MODERATING EFFECTS OF GOVERNMENT SUPPORT ON THE RELATIONSHIP BETWEEN ORGANIZATIONAL INNOVATIVENESS, CULTURE AND SUSTAINABLE CONSTRUCTION AMONG MALAYSIAN CONTRACTORS

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ABSTRACT

Drawing upon organizational readiness for change and resource-based view theories, this study examined the role of government support in moderating the effects of organizational innovativeness and organizational culture on sustainable construction among Malaysian large contractors (the G7 contractors). A total of 172 contractors from the eleven states in peninsula Malaysia participated in the survey. The data collected were initially screened using SPSS (version 21), while Partial Least Squares Structural Equation Modeling (PLS-SEM) algorithm and bootstrap techniques were employed to test the hypothesized paths in this study. Specifically, the results indicated that the extent of sustainable construction among Malaysian large contractors is high (mean score: 3.95). The empirical evidence also supported the hypothesized direct effects of organizational innovativeness and organizational culture on sustainable construction. However, government support was found to be negatively but significantly related to sustainable construction. There also was a stronger positive relationship between organizational innovativeness and sustainable construction, to such an extent that this relationship becomes stronger (i.e. more positive) for contractors that are being aided by the government than it is for those that are disadvantaged in that regard. Similarly, the result regarding the moderating effect of government support on the relationship between organizational culture and sustainable construction was supported. Generally, these findings supported the view that government support has a strong contingent effect on the influence of contractors' innovativeness and culture on sustainability adoption in construction project execution. Therefore, to enhance sustainable construction adoption, more efforts are suggested to be applied to developing and utilising organizational innovativeness and organizational cultural dimensions, while more government support is also encouraged. Some limitations of the study are indicated, suggesting opportunities for future research.

Keywords: sustainable construction, organizational innovativeness, organizational culture, government support, Malaysian contractors.

ABSTRAK

Berbekalkan teori kesediaan organisasi untuk perubahan dan teori pandangan berasaskan sumber, kajian ini mengkaji peranan sokongan kerajaan dalam mengantarakan kesan inovasi organisasi dan budaya organisasi dalam memampankan sektor pembinaan dalam kalangan kontraktor besar Malaysia (kontraktor G7). Seramai 172 kontraktor dari sebelas buah negeri di Semenanjung Malaysia telah mengambil bahagian dalam kajian ini. Data yang dikumpul disaring menggunakan SPSS (versi 21), manakala teknik algoritma dan butstrap dalam Permodelan Persamaan Kuasa Dua Terkecil Berstruktur (PLS-SEM) telah digunakan untuk menguji laluan hipotesis dalam kajian. Secara khusus, keputusan menunjukkan tahap pembinaan yang mampan dalam kalangan kontraktor besar Malaysia adalah tinggi (min: 3.95). Kajian ini menunjukkan bukti empirikal yang menyokong kesan langsung hipotesis inovasi organisasi dan budaya organisasi yang mampan dalam pembinaan. Walau bagaimanapun, sokongan kerajaan didapati negatif tetapi berkait secara signifikan dengan pembinaan yang mampan. Sekali lagi, terdapat hubungan positif yang lebih kuat antara inovasi organisasi dan pembinaan yang mampan, sehingga tahap yang menyebabkan hubungan ini menjadi lebih kuat (iaitu lebih positif) bagi kontraktor yang sedang dibantu oleh kerajaan berbanding mereka yang kurang bernasib baik dalam hal itu. Begitu juga hasil berkaitan dengan kesan pengantara sokongan kerajaan terhadap hubungan antara budaya organisasi dan pembinaan yang mampan turut disokong. Secara umumnya, dapatan kajian ini menyokong pandangan bahawa sokongan kerajaan mempunyai kesan luar jangka yang kuat ke atas pengaruh inovasi dan budaya kontraktor terhadap pengadopsian kemampanan dalam pelaksanaan projek pembinaan. Oleh itu, untuk meningkatkan pembinaan pengadopsian yang mampan, lebih banyak usaha dicadangkan untuk digunakan bagi membangunkan dan menggunakan inovasi organisasi dan dimensi budaya organisasi, manakala lebih banyak sokongan kerajaan juga digalakkan. Beberapa batasan kajian dikemukakan sebagai cadangan bagi penyelidikan pada masa hadapan.

Kata kunci: pembinaan yang mampan, inovasi organisasi, budaya organisasi, sokongan kerajaan, kontraktor Malaysia.

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LIST OF ABBREVIATIONS

ADC	Adhocracy
AVE	Average Variance Extracted
BIZ	Business Innovativeness
CCP	Construction Certification Program
CPD	Continuing Professional Development
CIDB	Construction Industry Development Board
CIMP	Construction Industry Master Plan
CMV	Common Method Variance
CREAM	Construction Research Institute of Malaysia
CVF	Competing Values Framework
D^2	Mahalanobis distance
ECP	Economic Prosperity
EDI	Electronic Data Exchange
EIA	Environmental Impact Analysis
EnSF	Environmental Sustainability Factors
ESF	Economic Sustainability Factors
EVT	Environmental Prosperity
f^2	Effect Size
FAO	Food and Agriculture Organization
GASSIC	Green Assessment System in Construction
GDP	Gross Domestic Product
G7	Grade 7
GoF	Goodness-of-Fit
GOVT	Government Support

HCM	Hierarchical Component Model
IBS	Industrialised Building System
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
MKT	Market Orientation
NEWT	New Technology
PRC	Product Innovativeness
PhD	Doctor of Philosophy
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares-Structural Equation Modeling
PPP	Public-Private Partnership
PRO	Product Innovativeness
Q^2	Construct Cross-validated Redundancy
R&D	Research and Development
R^2	R-squared values
RBV	Resource-Based View
SEM	Structural Equation Modelling
SMEs	Small and Medium-sized Enterprises
SPSS	Statistical Package for the Social Sciences
SSF	Social Sustainability Factors
SWB	Social Wellbeing
UNCHS	United Nations Centre for Human Settlement
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural
Organization	

VIF	Variance Inflated Factor
WWF	World Wildlife Fund

CHAPTER ONE

1.1. Introduction

The first section in this chapter introduces the background of the study by explaining the concept of sustainability as the basis of this study's variable of interest - sustainable construction. It then went further to espouse the background of organizational innovativeness and organizational culture within the context of this study. This was swiftly followed by the scenarios within the Malaysian construction industry in terms of sustainable construction attainment. Then, the related issues and research gap were identified, and the research questions and objectives that this study intends to achieve were presented, followed by the scope of the study. The last section in this chapter is the significance of the study.

1.2 Background

Sustainable construction emerged as a new concept to provide a favourable built environment that meets humans' present needs without jeopardising the ability of the future generation to meet theirs (Opoku & Fortune, 2011). In principle, sustainable construction essentially covers environmental, social and economic attributes that are exemplified in the sustainable development mantra. Du Plessis (2002) affirms that sustainable construction came up to fundamentally address the complex problems of construction and the environment in order to restore balance between the natural environment and the built environment, as both realms are highly interconnected.

The construction industry in the twenty-first century is faced with greater challenges than any other industry, because the century is associated not only with technological advances, but also an increasingly sophisticated and competitive market, requiring improved sustainability performance of both the construction products and the processes (Suprun & Stewart, 2015). Although, the construction industry's reputation in terms of sustainability is a valuable commodity in today's marketplace, the industry's environmental damaging effects, such as various forms of environmental pollution, resource depletion, extremity of destruction to ecology and biodiversity loss on a global scale (Khatib, 2009; Opoku & Fortune, 2011) require urgent attention by all industry players. Similarly, excessive resource consumption has also been attributed to the industry, as building and construction activities worldwide are responsible for an estimated loss of 3 billion tons of raw materials on a yearly basis (The World Watch Institute, 2003).

These damaging impacts, among others, place the construction industry in a position of major contributor to the sustainable development agenda because the industry impacts all human activities, including communities and the safety of the general public (Pitt, Tucker, Riley & Longden, 2009). As a result, the social sustainability agenda of the construction industry must necessarily address issues of improving quality of human existence, employees' safety, skills training and capacity building for the less-priviledged, minimization of poor working conditions, fair distribution of construction social benefits, and adherence to intergenerational justice (Shen, Li Hao, Tam & Yao, 2007; Egan, 2002). These conditions become necessary owing to the excessive unethical practices associated with the construction industry.

The pursuit of sustainable construction within the construction industry is important in both practical and ethical senses, because the economic costs involved in running, maintaining and eventual construction project disposal (the full life costing calculations) can be reduced drastically (Parkin, 2000), as construction always involves huge financial investment. This notion should also consider clients' demands for better quality construction products/buildings with reduced cost (Levander, Engström, Sardén & Stehn, 2011). This, according to Opoku, (2015), can be achieved by building policy frameworks between the construction industry and the government towards changing the culture of the construction industry.

Therefore, there has been an increasing concern within the construction industry for the consideration of sustainability issues in construction project delivery, owing to the industry's contribution to environmental degradation (Li, Ng, & Skitmore, 2012; Tam & Tong, 2011; Teo & Loosemore, 2003). Construction industries across the globe are currently engaging in the sustainability debate and are formulating business strategies in response to these demands for sustainable construction adoption (Zhao, Huang, Shu, Jia & Woods, 2012), such that there is now a far-reaching recognition that the construction industry must necessarily play a significant role towards the attainment of the sustainable development agenda, and considering the construction industry's impact on the environment, human society and economy, the industry is now among the major drivers of sustainable construction achievements (Mustow, 2006). These three dimensions are the core principles of sustainable development, going by the Brundtland's (1987) announcement (Report of the World Commission on Environment and Development), and it has been stressed that sustainable construction is commonly used to describe the proper implementation of sustainable development concept in the construction industry (Salama & Hana, 2010). Essentially, sustainable development is aimed at balancing and protecting resources in the environment and social progress and economic development for the present population and the future generations. Hannon and Callaghan, (2011) then observed that firms that are dedicated to sustainability adoption are, at the same time, required to consider economic, environmental and social impacts and the effects of their corporate decisions.

Although, defining sustainable development is highly context-specific and its conditions are based on certain values (Pintér, Hardi & Bartelmus, 2005; Shortall, Davidsdottir & Axelsson, 2015), several definitions have been attributed to the term from the literature. Parkin (2000), for instance, asserted that there are about 200 supposed definitions of the terminology in circulation. However, the three key areas that are generally involved in sustainability are environmental responsibility, social awareness and economic profitability (Pitt, et al., 2009), and the construction industry markedly contributes in all these three areas. Therefore, construction stakeholders need to realise that whatever is built today provides the future built environment, and consequently influences the future generation's ability to meet their needs (Dickie & Howard, 2000).

Sustainable construction, which is also referred to as "green construction", explains the construction industry's responsibility to improve the efficient use of finite resources (energy, water and materials) while reducing building impacts on both humans and the environment throughout the phases of construction (Chua & Oh, 2011), and in this study, it is defined as the responsibility of the construction industry to adopt the principles of sustainable development in project execution by striking a balance between environmental conservation, social well-being and maintaining prosperity in development for the benefit of the present and future generations.

Therefore, as the sustainable construction initiative continues to gain more popularity, critics as well as its supporters are constantly evaluating its progress. In the spirit of this agenda, however, it is expected that the evaluation must include more than the immediate investors or tenants of the construction project. It should also consider the suppliers, the local community in which the structure resides and other stakeholders.

Therefore, the inter-generational aspect of sustainability, which ensures that the needs of generations to come are not compromised by present activities, is quite pertinent in sustainable construction, since structures are typically influencing the needs and requirements of present and future generations. Sustainable construction is a new and emerging field which aims to incorporate general sustainability concepts and agenda into conventional construction (Matar, Georgy, & Ibrahim, 2008).

While incorporating the principles of sustainability into construction projects, the construction companies are expected to be innovative to achieve societal and clients' satisfaction, aspirations and needs, while also improving their competitive advantage (Liu, Low & He, 2011). This will require the industry to develop and implement new ideas that have both practical and commercial benefits (Dulaimi, Nepal & Park, 2005). Innovation in construction is generally believed to include a significant introduction of new processes, products or management approaches, which are expected to increase organizational efficiency (Xue, Zhang, Yang & Dai, 2014).

Organizational innovativeness has been defined in various contexts by scholars and researchers (Siguaw, Simpson, & Enz, 2006; Rogers, 2003; Wilson, Ramamurthy & Nystrom, 1999; Cooper & Kleinschmidt, 1995). However, efforts to advance further organizational innovativeness definitions must be based on a set of guiding principles emerging from extant literature. However, due to the nature of this study, which seeks to determine the effects of organizational innovativeness on sustainable construction of Malaysian contractors, the definition of Kamaruddeen, Yusof and Said (2012) was adapted to suit the construction industry. According to the study, organizational innovativeness is defined as "the propensity or capacity of a firm to adopt innovative building products, construction methods, or processes, or concepts, and business systems that are new to the firm and/or the housing industry. The purpose is not just for maximizing profits, but also to meet the needs of the customers or end users, and taking cognisance of sustainability, and environmental issues" (Kamaruddeen, Yusof & Said, 2012 p. 120). As a result, this study notes the sustainability element embedded in the definition as it relates to the variable of interest in this present study, and defines organizational innovativeness as a construction company's drive or capacity to adopt innovation in construction products, processes or concepts, business and technology that are new to the construction company or the industry in order to attain competitive advantage, meet the clients' needs, and for sustainability considerations.

To attain these organizational successes and change, organizations are required to cultivate and maintain a culture that could stimulate improvements (Cheung, Wong, and Lam, 2012; Sattler *et al*., 2003), such that it reflects what an organization values, the leadership and managerial style that dominates such organization, its language and symbols, routines and procedures, and how success that makes the organization unique is defined (Cameron & Quinn, 2011).

Ankrah, Proverbs and Debrah (2009) posit that the culture within construction organizations emphasize the characteristics, construction approaches and competence of the craftsmen and other employees, including goals and core values of those organizations. In this sense, organizational culture is viewed contextually, considering varying factors that characterise individual construction organization's environment, which are invariably instrumental in its emergence. Thus, this present study considers organizational culture and organizational innovativeness as antecedents of sustainable construction among Malaysian large contractors.

1.3 The Malaysian Scenario

In Malaysia, continuous economic growth through physical development of buildings and infrastructural facilities since independence in 1957 had always been neglecting the environmental consequences (Abidin, Yusof, & Othman, 2013). However, sustainable construction within the Malaysian Construction Industry (MCI) has started generating a lot of attention lately, as the country quickly moved to being one of the first nations in the world to have shown serious concern towards the environment by enacting the Environment Quality Act way back in 1974 (Hamid, Kamar, Ghani, Zain & Rahim, 2011). Again, the adoption of sustainable construction was duly highlighted in the Construction Industry Master Plan (CIMP 2006-2015). Specifically, one of the critical success factors that was identified was to further stimulate sustainable practices within the construction industry in order to preserve the well-being of future generations. In section 3 of the 10th Malaysian plan, the integration of environmental concerns into economic growth was highlighted. During the same period covered by the plan, the government expects concerted efforts geared towards green technology and environmental management. Such awareness in green and sustainable issues were stressed for building and infrastructural development, as stipulated in these plans, in order to address green and sustainable construction.

Accordingly, the construction industry started moving towards adopting innovative construction in the form of Industrialised Building Systems (IBS), whose fundamental idea is moving on-site work to more a controlled environment in a manufacturing floor (Kamar & Hamid, 2012). This was also highlighted under Strategic Thrust 5 of the Construction Industry Master Plan (CIMP 2006-2015), where the development of innovative products or processes are essential for the improvement of productivity within the construction sector and also serves as an avenue to open up more opportunities for Malaysia's economy, which depends on the construction industry to provide the assets for production and other wealth creation activities (Sundaraj, 2007).

With the Malaysian government's support for the adoption of innovative construction, public perception of the industry will also be improved, as this will bring the much needed technology transfer and benefits to stakeholders in the construction industry, especially engineers, architects, surveyors and the clients as well. The introduction of innovation in the construction industry has resulted in improved product quality and price, reduction in cost and duration, additional services and enhanced technological image to the clients (Aktas & Ozorhon, 2015; Ozorhon, 2012), and according to Wang and Abdul-Rahman (2010), apart from the major preoccupations of many Malaysian contractors; which is client satisfaction and profitability, they also tend to support "monkey" culture, which is synonymous with teamwork and loyalty.

Given the aforementioned, this study assesses the extent of Malaysian contractors' sustainable construction and factors influencing its adoption. The factors are conceptualized as organizational innovativeness, organizational culture, and government support. The organizational innovativeness is considered under product, process, business systems and new technology dimensions. Following Kamaruddeen *et al*., (2012), organizational culture was conceptualized as adhocracy culture and market orientation, while government support is a uni-dimensional construct. And following the study of Baron and Kenny (1986), this study also introduces government support as moderating variable to strengthen the relationship between the independent variables (organizational innovativeness, organizational culture) and dependent variable (sustainable construction).

1.4 Problem Statement

There has been tremendous efforts in the Malaysian construction industry towards green building, a concept which is interchangeably used as sustainable construction, and which also entails increasing efficiency in resource consumption such as energy, water, materials, and land, while reducing building construction impacts on human health and the ecosystem throughout the building's lifecycle (Chua & Oh, 2011). Construction professionals were of the view that the construction industry's effort is not satisfactory in terms of the level of developing green construction. However, the government has a key role to play in promoting sustainable construction in Malaysia by delving into issues of lack of demand for sustainable building by the clients due to exaggerated associated costs of sustainable construction (Samari *et al.,* 2013). These expectations necessitated further research on factors that could influence Malaysian large construction companies to further adopt sustainable construction in their project executions.

However, the Malaysian government has identified unproductive issues, unsafe practices and sundry technological issues in the construction industry, and the need to demonstrate its ability to meet global standards and favourably compete in the global marketplace (Abidin, 2009). Again, due to the industry's significant contribution to economic growth, the government became committed to its improvement through various means. One of such means was through its corporate body - the Construction Industry Development Board (CIBD), which was established mainly for the development, improvement and expansion of the Malaysian construction industry.

The Construction Industry Development Board has also identified inefficient and ineffective methods and practices as some of the key failures of project delivery in

Malaysia, while other studies have made reference to lack of innovations and other problems of low productivity and technological advancements (Chan & Theong, 2013; Mahbub, 2012). Essentially, the dynamic nature of the construction industry's business environment requires adoption of innovation for sustainable competitive advantages (Hilmi & Ramayah, 2008). However, the slow rate of technological advancement in the industry is a major concern for international competition. Thus, the Construction Industry Development Board (CIDB) in 2011 stressed that, for the Malaysian construction industry to survive in the international construction market, firms within the industry must be able to develop and apply innovative design processes and construction technologies (Seng, Kumar & Mohtar, 2012).

In this way, the construction firms within the industry require product innovativeness, in terms of developing new products with technology to supersede competitors in products introduced to the market in order to compete favourably within the industry and on the international sphere (Kam-Sing Wong, 2014; Pero & Lamberti, 2013). In the same manner, considering the peculiarities and the dynamic nature of the construction industry, firms within the industry also require process innovativeness, the adoption of which, according to Damanpour, (2010) is determined by both environmental and organizational factors.

Also, there have also been views supporting the need for organizations to incorporate culture that supports commitment to sustainability (Sharma, 2002; Wong & Avery, 2009; Linnenluecke & Griffiths, 2010; Network for Business Sustainability, 2010). Thus, studies have shown that cultures that foster dynamism, adaptability, creativity and flexibility – which adhocracy represents; and those that create the necessary behaviours for superior value for buyers, outpacing competitors; which market orientation represents, influence organizations' ability to successfully exploit sustainability, as higher levels of productivity and organizational effectiveness can best be attained through competition (Crittenden, Crittenden, Ferrell, Ferrell & Pinney, 2011).

Presently, there are several empirical studies focusing on sustainable construction both within Malaysia and in other countries. Studies like Shen, Wu, and Wang, (2002); Shen *et al.,* (2007); Mokal, (2007), Maldonado, (2007) Suresh, Egbu, Akintoye and Goulding (2012); Lam, *et al.,* (2011b); Pitt, *et al.,* (2009); Djokoto, Dadzie and Ohemeng-Ababio (2014); Samari, Ghodrati, Esmaeilifar, Olfat and Shafiei, (2013) addressed factors that could influence sustainability in construction, from various dimensions. However, the effects of construction companies' innovative capabilities and organizational culture were not given any consideration in their studies. It is therefore important to examine the moderating effects of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction among Malaysian contractors, using a single framework.

Similarly, several sustainability studies have been carried out in the Malaysian construction industry, like Shari and Soebarto, (2013); Osman, Udin and Salleh (2012); Abidin (2009); Hamid and Kamar, (2012); Marhani, Jaapar, & Bari, (2012), among others. While these several studies addressed sustainable construction within the Malaysian construction industry, less attention was given to the integration of organizational innovativeness, organizational culture, government support and sustainable construction in one single study. And considering the fact that the Malaysian Construction Industry Development Board has identified sustainability-related issues as one of the major concerns of the construction industry, sustainable construction remains one of the current issues in Malaysia. Hence, in response to the quest (from Malaysian government, practitioners and the academia) for a more sustainable construction to ensure a balance between construction and human environment for the benefit of the present and future generations, this study aims to fill the gap identified in the literature by further examining the extent of Malaysian contractors' sustainable construction. The study also investigates the moderating effects of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction among Malaysian G7 contractors, who have been identified as one of the crucial stakeholders in the attainment of construction sustainability within the construction industry (Osman, Udin & Salleh, 2012).

1.5 Research Questions

1. What is the extent of sustainable construction among Malaysian large construction companies?

2. What is the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies?

3. What is the relationship between organizational culture and sustainable construction among Malaysian large construction companies?

4. What is the relationship between government support and sustainable construction among Malaysian large construction companies?

5. What are the moderating influences of government support on the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies?

6. What are the moderating influences of government support on the relationship between organizational culture and sustainable construction among Malaysian large construction companies?

1.6 Research objectives

1. To assess the extent of sustainable construction among Malaysian large construction companies.
2. To examine the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.
3. To examine the relationship between organizational culture and sustainable construction among Malaysian large construction companies.
4. To examine the relationship between government support and sustainable construction among Malaysian large construction companies.
5. To determine the moderating influences of government support on the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.
6. To determine the moderating influences of government support on the relationship between organizational culture and sustainable construction among Malaysian large construction companies.

1.7 Scope of Research

Contractors constitute one of the important construction industry players in all countries in meeting the increasing demands for building and civil engineering products, and for the sustenance of national economic and social development objectives (CIB, 1999). Malaysia is not an exception to this, as contractors play a very important role in the Malaysian economy by providing essential services in construction projects such as building construction, railways, roads, drainages and so forth, based on individual contractors' expertise. Particularly, the 10th Malaysia Plan (2011 - 2015) specifically highlighted several initiatives that are expected to stimulate multiplier construction activities within the Malaysian construction industry. As noted by Mohd Zin, (2013), the contractor's improved performance can easily contribute to the continued development of the industry and nation as well.

Furthermore, contractors have been described as construction project initiators, due to their dominant influence over the entire project direction (Abidin *et al*., 2013). Government regulations will only be effective with contractors' (especially, large contractors) active participation in the sustainability agenda, due to their strategic position within the industry and their capabilities to integrate sustainable construction during the construction projects (Zhang, Platten, & Shen, 2011). In this way, their leadership dexterity is required to transform the construction industry towards sustainability agenda (Majdalani, Ajam & Mezher, 2006). Thus, due to the contractor's special role in transforming designs into real structures in order to support government initiatives, this study focusses on Malaysian large construction companies (G7 contractors) operating in the peninsula Malaysia.

Several measures have been developed to improve the performance of the construction industry in many countries recently, and in line with the CIB report (1999), developing the construction industry is considered a necessary process to improve the construction industry's capacity and effectiveness so as to meet building and civil engineering product demands. Sustainable construction has been noted as an all-inclusive process which aims at restoring and maintaining harmony between the natural and built environments, and create human settlements that uphold man's dignity and encourages economic equity among all stakeholders (Du Plessis, 2002). Furthermore, certain common challenges were identified by Du Plessis, (2002) affecting sustainable construction in both developing and developed countries. These include: internalising sustainability; public sensitization; improving construction process quality; building materials innovation; environmental health and safety; and procurement procedure.

With these challenges, it became clear that sustainable construction is not just a goal, but a process (AlSanad, 2015), and this process requires that construction organizations understand their culture as a means to improved performance, as culture remains one of the major distinguishing features , the most powerful factor, and the most important competitive advantage in gaining organizational success (Cameron & Quinn, 2011).

Organizational culture is a manifestation of organizational values, the dominant leadership styles, the language and symbols, the procedures and routines, and the definitions of success that make an organization unique (Cameron & Quinn, 2011). Hence, in achieving such uniqueness, key dimensions of culture should be measured by the management, in addition to developing strategies for changing and implementing the organizational cultural process. Thus, this study considers adhocracy and market cultures from the recognized four types of cultures (clan, adhocracy, hierarchy and market culture) in the literature (Shih & Huang, 2010; Avan Beek & Gerritsen, 2010).

Furthermore, the firm’s size has a role to play in influencing its commitment to sustainability (Dixon-Fowler, Slater, Johnson, Ellstrand & Romi, 2013; Klein Woolthuis, 2010). Consequently, this study is focused on the highest grade of Malaysian contractors - the G7 contractors - who are the largest contractors with capacity to undertake heavy and complex construction activities, and with no financial limit. The G7 contractors were considered in this study based on the findings from previous studies which indicated a significant relationship between construction firms' sizes and sustainable construction adoption (Akadiri & Fadiya, 2013; Du, Zheng, Xie & Mahalingam, 2014). Specifically, Waris, Liew, Khamidi, and Idrus, (2014) asserted that large contractors are more conversant with sustainable construction phenomenon for onsite construction undertakings. Other empirical studies (Zeng, Shi, & Lou., 2007; Li, Zhu, & Zhang., 2010; Qi, Shen, Zeng, & Jorge, 2010) also support the view that while large construction companies are better leveraged to embrace sustainable construction practices and environmental management, other small construction firms are prone to difficulties in adopting environmental friendly practices because of resource inadequacy to do so. Thus, data was collected from one representative of the construction companies who is conversant with innovative activities and sustainable construction of the concerned company.

It should also be noted that Malaysian contractor's grades ranges from grade 1 to grade 7 (G1 to G7), and each category of these contractors has a tendering capacity and financial limits that defines the value of projects that can be undertaken except for the G7 and foreign contractors, which has no financial limit. Also, the contractors within the Malaysian construction industry were categorised into two different sections. The first one is the general construction, where residential, non-residential and civil engineering construction are carried out. The second section is tagged the special trade works. In this section, activities such as metal works, plumbing electrical works, sewerage and sanitary construction works, refrigeration and air-conditioning works, painting, carpentry and joinery, tiling and flooring activities and glass works are carried out. For the purposes of this study, however, only the civil engineering and building construction categories within the construction industry are considered. Implying that only active G7 contractors within the categories of building construction (B) and civil engineering (CE), that are located within eleven states of peninsular Malaysia and that are duly registered with the Construction Industry Development Board of Malaysia (CIDB), are considered in this study. This was done because all contractors in Malaysia are required to register with the CIDB before undertaking any construction activity in accordance with the Construction Industry Development Board Act 1994. Again, due to logistics limitations, the states of Sabah and Sarawak in eastern Malaysia were excluded in this study. For that reason, sampling for this study was restricted to the G7 contractors in the eleven states of the peninsular Malaysia.

1.8 Significance of the study

This study's significance is considered under three areas. These are academics, industrial practice, and policy. The academic significance include: sustainability in study within the context of construction companies, research framework proposed in the study, and extending organizational readiness for change and resource-based view theories to suit the construction industry. A framework for assessing sustainable construction of contractors through organizational innovativeness and culture has not been given considerable attention by researchers. This study attempts to fill that research gap.

In view of the existing insufficient sustainable construction framework for assessing the Malaysian contractors' sustainability, a theoretical framework for assessing sustainable construction of Grade seven (G7) contractors in peninsular Malaysia is developed, by adopting items from previous studies to measure the variables in this study. This is further explained in chapter three (Table 3.4). The proposed framework will improve the construction sustainability of Malaysian contractors. Essentially, the framework seeks to achieve sustainable construction through organizational innovativeness, organizational culture and government support of Grade seven (G7) contractors in peninsular Malaysia.

This study's framework is used to determine the significance of organizational innovativeness and culture in achieving sustainable construction. Specifically, eight factors are combined to develop five main hypotheses based on both theoretical and anecdotal arguments. The findings of the study are used to develop a final theoretical framework of sustainable construction for contractors, which can be useful in exploring other areas of sustainable construction in future researches.

In theoretical terms, this study tests a model that is developed for construction companies which employs dependent variable (sustainable construction) that is suitable for construction companies when compared with previous studies on sustainable construction. Particularly, this study uses the triple bottom-line measure that captures the three main pillars of environmental protection, social well-being and economic prosperity of sustainability. Additionally, the study provides Malaysian contractors; the CIDB; other components of the construction industry and policy makers with an instrument that can be used to assess how contractors' innovativeness (in terms of product, process, business and new technology), culture (in terms of adhocracy and market cultures), and government support could influence their sustainable construction adoption. Underpinned by the theory of organizational readiness for change and resource-based view theory, this study empirically provides evidence to bridge the gap in the literature regarding antecedents of sustainable construction.

The study also determines the moderating effect of government support on the adoption of sustainable construction among Malaysian contractors. In practice, identifying the level of sustainable construction of Malaysian contractors can provide economic and organizational benefits for their business as well as a basis for their key success indicators. In addition, the framework in this study could inspire organizational change towards sustainable construction in the Malaysian construction industry.

This research advocates the culture of sustainability by examining the effect of organizational culture (adhocracy culture and market orientation) on sustainable construction. While market orientation is an innovative culture that emphasizes a firm's corporate culture to have temperament towards continuous delivery of superior value to its customers, adhocracy firms are also in the business of developing new products and services and making preparations for the future. The major task of adhocracy management is to foster creativity, and activity "on the cutting edge". The significant effects of construction industry on the environment will be addressed when contractors inculcate sustainable construction in their business system.

1.9 Organization of the Thesis

The rest of this thesis is organized as follows:

Chapter two started with review of the relevant literature regarding the global construction industry and the Malaysian Construction Industry. Then, the concept of sustainable construction and its dimensions, which include the environmental, social, and economic-related sustainable construction are reviewed. Thereafter, the factors that are identified in this study to influence sustainable construction are discussed. These include organizational innovativeness and its dimensions (product innovativeness, process innovativeness, business innovativeness, and new technology); organizational culture and its adhocracy culture and market orientation dimensions. This was followed by the review of the relationships between the predictor variables (organizational innovativeness, organizational culture, and government support) and the criterion variable (sustainable construction) in this study. The theoretical framework is then presented based on empirical and theoretical evidences from the literature, followed by the underpinning theories. The chapter was concluded with hypotheses development.

Chapter three presents the research methodology. The chapter started with the explanation of the research paradigms. Then, the research design, data collection procedures, sample size determination, measurement and operationalization of variables used in this study, the pilot study result, and finally, a brief explanation of data analysis technique adopted in this study are given.

Chapter four outlines the data analyses, and the key findings of this research. The summary of the research findings is then presented to end the chapter.

Chapter five draws conclusions from the key findings of this study, highlights the theoretical, methodological and practical implications of the findings. Additionally, the chapter presents limitations of the present study and offered recommendations and future research directions.

1.10 Synopsis of Papers

Table 1.1 below provides a brief outline of published journal articles and conference papers included in the thesis.

Table 1.1 Synopsis of articles from the Thesis

ID	Title	Journal/Conference	Status	Description
Paper 1	Factors Influencing Sustainable Construction among Construction Firms in Malaysia: A Preliminary Study using PLS-SEM.	Revista Tecnica de la Facultad de Ingenieria Universidad del Zulia, (2015), 38(3), 132 – 142. [SCOPUS INDEXED]	Published	The paper presents a research model alongside hypotheses development, and the result of a preliminary study on organizational innovativeness, culture and adoption of sustainable construction among the large contractors operating in Malaysia using PLS-SEM measurement model.
Paper 2	Preliminary study on antecedents of sustainable construction among contracting companies operating in Malaysia	Jurnal Teknologi, (2015), 77(4), 119-125. [SCOPUS INDEXED]	Published	The paper developed a framework that incorporates the antecedents of sustainable construction; and also assessed the validity and reliability of the research instrument.
Paper 3	Innovativeness and Sustainability: Difference and Antecedent Relationship.	Proceedings of the 12th Annual World Congress of the Academy for Global Business Advancement. *12*(1). 692-700.	Published	The paper outlined the antecedent relationship and the differences between innovativeness and sustainability within the construction industry.
Paper 4	Assessing the sustainable construction of large construction companies in Malaysia	*Proceedings of the International Conference on Applied Science and Technology 2016 (ICAST 2016),* April 11-13, 2016. *AIP Conference Proceedings*. 020027-1 – 020027-7. doi: 10.1063/1.4960867. Indexed in **Thomson Reuters Web of Science and Scopus.**	Published	This paper assesses the extent of Malaysian large contractors' sustainable construction. Using a five-level rating scale of sustainable construction found in the literature to assess Malaysian large contractors, statistical analysis reveals that their overall sustainable construction is high.
Paper 5	Does Government Support Matter? Influence of Organizational Culture on Sustainable Construction among Malaysian Contractors	International Journal of Construction Management. [Indexed in Thomson Reuters' Emerging Sources Citation Index (ESCI) and Scopus]	*In press*	The paper examined the moderating effects of government support on the relationships between adhocracy culture, market orientation, and sustainable construction among Malaysian large contractors.
Paper 6	Developing a Validation for Environmental Sustainability.	In: *Proceedings of the International Conference on Applied Science and Technology 2016 (ICAST 2016),* April 11-13, 2016. *AIP Conference Proceedings*. 1761: 020026-1 – 020026-9. doi: 10.1063/1.4960866. Indexed in **Thomson Reuters Web of Science and Scopus.**	Published	The paper examined the effects of product innovativeness, process innovativeness, and organizational culture on environmental sustainability among 172 large construction companies in Malaysia.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the review of literature relevant to this study. First, a global overview of the construction industry and its challenges were presented. This was followed by a review of activities of the Malaysian construction industry. Next, the concept of sustainability is presented. Then, the chapter discusses the concept of sustainable construction, and its dimensions in the context of the construction industry. The chapter further presents the concept of organizational innovativeness and organizational culture as factors influencing sustainable construction. The relationships between the constructs were highlighted, while government support as the moderator in this study was also discussed. The readiness for change theory is then presented as the underpinning theory to explain the theoretical framework of this study towards the end of the chapter. Then, hypotheses that were developed through theoretical and empirical arguments were presented. And lastly, a summary of the entire chapter is presented.

2.2 Construction Industry

Construction is used to describe the activity involving physical infrastructural development, and other related facilities (Razak Bin Ibrahim, Roy, Ahmed & Imtiaz, 2010). The industry's activities are project based, where the project teams consist of multi-disciplinary team members (like engineers, architects, quantity surveyors, main contractors, subcontractors, suppliers, and so forth), as well as the maintenance and repair of existing facilities (Gopikrishnan & Topkar, 2015; Pheng & Jayawickrama, 2012). Construction is sometimes defined with respect to the level of immobility of the end product of a sector. This definition was popularised by the United States

Department of Commerce (1984). In this manner, construction precludes the production of movable complex goods like mobile building, freight ships. These inconsistencies in appropriately defining the concept of construction, in addition to its disparate nature forced some researchers to conclude that the industry is imaginary. Whereas, Olanrewaju and Anahve, (2015) argue that the construction industry is simply the amalgamation of many stakeholders like clients, design and construction professionals, and operational teams, including those responsible for the supplies of the inputs needed for the industry production.

In a different line of thought, Ofori (1991) maintains that "a precise and appropriate definition of construction is crucial to any effort to understand the industry and attempt to improve it...." This definition encompasses all sectors of the economy engaged in activities ranging from planning to the eventual demolition of all kinds of buildings, civil engineering works, mechanical and electrical engineering structures and other similar works. The participants in the construction process are represented in Figure 2.1, which describes the industry as a series of related but discrete activities, persons or organizations.

However, the construction industry encompasses series of construction activities that have been noted to be vital to economic development (Bielsa & Duarte, 2011; Ramachandra, Rotimi & Rameezdeen, 2013). Research in the field of construction has established that the construction industry has a strong link with all other economic activities of any country, because it is instrumental to creating infrastructural facilities that facilitate national development (Chiang, Tao & Wong, 2015). This explains why the industry's success is always linked to the GDP growth in any country (Ozkan, Ozkan & Gunduz, 2012; Ramachandra, Rotimi & Rameezdeen, 2013), especially considering its partnering role with other sectors. Evidence from advanced economies also indicates that about 5 to 8 per cent of most countries' GDP comes from the construction industry, whereas, their counterparts from the developing nations contribute only 3 to 5 per cent to their nation's Gross Domestic Product (Kargi, 2013). Despite the great economic importance of the construction industry to the economy, the industry's productivity and performance is relatively lower than that of other related sectors (Erbil, 2013).

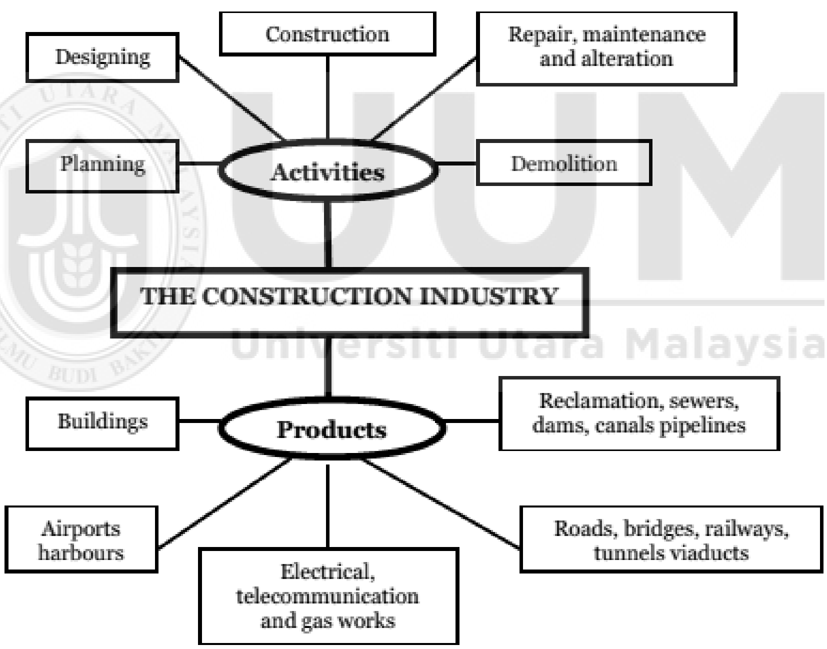


Figure 2.1
The Construction Industry (Source: Ofori, 1991)

As shown in Figure 2.1, participants, activities and outputs can continuously be added to the industry because construction is an industry of several related, albeit discrete activities. In this sense, Figure 2.1 only indicates the extent to which the components are not precise. However, the discreet activities within the construction industry is shown here to include enterprises engaging in planning, design, actual physical work on new or existing buildings, civil, mechanical and electrical engineering works. It also includes repairs and alterations made on construction products and the eventual demolition of such.

A major characteristics of the construction industry, according to (Osei, 2013), is its role in the socio-economic development of many countries by providing infrastructure, shelter and generating employment for millions of unskilled, semi-skilled and skilled labour, while also providing a growth impetus to other sectors through backward and forward linkages. Construction projects, which include general construction of infrastructural facilities, are important indices of developmental efforts to improve living standards (Razak Bin Ibrahim *et al*., 2010), aside its extensive contributions to wealth creation and quality of life of the populace. Some of these noble contributions of the construction industry were highlighted during the first conference of CIB TG29 on developing countries, where it was observed that construction industry development should be seen as a deliberate attempt aimed at improving the industry's capacity to meet the demands for building and engineering construction products, and to support sustainable national economic and social development objectives (CIB, 1999).

2.2.1. Challenges of Construction Industry

By its nature, the construction industry has several challenges that requires solutions such as sustainable construction that seeks to address the environmental issues, societal well-being and construction firms' financial gains. Apart from the challenges associated with the physical environment, where the industry's impacts are mostly felt, the consideration for training and educating construction personnel and other relevant stakeholders should be prioritised (May, Mitchell, Bowden & Thorpe, 2005).

Although, these challenges vary across countries, studies have shown that due to several mishaps within the construction industry (like human tragedies, de-motivation of workers, and disruption of site activities among others), its reputation globally has become dented (Hallowell, Hinze, Baud & Wehle, 2013; Pheng, 2005; Santos & Powell, 2001). The industry is not only considered dangerous for the construction workers, it has also been reported to be the most insensitive sector to the environment. According to the United Nations Centre for Human Settlement (UNCHS, 1996), most countries especially in the third world are faced with fragile environments and high levels of land degradation occasioned by the activities of the construction industry. The insensitivity of the construction industry was also reiterated by Li, Ding, Mi & Wang, (2013), as construction takes away several green-field sites from other uses, which eventually leads to loss of means of livelihood for millions of people worldwide.

However, construction industries in many developing nations are currently embracing useful measures from the industrialised nations to overcome the challenges of their construction industries. Many developed countries have been proactive in terms of government actions, market forces, institutional initiatives and operational environment to ensure the adoption of sustainable construction in materials selection, construction techniques and practices within their construction industries (Rosales-Carreón & García-Díaz, 2015). Thus, dedicated agencies were established in many countries to improve the construction industry, with varying objectives, authority levels and responsibilities. Whereas, the Construction Industry Board used to be industry initiatives in some developed nations, its counterpart institutions in developing countries like Malaysia (Construction Industry Development Board of Malaysia) are coordinated by the government.

2.2.2. Malaysian Construction Industry

In Malaysia, construction is defined as any new construction, alteration, repair or demolition. Installation of any machinery or equipment which is built-in at the time of the original construction is included, as well as installation of machinery or equipment after the original construction but which requires structural alteration in order to install (Department of Statistics, Malaysia, 1995).

The Malaysian construction industry, just like its counterparts in other parts of the world, has been an enabler of the growth of other industries through its role as a fundamental building block of the nation's socio-economic development (Ibrahim, Roy, Ahmed, & Imtiaz, 2010). All the essential elements of a healthy and functioning economy (educational institutions, government offices, tourist attractions, transportation infrastructure, housing, commercial property) are built and maintained by the construction industry. In addition, more employment opportunities are created through the development of infrastructure by the construction industry. The Malaysian construction industry provides job opportunities to roughly 800,000 people yearly, representing 8 per cent of the total workforce in Malaysia (CIMP, 2006). Although, the construction industry contributes below 5 per cent of the GDP, it is regarded as the growth enabler due to its extensive links with other sectors of the economy.

The linkage, according to Sundaraj (2010), stems from the industry's demand by other sectors of the economy. The demands are in two forms. One is through its ability to create wealth and improve quality of life by providing such infrastructure like housing. Equally, construction demand comes from the foreign markets, which do not add any multiplier effects to the economy as does the domestic demand. Thus, the Malaysian construction industry has been promoting green building initiatives to sustain economic growth and social development. The green building initiative became necessary because the construction practice in Malaysia is labour intensive, involving formwork fabrication, steel bending and concreting. It requires many wet trades on site such as skill carpenters, plasterers and brick workers. The practice poses a big challenge to the industry, considering non-renewable resource depletion, global warming and extreme destruction of the ecology and recurring biodiversity impacts. As such, sustainable construction became an essential concept in the industry to achieve resource management and social justice, while also maintaining economic prosperity (Abidin, 2009).

The Malaysian Government largely stimulates the construction industry through continuous spending towards the development of infrastructure that are included in government's master plan. According to the government's previous master plan (the 9th master plan), a total of RM600billion was expended mainly on the major economic sector (agriculture and rural development, transport, commerce and industry) from 1981 to 2010. The infrastructural development of the construction industry however suffered a setback recently, occasioned by the global financial crisis. However, the Malaysian Government, through the 10th Malaysian plan (which spans from 2011 to 2015) is strengthening the Public-Private Partnership (PPP) initiative by implementing all projects identified under the master plan. Thus, the industry is expected to grow within this period by 4.4 per cent annually as a result of construction-related projects under the two economic stimulus packages - a deliberate step by the government to enhance marketplace confidence. This growth was largely supported by the expansion in civil engineering, residential and non-residential, as well as the special trade works subsectors.

Earlier, the CIDB in 2003 had organised a roundtable discussion with major players in the industry to draw up the Malaysian Construction Industry Master Plan (CIMP). The CIMP is a comprehensive development plan that spans ten years, between 2006 and 2015, outlining the strategic position and the future direction of the Malaysian construction industry. In addition, it also aims at transforming the industry to one that can adequately support economic growth by cushioning the effects of future increased demands along construction value chains (Sundaraj, 2007).

In spite of several efforts to standardise the construction industry, there are certain peculiar challenges bedevilling the industry, as documented by earlier researchers (Goh & Abdul-Rahman, 2013; Mehr & Omran, 2013; Abdul-Rahman *et al*., 2006; Berawi, Berawi, Mohamed, Othman & Yahya, 2006; Imtiaz & Ibrahim, 2005; BIPC/CIDB, 2003; Pratt, 2000; Abdul Rahman & Alidrisyi, 1994). Aside excessive project delays acknowledged by Abdul-Rahman *et al*., (2006), substandard project quality and ineffectiveness in cost and function of construction projects have also been identified by Pratt (2000).

Similarly, the Construction Industry Development Board (CIDB) master plan for occupational safety and health Malaysia (2004-2010) also highlighted several drawbacks plaguing the construction industry. Some of them are poor image, low quality of construction projects, low productivity, unethical practices, inadequate skilled personnel and accident-prone work environment. Accumulation of construction material wastage has also always been an issue within the industry. Foo, Rahman, Asmi, Nagapan and Khalid, (2013) pointed out several reasons ranging from setting-out error to over-consumption of materials and construction personnels' misconduct.

While the Malaysian construction industry has been noted for its immense contribution to the economic growth of the country, its damaging impacts on the environment (such as soil erosion, flash floods, natural resources depletion, and over consumption of building materials among others) have also been identified. Thus, sustainable construction emerged as a panacea to these several construction-related issues in order to ensure that present physical development does not compromise the future as Malaysia continues to develop.

2.3. Sustainability

The term "sustainability" is based upon the axiom of reciprocity principle, a simple veracity proclaiming "…do onto future generations as you would have them do onto you". Although the literature is replete with complex and sometimes conflicting definitions of the term (Nushi & Bejtullahu, 2012), sustainable development came up as a concept in response to the negative social and environmental effects of the prevalent approach to economic growth in the 1980s. The concept was coined within the environmental movement during the World Conservation Strategy organised by the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) in collaboration with the Food and Agriculture Organization (FAO) of UNESCO. The initiative identified seven key objectives of conservation and requirements for their achievement, which, among others, include ecological processes, a system to support life, generic diversity and sustainable utilization. But it was not until the report of the World Commission on Environment and Development (WCED) was published in 1987 that sustainable development started gaining wider recognition.

Essentially, sustainable development is about managing the relationship between human needs and that of the environment such that non-renewable resources which have critical environmental limits are not unnecessarily exceeded and modern ideals of social equity and basic civil liberties are not obstructed. In other words, it emphasises averting environmental and social collapse by sustaining the existence of the modern society and that of the future generations (Du Plessis, 2007). In this scenario, human/environment relationship is influenced by certain factors which are outlined by Du Plessis, (2007, p 70) as the "interpretation of quality of life" held by a particular society; and the choices made in terms of the technological, political, economic and other systems adopted by human society. Again, these factors are informed by the value system adopted in a society. This value system is a determinant of the type of relationship that exists among people in that society, and also society's response to its environment.

Thus, Atkinson, Dietz and Neumayer (2007) argued that there should be an analysis of the rate of momentous impacts of human actions against the environmental values. This implies that if some environmentally threatened human actions are unchecked for generations, there would be a struggle between the current lifestyle of the present individuals and that of the future population. Sustainability therefore identifies and promotes responses that allows for the continued existence of the community at the best possible quality of life.

The Brundtland report necessitated a sequence of events and initiatives which, at present, brought us a comprehensive analysis of sustainable development. The 1992 Rio de Janeiro United Nations Conference on Environment and Development (the Earth Summit) was one of such vital events. At the summit, 27 principles (the Rio Principles) supporting sustainable development were endorsed by nearly 180 countries. The Framework Convention on Climate Change, the Convention on Biological Diversity, and the Forest Principles were also signed by the participating countries. And a Global Plan of Action (Agenda 21) was signed, which was aimed at delivering an improved sustainable development pattern and also gave a recommendation to all nations of the world to come up with national sustainable development policies (Akadiri, 2011). However, the Rio Conference was a major breakthrough which set a new paradigm for sustainable development.

Thus, following Pitt *et al*., (2009), sustainability in this study is defined as the development which is capable of being sustained, in other words, the amount to which the earth's resources may be exploited without harmful effects to man and the environment both presently and in the future, bearing in mind the triple bottom line of environmental responsibility, social awareness, and economic profitability. In the same line of reasoning, sustainable construction in this present study follows this tripartite principle of sustainability as discussed in the next section.

2.3.1 Sustainable Construction

Considering the size and importance of the construction industry to economic development of many countries and its immense contribution to environmental damage, suggestions have been made to consider the adoption of the emerging "sustainability" agenda as one of the very important conditions for measuring the construction industry's overall performance (Murray & Cotgrave, 2007). This new paradigm will enhance construction industries' effectiveness as much as contributing meaningfully to preserving the environment and enhancing social equity and economic prosperity. This necessitated the emergence of "sustainable construction", which addresses the construction industry's continuous resource-inefficient construction by utilising polluting substances, excessively specifying inefficient equipment, and overdependence on pollution-laden transport forms (Halliday, 2008).

For a long time, the construction industry has paid little or no attention to the continued existence of human communities. This understanding made the World Watch Journal in 1994 to observe that human beings are fast becoming super species with the development of structures that have the capacity to adapt to our varying environmentally-degrading lifestyles globally. In their analysis, Rode, Burdett and Soares Gonçalves, (2011) posit that an approximately 10% of the global energy consumption goes to building materials manufacturing. Construction and demolition contributes about 40% of the solid waste generated in the developed nations, while operation stage of construction products emits almost 40% of the entire global greenhouse gas emissions, making the construction industry the lead sector in global energy consumption (Rode, *et al.,* 2011; Wong & Zhou, 2015). Thus, an international effort emerged, during the last decade, to drive the construction industry towards the path of sustainable development. During the First International Conference on Sustainable Construction in Tampa, Florida, United States of America, Kibert (1994) proposed the first ever definition of sustainable construction as: "The creation and responsible management of a healthy built environment using resource efficient and ecologically-based principles" (cited in Kibert, 2005).

