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國際營造廠之環境管理與公司業績表現

Environmental Management and Firm Performances of Multinational Construction Firms

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國際營造廠之環境管理與公司業績表現

Environmental management and firm performances of multinational construction firms

本論文係王傳芳君（D00521033）在國立臺灣大學土木工程學系博士班完成之博士學位論文，於民國 107 年 7 月 16 日承下列考試委員審查通過及口試及格，特此證明

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中文摘要

隨著環境課題日益受到關注，營建業無可避免的必須在組織治理上做出改變。數份研究證實國際營造廠在環境管理上顯得比較積極主動，但是在環境管理，財務表現，及國際化之間關係的分析卻顯得不足。這項研究將針對國際營造廠為研究對象，主要研究目的是要探索環境管理策略和國際化之間的關聯、檢驗各個環境管理方式和財務之間的關係、並且進一步檢驗區域多元化是否會調節環境管理和財務之間的關係。

理論上，本項研究採用三項主要管理理論。資源基礎理論強調環境管理如何強化公司的競爭優勢，交易成本理論和組織學習理論則解釋國際化對財務表現的影響。

本研究從 Engineering News-Record (ENR) 2012 年度的頂尖營造廠表單中，採用其中 61 家國際營造廠為研究對象。接著通過內容分析法來分析各家廠商的環境報告，以此方式摘錄和評估各家的環境管理模式及其積極度。財務表現資料的主要來源是通過 Datastream 資料庫獲取的次級資料。國際化資料則是依據營造廠的國外銷售佔總銷售額比例，投資的地域擴張度，及地理集中度三方面來鑑定。

另外，此項研究採取三種不同的分析法解析資料以達到前述三個目標。其中包括：反差分析及其他類似分析法、多元逐步回歸分析法、及調節回歸分析法。

在 K 均值聚類演算中歸類出三種不同積極度的環境管理策略，分別命名為被動策略、預防策略、及積極策略。其後，從反差分析法得到結論是採用較積極環境管理策略的國際營造廠有助於其公司國際化，但是環境管理策略對國際化的影響是有局限的。相比採用被動和預防策略的營造廠，研究結果顯示採取積極策略

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的營造廠在國際化上並沒有顯著的不同，但是採取積極策略的營造廠在國際地理分佈上會傾向投資在發達國家中。

在財務表現的回歸分析中，有五項環境管理方式與公司財務表現明顯相關。其中包括實地污染處理、營業環境掃描、環境管理系統、環保相關的創新、及利益關係方參與。此外，實地污染處理和環保相關的創新都對財務表現呈現非直線型的關係。實地污染處理是 U 型曲線，另外環保相關的創新是倒 U 型曲線的關係。這發現有助於營造廠確立哪種環境管理方式會對財務造成影響，並且積極加強以增加公司的競爭力。

調節回歸分析法引用地理集中度為調節變數，並與實地污染處理、營業環境掃描、及環保相關的創新三種環境管理方式形成交互作用變數，檢驗它們對財務表現的影響。研究結果發現地理集中度對環境管理方式呈現正負不一的影響。地理集中度的影響是有賴於國際化的益處是否超越其成本。

綜上所述，本研究除了提供適當的理論來解釋環境管理、國際化、及財務表現三者之間的關聯，也進一步通過量化的實驗證明其關係。對於營造廠來說，永續環境的發展對公司治理會顯得越來越至關重要，營造廠必須採取適當的策略性環境管理來應對挑戰，並通過強化環境管理來提高其在國際市場的競爭優勢。

關鍵字：環境管理、國際化、財務表現、永續營建、資源基礎理論、交易成本理論、組織學習理論

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ABSTRACT

Growing attention on environmental protection has triggered drastic changes in the corporate practices of construction firms. Several studies have shown that multinational construction firms have been relatively proactive in environmental management. However, the relationships between environmental management, degree of internationalization, and financial outcomes are not fully comprehended. This study targets on multinational construction firms and the main goals of this study are to explore relationship between environmental strategy and degree of internationalization; examine the relationship between environmental practices and financial performance; and examine the moderating effect of regional diversification on the relationship between environmental practices and the financial performance.

Primarily, these relationships were established drawing from three profound management theories, Resource-based view explain how firms acquire competitive advantages from environmental management, transaction cost and organizational learning are two main perspectives that articulated firm performances with internationalization.

In total, 61 samples of multinational construction firms are drawn from the Engineering News-Record (ENR) Top International Contractor list published in 2012. Content analysis was used to extract and measure the degree of proactivity of environmental management disclosed through environmental reporting. Financial and accounting information is collected through secondary data disclosed in Datastream database. Degree of internationalization is measured based on investment intensity, geographical extensity, and geographical concentration.

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In addition, the study adopted three different analysis approaches to achieve the targeted goals. Analysis of variance (ANOVA) and other similar extension methods, stepwise regression, and moderated regression analysis are consecutively carried out to analyze the relationships that related to the goals.

Three clusters of environmental strategies have emerged from the statistical clustering which depict reactive, preventive, and proactive postures in strategic environmental management. The results denote that construction firms which are proactive in strategic environmental management would have improved internationalization to an extent where further proactivity would deem irrelevant to internationalization, and proactive firms would more likely to have greater geographical portfolio distribution in developed countries.

In regards of financial performances, five environmental management practices have been revealed to significantly associated with financial performances. These practices include pollution abatement on-site, environmental scanning, management systems and procedures, environmental innovation, and stakeholder engagement. Nonlinear relationships have been detected on both pollution abatement on-site (U-curve) and environmental innovation (inverted U-shaped). These findings can assist construction firms in determining the key environmental management practices that are able to enhance their competitive edge.

Furthermore, regional diversification is adopted as a moderator, forming interaction terms with environmental management practices such as pollution abatement on-site, environmental scanning, and environmental innovation to examine the impacts on financial performances. The results suggest regional diversification can be either positively or negatively moderate the relationships between environmental management

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and financial performances, and it depends on whether the benefits of internationalization outweigh the costs of internationalization.

In a nutshell, this study provides theoretical support and empirical evidences on the linkages between environmental management, internationalization, and financial performances. Besides, it also contributes to the growing body of evidence that environmental sustainability is becoming increasingly vital to the operations of construction firms, and proper strategic environmental management can enhance a firm's competitive advantage in the global market.

Keywords: environmental management, internationalization, financial performance, sustainable construction, resource-based view, transaction costs, organizational learning

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
EMS	Environmental management system
ENR	Engineering News Record
FSTS	Foreign Sales to Total Sales
MANOVA	Multivariate analysis of variance
MANCOVA	Multivariate analysis of covariance test
MNE	Multinational Enterprise
NSI	Network Spread Index
ROA	Return on assets
ROS	Return on sales
RDI	Regional Diversification Index
VIF	Variance Inflation Factor

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CHAPTER 1

INTRODUCTION

1.1 Overview

Growing attention to environmental protection has triggered drastic changes in the corporate practices of construction firms. Several studies have shown that multinational construction firms have been relatively proactive in environmental management and there are ample evidences indicate environmental management is crucial for business success in the international market. This study target on environmental management implemented by multinational construction firms and the its associated firm performances.

This Chapter discusses the background study, problem statements and research objectives. This Chapter also discusses the significance and scope of the research. The last part of this Chapter discusses the thesis outline for this research study.

1.2 Background of the Study

Commitment to the natural environment has become an important issue in the construction industry. Owing to the severe environmental impact of construction activities, advocates of sustainable construction strive to incorporate sustainable development principles into conventional construction practices and to accelerate the transformation of organizational management in construction firms.

The advancement of the concept "sustainable development", first introduced in 1987 (Brundtland, 1987), can be witnessed with the subsequent emergence and adoption of environmental practices or standards either related to production (life cycle analysis, green building standards etc.) or management procedures (environmental management

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system) in construction industry. Many studies have highlighted the drivers, drawbacks, and benefits of the implementation of these new practices, with some drawing attention to the strategic implications of adopting such practices (Fergusson and Langford, 2006; Tan et al., 2011).

1.2.1 Environmental Issues in Construction Industry

In the United States, approximately 43% of carbon dioxide emissions result from the energy services consumed by residential, commercial, and industrial buildings (Brown and Southworth, 2008), while the construction industry itself consumes about 42% of materials entering the global economy in 2010 (OECD, 2015).

Green or ecologically sustainable construction is important because creating and operating buildings are matters that account for about 40% of global annual energy consumption (Greenwood et al., 2007; Kibert, 1994), almost 40% of the global material deployment and also 25% of global waste (Bossink, 2011; Ding, 2008; Nelms et al., 2007; Ofori and Kien, 2004; Roodman et al., 1996; Vijayan and Kumar, 2005). Therefore becoming market responsive, minimizing waste, integrating the supply chain and engaging all stakeholders should be the aims of the construction industry (Myers, 2005).

1.2.2 Emergence of Sustainability Concern in Construction Industry

Following the emergence of sustainability discussions in the late 1980s including the Brundtland Report (Brundtland, 1987) ecologically sustainable construction has received much attention as a result of major environmental and social impacts created by the construction industry and also its lag with other sectors (Myers, 2005).

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The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and the environment pollution concern in the 1970s. The Rachel Carson's book Silent Spring is considered as one of the first initial efforts to describe this topic. The classical definition of sustainable development was defined in the Broundland's Report 1987 as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The pursuit of sustainable development throws the build environment and the construction industry into sharp relief (Bourdeau, 1999). An unprecedented sustainable construction movement is reshaping the conventional construction sector around in all aspects including planning / programming, design, construction, operation / maintenance, modification / renovation, demolition / deconstruction, financing, insurance, policy, marketing, management, etc (Xiaoping et al., 2009).

Sustainable construction as a concept encompasses the creation and management of a healthy built environment based on resource efficient and ecological principles. The results of the implementation of sustainable construction practices (i.e. building practices) are defined as practices that strive for integral quality in terms of economic, social and environmental performance. Sustainably designed buildings are designed to lessen their impact on the environment and improve environmental quality through: minimization of consumption of non-renewable resources; elimination or minimization of the use of toxins; and reduction of energy consumption (Mokhlesian and Holmén, 2012).

There are several terms about this topic, such as green building, sustainable building, sustainable construction, high performance building, and so on, and these terms are often used interchangeably. In fact, there are essential differences in these terms. Sustainable construction most comprehensively addressed the ecological, social, and economic issues of a building in the context of its community (Kibert, 2007).

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Sustainable/green buildings can be defined as the facilities which are the outcomes of sustainable construction for the purpose of promoting occupant health and resource efficiency, minimizing the impacts of the built environment on the natural ecology system. In the opinion of Kibert, sustainable/green building is a subset of sustainable construction, representing simply the structure (Kibert, 2004).

Emerging advocacy of sustainable construction aims at incorporating the general sustainable development concepts into conventional construction practices. While the foundation of knowledge in this field is continuously expanding, sustainable construction is not yet standard industry practice. In construction industry however, a slower pace is in response to the environmental issues in contrary to other industries. To be able to reduce, to a minimum, the impact of the organization's activities on the environment, construction managers must develop management strategies, which allow the matching of the activities of the organization, to the environment in which it operates (Johnston and Scholes, 1993). Moreover, only limited studies have investigated environmental practices as strategic management issue of construction firms which render obscurity on the output of implementation environmental practices.

Unlike financial reporting which have many standardized sources of data available, environmental data suffers for lack of consensus on how information should be presented, what indicators must be used and what their meaning is. In this regard, the problem of content standardization and uniformity was addressed by a number of global standardization associations and environmental non-governmental organizations (Jose and Lee, 2007). International Organization for Standardization (ISO) introduced ISO 14001 guidelines as a way to standardize corporate environmental management system. United Nations Global Compact lists nine principles focus on human rights, labor rights, environmental sustainability, and corruption for firms to follow. Dow Jones Sustainability

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Indexes cover and assess the leading companies with the best corporate sustainability practices. In order to provide a consistent guideline to disseminate environmental information, organizations such as CERES Report from the Coalition for Environmentally Responsible Economics (CERES), the ICC Business Charter for Sustainable Development (ICC), and the Global Reporting Initiative (GRI) have developed and promoting standard reporting practices.

Amidst the above reporting standards, GRI is pioneering among all with sample reporting items and guidelines provided specifically for construction and real estate sector. 70% of top 50 international contractors listed in ENR have reported to document their sustainability commitments in either standalone sustainability report or as a section of their annual report, and 28% have their sustainability report listed by the GRI (Zuo et al., 2012). The engagement of contractors in environmental reporting has provided an access for scholars to explore the environmental practices and performances of construction sector.

1.2.3 Challenges of Environmental Practices in the Construction Industry

The construction industry has long been criticized for its low level of innovation and efficiency. Yet innovation is essential to advance sustainable construction or environmental practices in the construction industry. In order to understand the barrier towards adoption of sustainable construction practices, the unique structures and peculiarities posed by the industry have to be comprehended.

An institutional view towards the construction industry identifies the characteristics of the industry that distinguish it from other industries as the main challenge to the adoption of green construction practices. Nam and Tatum (1988) contend that constructed products carry a high degree of social responsibility towards public safety

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and health, which reinforces a greater a sense of conservatism in design and specialization. This conservative ethos underpins the tendency of construction players to maintain their current practices despite potential innovations related to sustainability that they could otherwise adopt (Ahn et al., 2013). Furthermore, constructed products are one-of-a-kind products, with each project being unique and specific, and with individual challenges and problems, thus limiting the possibilities for production standardization (Vrijhoef and Koskela, 2005). This peculiarity poses challenges to firms in monitoring and normalizing their environmental performance over time, specifically on a year-to-year basis (Christini et al., 2004). In addition, the temporary production organization of construction projects can curtail the motivation to consider environmental impacts, which is predicated upon holding a more holistic and long-term perspective (Gluch and Räisänen, 2012; Vrijhoef and Koskela, 2005).

A structural view invokes fragmented decision processes and interactions across the players as key hindrances to the adoption of green construction practices. A construction project involves collaboration among players such as clients, regulators, architects, the principal contractor, sub-contractors, component suppliers, and different disciplines in engineering, each subject to varying interests and practice codes. These barriers result from the contradictions at the interface between the organization, the project, and the client (Gluch and Räisänen (2012). The argument is further extended to the adaptability problem, in which end users unable to utilize green features beyond what the designer and builder have made available (van Bueren and Priemus, 2002). In addition, it is argued that the uneven distribution of costs and benefits among designers, contractors, clients, and owners can discourage the realization of sustainable construction (van Bueren and Priemus, 2002), which is further frustrating if the environmental practices incur extra costs while not fully recognized by the government and clients (Ofori et al., 2000). The

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extra costs can in part arise from the additional communication and coordination needed between different specialized disciplines, and the uncertainties involved when new sustainable construction concepts are introduced into the project (Demaid and Quintas, 2006). Environmental management often evokes conflicts between environmental performance and contract time and construction costs, a stalemate that could only be resolved when the government enacts new policies and incentives to shift the traditional paradigm of project organization (Zhang et al., 2014).

Neglecting this context would lead to insufficient consideration of the uncertainties and interdependencies that impede the efficient application of environmental management practices in construction.

1.2.4 Environmental Management of Construction Firms

Previous environmental management studies of construction firms can be divided into two primary categories. The first category emphasizes the technical aspects, implementation, and consequences of new environmental practices from a project-level perspective. The second category examines how these new practices necessitate major changes in the structure and production of construction firms (Ahn and Pearce, 2007), leading to a reorientation of business models and value creation (Mokhlesian and Holmén, 2012), thus having a focus more from a firm-level perspective.

In construction industry, the growth of sustainability services in the sector has been characterized by a distinct global unevenness; relative economic prosperity in the developed world has afforded market and policy expansion whilst developing countries have been unable to prioritize sustainability in the same way (Preece et al., 2011).The distinctive impetus of internationalization would have drawing the multinational construction firms towards different environmental strategic setting.

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Construction firms recognize that reducing environmental risk, improving their environmental image, and saving on costs are among the benefits of environmental management (Shen and Tam, 2002). The adoption of environmental management system ISO14001 is also perceived to entail a synergy effect in entering the international construction market (Turk, 2009; Zeng et al., 2003). A study on Korean contractors concluded that global contractors are more proactive in environmental strategies than their local counterparts (Park and Ahn, 2012). Zuo et al. (2012) also indicated a high commitment of environmental reporting among international contractors. Yet, there have been no studies from the strategic environmental management perspective that articulate the interplay between a multinational contractor's internationalization characteristics and its environmental practices.

1.3 Problem Statements

Despite there are number of studies on environmental management in other industries, particularly in the manufacturing industry, generalization to the construction industry might be limited due to the unique structures and peculiarities posed by the industry. Unlike other industries, it is reported that construction industry exhibits a very low level of innovation (Seaden and Manseau, 2001). Many construction firms do not need to innovate in order to remain successful or viable since they are able to sustain themselves by meeting local needs, responding to regulations and drawing new technologies from their suppliers and customers (Reichstein et al., 2005). The conservatism and non-innovative behavior in construction industry raise the question whether it would be profitable for proactive in managing environmental issues like some other industries. Besides, construction projects are complex processes and involve multiple players. Thus, the environmental information of a firm is usually dispersed across numerous players

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inside and outside the firm. Unless there is an established and formal channel to gather, consolidate, and circulate environmental information, it is very challenging to obtain reliable data.

The construction industry has the highest rate of certified ISO 14000 among all industries (Marimon et al., 2011), yet construction firms are seldom sampled and studied for their business performance in the environmental management literature. The construction industry differs from manufacturing and service industries on many aspects, including the products offered, the market segments served, technology, completion structure, capital and labor market variations, and the ecological impacts of the products (Zutshi and Creed, 2014). The construction industry's project-based business nature is different from other business models due to its limited time frame and often one-off project, involvement of adversarial relationships among actors, separation of design and production, competitive tendering, high degree of uncertainty, and standardization difficulty (Mokhlesian and Holmén, 2012). These distinguishing characteristics should be taken into account when considering how construction firms could benefit from pursuing proactive environmental management.

For construction firms, one of the perceived main impetuses to develop an environmental management system is the synergy effect when entering the international construction market (Zeng et al., 2003). A study on Korean contractors concluded that global contractors are more proactive in environmental strategies than their local counterparts (Park and Ahn, 2012). Zuo et al. (2012) also indicated a high commitment of environmental reporting among international contractors. However, recent environmental strategy studies in the construction industry (Fergusson and Langford, 2006; Park and Ahn, 2012; Tan et al., 2011), have not addressed the impacts of environmental proactivity on internationalization. It remained questionable whether

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proactive environmental management strategy help construction firms in their global expansion. In addition, if the linkage between environmental management and internationalization exist, one should also understand whether construction firm would enjoy the benefits of environmental management in different regions across the world.

Multinational construction firms usually exhibit higher proactivity and compliance in environmental management practices than domestic firms (Park and Ahn, 2012). The proactiveness of multinational construction firms are articulated with greater availability of slack resources which give the firm leeway in managing environmental issues as opportunities rather than a threat (Aguilera-Caracuel et al., 2011). While, some environmental management practice would have affected firm financial performance, it is arguably these relationships are moderated by multinationality of a firm.

There are ample evidence that proactive environmental strategies are likely to be accompanied by improved financial performance, however it is crucial to understand why only some firms in an industry implement such strategies (Sharma et al., 2007) and what are the circumstances which environmental practices could contribute to competitiveness (Christmann, 2000). One of the attempts to answer pertaining to why some only some firms are more competitive through implement proactive environmental strategy while others are not, scholars have devoted to perform an integrated analysis of the influence of exogenous variables on organizational capabilities (Sharma et al., 2007), and how such variables have a moderating effect on organizational capacity and firm performances. However, limited studies have underscored internationalization as a moderator on the relationship between environmental management practices and firm performances.

In a nutshell, this study addresses the imperatives to understand the limitations of previous studies which rendered several unclear outcomes on environmental management implemented by multinational construction firms. Through empirical study, this study

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aims to answer how environmental management relates with the financial implications and international strategic management.

1.4 Research Questions

The specific research questions and research hypotheses are listed as followings:

(i) What types of environmental management practices are disclosed in the environmental reporting of multinational construction firms?

(ii) Does environmental strategy have any influence on the internationalization of a multinational construction firm?

(iii) If environmental strategy has impacts on internationalization, in which dimension that internationalization is affected by environmental strategy?

(iv) Does the environmental strategy adopted by a firm would influence its business distribution portfolio across developed and developing regions?

(v) Which of these reported environmental management practices are associated with the short-term and long-term financial performance of the firms?

(vi) Do degree of internationalization (regional diversification) moderates the relationship between environmental management practices and financial performances?

Based on research question (vi), following hypotheses have been derived in Chapter 2:

Hypothesis 1a: Regional diversification negatively moderates the relationship between environmental scanning and short term financial performances.

Hypothesis 1b: Regional diversification negatively moderates the relationship between environmental scanning and long term financial performances.

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Hypothesis 2: Regional diversification positively moderates the relationship between process-related pollution abatement practices and short term financial performances.

Hypothesis 3: Regional diversification negatively moderates the relationship between environmental innovation and short term financial performances.

1.5 Research Objectives

The objective of the work reported in this thesis aim to enhance the understanding of environmental management practices implemented by multinational construction firms, and the impacts of environmental management on their international expansion and financial performances. Besides, this study attempts to adopt both strategy and multi-dimensional practices classification of environmental management in the analysis of environmental-firm performance relationships. More specifically, the research objectives of this study can be summarized as follows in response to the research questions stated in section 1.4:

(i) Identify the environmental management practices and strategy typologies implemented by multinational construction firms.

(ii) Explore the relationship between environmental strategy and degree of internationalization in multinational construction firms.

(iii) Investigate the firm geographical distribution portfolio across developed and developing regions based on the environmental strategy deployed by multinational construction firms.

(iv) Examine the relationship between environmental practices and the financial performance of multinational construction firms.

(v) Examine the moderating effect on the relationship between environmental practices and the financial performance of multinational construction firms.

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1.6 Significance of the Research

Given the peculiarities of construction firms and the difficulties in obtaining environmental information in the construction industry, very few studies have examined the interplay between environmental management and business performance from a firm-level perspective. This study contributes to the literature in two-fold, first it highlights the financial implications of environmental management practices in the context of construction firms. The study attempts to empirically evidence the linking of environmental management to the financial performance from a theoretical competitive perspective, and establish the interaction factor of internationalization on the relationship between environmental management and financial performances. Second, for the practical purpose, the study exemplifies the required strategic resources and capabilities, in which a multinational construction firm could financially benefit from environmental management and international strategic planning.

1.7 Scopes of the Research

Based on the objectives, the scopes of this research have focused on:

(i) Environmental information of construction firms is sourced from environmental disclosures published by each construction firm. Due to language proficiency, only reports in English and Mandarin were accepted. The environmental data were gathered from sustainability reports, corporate social responsibility reports, online annual reports, and public information on company webpages. The main targets were environmental reports published in 2011. Therefore, the environmental information is subjected to the content availability in the disclosure and limited the selection of study samples.

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(ii) The sample of multinational construction firms is drawn from ENR Top International Contractors 2012 (ENR, 2012). Only publicly listed firms from developed countries, with financial data available and environmental reporting published online, are included in the study.

(iii) While there is plenty influencing exogenous variables which adopted in the literature, not all of these variables which can be adopted as control variable are included in the study due to difficult to collect such information from the multinational construction firms that scattered across the globe. Primarily, the data is collected through content analysis method and based on secondary data disclosed in Datastream financial database.

(iv) In order to maintain consistency across different measure used in coding environmental management practices and to avoid confounding effects in the statistical analysis of financial data, most of the results are interpreted based on standardized values. Therefore, the results are best used to understand the relationship between the variables and not recommend for prediction purpose.

1.8 Outline of the Thesis

The introduction of this study, including the problem statements and objectives have been discussed in Chapter 1.

Chapter 2 provides an overview regarding the development of sustainable construction and previous studies that related to environmental management and internationalization. The literature review on environmental management are not limited to studies related to construction industry, but also include ample findings and management theory learned from business management domain. Based on the critical

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review, the study proposed four hypotheses that connects moderating effect of internationalization on environmental management practices and financial performances.

Chapter 3 depicts the methodology adopted in the study. This chapter brief on the research framework, sample used in the study, the data required to proceed for analysis, and the source of data. Besides, this chapter also expound the procedures and requirement to deploy K-means clustering, exploratory factor analysis, and content analysis. Three types of analysis methods have been expounded with details, include (i) Analysis of variance (ANOVA) and other extension methods, (ii) stepwise regression analysis, and (iii) moderated regression analysis. Last but not least, types of reliability and validity checking have been clarified in each respective section of analysis method.

Chapter 4 presents the ANOVA results of environmental strategies and internationalization. The results include: (i) three types of environmental strategy categorized based on K-mean clustering method and their construct validity, (ii) the results pertaining to the relationship between environmental strategy and degree of internationalization, (iii) the linkage between environmental strategy and internationalization portfolio of multinational construction firms across developed and developing countries.

The subsequent Chapter 5 discusses the financial implication of environmental management practices adopted by multination al construction firms. Stepwise regression is used to filter associated environmental management practices that significantly related to short and long term performances.

Chapter 6 presents the results and discussion of moderating effects of regional diversification on the relationships between environmental management practices and financial performances. The results of moderated regression are used to examine the four

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hypotheses posited in Chapter 2. The implication of the moderating effects is further explained in the discussion section.

Chapter 7 discusses the overall findings of this research. The limitations and future works of the research are reported accordingly in the last section of this Chapter.

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CHAPTER 2

LITERATURE REVIEW

2.1 Sustainable Construction

Following the emergence of sustainability discussions in the late 1980s including the Brundtland Report (Brundtland, 1987), ecologically sustainable construction has received much attention as a result of major environmental and social impacts created by the construction industry. The classical definition of sustainable development was defined in the Brundtland Report 1987 as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs". An unprecedented sustainable construction movement is reshaping the conventional construction sector around in all aspects including planning / programming, design, construction, operation / maintenance, modification / renovation, demolition / deconstruction, financing, insurance, policy, marketing, management, etc (Xiaoping et al., 2009).

As yet there is little publication that analyses green construction explicitly from a business model perspective. This implies that the understanding of these processes is poor at best. Fortunately, there are a number of papers that describe or analyze green construction where changes in firms' business models can be inferred. Thus, the purpose of this section is to review recent green construction publications to investigate what elements of the business model change when a construction-related company undertakes green construction, and ascertain whether there are any specific relations between changes in different business model elements. Table 2.1 shows the references of subjects of study in the literature.

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Table 2.1 Subjects of study and references

Subjects of study	References
Strategy and business modal	Fergusson and Langford (2006); Tan et al. (2011); Mokhlesian and Holmén (2012); Park and Ahn (2012)
Sustainable construction	Pitt et al. (2009); Manoliadis et al. (2006)
Environmental management system	Qi et al. (2010); Ball (2002); Kein et al. (1999); Ofori et al. (2000); Shen and Tam (2002); Zeng et al. (2003); Christini et al. (2004); Valdez and Chini (2002)
Sustainable building	Ahn et al. (2013); Häkkinen and Belloni (2011); Xiaoping et al. (2009); Bunz et al. (2006)
Corporate social responsibility disclosure	Martinuzzi et al. (2011);Myers (2005);Jones et al. (2006)
Green Procurement	Riley et al. (2003); Ofori (2000); Rwelamila et al. (2000); Ngowi (1998)

2.1.1 Drivers of Environmental Management in Construction

In construction industry, several researches conducted on environmental study highlighted on the motivation of implementation sustainable construction, environmental management ISO 14001, and sustainable building. These studies are geographically constrained in nature, however they are able to provide some understanding from the responses of the industry.

