

**THE PRACTICES OF SUSTAINABILITY FACTORS AND PERCEIVED
SUSTAINABLE CONSTRUCTION FIRMS' PERFORMANCE AMONG
CONTRACTORS IN MALAYSIA**

by

Waleed Mohamad Abdo Rashideh

**Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy**

2010

ACKNOWLEDGEMENT

This acknowledgement is dedicated to the following wonderful individuals who gave me invaluable assistance, guidance and contributions for the completion of this dissertation directly and indirectly.

I extend my heartfelt gratitude appreciation to my supervisors, Sr Dr. Ilias Said and Prof. Dr. Omar Osman, whom have exhibited tremendous support, encouragement, and inspiration, that all in, has tremendously helped me to keep my vision and mission alive, and to pursue the completion of my Doctoral degree.

I am grateful to the Universiti Sains Malaysia for granting me that provided the financial support. It enabled me to pursue this doctoral study programme.

This acknowledgement appreciates Ahmed Kamarudeen and Mustafa Khlufallah for being there whenever needed.

The dedication of this dissertation with all my love goes to all my family members for their constant love, care, assurances, psychological and emotional support, patience and understanding, especially my mother and my sisters who always giving me support to finish my thesis. Finally, I dedicate this dissertation to my lovely wife, for her patience.

TABLE OF CONTENTS

Acknowledgement.....	ii
Table of Contents	iii
List of Tables.....	viii
List of Figures	x
List of Abbreviations.....	xii
Abstrak	xiii
Abstract	xiv

CHAPTER 1 – INTRODUCTION

1.1	Research Background.....	1
1.2	Problem Statement	6
1.3	Research Questions	8
1.4	Research Objectives	9
1.5	Significance of the Study	9
1.6	Scope of the Study	11
1.7	Thesis Organisation.....	12

CHAPTER 2 – GENERAL CONCEPT OF SUSTAINABILITY

2.0	Introduction.....	13
2.1	The Concept of Sustainability.....	13
2.2	Definitions and Pillars of Sustainability	14

2.2.1	The Social Aspect of Sustainability	18
2.2.2	The Economic Aspect of Sustainability	21
2.2.3	The Environmental Aspect of Sustainability	22
2.3	Achieving Sustainability through Sustainable Development.....	24
2.3.1	Critical Issues to Address in Achieving Sustainability.....	27
2.4	The Concepts of Sustainability and Performance Improvement.....	29
2.5	Summary	37
CHAPTER 3 – SUSTAINABLE CONSTRUCTION AND ASSESSMENT FRAMEWORK		
3.0	Introduction.....	38
3.1	Construction Industry.....	38
3.1.1	Construction Firms.....	40
3.2	Sustainable Development and Construction Industry.....	43
3.2.1	Challenges Facing Sustainable Construction.....	48
3.2.2	Drivers of Sustainable Constructions.....	50
3.2.3	The Role of Construction in Achieving Sustainability.....	53
3.3	Assessment Models for Sustainability Performance Indicators.....	56
3.3.1	Indicators of Construction Sustainability.....	62
3.3.1.1	Social Indicators.....	68
3.3.1.2	Economic Indicators.....	70
3.3.1.3	Environmental Indicators.....	72
3.4	Conceptual Framework.....	75
3.5	Hypothesis.....	77

3.5.1	The Relationship between Environmental Aspects and Sustainable Construction Firms' Performance.....	77
3.5.2	The Relationship between Economic Aspect and Sustainable Construction Firms' Performance.....	78
3.5.3	The Relationship between Social Aspects and Sustainable Construction Firms' Performance.....	79
3.6	Summary	80

CHAPTER 4 - METHODOLOGY

4.0	Introduction.....	81
4.1	Research Design.....	81
4.2	Sampling Method.....	83
4.3	Data Collection Process	84
4.4	Instrumentation	85
4.4.1	Measurements and Instrumentation	87
4.4.2	Measurement and Operationalisation of Variables	88
4.4.2.1	Environmental Aspects	99
4.4.2.2	Economic Aspects.....	102
4.4.2.3	Social Aspects	104
4.4.2.4	Sustainable Construction Firms' Performance	106
4.4.3	Analysis of Reliability of Instruments	107
4.4.4	Analysis of Validity of Instruments	109
4.5	Data Collection.....	110
4.6	Method of Data Analysis	112
4.7	Summary	114

CHAPTER 5 - ANALYSIS AND DISCUSSION OF FINDINGS

5.0	Introduction	115
5.1	The Respondents of the Study.....	116
5.2	The Test of Assumptions - Linearity, Normality and Homoscedasticity, Multicollinearity Conditions of the Data	118
5.3	The Perception of Contractors towards Sustainability Factors and Firms' Performance - (Objective No. 2).....	121
5.3.1	Sustainable Construction Firms' Performance	121
5.3.2	Environmental Aspects	123
5.3.3	Economic Aspects.....	124
5.3.4	Social Aspects	125
5.3.5	Summary of the Perceptions of Contractors toward Sustainability Factors and Sustainable Construction Firms' Performance – (the achievement of Research Objective No. 2)	126
5.4	The Relationships between the Sustainability Aspects and Sustainable Construction Firms' Performance – (Objective No. 3).....	127
5.4.1	The Relationship between Environmental Aspects and Performance ..	128
5.4.2	The Relationship between Economic Aspects and Performance	129
5.4.3	Social Aspects and Performance.....	130
5.4.4	Summary	131
5.5	The development of Model for Sustainable Construction in Malaysia.....	132
5.5.1	Environmental Aspects	133
5.5.2	Economic Aspects.....	137
5.5.3	Social Aspects	140
5.5.4	Sustainable Construction Firms' Performance	143
5.5.5	Reliability Analysis for Instruments of Model.....	146

