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REDUCE, REUSE, RECYCLE AND RECOVERY IN SUSTAINABLE
CONSTRUCTION WASTE MANAGEMENT

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UNIVERSITI TEKNOLOGI MALAYSIA

REDUCE, REUSE, RECYCLE AND RECOVERY TECHNIQUE IN
SUSTAINABLE CONSTRUCTION WASTE MANAGEMENT

MOHD FIRDAUS BIN MUSTAFFA KAMAL

A project report submitted in partial fulfillment of the
Requirements for the award of the degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
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MAY, 2009

'I declare that this project report entitled "Reduce, Reuse, Recycle and Recovery Technique in Sustainable Construction Waste Management" is the result of my own research except as cited in the reference. The project report has not been accepted for any degree and is not currently submitted in candidature of any other degree.'

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Date : 6th MAY 2009

To my beloved mother, father and wife

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ABSTRACT

Construction industry consume substantial amount of raw materials in the process and the output is obviously the product and most importantly the waste material. Other than that, construction industry is well known as one of the worst environmental polluters. This study is to determine the use of waste minimization technique in creating sustainable waste management in order to identify the technique which has the most capabilities to reduce waste on-site. The objective is to assess the waste minimization techniques taken from the 4R concept which is reduce, reuse, recycle and recovery technique in minimizing the waste in construction waste management. Questionnaire has been distributed randomly across the district of Johor Bahru, and the data has been analyzed using Statistical Packages for Social Science (SPSS) software to determine whether the output meet its original objective. The most used waste minimization technique found in 4R concept would be the waste reduction. This shows that local construction industry has the awareness to plan out the waste management planning but the implementation is still far from satisfying. This is has been proven with the result of second objective which shows that none of the techniques tested in the 4R concept gave a significant relationship in minimizing the waste produced on site. However among four techniques tested for this research, waste recycle gave significant difference. This shows that physical profit gave reasoning for the construction practitioners to adapt to this technique because the nature of the industry which is profit making.

ABSTRAK

Industri pembinaan menggunakan bahan mentah yang banyak dalam menghasilkan sesebuah pembangunan dan hasilnya ialah sebuah produk dan yang paling penting ialah penghasilan bahan buangan. Industri pembinaan juga terkenal sebagai salah satu sektor yang menyumbang kepada pencemaran alam sekitar. Kajian ini dijalankan bertujuan mengenalpasti penggunaan teknik meminimakan sisa bahan binaan dalam membentuk sistem bahan buangan lestari bagi mengetahui teknik yang manakah berkemampuan untuk mengurangkan sisa di tapak bina. Objektif utama adalah untuk menilai teknik meminimakan sisa yang diambil dari konsep 4R iaitu pengurangan sisa, guna semula sisa, kitar semula sisa dan perolehan semula sisa dalam meminimakan penghasilan sisa dalam sistem pengurusan sisa buangan pembinaan. Borang soalselidik telah dihantar secara rawak kepada industri pembinaan di kawasan Johor Bahru dan data yang diperolehi telah dianalisa menggunakan perisian Statistical Package for Social Science (SPSS). Daripada analisa ini, teknik yang kerap digunakan adalah pengurangan sisa bahan. Ini menunjukkan industri pembinaan tempatan mempunyai kesedaran dalam merancang pengurusan sisa bahan tetapi masih gagal untuk melaksanakan. Ini dapat dibuktikan melalui objektif kedua di mana tidak terdapat satu pun perhubungan yang signifikan diantara teknik dalam konsep 4R dalam penghasilan sisa bahan ditapak. Walaubagaimanapun, kitar semula bahan mempunyai perbezaan antara keempat – empat teknik yang diuji. Keputusan ini menunjukkan keuntungan secara fizikal memberikan sebab yang baik untuk mereka mengamalkan teknik ini bersesuaian dengan fitrah semulajadi sektor ini yang mementingkan keuntungan.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Traditionally, construction management has concern itself with time, cost and quality. In view of increasing concerns about the environment, a fourth dimension should now be added. The environment is a major issue that affects everyday life and the level of awareness is steadily increasing as people become better informed to recognize the influence of both global and local environmental impacts on their quality of living (Joseph S.L., 2000).

