DETERMINING CRITICAL SUCCESS FACTORS FOR SUSTAINABLE CONSTRUCTION

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DETERMINING CRITICAL SUCCESS FACTORS FOR SUSTAINABLE CONSTRUCTION

by

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BCA	Building and Construction Authority
BREEAM	Building Research Establishment Environment Assessment Method
CH4	Methane
CIDB	Construction Industry Development Board
CO2	Carbon Dioxide
CRI	Carbon Reduction Institute
EPA	United States Environmental Protection Agency
FRTP	Factors Related to Project
FRTPM	Factors Related to Project Manager
FRTPT	Factors Related to Project Team
FRTME	Factors Related to Material and Equipment
FRTE	Factors Related to External
FRTC	Factors Related to Client
SF	Success of Sustainable Construction
GBI	Green Building Index
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IDR	Iskandar Development Region
KeTTHA	The Ministry of Energy, Green Technology and Water
LEED	Leadership in Energy and Environmental Design
N2O	Nitrous Oxide
TCT	The Carbon Trust
USGBC	United States Green Building Council

PENENTUAN FAKTOR-FAKTOR KEJAYAAN KRITIKAL TERHADAP PEMBINAAN LESTARI

ABSTRAK

Pembinaan lestari merujuk kepada aktiviti pembinaan bangunan yang berdaya saing dan menguntungkan dengan mengutarakan aspek-aspek seperti kualiti kehidupan manusia, ruang untuk perubahan, aktiviti pembinaan berasaskan mesra alam dan keberkesanan penggunaan sumber. Faktor-faktor kejayaan kritikal pembinaan lestari merujuk kepada faktor-faktor yang menyumbang kepada kejayaan pembinaan lestari. Faktor-faktor tersebut sepertimana yang diutarakan oleh para penyelidik sebelum ini adalah terdiri daripada enam faktor iaitu faktor berkenaan projek, pengurus projek, pasukan projek, peralatan dan bahan binaan, pelanggan projek dan faktor luaran. Pembangunan pembinaan berasaskan lestari masih kurang memuaskan walaupun wujud peluang dan kemudahan untuk mendapat sumber tenaga yang diperbaharui di Malaysia. Justeru itu, pembangunan kerangka yang berciri senarai faktor-faktor kejayaan kritikal pembinaan lestari perlu dilaksanakan untuk memotivasikan pemaju dan pihak-pihak yang terlibat dalam pembinaan lestari di negara ini. Selain itu, objektif kajian adalah untuk mengenalpasti tahap penerimaan daripada kumpulan faktor-faktor kejayaan kritikal pembinaan lestari, mengenalpasti hubungan antara faktor-faktor kejayaan kritikal dengan pembinaan projek lestari dan merangka kerangka kerja faktor-faktor kejayaan kritikal pembinaan lestari untuk mencapai kejayaan dalam industri pembinaan lestari. Kajian ini menggunakan teknik kaji selidik untuk proses pengumpulan data. Sejumlah 180 borang soal selidik diedar kepada responden yang terdiri daripada kontraktor di sekitar lokasi Semenanjung Malaysia. Sejumlah 120 borang soal selidik atau 66 peratus daripada jumlah borang soal selidik yang telah diedarkan berjaya dikutip.

Data kajian telah dianalisis dengan analisis deskriptif, analisis pekali laluan, analisis faktor, analisis kebolehpercayaan dan analisis regresi. Kajian penyelidikan ini menunjukkan bahawa terdapatnya perhubungan positif di antara kumpulan faktor-faktor kejayaan kritikal dengan kejayaan pembinaan projek lestari. Seterusnya, kesemua kumpulan faktor yang terlibat dalam kajian ini mempunyai kaitan dalam meramal kejayaan pembinaan projek lestari. Bagi tujuan kajian masa hadapan, disyorkan untuk meluaskan kategori responden kajian seperti penguatkuasa, pemaju, perunding dan pembekal bahan-bahan binaan yang akan meningkatkan keputusan keseluruhan kajian.

DETERMINING CRITICAL SUCCESS FACTORS FOR SUSTAINABLE CONSTRUCTION

ABSTRACT

Sustainable construction refers to construction activities which is competitive and profitable while focusing on several important aspects such as the quality of human life, space for changes, environmental concerned construction activities and utilised available resources. Critical success factors of sustainable construction refers to factors which contributed to success of sustainable construction. According to research studies carried out by previous researchers, the six factors are factors related to project, project manager, project team, material and equipment, client and external factors. The sustainable construction development is still poor although opportunities and facilities to obtain renewable energy resources are exist in Malaysia. Therefore, development of framework which focused on the criteria of success factors in sustainable construction is essential to motivate developers and other construction parties to involve in sustainable construction in the country. Besides that, the objectives of this study are to identify the level of responses of group of critical success factors, to determine the relationship between the critical success factors with sustainable construction practices and prepare a framework of critical success factors of sustainable construction to achieve success in sustainable construction. This research study uses survey method for data collection process. Total of 180 questionnaires distributed to respondents which consists of contractors in location around Peninsular Malaysia. Total of 120 questionnaires or response rate of 66 per cent was successfully collected back. The research data have been analysed with descriptive analysis, path coefficient analysis, factor analysis, reliability analysis and regression analysis. The research study