5.5.6	Descriptive Analysis for Modelling of Sustainable Construction Firms in Malaysia	147
5.5.7	The Proposed Theoretical Model	148
5.5.8	The Development of Sustainable Construction Firm Models	149
5.5.9	Summary	152
5.6	Chapter Summary.....	152
CHAPTER 6 - CONCLUSIONS AND RECOMMENDATIONS		
6.0	Introduction	153
6.1	Conclusion	153
6.2	The Fundamental Contributions of the Study	155
6.2.1	Contribution to Academia/Theory	155
6.2.2	Contribution to Practice	157
6.3	Limitations of the Study.....	158
6.3.1	Generalisation Issues.....	158
6.3.2	Methodological Limitation Perspective	159
6.4	Recommendations for Future Research	160
REFERENCES.....		162
APPENDICES		178

LIST OF TABLES		Page
Table 3.1	Total Contractors Registered by State of Registered, Contractor Registration Grade and Contractors Classification, Source: CIDB, (2008)	43
Table 4.1	Population and Recommended Sample Size of the Research	84
Table 4.2	Summary of Variables and Measurement of Instruments (Environmental Impact)	97
Table 4.3	Summary of Variables and Measurement of Instruments (Environmental Efficiency)	97
Table 4.4	Summary of Variables and Measurement of Instruments (Volunteer Action)	97
Table 4.5	Summary of Variables and Measurement of Instruments (Financial Indicators)	98
Table 4.6	Summary of Variables and Measurement of Instruments (Human-capital indicators)	98
Table 4.7	Summary of Variables and Measurement of Instruments (Ethics Indicators)	98
Table 4.8	Summary of Variables and Measurement of Instruments (Welfare Indicators)	99
Table 4.9	Summary of Variables and Measurement of Instruments (Sustainable Construction Firms' Performance)	98
Table 4.10	Reliability Level of Instruments – During Pilot Study	108
Table 4.11	Summary of Self-Administered Surveys	111
Table 4.12	Summary of Data Collection Techniques	111
Table 4.13	Summary of Questionnaires Distribution	112
Table 5.1	Background Information of the Contractors	117
Table 5.2	One-way ANOVA for Sustainable Construction Firms' Performance	123
Table 5.3	One-way ANOVA for perceived Environmental Aspect of Firms	124

Table 5.4	One-way ANOVA for Perceived Economic Aspect of Firms	125
Table 5.5	One-way ANOVA for Perceiving Social Aspects	126
Table 5.6	The Guidelines of Correlation Coefficient	127
Table 5.7	Pearson Correlation between Dependent and Independent Variables	128
Table 5.8	Summary of Test Results – Relationship between the implementation of Sustainability Aspects and Sustainable Construction Firms’ Performance	131
Table 5.9	KMO and Bartlett’s test for Environmental Construct	133
Table 5.10	Factor Analysis for Environmental Aspects	134
Table 5.11	KMO and Bartlett’s test for Economic Aspects	137
Table 5.12	Factor Analysis on Economic Aspects	137
Table 5.13	KMO and Bartlett’s Test for Social Aspects	141
Table 5.14	Factor Analysis on Social Aspects	141
Table 5.15	KMO and Bartlett’s Test	144
Table 5.16	Sustainable Construction Firms’ Performance	144
Table 5.17	Reliability Levels of Instruments – Cronbach Alpha	146
Table 5.18	Descriptive Statistics of the Variables (n=319)	147
Table 5.19	Multiple Regression Results for Independent and Dependent Variables (Overall Sustainable Construction Firms’ Performance)	150
Table 5.20	Multiple Regression Results for Independent (Overall Sustainable Construction Firms’ Performance)	151

LIST OF FIGURES		Page
Figure 3.1	Key Sustainability Issues for the Mining and Mineral Sector Source: Azapagic, (2004)	58
Figure 3.2	Generic Hierarchy Scheme For Calculation of Composite Sustainable Development Index, Source: Krajnc and Glavic (2005)	60
Figure 3.3	Sustainability Index Model, Source: Ding (2005)	62
Figure 3.4	Principal of Sustainable Construction, Source: Hill and Bowen (1997)	67
Figure 3.5	Construction Firms' Sustainability Model	76
Figure 3.6	Conceptual Relationship between Environmental Aspect and Sustainable Construction Firms' Performance	77
Figure 3.7	Conceptual Relationship between Economic Aspects and Sustainable Construction Firms' Performance	79
Figure 3.8	Conceptual Relationship between Social Aspects and Sustainable Construction Firms' Performance	79
Figure 4.1	Dependent and Independent Variables Construct	88
Figure 4.2	The Dimensions Of Environmental Construct	89
Figure 4.3	The Dimension of Economic Construct	89
Figure 4.4	The Dimension of Social Construct	90
Figure 4.5	Summary of the Environmental Impact Dimension Construct	91
Figure 4.6	Summary of the Environmental Efficiency Dimension Construct	92
Figure 4.7	Summary of the Volunteer Action Dimension Construct	92
Figure 4.8	Summary of the Financial Indicators Dimension Construct	93
Figure 4.9	Summary of the Human-Capital Indicators Dimension Construct	94
Figure 4.10	Summary of the Ethics Indicators Dimension Construct	95
Figure 4.11	Summaries of Welfare Indicators	95

Figure 4.12 Summaries of Sustainable Construction Firms' Performance Perception **96**

Figure 5.1 The proposed Theoretical Framework **149**

LIST OF ABBREVIATIONS

CIB	Conseil International du Bâtiment (International Council for Building)
CIDB	Construction Industry Development Board
GRI	Global Report Initiative

AMALAN FAKTOR-FAKTOR KELESTARIAN SERTA PERSEPSI PRESTASI FIRMA-FIRMA PEMBINAAN LESTARI DI KALANGAN KONTRAKTOR DI MALAYSIA

