A STUDY OF CONSTRUCTION WASTE MATERIAL MANAGEMENT IN MALAYSIA: A CONTRACTOR POINT OF VIEW

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ABSTRAK

Malaysia pada masa kini berkembang dengan maju, disebabkan itu pembangunan di Malaysia boleh dijangka. Disebabkan pembangunan yang pesat, penambahan sisa binaan menjadi masalah terutama kepada kontraktor dan alam sekitar. Hal ini dapat disokang dengan keratan akhbar yg telah dikeluarkan oleh surat khabar 'The Star'. Oleh itu, objektif kajian ini dilakukan untuk mendapatkan pandangan kontraktor mengenai pelbagai bahan buangan pembinaan dan kebimbangan terhadap alam sekitar yang disebabkan oleh sisa binaan ini. Selain itu, ia juga untuk mengenalpasti masalah yang mungkin timbul oleh sisa binaan dan menganalisis kaedah yang sesuai untuk menyelesaikan masalah yang berlaku oleh sisa binaan. Kajian ini akan merangkumi kawasan semenanjung Malaysia. Kajian ini juga akan menumpukan kepada pengurusan bahan buangan binaan oleh responden kontraktor yang telah dipilih dan didaftarkan dibawah CIDB. Soal selidik disediakan dan diserahkan kepada kontraktor yang terlibat dalam projek pembinaan. Pengumpulan maklumat dilakukan dengan melakukan kajian kesusasteraan, kajian soal selidik dan membuat temuduga yang berkaitan dengan kontraktor. Berdasarkan tinjauan soal selidik, beberapa masalah yang disebabkan oleh bahan buangan telah dikenalpasti. Faktor-faktor ini kemudiannya disenaraikan berdasarkan kepentingan relatifnya, berdasarkan data dari kajian soal selidik yang diedarkan kepada pelbagai bidang perkerjaan dalam industri. Maklumat yang dikumpulkan dari kajian ini akan dianalisis menggunakan perisian SPSS dan Microsoft excels untuk menentukan faktor yang mempengaruhi dan yang akan menyumbang kepada pengurusan sisa pembinaan di Malaysia. Berdasarkan analisis yang telah dijalankan, objektif dapat dicapai melalui hasil kajian mendapati kos pengangkutan, dan masalah pembiakan serangga mendapat indeks purata yang tinggi. Bagaimanapun cara untuk mengatasi masalah sisa binaan yang mendapat indeks purata tertinggi adalah menyediakan kawasan untuk meletakan sisa binaan. Kesimpulannya, ke semua objektif telah tercapai, factor-faktor yang menyebabkan lambakan sisa binaan dapat dikenal pasti, serta jalan penyelesaian untuk membantu kontraktor juga akan dijelaskan dalam penyelidikan ini.

ABSTRACT

Malaysia nowadays is develop at steady pace, because of that increasing in development in Malaysia is predictable. Because of the rapid development in construction industry, construction waste becomes a major problem for contractor and environment. This can be proving with newspaper clippings issued by the newspaper 'The Star'. Therefore, this study is to highlight contractor's perception on various construction waste materials and major environment concerns cause by this construction waste. Besides that, it is also to identify the problem that may arise by the waste product and analyses a suitable method to solve the problem that occurs by the construction waste. This research will cover peninsular area of Malaysia. This research also will focus on the construction waste material management by the respondent of contractor that has been selected and registered to CIDB. The questionnaires were prepared and hand out to the person involved in construction project. Data gathering carried out by doing literature review, applying a questionnaire survey and making related interviews through contractor. Based on the literature review, several problem causes by waste materials have been identify. These factors were then ranked on their relative importance, based on data from a questionnaire survey distributed to a wide range of professions in the industry. Data that collected from this study is analysis using SPSS software and Microsoft excels to determine influential factors contributing to construction waste management in Malaysia. Based on the analysis conducted, objectives can be achieved through the study finds that transportation costs, and a place for insect breeding gets a high average index. However the way to overcome the problem of construction waste that gets the highest average index is to manage areas to locate construction waste. In conclusion, to all objectives have been achieved, the factors that cause increasing of the construction waste can be identified, as well as the solution to help the contractor will also be explained in this research.

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LIST OF ABBREVIATIONS

CIDB	Construction Industry Development Board
ADC	Alternative Daily
C&D	Construction and Demolition
SPSS	Statistical Package for Social Sciences

CHAPTER 1

INTRODUCTION

1.1 Waste Management in Malaysia

Construction industry in Malaysia nowadays produces a lot of construction waste product from demolish and also construction. This waste is proving can be fatal to the human life. In this matter, it is necessary to identify and develop a ways to practically use by the professional in the industry about construction management in construction site. In this manner, illegal dumping and also other related problem can be reduces and can be controlled.

Demolition and construction can produce mixture of surplus material from excavation, demolish and construction structure, site clearance, building renovation and also road work. Even construction pro might have problem and difficulty to get rid of the waste that consist of material such as concrete, wood, steel, tiling and drywall. Nowadays, area for the landfill space in Malaysia is not sufficient to accommodate huge quantity of construction waste produce by construction site. In this matter, it does have created a big problem and environmental concerns. Data that collected from this study is based on the contractor that has been registered with construction industry development board (CIDB) of Malaysia.

In recent year, recycle and waste reuse has been introduce to the contractor in order to reduce the construction waste and protect the environment but effectiveness of this method is limited by its application because of condition for applying this method were not provided. Several condition must be met to use recycle and waste reuse that is good experience in recycle operation, proper site location, equipment to sorting out waste, trained supervisor, and knowledge of environment and safety regulations. Among material that is suitable to recycle is crushed concrete that can be reuse as

gravel or dry aggregate for new concrete, clean wood that can be reuse as biomass fuel, and lastly rock and sand reuse as alternative daily (ADC) in landfills. Effort by contractor in recycle and reuse waste is less because of they always focused in completing the project with the shortest among of time rather than environment problem.

Thus, the aim for this study is to highlight contractor point of view on the several of environment consents and also identify quantities of construction waste produce during project is running.

1.2 Problem statement

Malaysia nowadays is develop at steady pace, because of that increasing in development in Malaysia is predictable. In this matter, all of the construction waste also will increase and decrease in area suitable for create landfill prove can bring harm in the future. This problem also cause major problem to the contractor and environment. Therefore, this study is carried out to study management in construction waste from the contractor point of view.

1.3 Research of study

The main objective of this study:

1. To study construction waste material management in Malaysia
2. To identify the problem may arise by construction waste.
3. To analyses suitable method to solve the problem occurs by construction waste.

1.4 Scope of study

The researches is focus on the contractor that is been registered with construction industry development board (CIDB) of Malaysia in the area Kuantan, Pahang. Question will be prepared by the interviewee to answer by the contractor. Several restrictions may occur during this research such as there is a lot of Construction Company in Malaysia and this research may not represent overall population. Besides that, the research will covered during construction phase and material that is considered is timber, cement/mortar, concrete and block. Survey will be conducted using

questionnaires and personal interview to the contractor that has undertaking project that still in progress. The question prepared will be mostly about management in site, problem that occur during managing waste product and people that is responsible in handling waste management process.

1.5 Significant of the study

This study is meant to draw attention to the contractor and Construction Company to identify the type of waste that may produce during construction phase so contractor and Construction Company can manage it effectively and cost can be reduce significantly. Besides that, this study also intend to propose suitable method that can be used by contractor and Construction Company in managing waste produce during construction phase and reduce the cost for managing waste. This method also be expected to reduce any illegal dumpling that prove can be harmful to the environment.

Research is conducted by the contractor point of view by questioning them about suitable question that related to the waste construction product that produces during the construction phase. Cost, type and management of the waste product are factor that will be including in the question that will be prepared to question the contractor point of view. A few of constrain may be encounter during research. One of constrain is there is several construction company thus the research may not representative overall of the population.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the literature review, we will discuss about research that involves what others have written in the subject area of construction waste management. All about knowledge including insight and background will be explain briefly from the literature review to bring something new to the subject area. In this chapter review literature on the global construction industry, material waste, waste minimization strategies and also overview from contractor perfective.

2.2 The Global Construction Industry

All construction company primarily engaged in construction either as a primary contractor, general contractor, sub-contractor, specialist contractor or as a heavy contractor that construct mega project such as airports, highways and utility system. There are also several companies that are engage with the preparation of new site construction (earthwork) and also in subdividing land for building sites (surveyor). Construction can be described as new work, maintenance & repairs, addition and also alterations. There are several types that construction usually describe to such as residential (home building) or non- residential (commercial and government buildings and infrastructure projects), or by public or private funding. (Troschinetz & Mihelcic, 2009)

In many countries, construction sector is a primary or core economic activity. Construction sector not only provides the infrastructure to the countries but also accounted as a largest sector that is in the economy on its own. Government also relied in this sector to provided utilities such as public work. Government has set construction

sector as a strategically important industry for creating employment and sustaining growth. Based on this matter, government also gives a support to local construction company by funding a mega project such as construction of expressway (lebuhraya pantai timur) that is cost about RM4.26 billion for entire section. In the developing economy, construction industries have a particular task because it can give a basic structure, training new local generation, change in technologies and also improve access to information channels. In developing countries like Malaysia, the awareness of having a proper management of C&D wastes is still lacking (Esa, Halog, & Rigamonti, 2016).

Many countries in world used a service of the supplier that is established near the site for the work by local or regional operator. This service that provided by the local normally is much cheaper that hired a professional from others place. In this matter, contractor can reduce the cost for the project that they doing. Time for construction also can be reduce because it not take much time to hired people in the area compare to hired service from others place. Regardless this matter, some of the work may require contractor to find an expert or specialist to do the work such as plastering and others. .The civil engineering has been registered as higher growth in 2008. This is because of the implementation of project under Ninth Malaysia plan where the federal government expenditure is increasing to funding new project and also building new infrastructure. The higher growth of civil engineering sector has been affected by the sudden rise in building materials. The important part in construction such as cement and steel become expensive and this cause higher growth in construction sector become stunted. The rise in building material is likely because of the rise in oil and diesel prices in the second quarter of 2008. Oil and diesel have generate negative impact on the growth of the construction sector (Construction Industry Development Board Malaysia, 2009).

In 2008, early part of the year shows a positive growth in the non-residential sub-sector and it really widespread. This growth is supported by the increased activities of the office space segment. In Klang valley, higher demand for the office space can be detected because of the trend in business activities in the first part of the years. Besides that, resident sub-sector also showed positive growth during first part in 2008 but this growth start to decline during the second part in 2008. This situation is due to the consumer that become and remains wary of the inflation pressure and situation of the

global economic worsening. (Construction Industry Development Board Malaysia, 2009)

2.3 Wastes in the Construction Industry

In this sub chapter, literature review about waste in construction, further definition about waste product in construction, talk about construction waste, the type/example of waste in construction product and lastly material waste and magnitudes of waste in construction. Construction manager or project manager should consider to carefully managing waste product. It is because waste that produce during construction phase not only can affect performance of the production process, it also come with different factors and different types of wastes. Waste can be included such as substance, matter or thing that is generate by the result of construction work and abandoned whether or not it has been processed or stockpiled before being abandoned. It is a mixture of surplus materials arising from site clearance, excavation, construction, refurbishment, renovation, demolition and road works ("Environmental Protection Department - Introduction to Construction Waste - What is Construction Waste," n.d.).

2.3.1 Definition of waste

Waste product that is produce in construction is one of the main factors that cause problem for the environment and health. The substance that is produces such as asbestos which is generated during demolition works and can be hazardous. Asbestos is a naturally occurring mineral that is known for heat resistance, tensile strength and insulating properties usually mixed with cement to produce concrete but this mineral also highly toxic and can cause mesothelioma cancer. Mainly, construction waste is generating by the building material. There are several authors who have defined construction waste as follow:

- "Any substance, matter or thing which is generated as a result of construction work and abandoned whether or not it has been processed or stockpiled before being abandoned". ("Environmental Protection Department - Introduction to Construction Waste - What is Construction Waste," n.d.)
- "Waste defined as unwanted material". (Ikau, Joseph, & Tawie, 2016)

- “waste is considered to be an unsustainable activity that causes progressive deterioration of the environment”.(Mejía, Tobón, Osorno, & Osorio, 2015)
- “C&D waste had been defined as the waste that arises from construction, renovation and demolition activities”.(Kofoworola & Gheewala, 2009)
- “C&D waste is discarded building materials and rubble from the construction, renovation, repair, and demolition of buildings, bridges, roadways, retaining walls and other structures”.(By, Lambert, & Domizio, n.d.)

In the conclusion, all authors above have the same opinion about definition of the construction waste in construction phase. There are few classification can be made in the construction waste such as labour, material and machineries waste but all the waste is produce in construction phase. In Malaysia, construction waste not seriously manage and this condition been worse by the amount of construction waste rapidly growth. In this matter, all parties should take appropriate action to prevent this problem to damaging our beloved environment.

2.3.2 Construction waste

Construction waste in Malaysia has been considered as huge problem and this problem not only happen in Malaysia but it happen in many large cities in the world. The amount that been produced in a year increasing generate from the construction companies activities. Nowadays, construction industry in Malaysia takes a responsible to produce building that can be used by the consumer. It is also give benefit to the country economy and providing useful infrastructure (Ikau et al., 2016). Several research projects have been run around the world in recent years. Few of the research have the focused on the environment damage that result from the old generation material waste. Several products have been introduced to the industry to replace old material to the new material such as foam concrete technology. Foam concrete technology generally define as a lightweight type concrete that consist of a cementations binder with a high degree of void space, with or without the addition of fine aggregate (Zhang, Provis, Reid, & Wang, 2014). Some of the construction site waste product can be classified as the non-hazardous by product. This non-hazardous by product usually produce by activities during new construction and renovation process. In this time, not much material can be found at the construction site because of the site preparation, material use, material damage, and material not used.

Environmental protection department of Hong Kong indicate that construction & demolition waste is includes waste arising from any land excavation or formation, civil/building construction, site clearance, demolition activities, roadwork's and building renovation. It includes various types of building debris, rubble, earth, concrete, timber and mixed site clearance material ("EPD - Monitoring of Solid Waste in Hong Kong 2000," n.d.).