conducted indicated that there are positive relationship between the list of critical success factors and the success of sustainable construction. Furthermore, all the success factors in this research study significantly predict the success of sustainable construction. For future studies, it is recommended that the targeted responses of this research study need to be expanded to authority, developers, consultants and suppliers of construction materials which will enhance the overall result of the research study.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The United States Environmental Protection Agency (2014) classified greenhouse gases as gases that trap heat in the atmosphere and there are basically four types of greenhouse gases in the atmosphere which are Carbon Dioxide (CO^2) consists of 84%, Methane (CH_4) consists of 9%, Nitrous Oxide consists of 5% (N_2O) and Fluorinated gases consists of 2%. Carbon Dioxide which is the main contributor of greenhouse gas (GHG) emission can be generated to the atmosphere through burning fossil fuels, solid waste, trees and wood products.

Besides that, carbon dioxide is also believed to be generated through the manufacturing of cement for construction usage. Each of these gases is estimated to remain in the atmosphere ranging from a few years to thousands of years and thus contribute more to warming of the Earth (EPA, 2014). As one of the preventive measures to curb the warming of the earth, sustainable construction stated to rise in the nineties in the United States and followed with the establishment of several green foundations such as the United States Green Building Council (USGBC, 2014).

According to Kua and Lee (2002), green buildings are buildings constructed to achieve environmental performance criteria which are assessed using the green rating tools. While, Ho and Fong (2007), said that low carbon building refers to building which uses about 30 kWh/m^2 to 20kHh/m^2 and fitted with high level of building insulation such as energy efficient window, low level of air infiltration and heat

recovery ventilation to minimize emission of carbon dioxide. Ho and Fong (2007) also added that in tropical countries, low carbon builders are practising the usage of passive solar building design techniques, besides being involved in the efforts of reduction of energy usage for air conditioning and water heating. While Kubba (2010) mentioned that green buildings are constructed for achieving optimum energy efficiency with a preference for natural, reclaimed and recycled materials. Kubba (2010) also concluded that green building focused on maximising the efficient usage of resources of energy, water and raw materials.

Besides that, there are different types of definition for low carbon society and its scope around the world, where in China it depends on the level of preparedness, strategies, targets and commitment of a society to sustainability (Li *et al.*, 2011). While in Japan, Japanese Ministry of Environment (2007) classifies low carbon society and its scope as:

- A society that emits GHG only in an amount which can be absorbed by nature.
- To build a society where value is placed on family or community ties, health, interaction with mother nature and spirit to improve the quality of life.
- Harmony and coexistence with nature and promote 'nature-friendly technologies, such as utilization of biomass.

The development of sustainable construction inside the country is gearing towards a greater stage as Malaysia which is ranked in 58th place of carbon dioxide emission per capita per year country in 2007 unveiled the National Green Technology Policy on 24th July 2009. Aligned with the establishment of National Green Technology,

Malaysia is also committed to achieve 40% reduction of carbon emission intensity per (Gross Domestic Product) GDP by year 2020 since the announcement in Copenhagen on 17 December 2009 and launching of Low Carbon Cities Framework and Assessment System in September 2011 by Malaysian government. Low Carbon Cities Framework and Assessment System which target the local authorities, township developers, designers and individuals was created to guide and assess the development of cities and to support sustainable development in Malaysia (KeTTHA, 2013). Besides the establishment of Low Carbon Assessment System, Construction Industrial Development Board in Malaysia is also in the process of creating an assessment system called Green Pass to assess the environmental impact of building in Malaysia. Assistance and guidance by existence of system and development board in Malaysia is parallel with efforts by other countries of the world such as Australia and United Kingdom which have taken drastic steps by ensuring commitment into legal obligation to achieve transition of low carbon construction over the next 40 years (CIDB, 2012).

According to Kibert (2008), there are various green building rating schemes across the world such as Green Star introduced by Green Building Council of Australia, North American Leadership in Energy and Environmental Design (LEED) and UK Building Research Establishment Environment Assessment Method (BREEAM) which have been developed to assist the industry delivery green buildings and provide guidelines for green building development. In Malaysia, Green Building Index (GBI) in Malaysia is introduced to recognise a measure of performance and rating system for green or energy saving building. Creation of green rating tools assists low carbon cities development in Malaysia such as Putrajaya and Cyberjaya

towards achieving green policies and commitment for carbon dioxide reduction of 40% by year 2020 (KeTTHA, 2013).

