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

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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 industi 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 siknifikan 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.

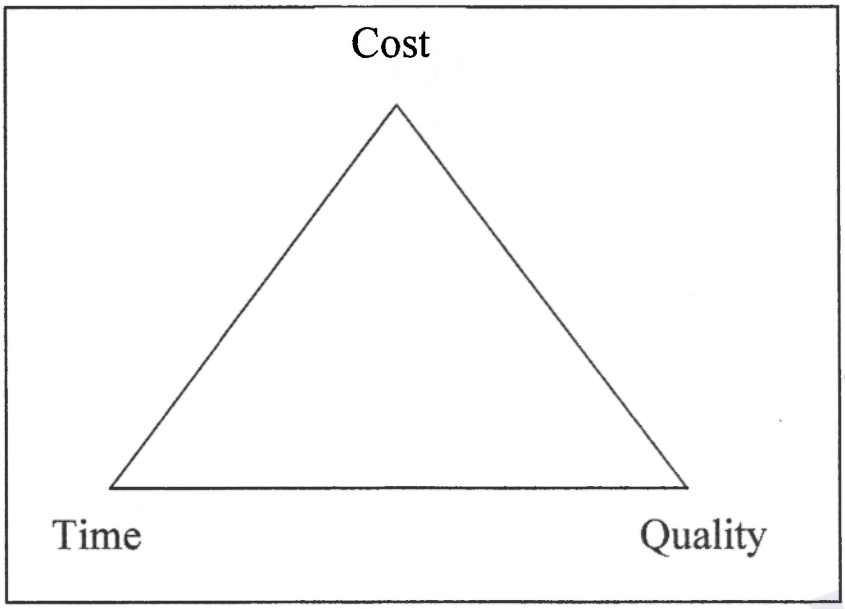

Figure 1.1: Construction Management with Three Dimensions

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.

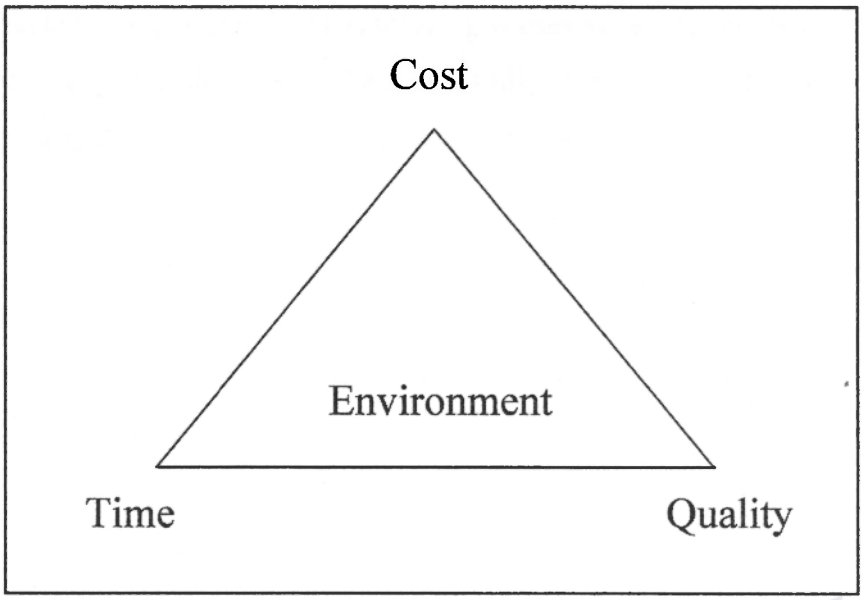

Figure 1.2: Construction Management with Four Dimensions

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 majo 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 form work 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:

Ho[1]: There is no significant relationship between waste reduction and waste produce

Ho : There is no significant relationship between waste reuse and waste produce

Ho : 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.

