in the survey. The figure provides information for the readers on clearer picture in what type of refurbishment projects in this research such as residential, offices, shops and etc. as above. Residential, office and shop categories are the majority in this survey. The "other" category is shopping malls, community hall and temples.

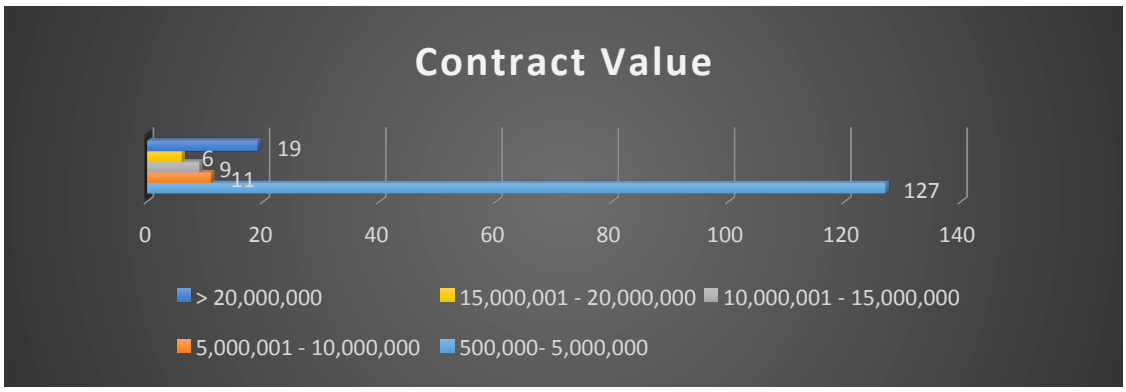

Figure 5: Contract Value of the Selective Project

Figure 5 indicates the level of contract value of refurbishment projects. Majority number of 127 respondents in this survey is RM 500,000-5,000,000 contract value. High numbers in this level of contract value is mostly from residential, offices and shops refurbishment projects. The second highest consist of 19 respondents with more than RM 20,000,000 contract value which consists of shopping mall, hotel and factory, follow by third highest with number of 11 respondents in between of RM 5,000,001 to RM 10,000,000 contract value. Then follow by 4th with number of 9 respondents in between of RM 10,000,000 – 15,000,000 contract value. The lowest number of 6 respondents in between of RM 15,000,001 to RM 20,000,000 contract value.

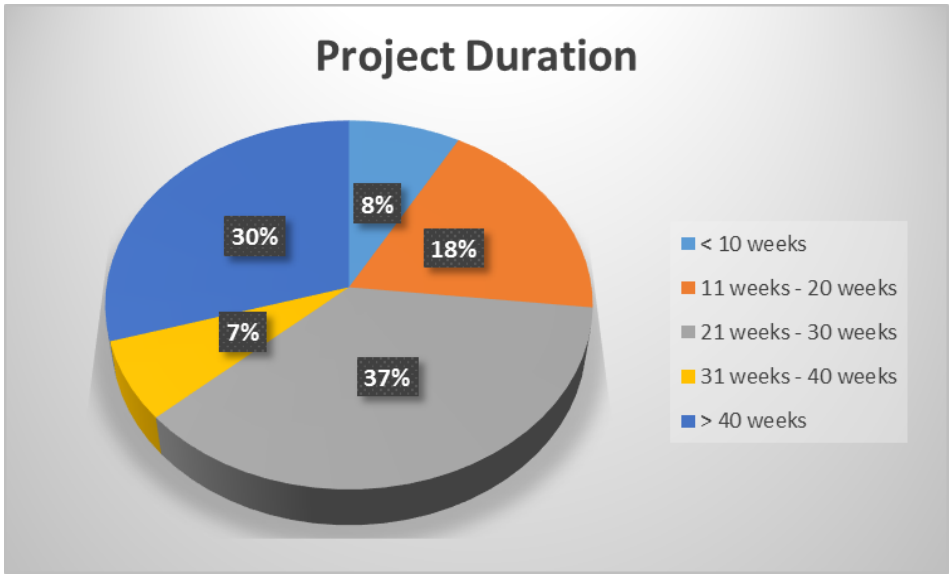

Figure 6: Project Duration

Figure 6 shows that 37% majority of the projects are completed between 21-30 weeks duration, and it is consider normal for refurbishment project to be completed within 21-30 weeks. The second highest 30% falls in more than 40 weeks duration. Third highest 18% of projects are completed in 11-20 weeks, follow by 8% falls in less than 10 weeks, last is 7% falls in between 31-40 weeks duration.

Table 3: ANOVA Analysis for Waste Minimization

ANOVA		
	F	Sig.
Use Prefabricated Material	.112	.953
Purchasing Management	3.959	.009
Education Training	2.489	.062
Proper Layout Planning	.472	.702
Recycle on Site	.352	.788
High Level Management	.045	.987
Recycle Facilities	2.982	.033
Metal Formwork	7.442	.000

Sig. ≤ 0.05, there is a relationship with waste minimization in refurbishment

The researcher is analysis the relationship in between the waste minimization variables with refurbishment project. The method to carry the relation is using Anova in SPSS 16.0.1. Table 3 is summarize for the Anova results between variables with the refurbishment project.