The success of sustainable construction also depends on the identification of critical success factors of sustainable construction. According to Enanche-Pommer and Horman (2009), determination of critical success factors plays an important role in the planning, design and construction of successful building projects. Therefore, the project team which is involved in sustainable construction need to identify the critical success factors in the initial stage in the project to minimize the chances of the project's failure. According to several authors, there are several benefits of identification of critical success factors through research and development such as:

(i) Increase the possibility of identification of risk factors in project (Van Rooij, 2008).

(ii) Act as a trusted solution predictive tool for success in a project (Barrett, 2007).

(iii) Function as key factor which can help to develop the construction industry (Fox and Skitmore, 2007).

1.2 Research Background

This thesis presents the results for determining critical success factors for sustainable construction. The participation of contractors representing their companies involved in sustainable construction as main contractor plays a most important role in the investigation. The determining of critical success factors for sustainable construction helps professionals to:

i. Study the existing critical success factors in sustainable construction to achieve project success.

ii. Grouping and evaluate the effectiveness of existing critical success factors being practised in sustainable construction in achieving project success.

iii. To identify the relationship between all the critical success factors being practised in sustainable construction.

iv. Develop a framework of critical success factors of sustainable construction as a guidelines for construction industry.

According to Haughey (2014), a project is considered as success if followed the listed requirements are followed:

i) Completed within the planned time period of project.

ii) Proper risk management with an action plan.

iii) Meet the expected construction cost without scope creep or additional budget.

iv) Able to satisfy client by achieving project objectives at the end of project.

v) Committed with proper action related to project task with justification, tolerable minor changes to project which accepted by all level of project members.

vi) A highly motivated project team with good communication skill.

vii) Proper understanding of success factors of the related project and acknowledged by client or customer.

viii) A proper planned project focusing on well documented project task, schedule, cost, resources and other important elements.

As mentioned by Haughey (2014), project completion within timeframe, existence of proper risk management in project, cost of project within permitted budget, satisfaction of client throughout the project, proper action related to project task, existence of motivated team, proper understanding of success factors by client and proper project planning are vital for ensuring success in project. Failure to comply the elements pointed by Haughey will lead to unsuccessful construction activities in project.

Baccarini (2009) has discussed in detail about project success in his research study. Baccarini (2009) elaborated that project success are divided to two main components which are project management success and product success. Project management success refers to level of success in the project management and product success refers to level of acceptance of end user of the product created through the project. Baccarini (2009) pointed out that a project is considered achieve the level of success only if the objective of both components of project success are achieved. The statement given by Baccarini (2009) about the importance of both elements of project success are true and valid as failure to one of the elements will not confer success to a particular project.

Meanwhile about sustainable construction, Morell (2010) has mentioned in his research study that a transparent project policy before project launching is important to ensure team members follow and implement the policy towards project success in sustainable construction. Besides that, the report also pointed that awareness of working responsibilities by all the team members towards evaluation of carbon efficiency as one of the critical success factor. The report also stated that proper

carbon efficiency plan and proper instrument and monitoring system during construction also plays important aspects towards achieving project success in sustainable construction. As elaborated by Morell (2010), it is important that all sustainable projects are launched with clear instructions and direction which can be obtained from existence of clear project policy and proper monitoring system to ensure project success.

As conclusion, there are many researchers contributed their thoughts and knowledge about project success in conventional projects as stated above but still there are needs to study the effectiveness of existing success factors which will help to identify the critical success factors in sustainable construction as further step of improvement.

1.3 Problem Statements

Spence and Mulligan (1995), have said that implementation of sustainable construction in construction industry in the 21st century will be an uphill task as there are several major issues which will be encountered during project implementation which can then be grouped into several factors such as cost, project team and project team. Therefore, it is wise that identifying critical success factors appropriately will minimise problems encountered during project implementation (Pinto and Kharbanda, 1996). Therefore, the process of identifying the existing critical success factors need to be carried out to ensure sustainable project success through this research study.

According to Puvanasvaran *et al*. (2012), the Malaysian government is providing full support for research and development of green technology such as introduction of

green technology financing scheme where the government would bear 2% of the interest rate. Puvanasvaran *et al*. (2012) also added that with regard to green technology Malaysia is still at modest level compared with other developed countries. Puvanasvaran *et al.* (2002) also added that more research study related to sustainable construction need to be carried out to create awareness of construction industry which will lead to mass development of sustainable construction projects in Malaysia. Furthermore, the identification of the level of responses and significant based on factors relating to project, project manager, project team, client, material and equipment and the external factors wil put more focus on research and development by the researchers to ensure success in sustainable construction project.

Besides that, Bakar *et al.* (2011) added that response for the sustainable construction is still poor although opportunities and facilities to obtain renewable energy resources such as biomass, biogas, hydropower and solar power exists through the incentives introduced by the government especially for commercial and industrial business in Malaysia. Therefore, the process of identification of theoretical framework of critical success factors in sustainable construction will motivate participation or involvement of more construction experts in sustainable construction activities towards achieving success.