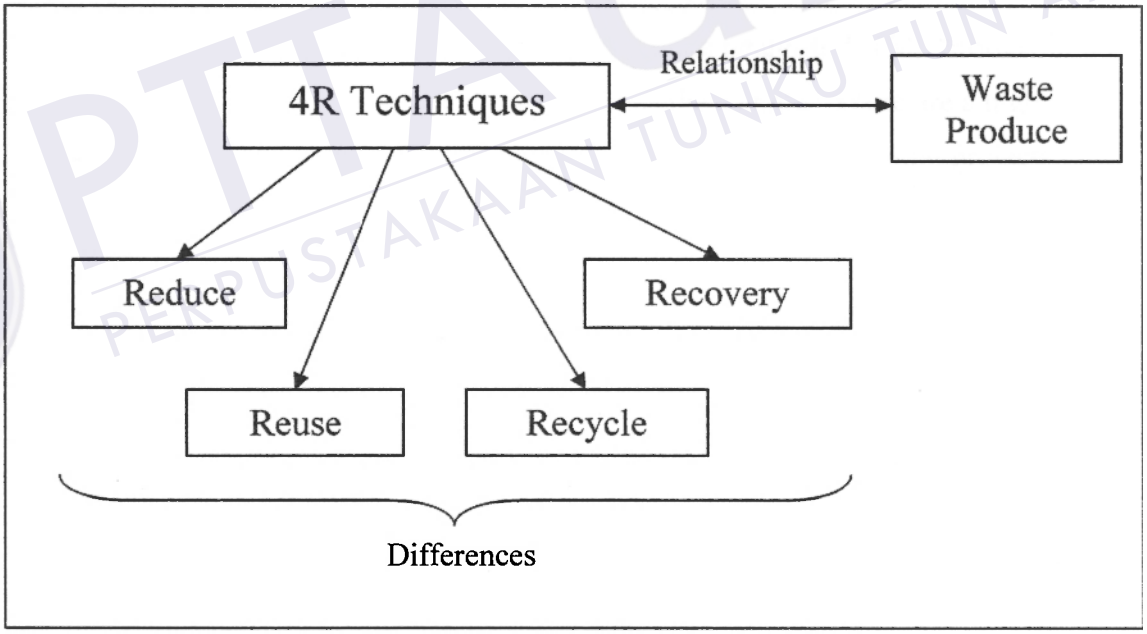

Figure 1.3: Research conceptual frame work

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

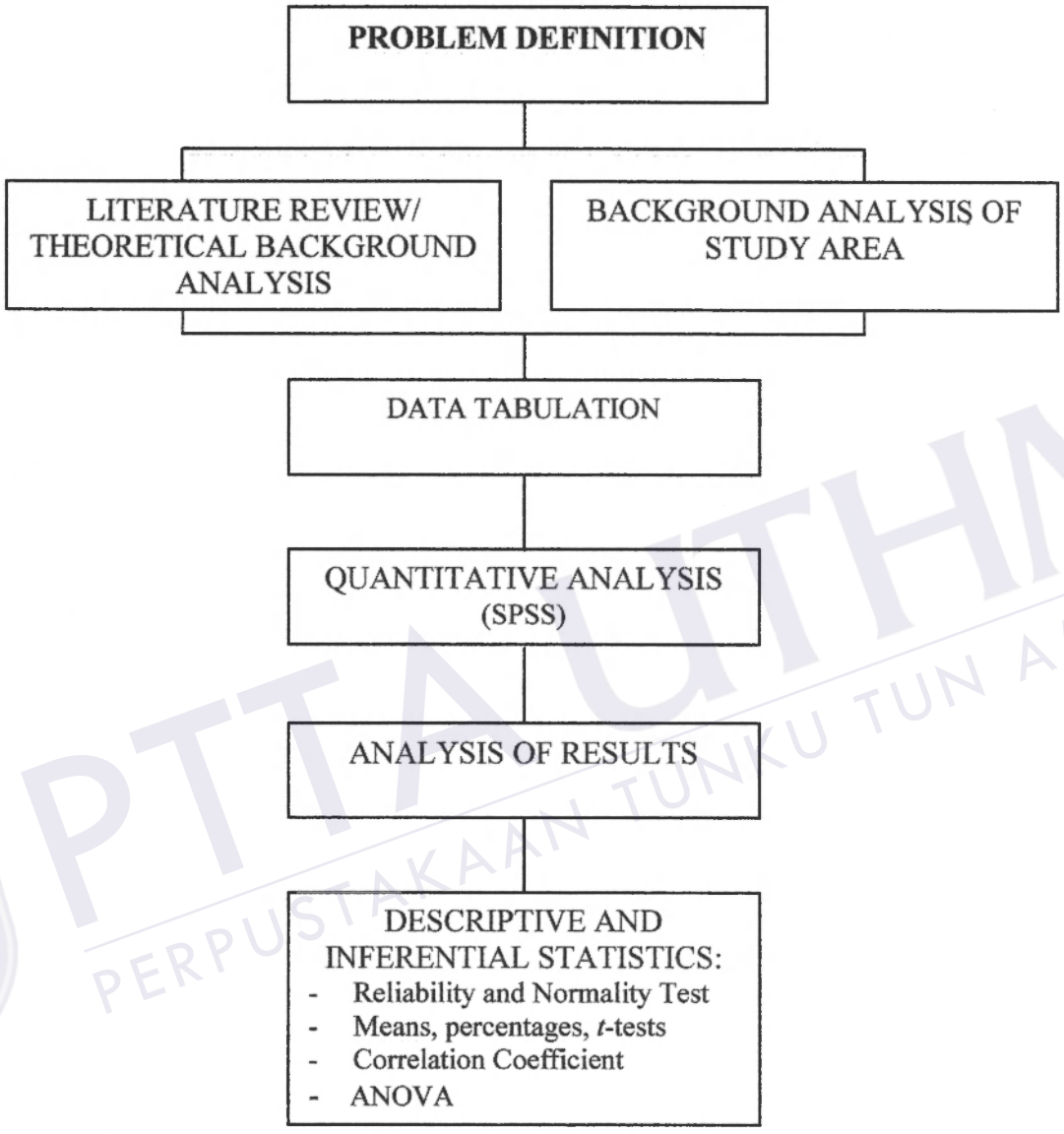

Figure 1.4: Work schedule / Approach of study

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.

CHAPTER H

LITERATURE REVIEW

2.1 Introduction

In this chapter, the conceptual review of the research will be presented as clear as possible. All literature will be reviewed deeply by referring to the previous research paper, journal and observation on-site to understand what the current situation of our construction industry is.

2.2 Waste Management System

Waste management system differs for developed and developing nations, for urban and rural areas, and for residential and industrial, producers. Management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator (firm whose activities produce the waste).

Waste management systems vary widely between areas for many reasons, including type of waste material, nearby land uses, and the area available. Disposal methods include landfill which involves burying waste to dispose of it, and this remains a common practice in most countries. However if not properly managed a landfill can create a number of adverse environmental impacts such as wind-blown

litter, attraction of vermin (pests), generation of liquid leachate, gas (mostly composed of methane and carbon dioxide). This gas can create odor problems, kill surface vegetation and is a greenhouse gas.

Incineration, (sometimes known as thermal treatment) is a disposal method that involves combustion (burning) of waste material. The method converts waste into heat, gas, steam and ash.

It is a practical method of disposing of hazardous waste materials such as chemical-based waste. It is a controversial method of waste disposal as it emits gaseous pollutants. Particular concern has focused on very persistent organics such as dioxins which may have serious environmental consequences in the area immediately around the incinerator. It is common in developed countries where land is scarcer. Waste-to-energy (WtE) or energy-from-waste (EfW) is common terms for facilities that burn waste to generate heat, steam and/or electricity.

The process of extracting resources or value from waste is generally referred to as recycling. There are many methods by which waste material is recycled: reprocessing of raw materials of high calorific content to make electricity; collection and reuse of everyday waste materials such as empty beverage containers. Material for recycling are better collected separately from general waste using dedicated bins or sorted directly from the sources. Common products recycled include aluminum, steel, and aerosol (spray) cans, plastic, glass and paper.