In this definition, the sustainable construction concept was centred on issues of non-renewable resources, especially energy, and ways to lessen impacts on the ecosystem with emphasis on such issues like materials, building components, construction technologies and energy related design concepts. However, Du Plessis *et al.,* (2002, p. 6) later suggests a broader definition of sustainable construction as "a holistic process aiming to restore and maintain harmony between the natural and the built environments, and create settlements that affirm human dignity and encourage economic equity”. This definition thus takes sustainable construction beyond just resource efficiency and ecological principles by introducing the idea of restoring the environment, as well as explicitly highlighting its social and economic aspects too. It shows that by adopting this concept, construction activities’ impact on sustainable development is considered under social, economic, and environmental dimensions. In this line of thought, non-technical issues (economic and social sustainability) are given equal prominence as environmental issues. This new paradigm therefore gave rise to the three main pillars (the triple bottom line) of sustainable construction, which are environmental protection, social well-being and economic prosperity (Abidin, 2009).

According to Tan, Shen and Yao, (2011), the key considerations in sustainable construction rest on “establishing effective construction programmes; developing and supporting well focused and capable public sector clients; designing and decision making based on ‘whole-life value’; using the appropriate procurement and contracting strategies; working collaboratively through fully integrated teams; evaluating performance, and embedding project learning” (p. 227). These important practices and principles, which have been documented in the extant literature (e.g., Bakhtiar, Li, & Misnan, 2008; Christini, Fetsko, & Hendrickson, 2004; Hwang & Tan, 2012; Hill & Bowen, 1997; Kein, Ofori, & Briffett, 1999; Kibert, 2008; Lam, Chan, Chau, Poon & Chun, 2011; Ngowi, 1998; Ogunbiyi, Oladapo & Goulding, 2013; Pitt, *et al*., 2009; Shen & Tam, 2002; Shen & Yao, 2006; Tan *et al*., 2011;), are represented in Table 2.1.

Table 2.1.
Practices involved in Sustainable Construction Delivery

	Important practices in sustainable construction	Principles involved in sustainable construction
1	Compliance with sustainable construction policies and legislation	Complying with governmental sustainable construction legislations, which includes environmental protection requirements, corporate social responsibility, and to improve competitive advantage in business.
2	Project design and procurement	Improving the project's whole life value through green design and promoting best practices in construction procurement.
3	Innovation and technology	Enhancing company's technology & innovation capacity to increase the sustainability of both the construction process and products.
4	Organizational structure and processes	Re-organizing and re-engineering of the organizational process and structure to expedite the passage and implementation of sustainable construction regulations.
5	Education and training	To increase organizations' commitment to sustainable construction through better education and training of every staff in the company
6	Measurement and reporting	Developing a new measurement and reporting procedure to evaluate construction firm's environmental, social and financial performance for further improvement.

Source: Tan, et al., (2011)

The attributes needed to promote sustainable construction were also highlighted by Hill and Bowen, (1997), which includes social, economic, biophysical and technical attributes, as well as a set of overarching, process-oriented principles. In their study, social sustainability was aimed at improving human life quality, implementing training and capacity building for less priviledged, delivering fair and equitable social costs of construction, seeking intergenerational equity and making provision for cultural diversity in construction development. The economic aspect of sustainability seeks affordability to the target groups of construction project. It also includes promoting employment generation, enhancing competitiveness, employing environmentally conscious contractors, and maintaining the needed capacity of construction projects to meet future needs. The bio-physical attributes of sustainable construction covers extraction of non-renewable resources at rates not exceeding their slow rate of regeneration, reducing the consumption of four (4) generic resources, which are: materials, energy, water, and land; maximising resources reuse or recycling; giving preference to renewable resources in place of non-renewable resources, minimising air, land and water pollution, maintaining and restoring ecological vitality and diversity, and minimising damage to sensitive land. The technical sustainability concerns durability, reliability, and functionality in construction, creation of quality built environment and revitalising the present urban infrastructure.

Equally, sustainable construction is the construction that is environmentally responsible, and which requires all stakeholders to make commitments towards attitudinal change and be ready to implement novel products, ideas and practices (Hwang & Tan, 2012; Tan, *et al.*, 2011). While some researchers dubbed sustainable construction as a panacea for change and development, the emphasis on it has always been on the adoption of design and construction practices that are efficient in resource consumption and without compromising environmental health or the associated health of the builders, occupants, the general public or future generations (Shen, Ou, & Feng, 2006). At the inception of the sustainable construction process, Kibert (1994) highlighted seven principles that are necessary in its implementation. These include minimising consumption of resources, maximising reuse of resources, utilising resources that are biodegradable and renewable, protecting the ecosystem and using nontoxic materials in order to create a healthy living atmosphere.

In line with the aforementioned discussion on sustainable construction, the concept is defined in this present study as construction companies' adoption of the principles of sustainable development in project execution by striking a balance between environmental protection, social well-being and economic prosperity for the benefit of both the present and future generations.

2.3.2. Dimensions of Sustainable Construction

The classical interface of economics, environmental and social dimensions of sustainable construction, widely referred to as the "triple bottom line" in business circles (Goodland & Daly, 1993; Lehtonen, 2004; Hall & Purchase, 2006) is considered in this study to describe construction project execution.

Earlier studies like Hill and Bowen (1997) added one more dimension to the triple bottom line in the promotion of sustainable construction, these are social, economic, biophysical, and technical dimensions. Kibert (1994) had hitherto propounded 7 principles necessary for the implementation of sustainable construction which are minimizing resource consumption, maximizing the reuse of resources, using renewable or recyclable resources, protecting the natural environment, adopting innocuous materials to create a healthy environment, applying whole life costing, and make provision for quality products (Kibert, 1994). A checklist towards a better understanding of the key issues affecting sustainability performance of construction projects across their entire cycle was provided by Shen, *et al*., (2007). Their study also considered the triple bottom line affecting sustainability performance of a construction project, which are economic sustainability factors (ESF), social sustainability factors (SSF), and environmental sustainability factors (EnSF) at inception, design, construction, operation and demolition stages of a project.

The environmental sustainability concerns reducing the ecological effects of present construction in terms of natural resources extraction for the sake of the future generation. While social sustainability dimension deals with the responsibilities of the construction firms to conduct business such that the construction impacts on the host communities is reduced (Jones, Shan & Goodrum, 2010), economic prosperity refers to the implementation of construction business practices that assure future economic development by considering micro and macro-economic issues. However, there are various issues relating to sustainable construction under these dimensions, some of which are quite similar across the scholars like Beheiry, Chong and Haas, (2006); Brownhill and Rao, (2002); Addis and Talbot, (2001); WS Atkins, (2001); Edwards, (1999); Hill and Bowen, (1997). These issues, which are not mutually exclusive as presented in Figure 2.2, are critically considered in construction projects for the achievement of sustainable construction.

Figure 2.2 is a representation of the dimensions of sustainable construction (environmental protection, social well-being concerns and economic prosperity) considered in this study, including the specific areas of concern and the items adopted from previous studies. Each of these dimensions is explained in the subsequent sections.

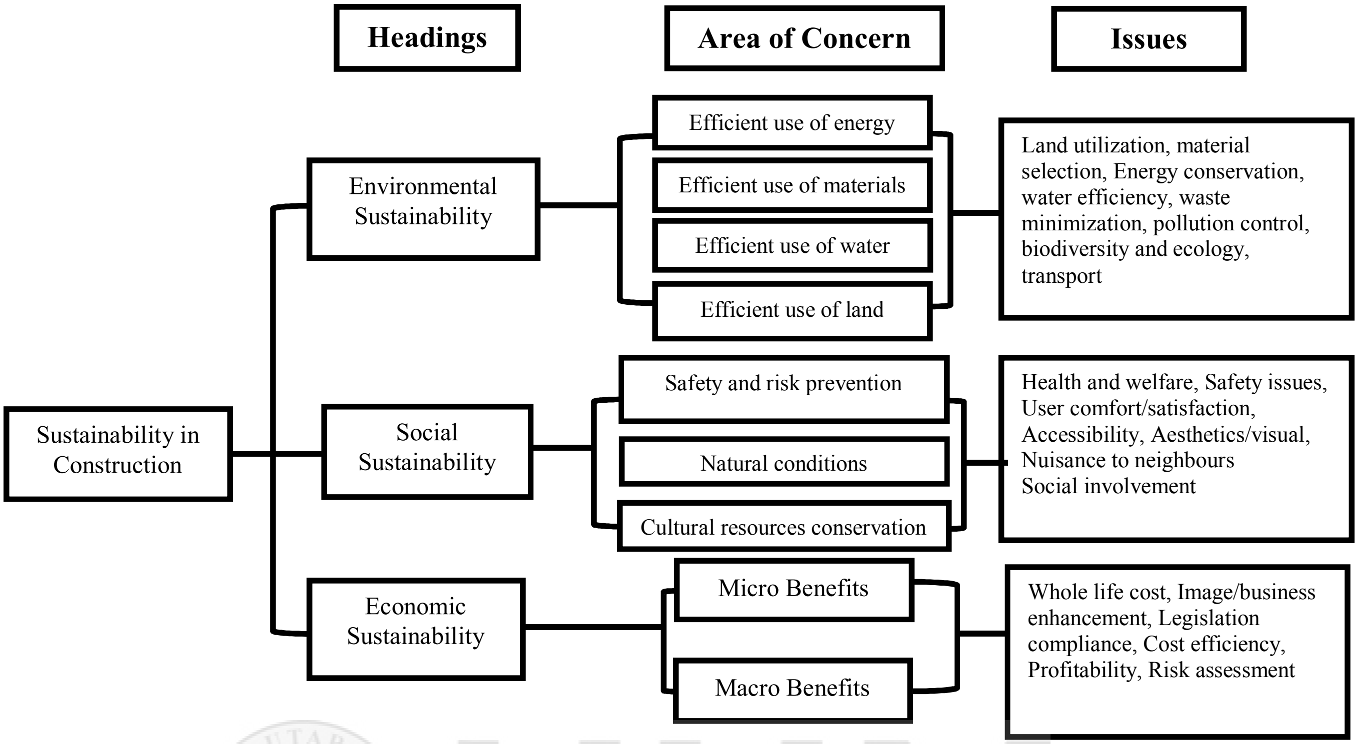


Figure 2.2
Sustainability Issues in Construction Projects (Adapted from Abidin, 2009; Sev, 2009)

2.3.2.1 Environmental Dimension of Sustainable Construction

Rapid urbanization in developing nations leading to building and infrastructural development is one very important consumer of energy. As a result, the environment is continually being stretched beyond its limits, and nations face the dilemma of delivering housing and infrastructure that could meet the population's social needs in an ecologically responsible manner (Chang, Ries & Wang, 2010; Gan, Zuo, Ye, Skitmore, & Xiong, 2015). Environmental activists have stressed this form of ideal society, where individuals live peacefully without necessarily depleting natural resources or degrading the natural environment, such that they leave man-made and environmental assets behind them in almost equal amount as they inherited from earlier generations (Preece, Pheng, Padfield & Papargyropoulou, 2011). However, the real world is far from this idea, as construction development is arguably not only one of the resource-intensive industries, but also tends to destroy the ability to sustain it. The aim of addressing environmental sustainability, therefore, is to reduce impacts and make the construction activities more sustainable (Zuo, Zillante, Wilson, Davidson & Pullen, 2012; Abidin, 2009). This is important because construction has damaging effects, such as various forms of environmental pollution, resource depletion and biodiversity loss on a global scale (Ofori *et. al.,* 2000). There are eighth identified issues under environmental sustainability (as shown in Figure 2.1) and this requires construction industry's impacts on the immediate environment to be analysed from the "cradle to grave" viewpoint (Ofori *et al.* 2000), such that the construction industry could create a healthy and non-toxic environment by consuming less renewable and non-renewable materials. According to World Watch Institute (2003), building and construction activities worldwide are responsible for 3 billion tons of raw materials each year. This reduction in resource consumption through effective environmental planning, management and control are capable of identifying the environmental risk and prevent water, ground and air pollution (Nahmens & Ikuma, 2011; Addis & Talbot, 2001). In the long run, a design that is environmental-friendly is capable of realizing the goals of sustainable construction, as it encourages a healthy and safe interior atmosphere, energy efficiency, the use of ecological benign materials, as well as eco-conscientious communities (Darwish, 2014).

In a related study, Addis and Talbot (2001) found that environmental sustainable construction also include natural resource extraction, which contractors and builders have little or no influence upon, but which they can discourage by demanding less finite natural resources, more recycled materials, and waste generated in other manufacturing processes, thus resulting in increased competition to produce more eco-efficient products (Ofori *et. al.*, 2000; Darwish, 2014). Shifting and adapting to reuse in construction is a movement that has gained more recognition from many researchers (Gallant & Blickle, 2005; Kohler & Hassler, 2002; Bon & Hutchinson, 2000) as this supports the key drivers of sustainable construction in terms of reducing resource consumption and energy use in transporting materials, thereby reducing pollution and conserving bio-diversity.

The objective of environmental sustainability consideration in construction is resource management or effective protection of the environment. A review of literature (Clough *et al.,* 2000; Kennedy, 2001; Liu, Low & He, 2012; Shi, Zuo & Zillante, 2012; Kibert, 2007; Sev, 2009; Marcouiller & Tremble, 2009; Tseng, Chiu, Tan & Siriban-Manalang, 2013; Walker 2007) reveals that all construction activities consume large amounts of certain constituents of the earth's non-renewable resources. The usage of these generic resources (energy, water, land and materials) results in changes to the ecological structure of the biosphere (Hudson, 2005). Thus, in order to continually maintain the construction products and the built environment, the construction industry requires inputs from the earth's resources. According to Sev, (2009), these inputs are the materials for construction, including the embodied energy of materials used. The construction firms responsible to the built environment should therefore consider resource management as a vital management tool to attain reduction, reuse and recycling of the non-renewable resources, because these resources play a vital role in construction activities. The resource management method is represented in Figure 2.3.

The principles of resource management as represented in Figure 2.3 explains the efficient use of the four generic resources. And according to Edwards and Hyett, (2001), the construction industry alone consumes about 50 per cent of the entire global resources. The energy requirement for the built environment also includes the embodied energy for material transportation, onsite assembly of construction components and building indoor environment maintenance. The consequences of this resource consumption requires the design team, in collaboration with the contractor and occupants, to consider building construction from the resource management perspectives. Resource management, according to Sev, (2009), and as shown in figure 2.3, presents the three R's which are reduction, reuse and recycling of non-renewable resources.

This study, however considers environmental-related sustainable construction as construction companies' adoption of environmental protection principles in project execution.

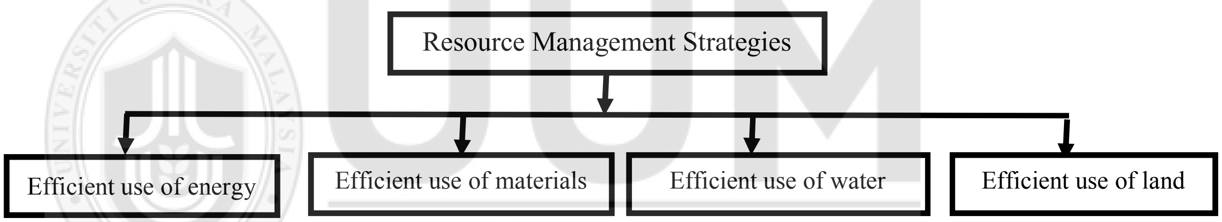


Fig.2.3
Strategies for achieving Environmental Sustainability in Construction
Source: Adapted from Sev, (2009)

2.3.2.2 Social Dimension of Construction Sustainability

Perhaps, the most challenging aspect of sustainable construction is the social justice perception in individual projects, and Hill and Bowen (1997) submitted that achieving global social sustainability is a remarkable mission. In Opoku and Fortune (2011), social sustainability in construction deals with legal, moral and ethical requirements of construction firms towards the intending users and other stakeholders. Sev, (2009) argues that as part of social obligations of the construction industry, it must balance human needs with the carrying capacity of the natural and cultural environments. An essential role of contemporary architecture is to ensure occupants' safety, health, physiological comfort, physiological satisfaction and productivity. This is in consonance with the submissions of Shen *et al.,* (2007) that social sustainability in construction seeks to improve the quality of human life, introduce skills training and capacity building for the less-priviledged, ensure fair distribution of construction social benefits, while also observing an intergenerational justice.

Social sustainability is described as construction stakeholders' engagement by ensuring that sustainability issues in construction are greatly appealing to clients, such that the whole idea is people-oriented, dealing with issues of safety, satisfaction, user comfort, aesthetics and social involvement (Lombardi, 2001; Parkin, 2000; Rodriguez-Melo & Mansouri, 2011; Valdes-Vasquez and Klotz, 2012) for the needs of the current and future generations. Social sustainability is relatively explained within construction projects based on the project's stage within its life cycle. One of such explanations, in Burdge (2004)'s view includes taking an estimation of the project's impacts on the community in terms of their living area, recreation and cultural locations. In this instance, it is expected that the Environmental Impact Analysis (EIA) is designed at the pre-construction phase of projects, which will include assessment of all indicators within the domain of sustainable construction. This customary analysis is carried out in line with the laid-down principles of sustainable construction (Nwokoro & Onukwube, 2011). Social sustainability, though elusive in part, mostly accounts for social impacts of projects on communities. This, according to Shaw, (2009), is important because construction impacts "extend beyond the financial bottom line", which in most cases are not considered under the conventional accounting practices, as it went further to address more comprehensive and accurate social costs and benefits of construction.

Furthermore, social sustainability perspective could also have a positive effect on the fabric of the society by addressing poverty and social equity among people and nations. Spence and Mulligan, (1995) had earlier popularised a notion that environmental degradation can be reduced only by improving the people's living standards, especially in the developing countries. There is a strong relationship between construction and human development in the developing world, as environmental deterioration is linked with overpopulation, leading to unsustainable consumption of fossil fuels or biomass fuels - the leading anthropogenic pollutants that contribute mainly to greenhouse gas emissions (Du Plessis, 2002). Earlier studies (Nikolopoulou, & Steemers, 2003; Abidin, 2009; Sev, 2009) acknowledged series of parameters that could necessarily enhance human adaptation to environment through design considerations. In the present study, social sustainability attributes are considered under workers and users' welfare.

Workers' considerations have to do with the safety of employees. Egan, (2002) maintained that the construction industry needs to engage in rethinking in its recruitment practices and health and safety indications by emphasising training along with consistent professional and personal development of the workforce at all levels. Construction projects should create an enabling environment for cutting-edge innovative construction, where new skills are learnt to make use of new materials and technology. This will expand workforce knowledge base and expertise. In this regard also, Egan, (2002) noted that construction firms, at every stage of project realisation must be proactive in improving health and safety records, minimize poor working conditions and the culture of long hours of working, address issues of employing casual labour and neglect, and general cases of employees' rights. This also includes ensuring that the facilities built will be safe in terms of maintenance and operations.

As regards users' welfare of construction facilities, emphasis is placed on explicit commitment on the part of the construction firms to consider how the new project affects the users and the generality of the local community (Addis & Talbot, 2001). The facilities should be made user friendly, and uphold the creation of a healthy built environment as well as ensuring users' health and comfort (Ofori *et. al.*, 2000; Sev, 2009). One sure way to guarantee health and safety of the locals in construction is to reduce pollution (air, noise and dust) levels through flexible design and choosing sustainable materials and products (WS Atkins, 2001, Sev, 2009). Flexibility of design includes prefabricated designs and standardisation, which not only allows for future changes with minimal resource consumption, but also supports necessary future technological changes (Kohn & Katz, 2002). Selecting local materials also drastically reduces the embodied energy associated with the material.

Thus, following Abidin (2009), social sustainability considerations in sustainable construction is defined in this study as the construction companies' adoption of social well-being principles in project execution.

2.3.2.3 Economic Dimension of Construction Sustainability

Economic factors in sustainable construction relate to aspects of cost and benefit in construction activities, which include the initial investment, benefit and payback time (Gan, *et al.*, 2015). These economic factors are always given much preference by construction firms and clients when new technologies are introduced into the construction industry, because, as against the conventional construction projects, sustainable construction requires additional initial investment (Hwang & Ng, 2013; Zhang, Platten, & Shen, 2011). This explains why there is always a misgiving in the understanding of sustainable construction in the sense that construction ecological impacts are often underestimated, whereas its perceived associated costs are exaggerated (Samari, 2012). The economic-related benefits of sustainable construction are long-term, and deal with the opportunity of savings and commercial advantage through good practice behaviour, as greater part of the savings from sustainable construction are through maintenance and utility costs (Kats & Capital, 2003). For example, operation cost reduction throughout the building service life, environmental performance improvement, construction firm's image enhancement, more employment opportunities, and a prolonged payback time for owners are few economic benefits which are often underestimated (Yung & Chan, 2012).

Furthermore, several other studies (Schaltegger & Synnestvedt, 2002; Wagner & Schaltegger, 2003) have established a relationship between sustainability delivery and companies' financial gains. As against the traditional neoclassical view, there are several economic benefits that are accruable to construction companies engaging in sustainability practices (Tan, *et al*., 2011). The revisionists argue that improved sustainable construction delivery will secure a competitive advantage for the construction company, leading to more efficient construction processes, improved productivity, reduced compliance costs, and new market opportunities (Tan, *et al*., 2011).

Major obstacles facing sustainable construction delivery stem from the confusion that there are higher capital costs and low market value (Bon & Hutchinson, 2000; Hydes & Creech, 2000; Zhou & Lowe, 2003). However, most clients and end users always demand for high quality buildings with lowest capital cost and shorter lead-time (Parkin, 2000), despite the fact that construction projects, particularly, sustainable construction, involves huge financial investment and other resources. Thus, in order to strike a balance in commercial advantage between the users and the constructing firms, there is a need for the construction organizations to consider both the micro and macroeconomic benefits of construction projects.

Macro-economic perspective of sustainable construction emphasises issues of price indexes, rate of growth of the construction market and construction contributions to national income and employment. Micro-economic considerations relate to the relationship and interaction between the construction companies and the users, which could generate profits for the construction company. Some of these considerations, according to Abidin, (2009), include the adoption of a suitable management procedure and the use of effective techniques like project's life cycle costing. In other studies, quality and risk management, increasing productivity and human resource optimization are considered as part of micro-economic issues (Addis & Talbot, 2001). Projects' whole life costing, which include initial costs, operating costs, maintenance costs, management costs and the eventual disposal costs of an asset do not only contribute to sustainable construction, but also increase productivity and optimize human resources (Parkin, 2000). This contribution becomes significant through reduced material use and waste, more efficient logistics, and through establishment of a comprehensive framework for lifetime review against which sustainability can be assessed (Moorhouse consulting, 2010). Thus, applying this principle will ensure project success, improve its image and stimulate competitive advantage within the industry.

Thus, this study defines economic-related sustainable construction as construction companies' adoption of the principles of economic prosperity in project execution. In the following sections, the factors that are considered in this study to influence the adoption of sustainable construction are examined.

2.4. Factors Influencing Sustainable Construction

A good number of construction projects nowadays are still procured using traditional techniques and principles, where preference is given to temporary solutions rather than an enduring one. Thus the achievement of sustainable solution to construction activities is hindered (Demaid & Quintas, 2006).

The implication for firm innovative techniques as a driver for sustainable construction is clear. The construction industry's contribution to ecosystem degradation, climate change, and several interdependent issues call for innovative construction technologies, products, businesses, processes and marketing approaches to address the underlying ecological loads of construction projects (Seebode, Jeanrenaud, & Bessant, 2012; Rohracher, 2001). Many empirical studies that examined the factors influencing the achievement of sustainable construction affirm the importance of innovative construction as a unique way of achieving sustainable construction (Chan & Liu, 2012; Bossnik, 2004; Gauthier & Wooldridge, 2012; Boxenbaum *et al*., 2010). In this study, however, organizational innovativeness and culture are examined as factors influencing sustainable construction.

2.4.1. Organizational Innovativeness

Organizational innovativeness is the first exogenous latent variable (the independent variable) examined in this study as an antecedent to sustainable construction, which is the endogenous latent variable (the dependent variable), i.e., the constructs that are being explained in the model (Hair, Hult, Ringle & Sarstedt, 2013).

However, it is important to note that innovation is oftentimes confused with innovativeness among academics, even though there is a general agreement in the literature that they do not mean the same thing (Kamaruddeen, Yusof & Said, 2010;

Walsh, Lynch, Harrington, & Holden, 2010). For the sake of clarification, Hult, Hurley and Knight, (2004) suggest that innovativeness is the precursor to innovation, and it is defined as the ability of a firm to innovate. In other words, while innovativeness is viewed as the organization's strategic and competitive innovation orientation, firms need innovation as a driver to gain success and competitive advantage (Menguc & Auh, 2006; Vorhies & Morgan, 2005). Thus, this study focusses on innovativeness at the organizational level.

Studies that have advanced our understanding of the term innovativeness include: Damanpour and Evan, (1992); Kocher, Kaudela-Baum and Wolf, (2011); Nihat and Torlak, (2014); Peters and Naicker, (2013); Salavou, (2005); Uzkurt, Kumar, Kimzan and Sert, (2012); Wang and Ahmed, (2004). Even though these studies addressed innovativeness in specific areas, few, like Postružnik & Moretti, (2012); Seaden, Guolla, Doutriaux and Nash, (2003); Winch, (2000) addressed organizational innovativeness in the construction industry. This explains varying definitions of the term in the literature. According to Knowles, Hansen and Dibrell, (2008), organizational innovativeness is defined as "the propensity of firms to create and/or adopt new products, processes, and business systems" (Knowles *et al*., 2008, p. 1).

Knowles *et al*. (2008)'s conceptualization of organizational innovativeness as a product, process, and business system did not capture new technology dimensions of firm innovativeness, in spite of several studies linking technology adoption with innovation (Kock, Gemünden, Salomo & Schultz, 2011). Thus, this study adopts Kamaruddeen *et al.,* (2012)'s definition of organizational innovativeness, and defines it as a construction firm's drive or capacity to adopt innovation in construction products, processes or concepts, businesses and technologies that are new to the construction company or the industry in order to attain competitive advantage, meet customers' needs and for sustainability considerations.

In the following subsections, the four dimensions of organizational innovativeness (product, process, business system, and new technology innovativeness) are explained.

2.4.1.1. Product Innovativeness

According to Damanpour, (2010), product innovativeness is a distinct phenomenon that contributes to organizational growth and competitiveness. It is becoming almost impossible for firms nowadays to ignore innovativeness in production, considering the outpouring of its importance and the rate at which companies rely on it for competitive advantage (Salavou, 2005), and also as a vital antecedent to product success (Sethi, Smith & Park, 2001; Wang & Ahmed, 2004).

In product innovativeness, perceived newness, originality, or uniqueness of products are core, and it is pursued in response to customers' demand for new products or organization executives' desire to penetrate new markets (Henard & Szymanski, 2001). According to Wang and Ahmed (2004), Hilmi, Ramaya, Mustapha and Pawanchik (2010); and Akgun, Keskin, Byrne and Aren (2007) as quoted in Kamaruddeen *et al*., (2010), product innovativeness refers to the uniqueness of new products that are being introduced to the consumers in an appropriate period. Thus, the innovativeness of a new product is important for several reasons. Aside the fact that it presents a great opportunity for firms in terms of growth and expansion into new areas, substantial product innovations are known to establish firms' competitive dominant positions, while giving newcomer firms a strong leverage within the industry (Danneels & Kleinschmidt, 1999). Earlier studies (Lynn, 1998; Lynn, Morone & Paulson, 1996) suggested that more innovative products require additional firm resources and a novel approach to be successful. In the same manner, product innovativeness implies capacity of the firm in developing new products using technology to supersede competitors in offering and other products introduced by the firm (Kock, *et al*., 2011)

Product innovativeness is also explained in terms of the degree of newness of the product when compared with the earlier products churned out by the firm (Goode, Dahl & Moreau, 2013). This newness stimulates consumer's regulatory goals in decision-making, and it is categorized as newness to the developing firm and newness to the market. In other words, new-to-world products are new to both the firm and the market and are the highest level of product innovativeness (Cucculelli & Ermini, 2012; Kim & Min, 2012). Thus, innovative construction products should satisfy customer choices, be flexible in construction type, which should be adaptable to users' changing needs, and should consume lesser materials and energy during material transportation and actual on-site construction (Dammann & Elle, 2006), including functionality of construction components.

Following Kamaruddeen *et al*., (2010), this study defines product innovativeness as Malaysian contractors' willingness to introduce innovative construction products or materials to the market, or adopt same within a reasonable timely fashion.

2.4.1.2. Process Innovativeness

Process innovativeness refers to innovation in the production mode. Whilst new products development are often regarded as innovation cutting edge within the marketplace, process innovativeness also plays a very important and strategic role by its ability to make products (technological or management related) no one else can, or fashion it in such a way that it is seen better than anyone else. According to Singh, (2012), process innovativeness portends a powerful source of advantage for firms, as it is characterized by innovations leading to the sequence of operations to achieve an outcome or end-product, even though, there is no requirement for the process innovation to affect the nature of the end product. Process innovativeness, being an "*optimization and getting the bugs out of the system*", empowers firms by reducing operational costs, and its adoption is assumed to be determined by certain environmental and organizational factors (Damanpour, 2010).

Thus, process innovativeness is important within construction, being an industry with certain peculiarities. Construction, according to Sexton and Barrett (2003), is an industry driven by single and unique projects. Thus, it is expected that the construction firms consider the uniqueness of each project and deploys methods within the context of client's requirement and demands. Therefore, each construction project requires a better understanding of the different forms of process innovativeness attributes existing within its context (Thomson, 2006).

In conclusion, Gann (2003) suggests that process innovativeness in the construction industry involves the concept of lean thinking and agile production within business process design. These concepts will allow firms to meet the market objectives in different perspectives, and will also require them to better understand customers' needs, minimize waste, and reduce defects during the production process. In this study, however, process innovativeness is the ability and willingness of the Malaysian contractors to implement innovative construction process in order to gain more competitive advantage within the industry.

2.4.1.3. Business Innovativeness

Business innovation, according to Lorente, *et al*., (1999), focuses on innovation in management thinking and primarily aims at value and wealth creation for all stakeholders, with a view to improving economic prosperity. Factors such as environmental changes, customers, competitors, suppliers and employees further stimulate business innovation. This view was supported by Grossi (1990), who argues that business innovativeness implies firms' adaptive capability to environmental changes is important to gain competitive advantage. More importantly, firms' good strategies alone are not enough for them to cope in the present dynamic business environment. It is expected that firms will be able to evolve and synchronize with the environment by applying business innovativeness ability (Hilmi & Ramayah, 2008). Therefore, without a strong business direction, innovators will fail to either deliver - or to capture - value from their innovations. Thus, Teece (2010) concluded that firms are expected to excel in business model design options, customer needs and technological trajectories in order to achieve outstanding business innovativeness.

In line with the definitions of Kamaruddeen *et al*., (2010), business innovativeness in this study is defined as the Malaysian contractor's ability to actively seek and implement innovative business systems that are important to their success.

2.4.1.4. New Technology

Following Kamaruddeen *et al*., (2012), new technology innovativeness in this study is defined as firm's tendency to adopt and also apply a technology which is new to such firm. And it is one of the various approaches used by renowned innovation scholars (Robertson & Wind, 1983; Van de Ven, 1986; Damanpour & Evan, 1992; Subramanian & Nilakanta, 1996; Dooley & O'Sullivan, 2000; Kocher *et al*., 2011) for measuring organizational innovativeness. According to Salavou, (2010), to create more unique and innovative products for the market, firm's orientations should be tailored to current technology adoption, which constitutes a key organizational capability. The main threat of many firms in the past was the inability to master new technology. However, nowadays, large firms are engaging in R&D which enables them to monitor, and absorb new technology (Wu, 2012).

The challenge thus lies in dealing with the implications of the newly introduced technology within the organizations, the effects of which may lead to a fundamental change in various sectors of the firm. So, it is not enough for firms to substitute an existing application with a new technology, as this may unlikely solve an impending problem. Consumer's preference for alternative technology may stem from reduced costs, better performance, dependability, or just fashion. In the section that follows, organizational culture is introduced as the second factor influencing sustainable construction aside organizational innovativeness.

2.4.2 Organizational Culture

Organizational culture is examined as another exogenous latent variable in this study, as it, alongside organizational innovativeness, explains the endogenous latent variable - sustainable construction among Malaysian contractors (see Figure 2.2). This construct (organizational culture) is measured using two dimensions. The first dimension is adhocracy culture, while the second dimension is market orientation. These dimensions are explained in the subsequent sections.

According to Ankrah and Proverbs, (2008), there are various schools of thought as regards what constitutes an organizational culture, and these differing views are reflected in most studies in the field of organizational culture. Seel, (2000), for example, considered giving a precise definition to culture as an awkward move as it is capable of reducing it to a "thing" which "belongs" to an organization. Yet, others (like Ochieng, 2012) contend that culture is a variable that an organization has. Hofstede (2001)'s multi-disciplinary definition captures culture as “transmitted and created content and patterns of values, ideas, and other symbolic meaningful systems as factors in the shaping of human behaviour and the artefacts produced through behaviour”. Thus, it is evident from organizational culture extant literature that most researchers perceive culture as something that the organization has (Bååthe & Erik Norbäck, 2013; Deal & Kennedy, 1982; Peters & Waterman, 1982) and there is a wide support for this view within the field of social anthropology (Edwards, Davey & Armstrong, 2013).

Schein (2004) refers to organizational culture as “a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems” (Schein, 2004, p. 17). In Daft’s (2005) view, it is a set of fundamental assumptions, perceptions, norms and values shared by all members of an organization and subsequently instilled in new members as the correct rule. Culture emerges in organizations when there is a need to proffer solutions to problems. Schein (2004) argues that successful problem solving procedures mostly become the dominant culture in addressing similar issues in the future. In a similar fashion, Omotola and Oladipupo (2011), while highlighting the importance of diagnosing culture within an organization, emphasized that organizational success is always tied to the choice of a suitable culture. And in the twenty-first century, organizations that are opposed to cultural changes are viewed as recalcitrant and stagnant, even though most organizations are still unaware of their cultural alienation until they encounter challenges.

Moreover, organizational culture is a major success factor of organizational transformation process, as they have a significant influence on organizational structures and processes leading to better firm performance (Yıldırım & Birinci, 2013). This is supported by researchers in the field of organization, most of whom attest to organizational culture as an area that has provided guidance for managers in preferring alternatives to improved and long-term organizational effectiveness. Thus, new employees within the organization have to be taught the culture as a way of solving organizational problems, and it essentially becomes an established norm of the organization.

However, considering the nature of construction industry where various experts and firms jointly execute projects, synchronization of cultures is essential while working together. Construction industry overall culture, according to Ankrah & Manu, (2012), is influenced by certain underlying factors like national culture, procurement culture, professional cultures, knowledge transfer and so forth. Gajendran, Brewer, Dainty and Runeson, 2012) also identified organizational, operational, professional and individualistic sub-cultures as main elements that are jointly responsible for the evolvement of culture within construction firms. Thus, it is important to identify the dominant orientation within a firm for cultural strength, type and congruence (Cameron & Quinn, 2011). Thus, Competing Values Framework (CVF) was considered to explore the desirable organizational culture among Malaysian construction companies, due to the fact that the instrument's reliability has been verified within the construction industry, as well as in so many other sectors of the economy (Cameron & Quinn, 2005). Additionally, it is the most commonly used instrument within the CIB Working Commission W112 "Culture in Construction" (Giritli, Öney - Yazici, Topcu – Oraz & Acar, 2013). Again, it incorporates several other organizational culture dimensions (like: Deal & Kennedy, 1982: Nadler & Tushman, 1980; Cameron & Ettington, 1988; and Quinn, 1988).

Competing Values Framework (CVF) provides a set of guidelines that helps leaders to accurately diagnose and manage organizational core, the basis of which is built on two distinct dimensions. While one dimension of the framework draws on values that emphasize flexibility, discretion, and dynamism, the other differentiates effectiveness criteria that stress internal orientation, integration, and unity from criteria that emphasize an external orientation, differentiation, and competition (Cameron & Quinn, 2011). The dimensions in this framework that specifically produce competing quadrants diagonally (shown in Figure 2.4) as presented by Cameron and Quinn, (2006) classify organizational culture into four basic types, which include: clan, adhocracy, hierarchical and market culture.

Most studies in organizational culture in Asia describe the dominant culture in association with the competing values framework. The dominant cultural styles are categorized under Rabbit, Monkey, Elephant, and Tiger. While Rabbit is related to adhocracy, monkey, elephant, and tiger are related to clan, hierarchy and market respectively (Wang & Abdul-Rahman, 2010). Therefore, considering the wide acceptance and adaptability of this framework, and in view of the fact that it has integrated most organizational culture dimensions in its domain, this study adopts its dimensions. The framework was empirically derived from studies in various fields of research, and it has been found to be reliable and valid by various authors (Banaszak-Holl, Castle, Lin & Spreitzer, 2013; Duygulu & Ozeren, 2009; Etherton-Beer, Venturato & Horner 2013; Kirkley et al., 2011; Dulaimi, Oney-Yazici, Giritli, Topcu-Oraz, & Acar, 2007; Duygulu & Ozeren, 2009). Again, these dimensions have been used on several occasions in studies on organizational cultures of construction industry organizations (for example: Rameezdeen & Gunarathna, 2012), and have provided numerous useful precedents. However, it should be stressed that none of these culture dimensions is superior to the other. Individually, they possess distinct qualities that are suitable for a particular firm in certain circumstances (Šandrk Nukić, & Matotek, 2014).

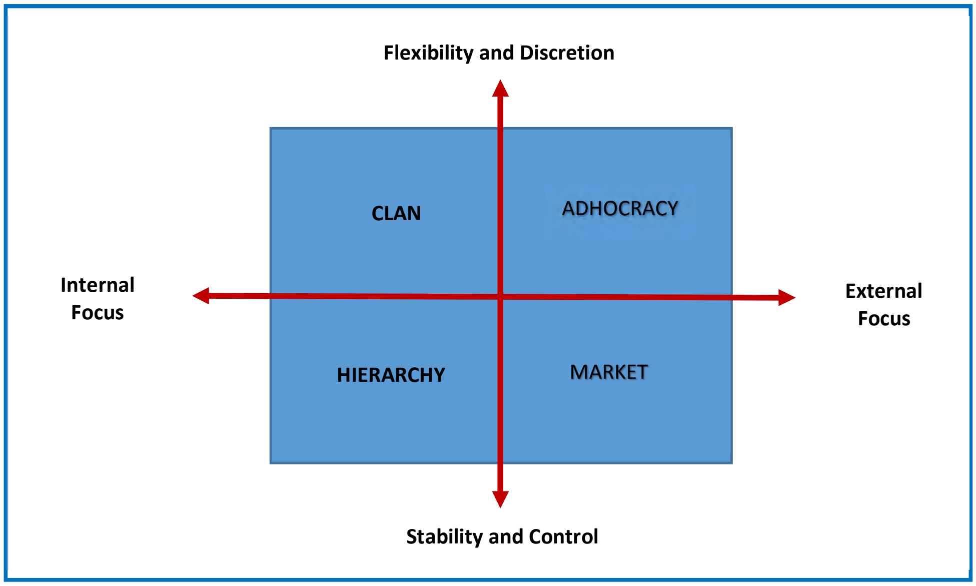


Figure 2.4
Competing Value Framework (Cameron & Quinn, 1999)

Similarly, the model is adjudged relevant within the Malaysian context, as it has been utilised across a significant field of studies to diagnose organizational culture across an array of Malaysian industries (Kamaruddeen *et al*., 2012; Suppiah & Sandhu, 2011; Wang & Abdul Rahman, 2010; Sambasivan & Ching, 2010), Thus, this study adopts the dimensions in this model (adhocracy and market orientation) as the most appropriate model to determine the extent of sustainable construction of Malaysian contractors. Moreover, these dimensions are quite related to innovativeness, which has been found to stimulate sustainable construction (Gauthier & Wooldridge, 2012; Bos-Brouwers, 2010; Seebode *et al*., 2012). The next subsection reviews the organizational culture dimensions that are considered in this study.

2.4.2.1 Adhocracy Culture

Adhocracy culture is one of the two dimensions of organizational cultures adopted in this study. The second being market orientation. And in line with the submissions of

Cameron and Quinn, (2006) it is defined in this study as an entrepreneurial and dynamic firm that is usually innovative and emphasizes acquisition of new resources.

Adhocracy type of culture emerged in response to “the hyper-turbulent, ever-accelerating conditions that increasingly typify the organizational world of the twenty-first century” (Cameron & Quinn, 2011, p.43). Its emergence was based on the assumption that organizational innovativeness and adaptation leads to new resources and economic prosperity. A major preoccupation of adhocracy organization is fostering adaptability, creativity and flexibility in addition to producing innovative products and services.

Unlike hierarchy organizations where power is mostly centralised, adhocracy emphasizes individualism and a focus on external constituencies where all employees partake in the production processes. A firm embedded in adhocracy culture is not only dynamic, but also entrepreneurial, where employees are trained as risk takers. This, according to Rameezdeen and Gunarathna, (2012), entrenches employees’ commitment to innovation and development. Cameron and Quinn (2011) emphasized that adhocracies are organizations that can quickly reconfigure themselves to adapt to new circumstances. Thus, such organizations are regarded as adhocracies where employees exhibit a strong level of "boundary spanning" (Hult, Ketchen & Nichols, 2002).

2.4.2.2 Market Orientation

Market orientation is considered as the second dimension to measure organizational culture in this study. And in line with Rameezdeen and Gunarathna’s (2012) study on organizational culture in construction industry, this study considers market orientation to influence Malaysian contractors’ adoption of sustainable construction, based on its emphasis on rational production and employees committed to long-term competitive actions and achievement of measurable goals.

Market orientation has been described in previous studies as a set of behaviours and processes, or an aspect of culture (Chou & Yang, 2011; Kohli & Jaworski, 1990; Narver & Slater, 1990). Thus, Hajipour and Ghanavati, (2011) submitted that it is a firm's marketing concept involving the organizational behaviour and culture by placing customer satisfaction at the core of business operations. It is argued that market orientation implies implementing marketing procedures that prioritises customer satisfaction more than competitor's ability to do same, because they believe that customer satisfaction is the most effective way to achieve firms' objectives.

Previous studies have suggested that market-oriented organizations are known for creating a corporate culture, which is the basis for developing a competitive advantage within the marketplace (Narver & Slater, 1990) and it is also an essential determinant of organizational performance (Hooley *et al.*, 2000; Aldas-Manzano, Küster, & Vila, 2005). The evolution of market orientation within organization cultural theory was to represent the firm's focus on all its stakeholders, customers, suppliers, competitors and governmental institutions (Slater & Narver, 1995).

Furthermore, market orientation has been conceptualised and measured using two widely accepted perspectives, according to Farrell, Oczkowski and Kharabsheh (2008). The first conceptualisation was developed by Narver and Slater (1990, p. 21), who concluded that a market orientation "is the organization culture that most effectively and efficiently creates the necessary behaviours for the creation of superior value for buyers, and, thus, continuous superior performance for the business". While Narver and Slater (1990) argues that market orientation is a combination of three elements, which are: customer orientation, competitor orientation and inter-functional coordination, Kohli and Jaworski (1990, p. 6) proposed another perspective of market orientation as "an organization-wide generation of market intelligence pertaining to current and future customer needs, dissemination of intelligence across departments, and organization-wide responsiveness to it". These dimensions require an efficient information system about customers and competitors, because customers' satisfaction and expectations is a continuous phenomenon that evolves over time, and consistently delivering quality products and services requires continuous observation and response to the changes and needs in the marketplace (Jaworski & Kohli, 1993). In this sense, organizations with market orientation will always be proactive in innovative capabilities to gain competitive advantage. Again, market orientation promotes penetrating the market with innovative products and services over old and unsustainable practices. Thus, drawing upon resource-based view of organizations, market orientation is perceived as one of organization-level resources that is rare, valuable and inimitable because it prioritizes client-centered service delivery.

2.5. Relationship between Organizational Innovativeness and Sustainable Construction

Several studies have examined the influence of innovative capacity on sustainability adoption, from organizational standpoint to economic and social angles (Du Plessis & Cole 2011; Hill & Lorenz 2011; Huedo & Lopez-Mesa 2013; Lam, *et al*., 2011b; Lützkendorf, 2010). Chan and Liu, (2012) demonstrate how innovativeness is rapidly influencing not only organizational productivity, profitability and competitiveness, but also as a vital procedure in sustainability adoption in an organization. Bossnik (2004) has earlier found that sustainable construction could be aided with the help of innovativeness, while emphasising the roles of end users as drivers of innovations for sustainable construction. This is consistent with the work of Rohracher (2001), who argued that innovative construction technologies and products could reduce the ecological burden of construction projects, but it will require the construction firms to change their technologies and better understand the fundamentals of sustainable building construction. Other findings by researchers concerning innovative products, process and business strategies confirm that firms that incorporate sustainability in their orientation and innovation processes mostly exhibit value creation in terms of introducing new products to the market, sometimes called radical innovations (Bos-Brouwers, 2010).

Gauthier and Wooldridge, (2012) also find that construction organizations could choose from a range of innovations in addressing sustainability issues in construction, as the development of a green technology strategy involves a strong innovation focus. Their suggestion was based on the premise that innovation in building design requires significant attention, considering the fact that construction consumes over 40 per cent of the world's non-renewable resources (Hoffman & Henn, 2008), making it the world's largest consumption of energy. Thus, innovation in construction warrants a significant consideration in order to deliver sustainable building with the aim of lessening environmental impacts. This explains why sustainability issues are always linked with standards and regulations where additional force towards innovation in products, processes and technological models is emphasized (Chuang & Ma, 2013).

While considering the growing pressures and emerging opportunities in the global sustainability agenda, Seebode *et al*., (2012) developed a new outlook to innovativeness, particularly encouraging organizations to take practical steps further than the rhetoric of moving towards greater sustainability or 'greening' of business. However, the challenge of adopting sustainable construction will put pressure on the construction SMEs who are not only operating regionally, but also with low innovative capacity and high labour intensity, because in sustainable construction, fresh knowledge and learning within organization and innovation form parts of the basic requirements (Rohracher, 2001, Rydin, 2006).

2.6. Relationship between Organizational Culture and Sustainable Construction

The relationship between organizational culture and sustainability adoption has been well documented in the literature (Al-Jamea, 2014; D'Incognito, Costantino & Migliaccio, 2013; Linnenluecke & Griffiths, 2010; Sharma, 2002; Wong & Avery, 2009). Thus, Trong Tuan, (2012) observed that organizational culture is a continuous process of identity building/re-building and meaning-making within an organization, which enables its social integration as well as sustainability of its subdivisions.

Other earlier studies have also shown that organizational culture influences not only operations within a firm, but also plays an essential role in the efficiency and improved productivity of an organization (Alas, Niglas, & Kraus, 2009; Cheung, Wong, & Lam, 2012), which are important initiatives in achieving sustainability within the construction industry. The construction industry needs to develop a business culture that promotes, supports and compensates sustainability adoption, which, according to Preuss (2008), form part of a veritable explosion of concepts aiming at explaining what the proper role of firms and businesses in the environment should be, which include terms such as triple bottom line, and sustainability adoption. Thus, culture should be prioritised and placed at the centre of development strategies due to its significant roles in framing people's relationship and attitudes towards the built and the natural environment. (Al-Jamea, 2014; Opoku, Ahmed & Cruickshank, 2015).

Again, organizational leaders need to communicate the importance of sustainability, and establish a culture incorporating sustainability into the daily management decisions (Avery, 2005). Sustainability dimensions are necessary in construction organization's culture and policy formulations, because practically all construction firms contribute to environmental degradation in several ways, from the mere lighting to generation of wastes and emissions during production processes (Bansal, 2005). However, D'Incognito, Costantino and Migliaccio, (2013) observed that organizational culture is one of the significant barriers to the adoption of sustainable construction in terms of Life Cycle Costing (LCC) and Life Cycle Assessment (LCA). Although, technical and financial barriers are also relevant, organizations cannot necessarily overcome them if culture forms a hindrance to the decision-making process.

It is thus suggested that construction organizations should be sustainability conscious by adopting cultures that promote corporate environmental management, social equity through corporate social responsibility, and economic prosperity through value creation. This was also emphasized by Dyllick and Hockerts (2002), who argued that the most accepted criterion for integrating sustainability in organization's culture depends on a firm's efficient use of natural capital, which is referred to as the economic value added by a firm in relation to its aggregated ecological impact.

In the same line of reasoning, Wong, Ng and Shahidi, (2013) reported that the contractors' organizational culture is capable of stimulating reduction in resource consumption. This present study seeks to assess the relationship between organizational culture (adhocracy culture and market orientation) and sustainable construction of G7 construction companies in Malaysia. In this study, adhocracy refers to organizations that are committed to fostering adaptability, creativity and flexibility in addition to producing innovative products and services, while market orientation is a culture that creates the necessary behaviours for the creation of superior value for buyers.

Organizational culture researchers concluded that a dynamic organizational culture, which adhocracy represents, can influence the role a business entity plays in a society, in terms of corporate citizenship and sustainability (Preuss, 2008). Equally, Trong Tuan, (2012) suggests that adhocracy culture is the best option for sustainability inclined companies, and entrepreneurship as an indicator of adhocracy facilitates organization's ability to successfully exploit sustainability opportunities.

Similarly, as consumers increasingly demand sustainable products and services, market oriented organizations can easily identify the dynamics in consumers' taste and quickly adopt sustainable practices leading to the production of environmentally friendly products and services (Green, Zelbst, Meacham & Bhadauria, 2012). Market oriented organizations' adoption of sustainable products and practices is driven by client's needs and satisfaction (Rehman & Shrivastava, 2011).

2.7. Relationship between Government Support and Sustainable Construction

In practice, sustainable construction refers to those construction activities that contribute to the principles of sustainable development in such a way that the contractors not only strive to meet corporate economic needs, but are also under obligation to evaluate the impacts of the construction on the users, while not forgetting environmental consequences of their construction activities. Government support, in terms of regulations and policies are the main approach to alleviating the damaging impacts of construction activities on both the environment and society at large (Gan, et al., 2015), especially, considering the fact that government is always a major client of the construction industry. Therefore, the government could stimulate sustainable construction practices (Du Plessis, 2002; Abidin *et al*., 2013) through grants and subsidies as incentives for its adoption. Although, this may be less effective in the event of declining government income and a limited revenue base, it is still recognised globally as a way of regulating and controlling environmental degradation resulting from the activities of the construction industry (Shen & Yao, 2006). Majdalani, et al., (2006) argued that the government, in addition to its role as the industry regulator, must necessarily drive sustainable construction delivery through its enormous influence by instituting a national vision for sustainable construction.

Research has also suggested that government support is related to sustainability delivery in construction. For example, government support in terms of regulatory framework has been linked to environmental protection, a dimension of sustainable construction (Chang, et al., 2010; Li & Shui, 2015). A cross-sectional study of Hwang & Tan, (2012) revealed that through the incentive schemes provided by the Singaporean government for the construction industry, sustainable construction adoption in design, construction practices, and ecologically friendly technologies were improved. Moreover, Rodriguez-Melo & Mansouri's, (2011) study on the influences of government policy, managerial attitude and stakeholder engagement on sustainable construction also indicated that a larger percentage of construction stakeholders emphasized a large effect of government policy on sustainable construction.