Manoliadis et al. (2006) has identified there are 15 potential drivers that would propel a change toward sustainable construction practices, including: energy conservation,

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waste reduction, indoor environmental quality, environmentally-friendly energy technologies, resource conservation, incentive programmes, performance-based standards, land use regulations and urban planning policies, education and training, re-engineering the design process, sustainable construction materials, new cost metrics based on economic and ecological value systems, new kinds of partnerships and project stakeholders, product innovation or certification, and recognition of commercial buildings as productivity assets. These driving forces for the construction firms to adopt different environmental practice can be further categorized into organizational concern, operational efficiency, competitiveness, market incentives, regulation compliance or risk aversion, and social responsibilities.

For organizational concern, construction firms initiate environmental practices by examining the organizational governance condition and its original management system, subsequently take effort to integrate new environmental practices when the internal conditions are fulfilled. The exemplary quotation of organizational concern are organizational condition that enable staffs to voice ideas and proposals; enabling condition to integrate new environmental strategy; environmental impact from prosecution or other adverse public reaction; and firm size (Fergusson and Langford, 2006). Qi et al. (2010) highlighted managerial concern is the most important driver for the adoption of green practice and business size is another concerning factor.

Firms that adopt environmental practices for improvement of operational process and managerial process are operational efficiency seeker. Energy conservation, resource conservation, waste reduction, improving indoor environmental quality, and environmentally friendly energy technologies are highlighted as motivation for changes (Ahn et al., 2013; Häkkinen and Belloni, 2011; Manoliadis et al., 2006). Ofori et al. (2000) in his study of implementation of ISO 14001 in Singapore, identified operational

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efficiency factors such as enable company to reduce material wastage, help to enhance company's productivity, reduce company's operating costs and improve company's procedures. Zeng et al. (2003) emphasized the potential of improvement in management.

As a matter of competitiveness, construction firms taking strategic responses in order to expand the market sharing in the industry and ease competitive pressure from their competitors. Several scholars contend reputation and corporate's image as the main drivers of sustainable construction practice (Fergusson and Langford, 2006; Ofori et al., 2000; Shen and Tam, 2002). The competing pressure in field (Christini et al., 2004; Ofori et al., 2000; Valdez and Chini, 2002), as well as expansion and entry to foreign market (Zeng et al., 2003) are able to create impetus for the practice change in a firm.

Pitt et al. (2009) asserted the market incentives as the strong impetus for promoting sustainable practices in the field. The scholars' study focused on factors that best promote or prevent sustainable construction practices and establish the consistency of how sustainability is measured. In their study through questionnaire surveys, financial incentives, building regulations, client awareness, client demand, planning policy, taxes/levies, investment, and labelling/measurement has been identified as main drivers in a decreasing order.

Regulation compliance or risk aversion is the most mentioned factor driving construction industry to sustainable development. The importance of regulation stem on the ability of coercive pressure to transform and compel the changing of construction activities. Almost every scholar in literature studies agreed that the regulation motivate sustainable practice (Fergusson and Langford, 2006; Kein et al., 1999; Manoliadis et al., 2006; Ofori et al., 2000; Pitt et al., 2009; Qi et al., 2010).

A few studies indicate that firms might adopt sustainable practices to account for the social benefits. Construction firm might change their practice to help improve workers'

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health, safety and welfare, and contribute to efforts to protect the environment (Ofori et al., 2000). Besides, the sustainable practices also contribute to environmental protection and able to improve the public environmental standards (Shen and Tam, 2002). Myers (2005) contended the main purpose of corporate social responsibility (CSR) reporting is to inform stakeholders of a company's environmental, social and economic performance. However, Qi et al. (2010) in their study of contractors' green innovation (change), indicated that perceived stakeholders' pressures have no significant relationship with the adoption of green construction practices.

2.1.2 Environmental Performances, Practices and Strategy of Construction Firms

The environmental management studies of construction have shed light on firm level as well as project management level. Firm perspective studies usually focus on aspects of environmental management that would influence the arrangement of firm's function which aim is to sustain business or create value. As highlighted by Mokhlesian and Holmén (2012), a firm has to consider to change their business model elements since engaging in sustainable construction might alter how it create value and generate profit from changing the environmental orientation of their businesses. A firm perspective studies would encompass the functions of strategic management, environmental management system, operational practices such as green innovation of construction process and building, stakeholder engagement, and procurement system etc.

In respect of environmental strategic management, Fergusson and Langford (2006) grounded environmental practices of construction firms into 7 themes which consist of (i) policy, (ii) management status, (iii) management integration, (iv) monitoring, (v) training, (vi) environmental performance, and (vii) sharing skill. Furthermore, the environmental competencies are shown to evolve over business performance and environmental

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performance improvement (Figure 2.1). Identically, Tan et al. (2011) proposed a guiding framework (Figure 2.2) to assist contractors improving their competitiveness by implementing sustainable construction practice on a continual improvement basis. According to Park and Ahn (2012), environmental strategy of construction firms could be classified into four typologies: ″exemplary,″ “infrastructure-oriented,” “technology-oriented,” and “passive” which based on a firm’s technological power and implementation abilities.

Environmental management system typically consists of policies, goals, information systems, task lists, data collection and organization, emergency plans, audits, regulatory requirements, and annual reports (Christini et al., 2004). The system is implemented to address an organization’s environmental impacts and formulate proper framework to improve its environmental performance. A standardized EMS was introduced by International Standardization Organization (ISO) in 1996 and coded as ISO 14000 series of standards. It is a widely recognized standard system which aimed for continual improvement of organization–level environmental performance (Turk, 2009). According to the current studies on ISO 14001, the certification can set up on firm level organization, construction project or site as a temporary organization. The benefits of adopt EMS or ISO 14000 are attributed to the contribution of environmental protection, minimize environmental risk, improve environmental image, cost saving, facilitate entry into international market, better on-site housekeeping etc. (Shen and Tam, 2002; Turk, 2009; Zeng et al., 2003).

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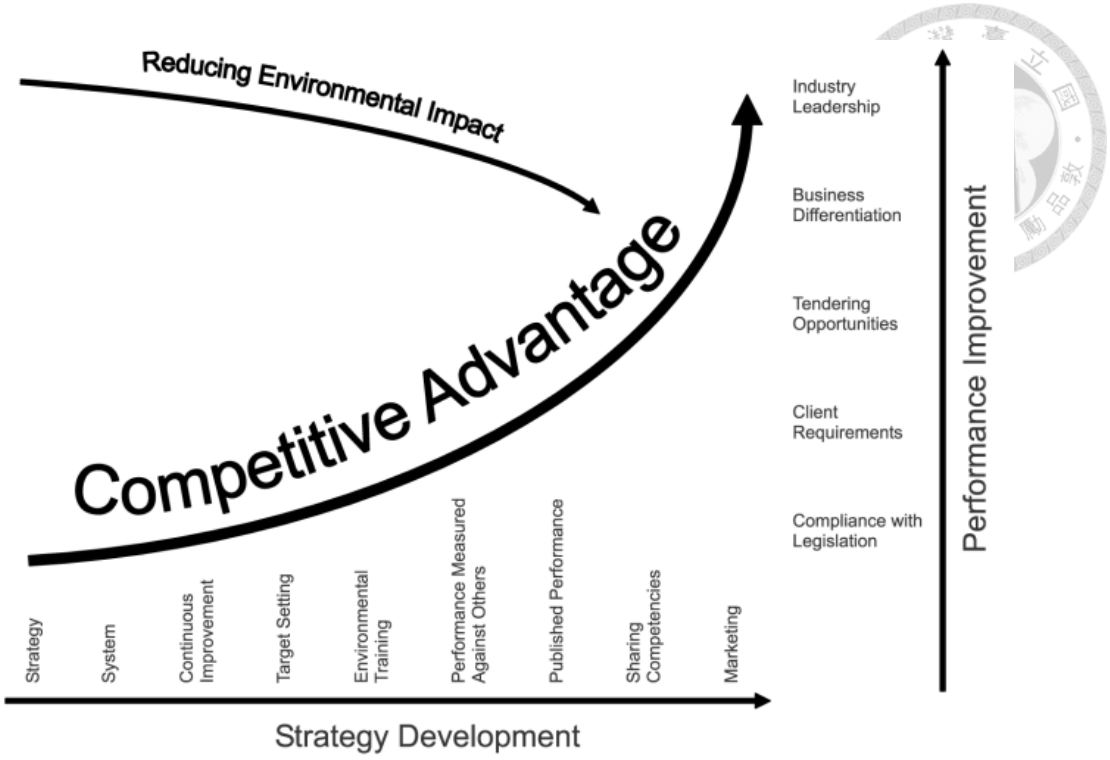

Figure 2.1 Increasing competitive advantages (Adopted from Fergusson and Langford, 2006)

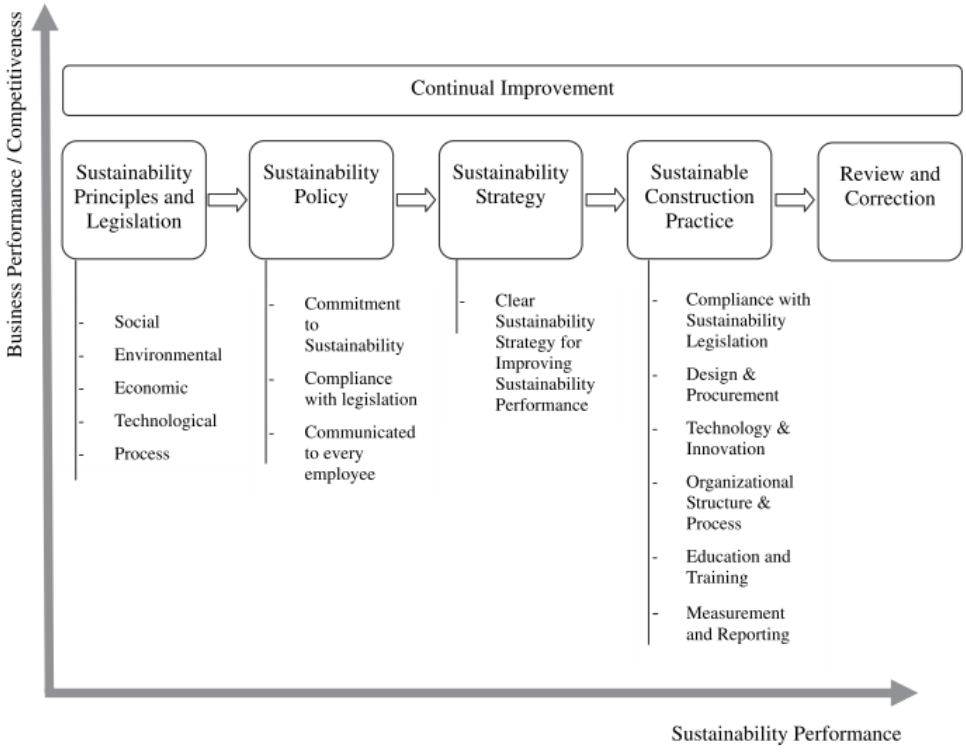

Figure 2.2 Implementation framework of sustainable construction (Adopted from Tan et al. 2011)

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Green innovation is a vital element to create firm's competitive advantage. Qi et al. (2010) asserts green innovation is composed of management innovation and technology innovation. The former refers to implementation of (i) ISO 14000, (ii) OHSAS 18001, and (iii) conduct research and development; whereas the latter highlights implementation of (i) investment in green equipment and technology, (ii) material saving, (iii) energy-saving, (iv) water saving, (v) land saving, (vi) noise controlling, (vii) waste abatement, and (viii) air pollution controlling. Through acquisition, assimilation, and transformation, construction firms could develop their capability to absorb green innovations and improve business performance (Gluch et al., 2009).

Nonetheless, commitment on environmental management practices usually are motivated by various source of stakeholder's pressure and managerial concern. Thus, construction would require capability of stakeholder engagement in order to integrate stakeholder environmental perspectives into design and construction. Firm required to communicate their construction project performance with stakeholders in regards of environmental impacts and how the impacts adding value to society (Walker, 2000). Besides, government pressure and managerial concern are driving construction firm's green innovation (Qi et al., 2010), and financial stakeholders have increasingly engaged in financing sustainable building related activities (Lützkendorf et al., 2011).

Environmental sustainability of construction is relied on the proficiency of client in formulating relevant green specifications in the contracts and develop the procurement process (Sterner, 2002). Some examples of green specification in contract include using of recycled materials, reduction of construction waste and demolition, adopt green building design, employ contractor or consultant who possess an EMS certification, and underline project specific environmental requirement etc. (Lam et al., 2009; Varnäs et al., 2009). However, proper green supply chain should be established to ensure reliable and

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flexible supply of services or materials from the standard distribution network (Lam et al., 2009).

Empirical studies on the potential financial implications of environmental management in construction firms are limited. Instead of directly analyzing firm-specific environmental management practices, previous studies resort to sustainability indices or adopt binary classifications of green versus conventional firms to measure environmental performance and investigate its impact on financial performance (Lu et al., 2013; Tan et al., 2015). Yet, both these studies denote green construction firms would expect better business performance than their counterparts.

On the other hand, the goal of environmental management practices at project scope are aimed to at least meet the requirement of environmental regulations (Gluch and Räisänen, 2012). The principals of sustainable construction practices are stemmed on resource management, life cycle analysis, and design for human (Sev, 2009). Common environmental practices in a construction project encompasses efficient use of energy and water, reduce, reuse and recycle of material, waste management, stormwater runoff and erosion control, dust control, noise control, preservation of land and ecology etc. (Christini et al., 2004; Sev, 2009). Commitment also has been laid down on eco-labelling scheme for sustainable buildings (Ball, 2002). Some of the well-known eco-labelling guideline standards are LEED standard from United States, BREAM standard from United Kingdom, and GBTool from Canada. These standards underscore cradle-to-grave design approach and recognizes environmental consequences of the entire life cycle of the building which cover phases of programming, design, building construction, building operation, and finally building demolition (Bunz et al., 2006).

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2.2 Environmental Management and Firm Performances

2.2.1 Measures of Environmental Proactivity

González-Benito and González-Benito (2005) contended two classifications of environment management studies, namely one-dimensional and multi-dimensional studies. One-dimensional studies assume environmental practices can be reduced to a single factor and follow a linear path towards higher level of proactive environmental management, for example the classification of environmental strategies by Hart (1995) and Buysse and Verbeke (2003b) which underscore embeddedness and path dependence. In contrary, multi-dimensional studies consider that there is no single path towards proactivity and the diversity of existing environmental management practices gives rise to different manifestations of strategic proactivity.

Several studies taken multi-dimensional perspective suggests measurement of environment proactivity should account for comprehensive set of environmental management practices (González-Benito and González-Benito, 2005; Montabon et al., 2007). For example, environmental practices can be distinguishable in three categories: planning and organizational practice; operational practices; and communicational practices (González-Benito and González-Benito, 2006), and can exert certain positive effects on performance based on portfolio of environmental practices that has been implemented (González-Benito and González-Benito, 2005). Montabon et al. (2007) covered a broad range of environmental practices in his studies. From the initial 48 sets of environmental practices, the study suggested recycling, waste reduction, remanufacturing, environmental design, and surveillance of market have positive effects on firm growth and innovation offset. Amidst the approaches for pollution reduction, King and Lenox (2002) purported only waste prevention approach leads to financial gain but not waste generation, waste treatment, and waste transfer.

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Through a review, Albertini (2013) found that environmental management variables, environmental performance variables, and environmental disclosure variables are three categories of environmental measures that adopted in the environmental-financial relationship studies. In comparison, qualitative environmental variable (environmental rating) is more likely to find a positive impact on environmental-financial relationship than adopting a quantitative environmental variable (such as the volume of waste generated or the amount of air emissions) (Horváthová, 2010). However, environmental data is hard to source. Amidst environmental data that are available, U.S. TRI, and Kinder, Lydenberg, and Domini (KLD) are two sources that most widely adopted in firm's environmental studies (Etzion, 2007). Lack of environmental data has leads many researchers to employ surveys, conduct case studies, and recently a new alternative is to source environmental data from firm's environmental reporting or disclosure (Etzion, 2007).

2.2.2 Environmental Disclosures and Content Analysis

Unlike financial reporting, which has many standardized sources of data available, environmental data suffers a lack of consensus on how information should be presented, what indicators should be used, and how they are interpreted. In order to provide consistent guidelines for disseminating environmental information, international voluntary organizations have developed and launched reporting frameworks to guide as well as promote corporate reporting standards. Some of the more prevalent reporting frameworks such as the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) have contributed to the increased reporting of corporations around the world. Among the various reporting standards that have been advanced, GRI is pioneering the development of the world's most widely used sustainability reporting framework, due

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in part to its success in integrating with other international frameworks and principles such as CDP, the United Nations Global Compact, OECD Guidelines for Multinational Enterprises, and ISO 26000 (Hřebíček et al., 2014). In addition, GRI has provided sample reporting items and guidelines specifically for construction and real estate sectors (Lamprinidi and Ringland, 2008). 70% of top 50 international contractors listed in the ENR have been reported to document their sustainability commitments in either a standalone sustainability report or as a section of their annual reports, and 28% have their sustainability reports listed on the GRI (Zuo et al., 2012). The engagement of contractors in environmental reporting has provided an access point for scholars to explore the environmental practices and performances of the construction sector.

The disclosure of information for environmental reporting generally reflects the importance given by management to environmental issues (Wilmshurst and Frost, 2000), despite the risk that presenting such information might hurt the credibility of the firm if it is perceived as an attempt at greenwashing. Nonetheless, the rich information and progressively standardized reporting formats can establish a clearer context for evaluating the environmental performance of a firm, and provide a valuable source of data for environmental studies (Dragomir, 2012). The voluntarily disclosed information can be presented in three major ways: monetary, quantitative and narrative (Alnajjar, 2000). Amidst these inconsistencies in reporting, Toms (2002) proposes a more theoretical way to evaluate the environmental information, which is based on the signalling theory. He asserts that a firm that has made genuine and significant environmental investments is more likely to offer the strongest possible quality signals, which are specified, quantifiable, and externally monitored, rather than being simply rhetorical statements.

Content analysis is a common methodology tool for extracting information from environmental reporting, whether the content is manifest or latent (Duriau et al., 2007).

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This method reveals manifest content through a number of text statistics, while latent content analysis is more concerned with the underlying meanings implied by the text, which may require more interpretation. In executing qualitative content analysis, Neuendorf (2002) suggests that appropriate measures should be exhaustive, mutually exclusive, and of the highest level of measurement.

Content analyses have been adopted by some scholars in construction management to explore the conceptual meaning behind voluntarily disclosed information. For example, Jones et al. (2010) employed a quantitative approach, measuring the recurrence of keywords to identify underlying concepts of sustainability within the US engineering and construction industry. Without specifying a particular approach, Zuo et al. (2012) adopted content analysis to investigate the sustainability practices of multinational contractors.

However, the use of environmental reporting and content analysis in econometric studies is quite rare. Some of the relevant studies include the work of Montabon et al. (2007) and Chen et al. (2015), who use coded environmental management practices to examine correlations between innovation performances and financial performances. Through the lens of RBV, Walls et al. (2011) conducted a content analysis of text extracted from various voluntary disclosures (environmental reports, corporate web pages, annual reports, etc.) from firms largely in the manufacturing industry, then performed regressions examining relationships between environmental strategy, environmental performance, and financial performance. After subjecting their construct to a battery of tests, they found it to have strong reliability and predictive validity. Nevertheless, our study underlines the predicaments faced particularly by the construction industry, which is largely due to the institutional barriers that make environmental management difficult to disseminate, and information difficult to source, rendering financial implications

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unverifiable. Since multinational construction firms are more engaged in publishing environmental reports, it would be a rational starting point to sample multinational construction firms and utilize content analysis to extract information related to the firms' environmental practices.

2.2.3 Resource-Based View on Competitive Advantages of Environmental Management

Resource-based view (RBV) underscores that every firm possesses a unique bundle of resources and capabilities that influences its strategic choices and ultimately its competitive advantage (Barney, 1991; Wernerfelt, 1984). Competitive advantage is seen as rooted in how a firm links its core competencies to resources in the firm's external environment while depending on organizational capabilities to leverage key resources. Based on the implication of resource heterogeneity and imperfect mobility, a resource can generate sustained competitive advantage if it is valuable, rare, inimitable, and supported by tacit skills or socially complex organizational processes (Barney, 1991).

One of the prominent theoretical paradigms extended from the RBV strand is the natural resource–based view (NRBV) proposed by Hart (1995). NRBV contends that competitive advantages are rooted in a firm's capability to facilitate environmentally sustainable economic activity. According to this theoretical derivation, firms acquire competitive advantages of lower cost, preempt competition, and future position through strategic environmental capabilities of pollution prevention, product stewardship, and sustainable development.

A RBV underscores that every firm possesses a unique bundle of resources and capabilities that influence its strategic choices and ultimately its competitive advantage (Barney, 1991; Wernerfelt, 1984). The RBV of the firm substitutes two alternate

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assumptions in analyzing sources of competitive advantage. First, this model assumes that firms within an industry (or group) may be heterogeneous with respect to the strategic resources they control. Second, this model assumes that these resources may not be perfectly mobile across firms, and thus heterogeneity can be long lasting (Barney, 1991). Based on the implication of resource heterogeneity an opportunity for sustained competitive advantage, a resource must be valuable, rare, inimitable, and supported by tacit skills or socially complex organizational processes (Barney, 1991).

Hart (1995) criticized the omission of RBV on the constraint imposed by the biophysical environment and expanded the RBV theory to hinge firm's competitive advantage as rooted in its capabilities to undertake activities that are environmentally sustainable. In his natural resource-based view (NRBV), he provided a schema that links the imperative of capturing a competitive advantage with the goal of securing and enhancing social legitimacy. He viewed external stakeholders as playing a pivotal role in moving corporations toward sustainability. The logical extension of this argument is that viewing societal demands as part of the external environment facing a firm trying to develop unique resources leads to expectations about when such resources will be valuable and inimitable. To this end, Hart argued that there were three stages of proactive environmental strategy, each involving strategic capabilities: pollution prevention, product stewardship and sustainable development, which differ in terms of external driving forces, necessary resources and source of competitive advantage. Pollution prevention focuses on minimizing emissions, effluents, and waste. The main competitive advantage of pollution prevention, achievable with continuous improvement, is lowered costs. Product stewardship focuses on minimizing the life-cycle costs of products. The main competitive advantage of product stewardship, achievable through stakeholder integration, is to preempt competitors. Sustainable development focuses on minimizing

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the environmental burden of firm growth and development, achievable through shared long term vision. Hart envisions the main competitive advantage of sustainable development as a firm's future competitive position. In later revisit on NRBV by Hart and Dowell (2011), sustainable development has been refined into clean technology and base of the pyramid (BoP). Clean technology focuses on tomorrow's technologies that make leapfrog improvement. The main competitive advantage of clean technology is similar to previous sustainable development (future position), and achievable with through disruptive change. BoP focuses on meeting the needs of poorest of the world's citizens. The main competitive advantage of BoP is long term growth and achievable with embedded resources.

As reviewed by Hoffman and Georg (2012), the study of RBV pays particular attention to the development of competitively valuable organizational capabilities (Hart, 1995; Sharma and Vredenburg, 1998), absorptive capacity (Delmas et al., 2011; Lenox and King, 2004) and complementary assets (Christmann, 2000) as key levers for creating competitive advantage through environmental performance. The organizational capabilities such as stakeholder integration, capability for higher-order learning, continuous innovation, pollution prevention, product stewardship and sustainable development, strategic proactivity, continuous innovation have been identified to positively associate with the environmental proactivity and performances (Hart, 1995; Sharma et al., 2007; Sharma and Vredenburg, 1998). Whereas, previous studies indicated that firms need to possess complementary assets in order to create competitive advantages from the implementation of environmental practices. The complementary assets are directed to capabilities for process innovation and implementation (Christmann, 2000), export orientation, employee commitment and environmental R&D (Darnall et al., 2008).

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In sum, most studies underscored cost advantage and differentiation advantages as two main competitive advantages of environmental management. Cost advantages can be achieved by producing less waste and better-utilizing inputs, resulting in lower costs for raw materials, waste disposal, and pollution activities (Hart, 1995). Empirical evidence shows that environmentally proactive firms, compared to reactive firms, can significantly save production costs by preventing pollution (Christmann, 2000; Delmas et al., 2011). Yet the degree to which environmentally proactive firms are able to leverage the competitive advantage of cost reduction depends on the presence of complementary assets such as absorptive capacity, innovation capability, and commitment to pollution prevention (Christmann, 2000; Delmas et al., 2011). Cost savings in construction can be achieved with improving the efficiency of the construction process, resource conservation, minimize construction waste, and compliance with environmental regulation would reduce litigation costs (Qi et al., 2010).

Differentiation advantages typically arise from customer perceptions that the green product is more valuable than the conventional product. Thus, differentiation advantages usually depend on the compatibility between product characteristics and market needs, and on a company's ability to market the environmental features of its products and services (Galdeano-Gómez et al., 2008). Differentiation advantage involves producing of a range of well-differentiated products that meet the specific needs of customer segments (Shrivastava, 1995). According to Delmas et al. (2007), differentiation of green products is most likely to appear where their points of uniqueness are valued by customers. By establishing the firm as an early mover in new green product domains, firm can create competitive preemption which based on its environmental reputation and differentiated products (Hart, 1995). For instance, a construction firm might feature its greenness by establishing supplier networking with those who have

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LEED building experience to participate in a building project and charge addition premium on the owner for LEED certified building.

Other advantages of environmental proactivity include a heightened entry barrier for competitors (López-Gamero et al., 2008), emergence of valuable organizational capabilities (Sharma and Vredenburg, 1998), and development of new firm competencies which in turn mediates positive relationship between proactive environmental management and differentiation competitive advantage (Lopez-Gamero et al., 2009).

From RBV perspective, some scholars have investigated the relationship between changes in environmental strategies and changes in financial performance. According to Buysse and Verbeke (2003a), firms with an environmental leadership strategy do tend to have a superior financial performance, but firms with a reactive environmental strategy do not appear to be less profitable than firms with a pollution prevention strategy. Based on four clusters of environmental strategies spanning from reactive to proactive, (Lee and Rhee, 2007) found no evidence indicates that there were any relationships between environmental strategy, environmental performance and financial performance. Walls et al. (2011) sourced different data to construct environmental strategies, however, only two types of reactive environmental measures were negatively associated with financial performance, none of the proactive strategies affect firm performance. Albeit the results are mixed, based on RBV theory, superior firm performance could be achieved with growing competencies and competitive advantages that rooted in environmental strategies.

Hence, from exploratory perspective, this study would examine on the linkage between environmental strategies of construction firm and financial performances.

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2.2.4 Relationship Between Environmental Management and Financial Performance

Although abundant of research have been carried out, the debate over the linkage between environmental management and financial remains inconclusive. The results showed that environmental management can be either positively (González-Benito and González-Benito, 2005; Hart and Ahuja, 1996; King and Lenox, 2002), negatively (Cordeiro and Sarkis, 1997; Hamilton, 1995) or neutrally (Gilley et al., 2000; Watson et al., 2004), associated with firm performances. Nevertheless, the evidences from meta-analyses suggest more likely a positive relationship between environmental and financial performances, in which it also depends on analysis methods, variables used, time, and countries where the samples' information are considered (Albertini, 2013; Horváthová, 2010). Most of these studies underline environmental practices rather than environmental performance as the core that contributes to greater financial performance.

Historically, environmental protection is articulated with additional costs imposed by government, which would erode a firm's competitiveness and divert manager's responsibility to maximize firm profitability (Friedman, 1970). However, recently scholars have found pollution reduction could reinforce firm competitiveness through better access to market, differentiating products, selling pollution reduction technologies, better risk and stakeholder management, and reduction of costs in materials, capital, and labors (Ambec and Lanoie, 2008).