Prevention of waste materials, also known as waste reduction employs methods such as reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable and encouraging consumers to avoid using disposable products.

2.3 Construction Waste Management

Waste management is the collection, transportation, processing, recycling or disposal of waste materials. The term waste is usually relates to materials produced by human activity, and are generally managed to reduce their effect on health, the environment or aesthetics (beauty). Waste management is also carried out to recover resources from it. Waste comes in forms such as solid, liquid, gaseous or radioactive substances, so management calls for different methods and fields of expertise. In term of this research, the waste will be the solid waste that is produce by the construction activities.

Waste is not just garbage; it is also energy, water, food, air, transportation, landscaping, time and money. Waste Management works toward reduction, reuse and recycling of all resources. It encourages the reduction of energy consumption, water conservation, the purchase of reused and recycled products, and alternate transportation methods.

2.3.1 Construction Waste

Construction waste is defined as relatively clean, heterogeneous building material generated from the various construction activities (Tchobanaglous *et al.* 1993). Possible sources of generating construction waste can be classified under six main categories (Gavillan, 1994), namely:

i- Design source
ii. Procurement source
iii. Handling of material source
iv. Operation source
v. Residual source
vi. Other sources

Waste can be either hazardous or non hazardous. Construction projects generally generate more non hazardous waste than hazardous wastes. Some of the types of wastes found at a typical construction site are construction waste, domestic waste and scheduled waste.

Construction waste are solid inert waste which usually consists of building rubble, but may also include demolition material, concrete, bricks, timber, plastic, glass, metals, bitumen, trees and shredded tires. Such wastes should be reused, recycled, or disposed of to an approved landfill. Disposal methods adopted depend on the nature of the material. Improper disposal can lead to the outbreak of diseases such as malaria, dengue and schistosomiasis, transmitted by mosquitoes and snails.

Domestic waste can be found on construction sites which have nearby base camps for the workers. Domestic wastes need to be properly disposed of to avoid the infestation of rodents, roaches and other pests. These pests bring with them vector borne diseases such as cholera and rabies.

The contractor is also responsible for the proper handling, storing, transporting and/or disposing of scheduled wastes. Examples of scheduled or hazardous wastes are used oil, hydraulic fluid, diesel fuel, soil contaminated with toxic or hazardous pollutants, waste paints, varnish, solvents, sealers, thinners, resins, roofing cement and more. It is the responsibility of the contractor to meet the Scheduled Waste regulations under the Environmental Quality Act 1974. The responsibility covers the proper handling, storing, transporting and disposal of these wastes.

However, quantity and quality of construction waste generated from any specific project would vary depending on the project's circumstances and types of materials use as shown in figure 2.1. The annual production rate of construction and demolition waste from the whole planet is around 3 billion tons (Elliot, 2000). A possible method of resolving this problem is to develop and implement a comprehensive and practical sustainable waste management strategy that manages

the amount and types of construction waste. Sustainable development for the construction industry can be develop through the entire life cycle of the building from cradle to cradle, including the early planning phase, the architectural and structural design phase, the construction phase and in the use phase.