Construction industry professionals are not ignorant of the need to consider the environment, but their focus is different. Many clients or contractors take the environmental issues into account only from their business benefit point of view. For example, they often consider the protection of construction components or activities or resources from the effect of the environment. Few give serious consideration to the effects on the overall environment. Mainly, this is because it is the tradition that construction management work has three dimensions which is time, cost and quality.

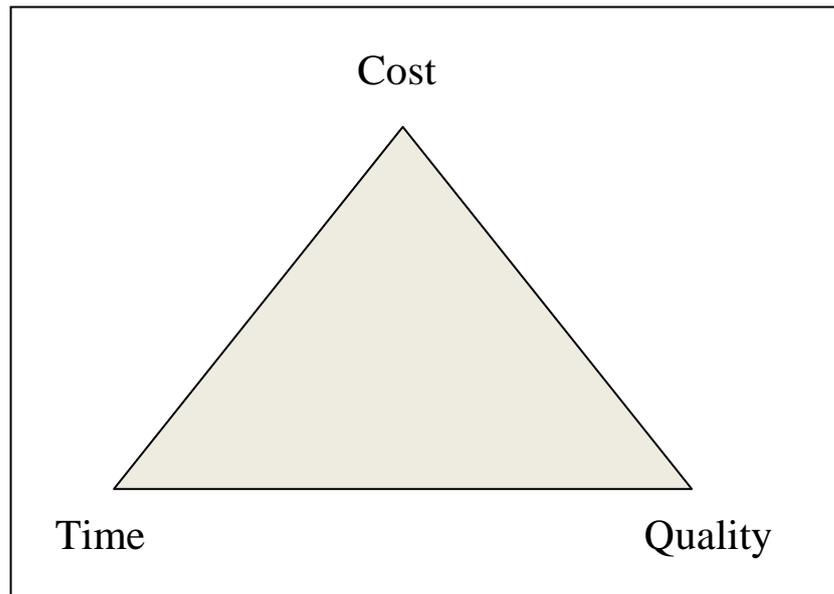


Figure 1.1: Construction Management with Three Dimensions

A “dimension” means a measurable direction or content with variable sizes, whereas objective is a certain thing without varying degrees. This traditional approach pays little attention to the environment but as environmental issues are given greater concern by all sectors in the society, this historical model has less value for future project success.

It is time that the management of environment dimension be integrated with management of cost, quality and time as illustrated in figure 1.2. Hence, the project should be assessed in four dimensions. Overall environment should be taken as a daily planning issue in construction management just like cost, time and quality issues. (Bagnall, 1992).

Within the new management system, cost, time and quality still remain the critical success factor, but a significant contribution will need to be made to examine the internal and external environmental factors, investigate their relevance to the construction and operation of a project and take actions against any pollution causes and effects.

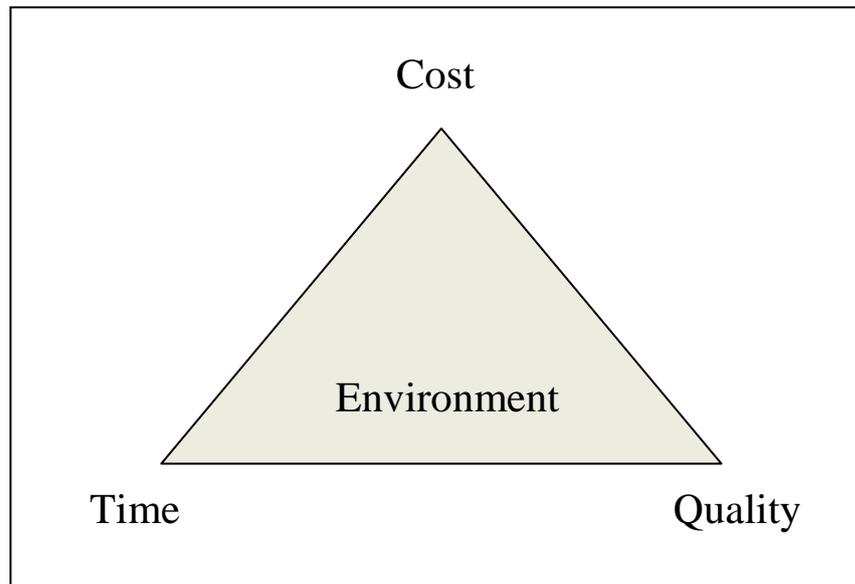


Figure 1.2: Construction Management with Four Dimensions

One of the causes of pollution is it waste produces. In order to do so, this research will focus on the 4R' concept which are the reduction, reuse, recycle and recovery of waste. The best approach to manage construction waste is to minimize it at the source before it becomes physical problem. Reduction at the source could be implemented almost throughout the project phase from initial work to handing over of the projects. Reduction focus more on preparing adequate and accurate planning of material used on site in order to reduce the waste produce.