(a)

(b)

Figure 2.1 (a) (b) Waste Materials With Concrete Based

(a)

(b)

Figure 2.2(a) (b) Waste Material With Timber Based

(a)

(b)

Figure 2.3(a) (b) Brick Block Waste Material

2.4 Source of material waste

Construction work basically produces a lot of construction waste. Activities that been carry out in the site construction such as refurbishment, construction and also repair work are the main factor that contribute to its.

In the design and construction phase, many wasteful activities can be detected. The activities not only consuming both time, it's also consuming effort without adding value to the client. Generation of the stream of waste is influenced by various factors.

2.4.1 Natural waste

Natural waste is the wastage that costs than more is saved if tried to prevent. Limit has been created up for waste material can be prevented. If the limit is been past, any action that is been conduct to prevent waste will not be viable, as the cost to saving the environment will surpass value of the material. Thus, natural waste is allowed in the tender.

Amount of natural waste is subjective to the cost effectiveness of the approaches used to manage it. For example, a project with a good material controlling policy can has lower cost of preventing wastage while project that not have good material controlling policy cannot reduce cost of preventing wastage (Hamzeh et al., 2010).

2.4.2 Direct waste

Waste can be prevented and which involves the actual loss or removal and replacement of material is called direct waste. Cost for direct waste usually not includes in cost of material but it is in cost of removing and disposing of the waste. There for the cost for preventing direct waste is straightforward and can be obtains. Direct waste can occur at any stage of the construction process before the delivery of material to the site and after incorporating the materials at the building. There are several categories of direct waste can be obtain from summarized table 2.1.

Table 2.1 Categories Of Direct Waste

Categories	Reason	Example
Delivery waste	During the transportation of materials to the site, unloading and placing in addition to the initial storage.	Bricks, glassing
Cutting and conventional waste	Cutting materials into various sizes and uneconomical shapes.	Formwork, tiles
Fixing waste	Dropped, spoiled or discarded materials during fixing.	Bricks, roof tiles
Application and residue waste	Hardening of the excess materials in containers and cans.	Paint, mortar, plaster
Waste caused by other trades	Damage occurs by succeeding trades.	Painted surfaces
Criminal waste	Theft and vandalism	Tiles, cement bags
Management waste	Lack of supervision or incorrect decisions of the management	Throwing away excess material
Waste due to wrong usage	Wrong selection of materials	Rejection of inferior quality marbles, tiles

2.4.3 Indirect waste

Indirect waste only occurs when material are not physically lost or not been use, but indirect waste is a waste that financially loss. For example, leftover concrete that is order for used in making slab and waste due to concrete slab thickness larger than that specified by the structural design.

Indirect waste arises principally from substitution of materials, waste caused by over allocation, where materials are applied in superior quantity of those indicated or not clearly defined in contract documents, from errors, and waste caused by negligence, where materials are used in addition to the amount required by the contract due to the construction contractor's own negligence.

Table 2.2 Categories Of Indirect Waste

Categories	**Reason**	**Example**
Substitution waste	Substitution of materials in work, which will incur losses to either contractor or client	Use of facing bricks for common bricks
Production waste	Contractor does not receive any payments for the works he has carried out	Work not in the contract
Negligence waste	Site errors because of the condemned work or use of additional material	Over excavation of foundation resulting in the use of additional concrete
Operational waste	Unavailability of proper quantities in the contract documents/ the materials that are left on sites	Formwork

2.4.4 Cause of construction waste

Construction wastes generally produce from the start of the project until the project is finish or from the start of the project until completion of the project. The main six causes of waste are design, procurement, materials handling, operation, residual, and other. One of the major causes for waste in construction site is late design change. This is because; material may be bought and not been use in new design. Another factor that may be a major is incomplete or late information, poor material management, incompetent labour, and damage during transportation are examples of C&D waste sources. Recently, several studies have indicated the importance of the design stage and problem may lies with architect that fail to implement waste reduction measures during design stage (Dajadian & Koch, 2014). Table below indicate list of source and cause of construction waste:

Table 2.3 Source And Cause Of Construction Waste

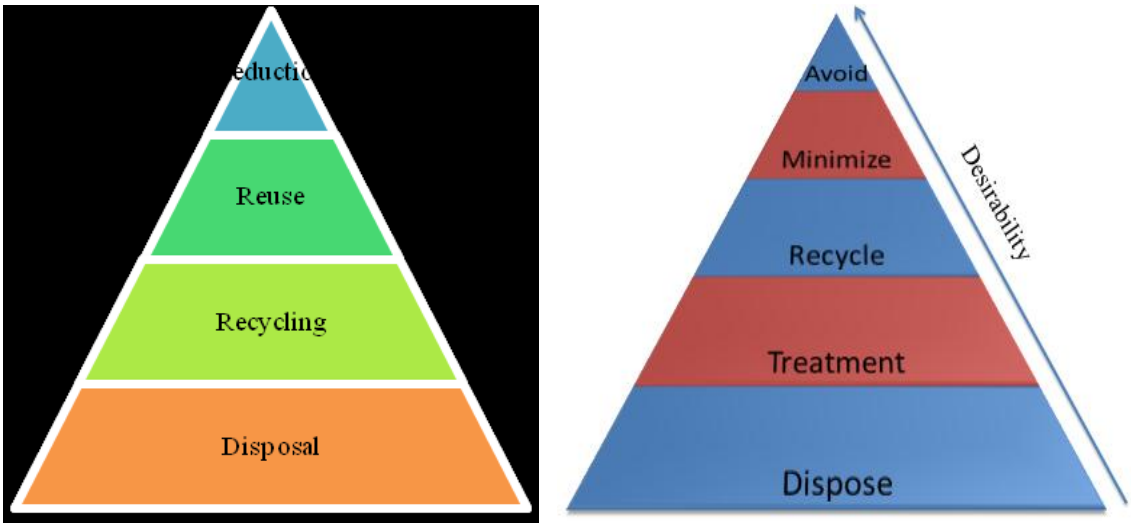
Sources of waste	Cause of waste
contractual	1. Errors in contract documents 2. Contract documents incomplete at commencement of construction
Design	1. Design changes 2. Design and construction detail errors 3. Unclear/unsuitable specification 4. Poor coordination and communication (late information, last minute client requirements, slow drawing revision and distribution)
Procurement	1. Ordering errors (i.e., ordering items not in compliance with specification) 2. Over allowances (i.e., difficulties to order small quantities) 3. Supplier errors
Transportation	1. Damage during transportation 2. Insufficient protection during unloading 3. Inefficient methods of unloading
On-site management and planning	1. Lack of on-site waste management plans 2. Improper planning for required

	quantities 3. Lack of on-site material control 4. Lack of supervision
Material storage	1. Inappropriate site storage space leading to damage or deterioration 2. Improper storing methods 3. Materials stored far away from point of application
Material handling	1. Materials supplied in loose form 2. On-site transportation methods from storage to the point of application 3. Inadequate material handling
Site operation	1. Accidents due to negligence 2. Equipment malfunction 3. Poor craftsmanship 4. Time pressure
Residual	1. Waste from application processes (i.e., over-preparation of mortar) 2. Packaging
Others	1. Weather 2. Vandalism

Sources: (Dajadian & Koch, 2014)

2.5 Waste management hierarchy

Construction waste should not directly dispose however it needs to pass through several processes before being disposed. It should be treated according to proper waste management hierarchy as proposed by Peng et. al., 1997 in Figure 2.4(a). The waste management hierarchy suggests that waste should be reduced, reused, recycled then be disposed to proper dumpsite like landfill. Further research by Wolsink in 2010 has improvised the waste management hierarchy as in Figure 2.4(b). He introduced one step more by avoiding the waste generation.



(a) (b)

Figure 2.4(a)(b) Waste Management Hierarcy

However the terms avoid, minimize and reduction from Figure (a) and (b) are literally similar in actions. In Hong Kong, the government focuses in reducing the waste at the source. This effort can avoid any activities and process that can cause the waste generaton. Common understanding and regular emphasizing through meeting amongst all parties about the importance of avoiding the waste generation is a good approach in avoiding the waste generation (Dajadian & Koch, 2014).

Since the waste generated is not fully avoidable, the next step should be consider is to reuse some of the construction waste likes using broken brick and concrete as a sub-grade of access road to the construction site. For waste that cannot be used at the site, it can be sorted for recycle purpose. Wastes like wood, steel, plastic and others can send to recycle factory. These efforts have to be carried carry out in order to reduce the disposal amount of construction waste to landfill. Thus, it will extend the life span of landfill.

Following the steps in the waste management hierarchy is benefited to the environment and economy to a country. Unfortunately, most of the contractors do not like this good practice of hierarchical waste management steps because they argued that the waste materials have little premium value and these cause them to dispose the waste in landfills. Under the Malaysia Solid Waste and Public Cleansing Management Act 2007 (Act 672), 'disposal' means the disposal of any solid waste by any means including

destruction, incineration and deposit or decomposing. One of the common methods of disposal construction waste in Malaysia is through dumping in landfill. Since landfill is simple and cheap method unlike incinerator which is more expensive and requires technological experts to operate it.

The locations of these landfills are in the densely populated area of peninsula Malaysia. The figure indicates that the disposal technique of waste is popular in Malaysia. Some of the landfills are well manage with proper technology and sanitation. However, there are also landfills that create nuisance to the surrounding and general public (Nagapan, Rahman, & Asmi, 2012a).

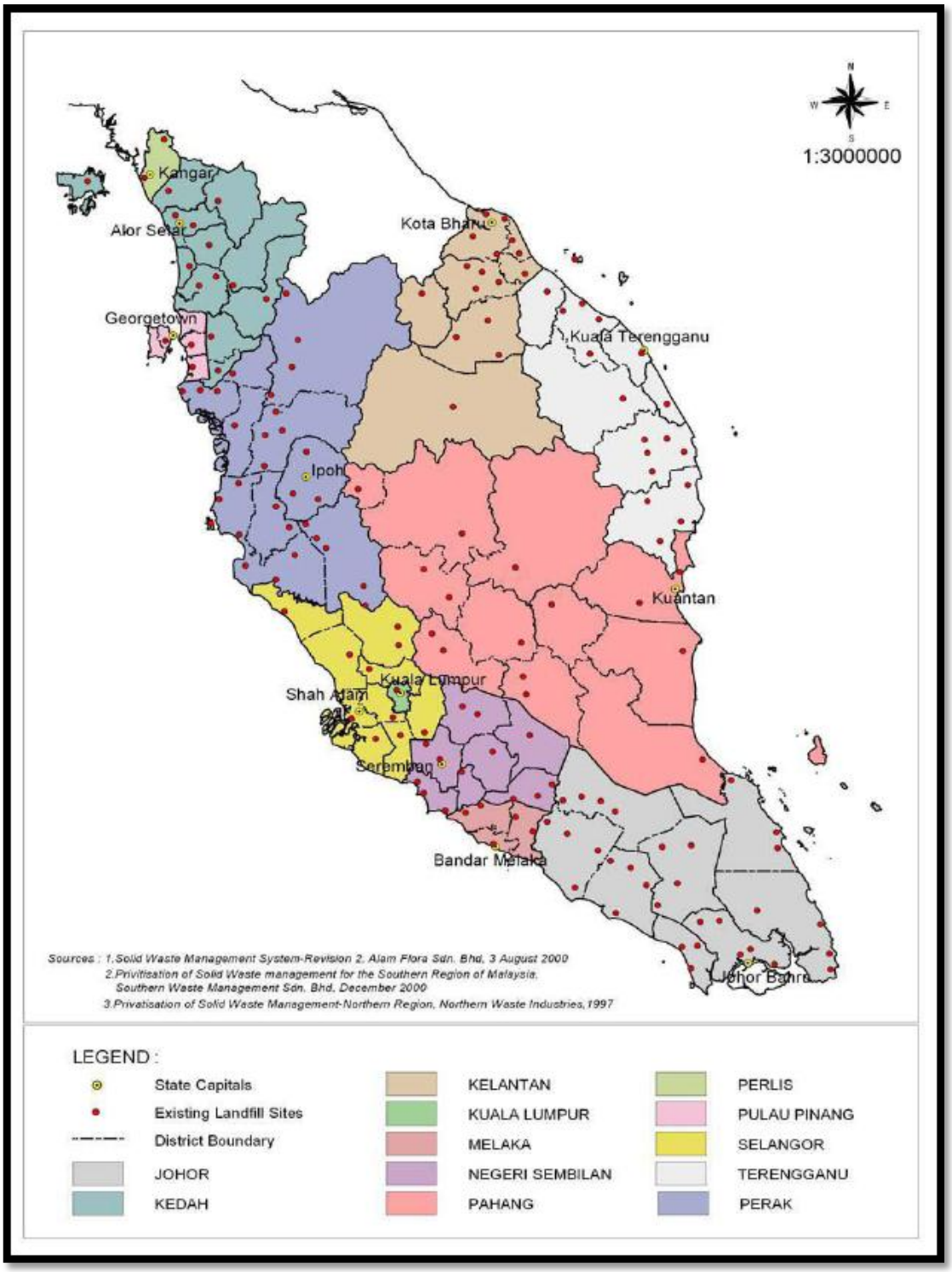


Figure 2.5 Landfills Site In Malaysia

Sources: (Nagapan, Rahman, & Asmi, 2012b)

2.6 Issues on construction waste

Construction waste generation is becoming a pressing issue in Malaysia. There are a lots of construction waste generated in the country because of rapid development in construction industry. Demand of houses and major infrastructure projects make the amount of construction waste getting increased.

Issues of illegal dumping have swelled rapidly all over the country. Recent news had highlighted that almost 30 tons of construction wastes was dumped illegally in tropical mangrove swamp near Bandar Hilir, Malacca and construction debris problem at MRR2 of Jalan Genting as shown in Figure 2.6 and Figure 2.7.

These illegal dumping has causing risk to human health and environment. Distance between the project location and the landfill site hinder the contractor to dispose in legal landfill. The contractors intended to maximise profit by avoiding transportation cost and payment charge to the gazetted landfill.

Meanwhile, a study conducted on 30 construction sites identified six types of waste materials which include concrete (12.32%), metals (9.62%), bricks (6.54%), plastics (0.43%), woods (69.10%) and others waste (2%) (Nagapan et al., 2012a). This indicates that wood waste generated is more than others for the composition of construction waste generated in this country.

