REVIEW THE IMPLEMENTATION WASTE MANAGEMENT PRACTICES IN CONSTRUCTION WORK AROUND TAMAN INDERA SEMPURNA, PEKAN-KUANTAN, PAHANG DARUL MAKMUR.

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ABSTRACT

The construction waste has been identified as one of the major contributors to the solid waste and hence contributed to the environmental impacts in both developed and developing countries. As a result, the waste management becomes the important function of construction project management in order to reduce the volume of waste on site. Waste management has been grouped under three main groups namely waste classification, waste management approaches and waste disposal technologies. Nevertheless, these approaches give less intention in the waste management on construction site. The study was carried out to analyze the waste handling processes in three selected construction site around Taman Indera Sempurna, Pekan-Kuantan, Pahang Darul Makmur by using the free flow mapping methods. The analysis leads to develop a waste management mapping model (WMMM), which incorporates the good practices embodied in the existing practices. The WMMM provides an alternative tool assisting in waste handling processes on construction sites. It can be a medium for comparing the waste management practices between construction sites, thus both good practices and weaknesses can be identified. Besides, it provided a level of indication about the current practice of waste management on construction sites.

ABSTRAK

Sisa pembinaan telah dikenalpasti sebagai salah satu penyumbang utama terhadap sisa pepejal dan menyumbang terhadap kesan persekitaran di negara yang maju mahupun negara yang sedang berkembang. Akibatnya, pengurusan sisa menjadi fungsi penting dalam pengurusan projek pembinaan untuk mengurangkan kuantiti sisa pembinaan di tapak. Pengurusan sisa telah dikumpulkan dalam tiga kumpulan utama iaitu klasifikasi sisa, pendekatan pengurusan sisa dan teknologi pembuangan sisa. Namun demikian, pengurusan sisa di lokasi pembinaan kurang diberi perhatian yang sewajarnya. Kajian ini dilakukan untuk menganalisis proses pengendalian sisa di tiga tapak pembangunan yang dipilih di sekitar Taman Indera Sempurna, Pekan-Kuantan, Pahang Darul Makmur dengan menggunakan kaedah pemetaan aliran bebas. Analisis mengarah untuk membangunkan pengurusan sisa model pemetaan (WMMM), yang menggabungkan amalan-amalan yang baik diwujudkan. Model tersebut merupakan alat alternatif untuk membantu dalam pengendalian sisa proses pada tapak pembinaan. Model tersebut dapat menjadi rujukan atau medium untuk membandingkan amalan pengurusan sisa antara tapaki pembinaan, sehingga kedua-dua amalan yang baik dan kelemahan dapat dikenalpasti. Selain itu, model tersebut memberikan tahap penunjuk tentang amalan pengurusan sampah di tapak pembinaan.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

High demands of the infrastructure projects implementation in the commercial buildings constructions and residential construction have shown a significant increase in construction and demolition (C&D) waste generation in the last decade. The daily average of C&D waste generated was four times as much as that of municipal solid waste (Poon *et al*, 2003; EPD, 2000). Moreover, previous studies suggested that the construction industry is the major contributor to the generation of waste and pollution. For example, in year 2004, there is 38 percent of the disposed solid waste in Hong Kong was generated by construction and demolition as shown in Figure 1.1 (Tam *et al*., 2007; EPD, 2003; Poon *et al*., 2001).