According to Zhou and Lowe (2003), the British government introduced several guidance and incentives apparatuses to encourage the transition to a sustainable construction culture within its construction industry. This form of policy becomes important to accelerate research and development of new technologies required in sustainable construction, and this can be transferred to construction firms to create products that can influence the marketplace.

In Häkkinen and Belloni, (2011), it was suggested that, because sustainable construction is an active process, achieving its objectives through adequate government support is assured. Thus, there should be concerted efforts from all stakeholders involved in the construction industry to get necessary awareness and take active roles to encourage its adoption and practice. Also, findings in Wong, et al., (2013), indicate that providing necessary assistance like tax rebates or other incentive arrangements for the contractors within the construction industry promotes organizational cultural change towards sustainability adoption.

2.8. Government Support as a Moderator

According to Baron and Kenny (1986) a moderator functions as a third variable that can be either a qualitative or qualitative variable affecting either the direction and/or strength of the relationship existing between an independent (predictor) variable and a dependent (criterion) variable. In other words, the moderating variable is one that has a strong contingent effect on the independent variable-dependent variable relationship. That is, the presence of this third variable (the moderating variable) modifies the original relationship between the independent and the dependent variables" (Sekaran & Bougie, 2013).

Government support in this study refers to the assistance rendered by the authority to stimulate the spread of sustainable construction within the construction industry. It is well recognized that government and its agencies are key players in the promotion of sustainable construction. Government is a well-established factor that exerts a significant influence on sustainability standards (Manning, Boons, Von Hagen & Reinecke, 2012), environmental protection regulations (Kumar, 2013), and social wellbeing of occupants and construction workers (Azar & Menassa, 2012; Hua, Göçer & Göçer, 2014; Nguyen & Aiello, 2013; Spiegel & Meadows, 2010).

For example, research has suggested that governments and construction stakeholders are getting committed to sustainability criteria as a requirement that is important to the society in project management (Rodríguez López & Fernández Sánchez, 2011). It has also been noted that the responsibility of construction sustainability belonged to the government, its agencies, and the construction companies (Shi, Zuo, Huang, Huang & Pullen, 2013), although its implementation and eventual success is contingent on the level of the construction player's acceptability.

To justify the potential role of government support as a moderator in this study, the proposition of earlier studies (Kim, Kim, Suh & Zheng, 2016; Michael & Pierce, 2009) were considered. Policies on government subsidies have been observed to have a noticeable influence on the processes and outcomes of both new and established firms. Thus, according to Samari, (2012), government support in stimulating green construction is the most effective, as it is more result-oriented in sustainable construction delivery. Again, governments have the capacity to facilitate sustainable construction adoption through a series of tax-based incentive policies for contractors promoting sustainable construction, although there are several barriers to developing it (Li & Shui, 2015; Shafii, Arman Ali & Othman, 2006).

In this study, government support for sustainable construction is considered as the moderating variable because of its strategic implication on firms operating within the industry by providing an impetus to achieve standardised and sustainable construction projects. Properly designed regulations within the built environment improve energy performance and living standards and mitigate climate change (Li & Shui, 2015). When projects were managed by government departments and agencies, and the management technique is characterized by rigid line control of all construction processes, as was done in China post-reform era, improvement in project delivery efficiency will be recorded (Qiang, Wen, Jiang & Yuan, 2015). This view was shared by Pitt *et al*., (2009) who argued that government is capable of driving sustainable construction agenda with a number of policies, including fiscal supports, legislation and standards, and building labelling with energy efficiency rating.

There are several other studies that have been examined using government support as either independent or dependent variables with varying results. One of such studies is Dominik (2014), which examined the appropriate indicators for capturing different aspects of eco-innovation, using existing regulations in terms of subsidies and other financial incentives as one of the factors to achieve eco-innovation. The sampling frame was drawn from Innovation Survey for the analysis, where the dataset consist of different 14 variables on environmental benefits and motivations. The findings indicated that variables related to existing environmental regulations and subsidies or other financial incentives for eco-innovation loaded up strongly, indicating that there is a strong motivation in relation to government policy measures towards achieving environmental innovation.

Ribeiro-Soriano and Galindo-Martín (2012) undertook an empirical study in 11 developed nations by examining the influence of government support on entrepreneurship development. The study not only developed a theoretical analysis of the relationship between government support and entrepreneurship, but also concluded that government support has an indirect positive relationship with economic growth, as it encourages entrepreneurial activities. However, Lin (2007) conducted a study on factors affecting logistics innovation among logistics service providers in China. Government support was used as one of the independent variables in the relationship between organizational encouragement, quality of human resources, environmental uncertainty, governmental support, and innovation in logistics technologies. Governmental support was found to have a significant positive influence on innovation in logistics technologies.

Additionally, Lai, Ngai and Cheng (2005) submitted in their findings that government, through regulation, can both encourage and discourage the adoption of information technology innovation. Their study used empirically based data collected through questionnaires distributed to 1,500 logistics service providers in Hong Kong on the extent of IT adoption in their operations, including the benefits and barriers in the adoption. Their findings reported a strong relationship between government support and information technology innovation adoption. Scopula (2003) argues that government support is one of the important drivers influencing the adoption of internet commerce by South Italian SMEs while investigating the environmental, organizational and technological drivers of e-commerce adoption and implementation in SMEs in Italy. This corroborates the work of Lacovou, Benbasat and Dexter (1995) on the success of Electronic Data Exchange (EDI) adoption by small organizations. The study identified 3 major factors influencing the adoption practice of EDI among small firms as organizational readiness, external pressure which include government support, and perceived benefit. Structured interviews involving managers of the selected 7 firms were conducted, where two firms in the group were observed to depend on government support to increase their level of readiness.

Peters and Naicker (2013) investigated the effects of government support on the growth of small medium micro enterprise businesses in South Africa, using empirical data collected from 282 South African SMMEs. The authors performed Pearson's Chi-square (x^2) test to evaluate relationships between the variables, and it was discovered that government support initiatives which include providing training, credit facilities, mentoring and necessary information to SMMEs has a significant correlation with the growth of SMME sector.

2.9. Conceptual Framework

Considering prior empirical evidences and theoretical gaps that have been identified in the previous sections, a conceptual framework for this study was developed, which illustrates the role of government support moderator variable on (1) organizational innovativeness – sustainable construction relationship and (2) organizational culture – sustainable construction relationship. These, including the dimensions of each of the latent variables, are depicted in Figure 2.5.

The independent variables are organizational innovativeness and organizational culture, with four and two dimensions respectively. In addition, this study suggests government support as a potential moderator variable on the relationship between organizational innovativeness, organizational culture and sustainable construction.

Furthermore, this study acknowledges the presence of government support that are beyond the control of construction firms, but which they can strategically react to. In this sense, properly designed government regulations are believed to have a strategic influence on the construction firms by providing opportunities to achieve the goals of sustainable construction (Lam *et al*., 2011a; Pietrosemoli & Monroy, 2013). Therefore, a conceptual model for assessing the sustainable construction of Malaysian contractors was developed by testing the hypotheses in this study. This conceptual framework, as represented in Figure 2.5, presents the relationships among the variables examined in this study. The relationship is between organizational innovativeness, organizational culture, government support, and sustainable construction.

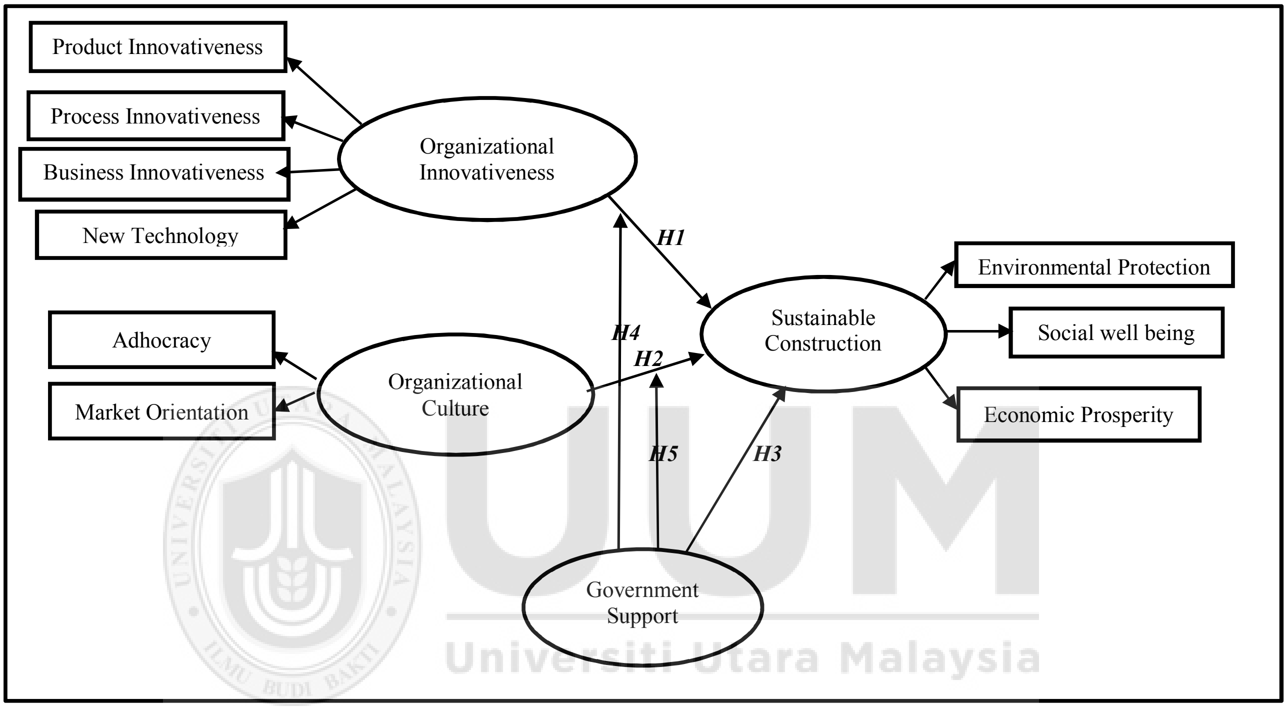


Figure 2.5
Conceptual Framework

2.10. Underpinning Theory

The moderating role of government support on organizational innovativeness – sustainable construction relationship, as well as organizational culture – sustainable construction relationship can be explained from various perspectives. Therefore, the underpinning theories used to explain this study's research framework include: organizational readiness for change theory and the resource-based view theory.

First and foremost, the central theme that is evolving in the strategic management resource-based literature rests on the premise that organizational resources (explained in terms of organizational culture) is one of the basic sources of sustainable competitive advantage (Conner & Prahalad, 1996). The Resource Based View (RBV) theory emphasizes the organization's usage of its internal resources to formulate strategies that could assist her in achieving a sustainable competitive advantage within the marketplace. Secondly, sustainable construction is perceived as a change initiative involving all actors within the construction organization at every level of the project execution, to be willing to change their behaviour in order to explore new concepts, practices, products and ideas (Papargyropoulou, Padfield, Harrison & Preece, 2012). Hence, the main underpinning theories used to explain the relationship between this study's variables are: organizational readiness for change and resource-based view theory.

2.10.1 Organizational Readiness for Change

The study of change and development has been a well-documented theme in social research and construction management (Khosrowshahi & Arayici, 2012; Pettigrew, Woodman & Cameron, 2001). According to Weiner, (2009), organizational readiness for change is a multifaceted construct which is composed of two dimensions: change commitment and change efficacy. The change commitment is a reflection of organizational employees' shared determination to implement the proposed change. Change efficacy, on the other hand, explains employees' shared belief in their collective capacity to implement a proposed change (Weiner, Lewis & Linnan, 2009). This is in line with organizational innovation extant literature, where organizational readiness is described as the firm's preparedness level for the adoption and implementation of innovation (Martin, Beimborn, Parikh & Weitzel, 2008).

Although organizational readiness for change has been conceptualized as a multi-level construct (Shea, Jacobs, Esserman, Bruce & Weiner, 2014), the focus here is on one set of the behaviours that is organization-specific. Considering the fact that innovation can either cause certain social changes, or it may be developed in response to those needs that were created by some social changes, firms need a better understanding of organizational readiness for change to implement or generate innovations (Panuwatwanich & Stewart, 2012). Again, sustainable construction is perceived as a change initiative involving all actors within the construction organization at every level of the project to be willing to change their behaviour in order to explore new concepts, practices, products and ideas (Papargyropoulou, *et al*., 2012).

This requirement goes further to include construction companies' willingness and ability to explore new territories in construction approaches and the preparedness to implement innovative products, new concepts and practices. Again, the fragmented and disparate nature of the industry makes it even less likely that sustainable construction will become a popular norm in the absence of determination and readiness to change (Cohen-Rosenthal, 2000). The outcomes of change readiness at individual, work group or at organizational members' levels of analysis is important. Change-supportive behaviours (Kim, Hornung, & Rousseau, 2011), which explains the actions employees engage in to actively participate in, facilitate, and contribute to a planned change, is one set of key outcomes that is likely to result from individual change readiness. This change-supportive behaviour explains compliance to sustainable construction ideals as opposed to the usual unsustainable practices that the construction firms within the industry are noted for.

Organizational readiness for change, in Weiner, (2009)'s view, is a function of the level at which organizational members appreciate the change and how they favourably evaluate the three key determinants of implementation capability, which are: task demands, resource availability, and situational factors. When organizational readiness for change is high, organization members are more likely to commence change, apply greater effort and persistence, and display more willing behaviour towards the change. Thus, more effective implementation is achieved.

Change management experts (Hardison, 1998; Armenakis *et al.,* 2002; Levesque, Prochaska, Prochaska, Dewart, Hamby & Weeks, 2001) suggested that in order to avoid failed outcomes, there is a need for organizations to create readiness within its ranks and file. Failure to adequately establish readiness accounts for one-half of all unsuccessful, large-scale organizational change efforts (Kotter, 1996). Thus, creating readiness requires "unfreezing" existing mindsets and replacing it with motivation for change. Again, studies have suggested that by highlighting the difference between current and desired performance levels, fomenting dissatisfaction with the status quo, creating an appealing vision of a future state of affairs, and fostering confidence that this future state can be achieved (Weiner, 2009).

Again, of importance is the notion of collective efficacy of organizational readiness for change. In this sense, the perceived collective efficacy promotes organizational commitment to its goals, resilience in the face of adversity, and performance accomplishments. And since sustainable construction is a path that is capable of making a significant contribution to the accomplishment of sustainable development goals, it can be concluded that as the perceived collective efficacy improves, the group's motivational investment also increases. And irrespective of occupational obstacles, their staying power becomes stronger, and the more remarkable their performance accomplishments (Bandura, 2000).

While studies in this direction adopts either stakeholder engagement theory or environmental modernisation theory to underpin the variables examined in those studies for instance, Kondoh, (2009), successful implementation of sustainable construction by construction stakeholders is a function of the firm's readiness for the sustainability initiative. The readiness of the construction organization members to implement sustainable construction in project execution is fundamental to the achievement of project sustainability. Therefore, underpinned by the organizational readiness for change theory, this study's conceptual framework of organizational innovativeness (consisting of product innovativeness, process innovativeness, business system innovativeness, and new technology innovativeness); organizational culture (consisting of adhocracy culture and market orientation) is set to predict Malaysian contractors' sustainable construction through the moderating influence of government support.

2.10.2 The Resource-based View Theory

Sustainable construction requires certain interrelated resources like materials and humans to apply advanced technologies (Hill & Bowen, 1997). Thus, there may be some hindrances in adopting needed and related technologies and techniques in achieving it when there is a dearth of, or inadequacy of these resources (Gan, *et al*., 2015; Zhang, *et al*., 2011; Zhang, Wu, & Shen, 2012) which may prevent construction companies from gaining business opportunities and competitive advantage.

The resource-based view has gained extensive usage in researches relating to organization's competitive advantage, and specifically within Information System (IS) organizations. However, according to the theory, organizations are made up of certain specific resources, upon which their performance, and the ability of organization's management in combining the resources, depend. These resources and their distinctive capabilities will enable them to gain competitive advantage and exploit market opportunities, which contribute to their performance (Penrose, 1959). Thus, the resource-based view theory argues that the resources possessed by firms are necessary for gaining competitive advantage, considering the fact that these resources are the most important unit of analysis in any organizational management (Barney 1991; Grant 1991).

Therefore, rather than placing emphasis on the conventional production factors (i.e., land, labour and capital resources), the resource-based view theory underscores the firm's core capabilities that has been identified as higher-order resources (Green, Toms & Clark, 2015). These resources, according to Prahalad and Hamel, (1990), are categorized as economic, physical, human, legal, informational, organizational, and relational, and they are both imperfectly mobile and heterogeneous in nature. Individual organizations are thus endowed with these unique competencies in terms of resources that are difficult to imitate by their competitors, because they (the resources) enable construction organizations to deliver valuable, effective and efficient construction products to consumers/clients in one or more market sections (Barney, 1991).

The resource-based view theory is relevant to this study due to its relationship, not only with the specific resources needed to deliver sustainable construction, but also with organizational culture, which has been presented in several studies as a strategic resource owing to its value, rareness, and imperfect imitability (Barney, 1986; 1991; Barney & Wright, 1997; Genç, 2013). Barney, (2015) refers to resources as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc., controlled by a firm that enable the firm to conceive of, and implement strategies that improve its efficiency and effectiveness" (p. 284). Particularly, Barney (1991), argues that there are three basic types of organizational resources that can aid firms in gaining competitive advantage. These resources include physical, organizational, and human resources. Firms' physical resources, according to resource-based view theory, are regarded as organizational plants, equipment, and finances. Firm's capital resources are composed of things like organizational structure, planning, human resource systems and so forth, while employees' skills, organizational relationships, judgement, history, intelligence and organizational culture, among others make up human capital resources (Barney & Wright, 1997).

Again, it should also be noted that organization's internal capabilities is one of the key determinants of the strategic choice it will make in sustaining competition in its external environment. In some cases, organizational resources may actually allow it to create new markets and value for the customers. Notably, materials and human resources are quite important for construction companies, because, the activities within the construction industry are based on such resources like assets, human capabilities, and competencies. Thus, for the construction companies to favourably compete in the delivery of sustainable construction products within the industry, they may need to develop capabilities to deliver unique processes leading to the delivering of sustainable construction products, as this portends a powerful source of advantage for firms (Opoku & Ahmed, 2015). In this way, construction organizations with robust cultures are oftentimes regarded as a typical example of excellent management (Mbeba, 2014), and managerial cultures which are occupationally-based are required for sustainable construction delivery. Resource-based view is also relevant to this study because sustainable construction delivery requires such resources like fresh knowledge, information and learning within organizations (Rohracher, 2001, Rydin, 2006). These internal capabilities determine firms' choice of strategic orientation while competing in its external environment or within the industry. And in some cases, organizational resources could afford construction companies more opportunities to create added value and new markets for their customers.

Following Barney (1991), this study focuses on those firms' resources that are heterogeneous and immobile as potential sources of competitive advantage, and these resources are considered strategic, intangible resources (Molloy, Chadwick, Ployhart & Golden, 2011). Thus, the organizational resources that are considered to influence sustainable construction adoption of Malaysian contractors are the intangible resources of the firm.

The Resource-Based View (RBV) theory and other previous empirical findings provide plausible justifications for these new findings. And, since this study explores the strategic and intangible organizational resources that could determine construction companies' adoption of sustainable construction, the Resource-Based View (RBV) theory is applied to investigate construction firms' key resources that could influence sustainable construction adoption (Chen, Ong & Hsu, 2016). Many empirical studies have proven that organizations' intangible resources and capabilities (e.g. knowledge, organizational culture, skills and experience) are not only unique to the organizations, but also valuable to them due to the fact that they were developed over time, and always result in inimitability, which represents competitive advantage for firms (Kumlu, 2014).

2.11. Hypotheses Development

Hypotheses for this study was formulated for empirical testing and validation using theoretical justification from the extant literature. There are four constructs in this study, which include: organizational innovativeness and organizational culture as the independent variables, government support as the moderating variable, and sustainable construction as the dependent variable. Five main hypotheses were formulated for testing in this study as regards the relationships between the variables.

According to Sekaran and Bougie (2013), there are two types of hypotheses: the directional and non-directional. The directional hypothesis indicates the direction of the relationship between the variables, while the non-directional hypothesis suggests a relationship without indicating the direction of such relationship(s). This study adopts directional hypothesis development to test the moderating influence of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction. This study's five main hypotheses are presented below:

H_1: There is a significant positive relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.

H_2: There is a significant positive relationship between organizational culture and sustainable construction among Malaysian large construction companies.

H_3: There is a significant positive relationship between government support and sustainable construction among Malaysian large construction companies.

H_4: Government support significantly moderates the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.

H_5: Government support significantly moderates the relationship between organizational culture and sustainable construction among Malaysian large construction companies.

Table 2.2 shows the previously highlighted research questions that guided the study, the specific objectives of this study that paved way for answering the research questions proposed, and hypothesis statement developed based on the main theoretical arguments addressed.

Table 2.2
Research Objective, Research Question and Hypotheses Chart

	Research objectives	Research Questions	Hypotheses
1.	To assess the extent of sustainable construction among Malaysian large construction companies.	What is the extent of sustainable construction among Malaysian large construction companies?	
2.	To examine the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.	What is the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies?	There is a significant positive relationship between organizational innovativeness and sustainable construction Malaysian large construction companies.
3.	To examine the relationship between organizational culture and sustainable construction among Malaysian large construction companies.	What is the relationship between organizational culture and sustainable construction among Malaysian large construction companies?	There is a significant positive relationship between organizational culture and sustainable construction among Malaysian large construction companies.
4.	To examine the relationship between government support and sustainable construction among Malaysian large construction companies.	What is the relationship between government support and sustainable construction among Malaysian large construction companies?	There is a significant positive relationship between government support and sustainable construction among Malaysian large construction companies.
5.	To determine the moderating influences of government support on the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.	What is the moderating influences of government support on the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies?	Government support significantly moderates the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies.
6.	To determine the moderating influences of government support on the relationship between organizational culture and sustainable construction among Malaysian large construction companies.	What is the moderating influences of government support on the relationship between organizational culture and sustainable construction among Malaysian large construction companies?	Government support significantly moderates the relationship between organizational culture and sustainable construction among Malaysian large construction companies.

2.12. Summary

In this chapter, the concept of construction and sustainability were espoused as they relate to this study. The global perspective of the construction industry and the roles of construction in an economy were also described to establish the importance of sustainable construction. Thereafter, the Malaysian construction industry scenario was presented with respect to sustainable construction adoption and progress. The chapter then went further to explain sustainable construction as operationalized in this study, and then to the factors that influence its adoption. These factors were highlighted as organizational innovativeness and organizational culture. While each of the factors were explained as they influence sustainable construction of Malaysian contractors, the external factor (operationalized as government support for sustainable construction) was also introduced as moderating variable between organizational innovativeness, organizational culture and sustainable construction relationship. The relationships existing among all the variables were also discussed at the tail end of the chapter, followed by hypotheses development and the theoretical framework.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

In this chapter, the research methodology that was adopted for the achievement of the research objectives is presented. The first section of this chapter explains the research design which includes justifications for adopting quantitative research approach, sampling technique and the procedure for the collection of data. Then, response rate, explanations about how variables are operationalized and measured are presented, followed by the procedures involved in the pilot study. Lastly, the chapter proceeded to tools and techniques used in analysing the data in this study.

3.2 Research Paradigms

Paradigm is a common terminology in social sciences which influences researcher's conception and ways of investigating social phenomena by gaining some knowledge about how the findings of such phenomena can be explained (Bryman, 2012; Saunders, Lewis & Thornhill, 2007). Thus, it strongly influences the manner in which social science and management researches are conducted. There is an age-old epistemological debate in literature about which research paradigm that scientific philosophers and researchers should adopt between positivism and interpretivism - the two common schools of thoughts (Bryman, 2012). These two distinct philosophical paradigms are explained in the sections that follows.

3.2.1 Positivist Paradigm

The positivist epistemological stance tends towards objectivism where researcher tries to discover absolute knowledge about an objective reality by drawing a line between the researched entity and the researcher. Thus, meanings, that the researcher mainly seeks, are absolutely inherent in the researched object, and not in researcher's conscience (Scotland, 2012). So, a positivist researcher not only remains independent while searching for the meaning and relationships between interested elements, hypotheses are also developed to arrive at meaningful conclusions (Carson *et al*., 2001).

Similarly, positivists, as a result of preferring scientific methods to explain phenomena, adopt quantitative techniques, which emphasize careful and appropriate procedure of data collection that is used to explain and test behavioural patterns and hypothetical-deductive generalizations (Ikeda, 2009; Chen & Hirschheim, 2004; Baker, 2000). Thus, according to Straub, Boudreau and Gefen, (2004), the hallmark of positivism is the ability to generalise the findings obtained from a given sample within a population. Positivist paradigm is commonly adopted in behavioural and managerial based researches where quantitative research techniques and tools are deployed to explain relationships. And since this present study proposes to test a conceptual framework and certain underlying hypotheses with the use of quantitative research approach that is survey-based, it is quite clear, therefore, that positivism paradigm is obviously the most appropriate philosophical approach to achieve this study's objectives than interpretivism.

3.2.2 Interpretivist Paradigm

Interpretivism is another epistemology advocating the necessity of understanding the varying differences in humans as a critical actor in interpreting the social roles of others and events (Saunders *et al*., 2007). In interpretivism, researchers set out to achieve research objectives by observing and interpreting a social phenomenon. The challenge remains that the researcher relates closely with the social world of the research context and subject in particular to seek understanding of their world and discover some basic truths of social realities (Burnett, 2012; Saunders *et al*., 2007). Marshall and Rossman, (2010), argued that interpretivists necessarily integrate themselves in the research subjects world to familiarise themselves with their (subject) real world situations.

In this line of reasoning, interpretivism philosophical based researches make use of qualitative technique to give explanation to phenomenon directly from the context as opposed to employing external factors or some basic theoretical explanations. This philosophy, therefore depends on qualitative technique of data collection (O'hEocha, Wang & Conboy, 2011)

As against positivism, where generalizability is key, interpretivist diametrically opposed to the notion of generalizability as a non-relevant issue in research. Their argument is based on a perception of the world as an ever-changing entity, where what is applicable today may seize to apply in no distant future. Also, generalizability is irrelevant if organizations in this age are truly unique. These two different philosophical approaches (positivism and interpretivism) are further represented in Table 3.1.

Table 3.1
Positivist and Interpretivist Approaches to Research

Research Fields	Positivism Natural sciences	Interpretivism Human sciences
Concepts	Structure, social and natural facts	Meanings and social development; Learned human phenomena
Methods	Quantitative statistical inference (testing of hypotheses); Cause/effects relationship; Measurement.	Qualitative; Hypotheses generation; Speculative interactions; Processes
Scope	Seeks explanations for things, generalisations, laws; Considers reality as objective, tangible and unique; Focused on what is general, average and representative such that generalizations can be made.	Seeks to understand the subjects; Context-dependent; Discernment; Socially constructed and multiplied realities.
Researcher's role	As uninvolved observer	An active participant
Analysis	Objective, abstract, fixed, value-free	Subjective, grounded, flexible, political

Source: Ikeda, (2009).

As presented in Table 3.1, the main difference between these two schools of thought is based on the viewpoint of individual researcher on the techniques to adopt in conducting a research. The positivists establish hypothesis statements, collect relevant data to test the hypothesis and draw conclusions by accepting or rejecting the result based on the formulated hypothesis. In this sense, the import is the identification of relationships or patterns. The underlying concept of interpretivism, on the other hand, rests on discovering meanings and social development by learning pattern of human behaviour. And the researcher influences this strategy greatly through speculative interactions. Their argument is that statistical patterns or correlations that are emphasized by the positivists are incomprehensible. And so, interpretivists believed that it is important that a researcher discovers the meanings of people's actions leading to certain patterns.

3.3 Ontological Assumptions

Ontology is basically concerned with the nature of reality. Ontological orientation largely raises the question of the researcher's assumptions about the particular way the world operates, and how committed the researcher is to that particular viewpoint (Saunders *et al*., 2007). Most researchers in the fields of business and management are devoted to the two aspects of ontological assumptions which are objectivism and subjectivism (Saunders *et al*., 2007; Hatch & Cunliffe, 2006).

Objectivism seeks to answer the question of whether social entities exist independently of the social actors. It explains that social phenomenon and sundry sub-categories of life routines are external to the actors. The social phenomenon could be explained in organizations as an entity that excludes the actor, but which possesses a tangible and separate reality of its own. On the other hand, "interpretation" of observed phenomena is greatly emphasised in interpretivism approach. According to Fellows and Liu, (2009), the act of interpretation suggests the presence of "a conceptual schema or model on the part of the interpreter such that what is being observed and interpreted is assumed to conform logically to the facts and explanations inherent in the mode" (Fellows & Liu, 2009, p. 69). This assumption asserts that meanings to social phenomena are constantly being accomplished by social actors. It deals with the question of whether reality exists by practically experiencing it (Hatch & Cunliffe, 2006).

Considering the context of this present study, which seeks to explore the extent of sustainable construction of Malaysian contractors through of organizational innovativeness and culture, objectivism ontological position, which is based on the assumption that the existence of social entities is external to the social actors is considered mostly appropriate. This is particularly so in view of the fact that there are certain shortcomings and biases inherent in interpretivist approach in construction management researches. Of note is the possibility of ethnocentrism while interpreting observable behaviours and cultural norms in multicultural studies. Again, the knowledge, bias and assumptions of the researcher is most likely to interfere with their conclusions and their validities even in studies dealing with homogenous cultural groups (Fellows & Liu, 2009).

3.4 Axiological Assumptions

In axiological philosophy, explanations are given to judgements about values. The philosophy deals with the exact role that the researcher's real values play in all stages of the research process for it to be credible (Saunders *et al*., 2011). Human values will necessarily be demonstrated at all stages of research process as a basis for drawing inferences and making judgements about the research and how it is being conducted. Interestingly, the discussion about axiology in the literature stresses the possibility (at some points) of writing one's statement of personal values regarding the study being conducted.

From the foregoing, axiological assumptions follow two viewpoints. The first one which posits that should be value free and unbiased is objectivist viewpoint, while the second stance that reflects biased and value-laden viewpoints is subjectivism. Thus, in line with the previously highlighted philosophical standpoint of the researcher, which posits that researchers engage the world realities in value-neutral manner, and to ensure that the study incorporates the broad input of the Malaysian contractors, quantitative methods is used to gain insights from Malaysian contracting firms. Again, this philosophy (objectivism philosophy) suggests that knowledge is best built cumulatively following scientific principles that emphasized observation, reliability in measurement and analysis, and confirmation or refusal of hypotheses that are logically derived from theory.

3.5 Research Design

In this section, the framework and strategies for the data collection is presented. The main objective of this research is to assess the extent of sustainable construction of large contractors operating in Peninsular Malaysia. Also, examining the relationship between organizational innovativeness, organizational culture and sustainable construction, as well as determining the moderating effect of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction of Malaysian contractors form part of this study's objectives. Thus, this study is a combination of correlational and descriptive researches. Examining the extent of sustainable construction of Malaysian contractors is a descriptive research. Examining the relationship between organizational innovativeness, organizational culture and sustainable construction is a correlational type of study. While descriptive research aims at describing characteristics of objects, people, groups, organizations, or environment; correlational study attempts to establish the relationships among predictor and criterion variables (Zikmund, Babin, Carr & Griffin, 2012).

Data collection in this study is done at organizational level. Thus, the unit of analysis for this study is organization (G7 contractors in Peninsular Malaysia). As explained earlier, the respondents in this study are representatives of contracting firms who are conversant with innovative activities and sustainable construction of the concerned company.

A cross-sectional design, according to Frethey-Bentham, (2011), facilitates quicker implementation of a research project because this design is a one-shot, single-point-in-time. Thus, this present study is cross-sectional in nature considering the fact that data were collected using structured questionnaire at one point in time.

3.5.1 Justification for Employing Quantitative Approach

This study uses quantitative cross-sectional survey design, because it is considered most appropriate research design and approach for several reasons. First and foremost, the main objectives in this study could be properly achieved through quantitative approach involving primary data collection and testing a theoretical model in order to be able to explain and predict future behaviours of the respondents (Henn, *et al.,* 2006). A major assumption of any theory is to explain the variables in a model and provides the foundation of some testable propositions, which can be investigated empirically (Davis, 1989). Researchers use theory to offer an explanation of some phenomena by describing the way other things correspond to the phenomena. Thus, understanding and predicting are the two purposes of a theory (Zikmund, *et al*., 2012). Gregor (2006) also asserts that, in the absence of a better understanding of the rationale behind the occurrence of an outcome, it is still possible to achieve the precise results of prediction of a theory by properly employing quantitative research methods. To better predict the willingness of construction companies to adopt sustainable construction, this study uses the partial least squares based structural equation modelling (PLS-SEM) approach in order "to obtain values of the latent variables for predictive purpose" (Chin, 1998, p.301) which necessitates the adoption of quantitative methods. Moreover, quantitative approach enables processing a large amount of data (data that were collected through the use of a structured questionnaire) with the aid of several computer softwares.

3.5.2 Sampling Procedure: Sample Size and Power Analysis

Determination of a sample size involves deciding the number of observations to be included in a sample by adopting an appropriate sampling technique (Kothari, 2009). Sampling techniques are broadly classified into two categories. These are: probability and non-probability sampling procedures.

In probability sampling technique, individual units of elements within the target population has a known, equal and unbiased chance to be chosen as a subject in the sample (Sekaran & Bougie, 2013). According to Bryman, (2012) if probability sampling is properly applied, the findings of the survey tend to have representativeness, which imply that samples that accurately reflect the target population is likened to a microcosm of the said population. In probability sampling approach, simple random sampling, stratified sampling, systematic sampling, cluster sampling and multi-stage sampling are the most commonly cited techniques (Hair *et al*., 2011).

- **Simple random sampling**: The common terminology in this direct method of sampling is that individual element within the survey population has a known, equal and fair opportunity of being selected (Sekaran & Bougie, 2013).
- **Systematic sampling**: This technique depends on a specified and systematic selection of the sample constituents at a specified and regular interval from the sample frame. This process involves initial random selection, followed by selection of the nth element from the sampling frame (Hair *et al*., 2011).
- **Stratified sampling**: In this sampling technique, researcher is required to make stratification process by dividing the population in a mutually exclusive and homogenous group in line with the peculiar features of the population (Sekaran

& Bougie, 2013). In this form of sampling, there is always a concept of homogeneity within each group and heterogeneity across groups.

- **Cluster sampling**: These are samples collected within a group that are considered an aggregate or a composition of a particular heterogeneous groups that is also referred to as cluster (Hair *et al*., 2011).
- **Multi-stage sampling**: in multi-stage sampling technique, sampling is done in a sequential stage so as to obtain a preferred sample size (Hair *et al*., 2011).

Thus, considering the characteristics of the population in this study, stratified random sampling is adopted. In adopting this sampling technique, the population of G7 contractors in all the eleven states of Peninsular Malaysia is firstly divided into mutually exclusive stratum (Sekaran & Bougie, 2013). Thereafter, a proportionate stratified random sampling is used, where members (G7 contractors) represented in the sample from each stratum (in this case, states in Peninsular Malaysia) is proportional to the entire number of elements in the respective strata. In Table 3.2, the population and sample size of the contractors obtained from CIDB database is presented. The total number of registered and active G7 contractors in all the eleven branches across the peninsular Malaysia from the CIDB database is given as 4,520. This is represented in Table 3.2.

Table 3.2
Distribution of G7 Contractors in Peninsular Malaysia

S/No	CIDB States Branches	No of Contractors
1.	Johor	377
2.	Kedah	200
3.	Kelantan	130
4.	Melaka	126
5.	Negeri Sembilan	91
6.	Pahang	137
7.	Perak	147
8.	Perlis	28
9.	Palau Pinang	346
10.	Selangor	1270
11.	Terengganu	184
12.	Wilayah Persekutuan	1484
	Total	**4520**

Source: CIDB Database, 2014

According to Salkind (2003), the suitability of sample size is a necessity in any research, because a relatively small sample size will jeopardize representativeness of the study population. And such small sample may prompt Type I error, which is the probability of erroneously rejecting a particular hypothesis when it should be accepted (Sekaran, 2003). In the same vein, too large sample size should also be avoided in order to stare clear of possibilities of type II error, which implies accepting a hypothesis when it should have been rejected in actual sense. Thus, determining an appropriate sample size from the study population requires a robust technique such as statistical power test, which is one of the most viable tools in sample size determination.

The power of a statistical test, according to Cohen, (1988), refers to the probability of rejecting a null hypothesis or rejecting a specific effect size of a particular sample size at a particular alpha level. Thus, the test is capable of detecting differences in a wider population, if it does exist. Again, Ramalu, (2010) argued that if other techniques have been adopted to determine sample size in a study, it is equally worthwhile to use power analysis to detect the effect of different sample sizes.

In utilizing the G*Power 3.1 software for sample size determination in this study, a priori power analyses (Cohen, 1988) was done, where sample size *N* was computed as a function of the required power level (1- β), the pre-specified level of significance α, and the effect size of the population that will be determined with probability $1 - \beta$. In a priori test, statistical power is efficiently controlled before the actual study is conducted (Faul, Erdfelder, Lang, & Buchner, 2007). Thus, in determining this study's sample size, a priori power analysis was conducted with the aid of G*Power 3.1 software package (Faul *et al.*, 2007). And Cohen's (1977) standards were adopted in this study to calculate the sample size. This include: effect size ($f2$= 0.15); significance alpha level (α= 0.05); desired statistical power (1-β = 0.95); and total number of 3 predictors (organizational innovativeness, organizational culture and government support).

As shown in Figures 3.1, the statistical test results indicated that a sample size of 119 will be required in this study for a linear multiple regression based statistical analysis. It is also evident that Cohen's (1977) recommended value of 0.9 for determining effect sizes was used in this study. However, the result (total sample size of 119) appears inadequate for a population of 4,520 contractors. Consequently, a different sample size determination technique was explored, which is Krejcie and Morgan's (1970) generalized scientific parameters for determining sample size from a given population was also used in this study. And as shown in Table 3.2, a total of 354 contractors were deemed appropriate for a population of 4,520 contractors.

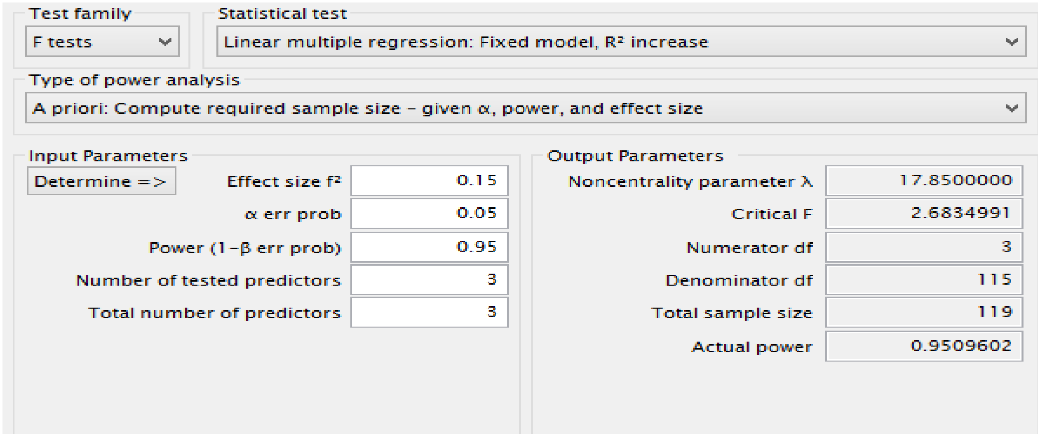


Figure 3.1
Power Analysis for Medium Effect

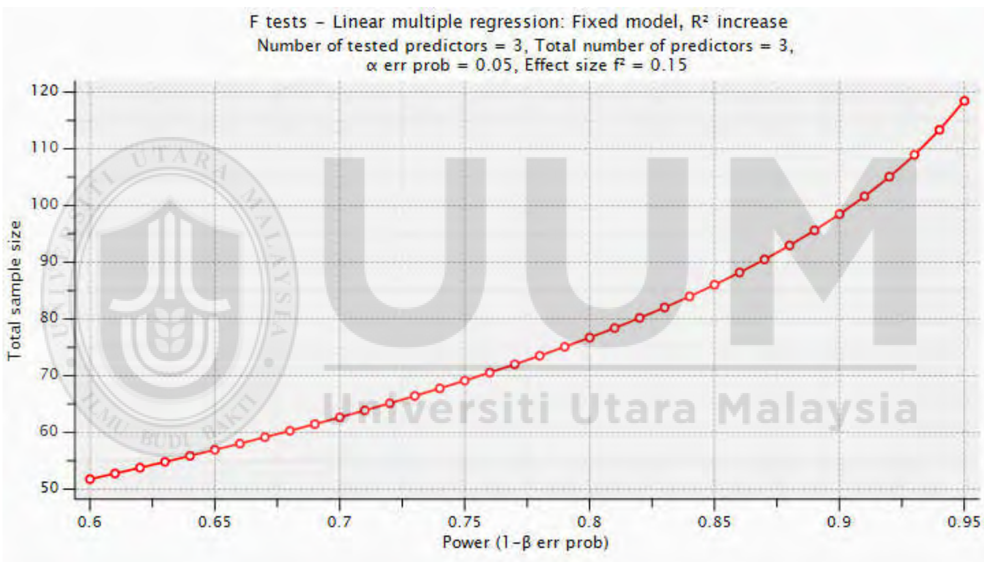


Figure 3.2
X-Y Plot for Medium Effect Power Analysis

Again, in any multivariate research, sample size is expected to be several times (usually10 times or more) larger than the research constructs (Hair *et al.,* 2010). This study has four main constructs, which, going by this rule, requires at least a sample size of 40 or more. Equally, Dillman's (2000) technique was incorporated in this study guide against incorrect sample size and to ensure accurate sample size that will be representative of the study's population. Therefore, using the study's population of 4,520, the computation of the sample size is given as:

$$n = \frac{(N)(p)(1 - p)}{(N - 1)\left(\frac{B}{C}\right)^2 + (p)(1 - p)}$$

Where *n* = the required sample size that is computed for the desired level of precision;

N = the population size;

p = the proportion of population expected to choose;

B = acceptable amount of sampling error, or precision; and

C = Z statistic associated with the confidence level which is 1.96 corresponding to 95% level of confidence.

Ideally, the value for B can be set at 0.1, 0.05, or 0.03, which amounts to ±10, 5, or 3% of the true population value, respectively. This study however, considers the acceptable amount of sampling error of 0.05 (5%). The confidence level of 1.96 also corresponds to the 95 per cent level.

Since the percentage of the participants that will respond to the survey was not known prior to the data collection, thus 0.05 value for B was used instead of 0.03 to achieve a consistent sample. By using 0.05, a greater sample size will be achieved, although, Biemer and Lyberg, (2003) argues that it always provides an adequate sample size for a smaller or greater population.

Thus, using the Dillman's formula:

$$n = \frac{(N)(p)(1 - p)}{(N - 1)\left(\frac{B}{C}\right)^2 + (p)(1 - p)}$$

Where N= 4,520, p = 0.5, B = 0.05, C = 1.96

$$n = \frac{(4520)(0.5)(1 \quad 0.5)}{(4520 \quad 1)\left(\frac{0.05}{1.96}\right)^2 + (0.5)(1 \quad 0.5)}$$

$$n = \frac{(4520)(0.5)(0.5)}{4519 \quad 0.000651 + (0.5)(0.5)}$$

$$n = \frac{1130}{2.942 + 0.25}$$

$$n = \frac{1130}{3.192}$$

$$n = 354.01 \quad 354$$

Thus, this computation shows that a minimum of 354 contractors are required as respondents in this study. Since there is no difference between the result of this computation (by Dillman, 2000) and Krejcie and Morgan's (1970) generalized sample size parameters, and this study aims at using a relatively larger sample size in order to achieve representativeness of the study population, thus, Krejcie and Morgan's (1970) parameters which gives a sample size of 354 is adopted in this study.

Table 3.3
Population and Recommended Sample Size

Organization	Population (*N*)	Required Sample (*n*)
Construction companies in Peninsular Malaysia	**4520**	354

Source: Based on Krejcie and Morgan (1970) guide to sample size.

In order to satisfy the guidelines of proportionate stratified random sampling, 8% of members from each stratum will be selected for the survey, such that member are consistently selected from each stratum (states).

3.5.3 Data Collection Procedure

The population for this study consisted of G7 contractors (as shown in Table 3.1) registered with CIDB in peninsular Malaysia as at 2014. Considering the assumptions of Krejcie and Morgan (1970), to ascertain significance at 95% confidence level, a sample size of 354 is required for a population of 4,520 G7 contractors. Again, as noted by Waris *et al*., (2014), Malaysian construction industry is associated with low rate of response. And to take care of this peculiar tendency and also minimize sampling error, the suggestions of Hair, Wolfinbarger and Ortinal (2008), that the sample size be doubled, is adhered to. Hence, a total of 708 questionnaires were sent out to the contractors across the eleven states in peninsular Malaysia.

Physical distributions of the questionnaires were done in states of Kedah, Perlis and Penang. This form of questionnaire administration in these states was done for the following reasons: (1) to allow for personal contact with the respondents in order to explain the significance and objectives of the study to them. (2) to increase the response rate and reduce the time taken to receive posted responses. Additionally, questionnaires were also physically administered to contractors during the CIDB year-round workshops called Continuing Professional Development (CPD). The workshop serves as a better avenue for the researcher to explain in greater details, the nature of the survey and the need for the respondents to participate in the survey. Three different workshops were attended by the researcher, and in each of the workshops, questionnaire were administered to contractors. A postal survey method was also adopted in the remaining states. The questionnaire was designed with a logo of the Universiti Utara Malaysia, and in English language.

In this study, survey method was used to obtain the respondent's perceptions about the relationship between organizational innovativeness, organizational culture, government support, and sustainable construction. Going by the recommendations of Waris *et al*., (2014); Hilmi *et al*., (2010); and Jantan *et al*., (2003) one representative (an executive director, a project manager, a marketing manager, an engineer, a quantity surveyor, a contract manager, a sales manager, or an account manager) in each construction company who have acquired satisfactory professional experience is enough as respondent to explain the relationships in this study.

Prior to data collection, a letter of introduction was obtained from the Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia, requesting assistance from the construction companies as regards the study. The letter assisted the researcher in reaching out to the respondent easily and also facilitated response a great deal by building trust and confidence in the respondents.

3.6 Questionnaire Design

This study employs structured self-administered questionnaire consisting of 60 closed ended multiple choice-questions for the survey. The instrument comprises 61 questions related to the four constructs of this study and seven questions related to the firm and respondent information.

The constructs for this study are sustainable construction, organizational innovativeness, organizational culture and government support. Three constructs (sustainable construction, organizational innovativeness, and organizational culture) are multi-dimensional constructs, while government support is a uni-dimensional construct. Thus, the questionnaire instrument is made up of five sections. Section 1, which consisted of seven questions, deals with general information about the respondent and the construction firm. Section 2 consisted of 15 questions to measure contractor's innovativeness. Section 3 consisted of 21 questions to measure organizational culture of the contractors. Section 4, which has 5 questions is to solicit response about government support for sustainable construction, while the last section about contractor's sustainable construction has 19 questions.

Following Brace, (2004)'s suggestion on questionnaire design, the questions are expressed in clear language to which the respondents can relate. Again, the questionnaire was designed in a booklet format with Universiti Utara Malaysia logo. This was done in accordance with the suggestions of Hair, Money, Samouel and Page (2007), a logical arrangement of the items in a questionnaire, transitional phrases and a well organised questions record a high response rate and minimal error.

3.7 Measurement and Operationalization of Variables

As depicted in Figure 2.1, the present study has four major constructs to be measured namely: organizational innovativeness, organizational culture, sustainable construction and government support. This section discusses the instruments used in measuring the constructs of the model.

Sustainable construction is measured in this study with five-point, multi-item rating scales adapted from previous studies (Abidin, 2005). The items/indicators were introduced with the question about respondent's understanding of sustainable construction concept. These items measure environmental protection, social well-being and economic prosperity of the respondents' company. These dimensions were assessed by having participants indicate the degree to which they consider the adoption of sustainable construction in project execution on a five-point rating scale, anchored by "very important" and "very unimportant."

In her study, eight items were considered to measure environmental sustainability in construction. These are location selection; material selection; waste minimisation; energy conservation; water efficiency; pollution control; and biodiversity protection, and heritage protection. Social sustainability in construction was also measured using seven items, these are: health and welfare; safety issues; user comfort /satisfaction; accessibility; aesthetics /visual; nuisance to neighbours; and social involvement. While life cycle costing; profitability; business image; cost management, and risk assessment were used to measure economic sustainability.

Table 3.4
Summary of Variables and Measurement of Instruments

Construct	Dimensions	Scale	No of items
Organizational innovativeness	Product innovativeness	5 points	5
	Process innovativeness	5 points	4
	Business innovativeness	5 points	4
	New technology innovativeness	5 points	4
Organizational culture	Adhocracy culture	5 points	11
	Market orientation	5 points	9
Government support		5 points	4
Sustainable construction	Environmental protection	5 points	8
	Social well-being	5 points	7
	Economic prosperity	5 points	5
Total number of items			**61**

3.7.1 Organizational Innovativeness

This construct is operationalized as product innovativeness, process innovativeness, business innovativeness, and new technology. Thus, in applying these dimensions to the G7 contractors within the Malaysian construction industry, a five-point, multi-item measurement scale adapted from prior research (Kamaruddeen *et al*., 2012) is used to measure the contractor’s propensity to adopt innovativeness in construction, anchored by “not at all” and “completely true”. The respondents are qualified contractors who are conversant with innovativeness within the firm. The questionnaire items used in measuring organizational innovativeness are presented as follows:

(a) Product innovativeness

Product innovativeness is measured using five questions including:

1. We actively develop new construction products in our company
2. Our company sees creating new construction products as critical to our success.
3. Our company tends to be an early adopter of innovative construction products or materials.
4. Within our company, we are able to adopt innovative construction products or materials used by other companies.
5. Our company seeks innovative construction products or materials from outside this organization.

(b) Process Innovativeness

Process innovativeness is measured using four questions:

1. We tend to be an early adopter of innovative construction process or practice in our company.
2. We are able to implement innovative construction process used by other company.
3. We actively develop in-house solutions to improve our construction development process.
4. We seek innovative construction process outside our company.

(c) Business Innovativeness

Business system is measured using four questions:

1. Creating new business systems is critical to the success of our company.

2. Our company tends to be an early adopter of innovative business system.
3. Within our company, we are able to implement innovative business systems used by other companies.
4. Our company actively seeks innovative business systems from outside this company.

(d) New technology

New technology innovativeness is measured using four questions:

1. In our company, we have a policy that encourages adoption of new technology.
2. Most employees are computer literate in our company.
3. Employees in our company support the application of information technology.
4. We use equipment and machineries that are up-to-date in our company.