Dumpsite shocker

A protected tropical mangrove swamp along the Bandar Hilir coastline in Malacca has been turned into a construction dumpsite. >3

Destroying Mother Nature

Tonnes of construction debris have been dumped on this mangrove swamp in Malacca, causing environmental pollution. — By A MALEK TAHIYA / The Star

Figure 2.6 Construction Waste Illegally Dumped In Mangrove Swamp

Sources: (“Dumpsite shocker,” n.d.)

Dumpsite operators ignoring orders

They are not adhering to specific instructions given by MPS

BY STUART MICHAEL
metro@thestar.com.my

TWO dumpsites, one behind the Gombak district police headquarters and another near the MRR2, off Jalan Genting, are still operating despite notices issued to the owners to cease operations.

The Selayang Municipal Council (MPS) has issued notices to the illegal dumpsite owner near MRR2 but lorries could still be seen unloading their rubbish in the area.

The council has not stationed enforcement officers at the site to monitor the area.

The dumpsite behind the Gombak police headquarters is only for construction waste but household rubbish was also being dumped there and open burning carried out.

There is fear that the open burning will pose a danger to residents living in apartments about 50m away from the site.

The dumpsite operator, known only as Lim, said the household rubbish was dumped by the previous operator.

"After taking over the project six months ago, we only allow construction waste and wood to be thrown here. Now, we are levelling the area with red earth.

Last week, MPS had told the operator to level the area with earth on top of the rubbish and stop the garbage trucks from entering the site.

However, rubbish trucks still come to offload their garbage, wood and construction waste in the area.

When contacted, MPS public relations director Mohd Zin Mastad said the dumpsite near MRR2 was illegal and many summonses had been sent to the operator.

"The dumpsite near the Gombak police station was given permit only to dump construction waste.

"However, we have closed the dumpsite and waiting for a report on the open burning at the site," he said.

The dumpsite near the Gombak police station was given permit only to dump construction waste. – MOHD ZIN MASDAD

Health hazard: Open burning at the dumpsite behind the Gombak district police headquarters in Selayang.

Dumping ground: A lorry dumping its load at the illegal dumpsite at MRR2 of Jalan Genting.

Figure 2.7 Construction Debris Problem At MRR2 Of Jalan Genting

Sources: (“Dumpsite shocker,” n.d.)

2.7 Conclusion

Construction activities generate avoidable and unavoidable waste. Identifying and categorizing the types and causes of avoidable waste help in its minimization. This chapter reviewed literature on the construction industry in the world and in Malaysia, material waste, sources and causes of material waste and waste minimization measures. It further introduces lean thinking, lean production, principles of lean production and concludes with the introduction of lean construction in the construction industry and barriers hindering its implementation.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will be about method and types of project that will be conducted. The study included a literatire review on the contractor point of view based on given question, to identify the problem may arise by construction waste and identify suitable method to solve the problem occurs by construction waste in malaysia. The selected contractors were seen as a representation of the Malaysian construction industry which does not have an official system or guidelines for managing construction wastes on site, yet.The contractors interviewed, were randomly chosen and are considered a convenience sample. The selected companies had different backgrounds and experiences, and are assumed to be reliable samples by the researchers as they will represent different groups in the construction industry. the respondents interviewed were experienced project managers and engineers with extensive involvement in construction projects. Flowchart is provided to illustriate flow of research as below:

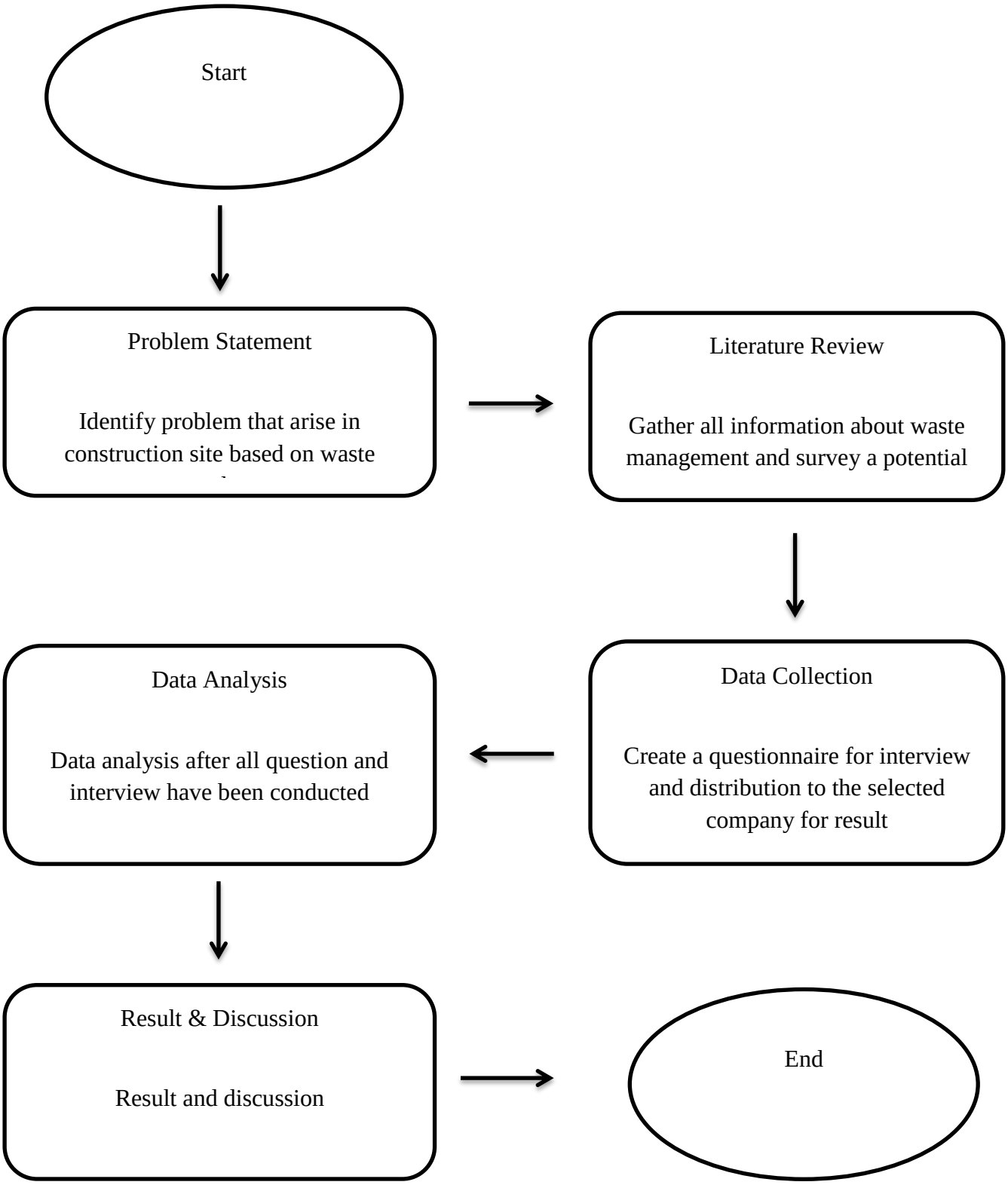


Figure 3.1 Flowchart For Methodology Process

3.2 Questionnaire Development

The contractors interviewed, were randomly chosen and are considered a convenience sample. The selected companies had different backgrounds and experiences, and are assumed to be reliable samples by the researchers as they will represent different groups in the construction industry. All chosen contractors were class G-7 companies with extensive experience in civil, infrastructure works and structures for the commercial, industrial and residential uses, among others. Meanwhile, the respondents interviewed were experienced project managers and engineers with extensive involvement in construction projects.

The interviews were conducted to obtain objective for the research produce by the researchers based on literature review. Contractors were also asked about their awareness of the campaigns made by the Government and Construction Industry Development Board (CIDB).

There were limitations to this research which could have inadvertently affected the results. Some of the selected firms were unresponsive and unsupportive, therefore making the data for the research incomplete and possibly biased. There were also time limitations to complete the research, thus fewer interviews were conducted than initially planned for. One the main barriers to this study was the low level of awareness amongst Malaysian contractors regarding sustainable resource and waste management. The lack of knowledge about waste management product made contractors more reluctant to implement any form of a waste management.

Finally, this study was conducted as a preliminary exploratory exercise to gauge the industry's level of awareness and commitment to sustainable waste management, identify current barriers and suggest future recommendations for an implementation strategy. Furtherinvestigations would be required to build on the findings of this study.

3.3 Types Of Question

Below is type of questions that can be included in questionnaires:

Table 3.1 Types Of Questionnaire

Types of questionnaires	Explanation
Open question questionnaires	Open questions differ from other types of questions used in questionnaires in a way that open questions may produce unexpected results, which can make the research more original and valuable. However, it is difficult to analyze the results of the findings when the data is obtained through the questionnaire with open questions.
Multiple choice question	Respondents are offered a set of answers they have to choose from. The downsize of questionnaire with multiple choice questions is that, if there are too many answers to choose from, it makes the questionnaire, confusing and boring, and discourages the respondent to answer the questionnaire.
Dichotomous Questions	This type of questions within questionnaire gives two options to the respondent – yes or no, to choose from and is the easiest form of questionnaire for the respondent in terms of responding it.
Scaling Questions	Also referred to as ranking questions, they present an option for respondents to rank the available answers to the questions on the scale of given range of values(for example from 1 to 10).

Sources: (Shekdar, 2009)

3.4 Sources Of Data

The study depended on both primary and secondary data. Primary data was made up of first-hand data collected by the candidate through the use of questionnaires, interviews and site visits (observation). The secondary sources of data were obtained using relevant books, journals, magazines and research papers.

3.5 Research Instrument

The research data was collected mainly through interviews and questionnaires. Field observations through site visits were also employed to gather data on high waste generating building materials.

3.5.1 Questionnaire Design

The questionnaire, which consisted of 4 section that is closed-ended questions was designed to obtain data on the sources and causes of materials waste and waste minimization measures, the questionnaire further sought to obtain information on the level of knowledge of construction professionals on the concept and benefits of lean construction. Interviews were also used to obtain more specific information about material waste and lean construction. The answer in in the form of scale from 1 to 5 which is 1for strongly disagree, 2 for disagree, 3 for average. 4 for slightly agree and 5 for strongly agree. In addition the background of the respondents also will be including in it to know their contribution in the project and experiences in construction industry. The reasons in adopting this simple answer are to provide the simplicity for the respondent to answer and easier to make evaluation of collected data. The questionnaire will be designed in order to get the respondent's opinion and views related to the objectives of this study. This questionnaire will be distribute using Google forms to make sure there is no waste of time for respondent and can be fill at any time and any where's.

3.6 Processing and Analyzing Data for Result

All the result that have been collected from the questionnaire are tabulated to the graph and the data will be gathered and tabulated accordingly based on the returned questionnaires and the interview responds and feedback. The graph will be the medium for the percentage distribution which will present the respondent's profiles data such as work sector, job position, working experience period and others.

3.6.1 Statistical package for social sciences (SPSS)

SPSS is software used for statistical data. All the data were analyzed in SPSS by using frequency analysis.

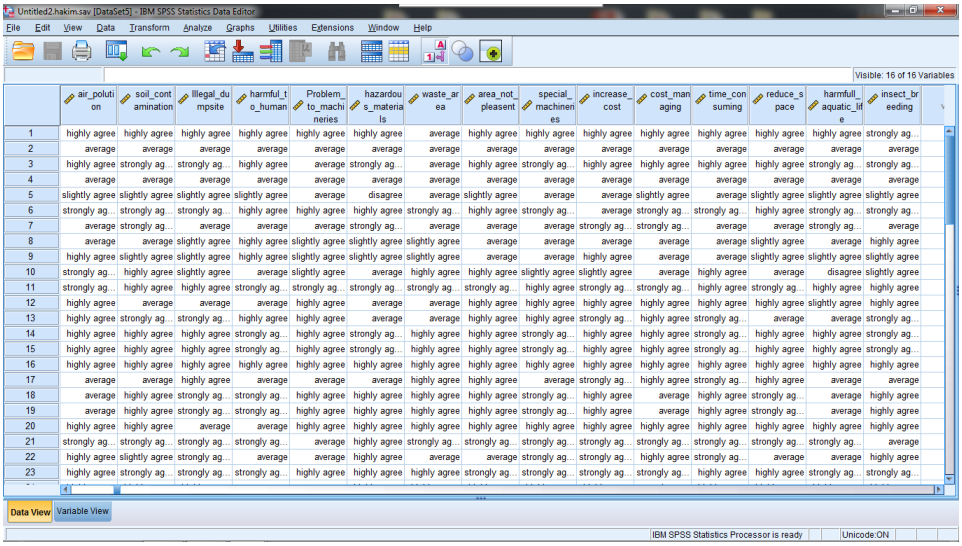


Figure 3.2 The Example Data Analysis In SPSS

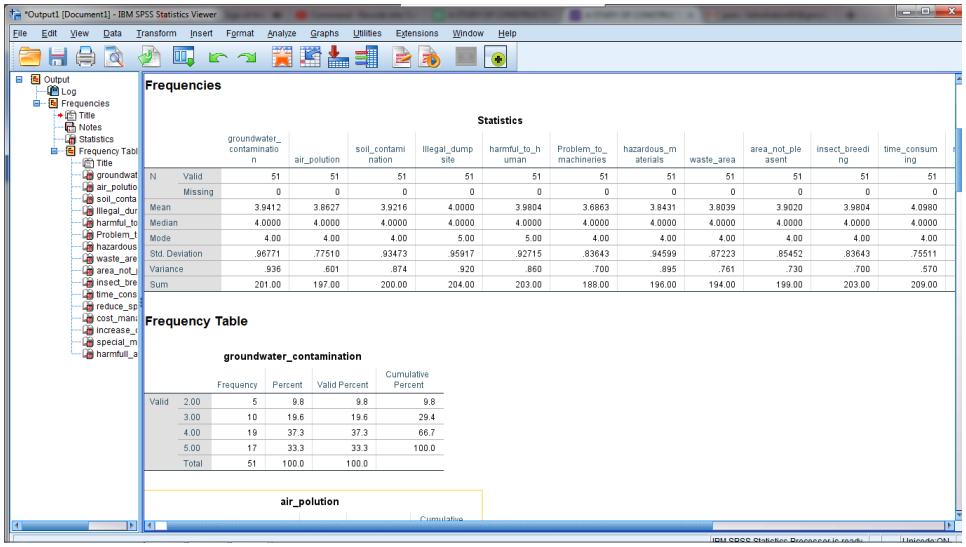


Figure 3.3 The Example Data Of Result In SPSS

3.6.2 Microsoft Excel

Microsoft excel will be used to calculate average index for data that we get. The average index will be calculate by using formula below:

$$Average\ index = \frac{\Sigma aixi}{\Sigma xi} \qquad 3.1$$

Where :

a = constant which represent the weightt of the i

x = the variable that represent the frequency of respondant i

I = 0,1,2,3,4, ……

The result of frequency analysis and the average index for each of the causes are tabulated in the same table. The highest values of average index shows the most important factor. This average index can be convert to percentage of index. Classification of the average index was referred to Abd. Majid and McCaffer (1997):

1. 1.00 ≤ average point ≥ 1.50
2. 1.50 ≤ average point ≥ 2.50
3. 2.50 ≤ average point ≥ 3.50
4. 3.50 ≤ average point ≥ 4.50
5. 4.50 ≤ average point ≥ 5.00

3.7 Conclusion & Recommendation

The conclution will be carried out based on the achievement of the three objective of this study that is to study the contractor point of view based on given question, to identify the problem may arise by construction waste and to analyses suitable method to solve the problem occurs by construction waste. There is few recommendation and suggestion for the improvement and also for furthers study or research will be point out with the hopes that construction company and stake holder will be accepted and can be practice during the construction process.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The problem that cause by waste product may cause a lot of damage to environment and others thing. It is important that identify a problem that cause by waste product and find a suitable method to prevent this problem from become bad to worse. There for this study have been conducted to identify and suggest a method to solve this problem. In this chapter, data that have been collected by questionnaire method will be analysed and process in the form of graph.