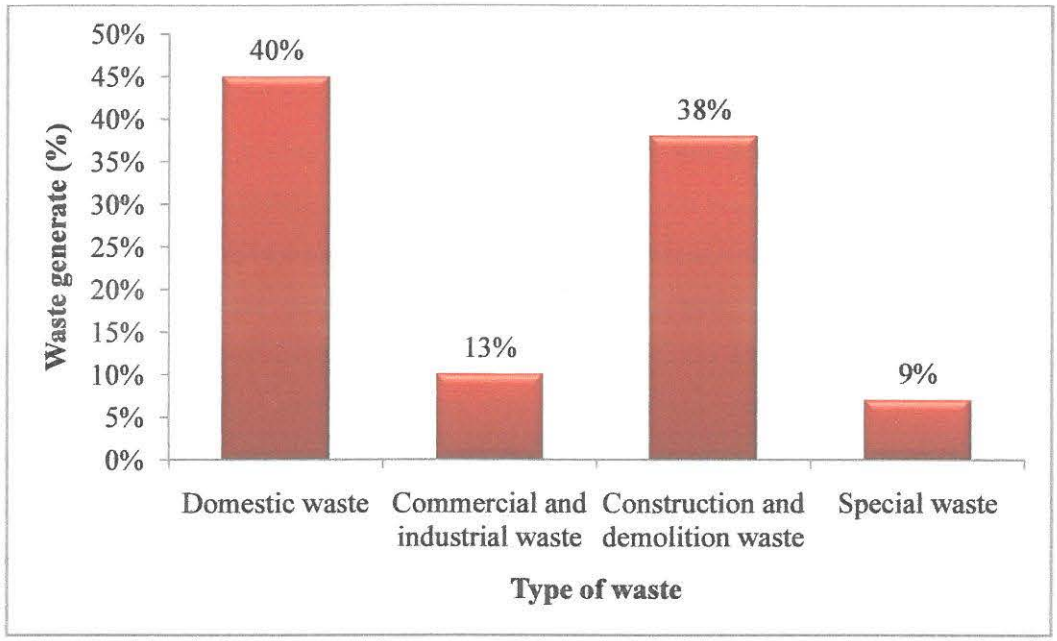

Figure 1.1 Type of solid waste disposed at landfills in 2004

Source: Tam *et al.*, 2007

At the same time, various waste management method have been developed by previous researchers and have been practiced in many countries. One of the waste management methods which had been practiced is by follow the waste management hierarchy which includes reduce, reuse, recycle, incineration and landfill (Renbi *et al*, 2001). Besides, prefabricated components are also introduced to reduce the application of conventional construction method. Despite these research works and implementation, it is still unclear that how waste are handled from the point of generation to disposal. Hence, this study will focus on the understanding of the existing waste handling within construction site in Malaysia.

1.2 STATEMENT OF THE PROBLEM

Malaysia is pacing into era of globalization in this decade. Due to the fast development of the construction industry, the construction waste becomes one of the major contributors of the solid waste in this country. Besides, it is become one of the major environmental problems in both developed and developing countries. Nevertheless, the cost of managing waste is often relatively higher than the benefits that the organization may gain from such management. As a result, the waste management has been receiving less attention comparison to construction cost and time management because there is a lack of awareness of environmental management in the construction site (Tam *et al.,* 2007). According to the statistic in Waste Management Framework Planning in Sarawak by Chong & Eulogius (2006), most of the construction waste are informally dumped which contributed 41 percent of the amount of construction waste whereas there is only 10 percent of the construction waste is recycled.

Although various methodologies for reducing construction waste have been introduced, their application is still ineffective (Tam *et al.*, 2007; Tam, 2002; Lingard *et al.*, 2000). There are many reasons for the limited effectiveness in implementation of these methods which included no specification of waste reduction methods, improper site layout planning, lack of equipment for waste sorting, lack of experience in waste recycling operations, lack of knowledge of secondary market, and poor knowledge of environmental and safety regulations (Tam *et al.*, 2007; Shen *et al.*, 2003). Apart from that, there is a lack of methodology in providing guideline on how to produce waste management plan (Sim 2006; Shen *et al.*, 2004). The study tends to identify alternative tool assisting in planning waste management practices in local construction site.