3.7.2 Organizational culture

There are two dimensions under organizational culture, and these are: adhocracy culture, and market orientation. Cameron and Quinn (2011)'s items were adapted in measuring adhocracy culture. While market orientation items were adapted from Jaworski and Kohli (1993).

(a) Adhocracy culture

Items for the measurement of adhocracy culture are eleven, and they include:

1. Our company is a very dynamic working place.
2. Entrepreneurship is encouraged in our firm
3. Leadership in our company are usually innovative.
4. Our company leadership always demonstrates risk-taking.

5. Freedom is demonstrated by the management of our company.
6. The management style in our company is characterized by uniqueness.
7. There is commitment to innovation in our company.
8. There is commitment to development in our company.
9. In our company, emphasis is placed on creating new challenges.
10. We emphasize acquiring new resources in our company.
11. We define success based on unique construction product in our company.

(b) Market orientation

The measurement of market orientation comprises of the following ten items:

1. We share competitor's information within the company.
2. We respond rapidly to competitive actions in our company.
3. Top management in our company regularly discuss the strength of our competitors.
4. We always focus on our clients in our company whenever we have an opportunity for competitive advantage.
5. We pay close attention to after-sales service in our company.
6. Business objectives are driven by customer satisfaction in our company.
7. Our competitive advantage is based on understanding clients' needs.
8. In our company, we closely monitor and assess our level of commitment in meeting the needs of our customers.
9. Business strategies are driven by the goal of increasing customer value in our company.

3.7.3 Government support

In this study, government support is a moderating variable with five items/indicators. And in measuring it, the following Akadiri & Fadiya's, (2013) items were adapted:

(a) **Government support for sustainable construction**

1. Government support is responsible for effective sustainable construction standards and incentives.
2. The need to meet regulation is increasing client's demand for sustainable construction.
3. Government support for sustainable construction have impacts on our construction practices.
4. Regulations for sustainable construction can effectively address issues regarding the sustainability of construction process.
5. The Malaysian sustainable construction laws are appropriate for the construction industry environment.

3.7.4 Sustainable Construction

Sustainable construction, in this study is operationalized into three dimensions. The dimensions are: environmental protection, social well-being, and economic prosperity. The items used in measuring this construct are adopted from Abidin (2005).

(a) Environmental protection

Environmental protection is measured using these items:

1. Location selection is an important sustainable construction consideration in our projects.

2. Material selection is an important sustainable construction consideration in our projects.

3. Waste minimisation is an important sustainable construction consideration in our projects.

4. Energy conservation is an important sustainable construction consideration in our projects.

5. Water efficiency is an important sustainable construction consideration in our projects.

6. Pollution control is an important sustainable construction consideration in our projects.

7. Biodiversity protection is an important sustainable construction consideration in our projects.

8. Heritage and amenity protection is an important sustainable construction consideration in our projects.

(b) Social well-being

1. Health and safety is an important sustainable construction consideration in our projects.

2. User comfort and satisfaction is an important sustainable construction consideration in our projects.

3. Community welfare is an important sustainable construction consideration in our projects.

4. Accessibility is an important sustainable construction consideration in our projects.

5. Social involvement is an important sustainable construction consideration in our projects.

6. Workers' welfare is an important sustainable construction consideration in our projects.

7. Aesthetics is an important sustainable construction consideration in our projects.

(c) Economic prosperity

1. Life cycle costing is an important sustainable construction consideration in our company.

2. Profitability is an important sustainable construction consideration in our projects.

3. Business image enhancement is an important sustainable construction consideration in our projects.

4. Cost management strategy is an important sustainable construction consideration in our projects.

5. Risk reduction is an important sustainable construction consideration in our projects.

These items were adopted from previous empirical studies that were published in reputable academic journals, and were subsequently adapted in this study. Table 3.5 shows the sources of these measurements.

Table 3.5
Sources of measurement instrument

S/N	Variables	Source	Remarks
1	Organizational Innovativeness	Kamaruddeen *et al*., (2012)	Adapted
2	Organizational Culture	Cameron & Quinn (2011) Jaworski & Kohli (1993)	Adapted
3	Government support	Akadiri & Fadiya, (2013)	Adapted
4	Sustainable construction	Abidin (2005)	Adapted

3.8 Pilot Study

A pilot study is the rehearsal of the main survey, carried out to ascertain the weaknesses (if any) in the questionnaires and also of the survey techniques. This is done in order to predict an appropriate sample size and improve the study techniques before the study goes live (Hulley, 2007). A pilot survey is significant owing to the fact that it addresses several shortcomings survey. Brace, (2004, p 164), recommends that pilot questionnaire to should answer the following questions before the actual survey takes place.

1. Do the questions sound right?
2. Do the interviewers understand the questions?
3. Do respondents understand the questions?
4. Have we included any ambiguous questions, double-barrelled questions, loaded or leading questions?
5. Can respondents answer the questions?
6. Are the response codes provided sufficient?
7. Do the response codes provide sufficient discrimination?
8. Does the interview retain the attention of respondents throughout?
9. Can the interviewers or respondents understand the routeing instructions in the questionnaire?
10. Does the interview flow properly?
11. Do the questions and the responses answer the brief?
12. How long does the interview take?
13. Have mistakes been made?
14. Does the routeing work?
15. Does the technology work?

According to Sekaran and Bougie (2013), the main reason for undertaking pilot survey include determining the validity and reliability of the questionnaire items; assessing the adequacy of the wordings of the items, phrases and the construction of the questions to generate accurate results; evaluating the items to determine their ability to yield better response; and to determine the ability of the respondents to provide the needed data.

Prior to the pilot survey, the content validity of the instrument was carried out. Content validity refers to the degree at which a measure covers the domain of the concepts under study or how well the dimensions and items of constructs in this study have been delineated (Sekaran & Bougie, 2013). And it involves consulting a panel of judges or experts to ascertain the validity of the items (Zikmund *et al*., 2012; Creswell, 2012). Thus, the study item was sent to four experts who are familiar with the constructs of this study. Three experts were selected from the School of Technology Management and Logistics, University Utara Malaysia. While another four construction industry's practitioners were also contacted for the same exercise. Their inputs and suggestions were subsequently incorporated into the final draft of the instrument.

Table 3.6
Expert's Comments during Content Validity

Items in questionnaire	Comment by Expert
Section 1	
Q2: How long have you been working with the company? .... years	Provide "options" in terms of ranges that respondents can choose from.
Q4: How old is the company you are working for?	Provide "options" in terms of ranges that respondents can choose from.
Q5: Which of the following best describe your company's operational location?	Add "s" to describe: "Which of the following best describes your company's operational location?"
Q7: What type of construction projects do your company specialize in?	"Please refer to classification made by CIDB"
Section 2	
<u>Product Innovativeness</u>	
Q1: We actively develop new products in-house in our company.	Contractors basically do not develop or create any product. So, include construction product.
Q2: Our company sees creating new products as critical to our success.	
Section 3	
<u>Adhocracy Culture</u>	
Q2: Entrepreneurship is encouraged in our company.	Remove this item.
<u>Market Orientation</u>	
Q1: Sales personnel in our company share competitor's information within the company.	Contractors do not always have sales personnel.

Q4: We always focus on customers in our company whenever we have an opportunity for competitive advantage. Q8: In our company, we closely monitor and assess our level of commitment in meeting the needs of our customers. Q9: Business strategies are driven by the goal of increasing customer value in our company.	Replace “customers” with “clients”
Q10: Top managers in our company regularly discuss competitors’ weaknesses.	Question about strength of competitors has been asked earlier in Q3. So, remove this item.
Section 4 **Environmental Protection** Q1: Location selection is an important sustainable construction consideration in our company. Q2: Material selection is an important sustainable construction consideration in our company. Q3: Waste minimization is an important sustainable construction consideration in our company. Q4: Energy conservation is an important sustainable construction consideration in our company. Q5: Water efficiency is an important sustainable construction consideration in our company. Q6: Pollution control is an important sustainable construction consideration in our company. Q7: Biodiversity protection is an important sustainable construction consideration in our company. Q8: Heritage and amenity protection is an important sustainable construction consideration in our company.	Relate items in this section with company’s experience on projects they have carried out.
Social Well being	Relate all items in this section with company’s experience on projects they have carried out.
Economic Prosperity Q2: Information circulation/communication is an important sustainable construction consideration in our company. Q3: Legislation compliance is an important sustainable construction consideration in our company.	These items does not reflect appropriate measures of economic prosperity in sustainable construction.
Section 5 Q1: Malaysian government provides financial support for our company.	Items are too general. Replace with relevant questions.

Q2: Malaysian government agencies provide incentives for sustainable construction in in our company. Q3: Malaysian government encourages our company to propose projects of sustainable construction. Q4: Government support encourages competition in Malaysian construction industry.	

Table 3.6 presents the comments received from expert on initial questionnaire developed. This was done to ensure all items in the questionnaire accurately measure the latent variables in this study.

Prior to the actual data collection, a pilot study was conducted where a total of Forty-five (45) questionnaires were administered personally during the Construction Industry Development Board (CIDB) seminar on "Innovation & Technology Sustainable Construction", held at Carlton Holiday Hotel & Suites, Shah Alam, Selangor on 16th June, 2015. This was based on the suggestion of Gay, Mills and Airasian (2006) that a small scale study of respondents is suggested for trial purpose before conducting the full-fledged study. Ideally, the sample size for pilot studies is suggested to be relatively smaller, ranging from 30 – 100 respondents, although an increase in the sample size for this purpose allows for a stronger result (Malhotra, 2008). Hence, a total of Forty-five (45) questionnaires were administered for this purpose and responses generated were used in determining the internal consistency for each of the constructs.

There are several reliability tests conducted by researchers, however, "the internal consistency reliability test" is commonly used (Litwin, 1995). The internal consistency of measures explains the homogeneity of measuring items that taps a particular construct. It is the extent to which items of a construct jointly and independently measures the particular construct in question, while the items are also correlated among each other, so that respondents attach the same overall meaning to each of the items. And the most popular internal consistency test is Cronbach's coefficient alpha. Thus, the higher the coefficients, the better the instrument (Sekaran & Bougie, 2013). As depicted in Table 3.7, all the results demonstrated high reliability coefficient, ranging from .862 to .945. In Cronbach's coefficient alpha test, 0.60 is considered average by research experts, while 0.70 and above is rated high reliability (Sekaran & Bougie, 2013; Hair *et al*., 2006; Nunnally, 1967).

Table 3.7
Summary of Pilot Test Reliability Result

Constructs	Dimensions	Number of Items	Cronbach's Alpha
Sustainable Construction	**Three (3)**		
	Environmental Protection	8	0.920
	Social Well-being	7	0.945
	Economic Prosperity	5	0.895
Organizational Innovativeness	**Three (3)**		
	Product Innovativeness	5	0.900
	Process Innovativeness	4	0.932
	Business Innovativeness	4	0.900
	New Technology	4	0.894
Organizational Culture	**Two (2)**		
	Adhocracy Culture	10	0.940
	Market Orientation	9	0.887
Government Support		5	0.862

Source: Researcher

3.9 Data Analysis

A combination of descriptive and inferential statistics were employed as methods of data analysis to achieve this study's objectives. As explained earlier in the research design, descriptive statistics deals with describing characteristics of objects, people, groups, organizations, or environment, and explains how one variable is related to another. Inferential statistics allows a researcher to draw conclusions (or to make inferences) from a sample. In this study, however, a combination of two major PLS SEM software applications, including SmartPLS (Ringle, Wende & Will, 2005) and

PLS-Graph (Chin, Marcolin, & Newsted, 2003) were employed in the analysis and result presentation.

3.9.1 Partial Least Squares - Structural Equation Modeling (PLS-SEM) Technique

PLS-SEM (also called PLS path modeling) is a generally referred to as a second generation structural equation modeling used by researchers to overcome the observed weaknesses in first-generation methods. PLS SEM is a relatively new technique that allows researchers to integrate unobservable variable that is measured indirectly by an indicator variable (Hair *et al*., 2013). Data obtained for this study was analyzed using PLS-SEM technique. PLS-SEM is becoming an interesting technique among researchers lately. Again, it is quite easy in PLS environment to concurrently specify the relationships among the variables of interest and the measures underlying individual construct, leading to simultaneous analysis of 1) how well indicators relate to construct under measurement model specification and 2) whether the hypotheses formulated at the theoretical level are significant empirically. This ability of multiple measures for individual variable in a model allows for a more robust and accurate estimations of the paths among the latent variables- a situation that is always biased downward by measurement error in other techniques such as multiple regression (Limayem, Hirt & Chin, 2001).

Furthermore, PLS path modelling is more suitable when dealing with real life applications. And according to Fornell and Bookstein, (1982); Hulland, (1999), it is always a useful tool to handle complex models, because the soft modelling assumptions allow it to estimate complex and large models. In this study, however, relationships among the constructs (i.e. organizational innovativeness, organizational culture, government support, and sustainable construction) were examined by employing PLS-SEM techniques for better prediction.

Additionally, social science and management researches tend to be associated with the problem of data normality, but PLS path modelling treats non-normal data reasonably well, due to its ability to model latent variables under non-normality conditions such that the data normality is no more a problem in PLS environment (Chin, 1998). As such, this study employs PLS path modeling to avoid the problem of normality that might likely occur during data analysis. Rönkkö, McIntosh and Antonakis, (2015) argues that while other methods of analysis often result in inconclusive results and might require additional analyses, PLS SEM offers valid and more meaningful results. Thus, it is adjudged one of the best statistical tools for social scientists to simultaneously test multiple relationships.

In this study, PLS path modelling is employed in order to establish measurement and structural models. While measurement model is used to give explanation to/or assess construct's reliability and validity, structural model is used to conduct bivariate correlation analysis. And to establish correlations and relationship effects among constructs under study, simultaneous regressions analyses will be used. In addition, with the use of PLS algorithm and bootstrapping, the moderating effects of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction will be analysed.

So, since the causal relationship between the independent and the dependent variables became altered due to the introduction of the moderator variable, the statistical analysis has to measure and also test the differential effect introduced by the moderator on the initial independent-dependent variable relationship (Baron and Kenny, 1986). This also justifies the adoption of PLS-SEM technique for data analysis in this study.

3.10 Summary

This chapter discussed the research methodology in this study. Initially, the divergent school of thoughts as regards research paradigms were highlighted. Then, the research design, under which justification for employing quantitative method, the sampling technique adopted, the required sample size and data collection procedure for this study were outlined. The chapter went further to highlight the expected questionnaire response rate and how the constructs of the study were measured and operationalized. Considerations and procedures for pilot study were subsequently highlighted, after which method of data analysis that was used (Partial Least Square-Structural Equation Modelling PLS-SEM), and the rationale for adopting such method were explained.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the results of data analysed using PLS path modeling were presents. The chapter begins by reporting the response rate from the field. Then, the initial screening of data and preliminary analysis are discussed. Thereafter, using SPSS, the results of the descriptive statistics for all this study's latent variables are reported. Then, the chapter presents the assessment of measurement model where individual item reliability, internal consistency reliability, convergent validity and discriminant validity were determined. This was followed by the analysis of the structural model, which was done to determine the relationships between the exogenous latent variables and the endogenous latent variable. In the end, the results of the moderating effects of government support on the structural model are presented.

4.2 Response Rate

Research response rate, according to Frohlich (2002) is the number of completed and returned questionnaires that is divided by the number of sample members that are eligible for the survey. To conduct a successful research, scholars depend on the willingness of respondents to complete questionnaires administered on them. While convention demands that researchers should not expect absolute response in studies where responding is voluntary, Lietz, (2010) argued that scholars intends to have high response by utilizing questionnaires, because the higher the response rate, the larger the data samples, as well as smaller confidence intervals around sample statistics. However, the average response rate for studies that make use of data that were collected from organizations, according to Baruch and Holtom (2008) has always been approximately

35.7 per cent. Frohlich (2002) then recommends that researchers should observe some methods in order to improve research response rate, and in this study, all the suggested techniques are relevant. The methods are:

1) Notify the respondents prior to sending of the survey.
2) Embed a third party's logo (such as CIDB logo) on the cover page of the questionnaire.
3 Send questionnaire by mail repeatedly.
4) Draft a sincere appeal on the front page of the questionnaire.
5) Continuously follow the questionnaire up.
6) Ensure the result of the research is provided ultimately.
7) Ensure the questionnaire is sent to the most appropriate respondent.
8) Provide prepaid postage stamp envelopes for the respondents.
9) Make sure that the questionnaire items are well structured.
10) Conduct pilot study and make use of the existing scale for the real survey.

This study adopts all the above strategies mentioned, with the exception of the use of third party's logo. But phone calls and frequent visits to the participated organizations were carried out to the end of the data collection. In the end, the distributions and collections lasted for 20 weeks (6 months).

The study employed both mailed and personally administered survey methods by using structured questionnaires. Mail survey method was extensively used in this study because of its ability to cover a wider geographical area and eliminate interviewer bias. A total of 110 G7 contractors sampled from CIDB database responded and returned the mailed questionnaires. Similarly, another 79 contractors responded during three different CIDB Continuing Professional Development (CPD), and Construction Certification Program (CCP) attended by the researcher. However, as shown in Table

4.1, a total of 172 questionnaires were acknowledged and retained for analysis as against the entire 189 total responses collected. Invalid and incomplete responses were specifically responsible for the exclusion of 9 responses. While another 8 cases were removed after the assessment of multivariate outlier. This gives a 24 % overall response rate. This low response rate was largely due to the nature of the survey, the unit of analysis, and confidentiality of information. However, this response rate is adequate according to researchers. Akintoye, (2000) and Dulaimi *et al*., (2003) argued that postal survey response for the construction industry is usually within the range of 20–30 per cent. Hence, the response rate in this study is justified.

Again, Tomaskovic-Devey, Leiter, & Thompson, (1994); Baldauf, Reisinger, & Moncrief, (1999) submitted that surveys carried out on organizations are always typified by low response rate, such that a response rate of 15 per cent is considered acceptable for organizational surveys. Hence, the current 24 per cent feedback is considered satisfactory for a meaningful analysis. The response rate is also deemed adequate considering researchers' suggestions that sample size should be 5 to 10 times higher than the number of constructs/ variables in a study (Kotrlik, & Higgins, 2001; Hair *et al*., 2010). Since there are 4 constructs (variables) in this study, a sample size of 40 is sufficient for analysis. It should also be noted that SmartPLS, which is the software used for analysis in this study, allows a relatively small sample size as low as 30 for analysis (Chin, 1998). Thus a sample size of 108 is notably adequate for analysis.

Table 4.1
Questionnaire Distribution and Decisions

Item	Frequency	%
Distributed Questionnaires	787	100.00
Returned Questionnaires	189	24.01
Rejected Questionnaires	17	1.14
Retained Questionnaires	172	22.87

4.3 Data Screening and Preliminary Analysis

This study relies on the treatment of missing values, normality test, outliers assessment, and multicolinearity test to screen data prior to data analysis. Accordingly, Sekaran and Bougie, (2013), assumes that there are several situations that could cause missing data. These include, inability of respondents to comprehend questions asked, difficulty in answering due to certain unforeseen circumstances, or unwillingness to respond. Thus, missing data is a common phenomenon in data analysis, and it is well articulated by research scholars. Tabachnick and Fidell, (2007) suggested several approaches to handle missing data. One of such is multiple imputation, which is considered one of the most suitable methods of handling missing data in any data set. In this study, however, 9 questionnaires were specifically excluded from data analysis due to several missing data per case. The exclusion of these observations from the data set is important, especially in multivariate analysis, as they do not represent the sample (Hair *et al.*, 1998).

4.3.1 Assessment of Outliers

Outliers, according to Barnett and Lewis (1994), are observations or its subsets appearing to be inconsistent with the rest of the dataset. Therefore, its presence in any regression-based analysis can distort regression coefficients estimates, which can generate unreasonable findings (Verardi & Croux, 2008). In order to identify observations that are outside the values in the SPSS dataset, frequency tables were firstly tabulated for all the variables in this study, using minimum and maximum statistics. The outcome of this frequency statistics indicated that no value was found to be outside the range given in the likert scale.

The dataset was subsequently examined to detect the presence of any univariate outliers. Thus, using standardized values with a cut-off of ±3.29 ($p < 0.001$) as criterion for the detection of univariate outliers (Tabachnick & Fidell, 2007), no value was identified as a potential univariate outlier using these standardized values. In order to further avoid deleterious effects of outliers on statistical analyses, multivariate outliers identification was also carried out by taking into account all variables in the model, and using Mahalanobis distance. Mahalanobis distance (D^2) refers to the distance of "a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all the variables" (Tabachnick & Fidell, 2007, p. 74). Thus, a case is denoted an outlier if the probability associated with its Mahalanobis distance (D^2) is .001 or less. Following this procedure, all the Mahalanobis distance (D^2) values that exceeded this value were deleted. Thus, eight multivariate outliers (which are in case numbers 6, 44, 82, 87, 94, 103, 147, and 169) were subsequently removed from the dataset in order to avoid their adverse effects on the data analysis accuracy. Therefore, after the removal of these eight outliers, this study's final dataset became 172.

4.3.2 Test of Normality

As against previous assertions by some researchers (Cassel, Hackl, & Westlund, 1999; Reinartz, Haenlein, & Henseler, 2009; Wetzels, Odekerken-Schroder, & Van Oppen, 2009) that PLS-SEM could provide accurate model estimations for data set that is extremely non-normal, it should be noted that this assumption may be incorrect as Hair, Sarstedt, Ringle and Mena (2012) had recently suggested that normality test should be performed by researchers before the data is put for further analysis, because highly skewed data set has a tendency to inflate the bootstrapped standard error estimates, which can consequently undermine the statistical significance of the path coefficients.

Thus, this study adopts graphical method to confirm the normality of collected data (Tabachnick & Fidell, 2007). In ascertaining this, it was suggested that whenever there is a large sample above 200, it is necessary to observe the graphical shape of the distribution instead of the value generated in the skewness and kurtosis statistics (Field, 2009). Again, there is a possibility of reduced standard errors in a large sample, which subsequently inflates the value of the skewness and kurtosis statistics. As such, there is a sound justification for representing normality test graphically rather than the usual statistical methods.

Based on the aforementioned suggestions, this study presents a histogram and normal probability plots to establish the fact that normality assumptions were not violated in Figure 4.1. As depicted in the plots, it is clear that data used for this study follow a normal pattern considering the fact that all the histogram bars are closed to a normal curve, indicating that the assumptions of normality were not violated in this study.

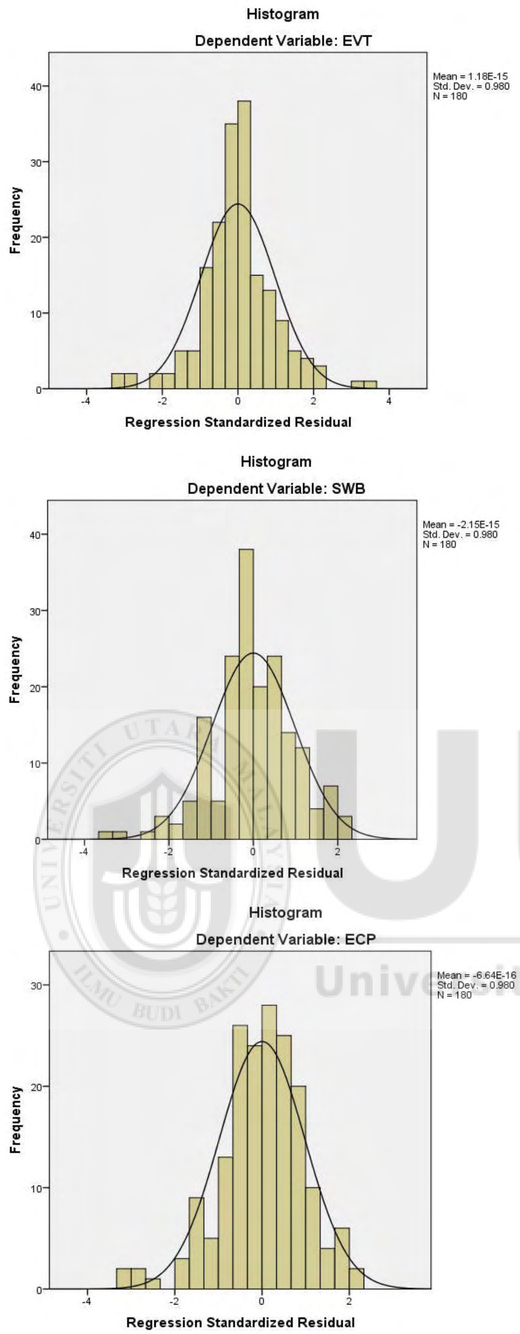


Figure 4.1
Histogram and Normal Probability Plots

4.3.3 Multicollinearity Test

Multicollinearity explains the extent to which predictors are correlated with other predictors. It occurs when two or multiple exogenous latent constructs are correlated in a model not just to the endogenous latent construct, but also to each other. In other words, it results when there are variables that are a bit redundant, which can make regression coefficients estimates and their statistical significance tests difficult or impossible (Chatterjee & Yilmaz, 1992; Hair, Black, Babin, Anderson, & Tatham, 2006). Essentially, there is always an increase in coefficient estimates' standard error with the presence of multicollinearity (Hair *et al*., 2013). Several methods has however been suggested by researchers to assess the level of collinearity. This study computes variance inflation factors (VIF) for each exogenous latent variable for collinearity diagnostic measures. Within PLS-SEM environment, Hair, Ringle, & Sarstedt, (2011) suggest a VIF value above 5.0 and a tolerance value of 0.20 or lower respectively to be indicative of multicollinearity problems. Table 4.2 shows the VIF and the tolerance values for this study's exogenous latent constructs.

Table 4.2
Tolerance and Variance Inflation Factors (VIF)

		Collinearity Statistics	
Dependent Variable	**Independent Variables**	**Tolerance**	**VIF**
Product Innovativeness	Process Innovativeness	.375	2.669
	Business Innovativeness	.393	2.542
	New Technology	.384	2.603
	Adhocracy	.326	3.070
	Market Orientation	.368	2.718
	Environmental Protection	.330	3.034
	Social wellbeing	.293	3.411
	Economic Prosperity	.398	2.513
	Government Support	.501	1.996
Process Innovativeness	Business Innovativeness	.416	2.404
	New Technology	.399	2.504
	Adhocracy	.325	3.074
	Market Orientation	.363	2.756
	Environmental Protection	.331	3.024
	Social wellbeing	.293	3.412
	Economic Prosperity	.400	2.499

	Government Support	.514	1.944
	Product Innovativeness	.402	2.489
Business Innovativeness	New Technology	.380	2.633
	Adhocracy	.334	2.993
	Market Orientation	.364	2.748
	Environmental Protection	.340	2.945
	Social wellbeing	.295	3.393
	Economic Prosperity	.411	2.431
	Government Support	.502	1.994
	Product Innovativeness	.339	2.953
	Process Innovativeness	.334	2.996
New Technology	Adhocracy	.414	2.417
	Market Orientation	.360	2.777
	Environmental Protection	.330	3.033
	Social wellbeing	.293	3.418
	Economic Prosperity	.399	2.506
	Government Support	.502	1.994
	Product Innovativeness	.325	3.077
	Process Innovativeness	.315	3.174
	Business Innovativeness	.373	2.679
Adhocracy	Market Orientation	.370	2.702
	Environmental Protection	.331	3.024
	Social wellbeing	.299	3.344
	Economic Prosperity	.404	2.474
	Government Support	.506	1.977
	Product Innovativeness	.322	3.103
	Process Innovativeness	.300	3.332
	Business Innovativeness	.384	2.604
	New Technology	.484	2.067
Market Orientation	Environmental Protection	.341	2.936
	Social wellbeing	.297	3.365
	Economic Prosperity	.433	2.307
	Government Support	.500	1.998
	Product Innovativeness	.329	3.037
	Process Innovativeness	.303	3.302
	Business Innovativeness	.379	2.642
	New Technology	.381	2.625
	Adhocracy	.335	2.986
	Social wellbeing	.351	2.851
	Economic Prosperity	.401	2.496
	Government Support	.503	1.990
	Product Innovativeness	.321	3.113

Environmental Protection	Process Innovativeness	.301	3.327
	Business Innovativeness	.385	2.600
	New Technology	.380	2.633
	Adhocracy	.326	3.069
	Market Orientation	.371	2.696
	Economic Prosperity	.437	2.288
	Government Support	.555	1.803
	Product Innovativeness	.322	3.105
	Process Innovativeness	.300	3.331
Social wellbeing	Business Innovativeness	.376	2.658
	New Technology	.380	2.632
	Adhocracy	.332	3.011
	Market Orientation	.365	2.742
	Environmental Protection	.395	2.529
	Government Support	.509	1.966
	Product Innovativeness	.321	3.113
	Process Innovativeness	.301	3.319
	Business Innovativeness	.386	2.591
	New Technology	.381	2.626
Economic Prosperity	Adhocracy	.330	3.031
	Market Orientation	.391	2.558
	Environmental Protection	.332	3.013
	Social wellbeing	.321	3.113
	Product Innovativeness	.322	3.109
	Process Innovativeness	.308	3.247
	Business Innovativeness	.374	2.672
	New Technology	.381	2.627
Government Support	Adhocracy	.328	3.045
	Market Orientation	.359	2.785
	Environmental Protection	.331	3.019
	Social wellbeing	.324	3.085
	Economic Prosperity	.405	2.471

Table 4.2 indicates that there is no evidence of collinearity among this study's exogenous latent constructs, considering the fact that the VIF values generated were less than 5 and all the tolerance values exceeds 0.20. Thus, based on the suggestions of Hair *et al.* (2011), multicollinearity is not an issue in this study.

4.4 Test for Non-response Bias

According to Berg, (2002), non-response bias is the mistake a researcher is expected to make during estimation of sample features. In quantitative studies, there is likelihood of underrepresenting some respondents due to non-response. Thus, in order to assess the utility of response rate as a measure of the survey quality, there is a need to investigate whether early respondents provided significantly different values on the measures compared to respondents who received multiple reminder messages. And in estimating this possibility, the suggestion of Armstrong and Overton (1977) that a time-trend extrapolation approach should be carried out, is followed in this study. This procedure entails comparing the early and late respondents (also tagged non-respondents). Based on the recommendations of Pallant, (2010); Armstrong and Overton, (1977), this study's respondents were divided into two different groups. This was done by labelling those who respond within the first 30 days of data collection as early respondents, and those who respond after the 30 days benchmark as late respondents. The 30 days benchmark was chosen because response rate noticeably dropped after the first 3 to 4 weeks of data collection (Vink & Boomsma, 2008; Chen, Wei & Syme, 2003).

This study uses independent sample t-test to compare these groups on all variables and their dimensions. Independent sample t-test was employed particularly to check whether there is any form of discrepancy between these two groups by comparing their means (Pallant, 2010). The result of the test is presented in Table 4.3.

Table 4.3
Results of Independent-Samples T-test for Non-Response Bias

Variables	Group	N	Mean	SD	Levene's Test for Equality of Variances	
					F	Sig.
Product Innovativeness	Early response	124	3.44	.81	.022	.881
	Late response	56	3.60	.84		
Process Innovativeness	Early response	124	3.61	.76	.999	.319
	Late response	56	3.82	.83		
Business Innovativeness	Early response	124	3.62	.69	.513	.475
	Late response	56	3.84	.83		
New Technology	Early response	124	3.82	.68	.337	.563
	Late response	56	3.99	.70		
Adhocracy	Early response	124	3.78	.67	.002	.963
	Late response	56	3.86	.71		
Market Orientation	Early response	124	3.73	.68	3.023	.084
	Late response	56	3.90	.61		
Environmental Protection	Early response	124	3.75	.68	1.353	.246
	Late response	56	4.05	.59		
Social wellbeing	Early response	124	3.91	.69	3.614	.059
	Late response	56	4.08	.54		
Economic Prosperity	Early response	124	4.02	.71	3.552	.061
	Late response	56	4.23	.52		
Government Support	Early response	124	3.90	.71	1.460	.229
	Late response	56	4.18	.59		

Table 4.3 presents the results of independent-samples t-test conducted in this study. And as suggested by Pallant (2010) and Field (2009) that the value of Levene's test for equality of variances should be greater than 0.05 has been met in this test. The result indicated that the significance values of equality of variance for each of this study's variables were all greater than the 0.05. This result thus suggested that those that responded early and willingly to this study's survey did not provide significant different response compared to the late respondents. So, the fact that the assumption of equal

variances between early and late respondents has not been violated in this study, it is evident that this study is not affected by non-response bias.

4.5 Common Method Variance Test

The common method variance (CMV), which is also referred to as monomethod bias, according to Podsakoff, MacKenzie, Lee, & Podsakoff, (2003), is the variance that could be attributed to the measurement method rather than to the variable of interest, and which can lead to a systematic measurement error and subsequently bias the estimation of the true relationship among theoretical variables. Therefore, there has been an agreement among researchers that the CMV is one of the major concerns for researchers that are using self-reporting survey like questionnaire, or poll whereby respondents read and select responses without any interference from the researcher (Lindell & Whitney, 2001; Podsakoff et al., 2003). According to Conway and Lance (2010 p. 325) "common method bias inflates relationships between variables measured by self-reports". Likewise, in Lawrence & Worsley, (2007), self-reporting is generally associated with problems of social desirability bias, poor understanding of terms, cognitively challenging, among others. In view of these daunting challenges, this study was able to adopt several procedural remedies to reduce the effects of common method variance, as suggested by previous researchers (e.g., MacKenzie & Podsakoff, 2012; Podsakoff *et al.*, 2003; Podsakoff, MacKenzie, & Podsakoff, 2012; Podsakoff & Organ, 1986; Viswanathan & Kayande, 2012). The first step taken was to reduce evaluation apprehension, this was done by giving prior information to the respondents that there is no right or wrong response and they were also assured that their responses will be treated with utmost confidentiality throughout the research. Secondly, in order to further reduce biases in this present study, the scale items were also improved. This was done by avoiding vague and inexplicit wordings in the questionnaire draft and whenever such concept is used, explanations were always given. Scale items were further improved by ensuring that the wordings of the questions in the survey instrument were written in a simple, straightforward and concise language that can be easily understood by the respondents.

Aside the aforementioned remedial procedures, the Podsakoff and Organ's (1986) Harman's single factor test was equally adopted to further examine common method variance. In conducting Harman's single-factor, and confirmatory factor analysis, post hoc statistical tests, all variables of interest were entered into exploratory factor analysis (EFA), with the aid of unrotated principal components factor analysis. This is done in order to determine the particular number of factors that are required to account for the variance in the variables. Thus, if there is a substantial amount of common method variance, then, either (1) a single factor will emerge from the factor analysis, or (2) one general factor will account for the majority of the covariance among the variables examined (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff & Organ, 1986; Podsakoff, Todor, Grover & Huber, 1984).

All the items in this study were thus subjected to principal components factor analysis, following the recommendations of Podsakoff and Organ (1986). The results of the analysis yielded ten factors, which explain a cumulative of 72.62% of the variance; with the first (largest) factor explaining 42.47 % of the total variance, which is a bit higher than 50% (c.f., Kumar, 2012). The results, thus, indicates that one of the 10 factors in this study slightly accounted for more than 50% of covariance in the predictor and criterion variables (Podsakoff et al., 2012). It should be noted that while the results of this test shows some possibilities of common method variance, they do suggest that common method variance is not of great concern in this study, and thus, it is unlikely to inflate the relationships among the variables measured in this study.

4.6 Profile of the Respondents

The description of the demographic profile of the respondents is given in this section. The particular demographic characteristics of the representatives of the companies who took part in the survey include position, work experience and gender. As presented in Table 4.4, 11.6% of the respondent were executive directors, 17.4% represents project managers, 2.8% were marketing managers, 16.7% engineers, 13.9% quantity surveyors, 8.9% contract managers, 7.2% construction managers, and 18.3% other senior staffs. This is followed by work experience of the respondents, where the highest percentage (46.5%) recorded was those whose experience was between 1 to 5 years, followed by participants with more than 10 years of experience, and 6-10 years in that order. As regards respondents' gender, male percentage was 67.5% as compared to 31.1% female respondents.

Table 4.4
Demographic Profile of Respondents

Respondents	**Frequency**	**%**
Position in the company		
Executive Director	20	11.6
Project manager	30	17.4
Marketing Manager	5	2.8
Engineer	30	16.7
Quantity Surveyor	25	13.9
Contract Manager	16	8.9
Construction Manager	13	7.2
Others	33	18.3
Work experience		
1-5 Years	80	46.5
6-10 years	42	23.3
More than 10 years	50	27.8

Table 4.4 (Continued)

Respondents	Frequency	%
Gender		
Male	116	67.5
Female	56	31.1

4.7 Profile of Firms

The first profile of companies sampled was company age. And the highest percentage (63.3%) represents companies that has been established more than 10 years ago. Next are companies that has been in existence between 6-10 years which constituted 15.6%, followed by those that were established within 1 - 5 years constituting 21.1%. Similarly, this descriptive statistics also reveals operational locations of companies sampled. And Table 4.5 reveals that majority of the sampled contractors (37.8%) operates across the entire Malaysia (including East Malaysia). The number of employees in the sampled companies was also revealed in this section. And companies with <100 employees responded most with 68.3% of the total sampled population. Finally, the company's descriptive statistics also shows respondents companies' specialization. Using a multiple response option, majority (31.7%) of the respondents chose residential, followed by infrastructure (26.3%), then, non-residential, social amenities, and others, constituting 24%, 10.3% and 7.7% respectively.

Table 4.5
Demographic Profile of Companies

Parameters	Frequency	%
Company age		
1-5 years	38	21.1
6-10 years	28	15.6
More than 10 years	114	63.3
Operational location		
Local market areas	35	20.3
Within few states	40	23.3
Regional	20	11.1

Table 4.5 (Continued)

Parameters	**Frequency**	**%**
Across the entire Malaysia (including East Malaysia)	68	37.8
International market	9	5.0
Workforce		
<100	120	69.7
101-250	13	7.6
251-500	10	5.6
>500	29	16.1
Specialization		
Residential apartment	99	31.7
Non-residential apartment	75	24.0
Social amenities	32	10.3
Infrastructure	82	26.3
Others	24	7.7

4.8 Descriptive Analysis of the Latent Constructs

In this section, the descriptive statistics for this study constructs are presented. This is done by computing both the mean and standard deviations. A five-point, using Alstone's (2001) Likert scale interpretation was used in measuring all the variables in this study, anchored by 1 = not at all to 5 = completely true. Values (range) in ascending order were assigned to these 5-point scale in the survey questionnaire thus: 1 = *not at all* (1.0-1.49); 2 = *slightly true* (1.5-2.49); 3 = *moderately true* (2.5-3.49); 3 = mostly true = (3.5-4.49); 5 = *completely true* (4.5-5.00).

Table 4.6
Descriptive Statistics for Latent Variables

Latent Variables	**Number of Items**	**Mean**	**Std. Deviation**
Product Innovativeness	5	3.489	.823
Process Innovativeness	4	3.679	.784
Business Innovativeness	4	3.688	.739
New Technology	4	3.876	.685
Adhocracy	10	3.809	.681
Market Orientation	9	3.781	.665
Environmental Protection	8	3.840	.668

Table 4.6 (Continued)

Latent Variables	Number of Items	Mean	Std. Deviation
Social Wellbeing	7	3.964	.653
Economic Prosperity	5	4.086	.665
Government Support	5	3.982	.686

In Table 4.6, it was revealed that the overall mean for this study's exogenous and endogenous latent variables were between the ranges of 3.489 and 4.086. Particularly, the mean and standard deviation for environmental protection, social wellbeing and economic prosperity were 3.840, .668; 3.964, .653 and 4.086, .665 respectively. Implying a moderate level sustainable construction Further, the table show a moderate score for government support with mean score of 3.982, and standard deviation of .686 respectively.

The descriptive statistics for the latent variables in this study depicts moderate score for almost all the variable. For instance, the mean of the four dimensions of organizational innovativeness (product innovativeness, process innovativeness, business innovativeness and new technology) were 3.489, 3.679, 3.688, and 3.876 respectively. This result is a strong indication that the respondents in this study have a moderate level of organizational innovativeness.

4.9 Assessment of PLS-SEM Path Model Results

It should be noted that a recent study by Henseler and Sarstedt (2013) recommends that goodness-of-fit (GoF) index is unsuitable for evaluation of the PLS SEM overall model, rather, a nonparametric evaluation criteria based on bootstrapping and blindfolding are considered (see also Hair et al., 2014 p. 101). In the light of this recent development, a two-step approach is adopted for the evaluation of PLS-SEM path model results. This two-step procedure, as recommended by Henseler, Ringle and Sinkovics (2009), comprises (1) measurement model assessment, where item reliability and validity are assessed, and (2) structural model assessment, where the significance of path coefficients are tested, and the coefficient of determination (R^2 value) is determined as shown in Figure 4.2.

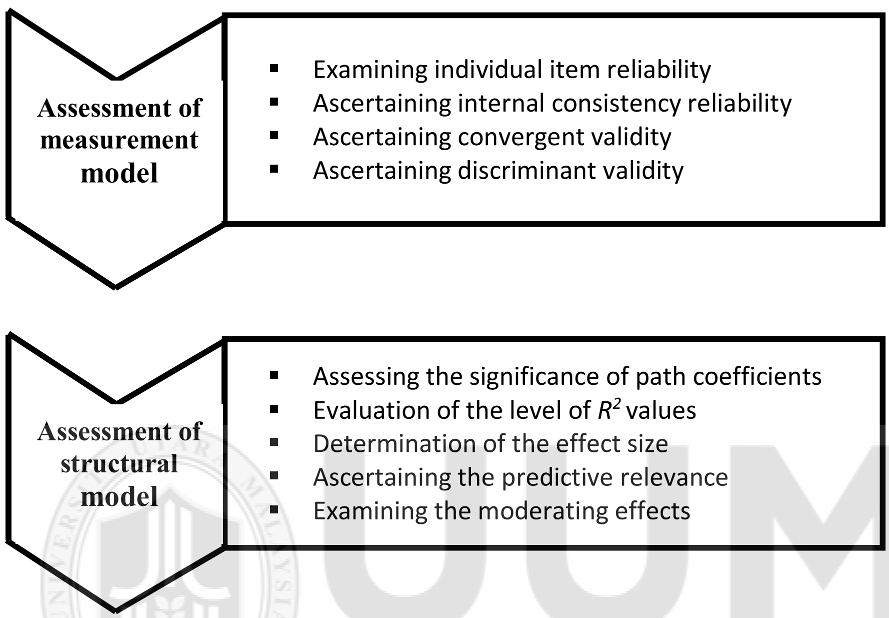


Figure 4.2
Approaches to PLS Path Model Assessment (Adapted from Henseler et al., 2009).

4.10 Measurement Model Evaluation

Measurement model evaluation involves the determination of individual item reliability, internal consistency of reliability, content validity, discriminant validity and convergent validity (Hair *et al*., 2014; Hair *et al*., 2011; Henseler *et al*., 2009).

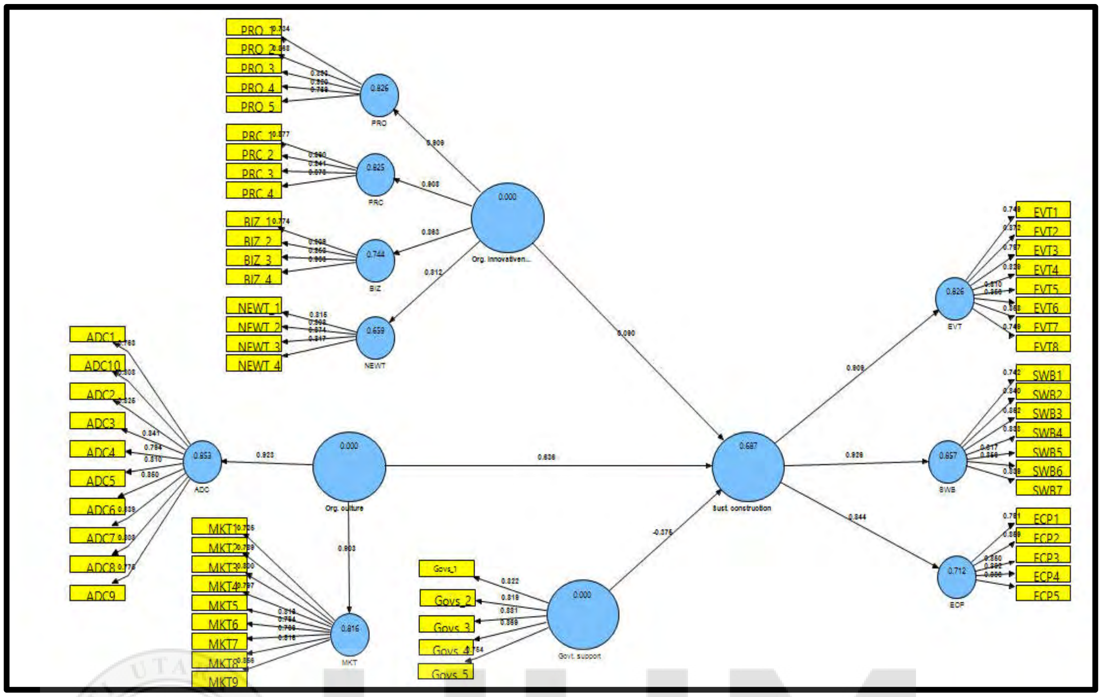


Figure 4.3
Measurement Model

4.10.1 Indicator/Item Reliability

The assessment of individual item reliability in this study was done by examining the outer loadings of each of the latent variables (Duarte & Raposo, 2010; Hair et al., 2014; Hair et al., 2012; Hulland, 1999). Following the rule of thumb that specifies the retaining of items having loadings between .40 and .70 (Hair et al., 2014), none of the 61 items in this study was deleted because they all presented loadings above the threshold of 0.40. Thus, in the whole model, the items had loadings between 0.725 and 0.909 (see Table 4.7).

4.10.2 Internal Consistency of Reliability

Internal consistency of reliability is the extent to which all parts of a given scale measure a concept (Sun *et al.*, 2007). In organizational research, Cronbach's alpha coefficient and composite reliability coefficient are widely used index in estimating the internal consistency of reliability of a scale, especially those containing multiple items (McCrae, Kurtz, Yamagata, & Terracciano, 2011; Peterson & Kim, 2013). Thus, in order to ascertain internal consistency of adapted measures in this study, composite reliability coefficient was preferred over Cronbach's alpha coefficient for some reasons. Research scholars (Barclay, Higgins & Thompson, 1995; Gotz, Liehr-Gobbers & Krafft, 2010) argues that in composite reliability coefficient, there is much less biased estimate of reliability than in Cronbach's alpha coefficient, because the assumptions of Cronbach's alpha coefficient is that all indicators simultaneously contribute to their mother construct, without giving credence to individual contributions of each of the items.

Further, as against composite reliability, there is a possibility of under-estimation or over-estimation of scale reliability in Cronbach's alpha, whereas composite reliability recognises the differences in item loadings in a model, which can be interpreted just as Cronbach's alpha.

Table 4.7
Loadings, Composite Reliability and Average Variance Extracted

Construct Dimensions	Items	Loadings	Composite reliability	AVE
Adhocracy	ADC1	0.763	0.951	0.659
	ADC2	0.825		
	ADC3	0.841		
	ADC4	0.794		
	ADC5	0.81		
	ADC6	0.85		
	ADC7	0.839		
	ADC8	0.808		
	ADC9	0.775		
	ADC10	0.808		
Business Innovativeness	BIZ1	0.774	0.92	0.742
	BIZ2	0.909		
	BIZ3	0.852		
	BIZ4	0.903		

Table 4.7 (Continued)

Construct Dimensions	Items	Loadings	Composite reliability	AVE
Economic Prosperity	ECP1	0.791	0.932	0.734
	ECP2	0.859		
	ECP3	0.85		
	ECP4	0.892		
	ECP5	0.886		
Environmental protection	EVT1	0.749	0.941	0.666
	EVT2	0.872		
	EVT3	0.797		
	EVT4	0.829		
	EVT5	0.81		
	EVT6	0.853		
	EVT7	0.858		
	EVT8	0.75		
Government Support	GOVS1	0.822	0.917	0.69
	GOVS2	0.819		
	GOVS3	0.881		
	GOVS4	0.869		
	GOVS5	0.754		
Market Orientation	MKT1	0.725	0.94	0.634
	MTK2	0.789		
	MKT3	0.8		
	MKT4	0.797		
	MKT5	0.816		
	MKT6	0.794		
	MKT7	0.766		
	MKT8	0.816		
	MKT9	0.856		
New Technology	NEWT1	0.815	0.898	0.687
	NEWT2	0.808		
	NEWT3	0.873		
	NEWT4	0.817		
Process Innovativeness	PRC1	0.877	0.926	0.758
	PRC2	0.89		
	PRC3	0.841		
	PRC4	0.873		
Product Innovativeness	PRO1	0.734	0.909	0.667
	PRO2	0.869		
	PRO3	0.883		
	PRO4	0.82		
	PRO5	0.769		

Table 4.7 (Continued)

Construct Dimensions	Items	Loadings	Composite reliability	AVE
Social Wellbeing	SWB1	0.742	0.938	0.683
	SWB2	0.84		
	SWB3	0.852		
	SWB4	0.833		
	SWB5	0.817		
	SWB6	0.856		
	SWB7	0.839		

Again, as suggested by the duo of Bagozzi and Yi (1988) and Hair *et al*., (2011), the rule of thumb for interpreting internal consistency of reliability using composite reliability coefficient was that the coefficient should not be less than .70. Thus, in Table 4.7, composite reliability coefficients of the study's constructs ranged from .898 to .951, indicating that the internal consistency of the latent variables in this study is adequate because they all exceed the minimum acceptable level of .70.

4.10.3 Convergent Validity

According to Hair *et al*., (2006), convergent validity explains the extent to which indicators of the latent construct correlate with each other and accurately represent the construct they are meant for. In determining this, the Average Variance Extracted (AVE), which is the average variance shared between a construct and its measures is examined. And this AVE value for a construct is expected to be greater than the variance shared between the construct and other constructs in the same model (Couchman & Fulop, 2006). The rule of thumb, however, is that an AVE value of 0.5 and above is considered acceptable (Barclay, *et al*., 1995). Table 4.7 provides the Average Variance Extracted (AVE) results with the resultant coefficients ranging from 0.634 to 0.758. This is an indication that convergent validity has been established for all the constructs in this study, as it was evident that all the items/indicators represent the latent constructs.

4.10.4 Discriminant Validity

Discriminant validity, according to Duarte and Raposo, (2010), implies the extent to which a latent construct differs from others in a model. To examine this, the square root of the AVE for each construct is used. That is, square roots of AVE coefficients are used to replace the correlation matrix along the diagonals (Fornell, & Larcker, 1981). Usually, the squared AVE (i.e., the diagonal coefficients) are expected to be greater than the off-diagonal coefficients or elements in the corresponding rows and columns (Hair *et al*., 2006). Besides, Fornell and Larcker (1981) suggests that an AVE score of .50 or higher is acceptable. And Table 4.7 has earlier indicated an acceptable level of AVE with values range from .634 to .758. Also, in Table 4.8, a comparison was made between the latent constructs' correlations and the square root of the AVE (appearing in bold), and it was clear that the square roots of all the AVE for all the constructs along the diagonals are higher than the corresponding off-diagonal coefficients both in rows and columns, signifying adequate discriminant validity (Fornell & Larcker, 1981).