Wagner and colleagues (2001) assert the relationship between environmental and financial performances can be depicted in three primary ways. The traditional view assumes pollution abatement increases production costs and the relationship is a negative linear form. A revisionist view assumes a uniformly positive relationship between environmental and financial performances, on the grounds that environmental innovation

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offsets those costs emphasized from a more traditional view. A third possibility is an inverted U-shaped form, in which the positive effects of environmental performance would slowly diminish and no longer be profitable after reaching a pinnacle. Underlying this third form of relationship are standard microeconomic theory and the limits of regulatory realities.

Amidst these three forms of relationship, traditional view has been notably contested by new theories that well align firm's competitive advantages with environmental management. Porter and Van der Linde (1995b) argue that pollution is a form of economic waste which is generated from resources that have been used incompletely, inefficiently, or ineffectively. When firms adopt pollution control or end-of-pipe methods that are merely aimed at regulatory compliance, the additional activities would only incur extra costs (Hart, 1995; Porter and Van der Linde, 1995b). However, firms can offset these costs and become competitive by solving pollution problems if the affected processes and products are improved to enhance resource productivity. Besides, stringent environmental regulations do not necessary lead to additional compliance cost, but it can trigger innovation that may offset the costs and possibly enhance a firm business performance (Ambec et al., 2013).

There are also prominent theoretical paradigms extending from the RBV, which contends that competitive advantages are rooted in a firm's capability to facilitate environmentally sustainable economic activity (Christmann, 2000; Hart, 1995; Sharma et al., 2007). Cost and differentiation advantages are the two main competitive advantages that translate proactive environmental management practices into better financial outcomes (López-Gamero et al., 2010).

In another strand of study, González-Benito and González-Benito (2005) hold that environmental proactivity of a firm should take a multi-dimensional perspective and

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encompass a comprehensive set of environmental management practices when examining firm performance. Not every environmental practice has the same effects on business performance and the relationship must be disaggregated into more specific form of practices (González-Benito and González-Benito, 2005). According to finding of Wagner and Schaltegger (2004), the relationship between environmental and economic performance is possibly manifested in predominantly positive, a mainly neutral, or a predominantly negative relationship which depends on specific conditions of strategy choice where the practices implemented.

In construction sector, construction activities have been attributed to broad range of environmental impacts. Hence, construction firms encompass a broad spectrum of operational practices for environment protection, such as material saving and usage, water saving, energy saving, land saving, biodiversity protection, air pollution control, waste abatement, and noise control etc. (Christini et al., 2004; Qi et al., 2010; Sev, 2009). Improvement on process-related operational practices is a potential source of competitive advantage as it can lead to more efficient processes, reduce waste, lower costs of compliance and might open to new market opportunities (Qi et al., 2010). Yet, the net marginal benefits from environmental protection will be decreasing with increasing costs of pollution prevention activities (Wagner and Schaltegger, 2004).

On the other hand, product-related operational practices, specifically directed to product innovation focuses primarily on the adoption of new construction methods that are environmental friendly and adopting sustainable building design (Ahn et al., 2013; Gluch et al., 2009; Qi et al., 2010). Highly innovative products are conducive to financial performance since they offer opportunities for product advantage and differentiation. Nonetheless, non-innovative products do well because they are close-to-home: synergies are high, and marketing activities are proficiently executed. For those moderately

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innovative products, neither they could garner the advantages of product advantage and differentiation, nor beneficial from the close-to-home effects. Thus, the performances of moderate innovative products usually fall below the two ends (Kleinschmidt and Cooper, 1991). Therefore, a curvilinear relationship would expound the effect of innovation on financial performances.

For other practices, (Dwyer et al., 2009) reviewed a list of environmental management practices through previous studies which include environmental strategy, the integration of environmental issues into the strategic planning process, environmental practices, process-driven initiatives, product-driven initiatives, technologies, means of reducing pollution, state of the environmental management system, and ISO 14001 certification. Amidst the literature reviews, integration of environmental issue positively affects financial performance (Judge and Douglas, 1998); waste prevention leads to financial gain of return on assets (ROA) and Tobin's Q ratio (King and Lenox, 2002); EMS adopters do not outperform non-EMS adopters on financial performance (Watson et al., 2004), out of 48 environmental practices, recycling, proactive waste reduction, remanufacturing, environmental design, and market surveillance positively associate with sales growth but negatively associate with return on investment (ROI) (Montabon et al., 2007), and ISO 14001 certification has found to positive impact on Tobin's q ratio (Wahba, 2008). In a same vein, (Chen et al., 2015) examined 33 practices, and only environmental information has positively associates with sales growth, while supply chain management, environmental statuses for suppliers, and environmental risk analysis exhibit negative correlations on sales growth.

The empirical results shown above are inconclusive. Even with similar environmental investment, firms probably would not enjoy the same competitive advantages, as the effects of environmental protection on firm performance can vary

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across the sector considered (Lopez-Gamero et al., 2009), and the extent to which firms can benefit from product differentiation depends on the structure of the industry and characteristics of the product market in which a firm competes (Reinhardt, 1998). Furthermore, the most significant adversity of environmental management for construction firms are the difficulty to offset high operation and administration costs (Christini et al., 2004; Shen and Tam, 2002; Turk, 2009). Normally, intervention of government is required to correct for negative behavior which would burden construction firms with additional costs (Shen and Tam, 2002; Tan et al., 2011). Therefore, it is questionable on how far the construction firms would go beyond environmental regulation. A careful and throughout examination on environmental management practices of construction firms has to be carried out to identify which practices and to what extent of these practices would affect firm's financial performances.

Hence, from exploratory perspective, this study would examine the linkage between environmental management practices and financial performances.

2.3 Internationalization

Dunning and Lundan (2008) defines multinational enterprise (MNE) as "an enterprise that engages in foreign direct investment and owns or, in some way, controls value-added activities in more than one country". Although this definition is widely acceptable by most scholars, yet the measurement of value adding activities, performance, ownership structure or management composition that take place in the internationalization process are still undergoing intense debate.

Underlie the consensus that the primary benefit to international expansion is the exploitation of market imperfections (Rugman, 1979), literature on corporates' geographical diversification unfold its association with range of benefits such as enables

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a firm to realize economies of scale and scope (Caves, 1996), learning experience (Barkema and Vermeulen, 1998), the scope to extend the product cycle (Contractor et al., 2003), the ability to preempt or match competitors (Mitchell et al., 1995), the possibility of exercising global market power (Grant, 1987), incentives to develop innovations (Hitt et al., 1997), and cross-subsidization, price discrimination, and arbitrage potential (Palich et al., 2000), and exploit its use of intangible asset (Lu and Beamish, 2004).

From the perspective of organizational learning, Porter and Van der Linde (1995a) suggest MNEs have operations in countries with various levels of environmental regulations allows them to transfer the environmental capabilities they developed in response to high levels of environmental regulation in developed countries to developing countries with lower levels of environmental regulations. Operations in different regions provide opportunities for firms to obtain location-specific resources. Location-specific resources refer not only to cheap, quality inputs and low production costs and levels of current or potential demand, but also to the opportunity to learn from demanding customers and leading competitors (Porter, 1990). Developing regions provide abundant low-cost production factors, whereas developed regions offer demanding customers and leading competitors (Qian, 2000; Qian et al., 2008).

Globalization has rendered construction industry increased foreign opportunities in participation of domestic construction. The rational of internationalization of construction firms can be understood with the ownership, internalization and locational advantages that may be exploited by the firms, underscore in Dunning's eclectic paradigm or well-known as OLI model (Dunning, 2000). Based on OLI model, Pheng and Hongbin (2004) extend another domain of specialty advantage, the market involvement of a firm among different specialized fields in the construction industry, to account for the importance of technical expertise that contribute to the international performance of

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contractors. Ho et al. (2010) developed a dynamic OLI model centered on the sequential processes of learning and development of ownership advantages possessed by contractors using different learning, location and entry strategies for the global competition.

2.3.1 Dimensions of Internationalization

Study of internationalization can be considered either at the level of country, region, or firm. Depend on scope of study, a variety of indicators or indices can be used to measure degree of internationalization (DOI), or interchangeable coins as degree of multinationality, degree of globalization or international diversification. Asmussen (2009) distinguished degree of globalization should refer to the extent to which a firm has achieved an equivalent economic presence across the globe whereas the term DOI refers to the extent to which a firm has achieved a presence beyond the borders of the firm's domestic home country. Therefore, globalization represents a specific form of internationalization.

According to Dunning and Lundan (2008), there are seven types of criteria used to assess the degree or internationalization, such as:

i. size of foreign affiliates or associate companies it owns or exercises control over;
ii. the number of countries in which it owns or in some way controls value-added activities such as mines, plantations, factories, sales outlets, banks, offices and hotels;
iii. the proportion of its global assets, revenue, income or employment accounted for by its foreign affiliates;
iv. the degree to which its management or ownership is internationalized

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v. the extent to which its higher-value activities are internationalized. This measure is intended to capture the quality or depth of foreign production; and the contribution of foreign affiliates to accessing or directly creating new knowledge;

vi. the extent and pattern of the systemic advantages arising from firm's governance of, and influence over, a network of economic activities located in different countries; and

vii. the extent to which responsibility for the creation and usage of institutions and assets, as well as decision making concerning financial and marketing issues, are devolved to foreign affiliates.

These indicators are further categorized in three dimensions: intensity, geographical extensity, and geographical concentration of internationalization (Ietto-Gillies and London, 2009). Intensity dimension measure the degree to which activities take place away from home country; geographical extensity captures the overall geographic scope of operations in terms of the number of countries the activities deployed; whereas geographical concentration captures the spatial concentration of activities in certain countries or specific regions. Concertedly, Rugman (2003) evidenced world's business is mainly conducted regionally rather than globally, hence the measurement of internationalization are contained within their home region or are spread across two or three regions.

On the other hand, Sullivan (1994) suggests that the DOI of a firm has three attributes: performance attribute pertains to firm's operation abroad; structural attribute measure the resources deployed oversea, and attitudinal attribute focuses on top management's international orientation. Table 2.2 summarizes prevalent internationalization indicators used in the internationalization business studies (Dörrenbächer, 2000).

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Although numerous studies are based on individual indicators, adopting merely single dimension of internationalization measurement would lead to narrow scope of internationalization, contradictory results concerning the DOI, and single indicators does not allow systematic control of measurement errors, contingent influences and transfer pricing manipulations (Dörrenbächer, 2000). Since no single indicator of international activity is likely to capture the relevant dimension for every firm, a few composite indices have been introduced to cover a multi-dimensional of DOI, for instance:

i. Transnationality Index (TNI) used by UNCTAD which published in World Investment Report, as a mean ratio of foreign assets to total assets, foreign sales to total sales, and foreign employment to total employment (UNCTAD, 1995)
ii. Rugman (2003) classifies multinational enterprises based on each firm's distribution of sales across the three dominant triad regions: North American Triad, European Triad, and Asia-Pacific Triad.
iii. Stemmed on performance, structural and attitudinal attributes of DOI, Sullivan (1994) measures DOI with the linear combination of foreign sales as a percentage of total sales, foreign assets as a percentage of total assets, overseas subsidiaries as a percentage of total subsidiaries, psychic dispersion of international operations, and top managers' international experience which aim to reduce sample, systematic, and random bias.
iv. Dunning (1996) uses three uni-variable indices based on assets, employment and R&D to arrive at a final transnationality index

Nonetheless, either uni-dimensional or multi-dimensional indicator of DOI is subjected to data availability. In many cases, the sources of such data are very fragmented and incomplete, has a high sectoral and national variance due to different accounting rules and publishing habits (Dörrenbächer, 2000). Eventually, the choice of indicator must

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account for the theories underpinning the motivations for internationalization and of the relationship of such motivations to the effects of internationalization, and depends on : (a) what effects of internationalization we are interested in; (b) what theoretical explanations regarding the motivations behind international activities and the relationships between those explanations and effects; and (c) how to link those theoretical aspects to the indices (Ietto-Gillies and London, 2009).

2.3.2 Internationalization and Firm Performance

Theoretically, being internationally diversified is supposed to increase profitability because (1) it makes it possible to exploit scale economies; (2) it provides better and more flexible access to resources; (3) it allows for more learning; (4) lower risk if firms have activities located in a portfolio of countries which were not economically integrated (Hennart, 2007).

In a similar vein, Oesterle and Richta (2013) summarized the past empirical studies of the internationalization / performance relationship where the main reasons for assuming a positive relationship are:

i. resource-based arguments under which subsume aspects connected to the deployment of firm's resources abroad;
ii. flexibility and arbitrage arguments which highlight the ability of firms to leverage and arbitrage factors of production
iii. across national borders;
iv. industrial economical effects;
v. arguments derived from the portfolio theory;
vi. arguments based on organisational learning.

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Table 2.2 Internationalization indicators (adopted from Dörrenbächer, 2000)

Structural indicators	Performance indicators	Attitudinal indicators	Regional diversification
1. Relating to foreign activities • Number of countries a company is active in • Number or proportion of foreign affiliates • Number or proportion of cases of non-capital involvement abroad • Amount or proportion of foreign assets • Amount or proportion of value added abroad • Amount or proportion of sourcing abroad • Number or proportion of foreign employees 2. Relating to governance structures • Number of stock markets on which a company is listed • Amount or proportion of shares owned by foreigners • Number or proportion of non-nationals in the board of directors	1. Foreign sales • Demand: Amount of foreign sales by customer location • Supply: Amount of sales of foreign affiliates 2. Operating income abroad • Sum of operating income of foreign affiliates	1. 'Soft' indicators • Ethno-, poly-, regio- or geocentric management style according to: organizational complexity, authority, decision making, communication flows, recruiting, staffing, control 2. 'Hard' indicators • International experience of top managers	1. Regional Concentration • Homogeneous vs. heterogeneous distribution of foreign activities • Extent to which the regional distribution of a certain indicator at a given company complies with the total distribution of this indicator in the world 2. Network Extension • Network spread index 3. Geographical and Cultural Distance • Countries are weighted according to their geographic and cultural distance to the home country • Psychic dispersion index

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In contrary, the main arguments for negative effect are:

i. increasing costs of coordination and control (or transaction or management);

ii. the "liability of foreignness" and;

iii. risks connected to foreign activities.

Nevertheless, transaction cost of internalization (TCI) assumes that agents compare the costs of organizing each interdependency within the firm with those of organizing it on the market. Hennart (2007) contend that a firm's overall degree of international diversification should be optimal, therefore internationalization should have no direct relationship on firm profitability. Besides, TCI claims that internationally diversified firms are subjected to rising governance costs with cultural, institutional, and geographical distance, because such distance increases the amount of information managers must collect to effectively direct the actions of employees while geographical distance increases the cost of observing their behavior. Thus, TCI arguments underline that the benefits of risk reduction, economies of scale, flexible access to resources; as well as learning effects could be counter by the transaction incurred in the multinational deployment.

Empirically, there are extensive literatures that have studied the relationship between internationalization and firm performance. Among them, empirical findings shown there are either a significant positive linear effect; or significant negative linear effect; or U-shaped curves effect; or inverted U-shaped curves; or cubic curves (sigmoid) relationship. The list of these studies can be found in meta-analysis done by (Ruigrok and Wagner, 2004).

In order to reconcile the contradiction of relationship found in the previous studies as shown above, Contractor et al. (2003) proposed a three-stage theory which assert previous inconsistency on the shape of relationship is due to the samples of studies merely

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capturing part of an overall sigmoid (S-shaped) function. Figure 2.3 depicts the three-stage relationship of internationalization on firm performance. In first stage, a firm in its early expansion has to endure the addition burdens resulted from liability of foreignness, initial learning costs, and insufficient economies of scale to cover administrative overhead burden. In second stage, further expansion allows market-exploiting and resource-seeking firms to engage in price discrimination, strategic cross-subsidization, and arbitrage, thus internationalization has positive effect on performance. While in the last stage, as a firm's network of foreign subsidiaries becomes extensively operate in more countries, lucrative markets become limited while governance and coordination costs escalate to the point where the costs can surpass the benefits of internationalization, and hence firm performance declines.

Lu and Beamish (2004) confirm this S-curve relationship in his study by using geographic diversification as measure of multinationality. Yet, Thomas and Eden (2004) study indicates that the three stages are in opposing direction as suggest by the theory, where the results showed slope of first stage is positive, second stage is negative, and third stage is positive again. For studies that related to service industry, Contractor et al. (2003) discover only knowledge-based service sectors exhibit S-curve relationship as hypothesized in the three stage model but not capital intensive service sectors which have shown a inverted S-curve function (capital intensive services sector includes construction sector). The deviation is attributed to the lower burden of tangible asset invested in knowledge-based sectors that enable them to reap the advantages of internationalization faster than capital intensive sectors and lack of stage three sub-sample in capital intensive service sectors also caused inability to reveal the proper effect in the last stage. On the other hand, Capar and Kotabe (2003) assert a U-shaped curvilinear relationship between multinationality and performance in service firms. Service industry suffer from

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diseconomies of scale in the initial expansion abroad due to considerably higher investments than manufacturing firms but gains cost savings by sharing cost-producing activities and learning across geographic markets in long run.

Despite there is no consensus on the form of internationalization-performance relationship, one of the major limitation that would alter the form is due to moderating factors that have been considered or omitted in the studies (Bausch and Krist, 2007; Oesterle and Richta, 2013). As what have revealed in the meta-analysis, the relationship is moderated by R&D intensity, product diversification, country of origin, firm age and size (Bausch and Krist, 2007).

According to Ofori (1990), although construction industry produces tangible items, its features characterise the service sector of the economy, which assembles what other sectors of the economy produce. Furthermore, since construction products are not standardized and the design is constrained to particular clients, it is unlikely to have the advantages of economies of scale. As reviewed in the early sections, construction industry as a capital intensive service sector has a few peculiarities compared with manufacturing industry. Since there are still limited studies on the relationship of internationalization-performance for construction industry, this linkage deems interesting area of exploration, yet this is not the main focal in this study. The question that lay down in this study is how internationalization moderate the relationship between environmental practices and financial performances.

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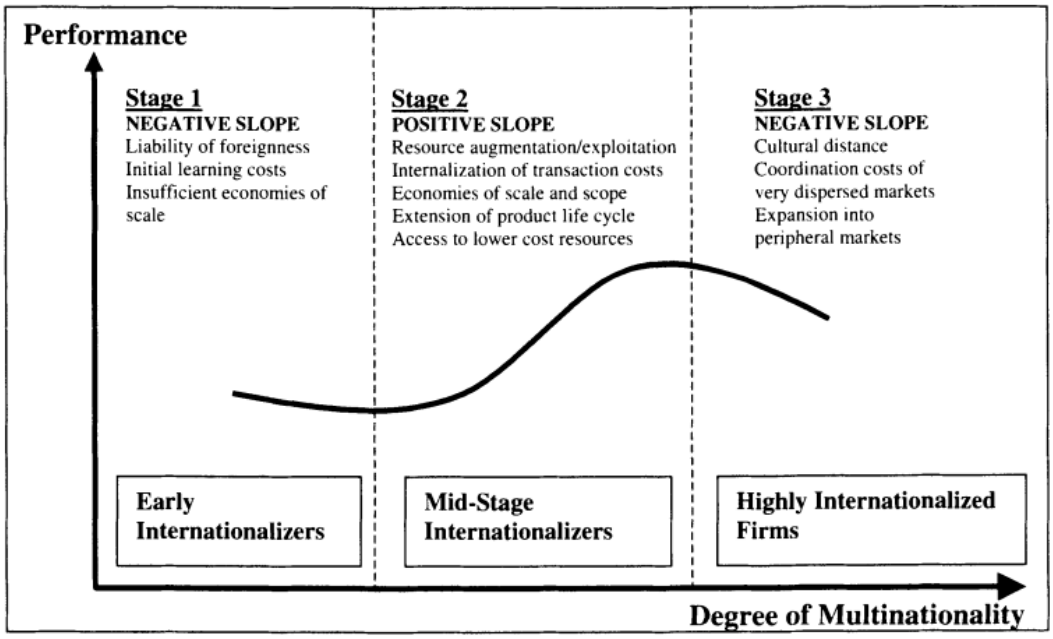

Figure 2.3 A three-stage sigmoid (S-shaped) hypothesis (Adopted from Contractor et al. 2003)

2.3.3 Relationship Between Environmental Management and Internationalization

The environmental impacts of internationalization have been debated for decades. Recent studies found that MNE, contrary to the expectation that they would turn third world countries into "pollution havens" because of a malignant "race to the bottom," they actually foster better environmental performance (Christmann and Taylor, 2001; Kennelly and Lewis, 2003).

For construction firms, one of the perceived main impetuses to develop an environmental management system is the synergy effect when entering the international construction market (Zeng et al., 2003). A study on Korean contractors concluded that global contractors are more proactive in environmental strategies than their local counterparts (Park and Ahn, 2012). Zuo et al. (2012) also indicated a high commitment of environmental reporting among international contractors. However, recent environmental strategy studies in the construction industry (Fergusson and Langford,

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2006; Park and Ahn, 2012; Tan et al., 2011), have not addressed the impacts of environmental proactivity on internationalization.

Furthermore, the growth of sustainability services in the construction sector has been characterized by a distinct global unevenness; relative economic prosperity in the developed world has afforded market and policy expansion whilst developing countries have been unable to prioritize sustainability in the same way (Preece et al., 2011). The distinctive impetus of internationalization would have drawing the multinational construction firms towards different environmental strategic setting.

A firm's approach to environmental strategy may lie along a continuum from "reactive" to "proactive." The reactive strategy is related with traditional methods, also known as end-of-pipe solutions that attempt to solve pollution that already exists (Triebswetter and Wackerbauer, 2008). Such an approach does not confer much competitive advantage to the firm since it usually adopts off-the-shelf technologies that can be obtained in the open market and be easily imitated by competitors (Berrone and Gomez-Mejia, 2009). In contrary, the proactive strategy adopts modern approaches designed to prevent the occurrence of problems by dealing with their sources (Schmidheiny, 1992), anticipating future regulations and social trends, and designing or altering operations, processes, and products to prevent negative environmental impacts (Hart, 1995; Sharma and Vredenburg, 1998). MNEs that lack of environmental capabilities might hinder their global business expansion due to (i) entry barriers and liability of foreignness, (ii) legitimacy problems, and (iii) lack of competitive advantages.

Environmental regulations increase the capital required for firm entry (Scherer and Ross, 1990); and exacerbate complexities for firms to meet environmental requirements at federal, state, and local levels (Dean and Brown, 1995). Due to foreignness, foreign firms are more often investigated, audited, and prosecuted than their

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domestic counterparts (Vernon, 1998). Firms facing greater uncertainty in business environment are more likely to deploy and developed proactive environmental strategy (Sharma et al., 2007). Firms following the reactive strategy intend only to meet minimum customer and stakeholder expectations. Without committing extra resources; they lack required capabilities to resolve the state uncertainty and complexity of the general business environment (Aragón-Correa and Sharma, 2003). When facing heightened risks of foreignness in new market abroad, firms requires anticipating and responding, rather than reacting to uncertainty, therefore are more likely to deploy its capabilities to develop proactive environmental strategy.

MNE required coupling with legitimacy to operate abroad. However, due to their size and visibility, MNE are more vulnerable to attacks from interest groups (Kostova and Zaheer, 1999). The emergence of international non-government organizations (NGO) and voluntary environmental initiatives has subjected MNEs and their global supply chains to higher scrutiny. MNEs are also particularly salient to the legitimacy spillover; foreign affiliates would encounter difficulty maintaining legitimacy if MNE as a whole or any of its other subunits experience legitimacy problems (Kostova and Zaheer, 1999). Reactive firms that lack the capability to integrate stakeholder interest can end up damaging their corporate reputation and lose customer approval due to poor compliance (Christmann et al., 2002). Firms adopting proactive environmental strategies tend to break through stakeholder management beyond regulatory sphere and managerial vision. Buysse and Verbeke (2003b) found that firms that posit as environmental leaders actively manage the changing norms and expectations of not only regulators, but also other stakeholders. Hart and Dowell (2011) contend that the development of clean technology strategies requires a focus on innovation and future positioning as the metric for success.

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These capabilities which usually complement with proactive strategy would improve their reputation and strengthen their legitimacy to operate abroad.

In order to facilitate multinational operations, firms also need organizational capabilities that depend upon tacit skill development. For instance, Bansal and Hunter (2003) exemplified a study of early adoption of ISO 14001 is necessitate to facilitate internal coordination on environmental issues and attain environmental legitimacy of the various jurisdictions when firms have greater international scope. Furthermore, environmental proactive firms are associated with emergence of firm-specific capabilities (learning, stakeholder integration, and innovation) and competitive advantages (Lopez-Gamero et al., 2009; Sharma and Vredenburg, 1998). Firms that develop better environmental capabilities such as pollution prevention and product stewardship would further enhance their competitive edge in terms of reducing costs, differentiation, gaining a strong reputation among customers, and increasing their competitiveness (Hart, 1995; Lopez-Gamero et al., 2009). These enhancements in environmental capabilities would strengthen their competitiveness in international market.

When an MNE pursuing reactive strategy faces extensive environmental pressure, it might opt to drop customers that are more demanding for environmental performance (Christmann et al., 2002). Unlike reactive firms, proactive firms with greater capabilities in environmental management would have more capable to fulfill the customer's needs in international market who seek greater environmental performances. The greater range of environmental products or services provided by environmental proactive firm would contribute to a firm's differentiation advantages in international market.

In a reciprocal perspective, internationalization can promote a firm environmental management capabilities. International diversification of firms offer access to multiple markets that would enhance learning of the unique resource endowments and location-

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specific advantages (Lu and Beamish, 2004), and improve firm's environmental self-regulation when they export goods to developed countries (Christmann and Taylor, 2001).

Stemmed on different internationalization contexts, environmental proactive firms should outperform reactive firms in internationalization when facing foreignness and legitimacy problem. Besides, with greater capabilities possessed by proactive firms, they are more competitive in international market. Thus, multinational construction firms with higher level of environmental strategy are perceived to associate with greater DOI.

Based on above arguments, this study attempts to investigate the questions pertaining to how multinational construction firms would likely to organize their global business deployment based on their environmental strategy. Specifically, the questions addressed in the study are: (i) Does environmental strategy have any influence on the internationalization of a multinational construction firm? (ii) If environmental strategy has impacts on internationalization, in which dimension that internationalization is affected by environmental strategy? (iii) Does the environmental strategy adopted by a firm would influence its business distribution portfolio across developed and developing regions?

2.4 Moderating Effects of Geographical Diversification on Environmental-Financial Performances

Multinational construction firms usually exhibit higher proactivity and compliance in environmental management practices than domestic firms (Park and Ahn, 2012). The proactiveness of multinational construction firms are articulated with greater availability of slack resources which give the firm leeway in managing environmental issues as opportunities rather than a threat (Aguilera-Caracuel et al., 2011). While, some environmental management practice would have affected firm financial performance, it

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is arguably these relationships are moderated by multinationality of a firm. However, the study in this area is limited.

This section reviews moderating effect of firm's multinationality in the relationship of environmental management practices and financial performance. Three environmental management practices: 1. surveillance of risks and opportunities; 2. pollution abatement; and 3. environmental innovation are arguably articulated to the moderating effects. These practices are highlighted since they are frequently shown to associate with firm performances (Montabon et al., 2007), and they are expected to augment the firm performance with higher multinationality. In order to understand and establish the conceptual relationship, literature reviews are drawn from extant theory from several disciplines such as environmental management, international management, and strategic management and also relied on specific theoretical domains such as transactions costs, the resource-based view, and organizational learning.

2.4.1 Environmental Scanning

There are ample evidence that proactive environmental strategies are likely to be accompanied by improved financial performance, however it is crucial to understand why only some firms in an industry implement such strategies (Sharma et al., 2007) and what are the circumstances which environmental practices could contribute to competitiveness (Christmann, 2000). One of the attempts to answer the problem, scholars have devoted to perform an integrated analysis of the influence of exogenous variables on organizational capabilities (Sharma et al., 2007), and how such variables have a moderating effect on organizational capacity and firm performances. Previous studies have identified moderating factors such as capabilities for process innovation and implementation

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(Christmann, 2000); and industry growth (Russo and Fouts, 1997) would strengthen the firm performances.