Reuse techniques is defined as re-employment of materials to be reuse in the same application or to be used in lower grade applications. The contractor has the major responsibility for adopting the reuse techniques in the project. Materials such as wood, earthworks, steel, concrete, masonry, tiles, plasterboard, insulation materials, paints, solvent and carpets can be profitably reused on the construction site.

Recycle technique is defined as utilizing wastes as raw materials in other applications. Recycle endeavors can be successfully utilized during the construction phase. The party responsible at this stage is the contractor.

A recovery technique is a process of generating energy from waste materials that cannot be reduced, reused or recycled. The party responsible at this stage is the contractor who can apply various waste recovery techniques such as briquetting, incinerating, pyrolysis, gasification and biodigestion. This recovery technique is a waste-to-energy recovery technique which is recommended universally. The best recovery technique is the waste-to-material recovery technique for conservation of natural resources.

1.2 Background of Research

Construction industry has a significant effect on the environment in term of unbalanced ecology, change of living environment, potential sewage, depletion of natural resources, energy consumption and generation of wastes. This research will mainly discuss on reduce, reuse, recycle and recovery technique in creating sustainable waste management in minimizing the waste that will be produce.

Sustainability promotes a balance approach by taking account of the need to continue in business but does not seek profitability at the expense of the environment or societies needs. (MaSC, 2002). Sustainability concerns protecting environment quality, enhancing social prosperity and improving economic performance (Addis et. al. 2002). There is an important distinction between sustainability and sustainable construction waste management. Sustainable waste management is a process whereby over time sustainability is achieved (Parkin, 2000). Hence sustainability could act as an objective.

Timber, steel, concrete and bricks waste is part of construction industry pollutant and a natural resource and currently depleting drastically. Due to high demand of this resource, it has made people forgot about preservation of environmental esthetic value for the sake of profitability. Later on the research, we will see whether these resources are being use to its full potential rather than just some substitute material for the construction industry.

1.3 Problem Statement

Construction industry consume substantial amount of raw materials in the process. The output is obviously the product and the waste material. Because of that, construction industries are well known as one of the worst environmental polluters (Khairulzan Y. *et. al.*, 2006).

Construction projects have an environmental implications mainly because of the material used, nature of design, method of construction, location and layout, physical structure and the use to which building are put (Ramachandran, 1990). Regarding occurrence of imbalanced ecological environment, the movements of various construction resources, water and soil will cause changes to the natural environment. Furthermore, the wastes from such movements emit a general pollution to the environment as well. This can affect the surrounding region and quality of life to a large extent and even bring a significant lost of live hood.

As stated in the Environment Hong Kong (1997) report, the excessive use of tropical hardwood for construction causes the depletion of forest resources. Thus, the Hong Kong government has taken steps to reduce their use for temporary structures such as wood as hoarding, false work, and formwork for construction by using more of steel and fiberglass.

1.4 Aims and Objectives of the Study

The aim of this research is to study the impact on reduce, reuse, recycle and recovery technique on local construction industry. Theoretically, it supposes to give an impact towards the local construction industry, but does it really give an impact towards the waste produce. Moreover, several issues regarding current local industry problems will be discussed to identify the root causes that affected the waste management.

For this research, three objectives have been list out accordance to the problem statement that has been identified.

1. To identify the most used reduce, reuse, recycle and recovery technique at construction site.
2. To identify the relationship between reduce, reuse, recycle and recovery technique and the waste produce in construction sites.
3. To identify the differences among the reduce, reuse, recycle and recovery technique.

In the first objective, investigation will be done on reduce, reuse, recycle and recovery technique used in the waste management system on-site to identify the most used 4R techniques.

Second objective will see whether the reduce, reuse, recycle and recovery technique used give a significant impact on the cumulative waste produce on site. In this objective, the finding will determine whether the technique used on site can reduce or produce more waste on site.

In third objective which is to identify differences among reduce, reuse, recycle and recovery technique used, we will determine which of the techniques are efficient or not in producing less waste.