1.3 AIM AND OBJECTIVES

The aim of the study is to analyses the implementation construction site waste management approaches used by different three contractors selected for their project around Taman Indera Sempurna, Pekan-Kuantan, Pahang. In order to ensure this study meets its purpose, the objectives are:

a) To investigate and analyze the flow process each of construction wastes around Taman Indera Sempurna, Pekan-Kuantan via mapping with the assistance of free-flow mapping presentation technique.
b) To identify weakness and advantages embodied in the existing waste management practices.
c) To propose an effective waste management mapping based on good operations embodied in the existing practices and also the outcomes of interview with the project proponents as well as observations on sites

1.4 SIGNIFICANCE OF STUDY

The construction wastes need to be handled in the correct methods. Therefore, the waste handling practices in site will be identified. From this study, the data obtained will be useful in analyzing the weaknesses and advantages of each practice. As a result, the alternative waste handling practices will be proposed based on the comparative between the existing waste handling practices among the three project site located around Taman Indera Sempurna, Pekan-Kuantan, Pahang Darul Makmur. Therefore, a level of indication can be provided about the current practice of waste management at construction site.

1.5 SCOPE OF STUDY

The scope of the study will be limited to the construction sites located around Taman Indera Sempurna, Pekan-Kuantan, Pahang Darul Makmur. In this case, three project sites had been selected. They were made up of mainly building development. This study involves the data collection from the site and interviews with the site managerial staffs. The process of waste handling processes on site will be focused.

1.6 RESEARCH METHODOLOGY

The study started with the identification of the problem, objectives and scope of study. The literature review was done to collect the data and information from the previous study. In this study, most of the information obtained from the journals in the related field. Besides, the information such as waste management guideline from other countries can obtained through the internet sources. For the data collection in waste handling processes, the data obtained through the distribution of the questionnaire as well as interviews with the site managerial staffs and on-site observations. After data were analyzed, the recommendation will be proposed. The flow of the methodology is as shown in Figure 1.2.