Table 4.8
Latent Variable Correlations and Square Roots of Average Variance Extracted

Latent Variables	1	2	3	4	5	6	7	8	9	10
1. Adhocracy	**.812**									
2. Business Innovativeness	.590	**.861**								
3. Economic Prosperity	.561	.316	**.857**							
4. Environmental Protection	.619	.532	.634	**.816**						
5. Government Support	-.456	-.442	-.550	-.583	**.830**					
6. Market Orientation	.670	.523	.667	.680	-.510	**.796**				
7. New Technology	.731	.594	.418	.514	-.441	.556	**.829**			
8. Process Innovativeness	.563	.721	.394	.519	-.515	.488	.653	**.870**		
9. Product Innovativeness	.601	.705	.412	.526	-.473	.566	.649	.781	**.817**	
10. Social wellbeing	.595	.377	.718	.751	-.638	.662	.451	.407	.417	**.826**

Again, as suggested by Chin, (1998), discriminant validity could also be assessed by comparing the values of indicator loadings with that of cross-loadings, where all the indicator loadings, as a rule of thumb, should be higher than the corresponding cross-loadings.

This was depicted in Table 4.9, and it was evident that all indicator loadings (appearing in bold) did not only loaded above the recommended threshold value of 0.5 (Hair *et al.*, 2010), they are also higher than the cross loadings. This suggests that discriminant validity of the outer model is satisfactory.

Table 4.9
Cross Loadings

	ADC	BIZ	ECP	EVT	GOVT	MKT	NEWT	PRC	PRO	SWB
ADC1	**0.763**	0.489	0.445	0.511	-0.366	0.548	0.643	0.502	0.541	0.444
ADC2	**0.825**	0.449	0.348	0.475	-0.347	0.464	0.585	0.460	0.456	0.424
ADC3	**0.841**	0.450	0.435	0.410	-0.329	0.467	0.583	0.472	0.464	0.430
ADC4	**0.794**	0.403	0.544	0.453	-0.396	0.555	0.592	0.402	0.425	0.494
ADC5	**0.810**	0.514	0.530	0.463	-0.408	0.566	0.547	0.423	0.493	0.510
ADC6	**0.850**	0.456	0.453	0.502	-0.361	0.583	0.581	0.471	0.514	0.477
ADC7	**0.839**	0.499	0.532	0.628	-0.437	0.649	0.630	0.428	0.516	0.579
ADC8	**0.808**	0.466	0.434	0.461	-0.316	0.541	0.624	0.409	0.459	0.466

Table 4.9 (Continued)

	ADC	BIZ	ECP	EVT	GOVT	MKT	NEWT	PRC	PRO	SWB
ADC9	**0.775**	0.499	0.384	0.554	-0.367	0.537	0.577	0.495	0.503	0.449
ADC10	**0.808**	0.562	0.429	0.557	-0.360	0.505	0.573	0.518	0.505	0.546
BIZ1	0.455	**0.774**	0.292	0.438	-0.322	0.347	0.491	0.550	0.562	0.313
BIZ2	0.580	**0.909**	0.370	0.528	-0.434	0.523	0.538	0.701	0.686	0.389
BIZ3	0.432	**0.852**	0.129	0.397	-0.339	0.407	0.479	0.608	0.544	0.244
BIZ4	0.552	**0.903**	0.285	0.462	-0.419	0.508	0.535	0.615	0.625	0.346
ECP1	0.534	0.337	**0.791**	0.604	-0.517	0.550	0.376	0.392	0.417	0.653
ECP2	0.430	0.234	**0.859**	0.461	-0.425	0.521	0.321	0.307	0.310	0.525
ECP3	0.455	0.253	**0.850**	0.510	-0.517	0.600	0.327	0.360	0.349	0.647
ECP4	0.476	0.250	**0.892**	0.546	-0.452	0.603	0.364	0.288	0.313	0.600
ECP5	0.496	0.273	**0.886**	0.580	-0.440	0.574	0.394	0.336	0.367	0.635
EVT1	0.584	0.460	0.478	**0.749**	-0.537	0.590	0.470	0.420	0.421	0.648
EVT2	0.551	0.435	0.556	**0.872**	-0.458	0.618	0.441	0.466	0.497	0.626
EVT3	0.461	0.412	0.545	**0.797**	-0.476	0.546	0.441	0.417	0.441	0.576
EVT4	0.465	0.465	0.522	**0.829**	-0.473	0.558	0.403	0.396	0.421	0.565
EVT5	0.485	0.402	0.515	**0.810**	-0.412	0.507	0.357	0.423	0.408	0.560
EVT6	0.457	0.408	0.505	**0.853**	-0.479	0.512	0.429	0.389	0.388	0.617
EVT7	0.545	0.491	0.528	**0.858**	-0.507	0.584	0.446	0.448	0.453	0.655
EVT8	0.489	0.396	0.485	**0.750**	-0.460	0.517	0.359	0.426	0.396	0.652
Govs1	-0.324	-0.260	-0.461	-0.438	**0.822**	-0.399	-0.273	-0.382	-0.340	-0.552
Govs2	-0.392	-0.438	-0.497	-0.504	**0.819**	-0.416	-0.402	-0.442	-0.391	-0.527
Govs3	-0.394	-0.376	-0.505	-0.487	**0.881**	-0.472	-0.380	-0.444	-0.423	-0.573
Govs4	-0.397	-0.429	-0.440	-0.527	**0.869**	-0.449	-0.402	-0.472	-0.445	-0.546
Govs5	-0.385	-0.325	-0.373	-0.461	**0.754**	-0.373	-0.373	-0.392	-0.359	-0.446
MKT1	0.513	0.395	0.416	0.543	-0.303	**0.725**	0.452	0.376	0.405	0.483

Table 4.9 (Continued)

	ADC	BIZ	ECP	EVT	GOVT	MKT	NEWT	PRC	PRO	SWB
MKT2	0.581	0.428	0.546	0.547	-0.354	**0.789**	0.507	0.363	0.410	0.508
MKT3	0.519	0.428	0.561	0.564	-0.402	**0.800**	0.441	0.401	0.472	0.556
MKT4	0.570	0.414	0.559	0.550	-0.394	**0.797**	0.452	0.440	0.489	0.523
MKT5	0.562	0.457	0.549	0.589	-0.480	**0.816**	0.447	0.445	0.481	0.603
MKT6	0.499	0.411	0.492	0.501	-0.380	**0.794**	0.416	0.375	0.461	0.485
MKT7	0.464	0.376	0.513	0.458	-0.396	**0.766**	0.424	0.365	0.425	0.481
MKT8	0.505	0.394	0.514	0.513	-0.418	**0.816**	0.425	0.340	0.405	0.531
MKT9	0.572	0.437	0.612	0.595	-0.510	**0.856**	0.424	0.386	0.501	0.566
NEWT1	0.629	0.609	0.341	0.496	-0.321	0.534	**0.815**	0.655	0.660	0.383
NEWT2	0.577	0.352	0.341	0.368	-0.367	0.350	**0.808**	0.454	0.434	0.368
NEWT3	0.623	0.446	0.383	0.430	-0.409	0.443	**0.874**	0.505	0.460	0.405
NEWT4	0.586	0.517	0.322	0.388	-0.373	0.486	**0.817**	0.518	0.557	0.338
PRC1	0.576	0.666	0.341	0.435	-0.402	0.466	0.626	**0.877**	0.764	0.338
PRC2	0.455	0.569	0.348	0.444	-0.475	0.393	0.597	**0.890**	0.662	0.338
PRC3	0.494	0.630	0.384	0.513	-0.448	0.432	0.505	**0.841**	0.650	0.395
PRC4	0.428	0.643	0.301	0.418	-0.472	0.403	0.541	**0.873**	0.636	0.351
PRO1	0.396	0.538	0.234	0.327	-0.355	0.357	0.398	0.547	**0.734**	0.263
PRO2	0.510	0.615	0.283	0.421	-0.382	0.434	0.568	0.665	**0.869**	0.335
PRO3	0.504	0.608	0.323	0.470	-0.370	0.438	0.562	0.677	**0.883**	0.361
PRO4	0.552	0.569	0.422	0.466	-0.402	0.526	0.523	0.636	**0.820**	0.378
PRO5	0.484	0.544	0.416	0.452	-0.424	0.552	0.585	0.655	**0.769**	0.360
SWB1	0.370	0.214	0.558	0.546	-0.440	0.485	0.308	0.297	0.322	**0.742**
SWB2	0.447	0.250	0.608	0.584	-0.523	0.514	0.339	0.312	0.292	**0.840**
SWB3	0.529	0.253	0.600	0.679	-0.472	0.556	0.388	0.308	0.317	**0.852**
SWB4	0.498	0.335	0.602	0.667	-0.526	0.582	0.373	0.360	0.370	**0.833**

Table 4.9 (Continued)

	ADC	BIZ	ECP	EVT	GOVT	MKT	NEWT	PRC	PRO	SWB
SWB5	0.568	0.441	0.589	0.649	-0.576	0.559	0.387	0.382	0.393	**0.817**
SWB6	0.496	0.327	0.635	0.624	-0.572	0.560	0.423	0.335	0.355	**0.856**
SWB7	0.523	0.356	0.557	0.585	-0.582	0.570	0.383	0.363	0.364	**0.839**

Thus far, the construct validity of this study's outer model has been established, and this is an indication that subsequent analysis, especially in terms of hypothesis testing, would be meaningful because valid and reliable latent constructs mostly offer remarkable contributions and findings that could be generalized. In essence, construct validity has been established in this study with the trio of content, convergent and discriminant validities.

4.11 Higher-order Model Establishment

Here, the justification for the inclusion of the higher-order model, also known as hierarchical component model (HCM), in this model is presented. As suggested by Hair, Hult, Ringle, & Sarstedt, (2013) higher-order constructs involves testing a second-order structures containing two levels of components – an approach that allows for a more parsimonious theoretical relationship and a reduction in model complexity. Again, this procedure gives more evidence in support of the theoretical model as indicated in the structural model, and it was performed in line with the suggestions offered by Chin (2010). Based on previous studies, three constructs in this study (organizational innovativeness, organizational culture and sustainable construction) are multi-dimensional and were considered as second order measurement model. The last construct, government support was measured as first order constructs, that is, it was measured directly by a respective set of indicators. Organizational innovativeness has four dimensions namely: product innovativeness, process innovativeness, business innovativeness and new technology. The dimensions of organizational culture are adhocracy and market orientation, while sustainable construction has environmental protection, social wellbeing and economic prosperity as its dimensions. In estimating the model, the latent variable scores of these construct's dimensions were taking as indicators.

Subsequently, to further advance knowledge on the existing theoretical basis, the consideration of the first order constructs (i.e., the dimensions of organizational innovativeness, organizational culture, and sustainable construction) should be described conceptually by their second order constructs (organizational innovativeness, organizational culture, and sustainable construction), as suggested by Byrne (2010) that the first order constructs have to be explained appropriately by the hypothesized second order constructs and they are also expected to be remarkably distinct. Thus, before the estimation of the research model, it is important to establish the fact that the second order constructs are capable to conceptually describe the first order constructs under consideration. Hence, Table 4.10 presents the results that establishes organizational innovativeness, organizational culture, and sustainable construction as the second order constructs in this present study.

Table 4.10
Second-order Construct Establishment

Second-order Constructs	First-order Constructs	Standardized Loadings	SE	T-Value	P-Value	R^2
Organizational Innovativeness	Product Innovativeness	0.909	0.012	23.931	0.000	0.826
	Process Innovativeness	0.908	0.013	21.484	0.000	0.825
	Business Innovativeness	0.863	0.013	21.298	0.000	0.744
	New Technology	0.812	0.015	19.529	0.000	0.659

Table 4.10 (Continued)

Second-order Constructs	First-order Constructs	Standardized Loadings	SE	T-Value	P-Value	R^2
Organizational Culture	Adhocracy	0.924	0.014	37.452	0.000	0.853
	Market orientation	0.903	0.017	34.337	0.000	0.816
Sustainable Construction	Environmental Protection	0.909	0.010	39.378	0.000	0.826
	Social wellbeing	0.926	0.008	47.680	0.000	0.857
	Economic Prosperity	0.844	0.010	37.666	0.000	0.712

P <0.01

It can be seen in Table 4.10 that the four first order constructs of organizational innovativeness which are: product innovativeness, process innovativeness, business innovativeness, and new technology are well explained by organizational innovativeness construct as the R^2 values for these four range from 65.9% to 82.6%. In the same manner, the two first order constructs of organizational culture (adhocracy and market orientation) are also seen to have been explained well by the second order construct (organizational culture), considering the R^2 value recorded for market orientation and adhocracy, which are 81.6% and 85.3% respectively. Again, as regards the R^2 value recorded for the three first order constructs of sustainable construction, the value shows that they have been able to better explain the sustainable construction construct with environmental protection having 82.6%, social wellbeing with 85.7%, and economic prosperity with 71.2%. Therefore, the results shown in Table 4.10 confirm the distinct nature of this study's constructs, and as such, organizational innovativeness, organizational culture, and sustainable construction as second order constructs have been established and explained by nine hypothesized constructs in the first order.

4.12 Assessment of Significance of the Structural Model

Here, having ascertained the veracity of the outer model in this study, the assessment of the structural model, where the relationships between latent variables (constructs) will be established. Thus, this study applied the nonparametric evaluation criteria based on bootstrapping procedure with 5000 bootstrap samples and 172 cases to in order to assess the significance of the path coefficients (Hair *et al*., 2014; Hair *et al*., 2011 ; Hair *et al*., 2012; Henseler *et al*., 2009). In Figure 4.4, this study's structural (inner) model, including the moderating effects is depicted.

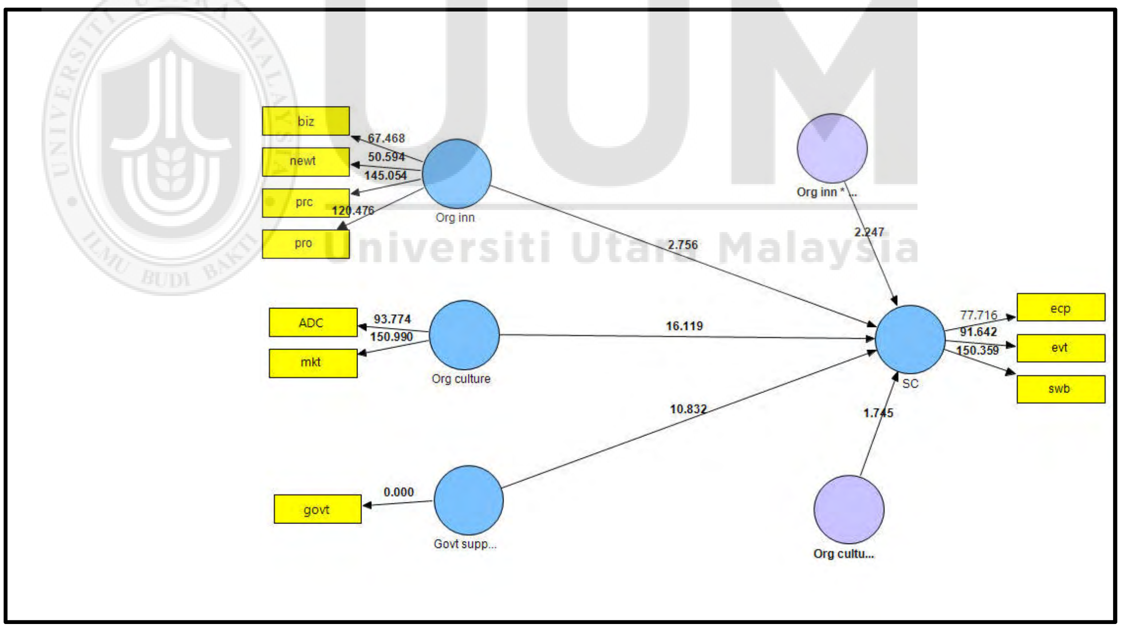


Figure 4.4
Structural Model with Moderator (Full Model)

Equally, Table 4.11 shows the estimates for the full structural model including the moderating variable, which is government support.

Table 4.11
Structural Model Assessment with Moderator

Hyp	Relationship	Std. Beta	SE	t-value	P-Value	Decision
H1	Org. Innovativeness -> SC	0.101	0.036	2.836**	0.002	Supported
H2	Org. Culture -> SC	0.651	0.040	16.181***	0.000	Supported
H3	Govt. Support -> SC	-0.366	0.034	10.861***	0.000	Not Supported
H4	Org. Innovativeness * Govt. Support -> SC	0.086	0.040	2.141**	0.016	Supported
H5	Org. Culture * Govt. Support -> SC	0.062	0.037	1.698**	0.045	Supported

Note: ***Significant at 0.01 (1 tailed), **Significant at 0.05 (1 tailed)

Table 4.11 shows the assessment of the full model (including the moderating effect). Originally, it was predicted in hypothesis 1 that organizational innovativeness is positively related to sustainable construction. And the result in Table 4.11 indicates that when a construction company exhibits the capacity and propensity to create new construction product, process, business or new technology, adoption of sustainability in construction project execution will also be improved. By implication, construction company's drive and capacity to innovate in construction products, processes or concepts, business and technology is necessary for achieving sustainable construction ($\beta = 0.101$, $t = 2.836$, $p < 0.05$).

Secondly, the result in Table 4.11 also demonstrates that organizational culture strongly influence sustainable construction ($\beta = 0.651$, $t = 16.181$, $p < 0.01$). In other words, sustainable construction improves with construction company's set of fundamental assumptions, perceptions, norms and shared values (considered here as adhocracy culture and market orientation). Thirdly, the result demonstrates that Malaysian construction companies can adopt sustainable construction in their project execution without the influence of government support ($\beta = -0.366$, $t = 10.861$, $p < 0.01$). Fourthly, organizational innovativeness was also predicted to be positively related to sustainable construction (Hypothesis 4). The result demonstrated that there is a significant positive relationship between organizational innovativeness and sustainable construction.

Generally, insignificant results regarding relationship between government support and sustainable construction appears to be unexpected. It is surprising because it has been established in several contexts that government could stimulate sustainable construction through grants and subsidies as incentives for its adoption (Du Plessis, 2002; Abidin *et al*., 2013). Evidently, the result in this study has demonstrated that these variables are mutually exclusive in certain instances. This is an indication that construction companies operating in Malaysia has the capacity to adopt sustainable construction in their project execution without the support from the government.

4.12.1 Evaluation of Variance Explained in the Endogenous Latent Variables

According to PLS-SEM researchers (Hair *et al*., 2011; Hair *et al*., 2012; Henseler *et al*., 2009), another very important and commonly used criterion for assessing structural model is the coefficient of determination (*R*-squared value). This coefficient is a measure of the proportion of an endogenous latent construct's variance that is explained by one or more criterion construct(s). It measures a model's predictive accuracy and could be calculated as the squared correlation that exists between a specific endogenous construct's actual and predicted values (Elliott & Woodward, 2007; Hair *et al*., 2010; Hair *et al*., 2006). Thus, it is difficult to provide a rule of thumb for an acceptable R^2 value, as it varies across research disciplines and dependent on the complexity of research models (Hair *et al*., 2014). However, Falk and Miller (1992) had earlier suggested a minimum acceptable level of R^2 to be 0.10. Again, R^2 values of 0.67, 0.33, and 0.19 are considered as substantial, moderate, and weak, respectively (Chin, 1998). In Table 4.12, the R^2 value in the endogenous latent variable is presented.

Table 4.12
Variance Explained in the Endogenous Latent Construct

Latent Construct	Variance Explained (R^2)
Sustainable Construction	69%

As shown in Table 4.12, this study's model explains 69% of the total variance in sustainable construction, suggesting that the three exogenous latent constructs (organizational innovativeness, organizational culture and government support), including the contributions of their dimensions, jointly explain 69% of the variance of the endogenous latent construct-sustainable construction. Thus, going by the suggestions of Falk and Miller (1992), and Chin (1998), this study's endogenous latent construct showed a substantial R^2 value (69%).

4.12.2 Evaluation of Effect Size (f^2)

In determining the strength of a model, R^2 value of the endogenous latent construct is determined. And because this procedure is suitable in estimating how substantial the impact of exogenous latent construct (s) on the endogenous construct. Thus, this is done by running a PLS algorithm while removing one exogenous construct from the model in order to generate the R^2 excluded value for the same excluded construct. This procedure is repeated the second time by retaining the exogenous construct in the model to generate the R^2 included value (Hair *et al*., 2013). The changes in R^2 values obtained are used to compute the effect size (f^2) which, according to Hair *et al*., (2013) is calculated with the following formula:

$$f^2 = \frac{R^2 included - R^2 excluded}{1 - R^2\ included} \tag{4.1}$$

According to Cohen (1988), f^2 values of 0.02, 0.15 and 0.35 are considered as weak, moderate, strong effect sizes respectively. Thus, in Table 4.13, the respective effect sizes of each of the latent variables in the structural model is presented.

Table 4.13
Effect Size on the Endogenous Latent Construct, based on Cohen's (1988) recommendation

R-squared	R^2 Incl.	R^2 Excl.	R^2incl-R^2excl	1- R^2incl	Total Effect
Organizational Innovativeness	0.691	0.686	0.005	0.309	0.016
Organizational Culture	0.691	0.501	0.190	0.309	0.615
Government Support	0.691	0.600	0.091	0.309	0.295

As indicated in Table 4.13, the effect sizes for organizational innovativeness, organizational culture, and government support on sustainable construction are 0.016, 0.615 and 0.295 respectively. Thus, following Cohen's (1988) guideline, the effects sizes of these three exogenous constructs on sustainable construction can be considered as none, large, and medium respectively. Moreover, two out of the three exogenous constructs in this study, namely organizational culture, and government support were seen to contribute reasonably to the high R^2 value (69%) in the endogenous construct.

4.12.3 Predictive Relevance of the Model

According to Hair *et al*., (2010), analysis using PLS SEM relies on measures validating the model's predictive capabilities to determine the model's quality. This procedure is carried out following Stone-Geisser test of predictive relevance, which is mostly used to complement goodness-of-fit assessment in PLS SEM (Duarte & Raposo, 2010). The predictive quality of a model is assessed by examining the cross-validated redundancy measure, denoted by Q^2 (Chin, 2010; Geisser, 1974; Hair et al., 2014; Stone, 1974). And according to Fornell and Cha (1994), for a model to have a predictive validity, the redundant communality should be greater than zero for the endogenous constructs, thus, a research model with higher Q^2 values suggests a reasonable predictive relevance.

Table 4.14 shows the results of the cross-validated redundancy Q^2 test. SmartPLS uses blindfolding procedure to determine the predictive relevance of a model. In Blindfolding technique, according to Fararah and Al-Swidi, (2013), some data were removed and then they are estimated as missing values. These estimated parameters are thereafter used to recreate these missing data points, after which, a comparison is made to evaluate the difference between the real results and the implied results, thus generating the Q^2 values. However, there are varying forms of Q^2 depending on the form of desired prediction (Chin, 2010). When the underlying latent variable score cases are used in the prediction of data points, cross-validated communality has been achieved, however, when a latent variable which predicts the block under consideration is used in predicting the data points, cross-validated redundancy is said to have been obtained (Chin, 1998; Duarte & Raposo, 2010; Wold, 1982). Thus, Table 4.14 presents the results of the cross-validated redundancy Q^2 test.

Table 4.14
Construct Cross-Validated Redundancy

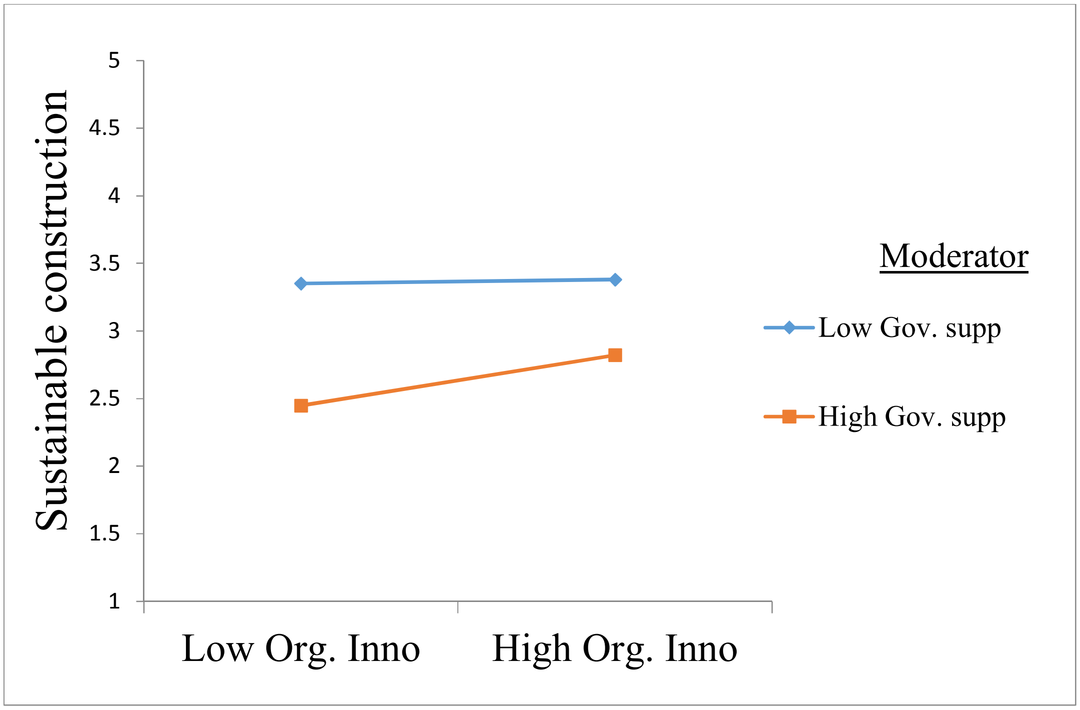
Total	SSO	SSE	1-SSE/SSO
Sustainable Construction	540	246.440	0.544

In table 4.14, the sum of the squared observations (SSO), including the sum of the squared prediction errors (SSE) were obtained. The table also shows the value of the predictive relevance Q^2 (1-SSE/SSO). Thus, in this path model, the predictive relevance Q^2 of the endogenous latent variable (sustainable construction) has a value of 0.544, which is above zero. This implies that the model has predictive relevance for this construct (Chin, 1998; Fornell & Cha, 1994; Henseler *et al*., 2009).

4.12.4 Testing Moderating Effects

When the influence of an exogenous construct on an endogenous construct is contingent upon the values of another construct, then, a moderating effect exists where such construct moderates the relationship between the exogenous and endogenous latent variables (Hair *et al*., 2013). In this study, government support was hypothesized to moderate the relationship between organizational innovativeness and sustainable construction (H4); and also the relationship between organizational culture and sustainable construction (H5). Thus, in this study, product indicator approach using PLS SEM is applied to estimate the strength of the moderating effect of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction (Chin *et al*., 2003; Helm, Eggert, & Garnefeld, 2010; Henseler & Chin, 2010; Henseler & Fassott, 2010). Product indicator approach (also called interaction term) is suitable in this study given the fact the exogenous latent variables and moderator variable are both measured reflectively. Again, the results of product indicator approach are usually equal or superior to group comparison approach (Hair *et al*., 2014)

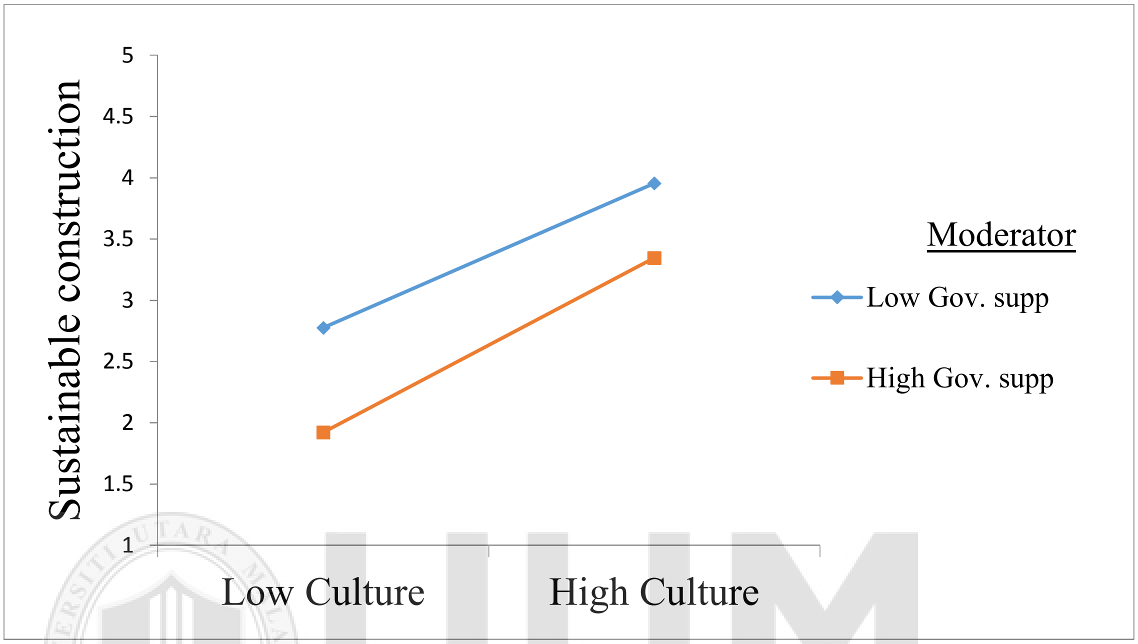
In order to apply the product indicator approach to test the moderating effects of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction, the product terms between the indicators of the exogenous latent variables (organizational innovativeness and organizational culture) and that of the moderating variable is created. According to Kenny and Judd, (1984), these product terms are then used as indicators of the interaction term in the structural model. In other words, the mean-centred indicator of the exogenous latent variable is multiplied by each indicator of the moderator. Furthermore, to determine the strength of the moderating effects, Cohen's (1988) recommendations is applied for the estimation of effect sizes. Thus, in both Figure 4.5 and Table 4.11, the estimates after the application of product indicator approach, (i.e., the product indicator approach for examining the moderating effect of government support on the relationship between exogenous and endogenous latent variables) has been established. Recall that Hypothesis 4 had earlier proposed that government support could moderate the relationship between organizational innovativeness and sustainable construction. As expected, the relationship is seen to be stronger for construction companies that benefits from government support than it is for those without support from the government, thus, indicating that the interaction terms representing organizational innovativeness and government support ($\beta = 0.086$, $t = 2.141$, $p < 0.05$) was significant statistically. Expectedly, hypothesis 4 was fully supported at 0.01 level of significance. The path coefficients in the structural model was also used in plotting the moderating effect of government support on the relationship between organizational innovativeness and sustainable construction, and Figure 4.5 clearly indicated that sustainable construction adoption through organizational innovativeness becomes more stronger (i.e. more positive) for construction companies with government support than for those that are not priviledged to have support from the government.



Government support strengthens the positive relationship between Organizational innovativeness and Sustainable construction.

Figure 4.5
Interaction Effects of Organizational Innovativeness and Government Support on Sustainable Construction.

Further, the result in Table 4.11 and Figure 4.6 support the fifth hypothesis, which stated that government support moderates the relationship between organizational culture and sustainable construction, to such an extent that this relationship is stronger (i.e. more positive) for contractors that are being aided by the government than it is for those that are disadvantaged in that regard ($\beta = 0.062$, $t = 1.698$, $p < 0.05$). The moderating effects of government support on the same relationship (i.e. relationship between organizational culture and sustainable construction) is also depicted in Figure 4.6, where it was shown that there is a stronger positive relationship between organizational culture and sustainable construction for contractors that are being supported by the government than it is for the contractors without support from the government.



Government support strengthens the positive relationship between organizational culture and sustainable construction.

Figure 4.6
Interaction effects of organizational culture and government support on sustainable construction.

4.12.5 Determining the Strength of the Moderating Effects

In this section, the strength of the moderating effects of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction is determined based on Cohen's (1988) effect sizes calculation. In this case, the strength of the moderating effects is determined by comparing the coefficient of determination (R^2 value) of the main effect model with the coefficient of determination (R^2 value) of the full model when the exogenous latent variables and moderating variable are combined (Henseler & Fassott, 2010a). The strength of the moderating effects is thus, expressed using the following formula:

$$\text{Effect size } (f^2) =$$

$$\frac{R^2 \, model \, with \, moderator - R^2 model \, without \, moderator}{1 - R^2 \, model \, with \, moderator} \quad (4.2)$$

Moderating effect sizes (f_2) values, based on Cohen's (1988) criterion is evaluated using:

✓ 0.02 small effect sizes

✓ 0.15 medium effect sizes

✓ 0.35 large effect sizes

Again, Chin *et al.* (2003) argues that a low effect size does not imply insignificance of the underlying moderating effect, as Limayem *et al*, (2001) argues that "if there is a likelihood of occurrence for the extreme moderating conditions and the resulting beta changes are meaningful, then it is important to take these situations into account" (p.281). In Table 4.15, the result of the strength of the moderating effects of government support on the endogenous latent variable (sustainable construction) is depicted.

Table 4.15
Strength of the Moderating Effects Based on Cohen's (1988) recommendations.

	R-squared			
Endogenous Latent Variable	**Included**	**Excluded**	**f-squared**	**Effect size**
Sustainable Construction	0.695	0.600	0.311	Medium

Considering Cohen's (1988) rule of thumb for the determination of the strength of the moderating effects in this study, Table 4.15 shows that the interaction effect of government support on the endogenous latent variable was 0.311, indicating a solid medium moderating effect (Henseler, Wilson, Götz, & Hautvast, 2007; Limayem *et al*, 2001; Wilden, Gudergan, Nielsen & Lings, 2013).

4.13 Summary of Hypotheses' Results

In this section, the summary of the results of the hypothesized relationships in this study are presented. As shown in Table 4.16, while hypotheses H1, H2, H4 and H5 were supported, only H3 is not supported.

Table 4.16
Summary of Hypotheses Testing

Hyp.	Hypothesized Paths	Findings
H1	Organizational Innovativeness -> Sustainable Construction	Supported
H2	Organizational Culture -> Sustainable Construction	Supported
H3	Govt. Support -> Sustainable Construction	Not Supported
H4	Organizational Innovativeness * Government Support -> Sustainable Construction	Supported
H5	Organizational Culture * Government Support -> Sustainable Construction	Supported

4.14 Discussion of Findings

4.14.1 Extent of Sustainable Construction (Objective 1)

As mentioned in Chapter 1, the first objective of this research is to determine the extent of sustainable construction among Malaysian large construction companies. Abidin (2005) categorizes sustainability considerations within the construction practitioners using a five-level rating scale, which include: 1= Very Low; 2= Low; 3= Moderate; 4= High; 5= Very High. In her study, Abidin described construction practitioners based on matters concerning sustainability and value management. Those having "very high" sustainability consideration in their construction project execution "consider almost all sustainability issues listed in the survey". Practitioners with "high" sustainability consideration are those that "consider most of the issues" in their construction project. And those with "moderate" sustainable construction consideration tends to "consider some of the issues" of sustainable construction in project execution. Construction practitioners with "low" sustainability consideration are those with the tendency to "consider a few of the issues", and "very low" signifies construction companies with "no consideration of the listed issues"

This research adapts Abidin's (2005) sustainable construction categorisation with little modifications. In the researcher's view, using the same likert scale for all the study's latent variables would not only generate consistency of the questionnaire items, it will also allow for comparability and make response easier for the respondents, so that they do not lose ground on the differences between elements in the scale. Thus, following Kamaruddeen *et al's*., (2012) interpretation of the Likert scale, the values used in this study to define the 5-point Likert scale were as follows: 1 = not at all (1.0-1.49); 2 = slightly true (1.5-2.49); 3 = moderately true (2.5-3.49); 3 = mostly true = (3.5-4.49); 5 = completely true (4.5-5.00). Then, Abidin's (2005) sustainable construction rating scale namely: very high, high, moderate, low, and very low were adapted to interpret this study's 1 to 5 point Likert scale as follows: not at all (1.0 to 1.49) = very low; slightly true (1.5 to 2.49) = low; moderately true (2.5 to 3.49) = moderate; mostly true = (3.5 to 4.49) = high; and completely true (4.5 to 5.00) = very high. Finally, Malaysian large construction companies' sustainable construction extent was determined by examining which of the range adopted corresponds with the mean score of sustainable construction recorded in the SPSS descriptive statistics output. For instance, a mean score that falls between 1.0 and 1.49 indicates a very low sustainable construction extent.

Table 4.17

Extent of Sustainable Construction among Malaysian Construction Companies

Sustainable construction extent	Frequency	Percentage	Mean	Median	Mode	SD
Very low	-	-				
Low	2	1.20				
Moderate	35	19.60				
High	108	60.00	3.95	4.00	4.00	0.59
Very High	35	19.50				

In Table 4.17, the frequency and percentage scores for the extent of sustainable construction among Malaysian construction companies are presented. Those contractors with high extent of sustainable construction has the highest frequency (108) with 60 %. The mean score (3.95) implies that extent of sustainable construction among Malaysian construction companies falls within those with high extent of sustainable construction.

Table 4.18

Extent of Environmental protection among Malaysian Construction Companies

Environmental protection extent	Frequency	Percentage	Mean
Very low	-	-	
Low	4	2.3	
Moderate	42	23.5	
High	98	54.5	3.84
Very High	36	20	

Table 4.18 presents the frequency and percentage scores of environmental protection among Malaysian construction companies. The highest frequency score (98) and percentage (54.5 %) are the construction companies with high extent of environmental protection in their project execution. However, the mean score (3.84) shows that the environmental protection extent of Malaysian large construction companies is high.

Table 4.19
Extent of Social wellbeing among Malaysian Construction Companies

Social wellbeing extent	Frequency	Percentage	Mean
Very low	-	-	
Low	3	1.80	
Moderate	36	20.00	
High	104	57.90	3.96
Very High	37	20.50	

Table 4.19 presents the frequency, percentage, and mean score for social wellbeing among Malaysian construction companies. The score with highest frequency (104) and percentage (57.90 %) falls within the high social wellbeing category. And the mean score (3.96) also implies that the social wellbeing of Malaysian large construction companies is at the high social wellbeing extent.

Table 4.20
Extent of Economic prosperity among Malaysian Construction Companies

Economic prosperity extent	Frequency	Percentage	Mean
Very low	1	0.60	
Low	1	0.60	
Moderate	30	16.60	
High	109	60.60	4.09
Very High	39	21.70	

In Table 4.20, the frequency and percentage scores for economic prosperity of Malaysian construction companies is presented. The score with highest frequency (109) and the percentage (60.6 %) is those construction companies that has high level of economic prosperity. The mean score (4.09) implies that economic prosperity of Malaysian contractors is at the high level. By implication, the extent to which the Malaysian large contractors adopt economic prosperity dimension of sustainable construction is high. The same goes for the remaining two dimensions of sustainable construction, which are environmental protection and social wellbeing.

The next section outlines the relationships among latent variables as stated in the study's objectives, and the hypothesized statements.

In this study, an empirical investigation was conducted to test a model that is based on relationships among latent variables as presented earlier in the theoretical framework. This study's framework pertains to influence of organizational innovativeness, culture, and government support on sustainable construction among Malaysian large contractors with the introduction of moderating effects of government support. Information/data for testing the hypotheses postulated in this study is from representatives (executive directors, project managers, marketing managers, engineers, quantity surveyors, contract managers, sales managers, or account managers) of the contracting companies from across peninsula Malaysia, which eventually led to the accomplishment of research objectives that emerged from the problem statement and research questions. Expectedly, the PLS SEM measurement model (outer model) was accomplished after numerous stages of desirable statistical treatment to establish the relationships between the exogenous latent variables and their indicators. This was adequately refined and paved the way for the structural model (inner model) which further enabled testing of the hypothesized paths. Thus, in the sections that follows, hypotheses results in relation to the research objectives are discussed.

Direct Paths

The second objective of this study was to investigate the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies. In order to achieve this objective, a hypothesis (H1) was formulated where organizational innovativeness was considered as antecedent of Malaysian construction companies towards adopting sustainable construction in their project execution.

4.14.2 Relationship between Organizational Innovativeness and Sustainable Construction (Objective 2, Hypothesis 1)

Hypothesis H1, which asserts a positive significant relationship between organizational innovativeness and sustainable construction was accepted using PLS output, when a significant relationship was found to exist between these two constructs. Organizational innovativeness have been empirically supported by various studies to have positive influence on sustainable construction. For example, previous researches in the field of construction management emphasized the need for construction organizations to focus on green innovation, not only to improve the construction projects' quality, but also for sustainability considerations, so that companies' position in the marketplace is improved (Gluch, Gustafsson & Thuvander, 2009). This result is also consistent with Sharifi and Murayama, (2013), who found that innovative construction techniques is being rewarded for its ability to improve adaptability, flexibility, and also the capabilities of the sustainability assessment tools. Additionally, innovativeness is noted for its significant benefits in green building systems and energy efficiency, and it has generated additional dimensions to the ongoing research in sustainable building (Ghaffarian Hoseini, *et al*., 2013).

In the same vein, Tan, *et al*., (2011) also attributed construction company's technology and innovation capabilities to the major principles necessary to attain sustainability of the construction processes and its resultant outputs. By exhibiting the ability for value creation in terms of introducing new product to the market, sometimes called radical innovations, firms will most likely be capable of incorporating sustainability in construction orientation and processes. Put differently, the higher the construction company's propensity and capacity to innovate, the stronger their ability to adopt sustainable construction in their project execution. And, with a β value of 0.101 for this relationship, organizational innovativeness has been established as having a strong influence on sustainable construction adoption in Malaysian large construction companies. This corroborates the findings of Bossnik (2004), who revealed that construction organizations employ several innovation drivers at all identified levels of organizations to attain sustainable construction.

4.14.3 Relationship between Organizational Culture and Sustainable Construction (Objective 3, Hypothesis 2)

Hypothesis H2 which predicted that organizational culture would be positively related to sustainable construction was also supported with a large effect size of ($f^2 = 0.615$), suggesting that when construction companies incorporates organizational culture (in terms of adhocracy and market orientation) the greater will their chances of adopting sustainable construction. This findings is in congruence with the Resource-Based View (RBV) theory, which suggests culture within an organization as a viable source of sustained competitive advantage (Barney & Clark, 2007); and that firms that possess strong cultures are regarded as models of management excellence (Peters & Waterman 1982). Recall that Deal and Kennedy (1982); and Peters and Waterman (1982) interprets culture as a complex set of values, beliefs, assumptions, and symbols that gives definition to the very way by which organizations do business. And based on the economic value description put forward by Peters and Waterman (1982), certain features of exceptional and successful organizations reflects, to a large extent, a strong values and beliefs in organizational cultures. And firms without such a strong values and beliefs are always laggards in productivity maximisation (Barney & Clark, 2007; Kantabutra & Suriyankietkaew, 2012). Thus, this relationship between organizational culture and sustainable construction was positive considering the fact that sustainable construction is always a success story wherever it is implemented, because, applying its principles in project execution ensures project success, improve project's image and stimulate competitive advantage within the industry (Parkin, 2000; Powmya & Zainul Abidin, 2014).

4.14.4 Relationship between Government Support and Sustainable Construction (Objective 4, Hypothesis 3)

In Hypothesis H3, it was postulated that there will be a significant positive relationship between government support and sustainable construction among Malaysian large construction companies. As indicated in the PLS path modelling results, government support was negatively but significantly related to sustainable construction. This findings indicate that government support is negatively correlated with sustainable construction. Although, the study design shows that sustainable construction is dependent on government support as one of the predictors, but the data collected does not have sufficient power to detect the dependence in this instance. Thus, the result in this study deviates from the findings of previous researchers in this field (Abidin *et al*., 2013; Du Plessis, 2002; Häkkinen & Belloni, 2011; Majdalani, et al., 2006; Akadiri & Fadiya, 2013; Shen & Yao, 2006; Khanna & Brouhle, 2009; Cabugueira, 2004; Akadiri et al., 2012). However, possible reasons that can be attributed to this inconsistent finding is that past researches on government support considered different indicators to measure government support. Furthermore, for government support to have a noticeable influence on sustainable construction delivery, it must incorporate supports like financial incentive, rebate and subsidy programmes, tax reduction strategies (Samari *et al*., 2013) to contractors in particular, who are one of the major players in the construction industry that can promote sustainable construction in all construction stages. Equally, this result corroborates a recent study by Abidin et al., (2013) which submitted that although the promotion of sustainable construction within the Malaysian construction industry in recent years has yielded several green movements, where R&D, government support, and public awareness should have created further opportunities for its adoption, however, the practice has not been widely applied. As such, future research efforts is necessary to examine the conditions under which a specified government support effect on sustainable construction will be considered.

Moderating Paths

4.14.5 Moderating Role of Government Support on the Relationship between Organizational Innovativeness and Sustainable Construction (Objective 5, Hypothesis 4)

The fourth hypothesis, which was formulated in response to the sixth research question, predicted that government support would significantly moderate the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies. This is also in line with the fifth objective of this study, which aimed to determine the moderating influences of government support on the relationship between organizational innovativeness and sustainable construction among Malaysian large construction companies. A moderating variable, according to Baron and Kenny, (1986), generally refers to "qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (p.1174). Specifically, this relationship is stronger (positively) for construction companies with high government support than it is for construction companies with low government support. Due to the fact that the findings regarding moderating effects represent the major contribution of this study, more robust explanations of the moderating effect government support could be given from both the theoretical perspectives and prior empirical studies.

The present study considers government support to moderate the relationship between organizational innovativeness, organizational culture and sustainable construction based on the findings in several earlier studies that argued in favour of its potentialities to play a significant role in promoting sustainable construction within the construction industry. Governments has been a major player in both initiation and implementation of sustainable construction practices by developing environmental policies that defines sustainability goals and visions for several years (Joss, 2011; Samari et al., 2013). The findings is also consistent with Pekuri, Haapasalo, and Herrala, 2011; and Seng, *et al*., (2012) who reported the role of the Malaysian government, through the Construction Industry Development Board (CIDB) in strengthening the construction players through periodic workshops, conferences and seminars to guarantee them a prominent place within the international marketplace; and by developing capabilities and apply advanced design and construction technologies for sustainable delivery and overall performance of the construction industry. Again, Wade (1990) had earlier reported the successes in government-industry relations in the Newly Industrialized Economies (NIEs) by revealing that a substantial government intervention was witnessed in the so called "free market" success stories. In the same line of reasoning, Hobday, Cawson and Kim (2001) also drew our attention to government intervention in the electronics industries of East and South-east Asia, where they found that government support was able to give direction and also reflect industrial structure and corporate behaviour.

4.14.6 Moderating Role of Government Support on the Relationship between Organizational Culture and Sustainable Construction (Objective 6, Hypothesis 5)

Hypothesis 5, which asserted a positive moderating influence of government support on the relationship between organizational culture and sustainable construction among Malaysian large construction companies was found to be supported. This hypothesis was formulated to respond to the sixth research question, and findings provide support for the hypothesis. These findings are not surprising because they are in consonance with earlier studies. Mousa, (2015) had indicated that modest sustainable construction could be more practiced within the construction industry in most developing countries with the presence of governmental monitoring and legislative support, and also when the construction industry's informal culture is transformed through unfreeze-change-lock model. Again, Häkkinen and Belloni, (2011) had argued that the fragmentized culture of the construction industry and the involvement of several actors in construction project execution require performance-based government regulations to support construction sustainability. In the same line of reasoning, while highlighting the importance of government support for sustainable construction, Pitt *et al*., (2009), noted that fiscal incentives and regulations drive its adoption. The drive towards the sustainable construction implementation results from the government's involvement and support in terms of regulation incentives provided to construction stakeholders that are responsible for sustainable construction delivery (Bamgbade, Kamaruddeen, Nawi, & Aziz, 2015). Particularly, one of the effective measures to undertake is to encourage ecological inducements in the taxation system. This, according to Priemus, (2005), will greatly alleviate problems associated with sustainable construction delivery.

In sum, support was found for four of the five hypotheses; a weak beta value was found in hypothesis H3 in particular. This does not imply that the hypothesis should be rejected absolutely. Rather, some measures need to be strengthened and a longitudinal study of these construction companies may be required to observe the full strength of government support on sustainable construction.

4.15 Summary of the Chapter

Due to the fact that this research model aims at extending the domain of organizational readiness to change theory and Resource-Based View (RBV) theory, thus, PLS-SEM was used to test the formulated hypotheses, as it has been found to be extremely useful in organizational research. The analysis started with the description of the variables in this study, including the profile of the respondents and the organizations they represent. Thereafter, the measurement model (also known as outer model in SmartPLS) was estimated to determine the validity and reliability of the construct measures. Immediately after these procedure, the structural model (inner model) was examined, where the relationships between latent variables were tested. On the final note, summary of hypotheses results was presented, which was followed by a comprehensive discussion on the results. In the next chapter, the key findings and contributions of this study are presented.

CHAPTER FIVE

RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

In this chapter, the main research findings that were presented and discussed in the previous chapter (Chapter Four) are related to the theoretical perspectives and previous studies related to sustainable construction. In specific terms, the rest of the chapter is organized as follows: recapitulation of this study's research findings was presented in Section 2. In Section 3, discussion was given on the findings of the study from the perspectives of the underpinning theories and previous studies. Theoretical, practical and methodological implications of the study are discussed in the sections that follow. And in the last section, this study's limitations are noted. And based on these limitations, suggestions for future research directions are made. Conclusion is then drawn in the final section.

5.2 Recapitulation of the Study

This study investigated the influence of organizational innovativeness and organizational culture on sustainable construction among Malaysian contractors, with moderating effects of government support. The theoretical framework under study was underpinned by the organizational readiness to change and Resource-Based View (RBV). After an extensive literature review was conducted, adopted scale items from the previous studies were adapted to suit this present study. Thereafter, a pilot study was carried out, where a total of forty-five (45) contracting firms' representatives were sampled during the Construction Industry Development Board (CIDB) seminar on "Innovation & Technology Sustainable Construction", based on a 5-point interval scale which have been validated through several statistical measures (item's reliability and validity). Furthermore, the main data collection was done in all the eleven states of the Peninsular Malaysia, leading to the screening of the data, estimation of content validity, factor loading significance and convergent and discriminant validities under PLS SEM outer model specification with the aid of SmartPLS 2.0 SEM software. After the establishment of the measurement model, two independent variables (organizational innovativeness and organizational culture) and the dependent variable were established as second order constructs which necessitated further examination of effect sizes and predictive relevance of this study's model. Upon satisfactory examination of these statistical measures, the inner model specification (structural model), which was used for testing the hypothesized paths was evaluated. In this study, a variance of 69 % (Table 4.11) for sustainable construction is considered "substantial" going by the suggestions of Falk and Miller (1992) and Chin (1998) that R^2 values of 0.67, 0.33, and 0.19 are considered as substantial, moderate, and weak, respectively. This study's hypotheses consisted of direct and moderating paths which were calculated using several statistical analyses to determine the significance of their results. Specifically, the moderating effects of government support on the relationships between organizational innovativeness – sustainable construction, and organizational culture – sustainable construction were tested through bootstrap method.