As there are many opinions and contribution of knowledge by researchers regarding success factors and condition of success in conventional construction such as Zwikael (2009) and Horman (2009) and Garbharran *et al.* (2013), this research will explore the existence of critical success factors suggested by researchers in sustainable construction. There is other framework or model which exists as

guidelines for sustainable construction which is the Low Carbon Cities Framework and Assessment System which was established in September 2011 by Malaysian government. Low Carbon Cities Framework and Assessment System created earlier by the government is targeted the local authorities, township developers, designers and individuals to guide and assess the development of cities and to support sustainable development in Malaysia. Therefore, this research attempts to develop a different framework focusing on success factors of sustainable construction which is not available presently. Therefore, it seems clear that effort should be carried out to determine the list of critical success factors in sustainable construction in Malaysia which is required before the commencement of the sustainable construction.

In addition, this research will also help to identify the level of responses among the group of critical success factors in sustainable construction. Then, all the identified critical success factors will be classified into groups to analyse the interaction or relationship between the factors which will determined the combined effects of those factors in eventually leading to project success or failure. This is because practise of a single factor directly will not affect project success or failure. It is clear to deduce that there is a need for a new framework of list of critical success factors in sustainable construction which will be created with appropriate analysis method.

1.4 Research Questions

In order to fulfil the objective mentioned above, the following questions need to be answered:

1) What are the existing critical success factors for sustainable construction?
2) What is the level of responses among the group of critical success factors

in sustainable construction?

3) What are the interactions between critical success factors identified for sustainable construction?
4) What is the new framework of sustainable construction practises to be created to improve the industry?

1.5 Research Objectives

The objective of the research studies are;

1) To identify the level of responses of group of critical success factors in sustainable construction.
   - By conducting survey through questionnaire which helps to reveal the mean and standard deviation.
2) To examine the relationship between the critical success factors and success of sustainable construction.
   - By analysing the path coefficient analysis to identify the significance of direct effect between independent variables and dependent variable in partial least square software.
3) To develop a multidimensional framework of critical success factors of sustainable construction as a framework of sustainable construction practices in the construction industry.
   - By analyse the data (data collected during questionnaire) using factors analysis in path analysis of partial least square software.
   - Identify the proposed framework of critical success factors in sustainable construction by referring to R Square (R2) value,

average variance extracted (AVE) and composite reliability of independent and dependent variable after factors analysis in partial least square software.

1.6 Scope and Limitation of Research

This research aim to identify existing critical success factors and creates new framework of critical success factors in sustainable construction. Questionnaires have been used to collect data from respondents all over Malaysia. This research has some limitation as there are limited numbers of sustainable project than conventional project in Malaysia. Limited number of sustainable projects creates difficulties to identify sufficient respondents from construction companies involved in sustainable construction. The findings from this research studies will be very useful as there are no existing framework of critical success factors available to use as guidelines in Malaysia.

1.7 Significance of Study

This research has three main significances which are:

1) A new framework for critical success factors in sustainable construction in Malaysia will be created through research study.
2) The findings and results from this research will help the construction related parties involved in sustainable construction in Malaysia to identify critical success factors of their respective project more easily towards achieving overall success.
3) This research will help and guides the construction parties to improve the sustainable construction in Malaysia by using the framework of critical

success factors as guidelines to rectify the loopholes of sustainable construction activities and as baseline to identify type of research and development to improve sustainable construction industry in Malaysia.

1.8 Overview of Research Methodology

The methodology used in this research study is based on quantitative research study which emphasised on data in the form of numbers and statistics. Rajasekar *et al.* (2006) elaborates quantitative research as type of research which collects numerical data to analyse using mathematical based methods, presented in tables and graphs in particular statistics. Rajasekar *et al.* (2006) also added that the quantitative method involves elements of what, where and when of decision making of process.

According to Degu and Yigzaw (2006), the objective of quantitative research is to classify the amount or number which related to how many, how often and to the level of extent a figure involves in research topics. Clarke (2005) also added that quantitative method also known as traditional or experimental type of research method. Spoon (2014) has discussed about differences of quantitative and qualitative type of research method and mentioned that quantitative type of research data can be used for comparison all the period of time while unable to do so for qualitative type of research method.

Meanwhile, Sibanda (2009) said that quantitative research design is characterised by the process of collecting data after all aspect involved in process of data collection are check throughly. There are several points need to be considered during the data collection for quantitative type of research method;

- Design of study.
- Collection of data.
- Data analysis.
- The way or method to report the findings.

Smith (1991) further supported the quantitative methodologies by adding the following advantages and benefits of using the quantitative methodologies:

- Comparison and replication are allowable.
- Independence of the observer from the subject being observed.
- Subject through analysis is measured through objective methods than being inferred subjectively through sensation, reflection or intuition.