1.5 Research Hypothesis

Hypothesis for this research are,

To identify the relationship between reduce, reuse, recycle and recovery technique used on site with the waste produce in construction site, four hypotheses has been develop, which are:

H_0^1 : There is no significant relationship between waste reduction and waste produce

H_0^2 : There is no significant relationship between waste reuse and waste produce

H_0^3 : There is no significant relationship between waste recycle and waste produce

H_0^4 : There is no significant relationship between waste reduction and waste produce

1.6 Importance of Study

The importance of this study is to show the level of construction waste management system in our country compared to other developing country in the region. Suggestion on improvement will be proposed using reference from develop country such as United Kingdom to boost the performance of our construction waste management system.

1.7 Conceptual Framework

Figure 1.3 will illustrate the relationship of all the variables construct in this research.

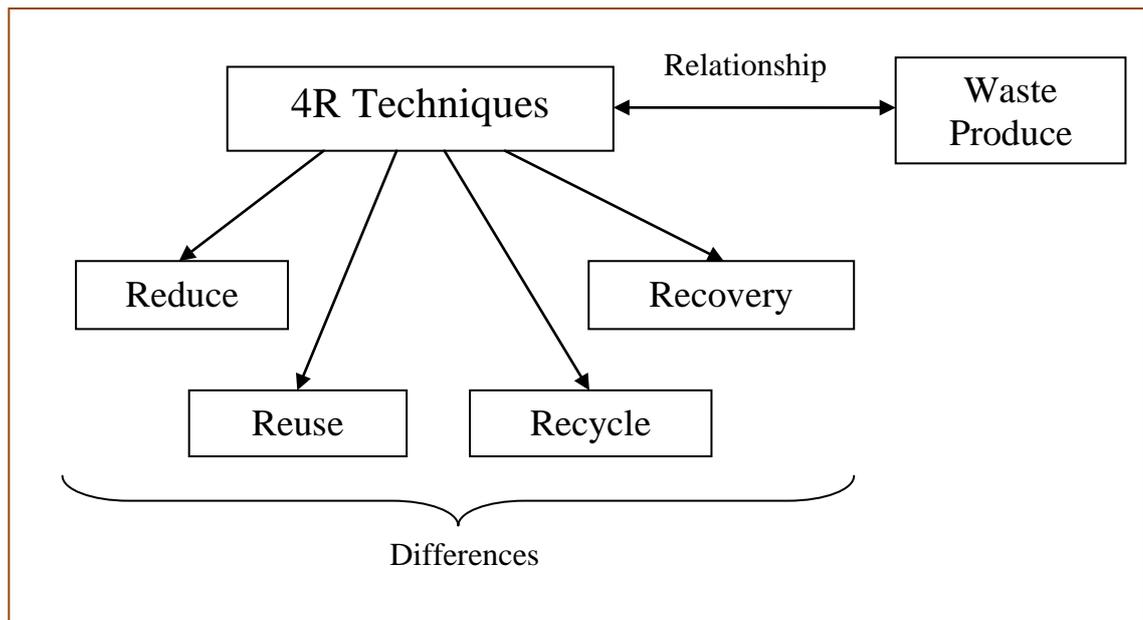


Figure 1.3: Research conceptual frame work

Based on figure 1.3, researcher has identified both the dependent and independent variable. 4R techniques are the independent variables where as all the testing will be done onto the dependent variables which is the waste produce.

1.8 Scope of Study

This research is focus on timber and lumber waste, steel waste, concrete waste, and brick waste. The type of waste is being narrow down due to the vast type of waste found on construction site. But this chosen waste are consider the major contributor to the waste produce on site. To assess the whole material or waste that been used in construction will take long term process.

This research will be held in Johor Bahru area only. Due to the lack of funding and time, it is only possible to take the samples that are nearer to UTM. Moreover, only four types of construction project will be chosen as the sample. There are a high rise building projects, industrial projects, commercial projects and residential projects.

1.9 Expected Outcome

The expected outcome is to evaluate and identified whether is there any effort in creating a more sustainable construction waste management in local construction industry through implementing 4R concept.