ABSTRAK

Kelestarian mengandungi tiga tiang utama, iaitu alam sekitar, ekonomi dan sosial. Perkara paling utama kelestarian ini adalah untuk menyeimbangkan penggunaan sumber bagi generasi sekarang dan generasi akan datang. Sebagai salah satu daripada penyumbang utama di dalam masalah persekitaran global dan lokal, industri pembinaan berada di dalam keadaan tertekan untuk membuat perubahan. Di dalam konteks industri pembinaan di Malaysia, timbulnya keperluan untuk menghasilkan rangkakerja penilaian kelestarian yang menggabungkan faktor-faktor alam sekitar, ekonomi dan sosial. Rangka kerja ini boleh menjawab kepada pelbagai permasalahan di dalam usaha industri untuk mencapai tahap kelestarian yang lebih tinggi lagi. Objektif penyelidikan ini adalah untuk mengkaji perbezaan persepsi kontraktor terhadap kelestarian, mengkaji hubungan di antara faktor-faktor kelestarian dengan syarikat-syarikat pembinaan dan membangunkan rangkakerja penilaian untuk kelestarian. Hipotesis digunakan untuk memahami hubungan di antara praktis kelestarian dan prestasi firma pembinaan. Sumbangan utama kajian ini adalah pengenalanpastian dan integrasi konsep-konsep kelestarian di dalam prestasi firma-firma pembinaan. Di samping itu, kajian ini juga mengetengahkan bukti empirikal bahawa praktis kelestarian adalah amat relevan, sah, dan praktikal di dalam industri pembinaan. Kaedah kajiselidik dan temubual digunakan di dalam pengutipan data. Skala Likert 5-penanda digunakan di dalam borang soalselidik. Populasi kajian adalah firma-firma pembinaan yang berdaftar dengan Lembaga Pembangunan Industri Binaan gred G4, G5, G6 dan G7. Responden adalah dipilih dengan menggunakan teknik sampel bebas. Daripada 520 borang soalselidik yang dihantar, 319 borang telah dijawab dan dihantar kembali, kadar pulangan sebanyak 61 peratus. Data dianalisa dengan menggunakan statistik deskriptif, analisa faktor, korelasi dan analisa regresi pelbagai. Persepsi kontraktor terhadap faktor-faktor kelestarian dan prestasi firma adalah lebih kurang sama. Dapatan kajian menunjukkan bahawa adanya hubungan positif di antara pelaksanaan faktor-faktor kelestarian dan prestasi firma yang berlestari di Malaysia. Berdasarkan kepada dapatan, ini membuktikan lebih tinggi tahap pelaksanaan prinsip-prinsip lestari, lebih baik pula prestasi firma-firma pembinaan. Analisa regresi pelbagai menunjukkan kesemua variabel boleh meramalkan prestasi kelestarian kontraktor di Malaysia. Kajian ini mencadangkan, kumpulan-kumpulan lain di dalam industri pembinaan seperti pakarunding, pembekal dan pembiaya projek perlu dilibatkan sama di dalam penyelidikan akan datang. Perbandingan di antara mereka boleh memberikan kefahaman yang lebih tinggi berkenaan prestasi kelestarian syarikat-syarikat di Malaysia.

THE PRACTICES OF SUSTAINABILITY FACTORS AND PERCEIVED SUSTAINABLE CONSTRUCTION FIRMS PERFORMANCE AMONG CONTRACTORS IN MALAYSIA

ABSTRACT

Sustainability consists of three main pillars, namely: environmental, economic and social pillars. Its major thrust is an attempt to balance the use of resources between the present and future generations. As one of the major contributors to the global and local environmental problems, the construction industry is hard pressed to streamline its processes while executing projects. In the context of the Malaysian construction industry, there is a need for sustainability assessment framework that will integrate environmental, economic and social factors. This framework should answer a multitude of problems in achieving a higher degree of sustainability in the industry. The objectives of this research are to examine the differences in the perceptions of contractors toward sustainability; examine the relationships between sustainability factors and construction companies; and develop an assessment framework for sustainability. The hypotheses were used to understand the relationship between the sustainability aspect practices and sustainable construction firms' performance. The major contribution of this study is the identification and integration of the concept of sustainability in the construction firms' performance. Besides, this study also provides empirical evidence that sustainability practices are very much relevant, valid and applicable in the construction industry. Survey questionnaire and interview methods were employed to collect the data. A 5-point Likert was used in the questionnaire. The research population is construction firms operating in Malaysia and registered with the Construction Industry Development Board under the grades of G4, G5, G6, and G7. The respondents were selected by using simple random sample technique. Out of 520 questionnaires sent out, 319 answered questionnaires were returned –a response rate of 61 percent. The data were analysed by using descriptive statistics, factor analysis, correlations and multiple regression analysis. The perceptions of contractors toward sustainability factors and sustainable construction firms' performance were almost equal. The results suggest that there were positive associations between the implementation of sustainable factors and sustainable construction firms' performance of contractors in Malaysia. Based on the research findings, the results seem to prove that the higher the levels of the implementation of the sustainability principles, the better sustainable firms' performance of the contractors in Malaysia. The multiple regression analysis showed that all the variables could significantly predict the sustainable construction performance of the contractors in Malaysia. This study recommends that future studies should include other players in construction industry such as consultants, suppliers, and project financiers. Comparisons of these industry players may provide a better understanding of how sustainability practices enhances sustainable construction performance of companies in Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Research Background

The importance of sustainability for the future generation cannot be overemphasized. There is currently an increased awareness about sustainability issues both locally and globally among governments and at organizations level. The sustainability of firms depends on three important criteria: environmental, economic and social, which reflect the views of governments or the society through the application of these criteria for sustainability. When the firms do not apply these standards, it could be due to a number of constraints, both at the governmental level or as a result of social status. Malaysia as a developing country is one of the fastest growing countries in South East Asia, which has started playing its role in promoting sustainability practices.

The agenda 21 addresses today's problems in addition to preparing the world for the challenges of the next century. It reflects a political commitment and global consensus at the highest level on development and environment cooperation. It also reflects its successful implementation which is at first the responsibilities of governments. Therefore, national strategies, plans, policies and processes are crucial in achieving this. The objectives of development and environment in agenda 21 will need a substantial flow and other financial resources in developing countries in order to deal with global environmental problems and accelerate sustainable development. Therefore, the Rio Declaration on environment and development confirmed that human beings are

the centre of concerns for sustainable development. However, environmental protection is the first step to achieve sustainable development (UNCED, 1992).