When MNE operate or expand their business abroad, there are other additional costs These additional costs, termed as liability of foreignness, is defined as the additional costs incurred in interacting with all the elements of the international business environment once the firm ventures abroad, where the MNE usually subjected to unfamiliarity and discrimination in the host country's environment (Sethi and Guisinger, 2002). These also include costs incurred in acquiring and developing the skills needed to read and deal with the intense complexity and volatility of the international environment.

As business environments serve as a source of uncertainty for an organization's decision makers, information acquisition is one strategy that may be employed for reducing uncertainty. Particularly, requirements for information is imminent when business environments become more complex or heterogeneous and ensued with increasing uncertainty (Culnan, 1983).

Environmental strategies involve the search for and adoption of innovative technologies that add "complexity to production or delivery processes" and increase the level of risk for a company and its managers (Russo and Fouts, 1997). Depending on the managerial interpretation, the managers might view environmental issues as a threat or opportunities and thus influence the choice of environmental strategy (Sharma, 2000).

In order to successfully integrate environmental issues into strategic planning of a multinational firm, capability of surveillance of risk and opportunity is required. Muralidharan (2003) reported that firms improve their scanning frequency to exploit opportunities arising out of environmental shifts in their markets, or in adjusting their strategies in response to invalid planning assumptions. It is also coined as 'environmental scanning' in literature. Environmental scanning is the process by which an organization

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collects information that it then utilizes in its strategic management process (Subramanian et al., 1993), typical focal points of environmental scanning include competition, technology, regulatory activity and the economy which would impact on a firm's short and long term financial performances.

Many organizations have established their own central environmental scanning unit for gathering, analyzing, and distributing competitive information. Thus, for those sources it monitors internally, coordination is required to assign the responsibility between a central unit or the line units. Furthermore, users in line units can monitor some sources personally and delegate others to subordinates (Choudhury and Sampler, 1997).

Evidently, strategic environmental scanning helps in seizing the opportunities and avoiding threats and it leads to organization profitability (Babatunde and Adebisi, 2012; Subramanian et al., 1993). Yet, barriers to strategic change such as inadequate production capacities and managerial preferences for the status quo would have limited the efficiency of environmental scanning in generating profit (Muralidharan, 2003).

For a MNC, heterogeneous market conditions often are considered a source of incremental information processing and coordination cost (Goerzen and Beamish, 2003; Hitt et al., 1997). For instances, coordination difficulties, information asymmetry, and incentive misalignment between headquarters and divisional managers in multidivisional firms can be also manifest in multinational enterprises between headquarters and subsidiary managers (Denis et al., 2002). During the scanning process, intra-firms require to gather, analyze, and distribute information to form strategic response to environmental issues, therefore the number of internal transactions increases along with the number of foreign subsidiaries established in a firm, governance costs can rise rapidly to a point at which the governance costs exceed any internalization benefits (Lu and Beamish, 2004). Besides, due to the complexity in achieving both global coordination and local market

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responsiveness simultaneously, high levels of international diversification would more likely to impair firm performance (Galbraith and Kazanjian, 1986). Therefore, greater levels of internationalization contribute positively to firm performance only if there is sufficient absorptive capacity to cope with increasing complexity, else over-diversification might eventually exhaust managerial capacity (Bausch and Krist, 2007).

In a nutshell, multinational construction firms that conduct frequent environmental scanning are more capable to evaluate the potential risks and opportunities in an environmental sustainable market and thus more efficiently in forming strategy to mitigate the risks and seize the market opportunities. However, the greater a firm expand geographically, the higher the costs incurred for a firm to utilize the information gathered and coordinate a strategic change.

Hypothesis 1a: Regional diversification negatively moderates the relationship between environmental scanning and short term financial performances.

Hypothesis 1b: Regional diversification negatively moderates the relationship between environmental scanning and long term financial performances.

2.4.2 Process-Related Pollution Abatement

Process related practices shed light on implementing manufacturing and operational methods and processes that would minimized the negative impacts on environment (González-Benito and González-Benito, 2005). Similarly, Montabon et al. (2007) asserted that operational level environmental management practices are internally focused and pertain to shop floor operations.

Construction activities have been attributed to broad range of environmental impacts. Hence, construction firms encompass a broad spectrum of operational practices

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for environment protection, such as material saving and usage, water saving, energy saving, land saving, biodiversity protection, air pollution control, waste abatement, and noise control etc. (Christini et al., 2004; Qi et al., 2010; Sev, 2009).

As shown in Figure 2.4, two specifications of relationship have adopted to understand the effect of corporate environmental protection on the economic success (Schaltegger and Synnestvedt, 2002; Wagner and Schaltegger, 2003). From the 'traditionalist' view, the purpose of environmental regulation is to correct for negative externalities and that consequently burdening companies with additional costs. On the other hand, 'revisionist' view perceived improved environmental performance is a potential source of competitive advantage as it can lead to more efficient processes, improvements in productivity, lower costs of compliance and new market opportunities. Yet, the net marginal benefits from environmental protection will be decreasing with increasing costs of pollution prevention activities.

Furthermore, underlie the premise of society growing demanding on cleaner environment, the positive relationship is attributed to firms that respond beyond compliance and rely on people intensive and tacit skill development to develop pollution prevention capability. This capability is likely to facilitate lower costs advantage (Hart, 1995). A construction firm that encompass greater environmental scopes in their operational practices entailed with higher tacit skills and these skills are embedded within the organization and employees, which is hard to imitate by other firms, hence able to enhance its sustained competitive advantages. The pollution abatement could improve firm financial performances through reduces costs from unnecessary waste and the penalty as well as litigation costs of conviction in breaching the environmental regulation. However, the diminishing return will impair the profit obtained from environmental performances. At some point, further improvement of environmental performance from

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pollution prevention activities is too costly and unprofitable. Thus, from exploratory perspective, process-related pollution abatement is negatively or curvilinear (inverted-U shaped) related to firm's financial performance.

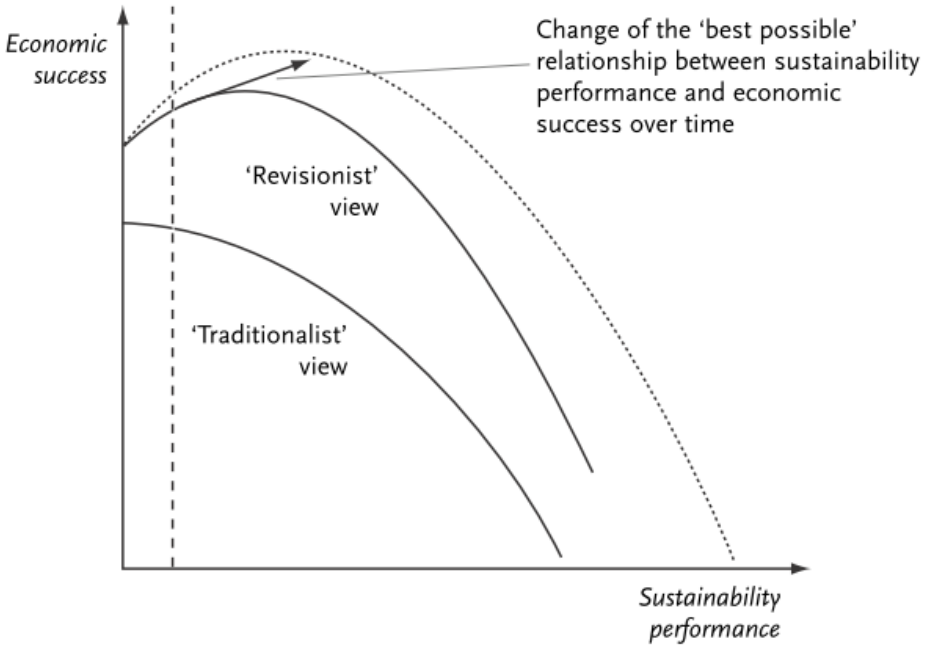

Figure 2.4 Illustration of relationship between sustainability and economic performance (adopted from Wagner and Schaltegger, 2003)

Stem on organizational learning perspective, multinationality confer two competitive advantages that would translates environmental management into greater financial performances. First, the firm's involvement in multiple markets contributes to giving it access to relationships that enhance learning (Aguilera-Caracuel et al., 2010; Hsu and Pereira, 2008). International diversification contributes to creating experiences that allow firms to explore and search for new knowledge through interacting with new cultures, demographics, regulations, and technologies. Thus, organizational learning facilitates the combination of new and different social, technological, and market skills with existing ones and creates superior performance.

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Second, international diversification can contribute to using the selective advantages of multiple countries and integrate them within the organizational strategy, one of the capabilities that can be generated through the internationalization process is related to the generation of valuable and innovative environmental managerial practices (Christmann and Taylor, 2001). MNEs have operations in countries with various levels of environmental regulations. This allows them to transfer the environmental capabilities they developed in response to high levels of environmental regulation in developed countries to developing countries with lower levels of environmental regulations.

Nonetheless, knowledge diffusion between organizations is more plausible when their geographical proximity is closer (Aguilera-Caracuel et al., 2011; Galdeano-Gómez et al., 2008). Differences in local conditions, and the difficulty of managing distant conditional and tacit skills prevent the transfer of successful environmental practices, as a result, foreign-owned establishments generally generate more waste than domestic firms (King and Shaver, 2001). A low institutional distance between a firm's host and home countries would facilitate a firm to adjust its legitimacy requirements of a country that is institutionally similar to its home country (Kostova and Zaheer, 1999). Tallman et al. (2004) argue that companies in geographical clusters share firm specific and cluster specific knowledge that helps them to develop capabilities which lead to superior performance compared to the firms not placed in the geographical area. Therefore, the learning effects would be hampered for firms that operate across multiple and diversified regions.

Whether the benefits of multinationality of a firm could outweigh its adversity on the environmental-financial performance is worthy to highlight in the study. Drawing from Aguilera-Caracuel et al. (2010) study which indicates small and medium enterprises could take advantage of different environmental competitive advantages from regional

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diversification, hence presumably the financial advantages of multinationality would have outweighed the learning barriers.

Hypothesis 2: Regional diversification positively moderates the relationship between process-related pollution abatement practices and short term financial performances.

2.4.3 Environmental Innovation

Environmental innovations in construction have focused primarily on the adoption of new environmental practices and sustainable building (Ahn et al., 2013; Gluch et al., 2009; Qi et al., 2010). The cluster analysis of construction firms in Korea revealed firms resorted to researching and investing in environmental technologies to respond to climate changes and pollutant reduction (Park and Ahn, 2012).

Environmental product innovation is a key to leverage the financial performance through redesign and develop production process, and integrating life-cycle analysis in the product development process. Porter and Van der Linde (1995a) conceived environmental innovations would lower production costs by enhanced resource productivity, and gain early-mover advantage in product development over competitor. Environmental innovation can be articulated with either pollution prevention technologies or product stewardship which highlighted by Hart (1995), the former focuses on reduction of environmental impacts and improvement in production and operation processes, the latter take the design of products and services into account and would entail with advantages of green reputation and future differentiation gains.

Empirically, Christmann (2000) found that firms' capability in innovation of proprietary pollution prevention technologies contributes to cost advantage. Besides, continuous innovation is one of the important capabilities that reported to associate with

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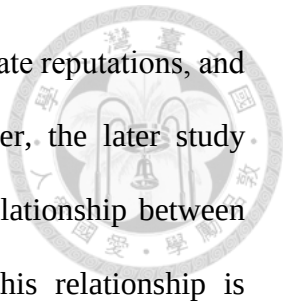

several competitive benefits such as cost reductions, improved corporate reputations, and better employee morale (Sharma and Vredenburg, 1998). However, the later study conducted by Amores-Salvadó et al. (2014) has shown no direct relationship between environmental innovation and firm financial performances, but this relationship is positively moderated by green corporate image. The results indicate that firms' environmental product innovation efforts only pay when they are adequately promoted. On the other hand, Christmann (2000) also highlight the successful adoption of the innovating proprietary pollution prevention technologies requires special capabilities to innovate and implement modifications in production processes, and this capability would positively moderate the financial performance of environmental innovation.

Alike environmental innovation literatures, the studies on relationship between innovation and financial performance is always moderated or mediated by other complementary capabilities possessed by a firm. Depending on the variables used in the studies, the relationship between innovation and financial performances might be varied. Empirical evidences suggest the innovation-performance relationship might be positive, negative, as well as they are not significantly related (McNally et al., 2010). The logic for negative relationship underscores innovative products are less familiar to the firms and consumers, and entailed higher risks of product failure in the market. Proponent of positive relationship suggested innovative products due to their uniqueness and newness are more likely to achieve advantages of product differentiation and proprietary position than the follower(Kleinschmidt and Cooper, 1991). The second argument is echoing with Hart's (1995) proposition that through 'design for environment', a firm is likely to achieve competitive pre-emption advantage.

Further, Kleinschmidt and Cooper (1991) proposed a curvilinear U-shaped relationship exist between innovativeness and financial performance. On one hand, highly

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innovative products are conducive to financial performance since they offer opportunities for product advantage and differentiation; on the other hand, non-innovative products do well because they are close-to-home: synergies are high, and marketing activities are proficiently executed. For those moderately innovative products, neither they could garner the advantages of product advantage and differentiation, nor beneficial from the close-to-home effects. Thus, the performances of moderate innovative products usually fall below the two ends. The curvilinear relationship combines the two arguments of positive and negative relationship and able to provide a holistic picture of the effect of innovation on financial performances. The curvilinear relationship should also hold for environmental innovation initiative of services, technologies, products offered in construction industry, presumably that the market underscores the importance of environmental issues.

When internationalization interplays between the innovation-performance relationship, the context become sophisticated. According to Kafouros et al. (2008), internationalization of a firm can influence the return of innovation through increase firm's innovative capacity, allow a firm to better exploit its technological developments and to protect and appropriate the fruits of innovation. Internationally diversified firms can improve their innovative capacity by being better able to utilize the wider range of resources available globally (Kotabe, 1990), promote innovation by using the specific advantages of different countries (Hitt et al., 1997), and by making contacts and establishing alliances with local suppliers, universities, research centers and competitors (Santos et al., 2004). Evidence suggests international diversification contributed to higher innovation and thus able to provide larger markets from which to obtain returns from innovation (Hitt et al., 1997). International diversification provides greater opportunities to achieve optimal economic scale and to amortize investments in critical functions such

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as R&D and brand image over a broader base (Hitt et al., 1997). Besides, innovative firms that operate in many regions can lower production costs and increase their performance by transferring and applying their process innovations to many production plants (Kotabe et al., 2002). This resource sharing can facilitate exploitation of common sets of core competences to produce synergy (Grant et al., 1988).

The negative impacts of multinationality is pertained to the peculiarities of construction industry (Ahn et al., 2013), increasing transaction costs, coordination, information-processing and control problems that associates with greater international diversification (Hitt et al., 1997). Constructed products are one-of-a-kind products, with each project being unique and specific, and with individual challenges and problems (Vrijhoef and Koskela, 2005), thus limiting the possibilities for marketing the same green innovation in other countries. Construction project involves collaboration among players such as clients, regulators, architects, the principal contractor, sub-contractors, component suppliers, and different disciplines in engineering, each subject to varying interests and practice codes. Nam and Tatum (1988) contend that constructed products carry a high degree of social responsibility towards public safety and health, which reinforces a greater sense of conservatism in design and specialization. Due to varying interests and practice codes across multiple parties in construction, these players are more likely to maintain their current practices despite potential innovations related to sustainability that they could otherwise adopt (Ahn et al., 2013). Extra costs would arise from the additional communication and coordination needed between different specialized disciplines, and the uncertainties involved when new sustainable construction concepts are introduced into the project (Demaid and Quintas, 2006). The coordination and communication cost would further augment when a new green innovation is introduced to other operation abroad, problems of coordination difficulties, information

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asymmetry, and incentive misalignment would have surfaced between headquarters and divisional managers in multidivisional firms. As pointed out by Granstrand et al. (1993), information exchange between individuals, teams and divisions is required to promote learning and avoid duplication. The efficiency of communication between teams decreases exponentially with geographic distance, raising the risk of misunderstandings (Fisch, 2003), and thereby discourage the learning effect and adoption of green environmental innovation products, eventually impair the financial return from the innovation.

The reward of newly introduced environmental innovation either through the improvement of product or through introduce newly green services must outweigh the above costs and the vast investment in R&D, in order to generate profits from the innovation. Overall, stemmed on peculiarity of construction industry, it may perceive that multinationality would negatively moderates the innovation–performance relationship.

Hypothesis 3: Regional diversification negatively moderates the relationship between environmental innovation and short term financial performances.

2.5 Summary of Literature Review

The literature reviews have drawn from multiple disciplines and theoretical frameworks such as sustainable construction, environmental management, international management, strategic management, resource-based view, transaction costs and organizational learning perspectives.

Based on the literature reviews, four scopes of study area are highlighted.

i. First, identification of the prevalent environmental practices or strategy implemented in construction firms.

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ii. Second, explore the possible relationship between environmental management practices and financial performance and the limitation in previous studies. Generally, the relationship is constructed based on RBV.

iii. Third, the reviews highlight the reciprocal linkage between environmental strategy and DOI.

iv. Forth, stemmed on theoretical frameworks of RBV, transaction costs and organizational learning perspectives, the interaction effects of multinationality on three environmental management practices are highlighted. The three environmental management practices are comprised of environmental surveillance, process-related pollution abatement, and environmental innovation. The relationships are posited from the extensive theoretical arguments.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

As highlighted in Chapter 2, the environment management studies comprised of one-dimensional and multi-dimensional studies (González-Benito and González-Benito, 2005). This study attempts to adopt both one-dimensional and multi-dimensional classification of environmental management in the analysis of environmental-firm performance relationships. Drawing the samples from a list of multinational construction firms, the study focuses on the following six major research questions:

(1) what types of environmental management practices are disclosed in the environmental reporting of multinational construction Firms?

(2) Does environmental strategy have any influence on the internationalization of a multinational construction firm?

(3) If environmental strategy has impacts on internationalization, in which dimension that internationalization is affected by environmental strategy?

(4) Does the environmental strategy adopted by a firm would influence its business distribution portfolio across developed and developing regions?

(5) Which of these reported environmental management practices are associated with the short-term and long-term financial performance of the firms?

(6) Does internationalization moderate the relationship between environmental management practices (environmental surveillance, process-related pollution abatement, and environmental innovation) and financial performances?

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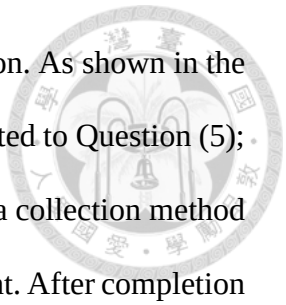

These six questions are subjected to three testings for validation. As shown in the Figure 3.1, Test 1 is related to Question (2), (3), and (4); Test 2 is related to Question (5); and Test 3 is related to Question (6). Content analysis is the main data collection method adopted to evaluate firm's proactiveness in environmental management. After completion of literature review, a total of 38 items are conceptualized and coded in the coding form, a codebook is prepared to guide the content analysis. Question (1) can be answered after the coders complete all samples' coding process. The environmental management data would further proceed with the construct of environmental management variables, as well as environmental strategy classification. The environmental strategy is classified based on K-mean clustering method. The environmental strategy typology is used to investigate Question (2), (3), and (4), while the environmental management practice's variables are used in the investigation of Question (5) and (6).

Other variables such as financial performances, degree of internationalization (DOI), and control variables are required in the analysis. Financial related variables are extracted from the Datastream database; while variables of DOI are computed from the information published in ENR Top International Contractors 2012 (ENR, 2012).

Three different analysis methods are used to achieve the objective of the studies. For Test 1, analysis of variance (ANOVA) and other similar extension of ANOVA methods are used to assess the potential difference of scale-level dependent variable DOI on the environmental strategy classification. Test 2 adopted stepwise regression method to screen for environmental management practices that associated with financial performances. Lastly, Test 3 has adopted moderated regression analysis to test the moderating effects of DOI on the relationship between environmental management practices and financial performances. The reliability and validity of both the variables used and all the models would be examined.

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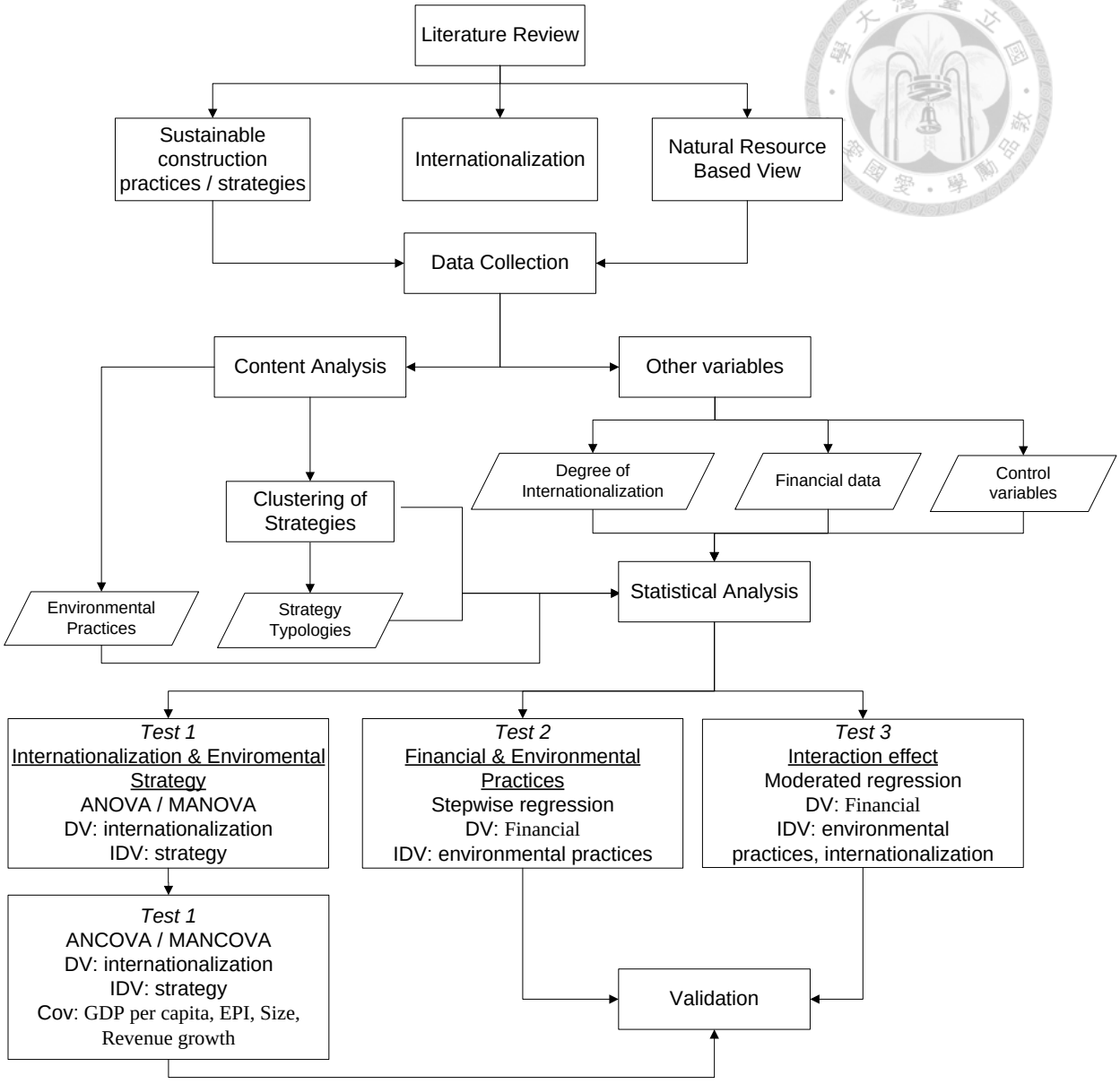

Figure 3.1 Research process framework

3.2 Samples

The sample of multinational contractors is drawn from ENR Top International Contractors 2012 (ENR, 2012). Only publicly listed firms from developed countries, with financial data available and environmental reporting published online, are included in the study. Out of the 225 contractors listed, 61 firms fulfill the inclusion criteria. The selected firms, home country, and continent-of-origin are shown in Table 3.1.

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Table 3.1. Sample of firms

Asia & Pacific	*Korea*	*Germany*	*Spain*
Australia	Samsung C&T	Bilfinger Berger	SacyrVallehermoso
Lend Lease	Doosan E&C	HOCHTIEF	ACS
Leighton	Daewoo E&C	Bauer	FCC
WorleyParsons	Hyundai E&C		OHL
	Samsung Eng.	*Greece*	SANJOSE
China	GS E&C	ELLAKTOR	Tecnicas Reunidas
China Railway Group	Daelim Industrial	SA	
China Gezhouba		Metka	*Sweden*
CSCEC	*Taiwan*		Skanska AB
Shanghai	CTCI	*Italy*	
Construction		IMPREGILO	*UK*
Shanghai Electric	**Europe**	Saipem	Balfour Beatty
CRCC	*Austria*		AMEC
	A. Porr AG	*Netherlands*	Petrofac
Japan	STRABAG SE	Van Oord	
Toyo Engineering		Royal BAM	**Americas**
Taisei	*Denmark*		*Canada*
JGC	Per Aarsleff	*Norway*	SNC-Lavalin
Kajima		Veidekke ASA	
Obayashi	*France*		*US*
Chiyoda	VINCI	*Portugal*	Willbros
Shimizu	BOUYGUES	Soares Da Costa	Jacobs
Kinden	TECHNIP		KBR
Taikisha			Fluor
Nishimatsu			Layne Christensen
Construction			URS

3.3 Content Analysis

Content analysis is adopted to extract the environmental management practices from the environmental disclosures published by each construction firm. The benefits of a content analysis approach are attributed to its ability to infer from data what would be too costly, no longer possible, or too obtrusive to capture through the use of other techniques (Krippendorff, 1980). Environmental data were gathered from sustainability reports, online annual reports, and public information on company web pages. The main targets are environmental disclosures published in 2011. Since not all firms report annually on their environmental activities, if a report for 2011 is missing, the report produced closest

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to 2011 would be chosen. When an environmental report is not available or data is scarce, additional information is sourced from firm's website. Documents or reports containing environmental data of construction firms are collected through their respective websites.

According to Guthrie and Abeysekera (2006), there are two main approaches to measuring disclosure in annual reports. The first approach uses content analysis, which is a method of codifying the content or text of a piece of writing into categories based on chosen criteria in a quantitative way. The second approach is the use of disclosure indices to assess, compare and explain qualitative differences in the extent and comprehensiveness of disclosure in annual reports. Alongside with the mentioned objectives, latter approach is more pertinent towards the research questions. In most studies, disclosure is measured by volume-based content analysis (Abbott and Monsen, 1979; Wiseman, 1982). Nonetheless, there has been recognition that reliance on mere number of disclosures may be misleading (Cowen et al., 1987). Toms (2002) acknowledged the flaw in disclosure measurement and presumed firms have made genuine and significant environmental investments is difficult to imitate, therefore management is more likely to offer the strongest possible quality signal which are specified, quantifiable, and external monitored. The categories of the items in this study following his assertion would hence rank higher for disclosure that are specified, quantifiable, and external monitored, while lower for rhetorical disclosure in the hierarchy. The study investigated scope and intensity of firm environmental capabilities, 0 score will be allocated if the coder couldn't detect any sign of involvement, and higher score will be given for high intensity of involvement.