From Table 3, the highlighted factors which are sig. value ≤ 0.05 and there are “Purchasing Management”, “Recycle Facilities” and “Metal Formwork”. From this result, it can conclude that these waste minimization is highly affects and contribute to effectiveness of waste minimization in refurbishment projects.

From the analysis of previous chapter on variable with project performance, it founded that the “Metal Formwork” is most significance. Peng and Scorpio (1997) has supported that reduction of construction waste is one of the best solutions. Reduction is the best and most efficient method for minimizing the generation of waste and eliminating many of the waste disposal problems. Formwork used were made by metal, it can be recycle and reuse it again and again. As the result, the waste can be reduced. Reductions in waste and environmental merits result through using less timber formwork, less wet trades being carried out on site, resulting in less water pollution, less noise nuisance being generated from reduced construction activities and other overall improvements in waste management as well as waste disposal.

The second significance is “Purchase Management”. Purchase management is the management of purchasing material for construction process. The key of success in this management

is on client where by the when purchasing the raw material it has to consider the factor what would lead to waste generation. Tam (2008) states that "Purchase Management" is considered as one of the most effective measures to implement waste management plan compare to the others method that mentioned in the paper. By having effective purchase management, waste can be reducing from extra-over purchased of materials effectively.

According to Dainty & Brooke (2004), client always requested for effective waste performances from the main contractors where the requirement has to channel to the down line (subcontractors and suppliers). Specialist contractors are compulsory to responsible in applying waste management strategy to adopt the project waste management plan. It is common that the more familiar of the industry or scope of work, the more effective measures can be carried out on site.

The third is "Identification of Available Recycling Facilities". This is the method of knowledge on the recycling facilities available in site. It is analyzing that is significance to contribute more to the actual cost of the project. As the assumption of the researcher, this implementation is same as "On-site Recycling Operation" which is both giving negative impact to actual cost of project. From chapter 2, these two variables are identified to be benefit for the cost of project, Begum et al. (2007) reported that the study on demonstrates huge amount of household waste were from construction generated waste. Therefore, as much as 73% of wastage of material is reused and recycled due to the waste minimization is common in construction site. This is economically due to the advantages from the reuse and recycle waste material rate is approximated at 2.5% of the total construction cost. Thus, the sector can contribute to cost saving by carrying waste minimization practices on the site. However, the result come out from analysis is harmful to the cost of project. In the researcher opinion, these implementations have high level of understanding and need to be knowledgeable to apply in construction industry of Malaysia.

Table 4: Reliability Statistics for Waste Minimization

Reliability coefficient	Value
Alpha	0.800

Reliability test is conducted to ensure that the questions designed in the questionnaire are reliable and able to provide information about the relationships between individual items in the scale. Reliability is also an assessment of the degree of consistency between multiple measurements of a variable. The objective is to ensure that responses are not too varying so that measurement taken is reliable. The most frequently used measure of reliability is internal consistency, which applies to the consistency among the variables in summated scale.

In this study, Cronbach's coefficient alpha was used to test the reliability of the 16 and 8 variables that are used in the Correlation analysis. From the analysis, the value is 0.838 and 0.800 respectively. This value clearly explained that the questionnaire has the degree of reliability of 80% and above. This result also proved that the primary data obtained from the questionnaires can be relied upon and is suitable for analysis.

CONCLUSION & RECOMMENDATION

Waste management is a critical issue in Malaysia construction industry, the reason being that the industry is one of the biggest generators of pollution, In fact it is critical issue for all the country around the world. This study has determined the important and significant factors that waste implementation with total cost of project.

The objective in this research is to examine the relationship between waste of materials and cost performance in refurbishment project. From the questionnaire surveys the results show that with a proper way of waste minimization, the actual cost of project could be reduced.

The survey provides effective waste minimization in refurbishment projects to readers. From ANOVA Analysis, "Metal Formwork", "Purchase Management" and "Recycling Facilities" is significance to waste minimization in refurbishment projects. This study provides empirical evidence on the significant level of contribution and the level of practice among the waste minimization factors. The findings will assist in the formulation of appropriate policy interventions in addressing the waste management problem in Malaysia and indirectly improving the quality of refurbishment project in the country.

Waste reduction can be achieved by implementation waste management plan. A details of waste management has to be listed out and input to every parties involved in order to enhance the knowledge in waste minimization process or better understanding in reuse of materials in design and construction stages respectively. Even though each of the refurbishment projects are unique, this

comprehensive results can provide an informative information, solutions and appropriate approach to the readers.

Moving forward with waste minimization in refurbishment requires a through source evaluation of design waste, which should set out to influence a change to a waste reduction design paradigm. Thus, these implementations should be helpful to total cost of project and waste management planners as well as to policy makers as they manage waste in order to reduce environmental pollution and hopefully improve performance within the industry.

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