Over the years, there is a growing recognition among leading scientists and the public and politicians are increasingly aware that we are using the planet's resources in ways that exceed its long-term capacity and which may undermine its vital life support systems. In the last decade, the difference in living conditions between the rich and the poor, both between and within countries has also widened, exacerbating the environmental damage (TCPA, 2003).

According to Tonn (2007), sustainability is more important than consumption which should stimulate political and economic institutions to consider cooperation rather than competition. Sustainability is based on striving for a balance between the present and future generations. On the other hand, Becchio *et al.* (2009), Elkington (1997) and Linnenluecke and Griffiths (2009), considered sustainability as a comprehensive concept which should include the principle of the three bottom lines. The three bottom lines were defined by Ding (2008), Elkington (1997) and Gasparatos *et al.* (2009) as the social, environmental and financial performance of sustainable development. These aspects are considered the comprehensive dimensions of the sustainable development concept. The current research defines more dimensions of sustainability which require more policies to be effectively used (Mayer, 2008).

Sustainability plays important roles in several aspects. According to Boyko *et al.* (2006), from the social aspects perspective like providing access to good education,

creating goodwill, the improvement of community consultation; in order to attract new people to these areas, consideration should be given to the significant issues influencing these areas such as poor health, crime and social exceptions, which could help to make the area to be socially sustainable. Therefore, dealing effectively with sustainability must consider the need for extra knowledge. Identifying the database for knowledge to make it easy to use and to practice new skills would support this process (Gloet, 2006). Considering the planet in future and its protection, with the satisfaction of the needs of different stakeholders is one of the fundamental agreements among several groups of academic fields (Boyko *et al.*, 2006).

Sustainability is a global problem which requires global solutions (Ugwu *et al.*, 2006a; Ugwu & Haupt, 2007). These solutions come through concerted efforts locally and globally. Therefore, working alone will not achieve the target for sustainability, but by changing the thinking and behaviour of man to achieve sustainability concept (Phillips, 2003). The concept of sustainable development has become popular among different sectors, including the construction industry (Becchio *et al.*, 2009; WCED, 1987). The importance of sustainable development in the construction industry comes from its great effect on the environment. Construction industry is also very important to the human society. DETR (2000) maintained that the construction industry contributes to the achievement of the following sustainable developments aims: 1) making them more profitable and more competitive, 2) delivering buildings and structures which provide greater satisfaction, well-being and more added value to customers and users, 3) more fair respect and treatment for its stakeholders, 4) enhances and better protects the

natural environment, and 5) minimizes its impact on the consumption of energy (especially carbon-based energy) and natural resources.

Construction firms must understand the impact of environmental damage they cause and to take tangible measures to highlight the problems. In regards to this, Hill and Bowen (1997) highlighted that the purpose of proposing sustainable construction emerged to describe the responsibility of the construction industry in attaining sustainability. To do so, it must be contributed to the improvement of environment and the advancement society (Shen *et al.*, 2010). The principles of sustainable construction projects attempt to adhere to the definition of sustainable development of protecting the environment and enabling all people to improve their lives through the pursuit of economic and social objectives. Alameda County (2002) reported that these principles are: 1) building for the long term – construct buildings that are durable and long lasting, 2) build for our children – make their environment safe, and 3) build for the planet – make the material from sustainable resources. Hence, sustainable construction is all about interaction with the environment.

WCED (1987) reported that in addition to fulfilling environmental dimension, the construction industry should also look into the other two pillars of sustainability; which are economic and social, to avoid the danger of only concentrating on the improvement of technology to fulfill sustainability strategy and policy. To avoid this, indicators specifically designed for the Malaysian scenario should be formulated and then implemented in the construction industry. This is to ensure a more structured and balanced approach towards achieving sustainability in the construction industry.

Construction plays a different role as an economic driver and environmental challenge, when it seeks for safe sustainable development (Patermann, 1999). Since the 1992 Earth Summit in Rio de Janeiro, the construction industry had been hard-pressed to be more proactive towards achieving sustainability, which in turn, could contribute towards the bigger picture of sustainable development. A study conducted in the US indicated that the construction and operation of buildings consume 35% of total U.S. energy output. More than 60% of the electricity generated there is consumed by buildings, accounting for at least 35% of all carbon dioxide (CO₂) emissions. Buildings use over 35% of all materials produced in the U.S. and more than 25% of the world's harvested wood (City of Portland Office of Sustainable Development and Portland Development Commission, 2002). The CO₂ emissions coming from houses are not much different in the UK which is at about 27% (TCPA, 2003).

Sustainability of construction firms has the ability to generate projects which produce and create enough amount of business during a particular period (WCED, 1987). Several studies have been conducted in the construction sector, which concentrated on project delay, risk and labour management and developing standards of building materials. Specific studies on the measurement of sustainable construction performance practices of the Malaysian contractors, has so far to our knowledge been neglected. Based on the available theories and empirical evidences, there is a clear gap governing the issues of sustainable aspects and performance practices of construction in the Malaysian context. Therefore, the need for a study to investigate and fill in this gap in theory and at the empirical level is very necessary.

Willard (2002) claimed that sustainability has a role in transforming companies into the perspective of the natural environment and future generations. Since the Rio Earth summit in 1992, many governments, companies and other organizations have implemented various sustainable development policies and initiatives. In the later stages of their policy implementation, they realised that these policies must be assessed and evaluated. Conscious of this pertinent matter, sustainable development researches have developed sustainable development assessment framework (Ding, 2005). Therefore, there is indeed a need to assess the sustainability of firms using combination of economy, social and environmental factors.

1.2 Problem Statement

There is an increased demand in the private and public sectors, to understand the sustainable construction practices. This increase in demand, which is driven by the understanding of sustainable practices become clear to owners and operators. These practices on the one hand, help the environment and improve economic profitability in addition into strengthening the relationships with stakeholders (Wrap, 2000).