The techniques adopted here for the analysis of questionnaire survey were frequency analysis and average index (AI). The set of questionnaires has been made in Google form and the link is been spread in Peninsular Malaysia focused on construction field only. The causes are categorized in 2 scopes by consultant and contractor. In the questionnaire parts, data collections and analysis must based on the objective of the study that consist of 3 objective. To achieve the objective of this study, questionnaires were divided to 4 parts which are:

Part A: general information

Part B: solid waste management

Part C: problem in managing construction waste materials in site

Part D: method to solve problem occur by construction waste

4.2 Analysis for general information

In the general information section, analysis is about the respondent. From the analysis, it shown the location of highest respondent is in Pahang with 37%. The second highest location is Kedah with 13% following with Selangor with 12%, Pulau Pinang and Kelantan with both have 6% and the lowest respondent is Johor, Perlis, Terengganu and Kuala Lumpur. By the collected data, Pahang have highest respondent and second highest is Kedah. The lowest respondent is share between four states that is Johor, Perlis, Terengganu and Kuala Lumpur.

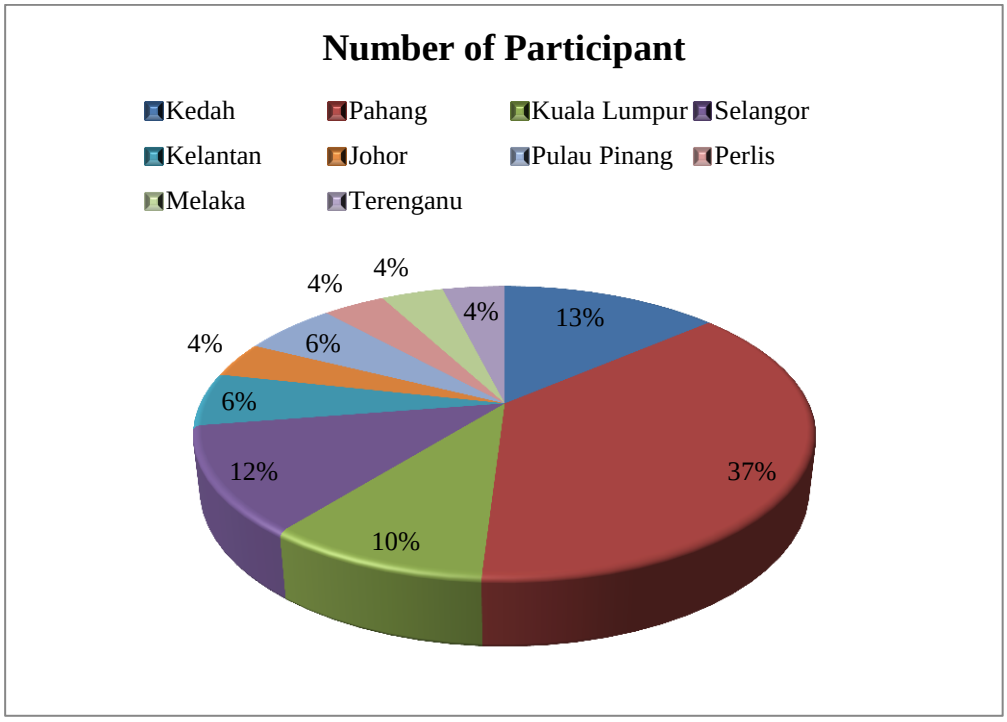


Figure 4.2.1 Number Participant By States

The positions that respond for this questionnaire mostly consist of site supervisor that is about 39.2%. This is because site supervisor for a big project used many supervisors. Sometimes, a project consists of many building and supervisor will only supervise one building per person. Second ranking is resident engineer and clerk of work (COW) that has percentage about 13.7%. In construction site that build a building, there is a lot of technical stuff such as civil, mechanical and electrical, so it is contribute to this percentage. Design engineer, safety officer and environment consultant have

similar percentage that is 7.8%. Others is senior engineer that has percentage 5.9%. Lastly the position is construction manager that has percentage 3.9%.

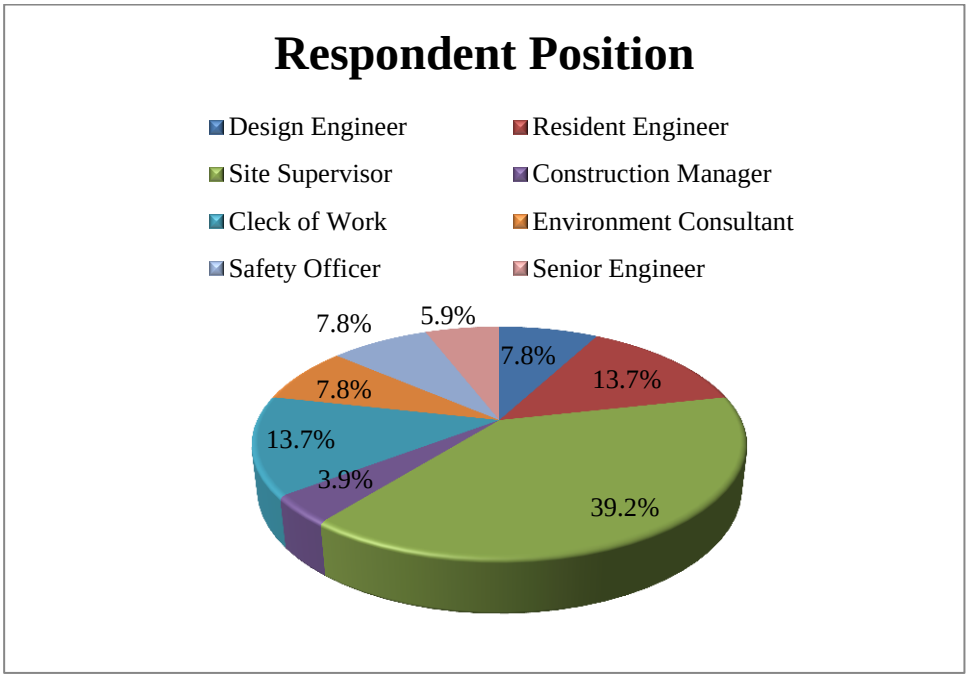


Figure 4.2.2 Respondent Position

For academic qualification, most of the respondent have degree certificate with is 51%. Nowadays, most of the construction company will require a certificate to work with them. This one of the factor that contributes to this percentage. Other qualification is diploma that has 43%, 4% have Master and lastly is SPM certificate with is 2%.

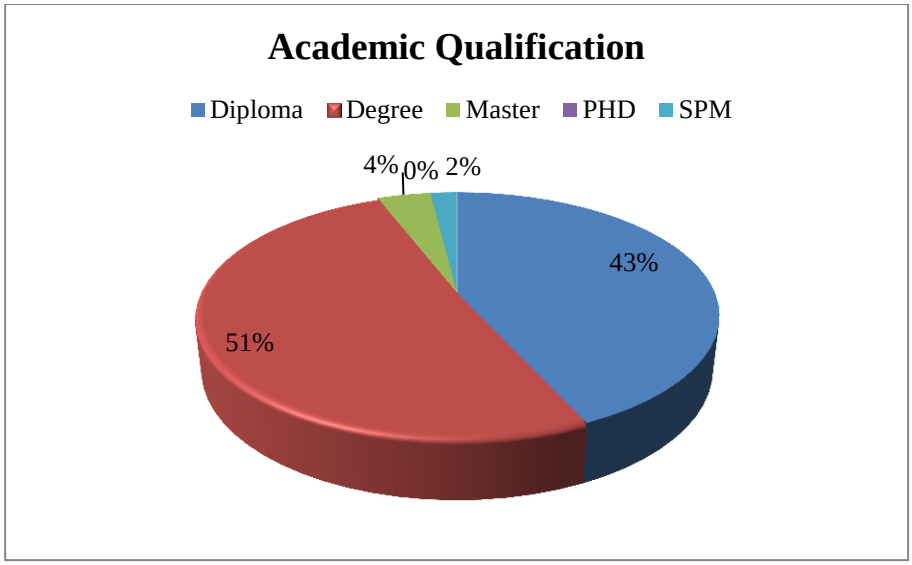


Figure 4.2.3 Academic Qualification Of Respondent

Respondent have been ask with the question "how many project that has been involve with waste material management?' there are 59% answer for 1 until 5 project involvement. This high percentage because respondent maybe new in this industry. Others than that, 6-10 project have 29% while 11-25 project have 8% and lastly 4% with is 16-20 project.

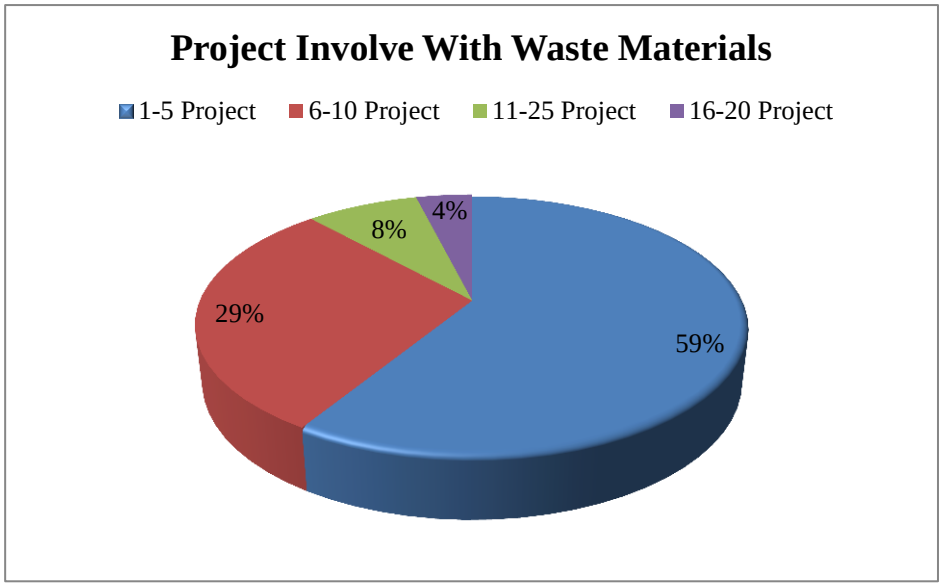


Figure 4.2.4 Project With Involvement Waste Materials

The last question for general information is about experience that respondent have regarding waste material management based on the project that they involve with waste materials. Based on the data that has been collected, the highest percentage is 1-10 year with has 88%. This percentage is influence by the respondent that has position as engineer and site supervisor with working experiences 1-10 years with waste materials. Second highest percentage is for 11-20 years' experience and lastly is 21-30 years experiences with 2%.

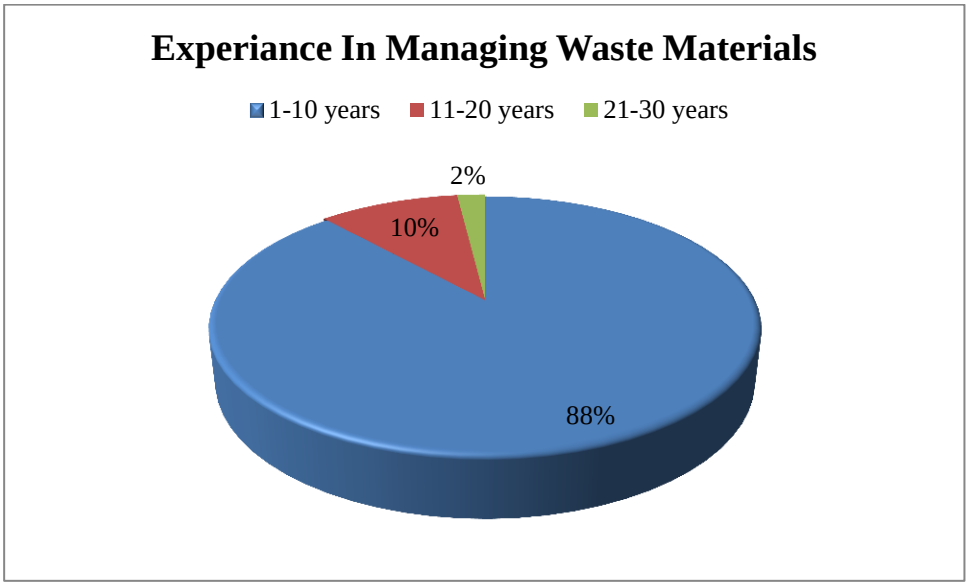


Figure 4.2.5 Experience In Waste Material Management

4.3 Analysis of solid waste management

This analysis is important to this study, it is because waste management one of the main objective of this study. This is section will be on contractor point of view based on given question regarding waste material management. Question in this section is about solid waste management and how to state of solid waste management in respondent construction site.