For the measurement scale of each item, an appropriate scheme of categories or levels should be exhaustive and mutually exclusive and comprised of appropriate level of measurement (Neuendorf, 2002). Therefore, each item is designated with different scale

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that best suit the nature of report content and classification. However, if items are on different metrics, ignoring different amounts of variability in the observed variables might result in less reliable factor scores. A remedy is to standardize variables on different metrics before running reliability and validity checking. The average of the three raters' scores for each item at each firm was used during the analysis.

The unit of analysis considered in the content analysis is firm report. Latent variables indicate features of each entire document are extracted through the content analysis. Three raters manually performed the content analysis, and prior to the real assessment, training has been carried out iteratively to ensure each rater's proficiency in the coding instruments. In this study, content analysis is pursued to statistically test the relationship between environmental management with financial performances and degree of internationalization. The detailed procedures of content analysis as recommended by Neuendorf (2002) are followed and stated as following:

(i) Theory and rationale: The content analysis is guided by RBV theory and environmental management literature. Relationship testing will be carried out is later stage by linking data from content analysis with financial and internationalization data from other sources.

(ii) Conceptualizations: Total 38 questions have been designed in the coding form. The questions is designed based on the content analysis from a random 15 samples.

(iii) Operationalization (measures): The measures of each question have been design in this stage. An a priori coding scheme describing all measures has been created and setting appropriate measurement that is exhaustive and mutually exclusive. The excerpts are keywords or phrases that extracted from the firm's reports, and company name is hidden in the excerpt to avoid bias in coding process. Content

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validity also has assessed at this point by matching topic of each question with theory.

(iv) Coding schemes: A complete codebook and coding form are prepared. The codebook would define the variable and offer detailed excerpts from relevant statements that serve to document the researchers' interpretations.

(v) Training and pilot reliability: Neuendorf (2002) contends that content analysis requires minimum two coders for reliability testing. The coding (rating) training is ensuing with complete codebook and form, and would be conducted by 3 coders. Two of the coders are senior undergraduate student of Department of Science, National Taiwan University, while the third is the author, all the three coders have good English and Mandarin proficiency. Milne and Adler (1999) found ‘‘novice’’ coders to be sufficiently reliable for this type of analysis. During the training, agreement on the coding of variables must achieved mutually from the three coders before can proceed to the next stage. In order to achieve mutual agreement on scoring, 10 samples of firm’s environmental disclosure have been randomly adopted in the pilot study and used for training purpose, the coders will score each disclosure individually and group discussion has been carried out to discuss on disparity among the coders. After this training, the coders should be competent to run independent coding test. While coding a report, the coders may discover that some of the content falls outside coding scheme, then the researcher needs to create a set of categories based on the themes to ensure the inclusiveness of codebook. This process requires to move back and forth between text and the output of content analysis for progressive refining and validating of the coding scheme. The revision process is iterative and every round of the session would follow by discussion and possible revision.

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This stage ended when both the codebook and code form are finalized, and the coders are familiar with codebook and coding form, and achieve mutual agreement on scoring. The coding form is shown in Table 3.2 and codebook is shown in Table 3.3.

(vi) Coding: Following the training and revision sessions, coders have to read and code all the 61 firm's corporate reports. The score of items are compiled and used for further statistical analysis.

(vii) Final reliability: Internal consistency reliability is tested which items on a test measure a single construct, and is computed as Cronbach's alpha, the value should be greater than 0.7. Interrater reliability is assessed by computing intraclass correlation (ICC), the ICC value should higher than 0.4. Test-Retest reliability is conducted on the consistency of a group of individuals' scores on a test over time, coders are asked to re-rate the first few reports a second time, after they analysed all of the reports.

(viii) Tabulation and reporting: finally, the results of content analysis are reported.

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Table 3.2 Coding form for content analysis

Topic	Question	Measurement scale
1. Corporate environmental policies	How well the contractor addresses environmental issues in its corporate policies?	0: Not addressed 1: General rhetoric 2: Commit to regulatory compliance 3: Setting organizational goal / target 4: Invest in clean technology
2. Standardization of environmental management system	To what extent the contractor standardized its management system in the international operation?	0: Not addressed 1: Limited 2: Partial mandated (some division) 3: Committed to extend to the whole group
3. Senior environmental executive	Does the contractor assign senior environmental executive to manage the environmental issues?	0: Not addressed 1: Yes
4. Formal organizational structure	Does the contractor incorporate formal organizational structure for environmental matter?	0: Not addressed 1: Yes
5. Reporting structure level	To what extent the contractor establishes their environmental reporting structure?	0: Not addressed 1: Facility level 2: Senior environmental executive 3: Board of Directors
6. Environmental information is being circulated internally	Does the contractor circulate environmental information internally?	0: Not addressed 1: Yes
7. Environmental reporting is external audited	Does the environmental reporting audited by external party?	0: Not addressed 1: Yes

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8. Environmental reporting meet international reporting requirement	How well the environmental reporting comply to the international standard?	0: Not addressed 1: Partially comply 2: Highly comply (GRI rating A or A+)
9. Environmental training programs	To what extent the contractor emphasis on employee training in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of training programs 3: provide details of training programs, and training coverage is being measured and reviewed
10. Surveillance of the risks and business opportunities for environmental issues	To what extent the contractor surveil the risks and opportunities on environmental issues?	0: Not addressed 1: Written statement, limited coverage and ambiguous endeavour 2: Written statement with limited coverage and endeavour 3: Written statement with broader coverage and more specified endeavour 4: Broad coverage and well specify endeavour
11. Address an environmental issue earlier than competitors (establish environmental policy, program, department, etc., EMS excluded)	When was the contractor first embraced corporate environmentalism in operation?	0: Not addressed 1: 1-10 years 2: 11-20 years 3: 21-30 years 4: >30 years
12. Year of EMS first been certified	When was the first environmental management system adopted?	Write down the year:_____ 0: Not addressed 1: 1-3 years

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		2: 4-6 years 3: 7-9 years 4: >9 years
13. Environmental R&D	To what extent the contractor invests in environmental R&D?	0: Not addressed 1: General rhetoric 2: Statements with research commitment and outcomes but little explanation 3: Statements with research commitment and well explained outcomes such as showing the advantages and improvement 4: Statement that shows high commitment and detailed research outcomes that aligned with business
14. Life cycle analysis (adopt green building standard)	Does the contractor incorporate or provide service of life cycle analysis in the product development?	0: not addressed 1: only statement 2: provide details of implementation, examples
15. Incorporate environmental impact assessment in the planning of construction	Does the contractor incorporate or provide service of environmental impact assessment in the planning of construction?	0: not addressed 1: only statement 2: provide details of implementation, examples
16. Include supplier policy in the construction procurement	Does the contractor establish environmental procurement policy in the selection of supplier?	0: not addressed 1: only statement 2: provide details of implementation, examples

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17. Integrate interest between firm and Government / public agencies through environmental program	Does the contractor recognize the interest of government / public agencies in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
18. Integrate interest between firm and NGO through environmental program	Does the contractor recognize the interest of NGO in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
19. Integrate interest between firm and Business/industry associations through environmental program	Does the contractor recognize the interest of business or industry association in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
20. Integrate interest between firm and Community programs through environmental program	Does the contractor recognize the interest of community programs in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
21. Integrate interest between firm and International agreements through environmental program	Does the contractor recognize the interest of international agreements (UN Global Compact, OECD in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
22. Integrate interest between firm and Customer through environmental program	Does the contractor recognize the interest of customers in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples

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23. Integrate interest between firm and Supplier (exclude procurement) through environmental program	Does the contractor recognize the interest of supplier in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
24. Integrate interest between firm and Employee through environmental program	Does the contractor recognize the interest of employees in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
25. Integrate interest between firm and Socially responsible shareholders through environmental program	Does the contractor recognize the interest of socially responsible shareholder (listed in Dow Jones Sustainability Indices, communicate with shareholders) in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples
26. Energy efficient practices in office and administration	Using energy saving electronic appliance, air-conditioning and ventilation system etc.	0: no 1: Provide measures 2: Provide measures and publish results
27. Water efficient practices in office and administration	Recycle used water, water conservation of office etc.	0: no 1: Provide measures 2: Provide measures and publish results
28. Waste reduction (reuse, recycling etc.) practices in office and administration	Reduce, reuse, recycle office paper, furniture etc.	0: no 1: Provide measures 2: Provide measures and publish results
29. Eco efficient transportation practices in office and administration	Reduce the need to travel, adopt car-pooling program or clean energy vehicle for employee, teleworking etc.	0: no 1: Provide measures 2: Provide measures and publish results

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30. Efficient use of energy in construction and production facility	Low-energy urban development, passive heating and cooling through orientation, using alternative energy sources, choosing materials with low embodied energy, avoidance of heat gain and loss through insulation and additional devices, utilizing energy efficient equipment	0: no 1: Provide measures 2: Provide measures and publish results
31. Efficient use of water in construction and production facility	Potable water reduction, utilizing non-potable water substitution systems, recycling water, designing low-demand landscaping, collecting rainwater	0: no 1: Provide measures 2: Provide measures and publish results
32. Efficient use of materials in construction and production facility	Adapting existing buildings to new uses, incorporating recycled or reclaimed materials reducing material use by properly sizing the building, selecting durable materials, selecting materials that are recyclable, reducing waste material	0: no 1: Provide measures 2: Provide measures and publish results
33. Emission control in construction and production facility	Minimize greenhouse gas, dust control	0: no 1: Provide measures 2: Provide measures and publish results
34. Oil and chemical spill control in construction and production facility	Monitoring and preventing oil and chemical spill	0: no 1: Provide measures 2: Provide measures and publish results
35. Noise control in construction practices	Prevent and minimize noise emission	0: no 1: Provide measures 2: Provide measures and publish results

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36. Efficient use of land and preserve biodiversity in construction and production facility	Using existing built environment, respecting the natural landscape, preventing the expansion of the built environment, prevent erosion, restricting the amount of soil taken off project sites, preserving biodiversity, land recovery after construction, brownfield revitalization	0: no 1: Provide measures 2: Provide measures and publish results
37. Integration with long-term business strategy (vision and future commitment)	To what extent the management integrate environmental issues in their long-term business planning?	0: No visionary statement 1: Written statement, ambiguous endeavour 2: Written statement with specific endeavour 3: Progress is reviewed and follow-up 4: Conduct long term master planning
38. More likely to adopt and implement new environmental innovation either in design, planning, construction process, service or product as compare to competitors. (construction)	Does the contractor more likely to adopt and implement new environmental innovation in their design, planning, construction process, service or product development? Score is depended on degree of novelty of innovation	0: not addressed 1: implement and adopt well recognized and common environmental technology or method, but new to the contractor 2: adopt new to the market innovation and the main market is national 3: implement and adopt novel and unique environmental technology or method, first in the international market

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Table 3.3 Codebook and guidelines for content analysis

Topic	Sample phrases / Examples / Criteria	Measurement scale
1. Corporate environmental policies	1. XXX works together with and for the benefit of the environment, in harmony with the local people, and in accord with their culture…… a mutual understanding between geographical and cultural contexts and with the economic and social fabric, an integration that favours new development opportunities. 2. Compliance with national and European environmental legislative requirements, as well as continuous improvement…… 3. XXX recognises the environmental impacts of its activities and takes steps to limit them, in particular by using ISO 14001 certification. The Group endeavours to reduce its consumption of natural resources and energy, cut waste and CO_2 emissions, evaluate and limit health and toxicological impacts and preserve biodiversity. 4. XXX's policy is to address the environmental aspects of its operations at all levels. In addition to complying with regulations and anticipating regulatory changes, the Group's companies consider the environmental challenge to be a real and expanding opportunity for business development. R&D efforts focus heavily on improving the environmental performance of everyday life, infrastructure and mobility.	0: Not addressed 1: General rhetoric 2: Commit to regulatory compliance 3: Setting organizational goal / target 4: Invest in clean technology
2. Standardization of environmental management system	1. 65 iso 9001 quality management certifications, 10 iso 14001 environmental management certifications. 2. XXX's environmental performance in North America, the United Kingdom, the Middle East-North Africa region, and Australia is managed, monitored, and improved through our formal EMS programs, guided by the ISO 14001 Standard. Throughout the world, environmental stewardship is encouraged and championed by informal green teams that address sustainability issues in their offices and communities.	0: Not addressed 1: Limited 2: Partial mandated (some division) 3: Committed to extend to the whole group

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	3. Progressively extend the environmental management system (EMS) to all Group companies.	
3. Senior environmental executive	1. Deputy CEO of the XXX group, oversees Group-wide sustainable development initiatives. 1. Infrastructure & Environment Division appointed a Sustainability Business Line Director with responsibility for expanding our global sustainability practice and for leading the development of an internal sustainability program.	0: Not addressed 1: Yes
4. Formal organizational structure	1. Group Sustainable Development and Quality Safety Environment (QSE) Department Quality and HSE Division	0: Not addressed 1: Yes
5. Reporting structure level	1. At the corporate level, we provide oversight using, among other things, a Balanced Scorecard, while the business segments are empowered with the flexibility to implement in accordance with the business priorities. 2. A Sustainability Board, comprising the XXX Executive Committee, will now be accountable for the sustainability performance of XXX. 3. The Board of Directors has primary responsibility for defining, promoting and overseeing the Group's Corporate Responsibility strategy.	0: Not addressed 1: Facility level 2: Senior environmental executive 3: Board of Directors
6. Environmental information is being circulated internally	Environmental information is published regularly across the whole Group and keeps staff updated on issues such as handling waste materials and any legal changes.	0: Not addressed 1: Yes
7. Environmental reporting is external audited	This report has been independently verified by the BSI for content reliability.	0: Not addressed 1: Yes
8. Environmental reporting meet international reporting requirement	We report our sustainability performance according to the Global Reporting Initiative's (GRI) indicators. Our self-declared level of application of the GRI Guidelines is B.	0: Not comply 1: Partially comply 2: Highly comply (GRI rating A or A+)

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9. Environmental training programs	1. As part of the Green Team initiative, XXX employees receive training on what they can do to improve the Company's overall environmental performance. 2. In order to sensitise our employees to this issue, regular training sessions are held in which company waste representatives are brought up-to-date on the latest laws and technology so they can pass this information on to the employees. 3. In 2011, 8,063 hours of environmental training were taught in Spain to 1,117 employees through courses and informal discussions in various forms	0: not addressed 1: only statement 2: provide details of training programs 3: provide details of training programs, and training coverage is being measured and reviewed
10. Surveillance of the risks and business opportunities for environmental issues	1. Through our production processes at production facilities and at construction sites as well as in transport, contamination of air and water is possible. We counter such risks through preventative measures in the selection of materials and products, the course of the processes and work instructions as well as through relevant controls. We are insured against any environmental damage that may occur despite these precautions. 2. The responses to those challenges are also business opportunities that Bouygues Construction intends to grasp. A new Innovation and Sustainable Construction department coordinates…… 3. The energy efficiency and environmental performance of buildings should become increasingly important going forward. Accordingly, we intend to steadily capture demand from these sources. 4. Like many businesses in the twenty-first century, XXX faces a complex range of sustainability risks and opportunities that can have a material impact on our business performance in the short, medium and long term. A selection of these risks and opportunities is presented below, alongside actions taken by the Group.	0: Not addressed 1: Written statement, limited coverage and ambiguous endeavour 2: Written statement with limited coverage and endeavour 3: Written statement with broader coverage and more specified endeavour 4: Broad coverage and well specified endeavour
11. Address an environmental issue earlier than competitors	1. In Canada, XXX has had an environmental policy since 1994, and we opened our Office of Aboriginal and Northern Affairs in 1998. 2. 1980 – establishment of Safety and Environmental Protection department	0: Not addressed 1: 1-10 years

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(establish environmental policy, program, department, etc., EMS excluded)		2: 11-20 years 3: 21-30 years 4: >30 years
12. Year of EMS first been certified	*Not given.	Write down the year:__ 0: Not addressed 1: 1-3 years 2: 4-6 years 3: 7-9 years 4: >9 years
13. Environmental R&D	1. As part of the Sustainability Initiative, the office has researched funding possibilities for use on our projects 2. Among the R&D&I projects developed by the Group, highlight the following: "Use of recycled products in civil engineering." Project funded by CITD, "Energy recovery from biomass by gasification Forcarei"…… 3. To guarantee the FaunaGuard's effectiveness, XXX collaborates with renowned marine research XXX. Experts in the fields of marine biology and underwater acoustics are involved to establish which animals respond to which signals under laboratory conditions. Successful experiments have been completed for several sorts of fish, porpoises and marine turtles. 4. For years XXX has been committed to internal research and development. In 2009 alone, over 20 development projects were subsidized at XXX. One particularly important method developed independently by XXX is the BIOPUSTER© method. It is used for waste treatment and significantly reduces pollution from methane gas, proven to be a key contributor to climate change. The BIOPUSTER© method involves blasting oxygen into waste….. Another method developed by XXX helps to conserve groundwater……	0: Not addressed 1: General rhetoric 2: Statements with research commitment and outcomes but little explanation 3: Statements with research commitment and well explained outcomes such as showing the advantages and improvement 4: Statement that shows high commitment and detailed research outcomes that aligned with business

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14. Life cycle analysis (adopt green building standard)	1. We do this by integrating sustainability principles into each step of the project life cycle—from planning, design, construction, and operations to sustaining the project or program over time. 2. XXX's goal is to produce Environmental Product Declarations (EPDs) for our core products. They describe and quantify the environmental impact and performance of XXX products through every phase of their life cycles, covering raw material extraction, component manufacture, transportation and use over their full operating lifetime. We have developed associated Life Cycle Assessment (LCA) tools……	0: not addressed 1: only statement 2: provide details of implementation, examples
15. Incorporate environmental impact assessment in the planning of construction	1. Before the start of the projects, XXX Group conducts the appropriate environmental impact study, choosing the most environmentally friendly option from the choices available. 2. On the basis of the impacts identified in the approved Environmental and Social Impact Assessment (ESIA), an Environmental and Social Management Plan (ESMP) is prepared and submitted to the client for its review and approval. The ESMP describes the proposed measures that the contractor, the client and other institutions will have to implement during construction and operational phases of the project, to ensure compliance with all the socio-environmental requirements identified in the ESIA.	0: not addressed 1: only statement 2: provide details of implementation, examples
16. Include supplier policy in the construction procurement	1. Green Strategic Procurement Agreements: spent US$31 million last year on green procurement agreements for materials used internally such as office furniture, and developing a similar strategy for project materials such as concrete and steel. 2. This strategy for sustainable procurement is a fundamental component of our decision to select or keep certain contractors. 3. The procurement of construction machinery, equipment, plant and vehicles takes into account the environmental compatibility of the procured items.	0: not addressed 1: only statement 2: provide details of implementation, examples

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17. Integrate interest between firm and Government / public agencies through environmental program	In China, XXX supported government activities in the area of energy conservation and environment protection in line with China's 12th Five-Year Plan. Jan Dell, XXX Vice President, Energy & Water Division, has been appointed by the U.S. Secretary of Commerce Gary Locke to serve a 3-year term as a member of the National Climate Assessment Development and Advisory Committee.	0: not addressed 1: only statement 2: provide details of implementation, examples
18. Integrate interest between firm and NGO through environmental program	The British subsidiary of FCC Waste Recycling Group, in collaboration with Hertfordshire County Council and the Sue Ryder NGO, is working on a project for social and environmental innovation that the recycling centre in Harpington (UK) represents.	0: not addressed 1: only statement 2: provide details of implementation, examples
19. Integrate interest between firm and Business/industry associations through environmental program	XXX Group continued in its participation and involvement in industry associations and CSR forums such as ASEPAM (Spanish Network for the United Nations Global Compact), Club of Excellence in Sustainability, Forética, CSR Commission of the CEOE (Spanish Confederation of Employers' Organisations), State Council of Social responsibility of Companies (CErSE), Pro-Clima Forum Madrid, Fundación Carolina.	0: not addressed 1: only statement 2: provide details of implementation, examples
20. Integrate interest between firm and Community programs through environmental program	During 2011 XXX Group launched the second edition of its environmental classes under the slogan "The future of the earth lies in the classroom".	0: not addressed 1: only statement 2: provide details of implementation, examples
21. Integrate interest between firm and International agreements through environmental program	The company adheres to the United Nations Global Compact, and the OECD Guidelines for Multinational Enterprises, which makes express reference to the freedoms of association and collective bargaining, are among the guiding principles of its policy.	0: not addressed 1: only statement 2: provide details of implementation, examples

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22. Integrate interest between firm and Customer through environmental program	At every stage of a project, we take into account the environmental challenges and offer innovative solutions tailored to the client's technical and geographic needs.	0: not addressed 1: only statement 2: provide details of implementation, examples
23. Integrate interest between firm and Supplier (exclude procurement) through environmental program	Our Incident & Injury Free and Employee Excellence Awards recognise outstanding achievements in safety, sustainability, leadership and business performance by not just our employees and projects, but also by our suppliers and project partners. Award categories include: Leadership in Safety; Leadership in Innovation; Leadership in Environmental Sustainability…… Supplier sustainability awareness training developed and delivered to over 200 suppliers in India and China.	0: not addressed 1: only statement 2: provide details of implementation, examples
24. Integrate interest between firm and Employee through environmental program	XXX holds an alternative transportation "Try It" week to encourage employees to experiment with different commuting modes, which culminates in Bike to Work Day. All U.S. employees have access to a program to use pre-tax dollars to pay for transit passes.	0: not addressed 1: only statement 2: provide details of implementation, examples
25. Integrate interest between firm and Socially responsible shareholders through environmental program	XXX has been a member of the Dow Jones Sustainability Index for ten years, confirming its reputable performance in sustainable development. We also engage with security holders through our reporting to the Dow Jones Sustainability World Index. *Actively communicate with shareholder on environmental issues	0: not addressed 1: only statement 2: provide details of implementation, examples
26. Energy efficient practices in office and administration	*Using energy saving electronic appliance, air-conditioning and ventilation system etc.	0: no 1: Provide measures 2: Provide measures and publish results

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27. Water efficient practices in office and administration	*Recycle used water, water conservation of office etc.	0: no 1: Provide measures 2: Provide measures and publish results
28. Waste reduction (reuse, recycling etc.) practices in office and administration	*Reduce, reuse, recycle office paper, furniture etc.	0: no 1: Provide measures 2: Provide measures and publish results
29. Eco efficient transportation practices in office and administration	*Reduce the need to travel, adopt car-pooling program or clean energy vehicle for employee, teleworking etc.	0: no 1: Provide measures 2: Provide measures and publish results
30. Efficient use of energy in construction and production facility	*Low-energy urban development, passive heating and cooling through orientation, using alternative energy sources, choosing materials with low embodied energy, avoidance of heat gain and loss through insulation and additional devices, utilizing energy efficient equipment	0: no 1: Provide measures 2: Provide measures and publish results
31. Efficient use of water in construction and production facility	*Potable water reduction, utilizing non-potable water substitution systems, recycling water, designing low-demand landscaping, collecting rainwater	0: no 1: Provide measures 2: Provide measures and publish results
32. Efficient use of materials in construction and production facility	*Adapting existing buildings to new uses, incorporating recycled or reclaimed materials, reducing material use by properly sizing the building, selecting durable materials, selecting materials that are recyclable, reducing waste material	0: no 1: Provide measures 2: Provide measures and publish results

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33. Emission control in construction and production facility	*Minimize greenhouse gas, dust control	0: no 1: Provide measures 2: Provide measures and publish results
34. Oil and chemical spill control in construction and production facility	*Monitoring and preventing oil and chemical spill	0: no 1: Provide measures 2: Provide measures and publish results
35. Noise control in construction and production facility	*Prevent and minimize noise emission	0: no 1: Provide measures 2: Provide measures and publish results
36. Efficient use of land and preserve biodiversity in construction and production facility	*Using existing built environment, respecting the natural landscape, preventing the expansion of the built environment, prevent erosion, restricting the amount of soil taken off project sites, preserving biodiversity, land recovery after construction, brownfield revitalization	0: no 1: Provide measures 2: Provide measures and publish results

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37. Integration with long-term business strategy (vision and future commitment)	1. In the future, we will continue to improve corporate governance and information accessibility so as to realize sustainable operations and fulfil CSR with greater effort in all aspects. 2. In the future, we plan to focus on developing and strengthening the programs and systems that will help us further integrate environmental stewardship into our operations…… The following is a list of actions to achieve this goal 3. XXX has set itself the following sustainability targets for completion by 31 December 2012…… Progress against commitments is listed below…… 4. As part of this view to 2020, in 2011 the XXX Group adopted its new Corporate responsibility Master Plan covering the 2012 – 2014 period. The Plan also takes stock of the results of the previous one (2009-2010), strengthening the points in the Plan on which the company can move forward in an even more resolute manner.	0: No visionary statement 1: Written statement, ambiguous endeavour 2: Written statement with specific endeavour 3: Progress is reviewed and follow-up 4: Conduct long term master planning
38. More likely to adopt and implement new environmental innovation either in design, planning, construction process, service or product as compare to competitors. (construction)	1. Designed to meet LEED® Gold standards, the facility is a striking, low-lying construction that uses natural earth as a wall and relies on passive energy for heating and cooling. 2. In December 2005, XXX built the first 3-liter house (a house that requires only 3 liters of heating oil per square meter per year) in Korea as an example of a passive house that generates only 20-30% of the cooling and heating costs compared to conventional houses. In September 2006, in our Construction Environment Research Center in Daejeon, we built the first 3-liter apartment house in Korea. 3. The XXX subsidiary Züblin Spezialtiefbau GmbH (Züblin Special Foundation Engineering) uses an innovative sealing method, called BioSealing, for groundwater flow and leakage. * Score is depended on degree of novelty of innovation	0: not addressed 1: implement and adopt well recognized and common environmental technology or method, but new to the contractor 2: adopt new to the market innovation and the main market is national 3: implement and adopt novel and unique environmental technology or method, first in the international market

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3.3.1 Construct of environmental strategy

Past literatures have used many domains to configure the environmental strategy, however, there is no congruent on the exact domains. The study attempted to match construction environmental management with profound RBV environmental management literature. None domains of environmental practices were borrowed from past literatures in environmental management studies of the construction industry (Christini et al., 2004 ; Fergusson and Langford, 2006 etc) and RBV theory (Buysse and Verbeke, 2003b; Walls et al., 2011 etc). These nine domains include (i) management systems and procedures; (ii) external environmental reporting; (iii) environmental training; (iv) surveillance of risks and business opportunities; (v) innovation capability; (vi) product stewardship; (vii) stakeholder engagement; (viii) pollution abatement on-site; and (ix) managerial vision. The study examined several aspects of the variable validity and reliability. First, the dimensionality of each domain was examined by exploratory factor analysis using maximum likelihood extraction (with eigenvalue>1) and Quartimax rotation, and items with factor loading below 0.4 would be omitted. Second, internal consistency of each variable would be examined by computing Cronbach's alpha, and should greater than 0.7.

The first domain is "management systems and procedures," which evaluates the development of formal written environmental policies (item 1), standardization of EMS (item 2); participation of top management executives (item 3), formal environmental organization structure (item 4), reporting structure level (item 5).

The second domain is "environmental reporting," which evaluates whether environmental information is being circulated internally (item 6), the environmental reporting conducts external audit (item 7) and complies with the international reporting standard (item 8).

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The third domain is “environmental training” which evaluated in item 10. It is a single item construct and hence no dimensionality and internal consistency checking conducted in this domain.

Similarly, the forth domain “surveillance of risks and business opportunities” measured in item 10 of coding form is a single item construct and hence no dimensionality and internal consistency checking conducted in this domain.

The fifth domain, “innovation capability” is designated to the organizational competencies of delivering new green product and sustainable construction services. ″Innovation capability” is related to (1) general innovativeness of a firm to update existing or implement new production technologies and equipment (item 38), and (2) their investment in research and development (R&D) in environmental technology (item 13).