5.3 Theoretical Contributions

This study's conceptual framework was based on prior empirical studies and theoretical gaps that have been identified in the extant literature. The framework was supported and also explained from two theoretical perspectives, which are: organizational readiness for change theory (Khosrowshahi & Arayici, 2012; Kim *et al*., 2011; Pettigrew, *et al*., 2001; Weiner, 2009), and resource-based view theory (Barney, 2015). This study also incorporated government support as a moderating variable to better explain and understand the relationship between organizational innovativeness, organizational culture and sustainable construction. Thus, based on the findings and discussions, this study was able to make several theoretical contributions within the field of sustainable construction, organizational innovativeness and organizational culture.

5.3.1 Additional Empirical Evidence in the Domain of Organizational Readiness for Change Theory

This study has been able to provide some theoretical implications by giving additional empirical evidence in the domain of organizational readiness for change. The theory originally postulates a broad-range approach that is meant to develop capacity that is useful for complex changes within healthcare service delivery organizations (Edwards *et al*., 2010; Fuller *et al*., 2007; Gotham, Claus, Selig & Homer, 2004; Weiner, 2009). In specific terms, the model highlights the motivation and attributes of healthcare workers, along with available organizational environment and resources, as the most important constructs that are needed to expose, adopt, implement, and routinize certain innovative practices within the organization (Lehman, Greener, & Simpson, 2002; Simpson & Flynn, 2007).

However, instead of focusing on the motivation and attributes of workers to create innovative processes as advocated in the original model, this study extends the theory by examining the influence of innovative capabilities of construction organizations to deliver sustainable construction in project execution.

Again, the study also tested the moderating role of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction. Extant empirical studies regarding the direction of organizational innovativeness and sustainable construction relationship (e.g., Chan and

Liu, 2012; Gauthier and Wooldridge, 2012; Pietrosemoli & Monroy, 2013) as well as the relationships between organizational culture and sustainable construction (e.g., Al-Jamea, 2014; D'Incognito, *et al*., 2013) reported inconsistent findings. Therefore, these inconsistent findings strongly necessitated the need for a moderating variable on these relationships. And following the suggestion of Baron and Kenny (1986), which states that "moderator variables are typically introduced when there is an unexpectedly weak or inconsistent relation between a predictor and a criterion variable" (p. 1178), this study attempted to fill these research gaps by incorporating government support as a moderator to further enhance our understanding of the influence of organizational innovativeness and organizational culture on sustainable construction among construction practitioners and the academics. In testing organizational readiness for change theory, the research findings revealed that both organizational innovativeness and organizational culture are significantly related to sustainable construction among the construction companies, which thus lend empirical evidence in support of this theory. Based on the results of this study, it can be concluded that the propensity and capabilities of Malaysian construction companies to innovate in construction product, process, business and new technology played a significant role in explaining their sustainable construction delivery in project execution. Equally, it is evident that organizational culture is an important phenomenon in explaining Malaysian large contractors' adoption of sustainable construction.

5.3.2 Additional Empirical Evidence in the Domain of Resource-Based View Theory

In addition to the organizational readiness for change theory, this study also provided theoretical implications based on additional empirical evidence within the domain of resource-based view theory. The resource-based view theory is premised on the assumption that organizations' survival is dependent on a set of specific resources, and on organizations' management capabilities to combine these specific resources to gain competitive advantage (Penrose, 1959). Thus, the construction companies' ability to develop and harness the unique resources within the industry will enable them to deliver sustainable construction, which serves as a powerful source of advantage for firms. This study has contributed to the resource based-view theory by assessing organizational culture on broader forms within the construction organizations. In the course of testing this theory, the findings reported in this study revealed that organizational culture significantly predicted sustainable construction, thereby establishing an empirical evidence to support the said theory.

Based on this study's results and discussions, it can be summed up that organizational culture is a significant predictor of sustainable construction among Malaysian large contractors. Therefore, it is important to pay attention to the organizational factors considered in this study to ensure sustainable construction delivery by contractors in project execution, especially considering the fact that the construction industry is one of the oldest industries, and it has always been labelled as a conservative and laggard sector. Thus, construction firms are required to make a better use of these rare and inimitable resources to implement best practices that will satisfy the clients' needs, safeguard the environment, and guarantee excessive profits for the firms.

5.3.3 Significant Moderating Role of Government Support

This study also provided some empirical evidence on the significant role of government support as a moderator on the relationship between organizational innovativeness, organizational culture and sustainable construction. While most previous studies (e.g., Bossnik, 2004; Chan & Liu, 2012; Zucchella & Urban, 2014) have mainly focused on investigating the direct connection between organizational innovativeness and sustainable construction as well as the direct relationship between organizational culture and sustainable construction, this study incorporated government support as a moderating variable on these relationships for the following reasons. Firstly, properly channelled government support in terms of construction regulations has been observed to improve environmental performance and communities' living standards, and mitigates climate change in the long run (Li & Shui, 2015), because government has the capacity to intervene in the construction industry by providing a series of tax-based incentive policies for contractors promoting sustainable construction. Secondly, government support is expected to moderate the relationship between organizational culture and sustainable construction because a transformed culture within the construction industry, coupled with the presence of governmental monitoring and legislative support that is characterized by rigid line control of all construction processes are capable of driving sustainable construction (Mousa, 2015; Qiang, Wen, Jiang & Yuan, 2015). As such, organizational culture is observed to contribute to sustainable construction with government support strengthening their relationship. Taken as a whole, this study has added empirical evidence to the body of knowledge in the area of construction sustainability and the research results could be a strong basis for future research on construction organizations' innovative propensities and capabilities as well as cultural factors that contribute to the delivery of sustainable construction by the construction organizations.

5.4 Practical Implications

Based on the findings in this research, the present study has been able to contribute several practical implications in terms of construction management within the context of the Malaysian construction industry. Firstly, the results suggest that Malaysian large construction companies' innovative capacity and drive are important considerations in the delivery of sustainable construction in project execution. The construction industry can record a considerable level of construction sustainability by promoting innovativeness, and establishing suitable cultures within the construction organizations. For example, the construction industry could substantially reward construction organizations for comprehensively implementing sustainable construction in their construction project execution to further its delivery. The National Renewable Energy Policy and Action Plan (NREPAP) which was launched in 2010, the Construction Industry Master Plan (CIMP), and the Malaysian development plans, with the exclusion of the latest one (the 10th Master Plan), were more focused on environmental protection goals. More efforts are however needed to promote social and economic sustainability within the construction industry.

Secondly, the findings suggest that certain organizational cultural factors are related to sustainable construction among Malaysian large contractors. By implication, Malaysian construction organizations could improve their chances of adopting sustainable construction when they incorporate organizational culture (in terms of adhocracy and market orientation). For example, by setting guidelines that could help construction organization leaders correctly diagnose and manage their organizational core values, as exemplified by Cameron and Quinn, (2011), their ability to deliver sustainable construction might be improved.

Finally, as stated at the outset of this thesis, sustainable construction came up to fundamentally address the complex problems of construction and the environment in order to restore balance between the natural environment and the built environment. Therefore, the results of the current study suggest that organizational innovativeness and culture should be given serious consideration for a successful adoption of sustainable construction among Malaysian large contractors. In particular, the moderating role of government support suggests that effective government incentives and support can go a long way in influencing the adoption of sustainability in construction project execution. Thus, Malaysian construction companies could consider government support as a criterion when making decisions on sustainable construction adoption. This can be achieved, for example, by lending a series of tax-based incentive policies for contractors that are promoting sustainable construction.

5.5 Methodological Contributions

Aside the previously highlighted theoretical contributions that this present study has made, there are also several sincere attempts to make methodological contributions. One of such contributions was following a rigorous sampling procedure. Survey response within the construction industry is usually low (Waris *et al*., 2014). However, the researcher went a step further to consider other possibilities in order to increase the response rate. Thus, apart from mailing the survey to all respondents in 8 states of the Peninsular Malaysia, physical distributions of the questionnaires was also done in three different states of Kedah, Perlis and Penang. Again, the survey instrument was also personally administered during three different CIDB Continuing Professional Development (CPD), and Construction Certification Programs (CCP) attended by the researcher. This was also followed up by phone calls to the respondents, and sending emails as reminder. These mix of various techniques adopted in this study is an indication that a stronger generalization of the findings in this study can be facilitated, and it will encourage future researchers in achieving more enhanced data quality from construction organizations' surveys.

Again, the measures used for different variables in this study were adapted and/or adopted from various sources. And those studies were conducted in different environments. Therefore, it is important to establish validity and reliability of these scales which was extensively done in this present study with the aid of several statistical calculations as mentioned earlier in the data analysis sections of this study. This indicates that the measures in this study offers a valid and reliable survey instrument to both Malaysian and international researchers who are willing to study sustainability issues, innovativeness, culture and government roles within construction organizations with an improved precision and simplicity.

Furthermore, assessing the sustainable construction of Malaysian large contractors (the G7 contractors) through organizational innovativeness and culture, which has not been given considerable attention by researchers, is another significant methodological contribution made in this study.

In the same vein, the consideration of sustainable construction, organizational innovativeness and organizational culture as second order constructs with three, four, and two dimensions respectively is another significant contribution of this study. Specifically, this approach allows for a reduced model complexity and theoretical parsimony. These constructs (sustainable construction, organizational innovativeness and organizational culture) were statistically established with the latent variable scores of their dimensions.

Another methodological contribution that this study was able to make is related to the usage of PLS path modeling for the assessment of the psychometric properties of individual latent variable in this study. In specific terms, this study has been able to assess these psychometric properties with the aid of convergent and discriminant validities. In examining the psychometric properties of these latent variables, item reliability, average variance explained (AVE) and composite reliability of each latent variable were determined. While the convergent validity was ascertained by determining the AVE value for individual latent variable, the discriminant validity was determined by comparing the square roots of the AVE for each latent variables with the correlations of other latent variables. In order to theoretically support the discriminant validity in this study's conceptual model, the cross loadings matrix results were also examined. Thus, this study has been able to use quite a more robust approach in PLS SEM to assess the psychometric properties of each latent variable that was illustrated in this study's conceptual model.

Also, in order to estimate the strength of the moderating effect of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction, product indicator approach in PLS SEM was applied. The superiority of this approach compared to other techniques is considered in its adoption, especially given the fact that the latent variables and moderator variable in this study are measured reflectively.

5.6 Limitations and Future Research Directions

Although, this study was able to provide support for the hypothesized relationships between the exogenous and endogenous latent variables, the findings recorded should also be interpreted by considering limitations in the study. First and foremost, this study adopts a cross-sectional research design which, apart from the fact that the data collection technique is one-shot, single-point-in-time, it also precludes causal inferences to be made from the study's population. Thus, an alternative research design, a longitudinal design, is suggested for future research considerations. This will allow the measurement of the latent variables at different points in time to further confirm the findings in this study.

Secondly, this study adopts probability sampling, (specifically, stratified random sampling technique), where eleven states of the Peninsular Malaysia were categorised as mutually exclusive stratum. Thereafter, the G7 contractors in each states of the Malaysian peninsular are considered to be proportional to the entire number of elements in their respective strata (states). The use of this technique has restricted the extent to which this study could reflect local constituencies' understandings, as direct application of the findings to specific local situations, contexts, and individual construction companies under review might be too abstract. Therefore, future research should go beyond using this sampling technique by obtaining sample frame through non-probability sampling technique.

Thirdly, this study offers quite limited generalizability as it focused mainly on large construction companies. Although, these large contractors (the G7 contractors) are observed to be more capable to adopt sustainable construction principles and environmental management than the construction SMEs who are constrained due to their size and resource inadequacy (see, for example, Darnall, Henriques & Sadorsky, 2010; Li, *et al*., 2010; Qi, *et al*., 2010; Waris *et al*., 2014; Zeng, *et al*., 2007). Nevertheless, other previous studies have revealed that government regulatory requirements compel larger construction companies to heed to sustainability considerations (Sezer, 2015), and the fact that sustainable construction adoption goes beyond firm size, but a function of perception of clear economic benefits to a large extent. Therefore, future researchers may wish to extend this study further to include construction SMEs and entrepreneurs who have also been shown to be more responsible towards sustainability within their organization's overall mission. And considering their size, smaller firms are more likely to be committed to changes in their construction products, processes and business initiatives that may be unsustainable (Sharma & Henriques, 2005). Smaller construction firms have also been observed to possess the ability to make quick decisions in response to issues within their industry due to their relative structural flexibility and movement (Darnall, *et al*., 2010).

Fourthly, the research model in this study was only able to explain 69% of the total variance in the endogenous latent variable (sustainable construction), implying that there are other latent constructs that could possibly and significantly explain the variance in sustainable construction. In other words, it shows that there are other factors that could explain the remaining 31% of the variance for sustainable construction. Thus, future research considerations should include other possible factors that are capable of motivating construction companies to adopt sustainability in their construction project execution, apart from their innovative capabilities, cultural factors and government support that are considered in this study. Particularly, future research might examine how a specific government support could further strengthen the relationship between organizational innovativeness, organizational culture and sustainable construction among different sizes of construction companies. For instance, research has demonstrated that effective and comprehensive energy regulations and its enforcement play a very important role in reducing the impacts of construction on the environment (Chandel, Sharma, & Marwaha, 2016; Zhang & Wen, 2008), although excessive regulations and bureaucracy may hinder it in few cases. Therefore, it is expected that specific regulatory framework might further strengthen the contractors' adoption of sustainable construction.

Finally, no significant relationship between government support and sustainable construction was found. Some moderating effects could possibly be introduced to contribute to the relationship. Specifically, this relationship may be moderated by organizational culture. Examining organizational culture as a moderator on this relationship could be an avenue for future research because government support, especially within green building research, has always been viewed from a multidimensional perspective. Again, past research considered different indicators to measure government support. Thus, more research is required to investigate such moderating effects. This is because research has shown that construction organizations with a structured culture tended to improve in project performance (Hooi, & Bakar, 2015).

5.7 Conclusion

Based on the overall research findings, this study has been able to provide additional evidence to the growing body of knowledge concerning the moderating role of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction, and the results from this study has been able to support the key theoretical propositions. Especially, it has successfully responded to all of the research questions posed, and also addressed all the formulated objectives despite some limitations. With regards to the five hypotheses formulated in this study, out of the three direct hypotheses that examine the relationships between organizational innovativeness, organizational culture, government support and sustainable construction, only one (government support and sustainable construction relationship) was negatively significant. While all the moderating paths were statistically significant and supported.

Despite the fact that many studies have examined several underlying factors to sustainable construction among construction companies, however, the present study has addressed a theoretical gap by incorporating government support as a significant moderating variable. This present study has also provided theoretical and empirical support for the moderating role of government support on the relationship between organizational innovativeness, organizational culture and sustainable construction. And it has also attempted to estimate how government support theoretically moderates the relationships between the exogenous latent variables and the endogenous latent variable. Again, this study's theoretical framework was also able to add to the domain of organizational readiness for change and resource-based view theory by examining the influence of organizational innovativeness on sustainable construction as well as the effect of organizational cultural factors on sustainable construction. In addition to this theoretical contributions, the results from this study has also provided some important practical implications to construction organizations and other construction stakeholders. Furthermore, regarding this study's limitations, several future research directions have been suggested.

In conclusion, this study has been able to meet all the relevant originality requirements of a doctoral thesis, according to Hart, (1998, p. 24). The requirements are: firstly, this study is an empirical-based research that has not been carried out earlier, and the model examined has not been tested among construction companies in Malaysia. Secondly, the study utilises already established and known ideas and practices, but imbibed new and different interpretations. Thirdly, the present study was able to present new evidences on the concept of sustainable construction in the Malaysian construction industry. Fourthly, the study explores new dimension to sustainable construction that scholars in the construction industry have not considered previously.

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APPENDICES

Appendix A
Research Questionnaire

Dear respondent,

This survey is a research on organizational innovativeness, culture and sustainable construction among Malaysian contractors. Your responses will strictly be treated as confidential. Thus, your identity is not required.

Your experience and opinion are highly valuable and would be appreciated if you could spare us a couple of minutes to take part in this survey by completing the questionnaire below.

If you have any inquiry about this questionnaire, please feel free to contact Sr. Dr. Mohd Nasrun Mohd Nawi on:

+60124900656
nasrun@uum.edu.my

Thank you for your anticipated cooperation and assistance.

SECTION 1: GENERAL INFORMATION ON THE RESPONDENTS AND THE COMPANY

Please tick the option that best describes you and your company

1. Which of the following best describes your position in the company?

[ ] Executive Director; [ ] Project Manager; [ ] Marketing Manager; [ ] Engineer;

[ ] Quantity Surveyor; [ ] Contract Manager; [ ] Construction Manager;

[ ] Others: …………………………………………..

2. How long have you been working with the company?

[ ] 1-5 years [ ] 6-10 years [ ] More than 10 years

3. Please specify your gender.

[ ] Male [ ] Female

4. How old is the company you are working for?

[ ] 1-5 years [ ] 6-10 years [ ] More than 10 years

5. Which of the following best describe your company's operational location?

[ ] Local market areas [ ] Within few states [ ] Regional [ ] Across the entire Malaysia (including East Malaysia) [ ] International market.

6. What is the total number of employees in your company?

[ ] < 100 employees [ ] 101 – 250 employees [ ] 251 – 500 employees [ ] > 500 employees.

7. What category of construction projects do your company specializes in? *(You may choose more than one option here)*

[ ] Residential [ ] Non-Residential [ ] Social Amenities [ ] Infrastructure

[ ] Others: ……………………………………..……………………

SECTION 2: INFORMATION ABOUT COMPANY'S INNOVATIVENESS

Please tick one option that best describes your company

Options: 1=Not at all; 2=Slightly true; 3=Moderately true; 4=Mostly true; 5=Completely true

Product innovativeness

1	We actively develop new construction products in-house in our company.	**1**	**2**	**3**	**4**	**5**
2	Our company sees creating new construction products as critical to our success.	**1**	**2**	**3**	**4**	**5**
3	Our company tends to be an early adopter of innovative construction products or materials.	**1**	**2**	**3**	**4**	**5**
4	Within our company, we are able to adopt innovative construction products or materials used by other companies.	**1**	**2**	**3**	**4**	**5**
5	Our company seeks innovative construction products or materials from outside this organization.	**1**	**2**	**3**	**4**	**5**

Process innovativeness

1	We tend to be an early adopter of innovative construction process or practice in our company.	**1**	**2**	**3**	**4**	**5**
2	We are able to implement innovative construction process used by other companies.	**1**	**2**	**3**	**4**	**5**
3	We actively develop in-house solutions to improve our construction development process.	**1**	**2**	**3**	**4**	**5**
4	We seek innovative construction process outside our company.	**1**	**2**	**3**	**4**	**5**

Business innovativeness

1	Creating new business systems is critical to the success of our company.	**1**	**2**	**3**	**4**	**5**
2	Our company tends to be an early adopter of innovative business system.	**1**	**2**	**3**	**4**	**5**
3	Within our company, we are able to implement innovative business systems used by other companies.	**1**	**2**	**3**	**4**	**5**
4	Our company actively seeks innovative business systems from outside this company.	**1**	**2**	**3**	**4**	**5**

New technology

1	In our company, we have a policy that encourages adoption of new technology.	**1**	**2**	**3**	**4**	**5**
2	Most employees are computer literate in our company.	**1**	**2**	**3**	**4**	**5**
3	Employees in our company support the application of information technology.	**1**	**2**	**3**	**4**	**5**
4	We use equipment and machineries that are up-to-date in our company.	**1**	**2**	**3**	**4**	**5**

SECTION 3: INFORMATION ABOUT ORGANIZATIONAL CULTURE

Please tick one option that best describes your company

Options: 1=Not at all; 2=Slightly true; 3=Moderately true; 4=Mostly true; 5=Completely true

Adhocracy culture

1	Our company is a very dynamic working place.	**1**	**2**	**3**	**4**	**5**
2	Leadership in our company is usually innovative.	**1**	**2**	**3**	**4**	**5**
3	Our company leadership has always demonstrated risk-taking	**1**	**2**	**3**	**4**	**5**
4	Freedom is demonstrated by the management of our company	**1**	**2**	**3**	**4**	**5**
5	The management style in our company is characterized by uniqueness.	**1**	**2**	**3**	**4**	**5**
6	There is a commitment to innovation in our company.	**1**	**2**	**3**	**4**	**5**
7	There is a commitment to development in our company.	**1**	**2**	**3**	**4**	**5**
8	In our company, emphasis is placed on creating new challenges.	**1**	**2**	**3**	**4**	**5**
9	We emphasize acquiring new resources in our company.	**1**	**2**	**3**	**4**	**5**
10	We define success based on unique construction product in our company.	**1**	**2**	**3**	**4**	**5**

Market orientation

1	We share competitor's information within the company	**1**	**2**	**3**	**4**	**5**
2	We respond rapidly to competitive actions in our company	**1**	**2**	**3**	**4**	**5**
3	Top management in our company regularly discusses the strength of our competitors	**1**	**2**	**3**	**4**	**5**
4	We always focus on clients in our company whenever we have an opportunity for competitive advantage.	**1**	**2**	**3**	**4**	**5**
5	We pay close attention to post construction reviews in our company.	**1**	**2**	**3**	**4**	**5**
6	Business objectives are driven by client's satisfaction in our company.	**1**	**2**	**3**	**4**	**5**
7	Our competitive advantage is based on understanding clients' needs.	**1**	**2**	**3**	**4**	**5**

8	In our company, we closely monitor and assess our level of commitment in meeting the needs of our clients.	**1**	**2**	**3**	**4**	**5**
9	Business strategies are driven by the goal of increasing client's value in our company.	**1**	**2**	**3**	**4**	**5**

SECTION 4: INFORMATION ABOUT SUSTAINABLE CONSTRUCTION

Please tick one option that best describes your company

Options: 1=Not at all; 2=Slightly true; 3=Moderately true; 4=Mostly true; 5=Completely true

Environmental protection

1	Location selection is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
2	Material selection is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
3	Waste minimisation is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
4	Energy conservation is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
5	Water efficiency is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
6	Pollution control is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
7	Biodiversity protection is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
8	Heritage and amenity protection is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**

Social well-being

1	Health and safety is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
2	User comfort and satisfaction is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
3	Community welfare is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
4	Accessibility is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**

5	Social involvement is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
6	Workers' welfare is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
7	Aesthetics is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**

Economic prosperity

1	Life cycle costing is an important sustainable construction consideration in our company.	**1**	**2**	**3**	**4**	**5**
2	Profitability is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
3	Business image enhancement is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
4	Cost management strategy is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**
5	Risk reduction is an important sustainable construction consideration in our projects.	**1**	**2**	**3**	**4**	**5**

SECTION 5: INFORMATION ABOUT GOVERNMENT SUPPORT

Please tick one option that best describes your company

Options: 1=Not at all; 2=Slightly true; 3=Moderately true; 4=Mostly true; 5=Completely true

1	Government support is responsible for effective sustainable construction standards and incentives.	**1**	**2**	**3**	**4**	**5**
2	The need to meet regulation is increasing client's demand for sustainable construction.	**1**	**2**	**3**	**4**	**5**
3	Government support for sustainable construction have impacts on our construction practices.	**1**	**2**	**3**	**4**	**5**
4	Regulations for sustainable construction can effectively address issues regarding the sustainability of construction process.	**1**	**2**	**3**	**4**	**5**
5	The Malaysian sustainable construction laws are appropriate to the construction industry environment.	**1**	**2**	**3**	**4**	**5**

THANK YOU

Appendix B

SmartPLS Output - Measurement Model

	AVE	Composite Reliability	R Square	Cronbachs Alpha	Communality	Redundancy
ADC	0.658851	0.950718	0.852790	0.942304	0.658851	0.560290
BIZ	0.741635	0.919593	0.744365	0.882312	0.741635	0.551100
ECP	0.733556	0.932164	0.711886	0.908670	0.733556	0.517443
EVT	0.665658	0.940761	0.826499	0.927628	0.665658	0.549108
Govt. support	0.689492	0.917151		0.886587	0.689492	
MKT	0.633926	0.939602	0.815615	0.927484	0.633926	0.516245
NEWT	0.686782	0.897558	0.659429	0.848764	0.686782	0.440054
Org. culture	0.540029	0.956992		0.952437	0.540029	
Org. innovativeness	0.543526	0.952517		0.946540	0.543526	
PRC	0.757521	0.925877	0.824523	0.893194	0.757521	0.622904
PRO	0.667312	0.908925	0.825672	0.873738	0.667312	0.550130
SWB	0.682898	0.937680	0.857012	0.922191	0.682898	0.584640
Sust. construction	0.554542	0.961298	0.686750	0.957506	0.554542	0.197184

Appendix C

Blindfolding Procedure Output

CV Red.

	1-SSE/SSO
ADC	0.560290
BIZ	0.551100
ECP	0.515190
EVT	0.545903
Govt. support	0.689493
MKT	0.516244
NEWT	0.440053
Org. culture	0.540029
Org. innovativeness	0.543526
PRC	0.622904
PRO	0.550129
SWB	0.580151
Sust. construction	0.380139

Indicator Cross-validated Redundancy

Total	SSO	SSE	1-SSE/SSO
ADC1	180	85.737225	0.523682
ADC10	180	84.611076	0.529938
ADC2	180	87.864289	0.511865
ADC3	180	85.127883	0.527067
ADC4	180	80.037929	0.555345
ADC5	180	75.815159	0.578805
ADC6	180	67.187901	0.626734
ADC7	180	58.741247	0.67366
ADC8	180	79.816923	0.556573
ADC9	180	85.121125	0.527105
BIZ_1	180	97.068465	0.460731
BIZ_2	180	61.239613	0.65978
BIZ_3	180	89.762494	0.501319
BIZ_4	180	74.7959	0.584467
ECP1	180	105.88505	0.41175
ECP2	180	103.30032	0.426109
ECP3	180	87.319299	0.514893
ECP4	180	84.554573	0.530252

ECP5	180	78.079317	0.566226
EVT1	180	88.544408	0.508087
EVT2	180	70.61905	0.607672
EVT3	180	85.890365	0.522831
EVT4	180	84.17636	0.532354
EVT5	180	87.651176	0.513049
EVT6	180	77.941027	0.566994
EVT7	180	71.274621	0.60403
EVT8	180	87.802777	0.512207
Govs_1	180	58.373817	0.675701
Govs_2	180	59.18951	0.671169
Govs_3	180	40.239634	0.776446
Govs_4	180	44.013034	0.755483
Govs_5	180	77.640486	0.568664
MKT1	180	99.078601	0.449563
MKT2	180	80.618454	0.55212
MKT3	180	88.362284	0.509098
MKT4	180	81.200661	0.548885
MKT5	180	79.740719	0.556996
MKT6	180	92.287211	0.487293
MKT7	180	100.81824	0.439899
MKT8	180	88.480418	0.508442
MKT9	180	72.454191	0.597477
NEWT_1	180	72.00585	0.599968
NEWT_2	180	121.45927	0.325226
NEWT_3	180	107.28078	0.403996
NEWT_4	180	97.796822	0.456684
PRC_1	180	51.778934	0.712339
PRC_2	180	70.174125	0.610144
PRC_3	180	76.805516	0.573303
PRC_4	180	72.141767	0.599212
PRO_1	180	105.16225	0.415765
PRO_2	180	68.603872	0.618867
PRO_3	180	67.068733	0.627396
PRO_4	180	81.518182	0.547121
PRO_5	180	82.147222	0.543627
SWB1	180	131.69683	0.268351
SWB2	180	114.81299	0.36215
SWB3	180	108.77351	0.395703
SWB4	180	104.89875	0.417229
SWB5	180	95.841339	0.467548
SWB6	180	102.24196	0.431989
SWB7	180	98.335393	0.453692

CV Com.

	1-SSE/SSO
ADC	0.658851
BIZ	0.741635
ECP	0.693291
EVT	0.654340
Govt. support	0.689493
MKT	0.633926
NEWT	0.686782
Org. culture	0.540029
Org. innovativeness	0.543526
PRC	0.757521
PRO	0.667312
SWB	0.678002
Sust. construction	0.554526

Construct Crossvalidated Communality

Total	SSO	SSE	1-SSE/SSO
ADC	1800.000000	614.067941	0.658851
BIZ	720.000000	186.022718	0.741635
ECP	900.000000	276.037660	0.693291
EVT	1440.000000	497.749949	0.654340
Govt. support	900.000000	279.456482	0.689493
MKT	1620.000000	593.039146	0.633926
NEWT	720.000000	225.516948	0.686782
Org. culture	3420.000000	1573.101533	0.540029
Org. innovativeness	3060.000000	1396.809794	0.543526
PRC	720.000000	174.584711	0.757521
PRO	900.000000	299.418957	0.667312
SWB	1260.000000	405.717945	0.678002
Sust. construction	3600.000000	1603.707450	0.554526

Indicator Cross-validated Communality

Total	SSO	SSE	1-SSE/SSO
ADC1	180	85.737225	0.523682
ADC10	180	84.611076	0.529938
ADC2	180	87.864289	0.511865
ADC3	180	85.127883	0.527067
ADC4	180	80.037929	0.555345
ADC5	180	61.798095	0.656677
ADC6	180	50.072619	0.721819
ADC7	180	53.164453	0.704642
ADC8	180	62.501839	0.652768
ADC9	180	71.79216	0.601155
BIZ_1	180	97.068465	0.460731
BIZ_2	180	61.239613	0.65978
BIZ_3	180	89.762494	0.501319
BIZ_4	180	74.7959	0.584467
ECP1	180	80.127446	0.554848
ECP2	180	103.43348	0.42537
ECP3	180	86.668484	0.518508
ECP4	180	84.517339	0.530459
ECP5	180	77.580349	0.568998
EVT1	180	87.309616	0.514947
EVT2	180	69.898302	0.611676
EVT3	180	84.857812	0.528568
EVT4	180	57.837294	0.678682
EVT4	180	84.194608	0.532252
EVT5	180	63.038489	0.649786
EVT5	180	87.374862	0.514584
EVT6	180	45.692961	0.74615
EVT6	180	77.414991	0.569917
EVT7	180	45.297622	0.748347
EVT7	180	70.585123	0.60786
EVT8	180	86.774214	0.517921
Govs_1	180	58.373817	0.675701
Govs_2	180	59.18951	0.671169
Govs_3	180	40.239634	0.776446
Govs_4	180	44.013034	0.755483
Govs_5	180	77.640486	0.568664
MKT1	180	99.078601	0.449563
MKT2	180	68.08682	0.62174
MKT3	180	64.715195	0.640471
MKT4	180	65.699245	0.635004
MKT5	180	60.122635	0.665985

MKT6	180	66.522271	0.630432
MKT7	180	74.339001	0.587006
MKT8	180	60.153541	0.665814
MKT9	180	48.023585	0.733202
NEWT_1	180	60.434706	0.664252
NEWT_2	180	62.614281	0.652143
NEWT_3	180	42.527301	0.763737
NEWT_4	180	59.94066	0.666996
PRC_1	180	41.569239	0.76906
PRC_2	180	37.578821	0.791229
PRC_3	180	52.696588	0.707241
PRC_4	180	42.740063	0.762555
PRO_1	180	83.12861	0.538174
PRO_2	180	68.603872	0.618867
PRO_3	180	67.068733	0.627396
PRO_4	180	81.518182	0.547121
PRO_5	180	82.147222	0.543627
SWB1	180	94.692312	0.473932
SWB2	180	76.477682	0.575124
SWB3	180	64.221116	0.643216
SWB4	180	67.667478	0.62407
SWB5	180	72.442739	0.59754
SWB6	180	67.560149	0.624666
SWB7	180	79.909351	0.556059

Appendix D

Literature Review Summary

S/N	Authors, Title, Publication	Objectives of the Study	Methodology	Analysis Techniques	Findings	Location of study
1.	**Waris, M., Liew, M. S., Khamidi, M. F., & Idrus, A. (2014).** Criteria for the selection of sustainable onsite construction equipment.	Determining a selection criteria based on the fundamental concept of sustainability and provides an assessment framework.	Research used both qualitative and quantitative research methods. Structured interviews and pilot survey were conducted from the selected construction practitioners to fill any gap and shortcomings before the full scale questionnaire survey was conducted. A questionnaire survey was subsequently administered to a classified group of Malaysian contractors to elicit information about sustainable selection of onsite machineries.	Relative Importance Index (RII) method was used for determining the relative importance of the sustainable criteria. The five-point likert scale of 1 to 5 (with 1 = not at all important, 2 = low important, 3 = neutral, 4 = very important and 5 = extremely important) was adopted and the relative importance indices (RII) for each of the sustainable criteria.	The study established criteria for the selection of sustainable construction equipment for onsite mechanization. The sustainable criteria presented as a result of this endeavour are different from the conventional way of procurement which emphasizes on cost, time and quality. The proposed criteria are envisaged to assist civil contractors in the selection and deployment of construction equipment and machineries that meets the triple bottom line of sustainability i.e. profit, planet and people.	Malaysia
2.	**Djokoto, S. D., Dadzie, J., & Ohemeng-Ababio, E. (2014).** Barriers to sustainable construction in the Ghanaian construction industry: consultant's perspectives	Identifying possible barriers to sustainable construction in the Ghanaian construction industry.	A questionnaire survey was conducted on randomly selected professionals in the construction industry in Ghana.	Data collected was analyzed using Relative Importance Index (RII) to rank barriers identified.	The key barriers to sustainable construction are lack of demand for sustainable buildings, lack of strategy to promote sustainable construction, higher initial cost, lack of public awareness and lack of government support.	Ghana
3.	**Samari, M., Ghodrati, N., Esmaeilifar, R., Olfat, P., & Shafiei, M. W. M. (2013)** The Investigation of the Barriers in Developing Green Building in Malaysia	To investigate the level of developing green building in the current situation; To find important key players and to identify, and to eliminate the important obstacles to green building development.	Randomly selected respondents from the professionals of Malaysian construction industry across the country. Questionnaire survey was used, which were sent manually and through e-mail. A total of 673 sets of questionnaire were sent out and 167 (24.81%) questionnaires were returned.	Quantitative method was used for data analysis through SPSS version 19	The level of developing green building in Malaysia is not satisfactory and government has a key role to play in the development of green buildings in Malaysia. The main barriers to developing green building identified as: a) Lack of credit resources to cover up front cost b) Risk of investment c) Lack of demand d) Higher final price.	Malaysia

4.	**Abidin, N. Z., Yusof, N. A., & Othman, A. A. (2013).** Enablers and challenges of a sustainable housing industry in Malaysia.	To discuss the enablers of creating a viable environment for a sustainable housing industry. Investigate the barriers limiting the progress of sustainable housing industry	A literature review was carried out to explore the four-angle enablers (technological, institutional, internal action and market influence) which are crucial to create sustainable construction in the construction industry. A mixed method comprising of a survey and interview was conducted. The first field study was a survey focused on housing developers located in the area of Kuala Lumpur (capital city of Malaysia) and Selangor (Kuala Lumpur neighbouring state). A total of 271 respondents were approached and 35 questionnaires were returned for analysis, giving the return rate of 12.9 per cent. A total of 5-15 per cent. response is a typical rate for questionnaire survey conducted in Malaysian construction industry (Idrus et al., 2008)		The study found out that government's lack of incentive programmes and the slow progress in revising related regulations are major hindrances for institutional enablers. For technological aspects, the problem lies in the cost of importing products because of the lack of locally-produced green technology. The cost factor and lack of "urgency" are the core problems in encouraging internal action, while the low demand by the potential buyers affects market influence.	Malaysia
5.	**Shari, Z., & Soebarto, V. (2013).** Investigating sustainable practices in the Malaysian office building developments	To explore the extent of sustainable construction practices (socially, environmentally and economically) in the Malaysian construction industry by focusing on the office building sector.	Semi-structured in-depth interviews with 30 stakeholders from various backgrounds of the Malaysian construction industry are used to explore their challenges and motivations for pursuing sustainable outcomes.	Qualitative research design was adopted. Purposive sampling (particularly judgment sampling) technique was used to gather information from a specialized population of stakeholders consisting of 12 consultants, 5 developers, 3 builders, 4 facility managers, and 6 policy makers.	The study finds that economic issues are the first priorities among stakeholders in any decision-makings for building projects and cost becomes one of the major reasons for the slow progress in implementing sustainable practices in building projects. Socially, there is still a wide gap of knowledge and awareness on sustainability issues among stakeholders, explaining the lack of commitment in achieving sustainability.	Malaysia
6.	**Yunus, R., & Yang, J. (2012).** Critical sustainability factors in	To identify critical sustainability factors for improved implementation of industrialised	A comprehensive literature review was carried out to identify sustainability factors, as perceived by practitioners and researchers.	A five-point likert scale is used to ensure an unambiguous result, ease of interpretation, and appropriate measurement on an ordinal basis.	Eighteen (18) sustainability factors are identified to be critical to IBS implementation. Their interrelationships and	Malaysia

	industrialised building systems**.**	building systems (IBS). To highlight the importance of decision support, through the establishment of decision-making guidelines, for sustainability deliverables in IBS development.	A study was conducted and statistical data analysis was done to examine the criticality of these sustainability factors in IBS implementation. The survey is designed around the 62 identified sustainability factors from literature. The respondents were asked to rate the level of significance of each of these factors based on their judgment and experience. The data was collected from contractors, designers and manufacturers.	Kendall's coefficient of concordance (W) was then used to determine the association among the critical sustainability factors identified.	driving forces are explored, which leads to the development of a conceptual model to map these factors for actions or potential solutions. It also provides a sound basis towards a set of decision-making guidelines for sustainable IBS implementation.	
7.	**Hamid, Z. A., & Kamar, K. A. M. (2012).** Aspects of off-site manufacturing application towards sustainable construction in Malaysia	To identify the contribution of off-site manufacturing application towards sustainable construction in Malaysia.	Examining different views and ideas of sustainable construction and assess the impact of off-site manufacturing towards sustainability.		Many aspects of off-site manufacturing practices and applications are contributing to sustainable construction.	Malaysia
8.	**Shari, Z., & Soebarto, V. (2012).** Delivering sustainable building strategies in Malaysia: stakeholders' barriers and aspirations.	To present categories of barriers and measures to overcome the barriers against the promotion of sustainable building practices in Malaysia.	Qualitative research was undertaken with thirty Malaysian building stakeholders via in-depth, semi-structured interviews.		The primary barriers that were identified by the stakeholders are: 1) Lack of expressed interest in the clients' requirements; 2) Lack of political will, legislation and enforcement; 3) Lack of technical understanding among project team members; 4) Lack of consideration of sustainability measures by project team members; and 5) Real and perceived costs. Measures were to the government and regulatory stakeholders, research and education sector, private sector, and clients of the construction industry.	Malaysia
9.	**Osman, W. N. B., Udin, Z. M., & Salleh, D. (2012)** Adoption Level of Sustainable Construction Practices: A Study on Malaysia's	To identify the current level of sustainability performance in the Malaysian construction industry among the local stakeholders. The sustainability concept was divided into	Simple random sampling technique was used to select the respondents who are Malaysia's local construction stakeholders. The research was a quantitative one carried out.	Criticality index was determined through Mean analysis	The highest mean score for financial sustainability for the whole data set as perceived by the construction stakeholders is 3.2045, while the minimum scores is 3.0227. And overall mean	Malaysia

	Construction Stakeholders.	financial sustainability performance (economics aspect) and non-financial sustainability performance (environment and social aspect).	The construction stakeholders are the consultants (architects, quantity surveyors and engineers), contractors (manifesting the design into reality), and the clients (the ones who drive the sustainability needs of the projects). The numbers of questionnaires received were 94. Where only 88 were usable for analysis.		for the whole data set is 3.1105. The highest mean score for non-financial sustainability performance for the whole data set was 3.1136. The minimum scores was 2.8523. The result shows that the adoption level of financial sustainability is better than non-financial sustainability.	
10	**Opoku, A., & Fortune, C. (2011).** Leadership in construction organizations and the promotion of sustainable practices.	To examine the role, drivers and factors affecting leadership in the effective implementation of sustainable construction practices in construction organizations.	Literature review was conducted Semi-structured interviews (lasting 30-40 minutes) with 8 sustainability leaders in United Kingdom construction consultant organizations, including sustainability directors, managers and consultants.		The study revealed that the leadership role in promoting sustainability in construction organizations include the development of strategies and the formulation of policies. A major driver for construction organizations to pursue sustainability is to win more business, while increased capital cost for sustainability is still a major challenge to many organizations.	United Kingdom
11	**Chua, S. C., & Oh, T. H. (2011).** Green progress and prospect in Malaysia.	To examine Malaysia's green developments by focusing on the National Green Technology Policy and Green Building Index introduced in 2009. To examine the benefits of going green to the country and incentives being offered by the Malaysian government.			The vision of a green future is bright in Malaysia if all the parties cooperate and collaborate with all efforts to make the plan a success. The penetration of green awareness among the public and private sectors is constant and encouraging due to government's involvement in spreading green developments through policies and offering incentives.	Malaysia
12	**Nwokoro, I., & Onukwube, H. N. (2011).** Sustainable or Green Construction in Lagos, Nigeria: Principles, Attributes and Framework.	To examine sustainable construction attributes (social, economic, biophysical and technical) in understanding sustainable and green construction as well as current practices and challenges of sustainable	Both quantitative and qualitative methods of data collection were used. The sample frame is the total number of built industry registered and practicing professionals in Lagos, Nigeria. A total of 85 respondents were randomly selected for study from each group. Focus group discussions (FGDs) were also	Data analysis was done using the mean item score. A multi- stage framework which required the application of environmental assessment and environment management systems for construction projects was utilized.	Findings show that the most important factors considered for sustainable construction with their mean item scores are quality of working conditions (0.852), strengthening and enforcement of relevant laws and regulations (0.872), encouraging construction waste management (0.819), and	Nigeria

		construction in Lagos, Nigeria.	conducted with all the above professional groups.		design for flexibility and adaptability. FGDs indicate that the current practice on sustainable construction does not take into consideration integrated design process, acoustic and visual comfort in the planning and construction of sustainable projects.	
13	**Abidin, N. (2010).** Investigating the awareness and application of sustainable construction concept by Malaysian developers	To investigate the awareness level, knowledge and implementation of sustainable practices based on the perceptions of the project developers in Malaysia.	Surveys and interviews were conducted on building construction developers, such as property and commercial buildings, located in Kuala Lumpur (capital city of Malaysia) and Selangor.	Survey data and interviews were analysed qualitatively as the information was in the form of opinions, comments and statements with exceptions on a few closed-type questions in the survey which were analysed quantitatively using averaging statistical analysis.	The findings were in three perspectives: a) The developer's level of knowledge and understanding of sustainable construction concerning the concept of b) The implementation of sustainable construction projects c) The future outlook for the industry. Large developers are observing sustainable construction in their construction projects, while small and medium companies, are not doing well in the implementation as they only fulfil minimum requirement set by the government. Implementation is low because of lack of knowledge, poor enforcement of legislation, education, experience and passive culture.	Malaysia
14	**Sev, A. (2009).** How can the construction industry contribute to sustainable development? A conceptual framework.	To evolve a conceptual framework for implementing sustainable construction principles and strategies to the construction industry from a life-cycle perspective towards contributing to sustainable development.	The framework that was developed relies on the sustainability principles, which are resource management, life-cycle design and design for human and environment. Through a review of literature, each principle involving strategies and methods to be applied during the life cycle of construction projects is explained and a few case studies are presented for clarity on the methods.		The proposed framework provides a brief overview of sustainability principles, strategies and methods, and emphasizes the need for an integrated approach and understanding of the different components of a sustainable system. The new design approach recognizes the impacts of every design choice on the natural and cultural resources of the local, regional and global environments.	Turkey

15	**Abidin, N. Z. (2009).** Sustainable Construction in Malaysia- Developers' Awareness.	To examine the actions taken by the Malaysian government, non-government organizations and construction players in promoting sustainable construction.	A total of 271 questionnaires were administered and 35 were returned for analysis.	The data analysis was done qualitatively and quantitatively. Statistical Packages for Social Sciences (SPSS) was used to analyse the quantitative data. The averaging statistical analysis was also used to calculate straightforward totals, percentages and averages. Qualitative technique was used.	It is deduced that majority of the respondent understand that sustainable construction aims at protecting the environment but many are still unaware that it is also about balancing social and economy aspects of construction.	Malaysia
16	**Matar, M. M., Georgy, M. E., & Ibrahim, M. E. (2008).** Sustainable construction management: introduction of the operational context space (OCS)	To address the barrier that hinders enacting sustainable construction through a three-dimensional operational context space (OCS). The three dimensions of OCS are: (1) project life cycle phases; (2) project executing entities; and (3) sustainability performance parameters.			An integration platform was introduced for sustainable construction called Operational Context Space (OCS). The context space comprises a number of operational matrices that are used to: a) Facilitate the association of responsibility by assigning each sustainability parameter performance requirement to a specific entity during specific project phases; b) Provide numerical assessment for construction projects using sustainability as a criterion.	Egypt
17	**Shen, L., Song, S., Hao, J., & Tam, V. W. (2008).** Collaboration among project participants towards sustainable construction- a Hong Kong study.	To examine various sustainable construction initiatives in Hong Kong construction industry.	A construction project participant collaboration framework was developed to improve communication among project participants towards sustainable construction implementation. The data used in the study are mainly from public reports produced by Hong Kong government. Also, the experience of the research team in the construction industry contributed to the data generation and analysis.	Team-orientated approach has been adopted throughout the study.		Hong Kong
18	**Grace K C Ding (2007).** Sustainable construction – the role of environmental assessment tools.	Examine the development, role and limitations of current environmental building assessment methods in ascertaining building sustainability used in	**i**. Developing a sustainability index using a multi-criteria approach in assessing and ranking projects. **ii**. Setting out a conceptual framework of a multi-criteria model for	Developing a sustainability index based on a multiple dimensional model that embraces economic, social and environmental value. With the algorithm (sustainability index), each criterion is measured in	The sustainability index provides a methodological framework to measure and monitor environmental performance of buildings.	Sweden

		different countries which leads to discuss the concept of developing a sustainability model for project appraisal based on a multi-dimensional approach.	appraising projects at the feasibility stage.	different units reflecting an appropriately matched methodology. Criteria can be weighted either individually or in groups to give preference to investor-centred or community-centred attitudes. Each criterion is measured and combined to give an index score. The higher the index, the more sustainable is the outcome.	It also alerts the building profession of the importance of sustainable development in the building process.	
19	**Shafii, F., Arman Ali, Z., & Othman, M. Z. (2006).** Achieving sustainable construction in the developing countries of Southeast Asia.	To examine the construction scenario of Southeast Asia and the developments in sustainable construction within the region. To examine the barriers to the implementation of sustainable construction.			It was found that sustainable construction in Southeast Asia is still in its infancy. The barriers include: lack of awareness, training and education and ineffective procurement systems.	Malaysia
20	**Majdalani, Z., Ajam, M., & Mezher, T. (2006).** Sustainability in the construction industry: a Lebanese case study	To investigate the role of construction industry in the sustainable development in Lebanon particularly.	Survey questionnaires were distributed to main construction industry players which include contractors, architects, engineers and Owners/Developers. These questionnaires are designed to collect information on companies' environmental awareness and social responsibilities and current practices including land development, material selections, energy efficiency, construction operations, waste handling, storage facilities, and sustainable designs.		Results clearly demonstrated widely varying levels of awareness regarding sustainable construction depending on the position and economic interest of parties involved.	Lebanon
21	**Shen, L., Wu, Y., Chan, E., & Hao, J. (2005).** Application of system dynamics for assessment of sustainable performance of construction projects		This paper is based on a study that developed a simulation model, using system dynamics methodology to assess the sustainable performance of construction projects. Three major factors are used to examine project sustainable performance (PSP): sustainability of economic development (E), sustainability of		The simulation model presented shows that a project's contribution to sustainable development can change due to the impact of various dynamic variables throughout its life cycle. It also indicates that the sustainability attainment from implementing a construction project can be improved by properly	China

			social development (S), and the sustainability of environmental development (En). Sustainable development ability (SDA) was used as a prototype to evaluate the degree of sustainable performance.		controlling the various dynamic variables. Also through a simulation process, the sustainable development ability (SDA) prototype model is appropriate for assessing the dynamic impact of a construction project on economic, social and environmental development. By using the prototype, sensitivity analysis on the dynamic impacts of a project on sustainability attainment can also be undertaken	
22	**Bossink, B. A. (2004).** Managing drivers of innovation in construction networks.				The findings indicated that Dutch construction organizations innovate in the field of sustainability by using these innovation drivers: *environmental pressure, *technological capability, *knowledge exchange, and *boundary spanning at all identified levels in the network of organizations.	Netherlands
23	**Hill, R. C., & Bowen, P. A. (1997).** Sustainable construction: principles and a framework for attainment.	To outline the evolution of the concept of sustainable development; To advance understanding of the concept of sustainable construction; To enunciate principles to be upheld in order to attain sustainable construction; To propose a practical framework for the attainment of sustainable construction.	Social, economic, biophysical and technical attributes of sustainability were singled out to advance understanding of the concept of sustainable construction.		A multi-stage framework for sustainable construction is proposed which requires application of Environmental Assessment (EA) during the planning and design stages of projects, and implementation of Environmental Management Systems (EMS) within construction organizations, and for each project, during construction, operation and, where appropriate, even decommissioning.	South Africa

Appendix E

Pilot Test Output

Product Innovativeness (PRO)

Reliability Statistics

Cronbach's Alpha	N of Items
.900	5

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.782
Bartlett's Test of Sphericity	Approx. Chi-Square	109.323
	df	10
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.605	72.105	72.105	3.605	72.105	72.105
2	.823	16.469	88.574			
3	.261	5.214	93.788			
4	.212	4.244	98.033			
5	.098	1.967	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
PRO1	.841
PRO2	.926
PRO3	.904
PRO4	.773
PRO5	.791

Process Innovativeness (PRC)

Reliability Statistics

Cronbach's Alpha	N of Items
.932	4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	93.399
	df	6
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.339	83.480	83.480	3.339	83.480	83.480
2	.311	7.786	91.266			
3	.205	5.120	96.387			
4	.145	3.613	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
PRC1	.921
PRC2	.923
PRC3	.876
PRC4	.933

Business Innovativeness (BIZ)

Reliability Statistics

Cronbach's Alpha	N of Items
.900	4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.625
Bartlett's Test of Sphericity	Approx. Chi-Square	97.626
	df	6
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.100	77.507	77.507	3.100	77.507	77.507
2	.642	16.058	93.565			
3	.187	4.665	98.231			
4	.071	1.769	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
BIZ1	.758
BIZ2	.947
BIZ3	.896
BIZ4	.909

New Technology (NEWT)

Reliability Statistics

Cronbach's Alpha	N of Items
.894	4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.842
Bartlett's Test of Sphericity	Approx. Chi-Square	67.642
	df	6
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.094	77.343	77.343	3.094	77.343	77.343
2	.386	9.660	87.004			
3	.278	6.941	93.944			
4	.242	6.056	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
NEWT1	.842
NEWT2	.897
NEWT3	.888
NEWT4	.891

Adhocracy (ADC)

Reliability Statistics

Cronbach's Alpha	N of Items
.940	10

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.835
Bartlett's Test of Sphericity	Approx. Chi-Square	266.225
	df	45
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.631	66.307	66.307	6.631	66.307	66.307
2	1.156	11.563	77.870	1.156	11.563	77.870
3	.672	6.717	84.588			
4	.517	5.168	89.755			
5	.371	3.708	93.463			
6	.252	2.517	95.981			
7	.145	1.451	97.431			
8	.096	.960	98.391			
9	.090	.897	99.288			
10	.071	.712	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
ADC1	.724	.512
ADC2	.774	.563
ADC3	.727	.501
ADC4	.770	-.240
ADC5	.766	-.361
ADC6	.889	-.151
ADC7	.889	-.153
ADC8	.897	-.124
ADC9	.874	-.223
ADC10	.805	-.166

Market Orientation (MKT)

Reliability Statistics

Cronbach's Alpha	N of Items
.887	9

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.769
Bartlett's Test of Sphericity	Approx. Chi-Square	186.303
	df	36
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.782	53.134	53.134	4.782	53.134	53.134
2	1.814	20.158	73.292	1.814	20.158	73.292
3	.843	9.365	82.657			
4	.564	6.269	88.926			
5	.345	3.829	92.756			
6	.300	3.335	96.091			
7	.160	1.781	97.872			
8	.112	1.244	99.116			
9	.080	.884	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
MKT1	.611	.688
MTK2	.647	.634
MKT3	.765	.585
MKT4	.781	-.131
MKT5	.824	-.114
MKT6	.775	-.455
MKT7	.610	-.309
MKT8	.726	-.410
MKT9	.785	-.309

Environmental Protection (EVT)

Reliability Statistics

Cronbach's Alpha	N of Items
.920	8

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.850
Bartlett's Test of Sphericity	Approx. Chi-Square	170.829
	df	28
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.272	65.903	65.903	5.272	65.903	65.903
2	.835	10.439	76.342			
3	.672	8.399	84.741			
4	.490	6.131	90.872			
5	.282	3.526	94.398			
6	.190	2.381	96.779			
7	.157	1.963	98.742			
8	.101	1.258	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
EVT1	.738
EVT2	.869
EVT3	.753
EVT4	.847
EVT5	.851
EVT6	.788
EVT7	.883
EVT8	.752

Social Wellbeing (SWB)

Reliability Statistics

Cronbach's Alpha	N of Items
.945	7

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.898
Bartlett's Test of Sphericity	Approx. Chi-Square	170.850
	df	21
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.299	75.706	75.706	5.299	75.706	75.706
2	.531	7.587	83.293			
3	.322	4.605	87.898			
4	.309	4.408	92.306			
5	.235	3.363	95.670			
6	.203	2.895	98.564			
7	.100	1.436	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
SWB1	.797
SWB2	.933
SWB3	.876
SWB4	.843
SWB5	.904
SWB6	.856
SWB7	.874

Economic Prosperity (ECP)

Reliability Statistics

Cronbach's Alpha	N of Items
.895	5

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.815
Bartlett's Test of Sphericity	Approx. Chi-Square	89.934
	df	10
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.562	71.248	71.248	3.562	71.248	71.248
2	.595	11.893	83.141			
3	.460	9.196	92.337			
4	.239	4.774	97.111			
5	.144	2.889	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
ECP1	.740
ECP2	.865
ECP3	.860
ECP4	.886
ECP5	.861

Government Support (GOVS)

Reliability Statistics

Cronbach's Alpha	N of Items
.862	5

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.806
Bartlett's Test of Sphericity	Approx. Chi-Square	69.825
	df	10
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.321	66.420	66.420	3.321	66.420	66.420
2	.639	12.772	79.192			
3	.528	10.565	89.757			
4	.295	5.910	95.667			
5	.217	4.333	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
GOVS1	.786
GOVS2	.859
GOVS3	.722
GOVS4	.897
GOVS5	.799

Appendix F

Decision on PhD Proposal Defence by the Panel Reviewers' Committee

PUSAT PENGAJIAN PENGURUSAN TEKNOLOGI DAN LOGISTIK
SCHOOL OF TECHNOLOGY MANAGEMENT AND LOGISTICS (STML)
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KEDAH AMAN MAKMUR•BERSAMA MEMACU TRANSFORMASI

Ref.No :UUM/COB/STML/A-3
Date :17 May 2015

Bamgbade Jibril Adewale (95819)
201T,Maybank Residential Hall UUM
Sintok 06010,
Kedah Darul Aman.