In construction, there is a common belief that measurement is vital to good management (CIDB, 2007; Torbett *et al.*, 2001). Azapagic (2003) reported that measuring and monitoring is essential, to guarantee that sustainability objectives and targets are achievable. This statement is also applicable in the implementation of sustainable development policies and initiatives in the construction industry. The current traditional environmentalism shown similarly among researchers and practitioners may be detrimental towards the implementation of sustainable development policies in the

construction industry. The construction industry has long been accused as one of the main perpetrators of environmental problems. The current perception towards sustainability within the industry is that, environmental protection only tends to increase the costs of production and hence reduces the competitive edge of firms. To this effect, there is the need for an assessment framework, integrating environmental, economic and social factors, so that practitioners within the industry could appreciate the benefits of implementing sustainable development strategies and policies as a necessary way forward and not as drivers of cost.

The decline in the performance of Malaysian construction industry in recent years has resulted for an urgent need for the Malaysian construction industry to develop a strategy towards strengthening its operations to meet current and future challenges (CIDB, 2007). CIDB (2007) reiterates the mission of Malaysian construction industry as the initiation of an industry-driven process of change and reform which strives to convert the industry into one that is more sustainable, delivers higher quality products and related services, is performance-oriented and has an improved image.

Due to the weaknesses facing the construction industry, their challenge has been in the areas of productivity, quality, safety, technology and unproductive practices (Zainul Abidin, 2008; Zainul Abidin, 2009b). The government currently strives to upgrade the country, including the construction industry (Zainul Abidin, 2008; Zainul Abidin, 2009a; Zainul Abidin, 2009b). This is indicating a real need to develop assessment framework to be used in the construction sector. The book “Malaysia's Vision” published in 1993 emerged as one of the basic visions for the country to be

ecologically sustainable. Sustainable development is one of the top issues of the eighth Malaysian plan (2001 - 2005) (Zainul Abidin, 2008; Zainul Abidin, 2009b). The construction industry development board Malaysia (CIDB) identifies environment and other sustainability issues as one of the top issues in construction industry (Zainul Abidin, 2008; Zainul Abidin, 2009b).

Hence, it is imperative to develop a framework specifically tailored to the Malaysian scenario because as a developing country with its own unique characteristics, the newly developed framework could answer a multitude of problems in relation to construction sustainability in the country. The developed Malaysian framework could be the right impetus to move the current inertia in promoting sustainable development as demonstrated by the country's construction companies. It is hoped that construction companies will not be scared and put off by the term "sustainable development", perceiving it to be additional costs. Rather, with an assessment tool integrating all the pillars of sustainable development, including environmental, economic and social, the companies will form a learned judgment towards sustainable construction.

1.3 Research Questions

This thesis attempts to answer the following research questions:

1. What are the characteristics of a sustainable construction company?
2. How sustainable is the Malaysian construction industry in terms of environmental, economic and social factors?

1.4 Research Objectives

The main objective of this research is to develop a multi-dimensional framework/model for the measurement of sustainability of construction projects in Malaysia. The framework will include an integrated assessment of all main pillars of sustainable development, which are; the environmental, economic and social factors.

The objectives of this research are:

- 1.To examine the existing assessment frameworks/models used for assessing sustainability.
- 2.To examine the differences in the perceptions amongst contractors towards sustainability factors in the Malaysian construction companies.
- 3.To examine the relationships between sustainability factors and the performance of construction firms among contractors.

1.5 Significance of the Study

The benefit of examining the existing framework used to assess sustainability toward the development of a multi-dimensional framework for measurement of sustainability construction projects in Malaysia are very significant for successful planning and policy development of sustainable construction. Without sustainable construction planning, it could result in severe damage to the natural environment, impact on the social dimension and economic prosperity.

This study is significant towards the development of a new framework of assessment of sustainability in the Malaysian construction industry. An audit of more than 20 assessment models developed previously revealed that none of them come from

Malaysia. It is imperative to develop a framework specifically tailored in Malaysian scenario because as a developing country with its own unique characteristics, the newly developed framework could answer a multitude of problems in relation to construction sustainability in the country.

In term of practice, this study could be used as an assessment tool to measure sustainability in the real construction projects. The developed Malaysian framework could give fresh impetus to the current inertia towards sustainable development as demonstrated by the country's construction companies. It is hoped that construction companies will not be scared away by the term 'sustainable development' perceiving it to be cost additions. Rather, with an assessment tool integrating all the pillars of sustainable development, those are, environmental, economic and social, the companies will form a learned judgment towards construction sustainability.

Another benefit of this study is not only towards environmental protection, but a combination of internal and external benefits for the firm, employee, owners and investors. These combinations of benefits reflect social, economic and environmental protection as well as maximizing profits while minimizing the costs of inputs.

The dimensions employed in this study, to measure the performance of the contractor consists of financial and non-financial measurements. In practice, clients only use the financial metrics to measure their performance. Therefore, a consideration of the non-financial measurement aspect is considered to be a contribution to the general

construction economic theory; specifically this study concentrates on the performance of the contractors.

1.6 Scope of the Study

This study is limited to the contractors registered with the CIDB in Malaysia. As at in June 2008, there were 63,465 registered contractors in Malaysia under various grades of classification; Grade G1, G2, G3, G4, G5, G6 and G7 (CIDB, 2008), based on the size of projects, capital and personnel resources contractors (Fadhlin, 2004). For the purpose of this study, it excludes none and dormant contractors from the calculations. Low Grade contractors (G1-G3) represented the highest registration (82%) compared to the other grades which accounted for 52,482 contractors. The middle category of contractors (G4-G5) represented (9.5%), accounting for 5,583 whilst the big contractors (G6-G7) accounted for 5,400 (8.5%). The G1 category, representing the lower contractors are usually driven by cost and working as sub-contractors to the bigger contractors (CIDB, 2008). This study considers the categories of G4, G5, G6, and G7 which are the medium to large contractors, for several reasons: 1) These contractors were involved and performed construction projects, 2) contractors had direct impact on the environment, and 3) from G1 to G3, the capital paid was less and number of employees was also less as well whereas for G4 to G7, the paid up capital and number of employees were substantially higher.