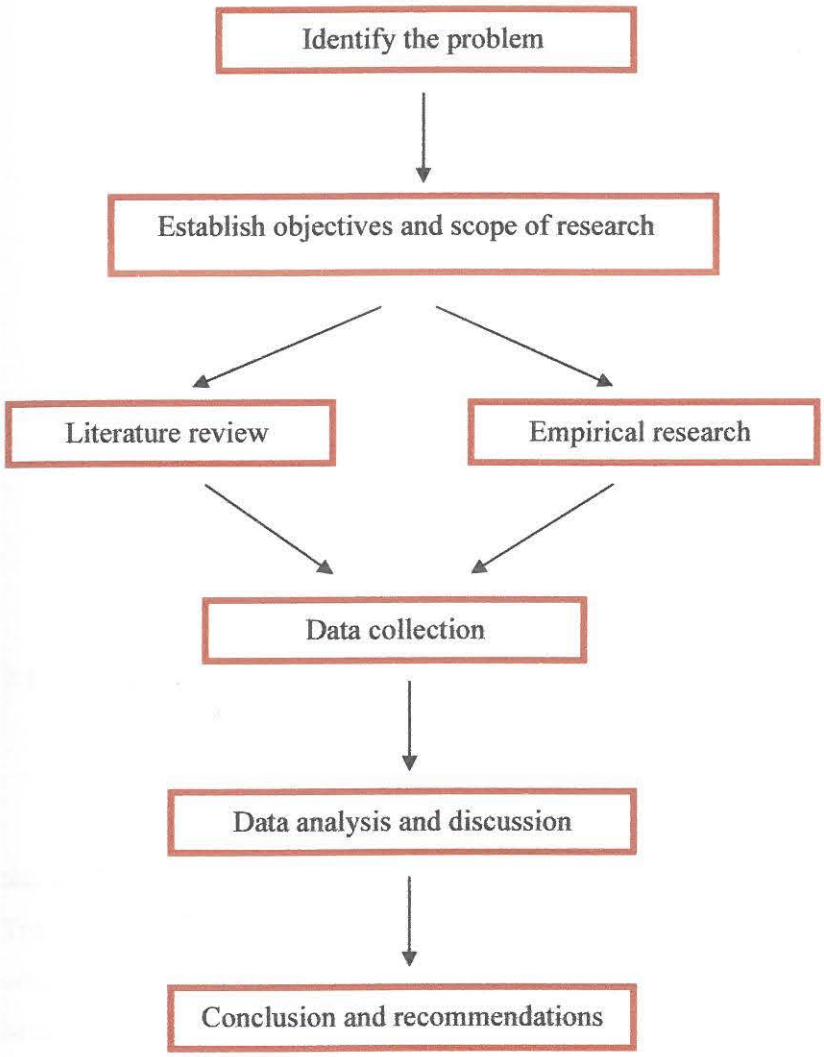

Figure 1.2 Flow of research methodology

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Construction and demolition (C&D) waste management has become one of the major environmental problems in both developed and developing countries. Tremendous amounts of C&D waste have been generated from ongoing new construction works, as well as renovation and demolition works. The C&D waste has been increased which has been resulted from the extensive building and infrastructure development projects as well as redevelopment of old districts. Construction and demolition (C&D) waste according to the EU Waste Strategy is considered as one of the 'priority' waste streams. This is because the European Union aimed to reduce the quantity of waste going to final disposal by around 20 percent on 2000 levels by 2010 and in the order of 50 percent by 2050 (EC, 2001). Hence, in the European Union, the framework of the Sixth Environmental Action Program entitled 'Environmental 2010: Our Future, Our Choice', in accordance with the EU Waste Strategy, establishes that recommendation actions need to be taken with respect to the stream of C&D waste (EC, 2001).

At the same time, the construction industry consumes 25 percent of virgin wood, 40 percent of the raw stone, gravel, and sand used globally each year. There is approximately 40 percent of the materials produced are utilized in building and construction work (Udayangani Kulatunga *et al.*, 2006; Holm, 1998). In general, a very high level of waste is assumed to exist in construction. Partial studies from varies countries have confirmed that waste represents a relatively large percentage of production costs (Formoso *et al.*, 2002). There is approximately 40 percent of the waste generated globally originates from the construction and demolition of buildings (Udayangani Kulatunga *et al.*, 2006; Holm, 1998). As a result, this situation contributes a major portion of the solid waste discarded in landfills around the world. For instance, in the Hong Kong it is approximately 40 percent (Hao *et al.*, 2007; Chen *et al.*, 2003)) and in UK 51.2 percent of landfills by mass (Nigel Lawson *et al.*, 2001). According to Hassan *et al.*, (1998), the construction waste make up a large portion of solid waste in Malaysia which contributed 28.34 percent of the sum of solid waste.

2.2 CONCEPT OF CONSTRUCTION WASTE

The concept of construction waste can be defined as the surplus materials arising from any land excavation or formation, civil or building construction, roadwork, building renovation or demolition activities (Hao *et al.*, 2007; EPD, 2001).Besides, construction waste can be defined as the by-products generated from construction, renovation and demolition workplaces or sites of building and civil engineering works (Tam *et al.*, 2007; Cheung, 1993).

Furthermore, according to U.S Environmental Protection Agency (USEPA), the waste building materials, packaging, and rubble resulting from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures.

Building and site improvement materials and other solid waste resulting from construction, remodelling, renovation, or repair operations (Udayangani Kulatunga *et al.,* 2006; Harvard Green Campus Initiative, 2004).

2.3 CONSTRUCTION WASTE CLASSIFICATION

According to Shen *et al*, 2004, the wastes can be classified into inert and organic materials. The inert wastes are normally used in public filling areas and site formation works and the remaining wastes are often mixed and contaminated, not suitable for reuse or recycling but disposed of at landfills.