Dear Sir,

RESULT FOR PHD PROPOSAL DEFENCE

With reference to the PhD proposal defence held on **12 May 2015 (Tuesday)**,the members of the Proposal Defence Board have agreed to award you the following status :

"PASS WITH MINOR REVISION – Pass with minor revision,and re-submit the amended proposal within One (1) Month".

In accordance with this :

1. You are given a maximum period of **One (1) Month** beginning from **12 May until 11 June 2015** to make correction and resubmit you proposal.
2. Correction should be done based on comments and suggestion made by reviewers
3. **Dr. Ahmed Mohammed Kamaruddeen** and **Sr. Dr. Mohd Nasrun Mohd Nawi**,will be responsible for supervising you in making the necessary correction.
4. For the purpose of making the required changes,the reports of the reviewers will be made available to your supervisor,i.e. **Dr. Ahmed Mohammed Kamaruddeen** and **Sr. Dr. Mohd Nasrun Mohd Nawi.**
5. Supervisors are required to submit a written report on the corrections undertaken to Dean,School of Technology Management and Logistics (STML) within the stipulated period.
6. The amended proposal will be re-examined **Dr. Mohd Norhasni Mohd Asaad**,who will then submit a written report to the Dean.You will be awarded a pass if the reviewers is fully satisfied with the amendments undertaken by you.
7. You are required to submit a copy of amended pproposal using the latest stardards format of writing to the Dean by **11 Jun 2015 (Thursday).**

Universiti Pengurusan Terkemuka
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Appendix G

Publications

Paper 1: Bamgbade, J.A, Kamaruddeen, A.M., Nawi, M.N.M. (2015). Factors Influencing Sustainable Construction among Construction Firms in Malaysia: A Preliminary Study using PLS-SEM. *Revista Tecnica de la Facultad de Ingenieria Universidad del Zulia.* 38(3), 132 – 142. Indexed in Scopus. SJR Impact Factor: 0.118.

Paper 2: Bamgbade, J.A, Kamaruddeen, A.M, Nawi, M.N.M, and Aziz, Z. (2015). Preliminary Study on Antecedents of Sustainable Construction among Contracting Companies Operating in Malaysia. *Jurnal Teknologi*. 77(4), 119-125. Indexed in Scopus. SJR Impact Factor: 0.146.

Paper 3: Bamgbade, J.A, Kamaruddeen, A.M., & Nawi, M.N.M (2016). Developing a Validation for Environmental Sustainability. In: *Proceedings of the International Conference on Applied Science and Technology 2016 (ICAST 2016),* April 11-13, 2016. *AIP Conference Proceedings*. 1761: 020026-1 – 020026-9. doi: 10.1063/1.4960866. Indexed in Thomson Reuters Web of Science and Scopus.

Paper 4: Bamgbade, J.A, Kamaruddeen, A.M., & Nawi, M.N.M (2016). Assessing the sustainable construction of large construction companies in Malaysia. In: *Proceedings of the International Conference on Applied Science and Technology 2016 (ICAST 2016),* April 11-13, 2016. *AIP Conference Proceedings*. 020027-1 – 020027-7. doi: 10.1063/1.4960867. Indexed in Thomson Reuters Web of Science and Scopus.

Paper 5: Bamgbade, J.A, Kamaruddeen, A.M., Nawi, M.N.M., Rushami Zien Yusoff, and Azahari Bin Ramli (In Print). Does government support matters? Influence of organizational culture on sustainable construction among Malaysian contractors. *International Journal of Construction Management*. Indexed in Thomson Reuters' Emerging Sources Citation Index (ESCI) and Scopus.

Factors Influencing Sustainable Construction among Construction Firms in Malaysia: A Preliminary Study using PLS-SEM

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Abstract: This study explores the influence of organisational innovativeness and culture on the adoption of sustainable construction among G7 contractors operating in Peninsular Malaysia. The purpose of this paper is to present the research model alongside hypotheses development, and the result of a preliminary study on organizational innovativeness, culture and adoption of sustainable construction among the large contractors (G7 contractors) operating in Malaysia. A pilot study was conducted, where a total of Forty-five (45) contracting firms' representatives were sampled during the Construction Industry Development Board (CIDB) seminar on "Innovation & Technology Sustainable Construction", held at Carlton Holiday Hotel & Suites, Shah Alam, Selangor on 16th June, 2015, with the aim of assessing the validity and reliability of the instruments that are intended for use in the main survey. The PLS-SEM measurement model was employed to assess the reliability and validity of the items in this study. The result shows that the measuring instruments are reliable and the data for pilot study indicated a strong evidence of rational validity.

Keywords: Organisational innovativeness, Organisational culture, Sustainable construction, Research model, Validity, Reliability.

1. INTRODUCTION

Sustainable development is the basis for enhancing the understanding of the principles of sustainable construction, which emerged as a new pattern to create a favourable built environment that meets human's present needs without jeopardizing the ability of the future generation to meet theirs (Ofori, 2001). In principle, sustainable construction essentially covers the triple bottom line of environmental, social and economic attributes that are exemplified in the sustainable development mantra. Du Plessis (2002) affirms that sustainable construction was introduced to fundamentally address the complex problems of construction and the environment in order to restore the balance between the natural environment and the built environment, as both realms are highly interconnected.

Several factors have been identified that could contribute to construction organisation's adoption of sustainable construction. However, the implication for firms' innovative techniques as the drivers for sustainable construction, is clear (Rohracher, 2001). The construction industry's contribution to ecosystem degradation, climate change, and several interdependent issues call for innovative construction technologies, products, business, processes and marketing approaches to address the underlying ecological loads of construction projects (Seebode, Jeanrenaud, &Bessant, 2012; Rohracher, 2001).

Many empirical studies (Chan & Liu, 2012; Bossnik, 2004; Gauthier & Wooldridge, 2012; Boxenbaum*et al*., 2010) that examined the factors influencing the achievement of sustainable construction have affirmed the importance of innovative construction as a unique way of achieving sustainable construction, albeit in a conflicting way. Obviously, sustainable construction requires fresh knowledge and learning within the construction industry, because firm's innovativeness not only improves client's satisfaction, competitive advantage and profitability, but also a vital procedure in sustainability adoption in an organization (Dulaimi, Nepal & Park, 2005; Rydin, 2006).

Again, earlier studies have also shown that organisational culture not only influences operations within a firm, but it also plays an essential role in the efficiency and improved productivity of an organisation (Alas, Niglas, & Kraus, 2009; Cheung, Wong, & Lam, 2012), proven to be important initiatives in achieving construction sustainability among construction firms.

Thus, government support is considered as a potential moderator on the relationship between organisational innovativeness, organisational culture and sustainable construction, due to its observed and noticeable influence on the processes and outcomes of both new and established firms. Again, this perceived relationship (between organisational innovativeness, culture and sustainable construction moderated by government support) has not been given a considerable attention within the Malaysian Construction Industry. Thus, this paper examines how innovative capabilities and propensity of construction firms (known as organisational innovativeness) and organisational culture could play a key determining role in guaranteeing green construction delivery by using the Partial Least Square (PLS) technique to test the reliability and validity of the survey instrument. Responses were obtained from thirty G7 construction firms using a sixty-one item instrument.

This paper is organized as follows: firstly, the explanation of the relationship in the research model is presented. Next, a description of the research methodology including the data collection and preliminary data analysis using the PLS SEM is presented. The paper was concluded with plans for future research.

2. ORGANISATIONAL INNOVATIVENESS AND SUSTAINABLE CONSTRUCTION

In this paper, sustainable construction refers to construction firms' adoption of the principles of sustainable development in project execution by striking a balance between environmental protection, social well-being and economic prosperity for the benefits of both the present and future generations.

Earlier studies have examined the influence of firm innovative capacity on sustainability adoption. Chan and Liu, (2012) demonstrated how innovativeness is capable of influencing not only organisational productivity, profitability and competitiveness, but also a vital procedure in sustainability adoption in an organization. Bossnik (2004) has earlier found that sustainable construction has always been improved with the help of innovativeness, while emphasising the roles of the end-users as drivers of innovations for sustainable construction. This is consistent with the work of Rohracher (2001) that innovative construction technologies and products could reduce the ***ecological*** burden of construction projects. Thus, this requires the constr uction firms to change their technologies and better understand the fundamentals of sustainable building construction. Other findings by researchers concerning innovative products, process and business strategies confirm that firms that incorporate sustainability in their orientation and innovation processes mostly exhibit value creation in terms of introducing new products to the market, sometimes called radical innovations (Bos-Brouwers, 2010).

Gauthier and Wooldridge (2012) also find that construction organisations could choose from a range of innovations in addressing sustainability issues in the construction as the development of a green technology strategy involves a strong innovation focus. Their suggestion was based on the premise that innovation in the building design requires significant attention, considering the fact that the construction consumes over 40 per cent of the world's non-renewable resources, making it the world's largest consumption of energy. This explains why sustainability issues are always linked with regulations where additional force towards innovation in products, processes and technological models is emphasized (Tidd, *et al*., 2003). Therefore, this study hypothesizes that organizational innovativeness can positively influence the adoption of sustainable construction among Malaysian contractors.

H1: There is a significant relationship between organizational innovativeness and sustainable construction among Malaysian contractors.

3. ORGANIZATIONAL CULTURE AND SUSTAINABLE CONSTRUCTION

The relationship between organisational culture and sustainability adoption is well documented in the literature (Al-Jamea, 2014; D'Incognito,Costantino&Migliaccio, 2013; Sharma, 2002; Wong & Avery, 2009; Linnenluecke & Griffiths, 2010). The culture within an organisation, according to Trong Tuan, (2012), is a continuous process of identity building/re-building and meaning-making within an organization, which enables its social integration as well as sustainability of its sub-divisions. It is defined in this study as construction firm's pattern of shared values and beliefs shaping their organisational functions and explaining the norms for behaviour within the organisation.

Other earlier studies have also shown that organisational culture influences, not only operations within a firm, but also plays an essential role in the efficiency and improved productivity in an organisation (Alas, Niglas, & Kraus, 2009; Cheung, Wong, & Lam, 2012), both of which are important initiatives in achieving sustainability within the construction industry. The construction industry needs to develop cultures that promote, support and compensate sustainability adoption. In so doing, culture should be prioritized and placed at the centre of development strategies due to its significant roles in framing people's relationship and attitudes towards the built and the natural environments. (Al-Jamea, 2014; Opoku, Ahmed & Cruickshank, 2015).

Furthermore, culture influences sustainability by emphasizing improved human lives and ways to leave a practical legacy for future generations. According to Avery (2005), this is achievable when organisational leaders not only communicate the importance of sustainability, but also establish a culture that incorporates sustainability into the daily management decisions. Hence, sustainability dimensions must be incorporated into construction organisation's culture and policy formulations because according to Bansal, (2005), practically all firms contribute to environmental degradation in several ways, from the mere lighting to the generation of wastes and emissions during the production processes.

D'Incognito,*et al*., (2013), observed that organizational culture is the most significant barrier to the slow adoption of sustainable construction in terms of the Life Cycle Costing (LCC) and Life Cycle Assessment (LCA). Although the technical and financial barriers are also relevant, organisations cannot necessarily overcome them if culture forms a hindrance to the decision-making process. Thus, going by the aforementioned, this study forms the following hypothesis:

H2: There is a significant relationship between organizational culture and sustainable construction among Malaysian contractors.

4. MODERATING ROLE OF GOVERNMENT SUPPORT

According to Baron and Kenny (1986) a moderator functions as a third variable that can either be a qualitative or qualitative variable affecting either the direction and/or strength of the relationship existing between a predictor and another criterion variable. In other words, "the moderating variable is one that has a strong contingent effect on the independent variable-dependent variable relationship. It means that the presence of a third variable (the moderating variable) modifies the original relationship between the independent and the dependent variables" (Sekaran & Bougie, 2013).

To justify the potential role of government support as a moderator, the proposition of earlier studies (Zerbinati&Souitaris 2005; Michael & Pierce 2009) is invoked. Policies on government subsidies have been observed to have a noticeable influence on the processes and outcomes of both new and established firms. Thus, according to Atsusaka, (2003); Samari, (2012), the government support in stimulating green construction is the most effective as it is more result-oriented than other techniques. Moreover, governments have the capacity to facilitate sustainable construction adoption in a variety of ways, although there are several barriers to developing it (Shafii*et al*., 2006).

In this study, government support is considered as the moderating variable in the relationship between organisational innovativeness, organisational culture and sustainable construction due to its strategic implications on firms operating within the industry by providing the impetus to achieve standardized and sustainable construction projects. Properly designed regulations always catalyze improved products and processes and cost reduction (Gann *et al*., 1998; Arditi*et al*., 1997). Regulations are designed to govern practice, by way of establishing rules in response to changes in market and technological conditions. This view is corroborated by Pitt *et al*., (2009) that government is capable of driving sustainable construction agenda with a number of policies, including fiscal supports, legislation and standards, and building labelling with energy efficiency rating. Thus, this study holds that government support will likely moderate the relationship between organizational innovativeness, organisational culture and sustainable construction among Malaysian contractors, with the following hypotheses:

H3: Government support significantly moderates the relationship between organizational innovativeness and sustainable construction among Malaysian contractors.

H4: Government support significantly moderates the relationship between organisational culture and sustainable construction among Malaysian contractors.

5. RELATIONSHIP BETWEEN GOVERNMENT SUPPORT AND SUSTAINABLE CONSTRUCTION

Sustainable construction refers to the practice in which construction activities contribute to the principles of sustainable development in such a way that the contractors not only strive to meet corporate economic needs, but they are also under obligations to evaluate the impacts of the construction on the users, while not forgetting environmental consequences of their construction activities. Essentially, this implies striking a balance between environmental protection, social well-being and economic prosperity for the benefit of both the present and future generations. Thus, it is best achieved through government support and regulatory frameworks, considering the fact that the government is a major client of the construction industry. The government could stimulate sustainable construction practices (Du Plessis, 2002; Abidin *et al*., 2013) through grants and subsidies as incentives for its adoption. Although, this may be less effective in the event of declining government income and a limited revenue base, it is still recognised globally as a way of regulating and controlling environmental degradation resulting from the activities of the construction industry. Majdalani*et al*., (2006) argued that the government, in addition to its role as the industry regulator, must necessarily drive sustainable construction delivery through its enormous influence by instituting a national vision for sustainable construction.

According to Zhou and Lowe (2003), the British government introduced several guidance and incentives apparatuses to encourage the transition to a sustainable construction within its construction industry. This form of policy becomes important in accelerating research and development for new technologies required in sustainable construction, and this can be transferred to construction firms to create products that can influence the marketplace. Häkkinen and Belloni, (2011) also suggested that because sustainable construction is an active process, and in achieving its objectives through adequate government support, there should be concerted efforts from all stakeholders involved in the construction industry to get the necessary awareness and to take active roles to encourage its adoption and practice. Based on the discussion of the theoretical and empirical literature on the influence of government support on sustainable construction adoption, the following hypothesis is formulated:

H5: There is a significant relationship between government support and sustainable construction among Malaysian contractors.

6. THEORETICAL BACKGROUND AND RESEARCH MODEL

Fig. 1: Research Model

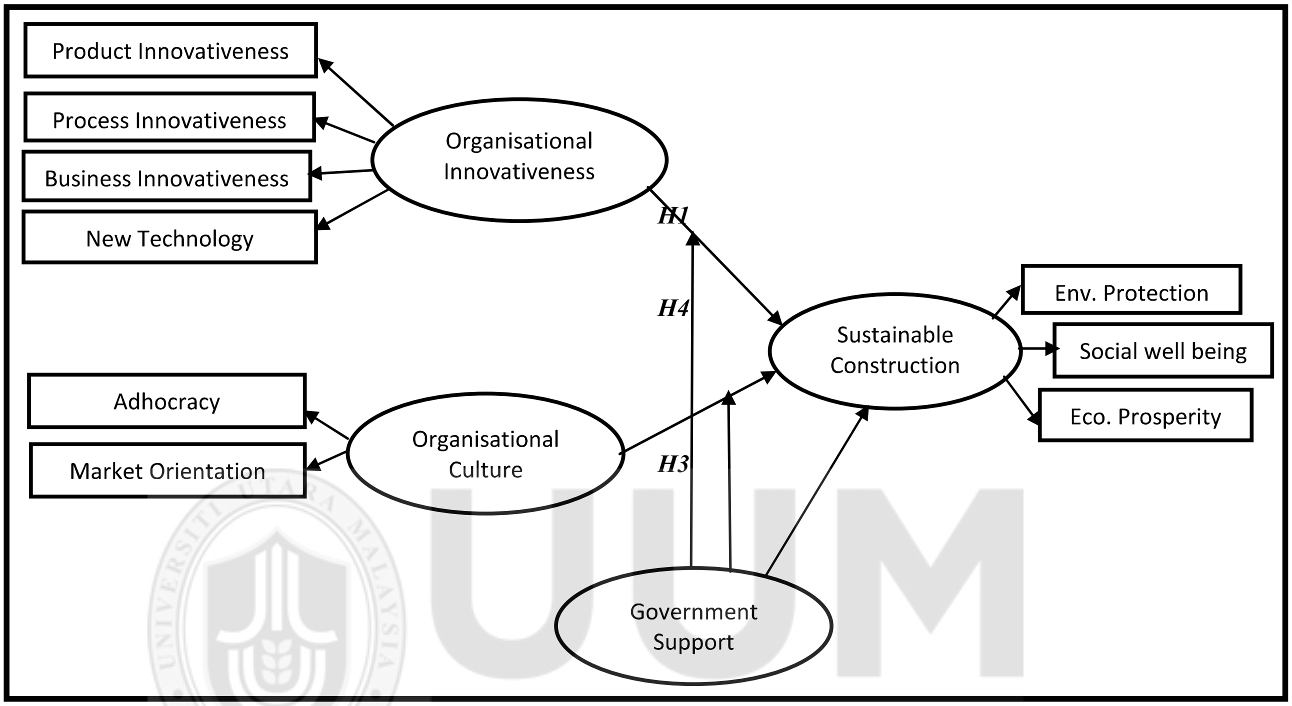

Fig. 1 is a representation of this study's research model including the hypotheses. This model explains the relationship between the exogenous latent variables (organisational innovativeness, organisational culture and government support) and the endogenous latent variable (sustainable construction). The exogenous latent variables, also known as independent variables in this model aim to explain the dependent variables in the path model. In the section that follows, the literature review in the context of this research model is presented.

7. RESEARCH METHODOLOGY

The CIDB (Construction Industry Development Board) database was used to obtain company names and addresses of G7 construction firms in (building construction and civil engineering sections) operating in Peninsular Malaysia. The database contains information on all Malaysian contractors, 4,520 of which are considered registered within the Civil Engineering and Building construction sub-sections in all the eleven branches across the Peninsular Malaysia.

This study is a cross-sectional research design. This indicates that the data were collected at a single-point-in-time using a structured questionnaire (Kumar, Abdul Talib&Ramayah, 2013; Sekaran & Bougie, 2013;Zikmund*et al*., 2013). The research approach is quantitative, which is a common research approach adopted in social sciences (Sekaran, Robert & Brain, 2001). Considering that this study is a pilot test, and in pilot testing, a small scale study of respondents is suggested for trial purpose before conducting the full-fledged study (Gay, Mills &Airasian, 2006). Ideally, the sample size for pilot studies is suggested to be relatively smaller, ranging from 30 – 100 respondents. It is also conducted to ensure the validity and reliability of the study items, in order to gather insights into what to expect during the actual survey. Thus, it enables the researchers to foresee inconsistencies in the study design and subsequently make necessary adjustments before the full scale study is conducted. The two major tests that will be reported in this study are the instrument validity and reliability. While the instrument validity is conducted to examine the extent to which the instrument is measuring what it is supposed to measure, the measurement reliability represents the consistency of the measuring instrument across time and also across various items in the scale, and the extent to which a measuring instrument is error free (Hair et al., 2008). Accordingly, this paper presents the result of the pilot test with regard to the relationship between organisational innovativeness, organisational culture, government support, and sustainable construction among Malaysian large contractors (The G7 contractors).

A total of forty-five (45) questionnaires were administered personally during the Construction Industry Development Board (CIDB) seminar on "Innovation & Technology Sustainable Construction", held at Carlton Holiday Hotel & Suites, Shah Alam, Selangor on 16th June, 2015. Forty (40) questionnaires were returned, out of which thirty (30) were deemed suitable for analysis.Ordinarily, 30 – 100 respondents are considered appropriate for pilot testing (Malhotra, 2008). The responses collected were subsequently used for measuring the internal consistency of each of the study constructs.

8. PRELIMINARY DATA ANALYSIS AND RESULTS

Partial Least Square (PLS) (smartPLS version 2.0) was used. Partial Least Square is a popular Structural Equation Modelling (SEM) technique used in data analysis, basically due to its ability to accommodate relatively small sample size (Goodhue*et al*., 2006, Chin, 1998) as against other co-variance-based Structural Equation Modelling (AMOS, LISTREL). Thus, because this study's sample is small, the PLS SEM is considered appropriate.

8.1. Reliability and Validity Assessment

The items used in this study were adopted from previous empirical studies that were published in reputable academic journals, and were subsequently adapted. Table 1.0 shows the sources of measurement in this study.

Table 1.0: Sources of Measurement

S/N	Constructs	Dimensions	Source	Remarks
1	Organisational Innovativeness	Prod. innovativeness Process innovativeness Business innovativeness New technology	Kamaruddeen *et al*., (2012)	Adapted
2	Organisational Culture	Adhocracy Market orientation	Cameron & Quinn (2011); Jaworski & Kohli (1993)	Adapted
3	Government support		OluwoleAkadiri&OlaniranFadiya, (2013)	Adapted
4	Sustainable construction	Environmental protection Social wellbeing Economic prosperity	Abidin (2005)	Adapted

The unit of analysis for this study is organization, thus, respondents were G7 construction firms (under the building construction and civil engineering sections) operating in Peninsular Malaysia. In an attempt to determine the measurement accuracy, PLS-Graph was used to assess the reliability and validity of the items in this study. Validity refers to how accurately a construct reflects what it is meant to measure, and reliability deals with the consistency of the instrument across time and across various items in the scale. Again, several criteria can be adopted to ascertain the validity of a construct. Some of these are the content validity, convergent and discriminant validity which were used in this study. Content validity was ascertained by consulting experts both within academics and practice before the pilot testing of the questionnaire items was carried out. Specifically, three experts were selected from the School of Technology Management and Logistics, University Utara Malaysia. Meanwhile, another four construction industry's practitioners were also contacted for the same exercise. Their inputs and suggestions were subsequently incorporated into the final draft of the instrument.

Similarly, for the convergence and discriminant validities, according to Tore, (2005), they seek to establish an agreement between a theory and a specific measuring instrument by examining whether the measuring scales are true representation of the attributes. Thus, factor loadings, composite reliability and average variance extracted (AVE) are parameters used in assessing convergence validity (Hair *et al*., 2010). Also, once there is an established correlation between all the items supposedly measuring a construct, convergent validity has already been established (Bollen& Lennox, 1991).

In order to detect problems with any particular items, respective loadings and cross loadings of the items are assessed. In Table 2.0, it shows the cross loadings of indicators in their respective construct. A measurement scale is considered to have displayed convergent validity when all the items/indicators load above 0.5 on their associated constructs, in a way that no item loads higher on other constructs than on their mother constructs that they are meant to measure (Hair *et al*., 2010; Barclay *et al*., 1995). In this preliminary analysis, all the items are loaded adequately on their respective construct in a manner that they all are loaded above the recommended threshold value of 0.5 (Hair *et al*., 2010). As depicted in Table 2.0, all the items are loaded on their mother constructs from a lower bound of 0.6063 to an upper bound of 0.9338.

Table 2. Cross Loadings

Constructs	Indicators	Product Innov.	Process Innov.	Biz. Innov.	New Tech.	Adhocracy	Mkt. Orientation	Evt. Protection	Social Wellbeing	Eco. Prosperity	Govt. Support
Organisational Innovativeness	PRO1	***0.8461***	0.7642	0.7253	0.5338	0.4108	0.0519	0.3113	-0.0476	-0.1213	0.2668
	PRO2	***0.9251***	0.7266	0.6131	0.5945	0.4654	0.164	0.3847	-0.083	-0.0781	0.2078
	PRO3	***0.905***	0.6939	0.6794	0.6144	0.5354	0.1946	0.4412	-0.018	-0.1079	0.2682
	PRO4	***0.7688***	0.5907	0.5931	0.4555	0.5196	0.5041	0.4662	0.207	0.3006	0.3233
	PRO5	***0.7893***	0.5358	0.6983	0.5163	0.549	0.5884	0.2999	0.1055	0.2608	0.1755
	PRC1	0.8312	***0.9268***	0.7941	0.7244	0.5534	0.1417	0.2818	-0.0644	-0.0502	0.2131
	PRC2	0.6769	***0.9213***	0.7229	0.482	0.3519	-0.0262	0.3269	-0.0813	-0.089	0.1796
	PRC3	0.6604	***0.8746***	0.7152	0.4591	0.3877	0.0375	0.4084	-0.0643	-0.0514	0.2125
	PRC4	0.682	***0.9306***	0.8089	0.4236	0.4306	0.0848	0.3785	0.0227	0.0144	0.3159
	BIZ1	0.597	0.6356	***0.7527***	0.3616	0.2863	0.1932	0.4074	0.0561	0.2764	0.2779
	BIZ2	0.7001	0.7589	***0.9447***	0.5137	0.5281	0.361	0.4671	0.1008	0.1758	0.3375
	BIZ3	0.7287	0.7635	***0.8991***	0.5393	0.5416	0.3385	0.484	0.0905	-0.0032	0.3198
	BIZ4	0.7113	0.7687	***0.9126***	0.5891	0.5232	0.2597	0.4489	0.0555	0.0097	0.1933
	NEWT1	0.6432	0.6514	0.6549	***0.8655***	0.5382	0.1226	0.2329	-0.1187	-0.1686	0.1343
	NEWT2	0.525	0.4991	0.4743	***0.8912***	0.5855	0.0915	0.0411	-0.0212	-0.0762	0.221
	NEWT3	0.476	0.408	0.2836	***0.8694***	0.4908	0.0719	0.0253	-0.1036	-0.0317	0.1407
	NEWT4	0.5826	0.4369	0.5432	***0.8877***	0.5482	0.2399	0.206	0.0273	0.1428	0.3169
Organisational Culture	ADC1	0.5871	0.611	0.6174	0.4244	***0.7105***	0.3119	0.3404	0.2067	0.1018	0.3571
	ADC2	0.6199	0.5716	0.5446	0.4904	***0.7594***	0.4045	0.3173	0.1741	-0.023	0.2905
	ADC3	0.5333	0.4844	0.3813	0.3906	***0.7131***	0.3066	0.0419	0.06	-0.0619	0.1389
	ADC4	0.4296	0.2101	0.3576	0.4257	***0.7842***	0.7042	0.2805	0.4869	0.4068	0.386
	ADC5	0.32	0.2377	0.4579	0.5355	***0.7815***	0.6125	0.3505	0.5302	0.426	0.4338
	ADC6	0.4504	0.3448	0.3532	0.605	***0.8894***	0.454	0.3693	0.3616	0.1091	0.3766
	ADC7	0.5156	0.4064	0.4372	0.5315	***0.8889***	0.531	0.5099	0.4581	0.247	0.5027
	ADC8	0.4895	0.3744	0.391	0.6754	***0.9003***	0.5463	0.3027	0.4585	0.252	0.4508
	ADC9	0.3943	0.39	0.4579	0.4934	***0.8757***	0.5003	0.3719	0.4913	0.2754	0.4635
	ADC10	0.4774	0.3902	0.4892	0.4194	***0.8066***	0.5068	0.4082	0.5485	0.2643	0.4267
	MKT1	0.2507	0.184	0.337	0.143	0.3792	***0.6186***	0.5711	0.6504	0.5493	0.3965
	MTK2	0.1427	-0.0485	0.2199	0.1323	0.3906	***0.6531***	0.565	0.6267	0.5919	0.329
	MKT3	0.2078	0.108	0.3742	0.1024	0.4224	***0.7711***	0.6453	0.7249	0.7288	0.4676
	MKT4	0.4292	0.2136	0.4092	0.1738	0.5919	***0.7884***	0.4024	0.3182	0.3441	0.4836
	MKT5	0.3501	0.089	0.3946	0.0875	0.5386	***0.8285***	0.3336	0.4481	0.3749	0.4711
	MKT6	0.2606	0.0318	0.119	0.0574	0.374	***0.7638***	0.3186	0.4391	0.3326	0.3777
	MKT7	0.236	0.0393	0.0775	0.1312	0.4187	***0.6063***	0.3484	0.4571	0.2979	0.4769
	MKT8	0.0386	-0.1064	0.0205	0.0447	0.4666	***0.7202***	0.2114	0.424	0.2676	0.2321
	MKT9	0.246	-0.0929	0.152	0.132	0.3885	***0.7736***	0.2949	0.4534	0.4722	0.3591
Sustainable construction	EVT1	0.2787	0.3155	0.4646	0.3333	0.5053	0.377	***0.7371***	0.554	0.2286	0.4852

	EVT2	0.2737	0.2984	0.3843	-0.0046	0.3007	0.4948	***0.8681***	0.555	0.344	0.4576
	EVT3	0.2802	0.2703	0.4068	0.0152	0.1102	0.4347	***0.7497***	0.4644	0.5116	0.4397
	EVT4	0.288	0.3352	0.4146	0.1652	0.1524	0.4054	***0.8395***	0.4049	0.4469	0.5552
	EVT5	0.4516	0.2836	0.4603	0.0162	0.3451	0.534	***0.8529***	0.5469	0.5246	0.6731
	EVT6	0.5484	0.3455	0.3831	0.3951	0.3915	0.4174	***0.7855***	0.4393	0.4718	0.5512
	EVT7	0.5504	0.4105	0.5441	0.1953	0.4587	0.5129	***0.8858***	0.5845	0.4661	0.5283
	EVT8	0.2027	0.1978	0.2723	-0.0692	0.4012	0.4174	***0.7604***	0.656	0.328	0.5225
	SWB1	0.1726	0.0222	0.2275	0.0696	0.4177	0.6733	0.576	***0.8037***	0.7855	0.6583
	SWB2	0.0122	-0.133	-0.0102	-0.0899	0.3725	0.6364	0.5838	***0.9338***	0.7442	0.6679
	SWB3	0.0616	-0.0569	0.0314	0.0372	0.4765	0.5575	0.6139	***0.8735***	0.5576	0.5276
	SWB4	-0.0627	-0.0994	-0.0272	-0.2175	0.3522	0.5785	0.6161	***0.8432***	0.6579	0.4352
	SWB5	0.0305	0.0446	0.2172	0.0359	0.5248	0.604	0.5889	***0.9048***	0.6406	0.6101
	SWB6	0.0134	0.0012	0.1292	-0.0664	0.3671	0.4899	0.5431	***0.8557***	0.6825	0.5232
	SWB7	-0.0549	-0.0919	-0.0497	-0.1567	0.4358	0.6066	0.4218	***0.8692***	0.5941	0.4639
	ECP1	0.2794	0.1826	0.3877	0.1726	0.4576	0.6802	0.5943	0.6972	***0.7721***	0.6849
	ECP2	-0.1061	-0.1756	-0.0511	-0.1319	0.0976	0.4264	0.2299	0.5544	***0.8403***	0.3744
	ECP3	-0.0255	-0.0303	0.0822	-0.2107	0.1244	0.4399	0.4841	0.6683	***0.868***	0.5571
	ECP4	-0.0742	-0.1411	0.0104	0.0061	0.1704	0.4935	0.3374	0.6153	***0.8673***	0.4327
	ECP5	0.0569	-0.0887	0.0186	-0.0464	0.2141	0.4475	0.4556	0.6688	***0.8627***	0.4019
Govt. Support	GOVS1	0.0245	0.1008	0.0099	0.0298	0.2873	0.3361	0.4247	0.4913	0.3586	***0.7825***
	GOVS2	0.2606	0.2987	0.4657	0.2767	0.4925	0.4999	0.5805	0.6013	0.5771	***0.8607***
	GOVS3	0.1858	0.1423	0.2268	0.1706	0.2438	0.4207	0.418	0.4178	0.4745	***0.7207***
	GOVS4	0.3173	0.2146	0.2348	0.1844	0.3761	0.4537	0.606	0.5676	0.5594	***0.8977***
	GOVS5	0.3697	0.2486	0.3306	0.2635	0.5302	0.5229	0.5974	0.5183	0.4309	***0.8015***

Source: Output of Measurement Model

Note. The bold and italicized indicators/items identify items belonging to the column's construct

Again, the convergent validity for this study was also assessed using the AVE- Average Variance Extracted. Following Fornell and Larcker (1981), for a construct to display the convergent validity, the Average Variance Extracted (AVE) should be at least 0.5. This implies that the variance explained by the construct is greater than the measurement error. In other words, the AVE describes the average variance shared between a particular construct and its measures. Thus, an AVE for a construct, according to Couchman and Fulop, (2006), is expected to be greater than the variance shared between that particular construct and other constructs in a given model.

Accordingly, all AVE readings in Table 3.0 are above 0.5, with 0.5311 as the lowest reading. This implies that the convergent validity in all the measures is adequate. Additionally, with this result that satisfactorily demonstrated adequate item loadings, composite reliability, and AVE coefficients for the individual items, there is enough evidence to prove that the items/indicators are a true representation of their latent constructs, thus giving another evidence of convergent validity.

Table 3.Convergence and Reliability Analysis

Construct Dimensions	Items	Loadings	Composite Reliability	AVE
Adhocracy	ADC1	0.7105		
	ADC2	0.7594		
	ADC3	0.7131		
	ADC4	0.7842		
	ADC5	0.7815	0.951	0.6625
	ADC6	0.8894		
	ADC7	0.8889		
	ADC8	0.9003		
	ADC9	0.8757		
	ADC10	0.8066		

Business innovativeness	BIZ1	0.7527		
	BIZ2	0.9447	0.932	0.775
	BIZ3	0.8991		
	BIZ4	0.9126		
Economic prosperity	ECP1	0.7721		
	ECP2	0.8403	0.925	0.7104
	ECP3	0.868		
	ECP4	0.8673		
	ECP5	0.8627		
Environmental protection	EVT1	0.7371		
	EVT2	0.8681		
	EVT3	0.7497	0.939	0.6589
	EVT4	0.8395		
	EVT5	0.8529		
	EVT6	0.7855		
	EVT7	0.8858		
	EVT8	0.7604		
Government support	GOVS1	0.7825		
	GOVS2	0.8607	0.908	0.6642
	GOVS3	0.7207		
	GOVS4	0.8977		
	GOVS5	0.8015		
Market orientation	MKT1	0.6186		
	MTK2	0.6531		
	MKT3	0.7711		
	MKT4	0.7884	0.911	0.5311
	MKT5	0.8285		
	MKT6	0.7638		
	MKT7	0.6063		
	MKT8	0.7202		
	MKT9	0.7736		
New technology	NEWT1	0.8655		
	NEWT2	0.8912	0.931	0.7718
	NEWT3	0.8694		
	NEWT4	0.8877		
Process innovativeness	PRC1	0.9268		
	PRC2	0.9213	0.953	0.8346
	PRC3	0.8746		
	PRC4	0.9306		
Product innovativeness	PRO1	0.8461		
	PRO2	0.9251	0.928	0.721
	PRO3	0.905		
	PRO4	0.7688		
	PRO5	0.7893		
Social wellbeing	SWB1	0.8037		
	SWB2	0.9338		
	SWB3	0.8735		
	SWB4	0.8432	0.956	0.7569
	SWB5	0.9048		
	SWB6	0.8557		
	SWB7	0.8692		

Furthermore, discriminant validity (as shown in Table 4.0) was duly established as the indicators/items loaded much better on their respective constructs than on other constructs. Discriminant validity establishes that the measures that are not expected to be related are, in actual fact, not related. To assess this, the square root of the AVE for each construct is used. This means that the square roots of AVE coefficients are used to replace the correlation matrix along the diagonal (Fornell, &Larcker, 1981). Usually, the squared AVE(i.e., the diagonal coefficients) is expected to be greater than the off-diagonal coefficients or elements in the corresponding rows and columns(Hair *et al*., 2006).

In Table 4, the diagonal coefficients show square roots of AVE for all the constructs, indicating the higher square roots of the AVE for Process Innovativeness (0.91), and the lowest for market Orientation (0.73). Thus, an evidence of discriminant validity is established since all the AVE square roots for all the constructs along the diagonals are higher than the corresponding off-diagonal coefficients both in rows and columns.

Table 4. Discriminant Validity

	Adhocracy	Biz. Innov	Economic Prosperity	Evt Protection	Govt. Support	Mkt. Orientation	New Tech.	Process Innov	Product Innov	Social Wellbeing
Adhocracy	**0.81**									
Biz. Innov	0.54	**0.88**								
Economic Prosperity	0.26	0.12	**0.84**							
Evt Protection	0.41	0.51	0.51	**0.81**						
Govt. Support	0.48	0.32	0.59	0.65	**0.81**					
Mkt. Orientation	0.61	0.33	0.60	0.56	0.55	**0.73**				
New Technology	0.62	0.58	-0.04	0.15	0.23	0.15	**0.88**			
Process Innov	0.48	0.83	-0.05	0.38	0.25	0.07	0.58	**0.91**		
Product Innov	0.58	0.78	0.04	0.45	0.29	0.34	0.64	0.78	**0.85**	
Social Wellbeing	0.48	0.09	0.77	0.65	0.64	0.68	-0.06	-0.05	0.03	**0.87**

***Note.* Diagonal values appearing in bold represent the average variance extracted while the other entries represent the squared correlations.**

In essence, the results presented in Tables 2.0, 3.0 and 4.0 demonstrate that items for all the ten constructs are accurately measuring their respective constructs, considering their statistical significance and parameter estimates(Chow & Chan, 2008). Thus far, the other aims of this preliminary study, which are to validate the study items and establish their respective reliability, have been accomplished.

9. CONCLUSION

The major contribution of this pilot study is to present the research model and explain the relationships among the study's exogenous latent variables and the endogenous latent variable (hypotheses development); and also to empirically explore the potency (in terms of validity and reliability) of the measuring instruments that are intended for use in the main survey using the PLS-SEM measurement model. The results from the PLS analysis showed that the items adopted in this study are indeed robust in measuring the constructs they are meant to measure, especially considering the benchmarks set for standardized loadings, composite reliability, the average variance extracted. Specifically, content validity, convergent and discriminant validity were simultaneously conducted to ascertain this study's construct validity. The result shows that the measuring instruments are reliable and the data for this pilot study indicated strong evidence of rational validity.

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PRELIMINARY STUDY ON ANTECEDENTS OF SUSTAINABLE CONSTRUCTION AMONG CONTRACTING COMPANIES OPERATING IN MALAYSIA.

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Graphical abstract

Abstract

There has been an increasing demand on the construction industry to incorporate sustainability practices and principles in their operations and construction products, considering the industry's contribution to environmental degradation. It is therefore crucial for the construction industry to adopt sustainable construction, thereby reducing the negative impacts of construction activities on the environment. While there are several sustainable construction studies in Malaysia, a study that integrates innovativeness, culture, government support and sustainable construction in a single framework has not been given a considerable attention. The objectives of this study are to develop a framework that incorporates the antecedents of sustainable construction; and to assess the validity and reliability of the research instrument. Data were obtained from thirty respondents using a sixty-one item instrument. The data obtained were analyzed using SPSS software to assess the instrument's reliability. The results of the Cronbach's Alpha test reveal a strong internal reliability of the study's constructs and the overall instrument. This paper complements the existing body of knowledge on sustainable construction.

Keywords: Sustainable construction; construction industry; organisational innovativeness; organisational culture; conceptual framework; validity; reliability.

1.0 INTRODUCTION

Sustainability has become a major concern across the globe, largely due to its benefits on the environment, human society and the economy [1]. Thus, construction industries across countries are currently engaging in sustainable practices and are formulating business strategies in response to the increasing demand from governments and the public for sustainable construction products and processes [2]. There is now a strong recognition that the construction industry must actively play a significant role towards the attainment of sustainable development. The industry is now among the major drivers of sustainable construction achievement [3].
The demand for sustainable construction can be attributed to certain driving factors. Among the most influencing factors are construction stakeholder's innovation capabilities and propensity [4-11] among others. As such, sustainable construction is now regarded as a road map to achieve the desired change and development. The emphasis is on the adoption of design and construction practices that are efficient in resource consumption and without compromising environmental health or the associated health of the builders, occupants, the general public or future generations [12].

While the Malaysian Construction Industry Development Board (CIDB) in 2011 identified the industry's capabilities to develop and apply advanced design and construction technologies as the most important factor that could guarantee the industry a prominent place within the international marketplace [13], literature affirms that inefficient culture, methods and practices, lack of innovations and performance improvement are part of the problems that hinder the implementation of sustainable construction. Thus, the drive towards the implementation of sustainable construction could be resulting from the government's involvement and support in terms of regulation incentives provided to construction firms that implement it [14-17].

However, there are diverse views among scholars on the antecedent factors of adoption that could possibly drive construction firms to implement sustainable construction [18-22]. This could be a result of the failure of the previous studies to examine organizational innovativeness, culture and external factors as antecedents of sustainable construction in a single comprehensive framework.

In narrowing the gap aforementioned, this paper examines organizational innovativeness, culture and government support as antecedents of sustainable construction among the contracting companies operating in Malaysia.

2.0 CONCEPTUAL FRAMEWORK

While the literature on the concept of sustainable construction reveals that there are certain antecedents of sustainable construction, there is a need to further develop a framework that integrates other antecedents not examined in previous studies to achieve a successful implementation of sustainable construction practices.

In this study, sustainable construction is the outcome of organizational innovativeness, whereas organizational culture functions as the dependent variable. Organisational innovativeness and organisational culture are thus regarded as the drivers of the implementation of sustainable construction. External factors, operationalized as government support moderates the relationship between organisational innovativeness, organisational culture and its outcome, which is sustainable construction. From the literature, the commitment of efforts and resources required from contractors to meet the need for sustainable construction adoption is motivated by certain underlying factors [21]. The proposed framework for this study is presented in figure 1 below, where it depicts the relationship between organizational innovativeness, organisational culture, external factors, and sustainable construction.

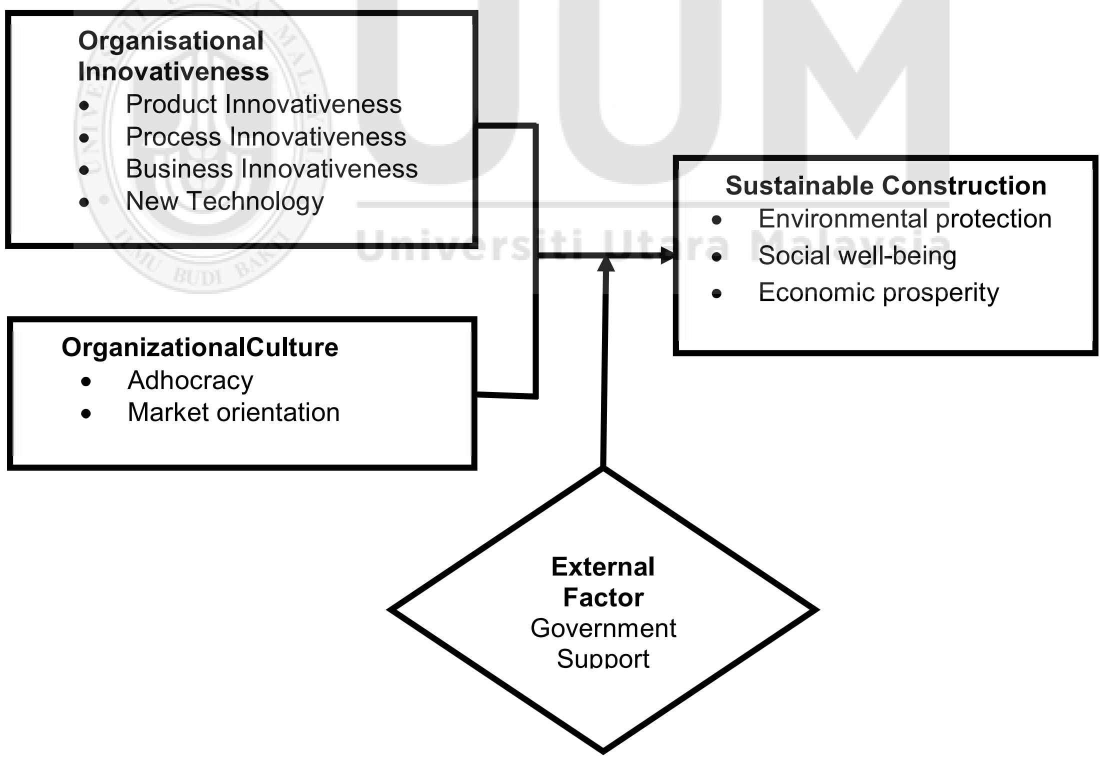

Figure 1 Conceptual framework

2.1 Sustainable Construction

Sustainable construction emerged owing to the construction industry's continuous resource-inefficient construction by utilising polluting substances, excessively specifying inefficient equipment, and being dependent mostly on pollution-laden transport forms [23]. Also, the construction industry is irresponsive to several social sustainability issues like the quality of human existence, its employees' safety, skills training and capacity building for the less privileged, minimization of poor working conditions, fair distribution of the construction's social benefits, and adherence to intergenerational justice [12;24]. Thus, sustainable construction is aimed at restoring and maintaining harmony between the natural and the built environments in order to create settlements that affirm human dignity and encourage economic equity [25]. By doing so, sustainability within the built environment has been taken beyond just the resource efficiency and ecological principles by introducing the idea of restoring the environment, as well as explicitly highlighting the social and economic aspects of sustainability. It thus shows that by adopting this concept, construction activities' impact on sustainable development is considered to fall under three dimensions, which are: social, economic, and environmental considerations. Previous studies have however highlighted that the successful implementation of sustainable construction is a function of the identification of its antecedents. Thus, organisational innovativeness and organisational culture have been identified in this study as the antecedents of sustainable construction.

2.2 Organisational Innovativeness

There is a growing concern about the influence of organisational innovativeness as a possible antecedent to sustainable construction adoption. [4] demonstrated how innovativeness is capable of influencing not only organisational productivity, profitability and competitiveness, but also it is capable to be a vital procedure in sustainability adoption in an organization. [8] has earlier found that sustainable construction has always been improved with the help of innovativeness, while emphasizing the roles of end users as drivers of innovations for sustainable construction. This is consistent with the work of [26] who argued that by developing innovative construction technologies and products, the ecological burden of construction projects could be reduced. This will require the construction firms to change their technologies and to better understand the fundamentals of sustainability in the construction project execution.