Zawawi (2007) also elaborated that quantitative methodologies has several advantages if compare with qualitative methodologies such as provide clear situation of research topic, least time consuming, suitable for statistics related analysis and many more.

1.8.1 Research Process

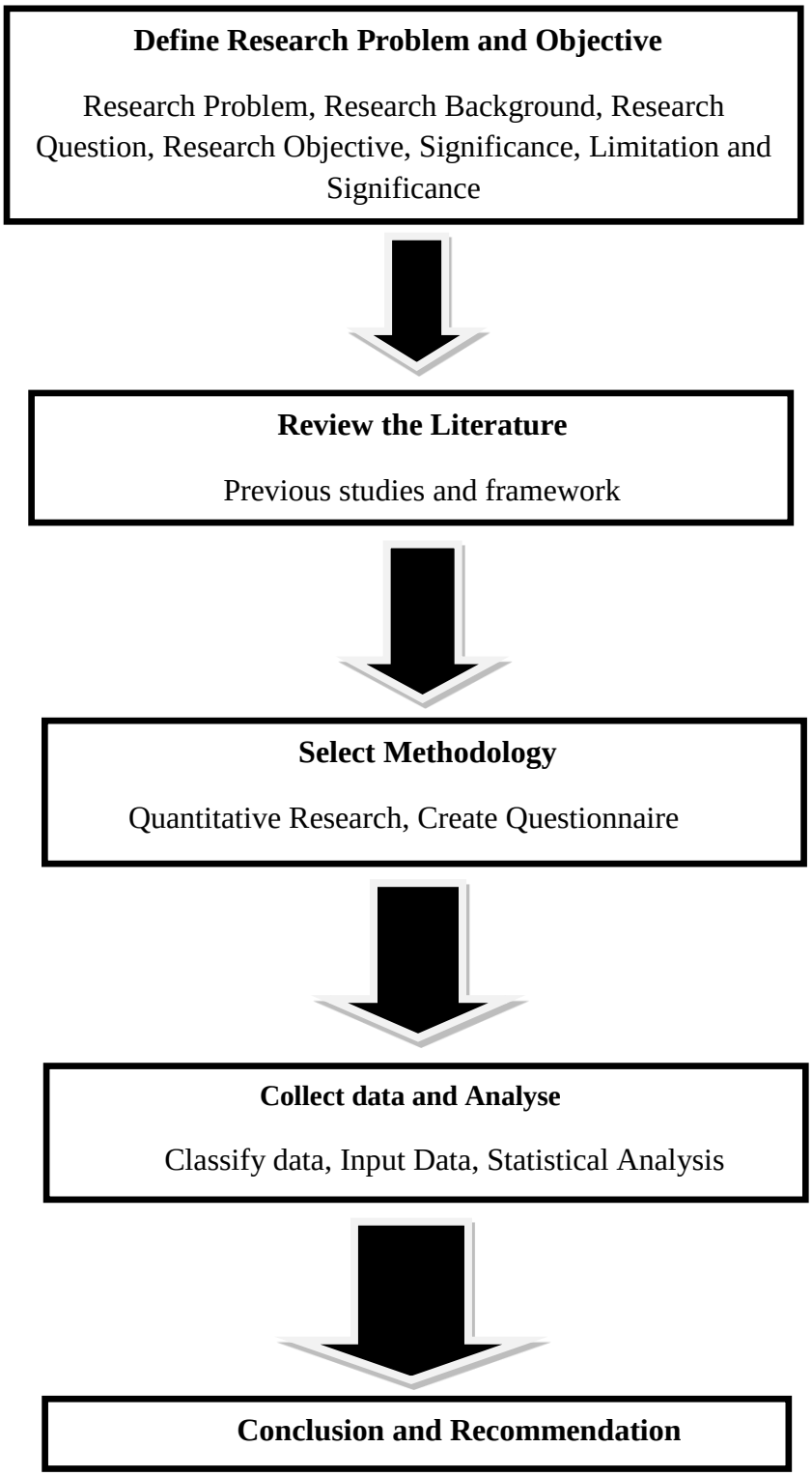

Figure 1.1 Research Process

1.9 Outline of the Thesis

The thesis are consists of six chapter. The summary of each chapter are as shown below:

Chapter 1: This chapter explain about the introduction of this research studies. This chapter also includes background of research, problem statement, research questions, research objectives, research scope, research limitation and thesis outline.

Chapter 2: This chapter revealed about the literature of sustainable development in globally and Malaysia. This chapter explained about the initial development of sustainable development and other environmental policies implemented in Malaysia and other parts of the world towards achieving sustainable development of green building practice.

Chapter 3: This chapter focused about the definition and historical development of critical success factors of sustainable construction. This chapter also discuss about the previous research findings about the critical success factors for sustainable construction.