The sixth domain is referred as “product stewardship”. This domain is directed to design and procurement capability of a firm to conduct life cycle analysis and manage its green procurement system. Competency of construction firms in adopting life cycle analysis (item 14), and green procurement practices (item 16) are used to construct this domain.

The seventh domain is identified as “stakeholder engagement.” Stakeholder integration has vital influence in environmental management, as firms are required to integrate the external stakeholder perspective into product design and development processes (Hart, 1995), and managers manage environmental issues based on the pressure that it receives and perceives from stakeholders (Buysse and Verbeke, 2003b). Six categories of stakeholder groups are evaluated in the content analysis which comprised of government (item 17), NGO (item 18), industry association (item 19), community (item 20), international agreement (item 21), customer (item 22), supplier (item 23), employee (item 24) and shareholder (item 25).

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The eighth domain is identified as "pollution prevention on-site" which is related to functional pollution prevention practices carried out by the firm throughout the construction operations. There are 7 coding items which include efficient use of energy (item 30), efficient use of water (item 31), efficient use of materials (item 32), emission control (item 33), oil and chemical spill (item 34), noise control (item 35), and efficient use of land and preserve biodiversity (item 36).

Lastly, single coding item is used to measure "managerial vision" (item 37). Managerial attention and the framing of environmental issues have also been identified as affecting firms' abilities to profitably enact environmentally proactive strategies (Qi et al., 2010). In NRBV, Hart (1995) proposed that shared vision is the key to generating the internal pressure and enthusiasm needed for achieving the sustainable development strategy. The managerial vision was evaluated based on the extent that environmental issues are integrated in long-term business planning.

The nine domains above are subjected to cluster analysis to determine the environmental strategy typology. The clustering followed the procedures underlined by Kabanoff et al. (1995) to avoid the influence of outliers. First, the initial cluster centers ar specified at -1, 0, and +1 standard deviation for each variable. Then, K-mean clustering is conducted to form three groups of environmental strategies, following Buysse and Verbeke (2003b) three-group classification. Nonhierarchical K-means method is adopted because it offers some advantages over hierarchical clustering method. The results of nonhierarchical method are less susceptible to outliers in the data, the distance measure used, and the inclusion of irrelevant or inappropriate variables (Hair et al., 2009). Besides, the environmental strategies are clustered with reference of study conducted by Buysse and Verbeke (2003). Therefore, the final clustering solution is validated through matching with theory. These clusters are identified as reactive, preventive, and proactive

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environmental strategies. The coherence and stability of the cluster solution can be confirmed by repeating the cluster analysis on randomly selected subsamples. Analysis of variance (ANOVA) is conducted to test whether the means of each environmental practice were statistically significant across the environmental strategy clusters.

3.3.2 Construct of environmental management practices

The coding sheet contains 38 coded items and would further refine into 18 environmental management practice variables. For descriptive and interpretation purposes, the environmental management practice variables are fall into one of the four classifications as suggested by González-Benito and González-Benito (2005): (i) planning and organizational practices; (ii) product-related operational practices; (iii) process-related operational practices; and (iv) communication practices. The details of each coding item, construct, and their corresponding sources of references for content verification are tabulated in Table 3.4.

In accordance with Wagner et al. (2001), a theoretical curvilinearity relationship might appear between process and product operational practices with financial performance. In order to account for this possibility, squared terms of items from number 10 to 16 (refer Table 3.4) were also incorporated into the analysis. The final number of environmental management practice variables amounted to 18 linear term variables and 7 squared term variables.

Since the presence of squared term variables are only sensible if they are positive values, standardized summed scores for these 6 variables were transformed into positive values (i.e. the minimum value of scores were made greater than 1). The data transformations have been executed by adding +12 to the scores, so the scores of these linear and squared terms would be positive.

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Regarding the reliability and validity of the variables, first the coding items match those in the related literature, particularly in the studies that adopted a content analysis approach to data collection. Second, unidimensionality test is carried out if a construct consists of more than two coding items. The unidimensionality test adopts maximum likelihood factor analysis and all the constructs must load on a single factor with an eigenvalue greater than 1, item with factor loading below 0.4 would be omitted. Third, the internal consistency of each construct was examined by computing Cronbach's alpha, and the values should be greater than 0.7.

Table 3.4. List of coding items and constructs of environmental management practices

Items	References
(I) Planning and organizational practices 1. Management systems and procedures a. Corporate environmental policies (item 1) b. Senior environmental executive (item 3) c. Formal organizational structure (item 4) d. Reporting structure level (item 5) 2. Standardization of EMS (item 2) 3. Internal communication (item 6) 4. Environmental training programs (item 9) 5. Surveillance of risks and business opportunities (item 10) 6. Address environmental issue earlier than competitors [a] (item 11) 7. Year of EMS first been certified [a] (item 12) 8. Managerial vision (long-term commitment) (item 37) 9. Environmental research and development (item 13)	Darnall (2006), Montabon et al. (2007), Walls et al. (2011), Christmann (2000)
(II) product-related operational practices 10. Adopt life cycle analysis (item 14) 11. More likely to adopt new product innovation [b] (item 38)	Walls et al. (2011), Amara and Landry (2005)
(III) process-related operational practices 12. Pollution abatement in office a. Energy efficiency (item 26) b. Water efficiency (item 27) c. Waste reduction (item 28) 13. Pollution abatement on-site a. Energy efficiency (item 30) b. Water efficiency (item 31) c. Efficient use of materials (item 32) d. Emission control (item 33)	Sev (2009), Christini et al. (2004), Aragón-Correa et al. (2008)

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e. Oil and chemical spill control (item 34) f. Noise control (item 35) g. Efficient use of land and preserve biodiversity (item 36) 14. Logistics and transportation arrangement to reduce fuel consumption (item 29) 15. Environmental impact assessment (item 15) 16. Green procurement policies (item 16)	
(IV) communicational practices 17. External reporting a. Environmental reporting is external audited (item 7) b. Environmental reporting meets international reporting requirements (item 8) 18. Stakeholder engagement a. Government /public agencies (item 17) b. Non-government organization (item 18) c. Industry associations (item 19) d. Community (item 20) e. International agreements (item 21) f. Customer (item 22) g. Suppliers (item 23) h. Employee (item 24) i. Shareholders (item 25)	Walls et al. (2011), Buysse and Verbeke (2003b), Qi et al. (2010)

[a] measured in the scale of years
[b] based on the novelty of innovation

3.4 Other Variables

3.4.1 Degree of Internationalization

Ietto-Gillies and London (2009) identified three major dimensions in the internationalization concept: intensity, geographical extensity, and concentration dimension. These three dimensions have been incorporated into the study. The intensity dimension focuses on the dichotomy measure of foreign versus domestic activities. From the geographical aspect of internationalization, extensity dimension measures the number of countries in which activities take place, while concentration dimension focuses on the degree to which activities are concentrated within the foreign countries. The market and locational advantages deviate across geographic regions due to differences in socio-economic environment (Qian, 2000), and have varying degrees of emphasis on

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environmental concern (Özen and Küskü, 2009). Therefore, when considering geographical dimension of internationalization, not only number of countries should be taken into consideration, the geographical concentration or regional effect should also be incorporated.

Foreign sales to total sales revenue: For the internationalization intensity, the most common measure used by researchers has been the percentage of foreign sales to total sales revenue (FSTS), and is adopted here as investment intensity. FSTS is computed according to the total revenues and international revenues shown in ENR report (ENR, 2012).(Engineering News Record (ENR), 2012)(Engineering News Record (ENR), 2012)

To compute the geographical extensity, and concentration, regional classification adopted in 2012 Environmental Performances Index data files are invoked (EPI, 2012). There are a total of six regions, according to the countries listed in EPI 2012. These regions are further sub-divided into four developed regions and six developing regions. The former includes Asia and Pacific; Europe; Middle East and North Africa; and Americas. The latter includes Asia and Pacific; Eastern Europe and Central Asia; Europe; Americas; Middle East and North Africa; and Sub-Saharan Africa. The countries of six developing regions are identical to World Bank's country classification, thereby ensure the convergent validity. The countries in which each firm worked in 2011 can be found in the ENR report (2012).

Network Spread Index (NSI): Developed by Ietto-Gillies (1998), NSI has been used to measure the percentage of foreign countries a firm is affiliated with in relation to the total number of foreign countries in which, potentially, the firm could occupy. As indicated in Pheng and Hongbin (2004) study, NSI has been adopted in this study for the country-level analysis of a firm's international business distribution and used as proxy to geographical extensity.

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Regional diversification index (RDI): Geographic regions are substantially different in socio-economic environment (Qian, 2000). The imperative for regional study underscores insufficiency of purely country-level analyses in the evaluation of a firm's operations across multiple locations that are distinct but not entirely independent of each other (Ghemawat, 2003). As in Qian et al. (2008) study, entropy measure is adopted to measure the geographical concentration. The entropy measure of regional diversification index is defined as:

$$RDI = \left[\sum_{i=1}^{m} P^i \ln\left(\frac{1}{P^i}\right)\right] / \ln(m)$$

where P_i is the probabilities of number of countries where a firm had its subsidiaries to regional market i, and ln ($1/P_i$) is the weight that is given to each global market region, *m* is the number of total regions considered in the computation.

Three NSI and three RDI related variables have been derived for comparison. First, NSI and RDI are derived from a global standpoint comprising all 10 regions ($NSI_{overall}$ and $RDI_{overall}$); second, NSI and RDI are used to measure the degree of internationalization according to the respective number of countries in the four developed regions ($NSI_{developed}$ and $RDI_{developed}$) and six developing regions ($NSI_{developing}$ and $RDI_{developing}$).

3.4.2 Financial Performances

The dependent variables comprise of different aspects of financial performance and all the data are extracted from the Datastream database. Generally, accounting profitability is assumed as measures of past or short-term financial performance and market performance as measures of future or long-term performance (Hoskisson et al., 1994). The study uses accounting-based measures of return on assets (ROA) and return on sales

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(ROS) to identify the short-term financial outcomes of environmental practices. Return on equity has been ruled out due to its sensitivity to capital structure differences (Hitt et al., 1997). ROA and ROS were calculated as the mean value over the 3-year period from 2011 to 2013. Firms will maintain higher ROA if their environmental management depend less on end-of-pipe control and rely on firm's capability to facilitate the environmentally sustainable economic activity. On the other hand, efficient utilization of raw material would reduce unnecessary waste and minimize input which would result in higher ROS. In addition, revenue growth and market-based measure, Tobin's Q ratio are selected to examine long-term financial performance from the environmental practices. Tobin's Q is computed by dividing the market value of assets to the replacement value of assets, and averaging the values over the 3-year period 2011 to 2013. Tobin's q is able to reflects what cash flows the market thinks a firm will provide per dollar invested in assets and higher Tobin's Q ratio is mirroring market expectation of future cash flows to be greater or less risky (King and Lenox, 2001). Revenue growth is computed as revenue change from 2011 to 2013. It is expected environmental management would assist greater business expansion which manifests in revenue growth. The samples of construction firms span across three developed continents, namely Asia and Pacific, Europe, and America. The financial performance differences attributable to the continent of origin and its concomitant effects, such as differences in accounting practices employed, might increase the potential for confounding effects in the statistical analysis (Michael Geringer et al., 1989). In order to control for these confounding effects, this study employed the method suggested by Michael Geringer et al. (1989), to standardize all the financial performance variables in accordance with the continent of origin. A list of financial variables is summarized in Table 3.5.

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Table 3.5 Financial performance variables

Measure	Calculation	Notes
ROA	ROA = Net Income / total assets	Mean value over the 3-year period from 2011 to 2013
ROS	ROS = Operating profit / sales	Mean value over the 3-year period from 2011 to 2013
Tobin's Q ratio	$Tobin's\ Q = \frac{Total\ firm\ market\ value}{Replacement\ value\ of\ firm's\ asset}$	Mean value over the 3-year period from 2011 to 2013. Tobin's Q ratio should be higher if future cash flows are expected to be greater or if they are expected to be less risky.
Revenue growth	Revenue growth = $[(revenue_t - revenue_{t-2}) / revenue_{t-2}] \times 100\%$	Long term performance, growth rate of revenue for consecutive 2 years, 2011-2013

3.4.3 Control Variables

The conditions of a firm's home country would influence its strategic environmental response in host countries (Kolk and Fortanier, 2013; Sharma et al., 2007). The influences of a firm's home country conditions are captures in two-ways. First, the environmental governance of a home country was measured according to the Environmental Performance Index (EPI), published jointly by Yale University and Columbia University in year 2012 (EPI, 2012). Next, the gross domestic product per capita (GDPCAP) of a construction firm's home country is included in the study. For firm-level considerations,

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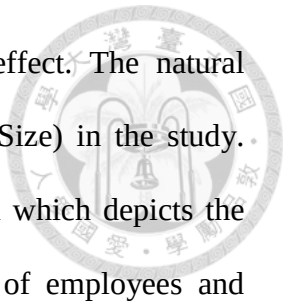

many studies in environmental management consider firm size effect. The natural logarithm of number of employees is used to measure firm size (Size) in the study. Another firm-level variable considered is revenue growth of a firm which depicts the difference of revenue over 2009 to 2011 (REVG0911). Number of employees and revenue over 2009-2011 are extracted from Datastream database.

3.5 Analysis

3.5.1 Analysis of Variance and Other Extension Methods

In Test 1, one-way ANOVA tests are adopted to test whether the means of each internationalization variables were statistically significant different across the environmental strategy clusters. The dependent variables used in this test are FSTS, NSI and RDI. In addition, post hoc Tukey's honest significant difference (HSD) tests are performed to further investigate the statistical differences between the pairwise clusters. Next, multivariate analysis of variance (MANOVA) was conducted based on overall internationalization variables (excluded FSTS) and environmental strategy clusters. Control variables such as EPI, GDPCAP, Size, and Revenue Growth over 2009-2011, are entered into the analysis as covariates and one-way analysis of covariance (ANCOVA) is performed to verify whether each of the dependent variable were still associated with differences among the strategy cluster after the home condition effects and firm control variables have been accounted for. A similar multivariate analysis of covariance test (MANCOVA) is performed by taking all the dependent variables of internationalization (except FSTS) together with the covariates, and the result was compared with MANOVA result.

The paired sample t-tests have been conducted to explore possible influences of business distribution portfolio within a specific strategy. With respect to each

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environmental strategy cluster, the pairwise $RDI_{developed}$- $RDI_{developing}$ and $NSI_{developed}$-$NSI_{developing}$ are used for comparison.

The Levene's tests would be carried out to test either the assumption of homogeneity of variance of ANOVA is being violated ($p>0.05$). As a remedy, the robust Welch's F-ratio would be reported if this assumption is violated. For ANCOVA, assumption of homogeneity of regression slopes can be tested by customizing the ANCOVA model in SPSS to look at the independent variable×covariate interaction and the p-value should be greater than 0.05.

3.5.2 Stepwise Regression

Test 2 is conducted to explore potential environmental management practices that associates with the short and long term financial performances. Stepwise multiple linear regression is adopted in this analysis. In stepwise regression, a predictor is added to the equation each time, a removal test is made of the least useful predictor. As such the regression equation is constantly being reassessed to see whether any redundant predictors can be removed (Field, 2009). The screening process of stepwise regression is based on the F-statistic, the entry threshold is set at 0.05 and the removal threshold is 0.10.

The stepwise selection assists in screening for those environmental practice variables that appear to significantly impact financial performance. The variables of environmental management practices are shown in Topic 3.3.2. The dependent variables used in the regression consist of ROA, ROS, Tobin's Q ratio and revenue growth from 2011 to 2013. Control variables such as firm size, and Revenue Growth over year 2009 to 2011 are included in the first stage before proceeding with the stepwise regression. In this analysis, ROA and ROS are both indicators of short-term financial performances,

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while Tobin's Q ratio and Revenue Growth over 2011 to 2013 are indicators of long-term financial performances.

Several regression diagnostics are further conducted to ensure that basic assumptions for ordinary least squares (OLS) regression are satisfied, such as:

(i) White test was performed to examine whether the sample met the homoskedasticity assumption of the OLS regression.

(ii) Ramsey reset test was performed to test specification errors such as omitted variables and non-linearity of functional form.

(iii) Variance inflation factor (VIF) test against each regressor was performed to test the no-multicollinearity assumption for OLS, especially for those with significant correlation.

3.5.3 Moderated Regression Analysis

Moderated regression analysis, a form of ordinary least squares regression method is adopted to examine the moderating effect of RDI on the relationship between environmental management practices and financial performances. Among the three variables of DOI, RDI is selected over the other two variables, as it is theoretical proven that regional differences increase the cost of coordinating geographically dispersed operations, can reduce or negate potential benefits associated with increased internationalization scope (Lu and Beamish, 2004; Qian et al., 2008). The three environmental management practices used in Test 3 are environmental surveillance, process-related pollution abatement, and environmental innovation. Five interaction terms would be constructed, three terms are formed by multiplying the linear terms of environmental management practices variables with RDI, and another two squared-term variables of process-related pollution abatement and environmental innovation are also

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used to form the interaction terms. The dependent variables used in the regression consist of ROA, ROS, Tobin's Q ratio and revenue growth from 2011 to 2013. Control variables consist of firm size, and Revenue Growth over year 2009 to 2011.

For each financial dependent variable, the regression starts with a control model which includes the control variables, RDI, linear and square-term of environmental management variables. Next, each interaction term of environmental surveillance, process-related pollution abatement, and environmental innovation would be included in the regression equation separately in order to minimize multicollinearity among the independent variables.

Significant regression coefficients for the interaction terms and significant increases in the explanatory power of the model through inclusion of the interaction terms support the hypotheses regarding moderating effects. T-tests were used to assess the significance of regression coefficients and F-tests to assess the significance of the increase in the explanatory power of the models.

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CHAPTER 4

ENVIRONMENTAL STRATEGIES AND INTERNATIONALIZATION

4.1 Introduction

This chapter presents the results that pertaining to the relationship between environmental strategy and degree of internationalization (DOI). Nevertheless, the results of validity and reliability tests are first reported which includes test results of (i) content analysis and (ii) construct. Next, the characteristics of each environmental strategy formed in the K-means clustering as well as their statistical results are expounded literally and statistically. The results of relationships between environmental strategy and DOI that found through the ANOVA and other similar extension analysis methods are further linked with its implications for construction firms.

4.2 Validity and Reliability of Environmental Strategy Constructs

Nine domains are used to construct environmental strategy. The reliability of content analysis where it has performed by three raters have been tested with intraclass correlations (ICC) and internal consistency Cronbach's alpha. As presented in Table 4.1, the ICC values ranged from 0.721 to 0.846 and the alpha value ranged from 0.826 to 0.943. Both the tests' values are well above the recommended values 0.4 and 0.7 respectively, which shown a high inter-rater reliability and consistency on the content analysis.

For construct validity, these domains are subjected to the dimensionality test (factor analysis) and internal reliability test (Cronbach's alpha) preceded clustering analysis.

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Results of the tests are presented in Table 4.2. From the factor analysis, item with factor loading below 0.4 would be omitted, every construct must result in a single dimension factor. After factor analysis, the remained items would subject to Cronbach alpha reliability test, and generally every domain has alpha value equal or greater than 0.70. Therefore, the construct validity and reliability are being validated.

Table 4.1 Reliability of content analysis

No.	Item(s) *	ICC	Cronbach's Alpha
1	Management systems and procedures	0.823	0.933
2	Environmental reporting	0.823	0.933
3	External environmental training	0.790	0.919
4	Surveillance of risks and business opportunities	0.721	0.826
5	Innovation capability	0.734	0.892
6	Product stewardship	0.832	0.937
7	Stakeholder engagement	0.846	0.943
8	Pollution prevention on-site	0.846	0.943
9	Managerial vision	0.817	0.931

Omitted items are excluded from the computation of ICC and Cronbach's alpha

Table 4.2 Construct validity

Item(s)	Factor Loading	Cronbach's Alpha #	Remarks
Management systems and procedures			
1. Corporate environmental policies	0.647	0.78	Item 2 omitted from first domain. The remaining items loaded on 1 factor.
2. Standardization of environmental management system	0.337 *		
3. Senior environmental executive	0.674		
4. Formal organizational structure	0.775		
5. Reporting structure level	0.635		
Environmental reporting			
6. Environmental information is being circulated internally	0.149 *	0.78	Item 6 omitted from first domain. The domain is therefore referred as "external environmental reporting"
7. Environmental reporting is external audited	0.668		
8. Environmental reporting met international reporting requirement	0.949		
External environmental training			No test conducted on single item variable
9. Environmental training programs	–	–	

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Surveillance of risks and business opportunities			
10. Surveillance of the risks and business opportunities for environmental issues	–	–	No test conducted on single item variable
Innovation capability			
13. Environmental R&D 38. More likely to adopt and implement new environmental innovation either in design, planning, construction process, service or product as compare to competitors.	–	0.82	Minimum three items are required for factor analysis test.
Product stewardship			Minimum three items are required for factor analysis test.
14. Life cycle analysis 16. Include supplier policy in the construction procurement		0.70	
Stakeholder engagement			
17. Integrate interest between firm and Government / public agencies through environmental program	0.446	0.71	4 factors have arisen from the first round of rotated factor analysis. Item 19, 20 are omitted due to factor loading <0.4. In second round, two factors have arisen, item 22 and 24 are omitted. In third round, 1 factor has arisen with factor loading >0.4 on the remaining items. Only factor loadings for the third round are reported.
18. Integrate interest between firm and NGO through environmental program	0.538		
19. Integrate interest between firm and Business/industry associations through environmental program	*		
20. Integrate interest between firm and Community programs through environmental program	*		
21. Integrate interest between firm and International agreements through environmental program	0.661		
22. Integrate interest between firm and Customer through environmental program	*		
23. Integrate interest between firm and Supplier (exclude procurement) through environmental program	0.678		
24. Integrate interest between firm and Employee through environmental program	*		
25. Integrate interest between firm and Socially responsible shareholders through environmental program	0.518		
Pollution prevention on-site			2 factors have arisen from the first round of rotated factor analysis. However,
30. Efficient use of energy in construction and production facility	0.753 0.798	0.81	

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31. Efficient use of water in construction and production facility	0.703		factor loading of item 34 is less than 0.4 on both factor and therefore omitted. The results of second round factor analysis are reported.
32. Efficient use of materials in construction and production facility	0.646		
33. Emission control in construction and production facility	*		
34. Oil and chemical spill control in construction and production facility	0.502		
35. Noise control in construction and production facility	0.611		
36. Efficient use of land and preserve biodiversity in construction and production facility			
Managerial vision			
37. Integration with long-term business strategy	–	–	No test conducted on single item variable

* Item omitted due to factor loading less than 0.4.

Items omitted from factor analysis are excluded from the computation of Cronbach's alpha.

K-mean clustering is performed to form three groups of environmental strategies from the nine domains, following Buysse and Verbeke (2003b) three-group classification. These clusters are identified as reactive, preventive, and proactive environmental strategies. The coherence and stability of the cluster solution have been confirmed by repeating the cluster analysis on randomly selected subsamples. Analysis of variance (ANOVA) was conducted to test whether the means of each environmental practice were statistically significant across the environmental strategy clusters. The results of ANOVA showed that the differences between cluster means are highly significant (Table 4.3).

Construction firms classified under reactive strategy (20 firms) are attributed to invest the least in environmental capabilities, and perceive environmental issues as regulatory compliance, although they usually adopt certified environmental management systems such as ISO 14001. As suggested by Buysse and Verbeke (2003b), the reactive environmental strategy is equivalent to Hart (1995) end-of-pipe approach. The

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construction firms that adopt preventive strategy (24 firms) integrated sustainable construction into their business operation and offered certain green products or services to clients. They focused on pollution prevention at operations and aimed to the benefits of "low hanging fruit", offered from the pollution prevention. The preventive strategy is equivalent to Buysse and Verbeke (2003b) and Hart (1995) pollution-prevention strategy, which is associated with moderate environmental competencies. Construction firms with proactive strategy (17 firms) score the highest across all green competencies. These firms posit themselves as leaders in the industry and invest heavily to enhance their environmental technological leadership. Besides pollution prevention efforts in operations, proactive firms developed the largest scope of green products or services that could offer to the clients.

Table 4.3 Descriptive statistics of environmental strategy clusters [a]

	Mean of strategy cluster			
	Reactive	Preventive	Proactive	ANOVA F
Management systems and procedures	-2.395	0.289	2.410	17.222***
External environmental reporting	-0.950	-0.332	1.587	13.909***
Environmental training	-0.631	-0.052	0.815	13.768***
Surveillance of risks and business opportunities	-0.681	0.006	0.792	14.444***
Innovation capability	-1.396	0.194	1.369	15.775***
Product stewardship	-1.284	0.003	1.506	18.427***
Stakeholder engagement	-2.695	-0.235	3.503	30.980***
Pollution prevention on-site	-5.028	1.221	4.192	420.106***
Managerial vision	-0.632	0.079	0.631	9.590***
Number of firms	20	24	17	

[a] Summation of standardized mean values are reported

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

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4.3 Linkage between Environmental Strategy and Degree of Internationalization

The study has included 61 samples of multinational construction firms. Their international business profile is shown in Table 4.4. The mean value and standard deviation indicate a highly diverse international business portfolio of the sample firms. However, half of the firms have revenues and FSTS ratio values lesser than respective mean values at 50^{th} percentile. The descriptive statistics indicate the sample firms generated uneven international and total revenue, most of the firms have much lower FSTS ratio, nonetheless a few firms have generated exceptional international and total revenue which eventually heighten the overall mean values. The details of revenue and FSTS of each firm are shown in Figure 4.1. In term of geographical diversification, averagely each firm deployed in 15 different countries, while most of the firms (24 firms or 39%) establish their operations within 11 to 20 countries (Figure 4.2).

The relationship between internationalization and environmental strategy is shown in Table 4.5. The Levene's tests have casted doubt on violation of the assumption of homogeneity of variance for $RDI_{developed}$ ($p<0.05$); therefore, the robust "Welch" F-ratio was reported.

First, the relationship between internationalization and environmental strategy as a whole global expansion are checked with $RDI_{overall}$, $NSI_{overall}$, and FSTS. Only the mean values of $RDI_{overall}$ and $NSI_{overall}$ are significantly varied across the clusters at 5% level, with preventive cluster ranks the highest, followed by proactive, and then reactive cluster.

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Table 4.4 Descriptive statistics of firm revenue profile

	International revenue (million US$)	Total revenue (million US$)	FSTS
Mean	4583	12563	0.454
Standard deviation	6596	17643	0.290
25th percentile	877	2266	0.163
50th percentile	2077	6202	0.424
75th percentile	5209	14876	0.724

In order to examine the impacts of environmental strategy on the business expansion in developing regions, $RDI_{developing}$ and $NSI_{developing}$ were investigated. The mean value of $NSI_{developing}$ is significantly varied across the clusters at 5% level. Amidst, preventive cluster has the highest mean, followed by proactive, and succeeded by reactive cluster.

In developed regions, $RDI_{developed}$ and $NSI_{developed}$ have been adopted to investigate the impact of environmental strategy on DOI. Both the means of $RDI_{developed}$ and $NSI_{developed}$ are significantly varied across the strategy clusters at 10% level.