1.7 Thesis Organisation

This thesis is organized in six chapters. In chapter one, the introduction of the core research problem was presented. It gives the details about the background of the study, research questions to be answered, research objectives to be achieved and scope of study, as well as the outline of the thesis. Chapter two reviews the literature about the sustainability concepts and issues and their relations to other aspects. The chapter also outlines the benefits and drawbacks of the sustainability approaches. Chapter three introduces the construction industry, its impact on the environment and the role of construction firms to the implementation of sustainability. It concludes by elaborating on past sustainable construction studies in the construction sector. Chapter four gives details of the data collection methods adopted and how the relevant instruments were designed and applied in the field. It also elaborates on the analysis of quantitative data as well as the approach utilized in analyzing non-parametric data. Chapter five gives the results of the study at the industry level and the analysis and discussions of responses obtained at company level. Finally, chapter six concludes with details about key findings and suggestions. It also offers recommendations for future research.

CHAPTER 2

GENERAL CONCEPT OF SUSTAINABILITY

2.0 Introduction

This chapter reviews current knowledge about sustainability. First of all, this chapter discusses the basic concept of the study i.e. sustainability and sustainable development in general. Additionally, the chapter briefly addresses sustainability issues. Key studies in the field of sustainability are also reviewed including history, trends and developments. Finally, this chapter lays the background of the underlying theory of the study and conceptualizes the theoretical framework.

2.1 The Concept of Sustainability

The notion behind sustainability comes from the appearing of several issues, these issues include the climate change, biodiversity loss, global water crisis and many other environmental changes (Baumgärtner & Quaas, 2010). Sustainability is one of the most important issues which discuss the future between professionals and academics (Baumgärtner & Quaas, 2010; Newman & Kenworthy, 1999). The three dimensions of sustainability (social, economic and ecological dimension) makes the concept universal, in terms of integration among them (Mickwitz & Melanen, 2009; Spilanis *et al.*, 2009). The holistic concept of sustainability is the reason which makes it as a relationship in our life systems (de Vries & Petersen, 2009; Reed, 2007). Singh *et al.* (2009) dealt with sustainability as more than an important issue in terms of its inter-linkages and dynamics of the system. It seems clear that the emergence of this concept forms the prominent

issues, as it relates to satisfying human needs, while the second issue is concerned about intra and inter-generational ethics (Lorenz *et al.*, 2007). This is supported by George (1999) and Guest (2009), who considered intergenerational equity as a core of sustainable development concept.

Therefore, it is clear from previous studies that sustainability would play an important role in the lives of the future generation. Based on the definition of sustainable development which emerged from the World Commission (1987) and other definitions which reflect on the life of the future generations, it becomes important to note that sustainability can only be achieved by concentrating on its elements which focus on environmental, economic and social aspects.

2.2 Definitions and Pillars of Sustainability

Sustainability and sustainable development are interchangeable concepts. Scholars also agree that both concepts have the same pillars and could be treated as the same. This fact was supported by CIB (1998) and Brühl (2002), who argued that the main pillars of sustainability and sustainable development have social, economic and ecological dimensions.

The notions of sustainability and sustainable development are widely used today in many areas of research, policies, monitoring and planning (Spilanis *et al.*, 2009). The major objective of development is to satisfy human needs and aspirations (WCED, 1987). According to Kühtz (2007), sustainable development is the cornerstone on which to base policies for the future. It seems to deduce that without sustainable

development, the new generation will face difficulties in their lives. In summary, the phenomenon of sustainable development provides debates and interests across the world. Tonn (2007) argued that sustainability has no one definition which is accepted all over the world. However, the most common definition is "*Our Common Future*". In 1987, in the world commission report on environment and development, titled "*Our Common Future*", sustainable development was defined as, "... *the development that meets the needs of the presents without compromising the ability of future generations to meet their own needs*" (WCED, 1987). Newman and Kenworthy (1999), further stressed that sustainability meant that any economic or social development should improve, but not harm the environment.

According to Spilanis *et al.* (2009), sustainability could be considered as the state and potential of an area for achieving sustainable development. It is an integrated process to achieve its objectives and goals; therefore, focusing on one dimension and ignoring others could lead to inconsistencies in the system. Therefore, it is now clear that the adoption of the whole pillars of sustainability is of utmost importance. In addition, Young (1997) claimed that the measure of sustainability must correspond to the actions of individuals and collective improvements to minimize the deterioration of the environment.

Brochner *et al.* (1999) described sustainability as long term behaviour. In brief, it considers the mind set of humans in dealing with actions of the present to sustain for future generations. However, there are difficulties facing sustainable development due to the level of understanding of sustainability issues among the society. In this respect,

Azapagic and Perdan (2000) believed that by educating the society, it helps to change the perceptions of the society at large towards sustainability.

Gloet (2006) highlighted that knowledge for sustainability was needed, to support the process of achieving sustainability. Therefore, this knowledge could be gained from research and academic investigations of the problems. Knowledge also seems to be the key to strengthen awareness towards sustainable issues. It is further claimed that national aspirations and strategies are part of sustainability initiatives and policies (Ugwu *et al.*, 2006a). However, in many circumstances sustainability fails to highlight and tackle these issues at the micro level, such as during decision making. Therefore in many ways, sustainability has had to deal with long term frames and is highly related to building principles of what is right or wrong (Bentivegna *et al.*, 2002).