Chapter 4: This chapter presents about the research design, data collection method, respondents, pilot study, the reliability and validity of data and method of analytical analysis.

Chapter 5: This chapter describes about the data collected through questionnaires which given to respondents. Data was collected through quantitative research method

and used for various analysis such as descriptive analysis, path coefficient analysis, factor analysis, reliability analysis and regression or R square value analysis identification. This chapter also discussed and revealed the findings of the research study on the identification of critical success factor in sustainable construction.

Chapter 6: This chapter finalised the thesis by describing limitation and give conclusion while provide recommendation for future research work. This chapter also discussed about the contribution of research study towards academia or theory and in term of real practise for parties involved in industry.

1.10 Summary

This chapter gives brief summary of the thesis where discuss about the research background, problem statement, research questions, research objectives, scope and limitation of research, significance of study, research process and outline of thesis. Besides that, this chapter also discuss about overall project success in conventional and sustainable related construction.

CHAPTER 2

SUSTAINABLE DEVELOPMENT AND CONSTRUCTION INDUSTRY

2.1 Introduction

This chapter explores the current sustainable development in Malaysia and globally. This chapter also explained about the initial development of sustainable and national policies implemented since the late 1970s in Malaysia and other parts of the world towards achieving sustainable development in construction industry.

2.2 Emission of Carbon Dioxide Globally

According to EPA (2013), GHG or greenhouse gases are gases inside in the atmosphere that absorbs and emits radiation within the thermal infrared range which contributes to the greenhouse effect. While, Orabi *et al.* (2012) have discussed about the construction activities especially during the handling of construction materials which tend to release the greenhouse gases which have indirect radiative effects into the atmosphere. The greenhouse gases consist of:

a) Fluorinated Gases

   Fluorinated gases referring to hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride which are released through various industrial or manufacturing processes.

b) Carbon dioxide

   Carbon dioxide released inside in the atmosphere through the burning of fossil fuel and manufacturing activities such as cement which produce chemical reaction and released into the atmosphere.

c) Methane

Methane is released into the atmosphere through various activities such as manufacturing and movement of coal, natural gas, and oil from one location to another location. Besides that, Methane also will be emitted through livestock and agricultural activities.

d) Nitrous oxide

Nitrous oxide is released into the atmosphere by almost same source as methane and carbon dioxide such as through agricultural and industrial or manufacturing activities, and by fossil fuels as well (EPA, 2013).

Carbon dioxide is one of the overall greenhouse gases (GHG) which are emitted through various activities by countries in the world. There is an estimation of 82% of carbon dioxide emission in the world atmospheres annually. Carbon dioxide is the prime gas responsible for enhancing the greenhouse effect (EPA, 2013). While in Malaysia, emission of carbon dioxide is alarming too. But still total amount of carbon dioxide emission in Malaysia is increasing at higher rate since 2005. Figure 2.1 below shows the rapid increase of carbon dioxide emission from the year 2005 to 2011 from 177372.8 kilo tonnes to 225,692.8 kilo tonnes. But in the year 2006, the emission of carbon dioxide in Malaysia reduced by 6725.3 kilo tonnes or 3.79% to 179,418 kilo tonnes. Carbon dioxide emission increased again to 188,124.4 kilo tonnes in the year 2007 and finally to 225,692.8 kilo tonnes (World Bank Group, 2015). This clearly shows the failures of Malaysia to contain the rapid increase of carbon dioxide emission, although efforts had been taken by the government to reduce carbon emission and promote energy efficiency.

Malaysia is one of the 172 countries which had signed the Kyoto Protocol to the United Nation Framework Convention on climate change on 12 March 1999 and further ratified on 4 September 2002 to control and combat global warming. But still Malaysia is not within the 35 countries that have agreed to cap their emission. Although Malaysia is not responsible enough to cap the emission, the government still promotes sustainable development through involvement in various environmental related developments which help the nation to earn the 38th position or ranking among 146 countries worldwide in Environmental Sustainable Index (ESI) with regards to environmental sustainability (Yale University, 2005).