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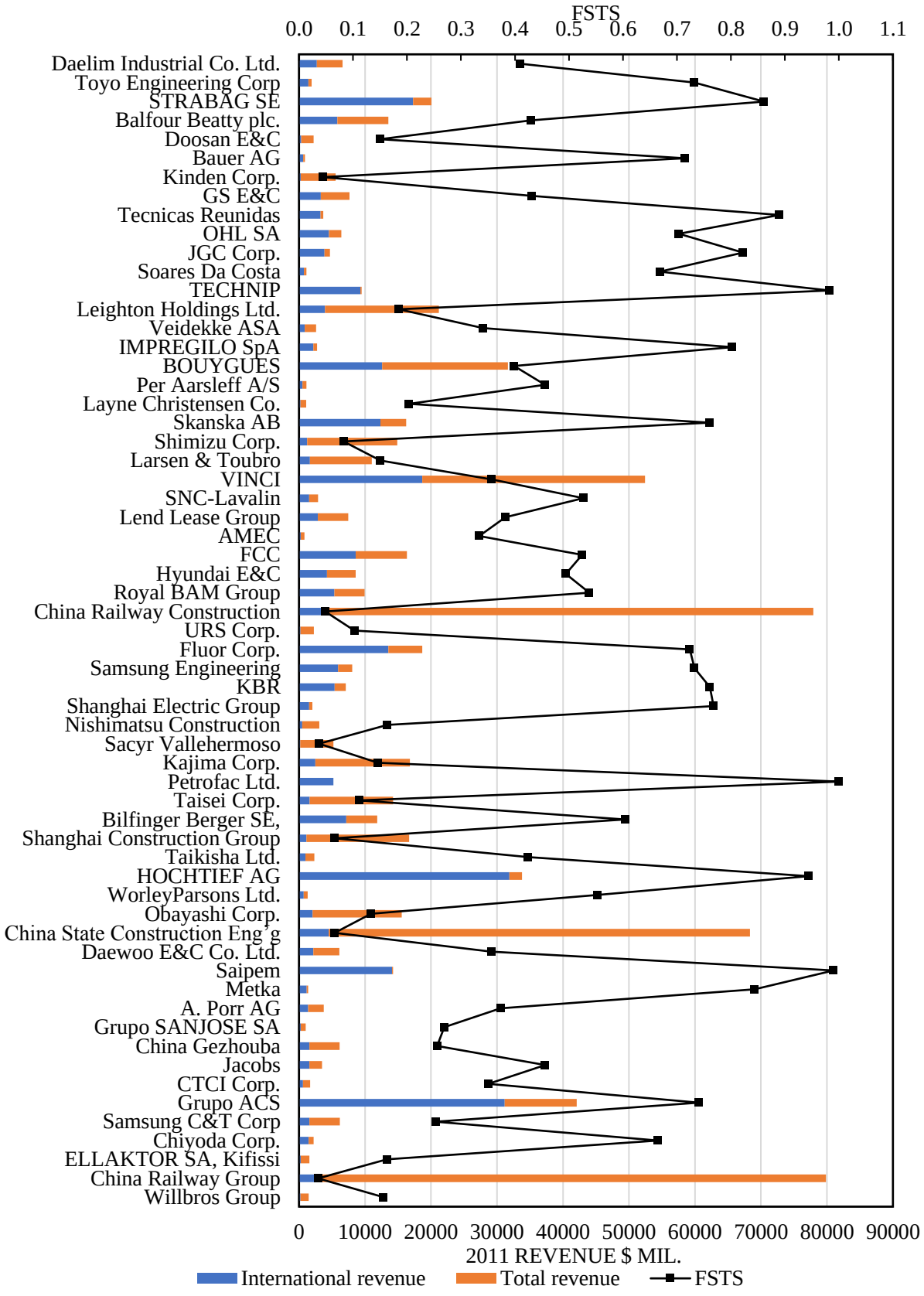

Figure 4.1 Revenue profile of multinational construction firms

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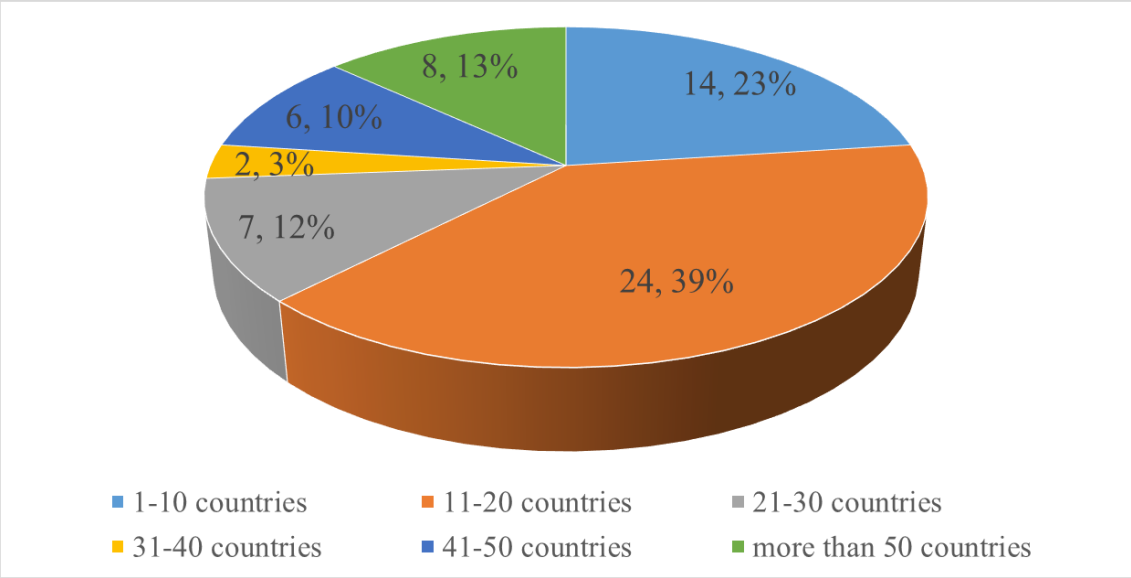

Figure 4.2 Number of firms and number of countries a firm deployed

Table 4.5 Effects of internationalization under three environmental strategy clusters

	Cluster of Environmental Strategy [a]			ANOVA F, Welch	MANOVA Wilki's λ [b]
	Reactive	Preventive	Proactive		
$RDI_{overall}$	0.608	0.762	0.658	3.292**	
	(0.248)	(0162)	(0.230)		
$NSI_{overall}$	0.113	0.238	0.154	4.343**	
	(0.087)	(0.186)	(0114)		
$RDI_{developing}$	0.536	0.658	0.475	2.069	
	(0.291)	(0.290)	(0.297)		
$NSI_{developing}$	0.092	0.199	0.113	4.292**	
	(0.077)	(0.156)	(0.088)		
$RDI_{developed}$	0.442	0.700	0.639	3.649**	
	(0.365)	(0.237)	(0.295)		
$NSI_{developed}$	0.158	0.326	0.242	3.473**	
	(0.157)	(0.269)	(0.186)		
FSTS	0.408	0.506	0.433	0.653	
	(0.289)	(0.298)	(0.287)		
					0.695*

[a] Standard deviations are in parentheses.
[b] MANOVA analysis excluded FSTS.
* $p < 0.10$
** $p < 0.05$
*** $p < 0.01$

For a more rigorous comparison, the mean differences across the strategy clusters are checked in pairwise by post hoc Tukey's HSD test. The results in Table 4.6 indicate

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that, for the significant mean differences found in ANOVA analysis comprised of $NSI_{overall}$, $NSI_{developing}$, $RDI_{developed}$ and $NSI_{developed}$, only pairwise clusters of reactive-preventive strategy have exhibited significant differences in mean values at 5% significance level. The negative values of mean difference indicate firms that adopt preventive strategy yield higher DOI than reactive firms. Nonetheless, $NSI_{developing}$ exhibites significant mean difference at 10% level between strategy cluster of preventive and proactive, and the positive value of mean difference indicate proactive firms have lower DOI as compared to preventive firms. Therefore, it is unnecessary proactive cluster yielded higher DOI than reactive and preventive clusters. Owing to the small sample size and exploratory purpose, the study does not rule out the possibility of relationship at 10% level, however the results should be approached with due caution, and further study for verification.

So far, several observations can be made from the ANOVA analysis and post hoc test. Higher level of environmental strategy adopted by a multinational construction firm is associated with greater DOI to an extent that preventive outperformed reactive cluster in internationalization, while the influence of proactive cluster is deemed limited or having slightly higher DOI than reactive cluster. The results partially supported the proposition that multinational construction firms with higher level of environmental strategy will more likely associate with greater DOI. In addition, the environmental strategy has manifested greater influence on the geographical extensity dimension (NSI) rather than intensity (FSTS) and geographical concentration dimension (RDI).

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Table 4.6 Pairwise comparison of environmental strategy clusters (for ANOVA)

Dependent Variable	Pairwise Clusters			Mean Difference (I-J)	Std. Error
RDI overall	Reactive	-	Preventive	-0.154*	0.064
	Reactive	-	Proactive	-0.051	0.070
	Preventive	-	Proactive	0.104	0.067
NSI overall	Reactive	-	Preventive	-0.126**	0.043
	Reactive	-	Proactive	-0.041	0.045
	Preventive	-	Proactive	0.085	0.046
RDI developing	Reactive	-	Preventive	-0.122	0.088
	Reactive	-	Proactive	0.062	0.096
	Preventive	-	Proactive	0.183	0.093
NSI developing	Reactive	-	Preventive	-0.107**	0.035
	Reactive	-	Proactive	-0.021	0.039
	Preventive	-	Proactive	0.086*	0.037
RDI developed	Reactive	-	Preventive	-0.258**	0.091
	Reactive	-	Proactive	-0.197	0.099
	Preventive	-	Proactive	0.062	0.095
NSI developed	Reactive	-	Preventive	-0.168**	0.065
	Reactive	-	Proactive	-0.084	0.071
	Preventive	-	Proactive	0.083	0.068
FSTS	Reactive	-	Preventive	-0.098	0.088
	Reactive	-	Proactive	-0.025	0.096
	Preventive	-	Proactive	0.073	0.093

* $p < 0.10$
** $p < 0.05$
*** $p < 0.01$

For MANOVA analysis, all the dependent variables except FSTS are included. As shown in Table 4.5, the result of MANOVA analysis for the six internationalization indicators taken together is significant at 10% level, and overall the model accounts for 30.5% (1–λ) variance. The MANOVA result suggests that environmental strategy has vital impact on the multivariate internationalization indicators.

With respect to the robustness of study, further analysis of ANCOVA and MANCOVA are shown in Table 4.7. These tests are used to investigate the relationship of environmental strategy with internationalization after remove the effects of covariates. For the ANCOVA analysis, except $RDI_{overall}$, all the other significant internationalization indicators that found in the previous ANOVA analysis remained significant and robust. The result of $RDI_{overall}$ might be affected by the undelimitated relationship between the

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strategy clusters and DOI in developing countries. Among the country-level covariates considered in this study, GDP per capita only exhibits significant impact on $RDI_{developed}$ at 5% level, while EPI has significant impact on $NSI_{overall}$ (5% level), $NSI_{developed}$ (1% level), and FSTS (5% level). Among all covariates considered, the firm-level covariate firm size has greater influences in mediating the relationship between environmental strategy and DOI than the country-level covariates. Firm size significantly influences all the internationalization indicators (at least 5% level), except FSTS. Revenue growth significantly influences on $RDI_{developing}$ and FSTS at 5% and 10% level respectively.

The MANCOVA result suggests that relationship between environmental strategy and DOI is still robust after incorporating home country and firm-level covariates into the analysis. When all covariates were taken into MANCOVA analysis, the net effect of environmental strategy on overall internationalization variables is accounted for 33% variance at 10% significance level. Thus, the incorporate of covariates have improved the explained variance between environmental strategy and internationalization.

Table 4.7 Effects of internationalization under different environmental strategy clusters, and accounting for covariates

	ANCOVA F							MANCOVA
	RDI overall	NSI overall	RDI developing	NSI developing	RDI developed	NSI developed	FSTS	Wilki's λ [a]
Strategy	1.70	3.62**	0.87	4.14**	4.37**	2.42*	0.03	0.668*
Covariates:								
GDPCAP	0.25	0.002	0.001	0.31	4.16**	0.72	0.24	0.814
EPI	0.27	6.12**	0.44	2.75	0.49	10.21***	6.63**	0.750**
Size	14.83***	63.30***	13.75***	50.67***	9.77***	62.13***	0.02	0.428***
Revenue growth	1.58	0.23	4.58**	0.85	0.003	0.04	3.14*	0.868

[a] MANCOVA analysis excluded FSTS.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

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4.4 Environmental Strategy and Internationalization Portfolio

The paired sample t-tests have been conducted to explore the distribution of business operation at both developed and developing regions within a specific environmental strategy cluster. The results are presented in Table 4.8. Positive mean difference indicates geographical extensity or concentration in developed regions is higher than developing regions, and vice-versa for negative mean difference. Except RDI in reactive cluster, the mean differences of geographical extensity and concentration are positive within the same strategy cluster. Significant differences have been observed for the pairwise comparison of geographical extensity (NSI) between developed and developing regions, and all the strategy clusters depict greater geographical extensity in developed regions than developing regions. Nonetheless, the significant $RDI_{developed}$ - $RDI_{developing}$ paired difference of proactive cluster denotes the operation distribution of proactive firms in developed regions not only just transcend in term of extensity (NSI) but also having greater geographical concentration (RDI) than developing regions. When comparison made across the strategy clusters, the mean differences of RDI and NSI steadily increase from preventive to proactive clusters. The mean differences become greater across the strategy clusters. Apparently, firms with higher level of strategic environmental capabilities would likely to sway their business distribution portfolio from developing regions to developed regions.

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Table 4.8 Paired sample t-tests for comparison of internationalization within environmental strategy cluster

	Paired comparison	Mean differences	Std. Deviation	t-value
Reactive	$RDI_{developed}$ - $RDI_{developing}$	-0.094	0.380	-1.104
	$NSI_{developed}$ - $NSI_{developing}$	0.066	0.137	2.139**
Preventive	$RDI_{developed}$ - $RDI_{developing}$	0.043	0.303	0.692
	$NSI_{developed}$ - $NSI_{developing}$	0.127	0.148	4.198***
Proactive	$RDI_{developed}$ - $RDI_{developing}$	0.164	0.264	2.558**
	$NSI_{developed}$ - $NSI_{developing}$	0.129	0.117	4.518***

1. * $p < 0.10$
2. ** $p < 0.05$
3. *** $p < 0.01$

4.5 Discussion

This study explored how construction firms devise environmental strategies on their internationalization profile across developed and developing regions. Aligned with RBV perspectives, the study articulates internationalization of a multinational construction firm is associated with the competitive advantages of environmental strategy adopted.

The study contributes to the environmental management of multinational construction firms in two folds. First, underlie the difficulty of obtaining firm environmental information, the studies sourced the data through content analysis of firm's environmental disclosure, and successfully construct environmental strategies with referring to RBV perspective and environmental management practices in construction industry. Three environmental strategies emerged from the clustering, which are reactive, preventive, and proactive in strategic environmental management. Such classification, rooted in RBV theory, is useful in delineating the competitive advantages embedded under complex configuration of bundles resources. Literally, a resource must be valuable, rare, inimitable, and supported by tacit skills or socially complex organizational processes in order to create sustained competitive advantages (Barney, 1991), thereby strategic

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environmental capabilities could convey sustained competitive advantages to multinational construction firms.

The second contribution pertains to unfold the linkage between environmental strategy and internationalization of multinational construction firms. The key research question of this paper is directed to whether environmental strategy choice has any impact on the internationalization of a multinational construction firm. The ANOVA results in Table 4.3 suggest firms with higher posture of strategic environmental management are associated with higher DOI, but only to an extent that firms pursuing preventive strategy would have higher DOI than those using reactive strategy, while firms pursuing proactive strategies have limited impact on DOI. Among the covariates considered, firm size has significant effect in moderating the linkage between environmental strategy and internationalization. Another covariate EPI, which are related to the ability of firm's home country to protect the natural environment and pressure exerted on the adoption of environmental strategy, is overall significant and would mediate the effect of environmental strategy on internationalization.

In addition, out of the three internationalization dimensions considered, the impact of environmental strategy adoption is evidence on geographical extensity, relatively weak on geographical concentration, and insignificant for intensity dimension. The last research question address in this study is directed to the possible influences of environmental strategy on business distribution portfolio across developed and developing regions. The results in Table 4.8 denote firms with greater environmental capabilities would more likely to increase their business distribution portfolio in developed regions.

The identification of a firm's environmental strategy and its global deployment remains an empirical question. Firms adopting preventive strategy transcend reactive

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firms in internationalization can be attributed to the effectiveness of preventive firms in deploying environmental capabilities to generate useful capabilities and competitive advantages to overcome challenges in international expansion such as market competition, entry barriers, liability of foreignness, and environmental legitimacy problems. In contrary, proactive strategy cluster has not depicted any significant impact on internationalization which contravene the expectation. Considering the complexity of internationalization, the unexpected result can be interpreted in two ways. First, proactive firms do not deem geographical business expansion as main corporate's goal. Proactive firms invest heavily to develop their environmental technologies in pollution reduction and marketable environmental products, hence higher market incentives are required to balance their funding in environmental research and development. Instead of geographical expansion, proactive firms might focus on market that prioritize environmental performance, society that have greater expendable income and higher willingness to pay. Besides, the business distribution portfolio of proactive firm, in term of both RDI and NSI, also affirms that proactive firms are more likely to deploy their business operation in developed regions which would provide ample business opportunity for environmental services and products. Second, as Sandhu et al. (2012) contended, while firms environmentalism by mean of pollution prevention is driven by pressures emerging from their international linkages, firms that respond beyond pollution prevention and engaged in new green product development are not driven by mere international linkage. Instead, they emanated from internal resource based competencies arising out of unique organizational history and culture organizational histories of being socially responsive.

For the three dimensions of internationalization, investment intensity (FSTS) indicator is suffered from lack of regional data, which render the result incomparable to

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other internationalization indicators of developed and developing regions. Besides, owing to the high institutional and societal differences in responding to environmental issues, number of countries (extensity dimension) is a better measure to capture the effect of environmental strategy instead of regional measure (concentration dimension).

Finally, this study highlights three managerial implications regarding the environmental management of multinational construction firms. First of all, it is essential for multinational construction firms to pay more attention to their environmental management capability development, as firms that adopt the reactive strategy would likely to lag behind in international deployment. Second, for construction firms that wish to expand business globally, they need to furnish with basic environmental capability as a way to enhance their public images and as a source of competitive strength against their competitors. In developed regions, while environmental practices are generally become norms of practices, firms lack of environmental capabilities would face heightened entry barrier and public scrutiny. Thus, proper environmental performance monitoring and transparency in environmental reporting would favor the legitimacy to operate in developed country. In developing regions, although firms could be more relax on the environmental requirement, developing environmental capabilities in pollution prevention could attain benefit of cost reduction, improved images and having cost advantages over their counterparts. Furthermore, the implementation of low-cost pollution prevention would entail with immediate financial benefits from the "low-hanging fruits" of environmental practices (Zeng et al., 2010). Lastly, firms pursuing proactive strategy might not be outstanding in the scale of internationalization. Despite, firms pursuing proactive strategy envision the importance of environmental sustainable business and would invest more to develop environmental innovation. In this respect, firms that adopt proactive strategy could organize their portfolio to deploy at countries

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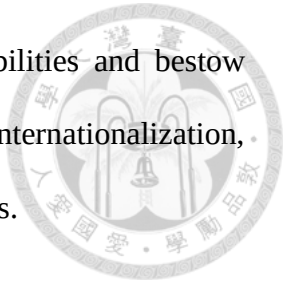
where they could exploit their advantages of environmental capabilities and bestow learning opportunities of sustainable construction in the process of internationalization, and on the other hand maintaining their markets in developing regions.



4.6 Summary of Findings

This chapter reveal the relationship between environmental strategies and DOI of multinational construction firms. Several important findings are shown as below:

1. Three environmental strategies emerged from the clustering analysis, namely reactive, preventive, and proactive in strategic environmental management. Such classification, rooted in RBV theory, is useful in delineating the competitive advantages embedded under complex configuration of bundles resources.
2. Higher posture of strategic environmental management are associated with higher DOI, but only to an extent that firms pursuing preventive strategy would have higher DOI than those using reactive strategy, while firms pursuing proactive strategies have limited impact on DOI.
3. The impact of environmental strategy adoption is evidence on geographical extensity (NSI), relatively weak on geographical concentration (RDI), and insignificant for intensity dimension (FSTS).
4. Firms with greater environmental capabilities would more likely to increase their business distribution portfolio in developed regions. Proactive firm could organize their portfolio to deploy at countries where they could exploit their advantages.

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CHAPTER 5

ENVIRONMENTAL MANAGEMENT PRACTICES AND FINANCIAL PERFORMANCES

5.1 Introduction

This chapter presents the results that pertaining to the relationship between environmental management practices and financial performances. The results of validity and reliability tests are first reported which includes test results of (i) content analysis and (ii) construct. Next, the robustness of OLS multiple linear regression are shown to ensure the assumptions are not being violated and thus enhance the validity of the models. Lastly, the results of four stepwise regression models that related to the relationships between environmental management practices and firm's short and long term financial performances are shown and their implications to construction firms are discussed explicitly.

5.2 Validity and Reliability of the Content Analysis and Constructs

The study assessed several aspects of the validity and reliability of the content analysis and as well as the variables used. There are total 38 items in the coding form, after coding the percentages showing "0" score (no sign of involvement or not being shown in firm report) for each item are reported in Table 5.1. Among all, over 50% of firm have not reported item 6, 7, 11, 12, 19, 25,29, 34, and 35. The high percentage of not reporting might hamper the reliability of results.

For the inter-rater reliability across three raters, intraclass correlations (ICC) and internal consistency Cronbach's alpha were assessed. Except item 19, the ICC values

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ranged from 0.707 to 0.885 and the alpha value ranged from 0.834 to 0.959. The results evidenced high reliability and consistency on the content analysis. Due to low ICC and consistency, Item 19 is omitted from the regression analysis. The poor ICC and consistency of item 19 is suffered from the ambiguity of excerpts in the codebook.

For construct validity, the variables shown in Table 5.1 are subjected to the dimensionality test (factor analysis) and internal consistency Cronbach's alpha test. Results of the tests are presented in Table 5.2. From the factor analysis, item with factor loading below 0.4 would be omitted, every construct must load on a single dimension factor. After factor analysis, the remained items would subject to Cronbach alpha reliability test, and generally every domain has alpha value equal or greater than 0.70. Therefore, the construct validity and reliability are being validated.

Table 5.1 Reliability of content analysis

Items	ICC	Cronbach's alpha
(I) Planning and organizational practices		
1. Management systems and procedures	0.823	0.933
a. Corporate environmental policies (item 1)		
b. Senior environmental executive (item 3)		
c. Formal organizational structure (item 4)		
d. Reporting structure level (item 5)		
2. Standardization of EMS (item 2)	0.727	0.889
3. Internal communication (item 6)	0.811	0.928
4. Environmental training programs (item 9)	0.790	0.919
5. Surveillance of risks and business opportunities (item	0.721	0.886
10)	0.845	0.942
6. Address environmental issue earlier than competitors [a]		
(item 11)	0.885	0.959
7. Year of EMS first been certified (item 12)	0.817	0.931
8. Managerial vision (long-term commitment) (item 37)	0.790	0.919
9. Environmental research and development (item 13)		
(II) product-related operational practices		
10. Adopt life cycle analysis (item 14)	0.756	0.903
11. More likely to adopt new product innovation [b] (item	0.707	0.822
38)		
(III) process-related operational practices		
12. Pollution abatement in office	0.879	0.956

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a. Energy efficiency (item 26)		
b. Water efficiency (item 27)		
c. Waste reduction (item 28)		
13. Pollution abatement on-site	0.846	0.943
a. Energy efficiency (item 30)		
b. Water efficiency (item 31)		
c. Efficient use of materials (item 32)		
d. Emission control (item 33)		
e. Noise control (item 35)		
f. Efficient use of land and preserve biodiversity (item 36)		
• Oil and chemical spill control (item 34) *	0.751	0.901
14. Logistics and transportation arrangement to reduce fuel consumption (item 29)	0.813	0.929
15. Environmental impact assessment (item 15)	0807	0.926
16. Green procurement policies (item 16)	0.804	0.925
(IV) communicational practices		
17. External reporting	0.823	0.933
a. Environmental reporting is external audited (item 7)		
b. Environmental reporting meets international reporting requirements (item 8)	0.846	0.943
18. Stakeholder engagement		
a. Government /public agencies (item 17)		
b. Non-government organization (item 18)		
c. International agreements (item 21)		
d. Suppliers (item 23)		
e. Shareholders (item 25)	0.370	0.638
• Industry associations (item 19) *	0.822	0.933
• Community (item 20) *	0.742	0.897
• Customer (item 22) *	0.825	0.834
• Employee (item 24) *		

* omitted item

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Table 5.2 Construct validity

Items		% not reported	Factor loading	
(I) Planning and organizational practices				
1. Management systems and procedures	(α = 0.78)			All items 1-4 loaded on single factor.
a. Corporate environmental policies (item 1)		0%	0.680	
b. Senior environmental executive (item 3)		36%	0.678	
c. Formal organizational structure (item 4)		26%	0.738	
d. Reporting structure level (item 5)		30%	0.647	
2. Standardization of EMS (item 2)		23%	–	
3. Internal communication (item 6)		69%	–	
4. Environmental training programs (item 9)		23%	–	
5. Surveillance of risks and business opportunities (item 10)		20%	–	
6. Address environmental issue earlier than competitors (item 11)		67%	–	
7. Year of EMS first been certified [a] (item 12)		62%	–	
8. Managerial vision (long-term commitment) (item 37)		16%	–	
9. Environmental research and development (item 13)		13%	–	
(II) Product-related operational practices				
10. Adopt life cycle analysis (item 14)		28%	–	
11. More likely to adopt new product innovation [b] (item 38)		5%	–	
(III) Process-related operational practices				
12. Pollution abatement in office	(α =0.83)			
a. Energy efficiency (item 26)		26%	0.739	
b. Water efficiency (item 27)		48%	0.856	
c. Waste reduction (item 28)		41%	0.776	
13. Pollution abatement on-site	(α =0.81) [#]			Item 34 is omitted due to factor loading <0.4 in the first round of factor analysis. The results of second round factor analysis are reported. Item 34 is omitted from stepwise regression due to high
a. Energy efficiency (item 30)		11%	0.753	
b. Water efficiency (item 31)		26%	0.798	
c. Efficient use of materials (item 32)		13%	0.703	
d. Emission control (item 33)		8%	0.646	
e. Oil and chemical spill control (item 34)	(omitted)	74%	*	
f. Noise control (item 35)		51%	0.502	

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g. Efficient use of land and preserve biodiversity (item 36)		25%	0.611	percentage of not reported in data collection.
14. Logistics and transportation arrangement to reduce fuel consumption (item 29)		52%	–	
15. Environmental impact assessment (item 15)		41%	–	
16. Green procurement policies (item 16)		33%	–	
(IV) Communicational practices				
17. External reporting	(α =0.78)			
a. Environmental reporting is external audited (item 7)		52%	–	
b. Environmental reporting meets international reporting requirements (item 8)		30%	–	
18. Stakeholder engagement	(α =0.71) [#]			Item 19, 20, 22 and 24 are
a. Government /public agencies (item 17)		23%	0.446	omitted due to factor loading
b. Non-government organization (item 18)		49%	0.538	<0.4 in the first and second
c. Industry associations (item 19)	(omitted)	66%	*	round factor analysis. In third
d. Community (item 20)	(omitted)	30%	*	round, 1 factor has arisen
e. International agreements (item 21)		38%	0.661	with factor loading >0.4 on
f. Customer (item 22)	(omitted)	36%	*	the remaining items. Only
g. Suppliers (item 23)		52%	0.678	factor loadings for the third
h. Employee (item 24)	(omitted)	39%	*	round are reported. Item 19,
i. Shareholders (item 25)		67%	0.518	20, 22, and 24 are omitted in stepwise regression due to inconsistency of construct.

* Item omitted due to factor loading less than 0.4.

Items omitted from factor analysis are excluded from the computation of Cronbach's alpha.