1.10 Organization of the Thesis

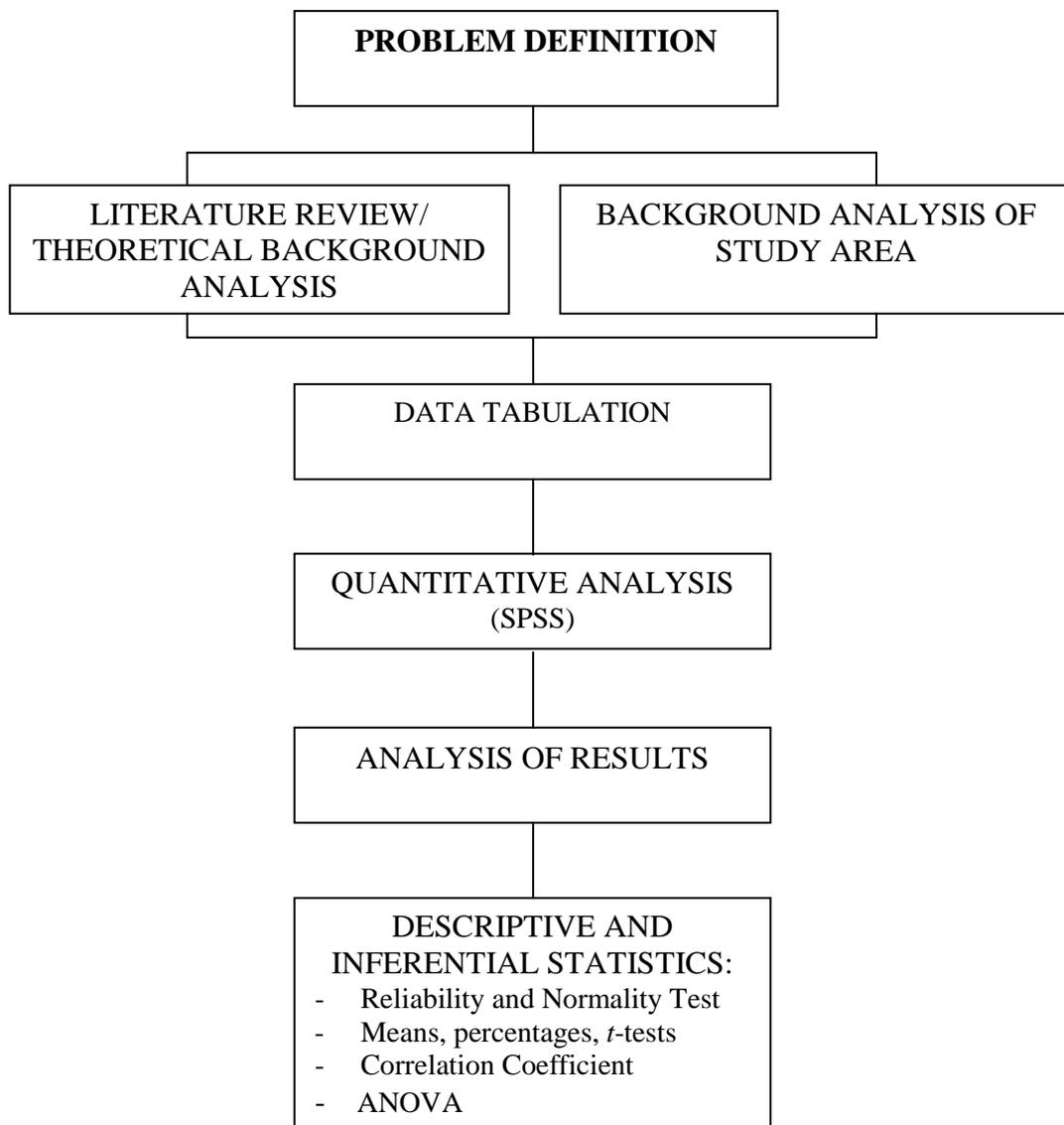


Figure 1.4: Work schedule / Approach of study

Based on figure 1.4, the thesis begins with statements of the purpose and objectives of the study in Chapter I, together with problems understudied and followed by the importance of the study. Chapter II explores the literature reviews concerning the topics of waste management system, as well as construction waste management systems, sustainable waste management systems. It later analyzes previous research works conducted locally and abroad. The overview of the theories provides a basis of all hypotheses developed in the study. Secondary data sources of existing management and institutional situations in the country are included in the chapter before focusing on the more specific scopes of the study. While other primary data and the information gathered about the study areas are discussed in Chapter III, along with the methodology and approach of the study. The chapter also explains the statistical analyses used. Chapter V covers the analysis of results, conclusion of the study and recommendations for future research based on the findings.