From the literature, there seem to be complicated interactions among the three major factors of sustainability (ecological, social and economic). According to Gibberd (2005), the main difficulty is to develop a comprehensive picture of sustainability status. The existence of such challenges could be resolved through management and leadership and these could be regarded as the major factors which support the promises to sustainable development (Gloet, 2006). Gibberd (2005) also claimed that there are several characteristics which contribute to sustainability. In another development, Ding (2005) pointed out that it was impossible to carry out building projects without measuring their environmental effects, which helps in decision making for environmentally friendly projects (San-Jose *et al.*, 2007). As a focus point in

sustainability, inter-generational and intra-generational equity are main principles that consider the environment (Browne *et al.*, 2005; Gasparatos *et al.*, 2009).

Several issues are considered as the focal point of sustainability such as pollution, waste generation and the diminishing of product value (Wilkinson *et al.*, 2001), opportunity costs (Kleivas *et al.*, 2009; Wilkinson *et al.*, 2001). Currently, pollutant emissions are considered one of the difficulties of sustainable development (Zimmermann *et al.*, 2005). It is also clear from the literature that an urgent need for methodologies and techniques for assessing sustainability and decision-making at various levels in the projects are required, such as conceptual design, construction and operations (Ugwu *et al.*, 2006a). Currently, the trends of research are developing on the environment and sustainability (Ugwu *et al.*, 2006b). This fact is supported by Zainul Abidin and Pasquire (2007), who asserted that there is an increasing pressure to develop techniques or methods to achieve sustainability.

It is also clear at this juncture that some of the issues of sustainability have global effect, but the solutions to these issues start locally, such as those affecting ozone layer and global warming. Therefore in summary, sustainability issues have a wide range of factors to be considered at micro and macro level, such as at sectors of industry, organizational level, at national and international levels.

According to Aras and Crowther (2009), the focal point of sustainability should not be mistakenly narrowed towards environmental issues only, but to consider other dimensions which include social and economic issues. It is also clear that human

activities should consider unsustainable activities which provide direct effect to human ecological systems, economic and social as well. These, in many ways promote sustainable development elements and gives benefits to all humans.

The definition of sustainability provides three main pillars to be considered, all of which deserve empirical investigation. This study reviews the main pillars of sustainability namely: environmental, social and economic aspects of sustainable development. Therefore, the issues of awareness and lack of understanding of these principles may, in many ways, provide obstacles in achieving the desired level of sustainability in organizations. Furthermore, these factors lead to the quality and performance of organizations. Therefore, the integration among these three dimensions of sustainability could be considered as the comprehensive model of dealing with the term sustainability. The following subsections discuss the pillars of sustainability in greater details.

2.2.1 The Social Aspect of Sustainability

Sustainability plays a significant role at the social level, like the ability to provide access to good education, creating goodwill and improving community well being. It also provides an avenue to make new people interested in the area and creates a conducive environment which deals with poverty, health care, crime and social exceptions. These factors lead to socially sustainable phenomenon (Boyko *et al.*, 2006). Spangenberg and Bonniot (1998) claimed that satisfaction of human needs and their aspirations and the distribution of justice reflect social sustainability. Considering that

sustainability has social elements, there is also need to consider the varieties of economic and social elements (Buchholz *et al.*, 2007). It becomes clear that sustainable development must consider the effective switch in future, improving the ability to understand the social responsibility and having awareness towards shareholders and social events (Gloet, 2006). Azapagic and Perdan (2000) claimed that in assessing sustainability, factors like human rights, population and future generation must never be neglected. It is evident from examples in the developed countries that the social sustainability are nurtured and achieved through changes in behaviour (Fricker, 1998; Kühtz, 2007), changes in lifestyles (Kühtz, 2007) and changes in attitude (Fricker, 1998) suggesting that social sustainability has several characteristics which cannot be ignored.

In another development, access to available technology, finance, data, services, shelters and land are the major objectives of social sustainable development (Gibberd, 2005). Gibberd (2005) further claimed that access to good education is a major role of social sustainability which creates the awareness and understanding to the current issues of sustainable development. Gibberd (2005) also added that improving health, safety, security and participation are worth considering in achieving social sustainability. These objectives could be clearly observed in developing countries' perspective, especially in the increased focus on social aspects in term of issues like quality, conditions of labour, economic feasibility, continuity and dependency on exact data (Gomes & Silva, 2005). To achieve sustainable development in terms of social progress, there arises the need to deal with several aspects, such as change, enhance the awareness and improvement in social responsibility (Gloet, 2006). However, there are other social issues facing the

society such as problems in accessing facilities, insufficient safety and security and bad quality of health (Bentivegna *et al.*, 2002). Some campaign groups became interested in corporate responsibility in social activities which have direct roles in influencing community in negative manner; these activities may include corruption, child labour and depravity of employees (Hauschild *et al.*, 2008). Moreover, according to Wilkinson *et al.* (2001), other issues which have been discussed belonging to social sustainability from the organization perspective in the pursuance of human capital resources provide impact in corporate profitability, continuity and satisfaction of employees' needs.

At this point, the more important issue is to invest in human capital through education, by preparing and training employees. It provides long term competitive advantages to the organizations and industry (Azapagic, 2004). In addition to this, the needs of society is another aspect of social sustainability which may involve neighbors, community, users, employees, in addition to other stakeholders who are connected to the project (Zainul Abidin & Pasquire, 2007).

To be successful in establishing social sustainability, one should interact with relevant social players such as government, local authorities, employees, end users, media and non governmental organizations (Zabel, 2005). Therefore, interactions among these groups provide great impacts in achieving social sustainability. In this context, it seems to imply that a good relationship between management officers and labours as one of the elements in achieving sustainable development successfully in the organizations is a vital consideration.

Zabel (2005) suggested a human behavior model which promotes sustainability. The proposed model supports several stakeholders such as companies, local authorities, governments and other organizations. The model suggested roles in enhancing sustainable behaviour at the individual level. The element of culture was regarded as one of the important elements in this model in achieving social sustainability. This model regarded behavior as part of the culture which influences sustainability. This study deduced that sustainability is a behavior suggesting that models and frameworks are necessary to change the values and behaviours of the individuals in the organizations.