The first question is 'have you ever heard about solid waste management?' The answer have been provided with three multiple choices with is 'yes', 'no', and 'maybe'. Most of the respondent has answer 'yes' with have 96.1%. Answer with is 'no' and 'maybe' have same percentage with is 2% each.

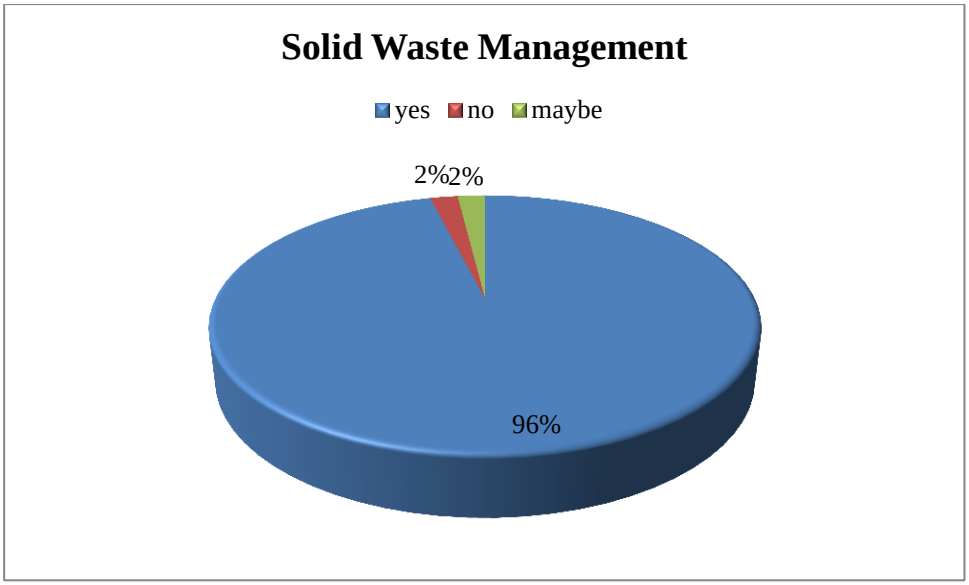


Figure 4.3.1 Solid Waste Management

The second question is depend on the first question with is, if respondent answer 'yes' in first question they must be answer second question with is how they know about waste management and in this question they can answer more 1 answer that have been provided. This question have 49 responses from total 51 respond because 2 of the respond already answer 'no' and 'maybe' at the first question with make them not required to answer this questions. Based on the respond that given, the highest is in seminar with has 30 respond and second highest is public meeting with has 24 respond followed by in school with has 23 respond in the third places. This high number of respond because they already have a lot experience in handling waste product and undergo seminar to managing it. After that, televisions have 8 respond and poster have 5 respond. Radio only has 3 respond while meeting and internet both get 2 respond. Lastly, subject in university only has 1 respond.

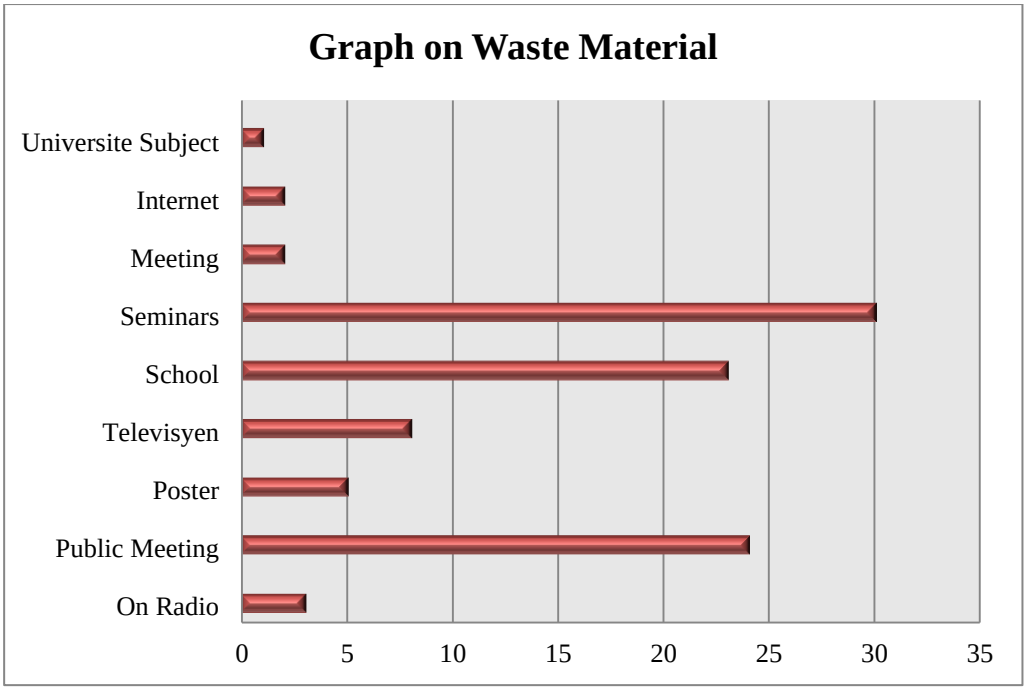


Figure 4.3.2 Knowledge On Waste Material

After second question, respondent has been asking about container that has been used to collect waste material. This question is to get a data on 'how often waste material container emptied'. According to the data that collected, container with one a week emptied has high percentage with is 41%. This high percentage because of the size of the project and a project that need demolished before construct a new project, thus create a lot of waste product needed to manage. In this matter, waste container must be emptied to avoid waste overflow and made it difficult to manage. Second and third high percentage is one in 6 days emptied with 22% and one in 3 days emptied with 21%. For emptied one a month, it has percentage 8%. Other than that, there are answers that have same percentage that is 2 week emptied and others. Others is an answers that is not listed by the given answer. Respondent write down an answer based on their experience. Example answers that have been given by respondent are based on project scale and depend on site size.

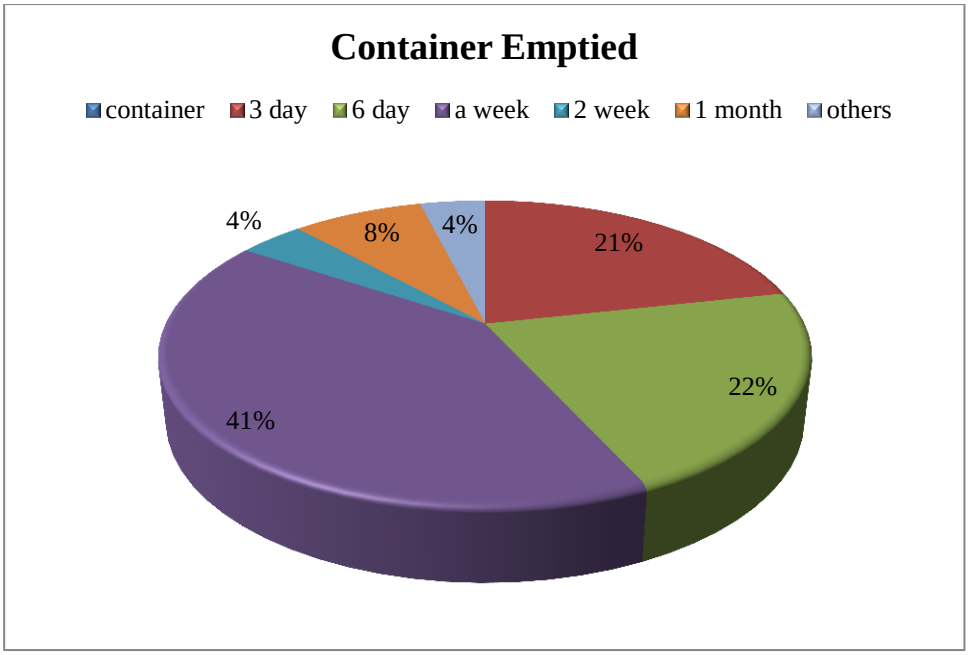


Figure 4.3.3 Waste Container Emptied

Next question is about collected material and where collected waste material is been managed. Based on the questionnaire that has been distributed, the highest percentage is 63% from the answer recycle material. Waste material can be recycle to be used as material to make a concrete but not all the material can be recycle and there is a limitation based on the structure that be construct. Besides that, there is 13% of the respondent that select answer hole in own compound while 12% select put the waste product in refuse chambers. Last three answers have 6%, 4%, and 2% with is put waste material in open area, transfer to dumpsite and sell the waste product to the others.

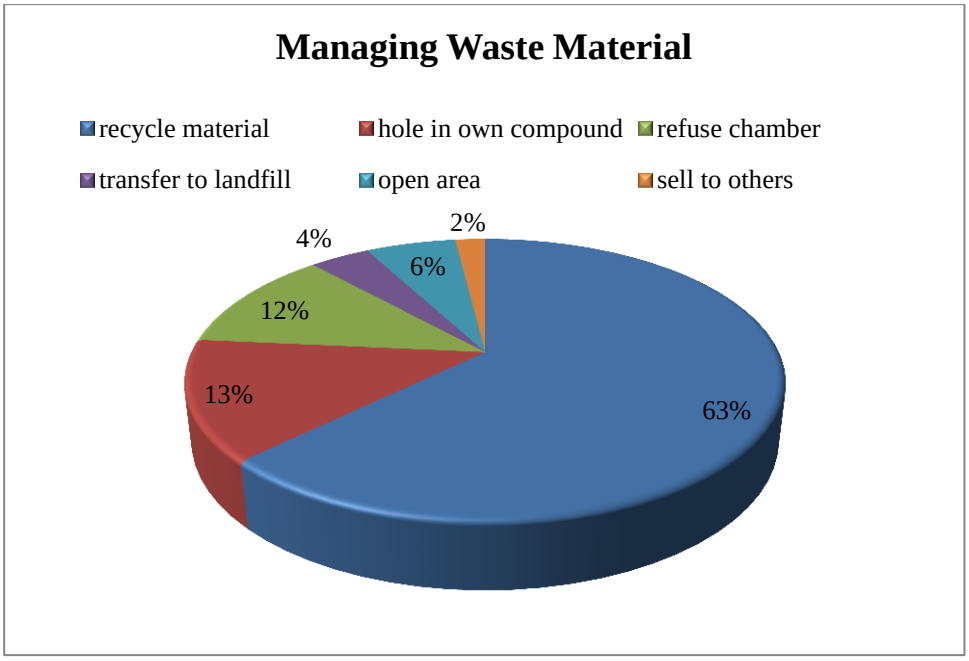


Figure 4.3.4 Put Away Waste Material

Others question is ‘are there any dumpsite near constructions site?’ The answer is in multiple choice question that is ‘yes’, ‘no’, and ‘maybe’. 49% of the respondent has select ‘yes’ while 35% of the respondent selected ‘no’ and 16% of the respondent has selected ‘maybe’.

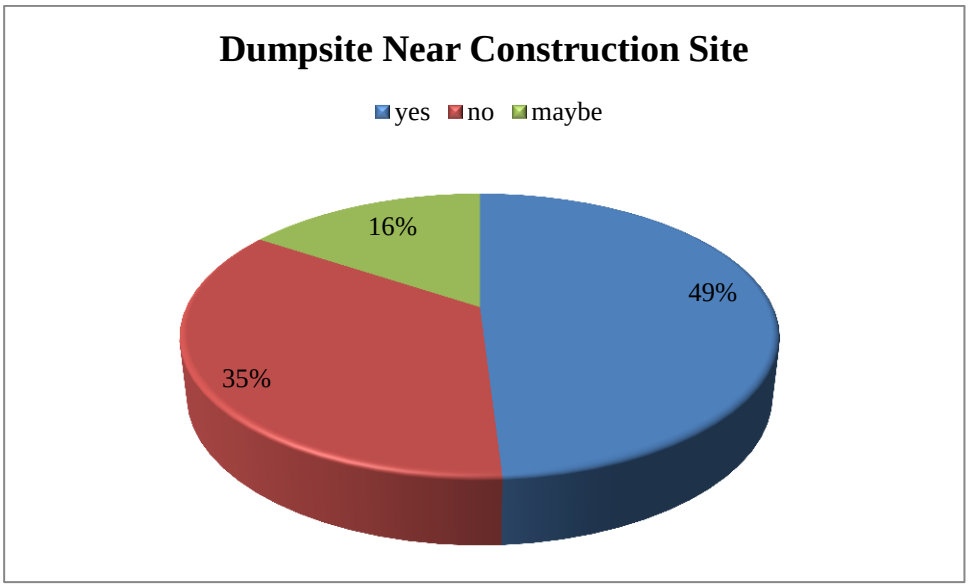


Figure 4.3.5 Landfill Near Construction Site

Condition of dumpsite is important to make sure waste material can be well maintained. Waste material can become dangerous to the environment if not well maintained. Not only to environment, it also become dangerous to living being if it exposed to the water sources. In this matter, state of the dumpsite near the construction site is important to manage and maintain waste materials. Respond to the question regarding this is 51% respondent select answer don't know condition of dumpsite. 15% selected answer too much waste materials in dumpsite and 14% selected answer dumpsite is in good condition. Others have select dumpsite is inadequate and not in good condition.

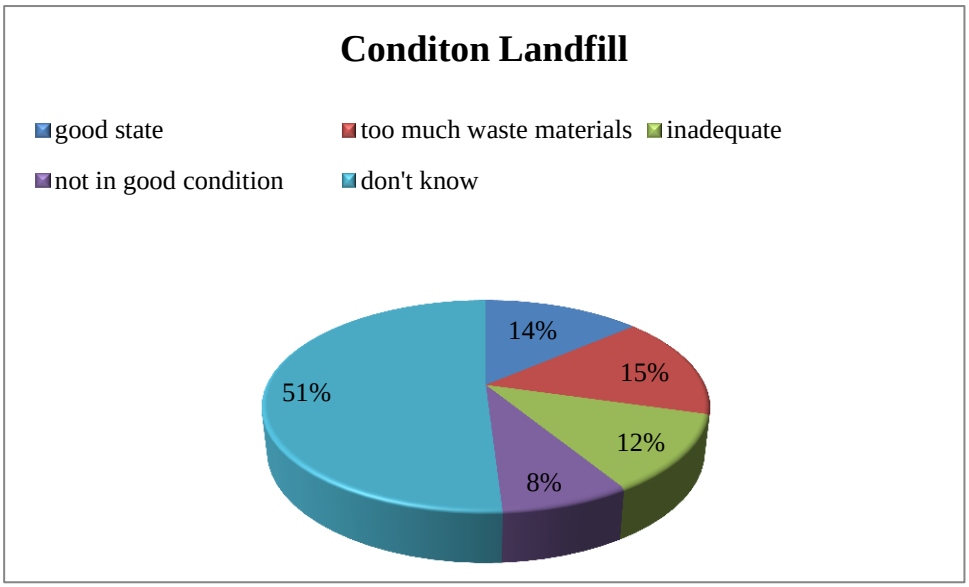


Figure 4.3.6 Condition Dumpsite

The next question is 'do you thing waste management is a problem in the area?' based on the answer provided 29% respondent selected 'yes', 24% select answer 'no' and 47% select answer 'maybe'.