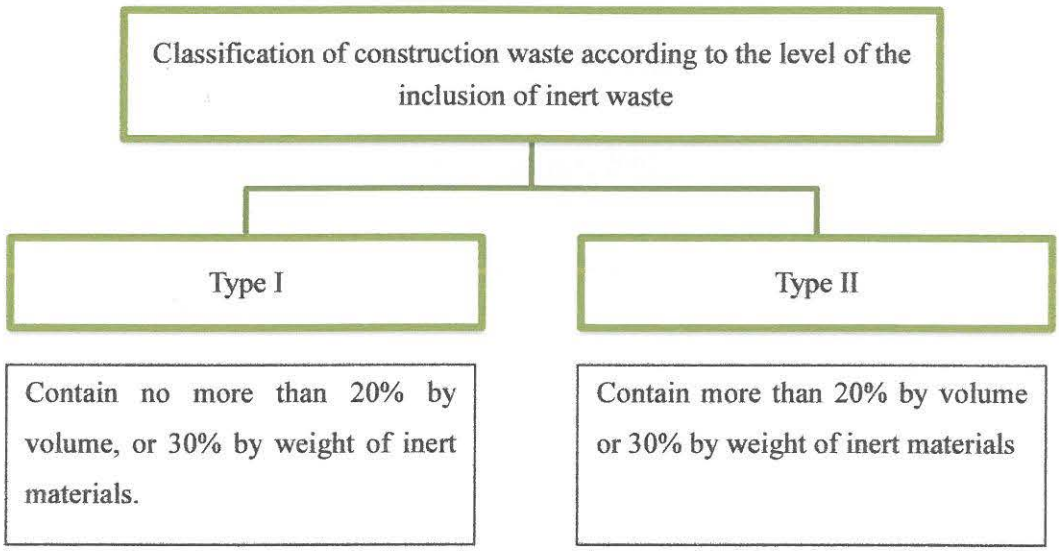

Figure 2.1 Classification of construction waste in Hong Kong

Source: Shen *et al*, 2004

Besides, the waste in construction can be originated due to different causes and situations. Cristiano, 2007 classified the factors of waste generation into four categories as shown in Figure 2.2.

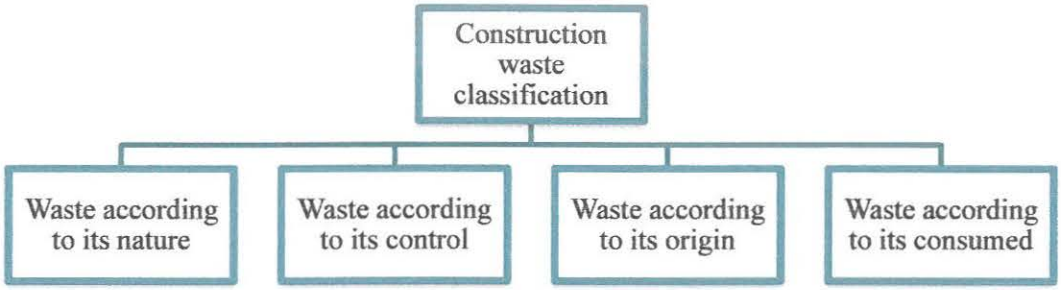

Figure 2.2 Construction Waste Classifications

Source: Cristiano, 2007

2.3.1 Waste According to the Type of Resource Consumed

According to the consumed resource, the waste can be classified in physical and financial waste as shown in Figure 2.3 (Cristiano, 2007; Andrade, 1999). This classification takes consideration on the physical waste of materials additional amount of material relative to the one specified in the project, physical waste of man-hour: men hours increased due to the delay in the arrival of materials and overproduction and physical waste of equipment: equipment hours increased in function of the problem cited for the man power.

Besides, the classification also considers on the financial waste in result of the physical waste: determine the costs associated with the physical waste and financial waste in result of material purchase: relative additional cost to the use of a material with superior value of the specified one.