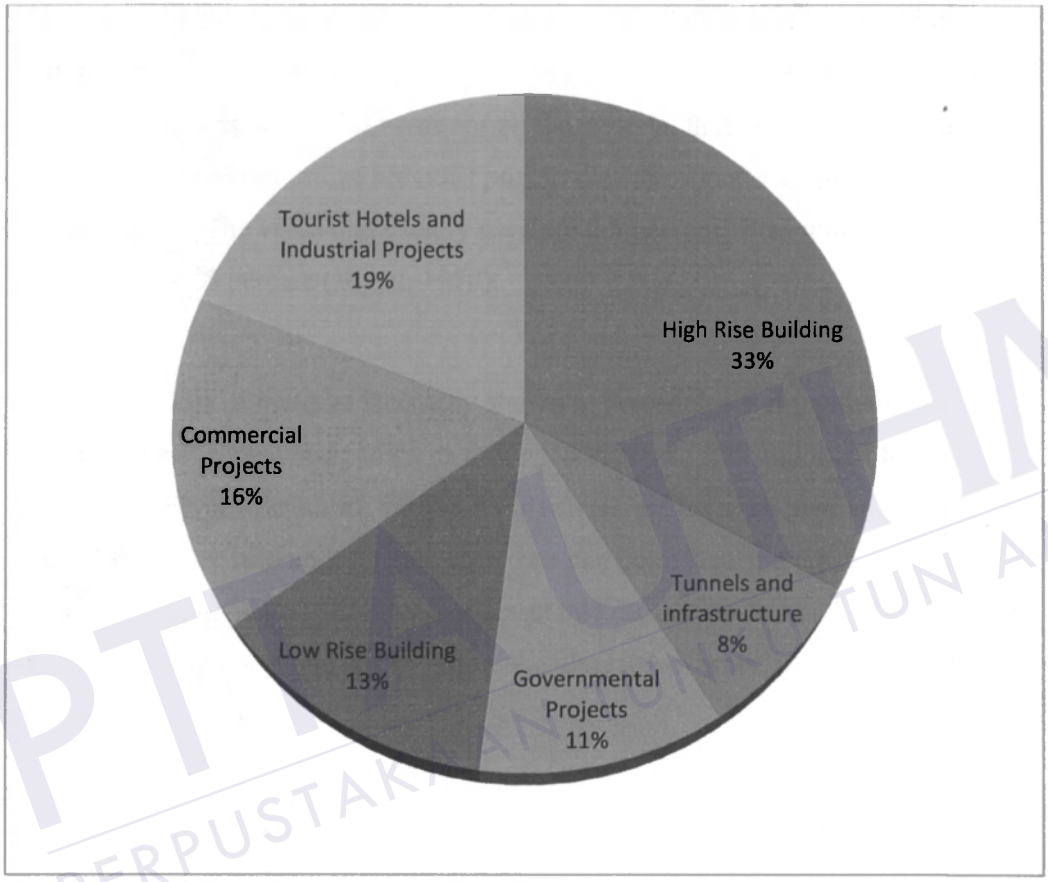

Figure 2.1: Cumulative Percentages of Projects Generating Construction Waste in Egypt

2.3.2 Waste Rate Estimation

A construction company always valued a project by its profit and loss. In order to ensure that the contractor get the maximum profit out of the project, contractor always keen to find alternatives to improved the productivity of their operations. However, without suitable approach to implement new technology, it is

hard to ensure that the method used will succeed. Thus this estimation rate will serve as a guidance to help the management to improve the method of handling material, reduce the waste rate and improve productivity.

Theoretically, performances of waste management in construction site are depending on the quantity surveyor decision on site. They will record all the material used on-site and all the material sent to site. It is important for the quantity surveyor to estimate material waste for all the material that has been purchase, but many of them seldom utilize previous project data to estimate the percentage of material used. The value that usually used are 2.5 percent, 5 percent, 7.5 percent, 10 percent and 12.5 percent (Wyatt, 1978).

Any loss of material is usually shown in percentage form without analyzing the factors that contributing towards those percentages. It is important for the quantity surveyor to evaluate the factors involved, the material used and type of project for future reference so that waste rate can be reduce and create more sustainable construction. The used of waste rate estimation from other sector are not practical and less accurate due to difference diversity of work and the dynamic of the sector.

2.3.3 Source of Construction Waste

Based on past research, the source of material waste can exist through out the construction project, whether in the initial stage, design stage, construction stage till the operation stage (Craven *et al.,* 1994; Faniran and Caban, 1998; Gavilian and Bernold, 1994; Spivey, 1974). Gavilian and Bernold (1994) and Craven *et al.* Have divided the source of waste into five categories which are:

i. Design stage
ii. Procurement stage
iii. Material management

iv. Operation stage
v. Excessive material
vi. Others

Discussion on source of waste stated by Gavilian and Bernold (1994) will be discussed in this section

2.3.3.1 Design Stage

In the early stage of construction, designers should apply a design that is sustainable. Before the designers identified the materials that want to be use, designer will consider several aspects of it and it sources, but bound to the manufacturer that been recognise only. Based on this manufacturer, the designer will chose the material using catalogue supplied to them. However, the catalogue provided is usually not frequently updated and thus, will arouse complication when works want to start at site.