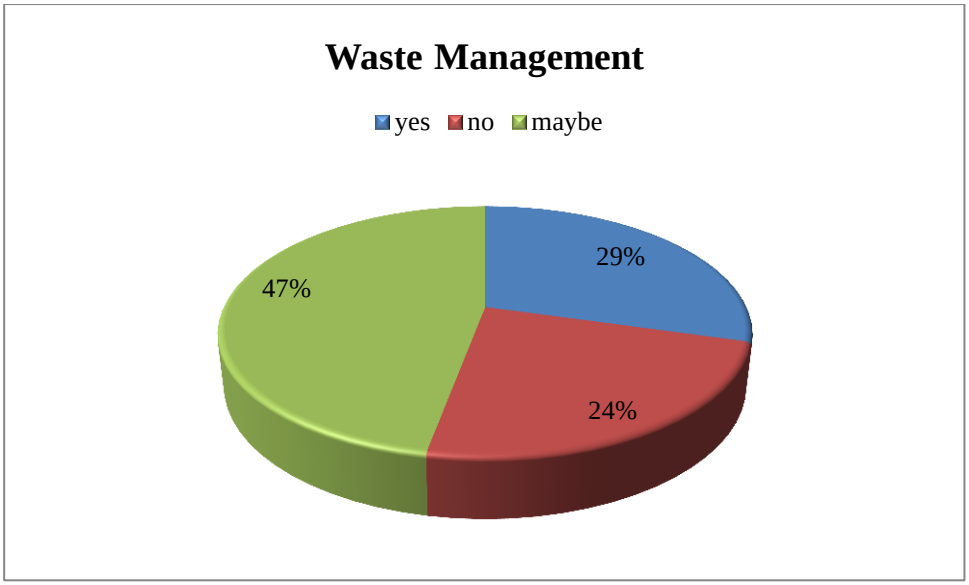


Figure 4.3.7 Problem By Waste Management

Last question for this section is about problem that has been encounter in managing construction waste product. There is a lot of problem that has been identifying based on the questionnaire that has been distributed. Some of the problem may be face by the different respondent but have the same problem. Example of the problem that is face by the different respondent is high cost to managing waste product and because of it, high cost is a highest among other problem with 12 respond.

Other problem that has high respond is transportation and also limited area to collect construction waste material with has 7 respond. For a project that has to demolish old building before construct a new building, waste material that produce must be high and require an area to placed it before transport to dumpsite. Transportation is important to make sure collected waste material can be move from the site area to the dumpsite. Inappropriate transportation may cause waste material falling off during transport process. Other than that, dust that produce by waste material is dangerous to human and not good for environment.

Other problem that encounter is waste material hard to manage and material hazardous get 5 respond while far away landfill and need specialize to handle get 4 respond. Lastly, cost overflown get 3 respond from the respondent.

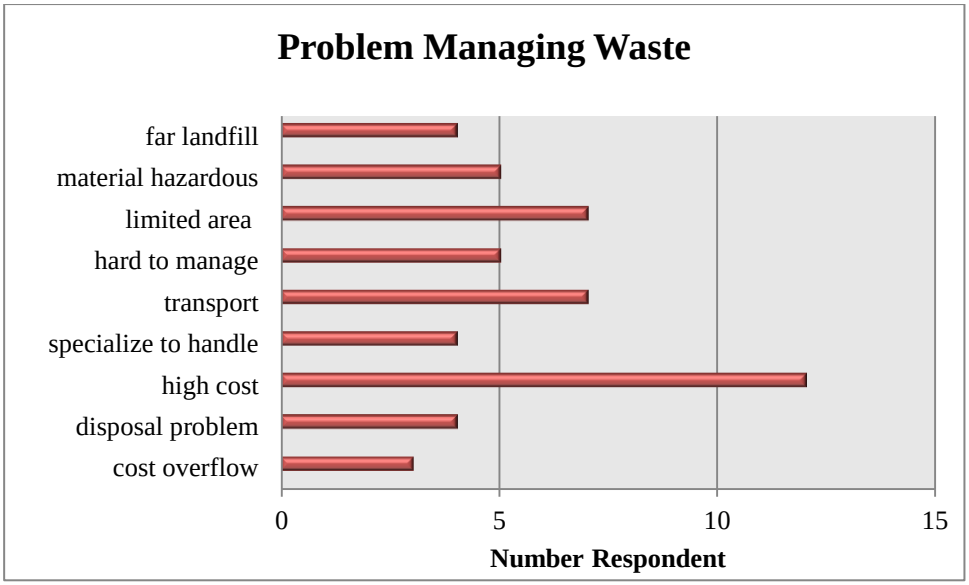


Figure 4.3.8 Problem In Managing Waste Materials

The last question that is been given to the respondent for section B is ‘how do you evaluate the state of solid waste management at your construction site?’ This question is included with four answer that is ‘good’, ‘fair’, ‘not good’ and ‘don’t have’. Respondent required selecting one of the answer provided to describe condition of waste management in their site construction.

The highest answer that respondent selected is ‘fair’ with 65%. This result shown that state of solid waste management at their site is fairly, not too good and not too bad either. Second high percentage is ‘good’ with the percentage is 21%. This shown that state of solid waste management is good at their site. All waste material is been well organized and separated by types of waste. Others answers have 10% and 4% that is ‘not good’ and also ‘don’t have’ any waste management.

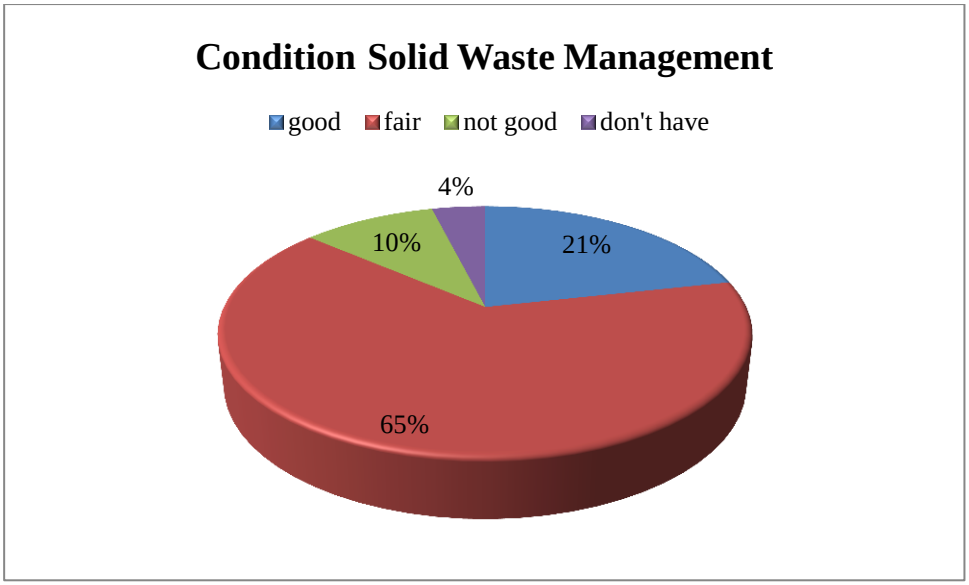


Figure 4.3.9 Condition Waste Management In Site

4.4 Problem in managing Construction waste materials in site

This is second objective in this study. There is several popular problem that is been listed in the questionnaire. This will help the analysis to determine with problem gives most trouble to the contractor in managing waste materials.

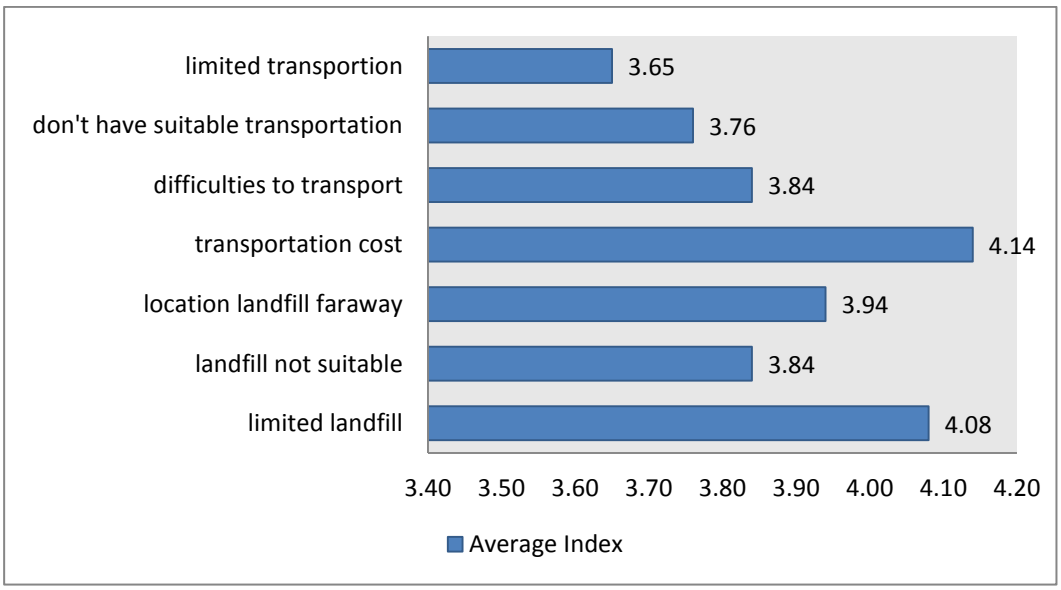


Figure 4.4.1 Average Index Of Problem In Managing Construction Waste Materials In Site

The problem in managing construction waste materials in site based on the analysis of the questionnaire in the form of average index above. From the average index graph, it shown that cost for transportation has the highest ranking with (AI=4.14), following by limited dumpsite area in surrounding construction site with (AI=4.08). Location of the dumpsite also get high selected answer that has (AI=3.94).

There is other answers that share same result that is difficulties to transport waste product and also dumpsite/landfill not suitable to dispose construction waste materials with has (AI=3.84). Absent of suitable transportation to transport construction waste materials have (AI=3.76) and lastly, limited transport (AI=3.65).

Table 4.4 Problem To Manage Construction Waste Materials

Problem To Manage construction waste materials	**1**	**2**	**3**	**4**	**5**	**Average Index**
limited landfill	0	4	8	19	20	4.08
landfill not suitable	0	5	12	20	14	3.84
location landfill faraway	0	6	9	18	18	3.94
transportation cost	0	0	11	22	18	4.14
difficulties to transport	0	4	14	19	14	3.84
don't have suitable transportation	0	4	14	23	10	3.76
limited transportation	0	8	12	21	10	3.65

4.5 Analysis the problem cause by the waste materials

Problem that cause by the waste materials can be dangerous and hazardous to the environment and also human. Some of it contain chemical that is must be dispose accordingly. Because of the irresponsible contractor, many open dumpsites can be located. This proves can be harmful to the environment and also create many others problem. All parties must take part to prevent this from happening in the future.

Analysis has been conducted using the questionnaire that has been answer the respondent. Using the questionnaire, one of the objective of this study is been analysis. This is second objective for this study. Figure below show several popular problems that have been faced by the contractor cause by the construction waste materials. Some of the problem that cause by waste materials is really famous because it selected by many respondent.

The highest cause by waste materials construction is waste required specialized to manage it with (AI=4.18). These shown that some waste materials contain chemical that prove harmful to the human that it need special attention from specialize to handle it. Second high selected answer is it time consuming with average index (AI=4.10), it's then followed by illegal dumpsite that is been done by irresponsible contractor with (AI=4.00).

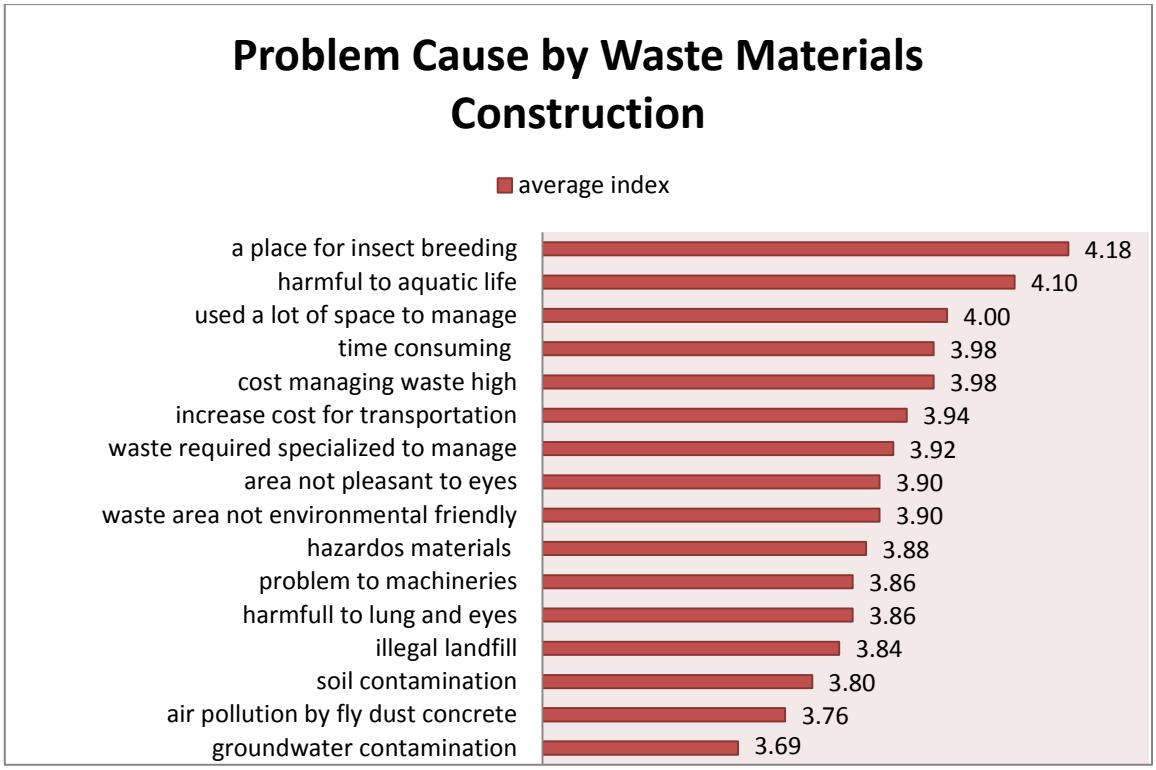


Figure 4.5.1 Problem Cause By Waste Materials Construction

The result then share by a place for insect breeding such as mosquito that can be agent to disease and harmful to lung and eyes with average index (AI=3.98). Next, groundwater contaminations (AI=3.94), soil contaminations with average index (AI=3.92). There is others that share same average index that is harmful to aquatic life and area not pleasant to eyes with (AI=3.90).