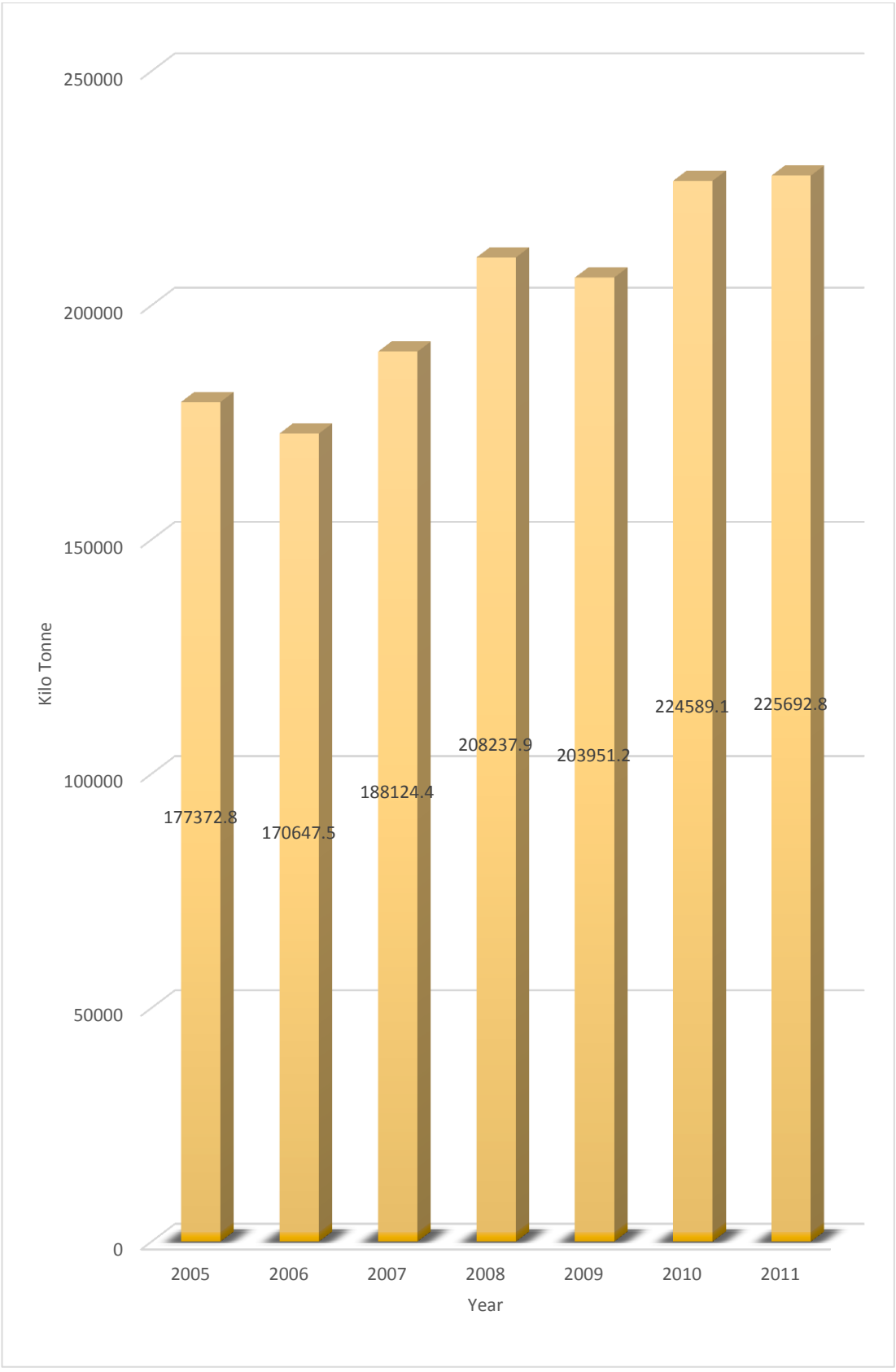

Figure 2.1: Carbon Dioxide Emission in Malaysia from year 2005 to 2011 sourced from World Bank Group (2015)

According to data collected by the World Bank Group (2015), there are thousands of kilo tonnes per annum of carbon dioxide released into the atmosphere through fossil fuels such as cement, gas flaring, coal, liquid fuels and gas fuels. World Bank Group (2009), released estimation of emission of carbon dioxide by countries in the world through fossil fuels. Table 2.1 below shows top seven emitter countries in the world compared with Malaysia with the respective figures from year 2009 to 2011.

Table 2.1: Top Seven Emitters of Carbon Dioxide in the World Compared with Malaysia from year 2009 to 2011

Country Name	2009 (Kilo tonnes)	2010 (Kilo tonnes)	2011 (Kilo tonnes)
China	7,687,113.77	8,256,969	9,019,518
United States	5,299,563.07	5,408,869	5,305,570
India	1,979,424.60	1,950,950	2,074,345
Russia	1,574,386.11	1,742,540	1,808,073
Japan	1,101,134.09	1,168,919	1,187,657
Germany	734,599.11	750,697	729,458
Iran	602,055.39	571,605	586,599
Malaysia	203,951.2	224,589.1	225,692.8