Designers need to include explanation of specification in each material and component that is needed in the contract. But usually, they only submit the British Standard code that is normally used including the general comment. Sometimes, ordered material cannot arrive at the site on time, forcing them to use substitute material in a very short time. With a limited time, designers are prone to choose material that is low in quality instead of the original requirement. The process of choosing material and component is important besides the design itself and good work skill in order to achieve the best result. If the material choose does not meet the requirement of the designers, this will eventually cause a conflict between the ecstatic value and practical requirement. This aspect is important and need to be emphasis to new designers (Craven *et al.,* 1994).

If the designers want to reduce waste to the optimum level, designers need to consider the construction process for each element. When work has began, designers need to ensure that there will only be a minimum change of design and all the information needed for the construction need to be finalize from the early stage of the project. Material utilization and low waste produced is depends to a good design and detailing.

2.3.3.2 Procurement Stage

Material waste also cause by the design requirement and specification. For example, brick size is not considered for the elevation design for masonry works. Over purchase due to failure in monitoring the material quantity also causes waste (Dainty *et al.* 2004). Sometimes it is also cause by the manufacturer due to communication failure between the contractor and supplier.

Failure in planning material schedule will result in failure of providing adequate and accurate order of material. Wyatt (1991) stated that, contractor always taken for granted the importance of material schedule. Although it is considered as a vital component in material management, it always being neglected due to the lack or inadequate of information in the early stage of construction. Moreover, other factor such as inexperience material scheduler, incomplete contract drawing and unknown quantity affected the process of making the material schedule. A complete waste schedule that has all the essential information can ensure the minimization of waste during procurement.

2.3.3.3 Material Management

Material waste can also happen when the material are not been handled properly. Material handling are always handled using mechanical equipment and sometimes by an unskilled worker. Modern material and component is always damage during material handling and installation of the material. Sometimes the material can be repaired if the damage is minimal, but some of the material are

irreparable when damage. Waste rate are different on different project. Many of it is cause during construction phase where time is essential and work need to be done fast. This is when the quality control is hard to monitor. But the main reason of waste produce is cause from weak control and monitoring, attitude and no adequate incentive.

During storage, material should be stored in proper way for example material should be stored above soil level and protected from the harsh climate to prevent the material from spoil and damage. Waste and loss of material occurred due to improper material management and administration. Material management and control can become more complicated in bigger projects. Contractors need to manage the component and material that are required on site. Once the material arrived at site, those material and component need to be unloaded, disseminate, or being stored. The purpose is to reduce the risk of theft, damage and loss of material. Several issues that are related to weak management of material are:

2.3.3.4 Material Storage Area

Storage area are usually not properly arrange and hazardous and sometimes the material are stored in several different places. Material that expose to wet condition and unsuitable places whereas machineries and vehicle always pass by will damage the material will cause the material to deteriorated and eventually will be damage. This will rise the percentage of loss and waste due to the damage material. This kind of scenario needed to be prevented to reduce waste produce on site.

i. Guarding and Protection of Material

Misused of material are always the issues in construction material management. Several materials are associated with soil, exposed to wet condition or dry rotation, and damages cause by humidity or water. Bad air flow and continuous exposure to sunlight ray have the probability to damage the material in the future or after completion of development.

This problem should be solved in the early phase even before acquiring the site. Planning for storage design and material placement in the early stage can minimize the risk of damage material.

ii. Misused and Used of Material

Material wastes that cannot be prevented are not literally because of material loss or unused material. Sometimes, there is a condition where the purchase material is excessive rather than the required material whether to fulfil the designers' requirement or the construction practice itself. For an example, in brickworks, the workers maybe need to use block bricks to achieve the floor height or designers' measurement. In this condition additional material can be seen as loss and if further improvement is done, this brick block should have not been use in the first place.

iii. Construction Operation

Many waste occurred that can be prevented exist due to excessive material arrived on site, or improper placement and storage of material. Material can be turn into waste if the material is not handled carefully during transporting and handling. If the material been transported oftenly, the risk of the material getting damage is higher and the waste produce will increase.