Other than that, used a lot of space to manage waste material construction average index (AI=3.88), while high cost for transportation also one of the problem cause by waste material with average index (AI=3.86). Other with the same average index with high cost for transportation is air pollution by fly dust that produces from the concrete debris. In addition, hazardous materials get average index (AI=3.80), and cost managing waste material is high (AI=3.76). Lastly, construction waste materials may cause problem to machineries such as flat tires with average index (AI=3.69). The proper result with the frequency is shown in the table 4.5 below:

Table 4.5 Problem Cause By Waste Materials

Problem By Waste Material	1	2	3	4	5	Average Index
groundwater contamination	0	5	10	19	17	3.94
air pollution by fly dust concrete	0	2	13	26	10	3.86
soil contamination	0	4	12	19	16	3.92
illegal landfill	0	4	11	17	19	4.00
harmful to lung and eyes	0	2	16	14	19	3.98
problem to machineries	0	4	16	23	8	3.69
hazardous materials	1	3	12	22	13	3.84
waste area not environmental friendly	0	4	13	23	11	3.80
area not pleasant to eyes	0	3	12	23	13	3.90
waste required specialized to manage	0	1	10	19	21	4.18
increase cost for transportation	1	2	11	26	11	3.86
cost managing waste high	1	3	13	24	10	3.76
time consuming	0	0	12	22	17	4.10
used a lot of space to manage	0	4	14	17	16	3.88
harmful to aquatic life	1	3	10	23	14	3.90
a place for insect breeding	0	3	9	25	14	3.98

4.6 Analyses suitable method o solve the problem occurs by construction waste

This is the last result that we get from questionnaire. This is also one of the objective of this study to analyses a suitable method to solve the problem occurs by construction waste material that has been practice by contractor. There are several ideas that get from literature review on managing waste construction materials. There are several selected answers has been provided to the respondent to select. Based on the answer provided, average index has been calculated and below is the graph of the result that been constructed.

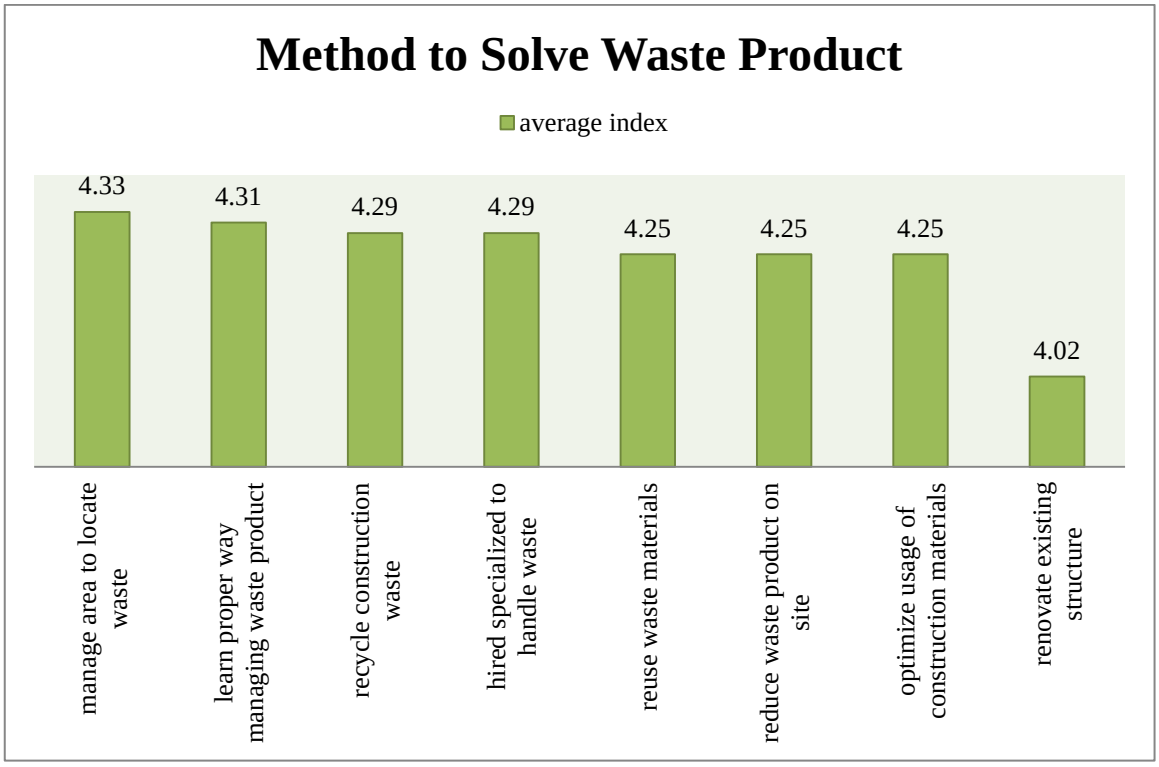


Figure 4.6.1 Method To Solve Waste Product

From the figure 4.6 above, show that the all the method that has been suggested is above 4 average index. This is because a lot of respondent agree with the method that has been suggested. From the analysis that has been produce, majority of the respondent agreed that managing the suitable area to locate/collect waste construction materials is important with has the highest average index (AI=4.33). Second high is to learn a proper way in managing waste construction material with has (AI=4.31).

The third place is share between two method with is recycle construction waste and also hired a specialized to handle waste materials that has average index (AI=4.29). Following with the reuse of the waste materials, reduce waste product that produce on site and optimize usage of construction materials the average index is (AI=4.25). Lastly, renovate existing structure to be used as new (AI=4.02). The proper results with the frequency are shown in the Table 4.6.

Table 4.6 Method To Solve Waste Problem

Method to solve waste Problem	**1**	**2**	**3**	**4**	**5**	**Average Index**
manage area to locate waste	0	0	6	22	23	4.33
learn proper way managing waste product	0	1	7	18	25	4.31
recycle construction waste	0	2	4	22	23	4.29
hired specialized to handle waste	0	1	8	17	25	4.29
reuse waste materials	0	0	8	22	21	4.25
reduce waste product on site	0	0	6	26	19	4.25
optimize usage of construction materials	1	0	7	21	22	4.24
renovate existing structure	0	1	14	19	17	4.02

CHAPTER 5

CONCLUSION & RECOMMENDATION

5.1 Introduction

All conclusion that been in this study will be based on the objective as mention in the chapter 1 section 1.3. After all questionnaires have been distribute and collected for analysis, next step is to create a conclusion and recommendation for the future study. In this chapter, researcher will evaluate data that have been collect and relate it with objective of the study to make sure all the data that been collect is relevant. This is to ensure the important of the data can be used to improve and also efforts that have been made to reduce waste materials can be used by contractor. In addition, the problems and limitations of the research encountered throughout the implementation of this study will also be briefly explained. Subsequently, proposals for future research in the relevant field of study will also be provided.

Data that has been collected will be compiling together, so that analysis can be brought up those data with statistic method and average index. Statistic methods and average index are applied through the use of computer software to obtain the desired results. Among the computer software involved is Statistical Package For Social Science (SPSS) and Microsoft Excel. Results for the research have been presented in detail in the chapter 4 in the form of pie chart, bar graph and also histogram..

Using questionnaire method, all three objective of this study has been achieved. The conclusion provided as below.

5.1.1 Objecif 1: To study construction waste material management in Malaysia

i. This objective has been achieved by the literature review in the chapter 2.

ii. Government and CIDB have made an effort to make sure waste material problem can be controlled and solved.
iii. Using waste management hierarchy by Wolsink in 2010 can improve waste management in Malaysia and make sure construction waste can be reduce
iv. From the respond that receive, most of the respondent aware about waste management.
v. Important of waste management is critical in construction site
vi. All parties must be involved in waste management to minimize any accident situation.
vii. A suitable place to dispose construction site materials must be established

5.1.2 Objective 2: To identify the problem may arise by construction waste

This objective has been achieved through the analyses that have been made from the data that has been collected from the contractor that is registered under CIDB Malaysia. There are many problems that may arise cause by the construction waste materials. From the analysis that has been made based on the questionnaire, respondent mostly faces problem with waste material required specialized to manage, time consuming and also illegal dumpsite. The lowest problem that cause by construction waste is problem with machineries.

Some of this problem can cause serious problem to the contractor in term of workers health, machineries cost and also contagious disease such as dengue. Due to the illegal dumping, it can be place with a lot of trouble because it can be place for insect breeding such as mosquito and any other insect that is dangerous. Other than that, it also not pleasant to the eyes and cost for the clean-up illegal dumping is costly. Lastly, waste materials can bring a lot of problem not to environment but also to the habitant around it. It must be controlled be thing will go worst.

5.1.3 Objective 3: To analyses suitable method to solve the problem occurs by construction waste.

This objective has been achieved through the analyses that have been made from the data that has been collected from the contractor that is registered under CIDB Malaysia. A suitable method must be creating to make sure problem regarding waste

materials can be solve without consume a lot of resources. A suitable method also can make sure decrease in cost, man power, and time consuming. Besides that, quality of the product also can increase drastically.

Based on the analyses, most method that has been selected by the respondent is managing area to locate waste materials and also learn a proper way in managing waste materials. Renovate an existing structure has the lowest point then others answer provided. It is because not all building can be used and some of it must be demolish to construct new structure. Improvement that has been made by Wolsink in 2010 in waste management hierarchy to added avoid stage is really accurate. To avoid processing the waste material can be reduce and easily to handle.

5.2 Recommendation

This issue regarding construction waste materials is not an easy subject to be study. There are too many factor and parameter that can be study for the future studies. Furthermore the views on the issues can be varied from different players in the industry. To increase understanding in this waste management problem, others can conduct study to make sure knowledge can be share to the various company in the nation. All grade of company must be included in the research to make the data more precise and accurate.

Other than that, study should be focuses on the impact of waste materials to the environment. It is because waste materials can be harmful to the environment especially flora and fauna. The study can be focus on the effect of waste material or it also can be focus to the type of waste materials that bring harms o the environment. Lastly, waste management system depends on numerous factors; however, the most important factor is the will of the people to change the existing system and develop something better.

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APPENDIX A
QUESTIONNAIRE FOR THE RESPONDENT

"A study of construction waste material management in Malaysia: a contractor point of view"

SECTION A: GENERAL INFORMATION

1) SITE LOCATION:……

2) ORGANIZATION: ☐ contractor ☐ consultant

3) POSITION:……

4) ACADEMIC QUALIFICATION:

☐ Diploma ☐ Degree ☐ Master
☐ PHD ☐ Others

5) EXPERIENCES IN CONSTRUCTION:

☐ 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-4
☐ 41-Above

6) PROJECT INVOLVEMENT:

☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20
☐ 21-25 ☐ 26-30

7) EXPERIENCE IN MANAGING WASTE MATERIAL:

☐ 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-40
☐ 41-Above

SECTION B: SOLID WASTE MANAGEMENT

1. Have you ever heard about solid waste management?

☐ Yes ☐ No

If yes, in what way (can be more than one answer)

☐ On radio ☐ over television

☐ Public meeting ☐ in school

☐ On poster ☐ seminars

Others ……..

2. Have you ever been educated on proper waste management by any organization/council?

☐ Yes ☐ No

3. Types of construction waste come from/produce by your construction site?

☐ Glass ☐ fiber material

☐ Wood/timber ☐ aluminum/steel

☐ Concrete/rubbles ☐ paper/carton

Others ……..

4. How often is the waste container emptied?

☐ One in 3 days ☐ one in 6 days

☐ One a week ☐ one in two weeks

☐ One a month others……

5. Where do you usually put away collected wastes?

☐ Refuse chamber ☐ by valley/lake/river

☐ On an open areas ☐ hole in own compound

☐ Recycle waste materials others …….

6. Are there any dumpsite near construction site?

☐ Yes ☐ No

If yes, what is the distance between construction sites with dumpsite:

☐ 1-5 km ☐ 6-10 km

☐ 11-15 km ☐ 16-20 km

☐ 21-25 km ☐ 26-30 km

Others ……..

7. Can you describe the state of the dumpsite near construction site?

☐ Good state ☐ too much waste materials

☐ Inadequate ☐ not in good condition

☐ Don't know others …….

8. Do you thing the waste disposal management is a problem in the area.

☐ Yes ☐ No

9. What problem that has you face in managing construction waste product?

a. ……

b. ……

c. ……

d. ……

e. ……

10. How do you evaluate the state of solid waste management at your construction site?

☐ Good ☐ Fair

☐ Not good ☐ don't have

SECTION C:

PROBLEM IN MANAGING CONSTRUCTION WASTE MATERIALS IN SITE.

Please kindly rank this problem by ticking the appropriate option from the options ranked 1-5.

1 – Disagree 2 – slightly agree 3 – average

4 – highly agree 5 – strongly agree

No	Problem in managing construction waste material in site	Option				
		1	2	3	4	5
1	Limited dumpsite area.					
2	Landfill not suitable to collect construction waste material.					
3	Location of the landfill is far away.					
4	Additional Cost in transportation.					
5	Difficult to transport waste product.					
6	Not have suitable transportation to relocate waste product					

PROBLEM MAY ARISE BY CONSTRUCTION WASTE.