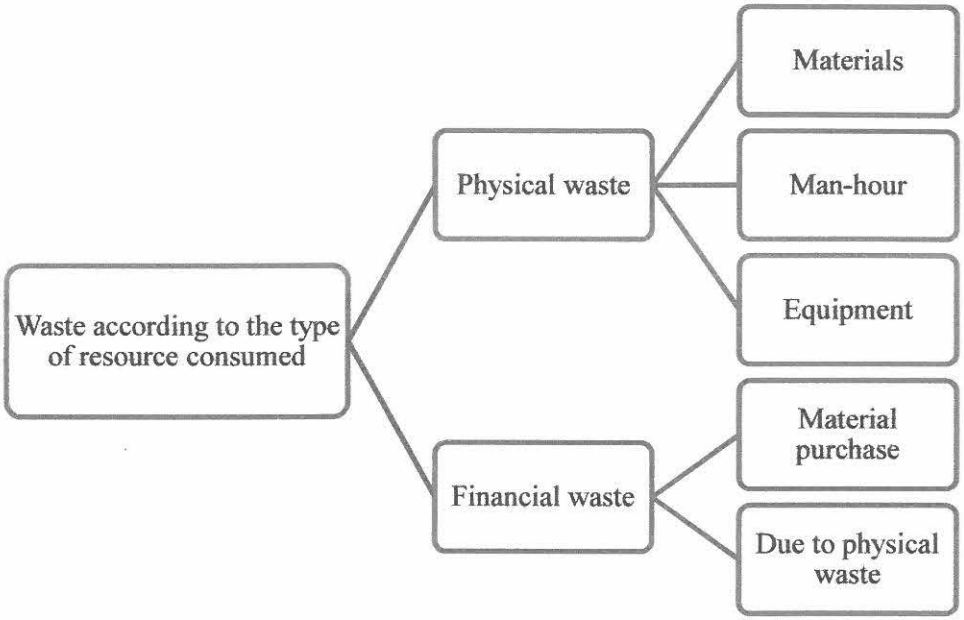

Figure 2.3 Waste according to the type of resource consumed

Source: Cristiano, 2007

2.3.2 Waste According to its Nature

Waste can be classified in indirect waste which is related to the financial waste and the use in excess of material and direct waste which is related to the physical waste of material, more specifically, the debris (Cristiano, 2007; Andrade, 1999).

The following classification resulted from a study conducted at the Federal University of Rio Grande do Sul (UFRGS), based on Shingo's seven wastes (Formoso *et al.*, 1999; Shingo, 1989) and on the analysis of some Brazilian building sites as shown in Figure 2.4.