Source: World Bank Group, 2015

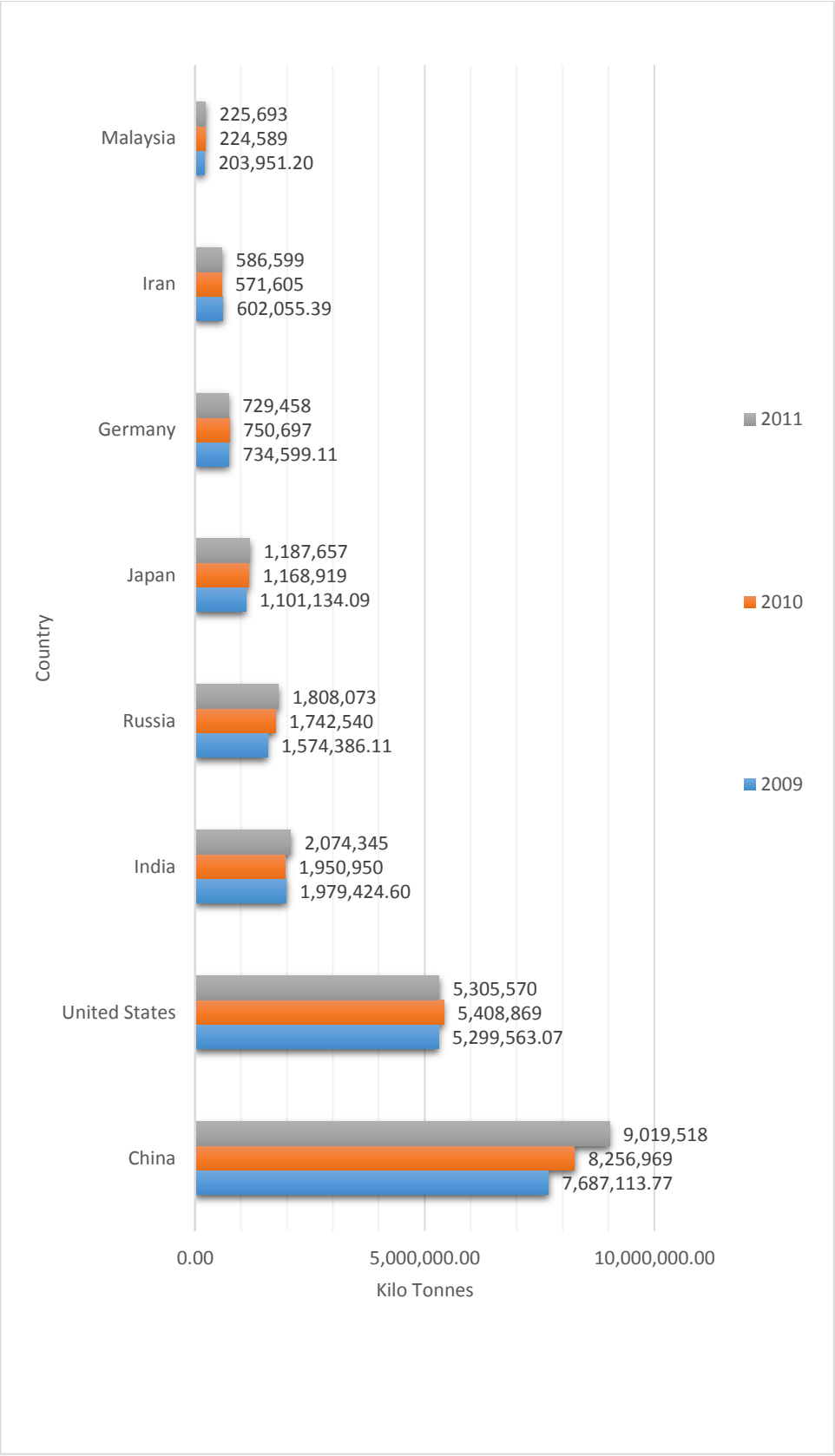

Figure 2.2: Emission of Carbon Dioxide by Top Emitters Countries Compared with Malaysia in the World from year 2009 to 2011 sourced from World Bank Group (2015)

Based on this Table 2.1 and Figure 2.2 above, China recorded the highest amount of emission of carbon dioxide from 2009 in total of 7,687,113.77 kilo tonnes to 2011 with a total of 9019,518 of kilo tonnes. Secondly ranked United States recorded a total of 5,305,570 of kilo tonnes in 2011 which decreased from previous value in 2009 with a total of 5,299,563.07 kilo tonnes. India which ranked third recorded 2,074,345 kilo tonnes in 2011 from the rest of the world. This value of emission increased from previous years by 4.79% from the year 2009 to 2011. While Russia recorded 1,808,073 kilo tonnes in the year 2011 which is increased by 14.8% from the year 2009. The other three countries which are Japan, Germany and Iran are placed in fifth, sixth and seventh position were recorded 1,187657 tonnes, 729,458 kilo tonnes and 586,599 kilo tonnes respectively. This table clearly shows that almost all the countries in the world have failed to curtain the emission of carbon dioxide into the atmosphere except few a countries such as Germany and Iran, which able to reduced the amount of carbon dioxide emission to small amount of percentage which is at 0.7% and 2.57%.