Another issue of social sustainability is the quality of life, which was regarded as the major dimension of social aspects (George, 1999), suggesting that the impact of the quality of life and environment may not be accepted by the affected social group. Therefore, knowledge still remains the most important element in enhancing the social sustainability at the individual, organizations, national and international levels. Finally therefore, dealing with sustainable development must be a task for companies to provide equality among workers in terms of knowledge and education (Azapagic, 2004). The equality enhances thoughtful positive actions towards achieving sustainability successfully, regardless of social related issues, obstacles and problems.

2.2.2 The Economic Aspect of Sustainability

The second pillar of sustainability is the economic dimension. According to Baumgärtner and Quaas (2010) sustainable economics is based on the notion of

efficiency in using scarce resources in order to achieve the satisfaction of individuals' needs and wants as well as justice between current and future generation. In the context of sustainable development, the objectives of economic sustainability are concentrated on the efficiency and effectiveness of employment and achieving acceptable level of productivity, in addition to knowledge and technology (Gibberd, 2005). Efficiency and justice is the core problem in achieving sustainability of economics (Baumgärtner & Quaas, 2010). This suggests that knowledge is still the key element in achieving sustainability. Therefore, economic sustainability looks to achieve high profitability by the effective use of resources and other related elements such as planning, good management, and effective design (Zainul Abidin & Pasquire, 2007), which are of utmost importance in any organization. Therefore, stimulating sustainable development depends on economic measures (Bon & Hutchinson, 2000).

Sustaining economics of business is a major element of sustainable development which creates profits, supports employment and contributes to social welfare (Azapagic, 2004). On the other hand, economic stress results in bad impact by reducing production, as well as insufficient finance (Bentivegna *et al.*, 2002). Therefore, there seems to be an urgent need to increase the awareness of economic performance which leads to the sustainability of the organization.

2.2.3 The Environmental Aspect of Sustainability

The third pillar of sustainability and the most important factor in the sustainability concept is the environmental dimension. General speaking, the major role

in environmental sustainability is played by governments through the provision of standards and regulation models, to ensure quality of life, which gives cost enhancement and competitiveness to the sector (Wilkinson *et al.*, 2001). There are several objectives for sustainable environment, such as size, diversity, productivity, as well as resource management, in addition to processing and extraction of resources (Gibberd, 2005). As a result, a wide range of research has confirmed indicators related to pollution and waste (Gangolells *et al.*, 2009; Gibberd, 2005), which have high impacts on the environment. Additionally, managing the consumption of resource use is considered as one of the objectives of environmental sustainable development (Gibberd, 2005), such as energy, water, land and material use (Azapagic, 2004; Bourdeau, 1999; CIB, 1998; Gibberd, 2005; Sjostrom & Bakens, 1999) in addition to human capital (Bourdeau, 1999; CIB, 1998).

Some of the issues facing environmental sustainability are loss in resources, pollution, land use, loss of diversity (Bentivegna *et al.*, 2002). To provide needs for current and future generation, these should be dealt with effectively by structure and technology without harming the environment (Gibberd, 2005). Working together is the way towards sustainability environment in construction by all actors (Warnock, 2007).

Several issues must be considered when dealing with environmental sustainability, through the protection of the environment when its resources are used and preventing its soil, water and air (Zainul Abidin & Pasquire, 2007). In addition to this, sustainable environment is dealing with waste products (Klang *et al.*, 2003). Therefore, it is necessary for an approach which improves the environmental performance of the

construction firm (Ofori *et al.*, 2000). As confirmed by Gangoellis *et al.* (2009), in his study to apply waste management approaches including waste minimization and recycling. Therefore, these procedures will strengthen the environmental performance aspects used by the construction firms.

2.3 Achieving Sustainability through Sustainable Development

There is a wide range of consensus that sustainable development is all about the relationship among environment and the needs of humans (Bentivegna *et al.*, 2002; Plessis, 2005). According to Plessis (1999), sustainable development tries to address the conflicts among environmental protection and achievement of the human's needs and development. Policy makers are also concentrating on sustainable development as a major objective in the industry (Singh *et al.*, 2009). Sustainable development basically is all about getting a high quality of life for everybody and for future generations (Erturgut & Soyseker, 2009; Raynsford, 1999). Based on several contributors, this could achieve the target of sustainability to make a better life for the society. Therefore, one of the concerns of sustainable development is the attitudes that get long-term for the sustainability aspects in the society (Ding, 2005; Ding, 2008). Furthermore, managing the relationship among human needs and the environment is one of the cores of sustainable development objectives as well as social equity and human rights (Plessis, 1999; Plessis, 2007). It seems clear that to achieve this target, there should be a change in attitude towards sustainable development by creating the awareness toward sustainability issues.

The term ‘sustainable development’ has become one of the most debated subjects among politicians, scientists, academics, industrial practitioners and the general public (TCPA, 2003). It is very important to include sustainable development in all aspects of life. According to Bentivegna *et al.*, (2002), sustainable development is all about achieving a balance between competitors continuously, over a long-term period. In brief, it is a continuous process towards achieving its objectives over time. Some of the challenges of sustainable development are however, never put into solid goals (Van Bueren & De Jong, 2007). Therefore, from the perspective of construction sector, sustainable development means changes (Bourdeau, 1999). These changes serve the continuous process of sustainability in the construction sector. In addition to this, for change as sustainable development to become successful, it must promote all aspects of sustainability as well as benefits (Gloet, 2006). The application of sustainable development concept are still limited to a few groups of professionals (Gomes & Silva, 2005). Therefore, the measurement of development and its processes involving some of the professionals who are experts in their fields and other tools of surveys and methods (Guy & Kibert, 1998) must come out with solid solutions for sustainability issues. For these issues to fill the gap noted in research and practice to be successful, there must be political support (Gomes & Silva, 2005). In summary therefore, the goal of sustainable development process is sustainability (Gibberd, 2005).

According to Bourdeau (1999), education and training are powerful tools used in promoting sustainable development concepts and increasing the awareness about sustainability among people. Furthermore, policy-makers must continuously develop stable growth plans to provide incentives and continuing education schemes for