Other previous studies concerning innovative products, process and business strategies confirm that firms that incorporate sustainability in their orientation and innovation processes mostly exhibit value creation in terms of introducing new product to the market, sometimes called radical innovations [27]. [6] also affirmed that construction organisations' choice of innovations could possibly address sustainability issues in construction as the development of a green technology strategy involves a strong innovation focus. In the same manner, several other studies [28-30] supported the view that innovative firms' performance in sustainability adoption is exceptional. As a result, this study posits a positive relationship between the organisational innovativeness and sustainable construction.

2.3 Organisational Culture

Culture emerges in organisations when there is a need to proffer solutions to problems. [31] argues that successful problem solving procedures mostly become the dominant culture in addressing similar issues in the future. Organizations need to determine whether they are only responsible for their economic benefits alone or other concerns as well. If they are to accept the responsibility for other concerns, then decisions have to be made on the relevant issues of concern and how they will be addressed [32]. Thus, the dimensions of sustainable construction must be incorporated into the construction organisation's culture and policy formulations because according to [33], practically all firms contribute to environmental degradation one way or another.

Earlier studies [34-35] have shown that organisational culture not only influences operations within a firm, but also plays an essential role in the efficiency and improved productivity of an organisation. Given its significance in an organisation, it is reasonable to conclude that culture is a fundamental antecedent behind organisational results, as represented by sustainable construction.

According to [36], organisational culture researchers affirmed that a dynamic organizational culture, which adhocracy represents, can influence the role a business entity plays in a society, in terms of corporate citizenship and sustainability. Thus, this present study seeks to assess the relationship between organisational culture (adhocracy culture and market orientation) and sustainable construction of Malaysian construction companies. In this study, adhocracy refers to organizations that are committed to fostering adaptability, creativity and flexibility in addition to producing innovative products and services. Meanwhile, market orientation is a culture that creates the necessary behaviours for the creation of superior value for buyers.

2.4 Moderating Role of Government Support

According to [37-38], policies on government subsidies have been observed to have a noticeable influence on the processes and outcomes of both new and established firms. Thus, government support in stimulating green construction is the most effective [39; 40] as it is more result-oriented than other techniques. Governments have the capacity to facilitate sustainable construction adoption in a variety of ways, although there are several barriers to developing it [41].

In this study, government support for sustainable construction is considered as the moderating variable due to its strategic implications on firms operating within the industry by providing an impetus to achieve standardized and sustainable construction projects. Properly designed regulations always catalyze improved products and processes and cost reduction [42; 43]. Regulations are designed to govern the practice by way of establishing rules in response to changes in the market and to technological conditions. This view is corroborated by [44] that the government is capable of driving sustainable construction agenda with a number of policies, including fiscal supports, legislation and standards, and building labeling with energy efficiency rating. As a result of the aforementioned discussion, government support is posited as a moderator between organisational innovativeness, organisational culture and sustainable construction. Properly designed government regulations are believed to have a strategic influence on the construction firms by providing opportunities to achieve the goals of sustainable construction [45].

3.0 METHOD

Considering the fact that this study is at the preliminary stage, samples of the Malaysian contractors were randomly selected. Basically, in the pilot testing, a small scale study of respondents is suggested for trial purpose before conducting the full-fledged study [46]. Ideally, the sample size for pilot studies is suggested to be relatively smaller, ranging from 30 – 100 respondents, although an increase in the sample size for this purpose allows for a stronger result [47]. Hence, a total of Forty-five (45) questionnaires were administered personally during the Construction Industry Development Board (CIDB) seminar on "Innovation & Technology Sustainable Construction", held at Carlton Holiday Hotel & Suites, Shah Alam, Selangor on 16th June, 2015. Forty (40) questionnaires were returned, out of which thirty (30) were deemed suitable for analysis. These responses were used for measuring the internal consistency of each of the study constructs.

3.1 Research Instrument

According to [48], questionnaire is one of the most appropriate instruments for survey research. Thus, to ensure that all the constructs in this study are fully measured, questionnaire items were drawn from several sources. The items for the constructs (sustainable construction, organisational innovativeness, organisational culture and government support) were adapted and modified from previous studies [49; 50; 51; 52] to suit this present study so as to establish the item pool and validity of the items. Thus, in order to establish the validity and reliability of the adopted items, a pilot test was conducted mainly to get a projection of the potential problems that are usually faced during the time the main survey was carried out. This study adopted a five-point Likert scale rating to measure responses to the items. A rating scale helps researchers to compute the means and standard deviation responses on constructs as well as the mid-point of the scale. Additionally, a scale between 5 to 7 points is adjudged to be more reliable and valid measure of items than relatively shorter or longer scale points [53].

The constructs in this study are all multi-dimensional except for the external factor, which is uni-dimensional. In Table 1, the details of these constructs and their corresponding dimensions are presented.

3.2 Validation of the Research Instrument

This pilot study was conducted among Malaysian contractors. The participants include the executive directors, project managers, marketing managers, engineers, quantity surveyors, also contract managers representing the G7 contractors. Grade Seven (G7) contractors were selected for this study because they have the privilege to undertake heavy and complex construction projects with no financial limit, and the capacity for the adoption of sustainable construction principles for onsite construction activities [21; 54; 55].

Table 1 Summary of reliability of the research instrument

Constructs	Number of Items	Cronbach's Alpha
Sustainable Construction		
Environmental Protection	8	0.920
Social Well-being	7	0.945
Economic Prosperity	5	0.895
Organisational Innovativeness		
Product Innovativeness	5	0.900
Process Innovativeness	4	0.932
Business Innovativeness	4	0.900
New Technology	4	0.894
Organisational Culture		
Adhocracy Culture	10	0.940
Market Orientation	9	0.887
External Factor		
Government Support	5	0.862

This pilot study was done essentially to get some feedback from the contractors to improve the data collection during the main survey. Earlier, content validity was conducted on the adopted items to test for the validation of the measuring instrument used in this study [53]. Seven experts were selected from the academics and industry to validate and verify the questionnaire before the actual pilot test was done.

The validation process involved four (4) experts from the industry and three (3) experts from the academics. Their suggestions and comments were subsequently incorporated in the modification of the contents and the wordings of the questions.

3.3 Reliability of the Research Instrument

According to [56], reliability measures the consistency of instruments when used at different points in time. This means that a reliable instrument must measure the same parameter over time. Thus, a reliability test was also conducted to determine the internal consistency of the items after the content validity was performed by the experts. Internal consistencies on individual basis attained through acceptable Cronbach's alpha values is the major criteria for adopting instruments from previous studies [57]. Thus, the Cronbach's alpha reliability coefficients for all constructs of this study were determined. [56] argued that thirty (30) or more samples are sufficient to conduct a pilot test. This study thus used 30 respondents for this pilot study. The result of this pilot testing (using Cronbach's Alpha value) is summarized in Table 1.

4.0 DISCUSSION

This study presents a framework that combines organisational innovativeness and culture as antecedents to sustainable construction, using government support as the moderator. This proposed framework is developed through a thorough review of literature to provide a deep understanding to both the academics and industry practitioners on the antecedents of sustainable construction and the moderating effects of government support on the established link.

Table 1 presents the Cronbach's alpha coefficient for all the constructs used in this study. The result of the pilot test analysis indicates that the Cronbach's Alpha of the variables ranges from 0.862 to 0.945. According to [58] and [57], the Cronbach's Alpha value that is greater than 0.7 is accepted; however, the value greater than 0.8 is preferable. In this study, the result of the internal consistency shows that the values of the Cronbach's Alpha for all the constructs are greater than 0.8, which indicates a very good reliability of the research instrument. Thus, no item was deleted on this basis. All items included in the instrument sufficiently proved to reflect on the fact that there is an adequate level of internal consistency following their respective measure. This study's reliability result reveals that all the variables of this study are appropriate to be used in the main survey.

Comparing the Cronbach's alpha value in this paper with previous studies, for example, in [45], the Cronbach's alpha value for government support is 0.803 compared to 0.862 value recorded in this study, albeit a preliminary study. Again, [50]'s study recorded Cronbach's alpha value of between 0.736 and 0.848 in organisational innovativeness construct. Meanwhile, this study has a range between 0.894 and 0.932 for items of the same construct. However, further reliability analysis will be performed on the main data collected after the determination of the factor analysis on the main study.

5.0 CONCLUSION

This paper presents a framework on the antecedents and sustainable construction. It also presents the validity and reliability of the instrument that was administered among Malaysian largest contractors (the G7 contractors). The reliability result of this study indicates that all items included in the instrument sufficiently reflect an adequate level of internal consistency pertaining to their respective measures.

The framework in this study is essentially developed to determine the significance of organisational innovativeness and culture in achieving sustainable construction among Malaysian contractors. A major limitation of this study is that it focuses only on large contracting companies in Malaysia and the validity of the instrument obtained is at the preliminary stage. Therefore, future researchers are recommended to investigate the sustainable construction adoption by other construction SMEs and also endeavored to empirically validate the proposed framework in this study.

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Developing a validation for environmental sustainability

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Developing a Validation for Environmental Sustainability

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Abstract. One of the agendas for addressing environmental protection in construction is to reduce impacts and make the construction activities more sustainable. This important consideration has generated several research interests within the construction industry, especially considering the construction damaging effects on the ecosystem, such as various forms of environmental pollution, resource depletion and biodiversity loss on a global scale. Using Partial Least Squares- Structural Equation Modeling technique, this study validates environmental sustainability (ES) construct in the context of large construction firms in Malaysia. A cross-sectional survey was carried out where data was collected from Malaysian large construction firms using a structured questionnaire. Results of this study revealed that business innovativeness and new technology are important in determining environmental sustainability (ES) of the Malaysian construction firms. It also established an adequate level of internal consistency reliability, convergent validity and discriminant validity for each of this study's constructs. And based on this result, it could be suggested that the indicators for organisational innovativeness dimensions (business innovativeness and new technology) are useful to measure these constructs in order to study construction firms' tendency to adopt environmental sustainability (ES) in their project execution.

Keywords: Environmental sustainability (ES); business innovativeness; new technology; Partial Least Squares – Structural Equation Modeling.

INTRODUCTION

The construction firms' non-renewable resource consumption has been contributing immensely to the greenhouse gas emissions. Although, the built environment notably contributes greatly to human's daily life, but the processes involved in the development of structures adversely impact the environment. Aside the air, noise and waste pollution generated by construction processes and the existing building stocks, fossil fuels and minerals extraction use crude processes that changes the land ecological characteristics [1]. While the recognition of the need for environmental sustainability within the construction industry has been around for several years, the construction sector is still taking the lead in energy consumption [2]. It has been reported that building materials manufacturing consumes approximately 10 percent of the global energy output. The construction and demolition stages contributes almost 40 percent of the entire solid waste generated in the developed nations, while construction operation stage emits almost 40% of the entire global greenhouse gas emissions [3]. In this way, construction is an essential sector to the attempt to efficient usage of resources. Equally, there are significant opportunities for the construction firms to improve energy-efficient buildings towards reducing global GHG emissions. Environmental sustainability considerations in new buildings and retrofitting energy use in existing buildings stock can improve, not only savings opportunities, but will also secure a competitive edge for the construction firms, leading to improved productivity, reduced compliance costs, and new market opportunities [4].

The environmental sustainability's role in addressing the complex problems of construction and the environment have become an increasingly pressing challenge, especially in order to restore balance between the natural and the built environment, as both realms are highly interconnected [5-7]. Again, in view of the obvious benefits that are associated with environmental sustainability within the construction industry, and considering the size and importance of the construction industry to economic development of many countries and its immense contribution to environmental damage, construction stakeholders, public governments and their agencies are increasingly integrating the concept into construction project execution to improve the construction industry's overall performance [8]. This important concept will also improve the industries' image, because for a long time, the construction industry pays little or no attention to the continued existence of human communities. This understanding made the World Watch Journal in 1994 to observe that human beings are fast becoming

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super species, with the development of structures that have the capacity to adapt to our varying environmentally-degrading lifestyles globally.

Furthermore, while incorporating the principles of environmental sustainability, the construction companies are expected to be innovative to attain society and clients' satisfaction, aspirations and needs while improving their competitive advantage. This will require the industry to develop and implement new ideas that has both practical and commercial benefits [9]. Innovativeness in construction is generally believed to include a significant introduction of new processes, products or management approaches, which is expected to increase organisational efficiency[10].

Towards meeting this objective, the rest of this article is organized as follows: the next section reviews the relevant literatures related to environmental sustainability (the criterion variable). Next, the independent variables (business innovativeness and new technology) are discussed. This is followed by the measurement model specification (convergent validity, discriminant validity).

LITERATURE REVIEW

Business innovativeness

Business innovation, according to Lorente [11], focuses on innovation in management thinking and primarily aims at value and wealth creation for all stakeholders, with a view to improving economic prosperity. Factors such as environmental changes, customers, competitors, suppliers and employees further stimulate business innovation. This view was supported by Grossi [12], who argues that business innovativeness implies firms' adaptive capability to environmental changes is important to gain competitive advantage. More importantly, firms' good strategies alone are not enough for them to cope in the present dynamic business environment. It is expected that firms will be able to evolve and synchronize with the environment by applying business innovativeness ability [13]. Therefore, without a strong business direction, innovators will fail to either deliver - or to capture - value from their innovations. Thus, Teece [14] concluded that firms are expected to excel in business model design options, customer needs and technological trajectories in order to achieve outstanding business innovativeness.

In line with the definitions of Kamaruddeen *et al*., [15], business innovativeness in this study is defined as the Malaysian contractor's ability to actively seek and implement innovative business systems that are important to their success.

New technology

Following Kamaruddeen *et al* [16], new technology innovativeness in this study is defined as firm's tendency to adopt and also apply a technology which is new to such firm. And it is one of the various approaches used by renowned innovation scholars [17-21] for measuring organisational innovativeness. According to Salavou [22], to create more unique and innovative products for the market, firm's orientations should be tailored to current technology adoption, which constitutes a key organisational capability. The main threat of many firms in the past was the inability to master new technology. However, nowadays, large firms are engaging in R&D which enables them to monitor, and absorb new technology [23].

The challenge thus lies in dealing with the implications of the newly introduced technology within the organizations, the effects of which may lead to a fundamental change in various sectors of the firm. So, it is not enough for firms to substitute an existing application with a new technology, as this may unlikely solve an impending problem. Consumer's preference for alternative technology may stem from reduced costs, better performance, dependability, or just fashion. In the section that follows, organisational culture is introduced as the second factor influencing sustainable construction aside organisational innovativeness.

Environmental sustainability

Rapid urbanization in developing nations leading to building and infrastructural development has become a very important consumer of energy. As a result, the environment is continually being stretched beyond its limits, and nations face the dilemma of delivering housing and infrastructure that could meet the population's social needs in an ecologically responsible manner [24, 25]. Environmental activists have stressed this form of ideal society, where individuals live peacefully without necessarily depleting natural resources or degrading the natural environment, such that they leave man-made and environmental assets behind them in almost equal amount as they inherited from earlier generations [26]. However, the real world is far from this idea, as construction development is arguably not only one of the resource-intensive industries, but also tends to destroy the ability to sustain it. The aim of addressing environmental sustainability, therefore, is to reduce impacts and make the construction activities more sustainable [27]. This is important because construction has damaging effects, such as various forms of environmental pollution, resource depletion and biodiversity loss on a global scale [28]. Issues surrounding environmental sustainability requires construction industry's impacts on the immediate environment to be analysed from the "cradle to grave" viewpoint [28], such that the construction industry could create a healthy and non-toxic environment by consuming less renewable and non-renewable materials. According to World Watch Institute (2003), building and construction activities worldwide are responsible for 3 billion tons of raw materials each year. This reduction in resource consumption through effective environmental planning, management and control are capable of identifying the environmental risk and prevent water, ground and air pollution [29]. In the long run, a design that is environmental-friendly is capable of realizing the goals of sustainable construction, as it encourages a healthy and safe interior atmosphere, energy efficiency, the use of ecological benign materials, as well as eco-conscientious communities [30].

3. RESEARCH METHODS

3.1. Design of the study

This design of this study is cross-sectional, and it covers the Malaysian peninsular, comprising of 11 states. The sample frame (4520) consists of names and addresses of large construction firms in all the 11 states of Peninsular Malaysia, obtained from the CIDB website in 2014. The construction firms' population in all the eleven states of Peninsular Malaysia was firstly divided into mutually exclusive stratum. Then, a proportionate stratified random sampling was used, where a member (G7 contractor) represented in the sample from each stratum (states in Peninsular Malaysia in this case) is proportional to the entire number of elements in the respective strata [31]. And, in order to satisfy the guidelines of proportionate stratified random sampling, 8% of members from each stratum was selected for the survey, such that member are consistently selected from each of the states.

DATA COLLECTION

Data collection was done at organisational level, implying that the unit of analysis for this study is organisation (G7 construction firms in Peninsular Malaysia). And the study population consisted of G7 construction firms that are registered with the Construction Industry Development Board (CIDB) in peninsular Malaysia as at 2014. In line with the assumptions of Krejcie and Morgan (1970) to ascertain significance at 95% confidence level, a sample size of 354 is required for a population of 4,520 G7 contractors. However, Malaysian construction industry has been associated with low rate of response [32]. So, to take care of this peculiar tendency and also minimize sampling error, the suggestions of Hair, Wolfinbarger and Ortinal [33], that the sample size be doubled, is adhered to in this study. Hence, a total of 708 questionnaires were sent out to the contractors across the eleven states in peninsular Malaysia.

Physical distributions of the questionnaires were done in states of Kedah, Perlis and Penang. This form of questionnaire administration in these states was done to allow for personal contact with the respondents, increase the response rate, and reduce the time taken to receive posted responses. Additionally, questionnaires were also physically administered to contractors during the CIDB year-round workshops called Continuing Professional Development (CPD). The workshops serve as a better avenue for the researcher to explain in greater details, the nature of the survey and the need for the respondents to participate in the survey. Three different workshops were attended by the researcher, and in each of the workshops, questionnaire were administered to construction firms. A postal survey method was also adopted in the remaining states.

In this study, survey method was used to obtain the responses regarding the level of sustainable construction of Malaysian large construction firms. Going by the recommendations of Waris *et al*; Hilmi *et al* [32, 34], one representative (an executive director, a project manager, a marketing manager, an engineer, a quantity surveyor, a contract manager, a sales manager, or an account manager) in each of the construction firms is enough as a respondent.

RESULTS AND DISCUSSION

The respondents' firms were classified according to operational location, workforce, and specialization. Out of 172 construction firms that participated in the survey, the descriptive statistics shown in Table 1 reveals that majority (37.8%) of the sampled construction firms operates across the entire Malaysia (including East Malaysia). The number of employees in the sampled firms was also revealed in this section. And companies with <100 employees responded most with 68.3% of the total sampled population. Finally, the descriptive statistics also shows respondents companies' specialization. Using a multiple response option, majority (31.7%) of the respondents chose residential, followed by infrastructure (26.3%), then, non-residential, social amenities, and others, constituting 24%, 10.3% and 7.7% respectively.

TABLE 1 Demographic profile of respondents' firms

Parameters	Frequency	Percent
Operational location		
Local market areas	35	20.3
Within few states	40	23.3
Regional	20	11.1
Across the entire Malaysia	68	37.8
International market	9	5.0
Number of employees		
<100	120	69.7
101-250	13	7.6
251-500	10	5.6
>500	29	16.1
Specialization		
Residential apartment	97	31.7
Non-residential apartment	73	24.0
Social amenities	30	10.3
Infrastructure	82	26.3
Others	22	7.7

Notes: Items for specialization used multiple response option. Thus, respondents were allowed to choose more than one option.

1.0 Measurement model

Measurement model assessment (the outer model) is the first step in PLS SEM analysis. Thus, in order to validate the environmental sustainability (ES) in the context of Malaysian large construction firms, this study employed PLS measurement model to determine individual item reliability, internal consistency of reliability, content validity, discriminant validity and convergent validity of all the constructs in this study [35, 36].

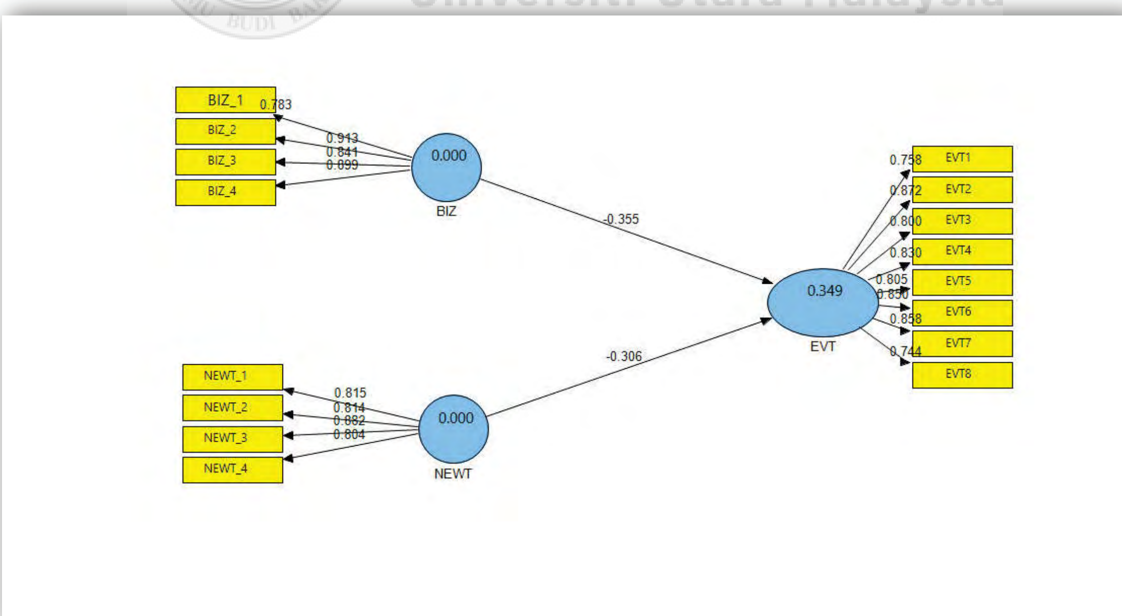

FIGURE 1. Measurement model

1.1. Indicator/Item Reliability

The assessment of individual item reliability in this study was done by examining the outer loadings of each of the latent variables **[35, 37].** Following the rule of thumb that specifies the retaining of items with loadings between .40 and .70 [35], none of the items in this study was deleted because they all presented loadings above the threshold of 0.40. Thus, in the whole model, the items had loadings between 0.725 and 0.909 (see Table 2).

TABLE 2 Convergent and reliability analysis

Constructs	Indicators	loadings	Composite reliability	AVE
Business innovativeness	BIZ_1	0.783	0.919	0.741
	BIZ_2	0.913		
	BIZ_3	0.841		
	BIZ_4	0.899		
Environmental sustainability	EVT1	0.758	0.941	0.665
	EVT2	0.872		
	EVT3	0.800		
	EVT4	0.830		
	EVT5	0.805		
	EVT6	0.850		
	EVT7	0.858		
	EVT8	0.744		
New technology	NEWT_1	0.815	0.898	0.687
	NEWT_2	0.814		
	NEWT_3	0.882		
	NEWT_4	0.804		

1.2. Internal consistency of reliability

Internal consistency of reliability is the extent to which all parts of a given scale measure a concept [38]. In organisational research, Cronbach's alpha coefficient and composite reliability coefficient are widely used index in estimating the internal consistency of reliability of a scale, especially those containing multiple items [39]. Thus, in order to ascertain internal consistency of adapted measures in this study, composite reliability coefficient was preferred over Cronbach's alpha coefficient for some reasons. Research scholars [40, 41] argues that in composite reliability coefficient, there is much less biased estimate of reliability than in Cronbach's alpha coefficient, because the assumptions of Cronbach's alpha coefficient is that all indicators simultaneously contribute to their mother construct, without giving credence to individual contributions of each of the items.

Further, as against composite reliability, there is a possibility of under-estimation or over-estimation of scale reliability in Cronbach's alpha, whereas composite reliability recognises the differences in item loadings in a model, which can be interpreted just as Cronbach's alpha.

As suggested by [42], the rule of thumb for interpreting internal consistency of reliability using composite reliability coefficient was that the coefficient should not be less than .70. Thus, in Table 2, composite reliability coefficients of the study's constructs ranged from .898 to .941, indicating that the internal consistency of the latent variables in this study is adequate because they all exceed the minimum acceptable level of .70.

1.3. Content validity

Prior to the pilot survey, the content validity of the instrument was carried out. Content validity refers to the degree at which a measure covers the domain of the concepts under study or how well the dimensions and items of constructs in this study have been delineated [31]. And it involves consulting a panel of judges or experts to ascertain the validity of the items [43]. Thus, the study item was sent to four experts who are familiar with the constructs of this study. Three experts were selected from the School of Technology Management and Logistics, University Utara Malaysia. While another four construction industry's practitioners were also contacted for the same exercise. Their inputs and suggestions were subsequently incorporated into the final draft of the instrument.

1.4. Convergent Validity

According to Hair *et al* [44], convergent validity explains the extent to which indicators of the latent construct correlate with each other and accurately represent the construct they are meant for. In determining this, and in line with Hair *et al*.'s [42] suggestion, the factor loadings, composite reliability and average variance extracted are considered in the assessment of convergence validity. And this is established if all the measures that are supposed to reflect a particular latent construct are related. Conventionally, the respective loadings and cross loadings are firstly assessed, in order to detect items with low loading. Table 2 presents the loadings and cross loadings of indicators in the respective constructs of this study. According to Hair et al., [42] the validity of a particular measurement scale is convergent when indicators/items load as high as 0.5 and above on their respective constructs. And at the same time, items are not expected to load higher on another construct than on the constructs that they are meant to measure [40].

TABLE 3 Factor loadings and cross loadings

Items	BIZ	EVT	NEWT
BIZ_1	**0.783**	-0.440	0.490
BIZ_2	**0.913**	-0.530	0.535
BIZ_3	**0.841**	-0.398	0.476
BIZ_4	**0.899**	-0.464	0.532
EVT1	-0.462	**0.758**	-0.470
EVT2	-0.437	**0.872**	-0.442
EVT3	-0.415	**0.800**	-0.442
EVT4	-0.466	**0.830**	-0.402
EVT5	-0.405	**0.805**	-0.359
EVT6	-0.409	**0.850**	-0.430
EVT7	-0.494	**0.858**	-0.447
EVT8	-0.397	**0.744**	-0.360
NEWT_1	0.610	-0.498	**0.815**
NEWT_2	0.353	-0.370	**0.814**
NEWT_3	0.447	-0.432	**0.882**
NEWT_4	0.518	-0.391	**0.804**

Convergent validity in this study was also determined by examining the Average Variance Extracted (AVE), which is the average variance shared between a construct and its measures is examined. And this AVE value for a construct is expected to be greater than the variance shared between the construct and other constructs in the same model [45]. The rule of thumb, however, is that an AVE value of 0.5 and above is considered acceptable [40]. Table 2 provides the Average Variance Extracted (AVE) results with the resultant coefficients ranging from 0.665 to 0.741. This is another indication that convergent validity for this study has been established for all the constructs.

1.5. Discriminant Validity

Discriminant validity, according to Duarte and Raposo, [37], implies the extent to which a latent construct differs from others in a model. To examine this, the square root of the AVE for each construct is used. That is, square roots of AVE coefficients are used to replace the correlation matrix along the diagonals [46]. Usually, the squared AVE (i.e., the diagonal coefficients) are expected to be greater than the off-diagonal coefficients or elements in the corresponding rows and columns. Besides, Fornell and Larcker [46] suggests that an AVE score of .50 or higher is acceptable. And Table 2 has earlier indicated an acceptable level of AVE for all the constructs. Also, in Table 4, a comparison was made between the latent constructs' correlations and the square root of the AVE (appearing in bold), and it was clear that the square roots of all the AVE for all the constructs along the diagonals are higher than the corresponding off-diagonal coefficients both in rows and columns, signifying adequate discriminant validity.

TABLE 4 Discriminant Validity

		1	2	3
1.	Business innovativeness	**0.861**		
2.	Environmental sustainability	-0.5366	**0.816**	
3.	New technology	0.5919	-0.5164	**0.665**

Note. Diagonals appearing in bold represent the AVE while the other entries are the squared correlations.

CONCLUSION

Generally, this study's results indicated that measures for all the three constructs including business innovativeness, environmental sustainability, and new technology are valid and acceptable measures of their respective constructs based on their parameter estimates. The findings also indicated that all the measuring items are both reliable and good measures in explaining their respective constructs (which explains construct validity). This was evidenced by the high items' loadings, composite reliability, average variance extracted (AVE), and square roots of the AVE for all the constructs.

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Assessing the Sustainable Construction of Large Construction Companies in Malaysia

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Abstract. Considering the increasing concerns for the consideration of sustainability issues in construction project delivery within the construction industry, this paper assesses the extent of sustainable construction among Malaysian large contractors, in order to ascertain the level of the industry's impacts on both the environment and the society. Sustainable construction explains the construction industry's responsibility to efficiently utilise the finite resources while also reducing construction impacts on both humans and the environment throughout the phases of construction. This study used proportionate stratified random sampling to conduct a field study with a sample of 172 contractors out of the 708 administered questionnaires. Data were collected from large contractors in the eleven states of peninsular Malaysia. Using the five-level rating scale (which include: 1= Very Low; 2= Low; 3= Moderate; 4= High; 5= Very High) to describe the level of sustainable construction of Malaysian contractors based on previous studies, statistical analysis reveals that environmental, social and economic sustainability of Malaysian large contractors are high.

Keywords: Sustainable construction level; Large contractors; Malaysian construction industry.

INTRODUCTION

There has been an increasing concern within the construction industry for the consideration of sustainability issues in construction project delivery, considering the industry's impacts on the environment and society [1-4]. In their analysis, Rode, Burdett and Soares Gonçalves, [5] found that an approximately 10% of the global energy consumption goes to building materials manufacturing. Construction and demolition also contributes about 40% of the solid waste generated in the developed nations, while the operation stage of construction products emits almost 40% of the entire global greenhouse gas emissions, making the construction industry the lead sector in global energy consumption [6-7]. These impacts has led to construction industry's shift from the traditional construction techniques to sustainable construction adoption, where the general sustainability concept of environmental, social and economic considerations (the triple bottom line) are given prominence [8-10].

The principles of sustainable construction emerged as a new concept to create a favourable built environment that meets human's present needs without jeopardising the ability of the future generation to meet theirs [11]. (Du Plessis [12] affirms that sustainable construction emerged to fundamentally address the complex problems of construction and the environment in order to restore balance between the natural environment and the built environment, as both realms are highly interconnected. Thus, construction industries across the globe are currently engaging in the sustainability debate and are formulating business strategies in response to these demands for sustainable construction adoption [13], such that there is now a far-reaching recognition that construction industry must necessarily play a significant role towards the attainment of sustainable development agenda.

The concept of sustainable construction explains construction industry's responsibility to efficiently utilise the finite resources (energy, water and materials) while reducing building impacts on both humans and the environment throughout the phases of construction [14]. And in this study, it is defined as the responsibility of the construction companies to adopt the principles of sustainable development in project execution by striking a balance between

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environmental conservation, social well-being and maintaining prosperity in development for the benefit of the present and future users.

In the spirit of this agenda, it is expected that the evaluation must include more than the immediate investors or tenants of the construction project. It should also consider the suppliers, the local community in which the structure resides and other stakeholders. Thus, the inter-generational aspect of sustainability, which ensures that the needs of generations to come are not compromised by present activities, is quite pertinent to sustainable construction since structures are typically influencing the needs and requirements of the present and future generations [15]. And construction companies that are dedicated to sustainability adoption are, at the same time, required to integrate the triple bottom line in their corporate decisions as their active participation in the sustainability agenda could only allow government regulations to be effective [16-17].

In view of the special role that the contractors plays in transforming designs into real structures in order to support government initiatives, and owing to the fact that their improved performance contributes to the continued development of the industry and nation as well [18], this study evaluates the extent of sustainable construction of Malaysian large construction companies (the G7 contractors) operating in the peninsula Malaysia. It should also be noted that contractors are important players in construction sustainability agenda because they have been described as construction project initiators due to their dominant influence over the entire project direction [19].

2. IMPORTANCE OF THE STUDY

This study on the sustainable construction literature aims to ascertain the sustainable construction extent of Malaysian large contractors. This research effort could help in revealing the level at which the contractors within the Malaysian Construction Industry (MCI) adopt the principles of sustainable construction in their project execution. The study verifies the findings in previous studies, where the Malaysian contractors' financial sustainable construction is relatively higher than non-financial sustainability considerations [20].

3. RESEARCH METHODS

3.1. Design of the study

This design of this study is cross-sectional [21], and it covers the Malaysian peninsular, comprising of 11 states. The sample frame (4520) consists of names and addresses of large contractors in all the 11 states of Peninsular Malaysia, obtained from the CIDB database (2014). The construction companies' population in all the eleven states of Peninsular Malaysia was firstly divided into mutually exclusive stratum. Then, a proportionate stratified random sampling was used, where a member (G7 contractor) represented in the sample from each stratum (in this case, states in Peninsular Malaysia) is proportional to the entire number of elements in the respective strata [21]. And, in order to satisfy the guidelines of proportionate stratified random sampling, 8% of members from each stratum was selected for the survey, such that member are consistently selected from each of the states.

4. DATA COLLECTION

Data collection in this study was done at organisational level. Thus, the unit of analysis for this study is organisation (G7 contractors in Peninsular Malaysia). The study's population consisted of G7 contractors that are registered with the Construction Industry Development Board (CIDB) in peninsular Malaysia as at 2014. In line with the assumptions of Krejcie and Morgan [22] to ascertain 95% confidence level, a sample size of 354 is required for a population of 4,520 G7 contractors. However, Malaysian construction industry has been associated with low rate of response [23]. So, to take care of this peculiar tendency and also minimize sampling error, the suggestions of Hair, Wolfinbarger and Ortinal [24], that the sample size be doubled, is adhered to in this study. Hence, a total of 708 questionnaires were sent out to the contractors across the eleven states in peninsular Malaysia.

Physical distributions of the questionnaires were done in states of Kedah, Perlis and Penang. This form of questionnaire administration in these states was done to allow for personal contact with the respondents, increase the response rate, and reduce the time taken to receive posted responses. Additionally, questionnaires were also physically administered to contractors during the CIDB year-round workshops called Continuing Professional Development (CPD). The workshops serve as a better avenue for the researcher to explain in greater details, the nature of the survey and the need for the respondents to participate in the survey. Three different workshops were attended by the researcher, and in each of the workshops, questionnaire were administered to contractors. A postal survey method was also adopted in the remaining states.

In this study, survey method was used to obtain the responses regarding the level of sustainable construction of Malaysian large construction companies. Going by the recommendations of Waris *et al*., [23]; Hilmi *et al*., [25]; and Jantan *et al* [26], one representative (an executive director, a project manager, a marketing manager, an engineer, a quantity surveyor, a contract manager, a sales manager, or an account manager) in each of the construction companies is enough as a respondent.

5. STATISTICAL ANALYSIS

The data collected were analyzed with the aid of Statistical Package for Social Science (SPSS) version 21 for Microsoft windows. The demographic profile of the firms and respondents were analyzed using descriptive statistics. This was followed by reliability testing to determine the goodness of the measures. Then, descriptive statistics such as the mean score, standard deviation, and percentage were analysed.

Abidin's [27] categorization of sustainable construction within the Malaysian construction practitioners, where a five-level rating scale (1= Very Low; 2= Low; 3= Moderate; 4= High; 5= Very High) was adopted. The study described construction practitioners based on matters concerning sustainability and value management. Those having "very high" sustainability consideration in their construction project execution "consider almost all sustainability issues listed in the survey". Practitioners with "high" sustainability consideration are those that "consider most of the issues" in their construction project. And those with "moderate" sustainable construction consideration tends to "consider some of the issues" of sustainable construction in project execution. Construction practitioners with "low" sustainability consideration are those with the tendency to "consider a few of the issues", and "very low" signifies construction companies with "no consideration of the listed issues".

This research adapts Abidin's (2005) sustainable construction categorisation with little modifications. In the researcher's view, using the same likert scale for all the study's latent variables would not only generate consistency of the questionnaire items, it will also allow for comparability and make response easier for the respondents, so that they do not lose ground on the differences between elements in the scale. Thus, following Kamaruddeen *et al's* [28] interpretation of the Likert scale, the values used in this study to define the 5-point Likert scale were: 1 = not at all (1.0-1.49); 2 = slightly true (1.5-2.49); 3 = moderately true (2.5-3.49); 3 = mostly true = (3.5-4.49); 5 = completely true (4.5-5.00). Then, Abidin's [27] sustainable construction rating scale namely: very high, high, moderate, low, and very low were adapted to interpret this study's 1 to 5 point Likert scale as follows: not at all (1.0 to 1.49) = very low; slightly true (1.5 to 2.49) = low; moderately true (2.5 to 3.49) = moderate; mostly true = (3.5 to 4.49) = high; and completely true (4.5 to 5.00) = very high. Finally, Malaysian large construction companies' sustainable construction extent was determined by examining which of the range adopted corresponds with the mean score of sustainable construction recorded in the SPSS descriptive statistics output. For instance, a mean score that falls between 1.0 and 1.49 indicates a very low sustainable construction extent.

6. RELIABILITY ANALYSIS

The internal consistency test - Cronbach's coefficient alpha - was used to determine the reliability of this study's items. This measure explains the extent to which items of a construct jointly and independently measures the particular construct in question, while the items are also correlated among each other, so that respondents attach the same overall meaning to each of the items [21]. Thus, higher coefficient alpha is an indication of greater consistency among the items for each factor and the confidence that the measurements are reliable. This study followed the minimum reliability acceptance level, where 0.60 is considered average by research experts, and 0.70 and above is considered high reliability [21], [29], [30]. However, all the Cronbach's coefficient alpha values obtained in this study demonstrated high reliability coefficient as they are all above the 0.70 minimum acceptable coefficient.

7. RESULTS AND DISCUSSION

The respondents' companies were classified according to age, operational location, workforce, and specialization. As shown in Table 1, out of 172 construction companies that participated in the survey, the highest percentage (63.3%) represents companies that has been established more than 10 years ago. Next are companies that has been in existence between 6-10 years which constituted 15.6%, followed by those that were established within 1 - 5 years constituting 21.1%. Similarly, this descriptive statistics also reveals operational locations of companies sampled. And Table 1 reveals that majority (37.8%) of the sampled contractors operates across the entire Malaysia (including East Malaysia). The number of employees in the sampled companies was also revealed in this section. And companies with <100 employees responded most with 68.3% of the total sampled population. Finally, the descriptive statistics also shows respondents companies' specialization. Using a multiple response option, majority (31.7%) of the respondents chose residential, followed by infrastructure (26.3%), then, non-residential, social amenities, and others, constituting 24%, 10.3% and 7.7% respectively.

TABLE 1. Demographic profile of respondent's companies

Characteristics	Frequency	%
Company age		
1-5 years	34	21.1
6-10 years	24	15.6
More than 10 years	114	63.3
Operational location		
Local market areas	35	20.3
Within few states	40	23.3
Regional	20	11.1
Across the entire Malaysia (including East Malaysia)	68	37.8
International market	9	5.0
Workforce		
<100	120	69.7
101-250	13	7.6
251-500	10	5.6
>500	29	16.1
Specialization		
Residential apartment	99	31.7
Non-residential apartment	75	24.0
Social amenities	32	10.3
Infrastructure	82	26.3
Others	24	7.7

Notes: Multiple response option was used for companies' specialization. Thus, respondents were allowed to choose more than one option.

7.1 Extent of sustainable construction among Malaysian contractors

As mentioned earlier, the objective of this research is to determine the extent of sustainable construction among Malaysian large construction companies. Abidin's [27] categorization of sustainability considerations within the construction practitioners using a five-level rating scale was adopted in this study with little modifications. The scale was categorized as: 1= Very Low; 2= Low; 3= Moderate; 4= High; 5= Very High. Those having "very high" sustainability consideration in their construction project execution "consider almost all sustainability issues listed in the survey". Practitioners with "high" sustainability consideration are those that "consider most of the issues" in their construction project. And those with "moderate" sustainable construction consideration tends to "consider some of the issues" of sustainable construction in project execution. Construction practitioners with "low" sustainability consideration are those with the tendency to "consider a few of the issues", and "very low" signifies construction companies with "no consideration of the listed issues". Thus, following Kamaruddeen *et al's*., (2012) interpretation of the Likert scale, the values used in this study to define the 5-point Likert scale were as follows: 1 = not at all (1.0-1.49); 2 = slightly true (1.5-2.49); 3 = moderately true (2.5-3.49); 3 = mostly true = (3.5-4.49); 5 = completely true (4.5-5.00).

Then, Abidin's [27] sustainable construction rating scale namely: very high, high, moderate, low, and very low were adapted to interpret this study's 1 to 5 point Likert scale as follows: not at all (1.0 to 1.49) = very low; slightly true (1.5 to 2.49) = low; moderately true (2.5 to 3.49) = moderate; mostly true = (3.5 to 4.49) = high; and completely true (4.5 to 5.00) = very high. Finally, Malaysian large construction companies' sustainable construction extent was determined by examining which of the range adopted corresponds with the mean score of sustainable construction recorded in the SPSS descriptive statistics output. For instance, a mean score that falls between 1.0 and 1.49 indicates a very low sustainable construction extent.

TABLE 2. Extent of sustainable construction among Malaysian construction companies

Sustainable construction extent	Frequency	Percentage	Mean	Median	Mode	SD
Very low	-	-				
Low	2	1.20				
Moderate	35	19.60				
High	108	60.00	3.95	4.00	4.00	0.59
Very High	35	19.50				

Table 2 shows the frequency and percentage scores for the extent of sustainable construction among Malaysian construction companies. Construction companies with high extent of sustainable construction has the highest frequency (108) with 60 %. The mean score of 3.95 implies that there is a high extent of sustainable construction among Malaysian large construction companies.

TABLE 3. Extent of environmental protection among Malaysian construction companies

Environmental protection extent	Frequency	Percentage	Mean
Very low	-	-	
Low	4	2.3	
Moderate	42	23.5	
High	98	54.5	3.84
Very High	36	20	

Table 3 presents the frequency and percentage scores of environmental protection among Malaysian large construction companies. The highest frequency score (98) represents 54.5% of the construction companies with high extent of environmental protection in their project execution. However, the mean score (3.84) shows that the environmental protection extent of Malaysian large construction companies is high.

TABLE 4. Extent of social wellbeing among Malaysian construction companies

Social wellbeing extent	Frequency	Percentage	Mean
Very low	-	-	
Low	3	1.80	
Moderate	36	20.00	
High	104	57.90	3.96
Very High	37	20.50	

Table 4 presents the frequency, percentage, and mean score for social wellbeing among Malaysian construction companies. The score with highest frequency (104) and percentage (57.90 %) falls within the high social wellbeing category. And the mean score of 3.96 also indicates that the extent of social wellbeing of Malaysian construction companies is high.

TABLE 5. Extent of economic prosperity among Malaysian construction companies

Economic prosperity extent	Frequency	Percentage	Mean
Very low	1	0.60	
Low	1	0.60	
Moderate	30	16.60	
High	109	60.60	4.09
Very High	39	21.70	

The construction companies' economic prosperity extent is summarised in Table 5. The score with highest frequency (109) and accounting for 60.6% indicates that the construction companies has high level of economic prosperity. And the mean score (4.09) also implies that level of economic prosperity of Malaysian contractors is high. By implication, the extent to which the Malaysian large contractors adopt economic prosperity dimension of sustainable construction is high. Similar extent was recorded for the remaining two dimensions of sustainable construction, which are environmental protection and social wellbeing.

8. CONCLUSION

The main objective of this study was to assess the extent of sustainable construction of Malaysian large construction companies. The study, thus attempts to answer this research question: What is the extent of sustainable construction of Malaysian large construction companies? Construction companies listed on the Construction Industry Development Board (CIDB) database in 2014 were stratified and randomly selected to participate in this survey. Findings of this study highlights the extent of environmental, social, and economic sustainability adoption of Malaysian large construction companies, where high extent was recorded for the three dimensions of construction sustainability. Thus, Malaysian large construction companies are efficient in utilising the finite resources (energy, water and materials), and have also been forthcoming in reducing construction impacts on both humans and the environment throughout the construction phases.

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Paper 5

Bamgbade, J.A, Kamaruddeen, A.M., Nawi, M.N.M., Rushami Zien Yusoff, and Azahari Bin Ramli (In Print). **Does government support matters? Influence of organizational culture on sustainable construction among Malaysian contractors.** *International Journal of Construction Management*. Indexed in Thomson Reuters' Emerging Sources Citation Index (ESCI) and Scopus.

Abstract: There have always been conflicting findings with respect to the effects of organisational culture on sustainable construction, suggesting the need for a moderator variable. Drawing on the resource-based view theory, this study examines the moderating effects of government support on the relationships between adhocracy culture, market orientation, and sustainable construction among 172 large contractors in Malaysia, using a sixty-one item instrument. Both mailed and personally administered survey methods with structured questionnaires were used to collect the data. Using a Partial Least Squared - Structural Equation Modeling (PLS-SEM) for the data analysis, we found a significant positive relationship between the adhocracy culture and sustainable construction. Similarly, the results also indicated that market orientation had a significant positive relationship with sustainable construction. The study also found a significant but negative relationship between government support and sustainable construction. As expected, government support was found to moderate the relationship between adhocracy culture and sustainable construction. Again, a significant interaction effect was found between market orientation and sustainable construction.

Keywords: PLS-SEM, Sustainable construction, Organisational culture, Resource-based view theory.

Introduction

Sustainable development is the basis for enhancing our understanding of the principles of sustainable construction (also known as green construction), which emerged as a new pattern to create a favourable built environment that meets human's present needs, without jeopardizing the ability of the future generation to meet theirs (Ofori 2001). In principle, sustainable construction essentially covers the triple bottom line of environmental, social and economic attributes that are exemplified in the sustainable development mantra (Tan, Shen & Yao, 2011). Also, it has been affirmed that sustainable construction had risen to fundamentally address the complex problems of construction and the environment, in order to restore balance between the natural and the built environment, as both realms are highly interconnected (Du Plessis, 2002).

Considering the size and importance of the construction industry to the economic development of many countries, (studies like Giang & Pheng, 2011; Wang, 2014 indicated that construction development has been an essential part of economic growth in Africa, Asia and the Pacific region), and its immense contribution to environmental damage, suggestions have been made to consider the adoption of sustainability in construction as one of the very important conditions for measuring the construction industry's overall performance (Murray & Cotgrave 2007). Sustainable construction will enhance construction industries' effectiveness, as well as contribute meaningfully towards preserving the environment, enhancing social equity and economic prosperity.

Also, for a long time, the construction industry has been paying little or no attention to the environment, irresponsive to the needs of the people, and inefficient in the consumption of finite resources, including labour, materials, water and energy (Bakhtiar, Li, & Misnan, 2008; Kibert, 2008; Ruparathna, 2013; Shen & Tam, 2002; Shen & Yao, 2006; Shen & Zhang, 2002; Shi et al. 2013; Tan, et al. 2011). This disregards the sustainability agenda in construction activities mentioned in the World Watch Journal in 1994 to observe that human beings are fast becoming super species, with the development of structures that has the capacity to adapt to our varying environmentally-degrading lifestyles globally.

Rode, Burdett, and Soares Gonçalves, (2011) indicated that an approximate 10% of the global energy consumption goes to the building materials manufacturing. Construction and demolition contribute about 40% of the solid waste generated in the developed nations, while the operation stage of construction products emits almost 40% of the entire global greenhouse gas emissions (Rode, Burdett, & Soares Gonçalves, 2011). With the apprehension associated with resource shortage and the ever-increasing cost of energy, it is imperative for the construction industry to adopt the principles of sustainable construction. This necessitated the emergence of an international collaborations during the last decade to drive the construction industry towards the path of sustainable construction (Kajikawa, Inoue & Goh, 2011). During the First International Conference on Sustainable Construction in Tampa, Florida, the United States of America, Kibert (1994) proposed the first known view of sustainable construction as “the creation and responsible management of a healthy built environment, using resource efficient and ecologically-based principles” (cited in Kibert, 2005). However, Kibert’s view mainly focused on issues of non-renewable resources, especially energy, and ways to lessen their impacts on the ecosystem, with emphasis on such issues like materials, building components, construction technologies and energy-related design concepts.

Thereafter, Du Plessis, (2002) brought a broader view of sustainable construction that takes the concept beyond just resource efficiency and ecological principles by introducing the idea of restoring the environment, as well as explicitly highlighting its social and economic aspects. It shows that by adopting this concept, construction activities’ impact on sustainable development is considered under social, economic, and environmental dimensions. In this line of thought, non-technical issues (i.e. economic and social sustainability) are given equal prominence as environmental issues. This new paradigm therefore gave rise to the Triple Bottom Line (TBL) of environmental protection, social well-being and economic prosperity dimensions of sustainable construction (Abidin, 2009), which have been adopted in this study.

Within the Malaysian Construction Industry (MCI), however, sustainable construction has been generating several attention for a long time, as the country moved to become one of the first nations in the world to show serious concerns towards the construction’s impacts on the environment by enacting the Environment Quality Act way back in 1974 (Hamid, et al. 2011). Despite this, several unsustainable practices have been highlighted to be plaguing the industry (Abdul-Rahmanet al. 2006; Goh & Abdul-Rahman, 2013; Mehr & Omran, 2013). Also, in spite of several noteworthy studies on sustainable construction (e.g., Abidin, 2009; Du Plessis, 2002; Liu, Fellows & Tuuli 2011; Shen et al. 2010), very little attention has been directed towards the effects of organisational cultural factors on sustainable construction. If any, findings of such studies are inconclusive, suggesting the possibility of a moderator (Baron and Kenny, 1986). Thus, government support is proposed in this study as a moderator because, government support in stimulating green construction is one of the most effective techniques as it is more result-oriented (Atsusaka, 2003; Samari, 2012). The government is also capable of driving sustainable construction agenda with a number of policies, including fiscal supports, legislation and standards, and building labelling with energy efficiency rating (Pitt et al. 2009).

Examining government support as a possible moderator is yet to be investigated within the context of the Malaysian Construction Industry. It has, however, been established that the construction project delivery could be improved with government support (Qiang, et al. 2015). Therefore, such consideration could increase our understanding by providing theoretical and empirical evidence on how government support could affect the direction and/or strength of the relationship that exists between organisational culture and sustainable construction in the context of Malaysian large construction companies.

Towards meeting the objective highlighted earlier, the rest of this article is organized as follows: the next section reviews the relevant literature related to organisational culture (from the perspective of adhocracy culture and market orientation), government support and sustainable construction, leading to the development of hypotheses. Next, we describe the methodology used in this study, and thereafter, we present the results and discuss the findings in greater detail by relating them to the underpinning theory and past studies. We also highlight several implications within the context of Malaysian large construction companies.