Lack of careful handling measure contributes more to the waste produce. For an example, try to reduce the amount of mortar for brickworks when work time is almost finish. Mortar waste is usually can go went up to 25 percent (Stoneman, 1980).

Variation order issued by superintendent officer throughout the project also contribute to the overall waste produce on site. It involved opening or demolished of finished work on site. Moreover, it will need new material in erecting and repairing the part that have been demolished.

2.3.3.5 Excessive Material

The way to prepare a material also can contribute to the waste produce but it can be identified in the early stage of construction. Any form of increment in waste produce should be study and corrected as early as possible to reduce the possibility of waste increase. Weak design also the cause of material waste and it also involved the workmanship quality that determines the level of waste.

For an example, excessive material is produce when the steel is cut into size. Sometimes, bigger size of steel is purchase due to fabrication problem of the steel. Based on the research of Carlos *et al.* (2002), found that a high waste rate produce on site that has a low standard and detailing in design and eventually causing waste due to the non-optimum of cutting steel.

2.3.3.6 Others

Instead of management and technical problem during construction process, there are still many issues on site and affecting the construction process itself. Creating a cleaner and tidy construction site will help to reduce loss and material waste and add to the safety on site.

There are so many statements that technical organisation and police department referred when there is theft involving machineries and material on site (Wyatt, 1991). The reasons are cause by:

i. External pressure that is not associated with the sites.
ii. Local resident that has just move in using the material as theirs.
iii. Worker themselves

To prevent this problem, they need to provide a secure area and lock valuable material. Security responsible should be expanded not only to the safety of the material and also to protect the site from damages that cause by human activity.

2.3.4 Problems in Current Waste Management System

Despite widespread awareness of the problems of construction related environment pollution and a range of technical and legal measures implemented, it seems that construction practitioners still have little concern. Further the pollution problems are increasing at alarming rate. The barriers to sustainable construction waste management are identified as follows.

2.3.4.1 Different nature of the environment from cost, time and quality

The environment dimension has two fundamental differences from cost, time and quality. First, from the viewpoint of business, the objective of cost, time and quality are established on behalf of clients, but the objective of protecting the environment is imposed by the external bodies such as Environmental Department, Labor Department and Urban Services Department.

Second, from the viewpoint of economic development impact, cost, time and quality are micro factors which influence the economy at the firm level at short term. The environment is a macro factor which affects the economy and its development in the long term globally. Such differences result from the fact that, although the seriousness of the environmental management problems from construction are

appreciated by the public, government departments and construction professionals, the action of protecting the environment in construction works is still only enacted to a limited extent.

2.3.4.2 Less Environment Concern at Initial Project Stage

In most cases, few environment management activities are involved at the project planning and design stages. Some government departments apply the government impact assessments approach, which is a method of assessing the total environmental impact associated with project's construction, use and disposal of materials. Then constructed facilities and components are assessed as product in terms of their impacts relative to comparable products.

However, this only applied to some major developments project. For the majority of the construction projects, the practice is rarely used. Many construction projects have considerable environment risks which are not apparent t the early project stages but cause many potential pollution problems after completions of project.

2.3.4.3 Results Oriented Policies and Their "Flooding"

In general, the environment regulations or policies usually respond to end products of the process, i.e. the pollutants. Less effort is used to identify pollution causes or study how to take a proactive approach in avoiding environmental problem such as air, noise and water pollution or water contamination. Some countries are establishing environmental auditing departments. Since the auditor is not really independent but supervised by the client, he speaks for the client with little effect in terms of environmental responsibility.

Furthermore, there are many regulations about environment issues in a variety of forms such as Ordinance, Acts or White Paper. Different guidance or legislation covers different aspects such as air and water pollution, waste, recycling,

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