No	Problem may arise by construction waste.	Option				
		1	2	3	4	5
1	Groundwater contamination.					
2	Air pollution by fly dust from concrete					
3	Soil contamination.					
4	Illegal dumpsite					
5	Harmful to human organ such as lung and eyes.					
6	Problem to machineries such as flat tires					
7	Hazardous materials not manage properly					
8	Waste area is not environmental friendly					
9	Area not pleasant to the eyes					
10	Waste must be manage using specialized machinery					
11	Increase cost for transportation waste management					

12	Increase cost for managing waste product					
13	Time consuming for managing product					
14	reduce space for construction site					
15	Harmful to the aquatic life					
16	A place for insect breeding.					

SECTION D: METHOD TO SOLVE PROBLEM OCCURS BY CONSTRUCTION WASTE.

Please kindly rank this problem by ticking the appropriate option from the options ranked 1-5.

1 – Disagree 2 – slightly agree 3 – average

4 – highly agree 5 – strongly agree

No	Method to solve problem occurs by construction waste.	Option				
		1	2	3	4	5
1	Recycle construction waste					
2	Reuse the waste product					
3	Hired a specialized to handle waste product.					
4	Manage area to locate waste product					
5	Reduce waste product on site					
6	Practice deconstruction instead of demolition					
7	Calculate the savings					
8	Optimize the usage of construction materials					

APPENDIX B
RESULT FROM SPSS

```
/STATISTICS=STDDEV MEAN MEDIAN SUM
  /ORDER=ANALYSIS.
```

Statistics

		limited_dumpsite	landfill_not_suitable	location_landfill_is_faraway	additional_cost	difficulties_tranport
N	Valid	51	51	51	51	51
	Missing	0	0	0	0	0
Mean		4.0784	3.8431	3.9412	4.1373	3.8431
Median		4.0000	4.0000	4.0000	4.0000	4.0000
Std. Deviation		.93473	.94599	1.00820	.74886	.92461
Sum		208.00	196.00	201.00	211.00	196.00

Statistics

		not_have_suitable_transport	not_transport
N	Valid	51	51
	Missing	0	0
Mean		3.7647	3.6471
Median		4.0000	4.0000
Std. Deviation		.86228	.97619
Sum		192.00	186.00

Frequency Table

limited_dumpsite

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	8	15.7	15.7	23.5
	highly agree	19	37.3	37.3	60.8
	strongly agree	20	39.2	39.2	100.0
	Total	51	100.0	100.0	

landfill_not_suitable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	5	9.8	9.8	9.8
	average	12	23.5	23.5	33.3
	highly agree	20	39.2	39.2	72.5
	strongly agree	14	27.5	27.5	100.0
	Total	51	100.0	100.0	

location_landfill_is_faraway

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	6	11.8	11.8	11.8
	average	9	17.6	17.6	29.4
	highly agree	18	35.3	35.3	64.7
	strongly agree	18	35.3	35.3	100.0
	Total	51	100.0	100.0	

additional_cost

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	11	21.6	21.6	21.6
	highly agree	22	43.1	43.1	64.7
	strongly agree	18	35.3	35.3	100.0
	Total	51	100.0	100.0	

difficulties_tranport

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	14	27.5	27.5	35.3
	highly agree	19	37.3	37.3	72.5
	strongly agree	14	27.5	27.5	100.0
	Total	51	100.0	100.0	

not_have_suitable_transport

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	14	27.5	27.5	35.3
	highly agree	23	45.1	45.1	80.4
	strongly agree	10	19.6	19.6	100.0
	Total	51	100.0	100.0	

not_transport

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	8	15.7	15.7	15.7
	average	12	23.5	23.5	39.2
	highly agree	21	41.2	41.2	80.4
	strongly agree	10	19.6	19.6	100.0
	Total	51	100.0	100.0	

STATISTIC TABLE

Statistics

		groundwater_contamination	air_polution	soil_contamination	Illegal_dumpsite	harmful_to_human
N	Valid	51	51	51	51	51
	Missing	0	0	0	0	0
Mean		3.9412	3.8627	3.9216	4.0000	3.9804
Median		4.0000	4.0000	4.0000	4.0000	4.0000
Mode		4.00	4.00	4.00	5.00	5.00
Std. Deviation		.96771	.77510	.93473	.95917	.92715
Variance		.936	.601	.874	.920	.860
Sum		201.00	197.00	200.00	204.00	203.00

Statistics

		Problem_to_machineries	hazardous_materials	waste_area	area_not_pleasent	insect_breeding
N	Valid	51	51	51	51	51
	Missing	0	0	0	0	0
Mean		3.6863	3.8431	3.8039	3.9020	3.9804
Median		4.0000	4.0000	4.0000	4.0000	4.0000
Mode		4.00	4.00	4.00	4.00	4.00
Std. Deviation		.83643	.94599	.87223	.85452	.83643
Variance		.700	.895	.761	.730	.700
Sum		188.00	196.00	194.00	199.00	203.00

Statistics

		time_consuming	reduce_space	cost_managing	increase_cost	special_machineries
N	Valid	51	51	51	51	51
	Missing	0	0	0	0	0
Mean		4.0980	3.8824	3.7647	3.8627	4.1765
Median		4.0000	4.0000	4.0000	4.0000	4.0000
Mode		4.00	4.00	4.00	4.00	5.00
Std. Deviation		.75511	.95178	.90749	.87223	.81746
Variance		.570	.906	.824	.761	.668
Sum		209.00	198.00	192.00	197.00	213.00

Statistics

		harmfull_aquatic_life
N	Valid	51
	Missing	0
Mean		3.9020
Median		4.0000
Mode		4.00
Std. Deviation		.94350
Variance		.890
Sum		199.00

FREQUENCY TABLE

groundwater_contamination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	5	9.8	9.8	9.8
	3.00	10	19.6	19.6	29.4
	4.00	19	37.3	37.3	66.7
	5.00	17	33.3	33.3	100.0
	Total	51	100.0	100.0	

air_polution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	2	3.9	3.9	3.9
	average	13	25.5	25.5	29.4
	highly agree	26	51.0	51.0	80.4
	strongly agree	10	19.6	19.6	100.0
	Total	51	100.0	100.0	

soil_contamination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	12	23.5	23.5	31.4
	highly agree	19	37.3	37.3	68.6
	strongly agree	16	31.4	31.4	100.0
	Total	51	100.0	100.0	

Illegal_dumpsite

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	11	21.6	21.6	29.4
	highly agree	17	33.3	33.3	62.7
	strongly agree	19	37.3	37.3	100.0
	Total	51	100.0	100.0	

harmful_to_human

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	2	3.9	3.9	3.9
	average	16	31.4	31.4	35.3
	highly agree	14	27.5	27.5	62.7
	strongly agree	19	37.3	37.3	100.0
	Total	51	100.0	100.0	

Problem_to_machineries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	16	31.4	31.4	39.2
	highly agree	23	45.1	45.1	84.3
	strongly agree	8	15.7	15.7	100.0
	Total	51	100.0	100.0	

hazardous_materials

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2.0	2.0	2.0
	slightly agree	3	5.9	5.9	7.8
	average	12	23.5	23.5	31.4
	highly agree	22	43.1	43.1	74.5
	strongly agree	13	25.5	25.5	100.0
	Total	51	100.0	100.0	

waste_area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	13	25.5	25.5	33.3
	highly agree	23	45.1	45.1	78.4
	strongly agree	11	21.6	21.6	100.0

	Total	51	100.0	100.0	

area_not_pleasent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	3	5.9	5.9	5.9
	average	12	23.5	23.5	29.4
	highly agree	23	45.1	45.1	74.5
	strongly agree	13	25.5	25.5	100.0
	Total	51	100.0	100.0	

insect_breeding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	3	5.9	5.9	5.9
	average	9	17.6	17.6	23.5
	highly agree	25	49.0	49.0	72.5
	strongly agree	14	27.5	27.5	100.0
	Total	51	100.0	100.0	

time_consuming

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	12	23.5	23.5	23.5
	highly agree	22	43.1	43.1	66.7
	strongly agree	17	33.3	33.3	100.0
	Total	51	100.0	100.0	

reduce_space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	4	7.8	7.8	7.8
	average	14	27.5	27.5	35.3
	highly agree	17	33.3	33.3	68.6
	strongly agree	16	31.4	31.4	100.0
	Total	51	100.0	100.0	

cost_managing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2.0	2.0	2.0
	slightly agree	3	5.9	5.9	7.8
	average	13	25.5	25.5	33.3
	highly agree	24	47.1	47.1	80.4
	strongly agree	10	19.6	19.6	100.0
	Total	51	100.0	100.0	

increase_cost

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2.0	2.0	2.0
	slightly agree	2	3.9	3.9	5.9
	average	11	21.6	21.6	27.5
	highly agree	26	51.0	51.0	78.4
	strongly agree	11	21.6	21.6	100.0
	Total	51	100.0	100.0	

special_machineries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	1	2.0	2.0	2.0
	average	10	19.6	19.6	21.6
	highly agree	19	37.3	37.3	58.8
	strongly agree	21	41.2	41.2	100.0
	Total	51	100.0	100.0	

harmfull_aquatic_life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2.0	2.0	2.0
	slightly agree	3	5.9	5.9	7.8
	average	10	19.6	19.6	27.5

	highly agree	23	45.1	45.1	72.5
	strongly agree	14	27.5	27.5	100.0
	Total	51	100.0	100.0	

STATISTIC TABLE

Statistics

		recycle_construction_waste	Reuse_waste	manege_area	hired_specialized	reduce_waste
N	Valid	51	51	51	51	51
	Missing	0	0	0	0	0
Mean		4.2941	4.2549	4.3333	4.2941	4.2549
Median		4.0000	4.0000	4.0000	4.0000	4.0000
Mode		5.00	4.00	5.00	5.00	4.00
Std. Deviation		.78215	.71675	.68313	.80732	.65858
Sum		219.00	217.00	221.00	219.00	217.00

Statistics

		practice_deconstruction
N	Valid	51
	Missing	0
Mean		4.0196
Median		4.0000
Mode		4.00
Std. Deviation		.83643
Sum		205.00

FREQUENCY TABLE

recycle_construction_waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	2	3.9	3.9	3.9
	average	4	7.8	7.8	11.8
	highly agree	22	43.1	43.1	54.9
	strongly agree	23	45.1	45.1	100.0
	Total	51	100.0	100.0	

Reuse_waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	8	15.7	15.7	15.7
	highly agree	22	43.1	43.1	58.8
	strongly agree	21	41.2	41.2	100.0
	Total	51	100.0	100.0	

Reuse_waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	8	15.7	15.7	15.7
	highly agree	22	43.1	43.1	58.8
	strongly agree	21	41.2	41.2	100.0
	Total	51	100.0	100.0	

hired_specialized

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	1	2.0	2.0	2.0
	average	8	15.7	15.7	17.6
	highly agree	17	33.3	33.3	51.0
	strongly agree	25	49.0	49.0	100.0
	Total	51	100.0	100.0	

reduce_waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	6	11.8	11.8	11.8
	highly agree	26	51.0	51.0	62.7
	strongly agree	19	37.3	37.3	100.0
	Total	51	100.0	100.0	

practice_deconstruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slightly agree	1	2.0	2.0	2.0
	average	14	27.5	27.5	29.4
	highly agree	19	37.3	37.3	66.7
	strongly agree	17	33.3	33.3	100.0
	Total	51	100.0	100.0	

APPENDIX C
RESULT FROM MICROSOFT EXCEL

site location	number of participant
Kedah	7
Pahang	19
Kuala Lumpur	5
Selangor	6
Kelantan	3
Johor	2
Pulau Pinang	3
Perlis	2
Melaka	2
Terenganu	2

parties involve	numbers
Contractor	36
Consultant	15

project involvement	numbers
1-5 Project	30
6-10 Project	15
11-25 Project	4
16-20 Project	2

position	number
Design Engineer	4
Resident Engineer	7
Site Supervisor	20
Construction Manager	2
Cleck of Work	7
Environment Consultant	4
Safety Officer	4
Senior Engineer	3

certificates	number
Diploma	22
Degree	26
Master	2
PHD	0
SPM	1

Condition dumpsite	numbers
good state	7
too much waste materials	8
inadequate	6
not in good condition	4
don't know	26

answer	number
cost overflow	3
disposal problem	4
high cost	12
specialize to handle	4
transport	7
hard to manage	5
limited area	7
material hazardous	5
far dumpsite	4

Problem to manage waste product	1	2	3	4	5	Average Index
limited dumpsite	0	4	8	19	20	4.08
landfill not suitable	0	5	12	20	14	3.84
location landfill faraway	0	6	9	18	18	3.94
transportation cost	0	0	11	22	18	4.14
difficulties to transport	0	4	14	19	14	3.84
don't have suitable transportation	0	4	14	23	10	3.76
limited transportion	0	8	12	21	10	3.65

Problem created by waste material	1	2	3	4	5	average index
groundwater contamination	0	5	10	19	17	3.94
air pollution by fly dust concrete	0	2	13	26	10	3.86
soil contamination	0	4	12	19	16	3.92
illegal dumpsite	0	4	11	17	19	4.00
harmfull to lung and eyes	0	2	16	14	19	3.98
problem to machineries	0	4	16	23	8	3.69
hazardos materials	1	3	12	22	13	3.84
waste area not environmental friendly	0	4	13	23	11	3.80
area not pleasant to eyes	0	3	12	23	13	3.90
waste required specialized to manage	0	1	10	19	21	4.18
increase cost for transportation	1	2	11	26	11	3.86
cost managing waste high	1	3	13	24	10	3.76
time consuming	0	0	12	22	17	4.10
used a lot of space to manage	0	4	14	17	16	3.88
harmful to aquatic life	1	3	10	23	14	3.90
a place for insect breeding	0	3	9	25	14	3.98

Method to solve waste Problem	1	2	3	4	5	average index
manage area to locate waste	0	0	6	22	23	4.33
learn proper way managing waste product	0	1	7	18	25	4.31
recycle construction waste	0	2	4	22	23	4.29
hired specialized to handle waste	0	1	8	17	25	4.29
reuse waste materials	0	0	8	22	21	4.25
reduce waste product on site	0	0	6	26	19	4.25
optimize usage of construction materials	1	0	7	21	22	4.24
renovate existing structure	0	1	14	19	17	4.02