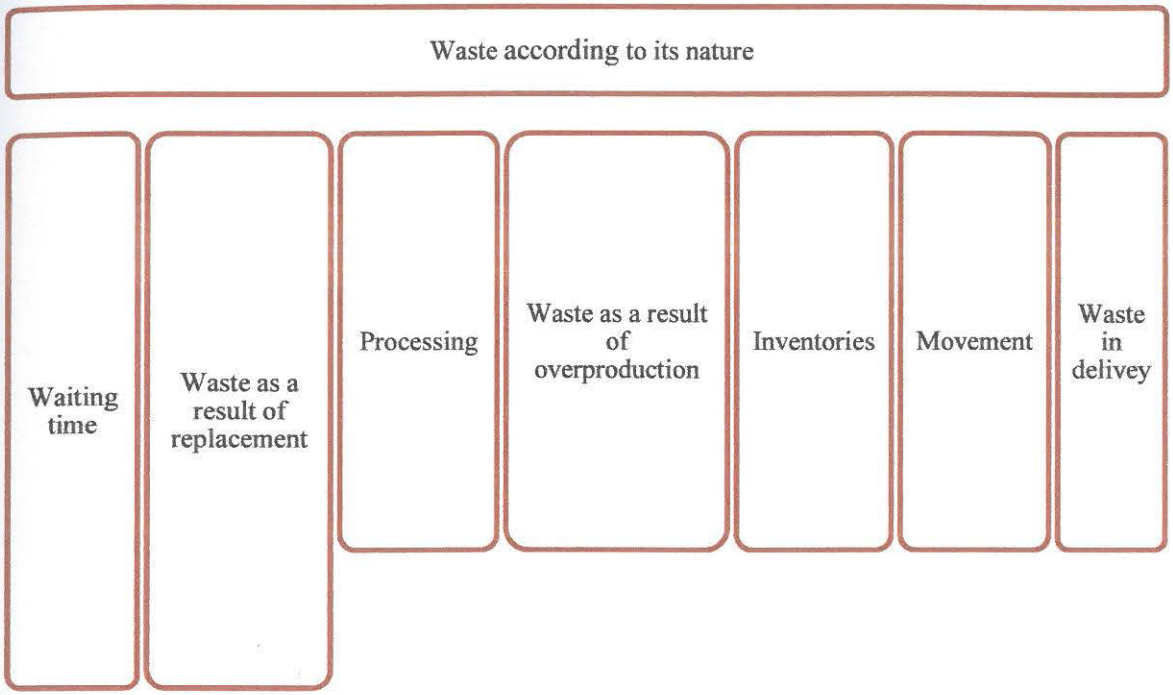

Figure 2.4 Waste according to its nature

Source: Formoso *et al.*, 1999

2.3.3 Waste According to its Control

Considering the possibility of controlling or reducing the index of waste detected, the waste is classified in avoidable or unavoidable categories (Cristiano, 2007; Paliari, 1999). The unavoidable waste is the one that the necessary investment for its reduction is superior to the economy obtained. Generally, this waste category represents an acceptable level of waste that its factors escape to the control of the builder, depending on the development of each company. On the other hand, this type of waste is the one that its reduction is economically viable because of the coat of waste is significantly higher than the cost to prevent it. The avoidable waste is consequence of a process of low quality, in which resources are used inadequately (Cristiano, 2007; Santos *et al.*, 1996).

2.3.4 Waste According to its Origin

According to Formoso *et al.* (1999), waste can also be classified according to its origin, i.e. the stage that main root cause is related to. Although waste is usually identified during the production stage, it can be originated by processes that precede production, such as materials manufacturing, training of human resources, design, materials supply, and planning.

Wastes occur in the different stages of the construction. For example, in conception phase, the use of a smaller space between the studs in relation to the considered correct standards or the extreme breaking of blocks during the execution can have origin in the lack of modulation. In planning stage, lack of necessary material in the moment of execution can be occurred. Moreover, the cement mortar production in superior amount that the one that will be used in the day of work or the use of inadequate techniques.

2.4 TYPES OF CONSTRUCTION WASTE

There are five major sources of construction waste, including roadwork material, excavated material, demolition waste, site clearance and renovation waste (Tam *et al*, 2007; Poon *et al.*, 2001; EPD, 1992). In a typical classification, construction waste is listed as asphalt, brick, tiles, concrete, mortar, reinforced concrete, rock, rubble, sand, soil, bamboo, ferrous metal, non-ferrous metal, glass, junk, fixtures, plastic, slurry, mud, trees, wood and other organics and garbage (Tam *et al*, 2007; Poon *et al.*, 2001; EPD, 1992). Table 2.1 shows the comparison between composition of construction waste in Hong Kong and United Kingdom.

Table 2.1 Comparison between composition of construction waste in Hong Kong and United Kingdom

Constituent	Percentage of Weight, %	
	Hong Kong (Tam et al; 2007)	**United Kingdom (Nigel Lawson et al; 2001)**
Asphalt	0.2	9.7
Concrete, bricks, block, aggregate	28.1	35.7
Rock/rubble	5.5	–
Sand	0.4	–
Soil	27.2	0.2
Bamboo	0.4	–
Metal	3.5	6
Glass	0.3	–
Junk/fixtures	0.4	–
Plastic	0.6	13.9
Slurry/mud	18.4	–
Trees	0.2	1.7
Wood	9.4	2.1
Other organic & garbage	5.4	–
Masonry	–	15.4
Vegetation	–	0.2
Road Planings	–	15

Source: Tam *et al*, 2007

2.5 CAUSES OF WASTE

There are various factors that contribute to the generation of construction waste. The factors causing construction waste span the project life cycle, including design stage, procurement, materials delivering/handling, construction/renovation, and demolition (Tam *et al*, 2007; Graham and Smithers, 1996). Whilst there are still other research works examining waste generation factors, the major waste generation factors across the projects stages can be summarized as listed in Table 2.2.

Table 2.2 Waste generation factors across construction project life cycle.

Project life cycle process	**Waste generation factors**
Design	Design errors Poor build ability Design changes
Procurement	Shipping error Faults in taking off Ordering error
Materials handling	Damage due to improper storage Deterioration Improper handling (on-site or off-site)
Construction/renovation	Human error Damage due to improper operation on equipment Abandoned work due o poor workmanship Trades person Equipment error Others (e.g. catastrophe, accident and weather)
Demolition	Trip ticket arrangement

Source: Tam *et al*, 2007