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5.3 Stepwise Regression on Environmental Management Practices and Financial Performance

5.3.1 Robustness of Stepwise Regression Analyses

Stepwise method of ordinary least squares multiple linear regression (MLR) analysis was used to test the relationship between environmental management practices and financial performances. OLS estimators are the best linear unbiased estimators. However, several regression diagnostics are required to ensure the assumptions are not violated. In this study, the regression models were diagnosed to ensure no multicollinearity problems, specification errors and heteroskedasticity that would affect the robustness of models.

As shown in Table 5.3, the correlations among the variables present no problem of multicollinearity where all the correlations are less than 0.8. Variance inflation factor (VIF) test against each regressor was further performed and affirmed there is no multicollinearity problem (VIF<5). Assumption of no specification errors such as omitted variables and non-linearity of functional form have been investigated by using Ramsey RESET test. The results suggest that the functional form problem was not significant ($p>0.05$). White test was used to investigate the homoskedasiticity assumption, since the F-statistic with p-value greater than 0.05, it fails to reject the null hypothesis of homoscedasticity. Therefore, these three assumptions of OLS regression are validated. The results of VIF, RESET, and White test are shown in Table 5.4 and Table 5.5.

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Table 5.3 Descriptive statistics and correlations

	REVG0911	Size	SqPCON	SURVEIL	EMSP	STAKEI	SqINNO
REVG0911	1.00						
Size	-0.10	1.00					
SqPCON	-0.03	0.04	1.00				
SURVEIL	0.09	0.04	0.52***	1.00			
EMSP	-0.05	-0.09	0.44***	0.40***	1.00		
STAKEI	-0.02	0.14	0.46***	0.50***	0.50***	1.00	
SqINNO	-0.25*	-0.06	0.43***	0.28**	0.35***	0.35***	1.00
Mean [a]	17.943	9.715	17.341	1.617	0.000 [b]	3.634	2.956
Standard deviation [a]	45.962	1.371	5.128	1.151	3.105 [b]	2.454	2.092

Note:
∗ p < 0.10; ∗∗ p < 0.05; ∗∗∗ p < 0.01
[a] Unstandardized mean and standard deviation
[b] Computation based on standardized summed scores since different metrics adopted for the items
REVG0911 - revenue growth from 2009 to 2011
Size - firm size, taken as logarithm of number of employee
SqPCON - squared term of pollution abatement on-site
SURVEIL - environmental scanning (item 10)
EMSP - management systems and procedures
STAKEI - stakeholder engagement
SqINNO - squared term of product innovation (item 38)

Table 5.4 Variance inflation factor (VIF) test

	Centered VIF			
Variable	ROA	ROS	Tobin'Q	REVG1113
REVG0911	1.034	1.034	1.011	1.090
Size	1.033	1.033	1.031	1.026
SqPCON	1.510	1.510	1.268	1.248
SURVEIL	1.467	1.467	–	–
EMSP	1.336	1.326	–	–
STAKEI	–	–	1.292	–
SqINNO	--	–	–	1.337

Notes:
REVG0911 - revenue growth from 2009 to 2011
Size - firm size, taken as logarithm of number of employee
SqPCON - squared term of pollution abatement on-site
SURVEIL - environmental scanning (item 10)
EMSP - management systems and procedures

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STAKEI - stakeholder engagement
SqINNO - squared term of product innovation (item 38)

Table 5.5 White test and Ramsey test

Dependent variable of modal	White Test		Ramsey Test	
	F-statistic	P-value	F-statistic	P-value
ROA	0.629	0.87	0.209	0.81
ROS	1.650	0.16	0.741	0.48
Tobin's Q	1.402	0.19	0.178	0.84
Revenue Growth 2011-2013	1.339	0.22	2.685	0.06

5.3.2 Results of Stepwise Regression Analysis

If the implementation of environmental management is to successfully improve financial output, then the specifics of each environmental management practice and the extent to which each practice is applied must be assessed in greater detail. Following the stepwise regression analysis, four models have been constructed and examined the relationship between environmental management practices and financial performance.

Building upon accounting measures, the first two models underpin short-term financial performance. The first model (ROA) shows that environmental management practices result in the efficient use of firm assets. The second model (ROS) articulates the impacts of environmental management practices on a firm's profit margin and operating efficiency. The response variables in the third and fourth models are market-based measures that focus on long-term economic value. The third model presents the impact of environmental management practices on stock market valuation through Tobin's Q ratio. The last model is used to identify whether environmental management practices would improve a firm's sale growth rate.

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According to the stepwise regression analysis (Table 5.6), five environmental management practices are significantly associated with these financial performance variables.

i. Squared pollution abatement on-site: These variables involve innovative measures taken to save energy, conserve water, minimize waste and emissions, control noise that would affect the community, protect biodiversity during construction, and recovery of the landscape. These environmental management practices have a significant impact on all the financial variables considered in the study, while the negative coefficients of the squared term imply an inverted U-shaped relationship between pollution abatement and financial performance.

ii. Surveillance on business opportunities and risks (environmental scanning): Firms frequently conduct surveillance on business opportunities and risks that pertaining with environmental issues are more capable to evaluate the potential risks and opportunities in an environmental sustainable market and thus more efficiently in forming strategy to mitigate the risks and seize the market opportunities. The results indicate business surveillance has positive effect on both ROA and ROS

iii. Management systems and procedures: /management system determines the governance, framework and distribution of responsibilities among different actors in a firm to facilitate decision making, execution, and supervision of environmental performances in order to attain the firm's environmental goals. The results indicate EMS governance structure is positively associated with both of the short-term financial performance variables ROA and ROS.

iv. Squared adopt new product innovation: Product innovation focuses on introducing new marketable services and products that incorporate green features. Product innovation has a significant U-curve relationship on firm revenue growth,

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which implies that non-innovative and highly innovative firms perform better than moderately innovative firms in the long-term.

v. Stakeholder engagement: stakeholder engagement covers the groups of stakeholders and the extent of interaction or responsiveness of the firm. Stakeholder groups considered in this study comprises of government or public agencies, non-government organizations, international agreements, suppliers, and shareholders. Stakeholder engagement is positively associated with Tobin's Q ratio.

Aside from the environmental management practice variables, significant positive relationships are found between control variables and financial performance. Previous revenue growth is positively associated with ROA and Tobin's Q ratio, while firm size (measured in log employee) is positively associated with ROS and late revenue growth of year 2011 to 2013. Overall, all the models generated high F-statistics and low p-values, indicating all the models are jointly significant.

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Table 5.6 Stepwise regression analysis on financial performances (61 samples)

	Short-term		Long-term	
	ROA	ROS	Tobin's Q	Revenue Growth 2011-2013
Constant	-0.232	-1.080	-0.144	-3.002**
	(0.818)	(0.834)	(0.884)	(1.180)
Control variables				
Revenue Growth 2009-2011	0.273**	0.114	0.302**	0.173
	(0.115)	(0.117)	(0.121)	(0.121)
Log Employee	0.109	0.188**	0.068	0.221**
	(0.081)	(0.083)	(0.087)	(0.086)
Stepwise selection				
Squared pollution abatement on-site	-0.005***	-0.005***	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
Surveil	0.301**	0.278**		
	(0.133)	(0.136)		
Management systems and procedures	0.074*	0.104**		
	(0.041)	(0.042)		
Stakeholder engagement			0.069*	
			(0.039)	
Squared adopt new product innovation				0.010*
				(0.006)
R-squared	0.300	0.272	0.192	0.197
Adjusted R-squared	0.237	0.206	0.134	0.139
F-statistic	4.725***	4.116***	3.329**	3.431**

Note: Standard errors in parentheses
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

5.4 Discussion

Previous studies generally suggest that environmental management practices or capabilities are positively associated with a firm's financial output. Yet the results of the present study suggest that these relationships take different forms in the context of construction firms, depending on the types of practices and financial indicators studied. Out of five variables attribute to process-related operational practices, only pollution abatement on-site is significantly associated with financial performances. In contrast to pollution abatement in the head office, pollution abatement on-site has a direct impact on

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production processes and is significantly different in terms of its complexity and objectives. The effect of pollution abatement on-site is pronounced, as it revolves around basic tasks and the core mission of construction firms in delivering their services. Conversely, other practices such as environmental impact assessment, pollution abatement in office, logistics and transportation arrangements, and green procurement can be considered subordinate to production in view of their trivial influence on the cost structure. A firm's procurement system may also be constrained by contractual arrangements that limit the application of environmental preferences (Mokhlesian and Holmén, 2012).

Pollution abatement on-site is shown to have an inverted U-shaped curvilinear relationship on both short-term and long-term financial indicators. Apparently, construction firms would benefit at the early stage of pollution abatement where there are plenty of "low hanging fruit". Pollution abatement appears to be cheaper than cleaning the pollution at "end-of-the-pipe" (higher ROA), and increase productivity and efficiency by better utilization of raw material and minimize waste (higher ROS). Such efforts could create tangible value and translate into a competitive advantage by shaping efficient cost structures as well as improving public relations and the firm's reputation which results in higher revenue growth and better market valuation. However, the net marginal benefits from environmental abatement decrease with increasing marginal costs of pollution prevention activities. At some point, further improvement of environmental performance from pollution prevention activities is too costly and becomes unprofitable. Drawing on the short-term project goal, excessive pollution abatement would incur extra costs and defer construction completion time. A construction firm with extra capability in pollution abatement might capture the niche attention but risk losing the mainstream business, thus result in lower market valuation and revenue growth.

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Within the class of planning and organizational practices, management systems and procedures, and environmental scanning are the only variables that demonstrate impact on the short term financial performances. In contrast, practices that do not appear to realize financial performance gains include: (i) level of firm having its subsidiaries or operations ISO 14001 certified, (ii) internal communication, (iii) environmental training, (iv) early addressing of environmental problems, (v) early certification of EMS, (vi) managerial vision and long-term planning, and lastly (vii) environmental research and development. However, some of these items receive little coverage in the environmental disclosures, which may impair the accuracy of the results. In addition, some practices are essential but might not have a direct impact on financial performance. Environmental training (iii) is an essential ingredient that promotes staff understanding of firm protocols for environmental management; research and development (vii) facilitate the adoption of innovation and marketing of new products. These variables thus may be mediators to or moderators of the relationship between other environmental practices and financial performance.

Environmental scanning is positively associates with both the short term financial performances. The result partially concurs with the finding of Chen et al. (2015) which found no significance relationship between environmental scanning with sale growth, but contradict with finding of Montabon et al. (2007) where it shows positive impact on overall firm performances which include sale growth. Both studies adopted content analysis method and source firm's report for data collection, yet it should be take note that their studies adopt canonical correlation method and Spearman's rho correlations test respectively and the difference in analysis method might render different outcome. Generally, environmental scanning would assist construction firms to seek potential construction technologies that would improve operational efficiency, reduce wastes and

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material inventory, and saving the costs from recovery and paying penalty due to bleaching local environmental legislation. In fact, through frequent environmental scanning, construction firms are able to reduce the liability of foreignness when operate abroad, and thus reduce additional costs incurred in the international business environment in term of environmental aspect.

Management systems and procedures are positively associated with the short-term financial indicators. The result is well aligned with previous studies (Darnall et al., 2008; Turk, 2009). The financial benefits of EMS governance are articulated through the improved internal operation efficiency. Firms with a comprehensive EMS governance structure can benefit from clear protocols for mobilizing resources and respond to environmental issues without overlapping directives. However, there is no evidence that EMS development and standardization are associated with long-term financial indicators, thus an assertion that EMS enhances market share and market value is not supported by the analysis.

In the class of communication practices, the results suggest that engaging target stakeholder groups, rather than disseminating information in general, has a significant impact on Tobin's Q ratio. From environmental disclosures, multinational construction firms sometimes portray their environmental responsibility through working closely with stakeholders in shaping certain construction related activities, such as relocating a construction site to protect a wildlife habitat and natural resources, restoring brownfield sites and forests, responding to government and NGO environmental programs, and offering community programs to promote environmental awareness. The main driver for construction firms to actively engage in environmental management is the incentive to access international markets (Turk, 2009). Such construction firms must develop stakeholder engagement capability in order to integrate environmental perspectives from

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a complex and vast range of key stakeholders in a global operation. The results confirm there is a positive linear relationship between stakeholder engagement and Tobin's Q ratio. Thus, for multinational construction firms, which usually face greater scrutiny, investors would favor a firm's capability to maintain a good relationship with key stakeholders in environmental issues in order to obtain legitimacy to operate abroad. In addition, firms that integrate stakeholders' environmental perspectives into product development are more likely to generate innovations which in turn contribute to product differentiation advantages.

For both variables attributed to product-related operational practices, only adoption of environmental innovation is significantly associated with revenue growth. In the classification of product-related operational practices, LCA pertains to the adoption of techniques or design standards that account for environmental impacts throughout the lifespan of products, while the adoption of innovation focuses on a firm's disclosure efforts related to environmental projects that have been completed or made a recent debut. Adoption of LCA and using LCA related benchmark standards in construction has insignificant impact on firm financial performances. The result may be articulated with the extra costs incurred in green labelling service might balance out the profits. Despite pursuit green labelling would incur additional costs, the costs might not be well reflected in service fee structure.

Innovative environmental products or services are more likely to have a U-shaped curvilinear effect on revenue growth. The relationship shows how firms that are less innovative or highly innovative perform better in revenue growth than moderately innovative firms. The results can interpret in three ways. First, the study has not incorporated other control variables that interacting with innovation (such as marketing, competitiveness accrued from product advantage, technological factors, and other firm

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strategic actions and protocols associated with new product development) which might smooth the curvilinear relationship. Second, high and low innovation firms are more likely to be successful than those of moderate innovativeness due to differences in product advantage, synergies, and execution of pre-development and marketing activities (Kleinschmidt and Cooper, 1991). Third, the structural and peculiarities of the construction industry have different impacts on the marketing of new product innovation, the conventional construction would prefer little change on product whereas high environmental innovation able to seize the niche market. The result underscores that laggards in environmental innovation do not necessarily experience comparatively poor financial performance compared to pioneers in environmental innovation. A follower might enjoy lower survival risk than the pioneer in the environmental innovation, and attain better financial performance through close-to-home effects, but the moderate firm would suffer by scoring much lower in product advantage and execution in comparison with highly innovative firms.

With respect to short-term and long-term financial implications, this study reveals five environmental management practices associated with financial performance, but the practices present different forms of relationship. The study generally supports the view that proactive environmental management practices perform better in business. Echoing previous studies, environmental scanning, environmental management system and stakeholder engagement are found to have linear positive impacts on financial performance. Nonetheless, the inverted U-shaped curvilinear relationship (pollution abatement on-site) and U-shaped curvilinear relationship (product innovation) highlight that there are optimal points of financial benefit. For pollution abatement on-site, excessive implementation can adversely impair financial performance. On the other hand, high and low innovation firms are more likely to generate greater revenue growth than

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moderately innovative firms. These findings can assist construction firms in determining the key environmental management practices that are able to enhance their competitive edge and financial performances.

5.5 Summary of Findings

This chapter reveal the relationship between environmental management practices and financial performance of multinational construction firm. Five environmental management practices significantly associated with financial performance, linear or non-linearly, as shown below:

1. Both environmental scanning, and management system and procedures positively associated with the short-term financial performance variables ROA and ROS.
2. Stakeholder engagement is positively associated with long-term financial performance variables Tobin's Q ratio.
3. Pollution abatement on-site is shown to have an inverted U-shaped curvilinear relationship on both short-term and long-term financial indicators which implies the financial benefit is subjected to the diminishing effect.
4. Innovative environmental products or services are more likely to have a U-shaped curvilinear effect on long-term financial performance variables, revenue growth. This relationship implies firms that are less innovative or highly innovative perform better in revenue growth than moderately innovative firms.
5. These findings can assist managers of construction firms in determining the key environmental management practices that are able to enhance their competitive edge and financial performances.

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CHAPTER 6

MODERATING EFFECT OF INTERNATIONALIZATION

6.1 Introduction

This chapter presents the results and discussion of moderated regression analysis. The primary goal of the analysis is to investigate the moderating effect of internationalization on the relationship between environmental management practices and financial performances. According to the literature reviews presented in Chapter 2, three hypotheses are posited on the moderating effect of multinationality on environmental-financial performances. The hypotheses are:

i. Hypothesis 1a: Regional diversification negatively moderates the relationship between environmental scanning and short term financial performances.

ii. Hypothesis 1b: Regional diversification negatively moderates the relationship between environmental scanning and long term financial performances.

iii. Hypothesis 2: Regional diversification positively moderates the relationship between process-related pollution abatement practices and short term financial performances.

iv. Hypothesis 3: Regional diversification negatively moderates the relationship between environmental innovation and short term financial performances.

Three environmental management practices have been adopted to form five interaction terms with internationalization variable (RDI). Each of the interaction term is formed by multiplying the environmental management practice (also include the square term of similar practice) with the moderator RDI. There are total twelve regression models generated and the interaction term adopted for each of the hypothesis testing are shown in Table 6.1. Model 1, 2, 7 and 8 represent the baseline models that only included

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control variables and environmental practice variables that used as reference point against which to compare in the other equations. Each interaction term is included in subsequent models and would compare with the baseline models to inspect the moderating effect in the models. Significant regression coefficients for the interaction terms and significant increases in the explanatory power of the model through inclusion of the interaction terms support the hypotheses regarding moderating effects.

Table 6.1 Summary of models

Model no.	Dependent variable	Interacting variables	Hypothesis
1	ROA (Baseline model)	None	–
2	ROS (Baseline model)	None	–
3	ROA	Scanning x RDI	1a
4	ROS	Scanning x RDI	1a
5	ROA	Pollution abatement on-site x RDI, Squared pollution abatement on-site x RDI	2
6	ROS	Pollution abatement on-site x RDI, Squared pollution abatement on-site x RDI	2
7	Tobin's Q (Baseline model)	None	–
8	Revenue Growth 2011-2013 (Baseline model)	None	–
9	Tobin's Q	Scanning x RDI	1b
10	Revenue Growth 2011-2013	Scanning x RDI	1b
11	Tobin's Q	Innovation, Squared innovation	3
12	Revenue Growth 2011-2013	Innovation, Squared innovation	3

6.2 Robustness of Moderated Regression Analysis

The regression models were diagnosed to ensure no multicollinearity problems, specification errors and heteroskedasticity that would affect the robustness of models. As shown in Table 6.2, no highly correlation presented between the linear term independent

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variables. However, high VIF values existed when square terms and interaction terms are included in the VIF testing. Nonetheless, it is nonessential multicollinearity that exists merely due to the scaling of variables used for square terms and interaction terms (Cohen et al., 2013).

Table 6.2 Descriptive statistics and correlations

	REVG0911	Size	RDI	SURVEIL	PCON	INNO
REVG0911	1.00					
Size	-0.10	1.00				
RDI	-0.06	0.44***	1.00			
SURVEIL	0.09	0.04	0.12	1.00		
PCON	0.002	0.09	0.13	0.51***	1.00	
INNO	-0.24*	-0.05	-0.02	0.27**	0.45***	1.00
Mean [a]	**17.943**	**9.715**	**0.683**	**1.617**	**4.109**	**1.579**
Standard deviation [a]	**45.962**	**1.371**	**0.220**	**1.151**	**0.680**	**0.686**

Note:
∗ p < 0.10; ∗∗ p < 0.05; ∗∗∗ p < 0.01
[a] Unstandardized mean and standard deviation
REVG0911 - revenue growth from 2009 to 2011
Size - firm size, taken as logarithm of number of employee
SqPCON - squared term of pollution abatement on-site
SURVEIL - environmental scanning (item 10)
EMSP - management systems and procedures

Assumption of no specification errors such as omitted variables and non-linearity of functional form have been investigated by using Ramsey RESET test. The results suggest that the functional form problem was not significant (p>0.05). White test was used to investigate the homoskedasiticity assumption, since the F-statistic with p-value greater than 0.05, it fails to reject the null hypothesis of homoscedasticity. Therefore, these three assumptions of OLS regression are validated. The results of VIF, RESET, and White test are shown in Table 6.3 and Table 6.4.

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Table 6.3 Variance inflation factor (VIF) test

Independent variables	Centered VIF			
	Model 1,2,7,8	Model 3,4,9,10	Model 5,6	Model 11,12
Constant	–	–	–	–
Revenue Growth 2009-2011	1.220	1.223	1.244	1.228
Log Employee	1.386	1.421	1.451	1.441
RDI	1.300	1.346	64.290	39562.2
Scanning	1.527	17.854	1.617	1.869
Pollution abatement on-site	31.992	32.204	374.79 5	33.572
Squared pollution abatement on-site	30.836	31.025	300.30 4	32.216
Innovation	379.459	382.002	380.03 3	11890.1
Squared innovation	380.431	383.858	380.90 8	11766.4
RDI x Scanning	–	17.868	–	–
RDI x Pollution abatement	–	–	781.08 5	–
RDI x Squared pollution abatement	–	–	440.55 6	–
RDI x Innovation				172319.7
RDI x Squared innovation	–	–	–	52698.0

Table 6.4 White test and Ramsey test

Model no.	White test		Ramsey Test	
	F-statistic	P-value	F-statistic	P-value
1	1.055	0.47	1.289	0.28
2	1.288	0.29	1.336	0.27
3	1.240	0.40	2.705	0.08
4	1.158	0.45	0.927	0.40
5	0.952#	0.50#	1.655	0.20
6	1.491#	0.17#	1.367	0.26
7	1.688	0.12	1.590	0.21
8	1.678	0.12	2.382	0.10
9	2.653	0.07	2.643	0.06
10	2.246	0.11	2.038	0.14
11	1.264#	0.28#	1.506	0.23
12	1.374#	0.22#	2.255	0.12

Exclude cross product terms due to insufficient observations for computation

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6.3 Result of Moderated Regression Analysis

Table 6.5 presents the results of moderating effect of RDI between the relationship of environmental practices and short-term financial performances (ROA and ROS). For each dependent variable, the regression analysis proceeds attentively in order to compare the explanatory power of models with and without interaction term. The hypothesis is supported if the regression coefficients for the interaction terms are significant and the explanatory power (R-squared) of the model with interaction term is higher than the baseline model. Overall, Model 1-6 are significant at 5% significance level (Model 3 is significant at 1% significance level), all the Model 3-6 exhibit greater explanatory power in comparison to the baseline Model 1 and 2.

Hypothesis 1a suggested that regional diversification negatively moderates the relationship between environmental scanning and short term financial performances. The result partially supported this hypothesis where the interaction term in Model 3 is negative and significantly associated with ROA at 10% significance level. The R-squared of baseline model without the interaction term increases from 0.297 to 0.337 when the interaction term is incorporated. The F-statistic test reveals that the increment in R-squared is significant ($p<0.01$). In contrary, the interaction term in Model 4 is insignificant associated with ROS, although it shows negative association.

Hypothesis 2 suggested that regional diversification positively moderates the relationship between process-related pollution abatement practices and short term financial performances. The relationships between pollution abatement and both the financial performances are in inverted-U shape. Model 5 shows that RDI-squared-pollution-abatement interaction is positive and significant at 10% level. Hence, Hypothesis 2 is partially supported. The increment in R-square for both Model 5 and 6 is significantly greater than Model 1 and 2 respectively.

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Table 6.5 Regression analysis on short term financial performances

Model	1	2	3	4	5	6
	ROA	ROS	ROA	ROS	ROA	ROS
Constant	11.663	14.848	13.857	15.989	6.789	11.564
	(12.730)	(13.099)	(12.479)	(13.173)	(12.764)	(13.307)
Revenue Growth 2009-2011	0.234*	0.115	0.221*	0.108	0.200	0.088
	(0.128)	(0.132)	(0.126)	(0.132)	(0.127)	(0.133)
Log Employee	0.061	0.122	0.032	0.107	0.100	0.148
	(0.097)	(0.100)	(0.096)	(0.102)	(0.098)	(0.102)
RDI	0.190	0.677	-0.014	0.571	7.994*	6.595
	(0.588)	(0.606)	(0.584)	(0.617)	(4.068)	(4.241)
Scanning	0.318**	0.283**	1.164**	0.723	0.293**	0.239
	(0.140)	(0.144)	(0.467)	(0.493)	(0.142)	(0.148)
Pollution abatement on-site	0.196	0.140	0.174	0.129	1.074**	0.874*
	(0.146)	(0.150)	(0.143)	(0.150)	(0.490)	(0.511)
Squared pollution abatement on-site	-0.012*	-0.010	-0.012*	-0.009	-0.045**	-0.039*
	(0.006)	(0.007)	(0.006)	(0.007)	(0.019)	(0.020)
Innovation	-2.122	-2.895	-2.456	-3.069	-2.197	-3.012
	(2.207)	(2.271)	(2.162)	(2.282)	(2.172)	(2.264)
Squared innovation	0.088	0.125	0.104	0.134	0.091	0.129
	(0.093)	(0.096)	(0.092)	(0.097)	(0.092)	(0.096)
RDI x Scanning			-1.247*	-0.648		
			(0.658)	(0.695)		
RDI x Pollution abatement					-1.368*	-1.155
					(0.734)	(0.765)
RDI x Squared pollution abatement					0.052*	0.048
					(0.030)	(0.031)
R-squared	0.297	0.256	0.337	0.268	0.347	0.290
Adjusted R-squared	0.189	0.141	0.220	0.139	0.216	0.148
F-statistic	2.747**	2.233**	2.883***	2.076**	2.654**	2.043**

Note: Standard errors in parentheses
* p < 0.10; ** p < 0.05; *** p < 0.01

Table 6.6 presents the results of moderating effect of RDI between the relationship of environmental practices and long term financial performances (Tobin's Q ratio and revenue growth). Amidst Model 7-12, Model 7, 8, and 9 are significant at 10% significance level, Model 12 is significant at 5% significance level. Since p-values for the F-test of Model 10 and 11 is above significance level 10%, there is no evidence that the independent variables incorporated in these models improve the fit.

Hypothesis 1b suggested that regional diversification negatively moderates the relationship between environmental scanning and long term financial performances. The

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result partially supported this hypothesis where the interaction term in Model 9 is negative and significantly associated with Tobin's Q ratio at 10% significance level. Model 9 is significant at 10% and has greater explanatory power as compared with baseline Model 7.

Table 6.6 Regression analysis on long term financial performances

Model	7	8	9	10	11	12
	Tobin's Q	Revenue Growth	Tobin's Q	Revenue Growth	Tobin's Q	Revenue Growth
Constant	12.486	18.647	14.711	19.210	97.825	174.81**
	(13.426)	(13.349)	(13.199)	(13.511)	(77.831)	(74.755)
Revenue Growth 2009-2011	0.244*	0.162	0.231*	0.158	0.233 *	0.139
	(0.135)	(0.135)	(0.126)	(0.136)	(0.137)	(0.131)
Log Employee	0.117	0.246**	0.088	0.239**	0.095	0.208**
	(0.103)	(0.102)	(0.102)	(0.104)	(0.105)	(0.101)
RDI	-0.612	0.097	-0.817	0.044	-121.6	-219.9**
	(0.621)	(0.617)	(0.618)	(0.633)	(109.04)	(104.73)
Scanning	0.198	-0.135	1.053**	0.082	0.223	-0.117
	(0.148)	(0.147)	(0.494)	(0.506)	(0.165)	(0.158)
Pollution abatement on-site	0.129	0.049	0.107	0.043	0.167	0.122
	(0.154)	(0.153)	(0.151)	(0.154)	(0.158)	(0.152)
Squared pollution abatement on-site	-0.008	-0.005	-0.007	-0.005	-0.009	-0.007
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Innovation	-2.168	-3.790*	-2.505	-3.876*	-16.47	-29.76**
	(2.328)	(2.315)	(2.286)	(2.340)	(13.125)	(12.606)
Squared innovation	0.087	0.169*	0.103	0.174*	0.684	1.244**
	(0.098)	(0.098)	(0.097)	(0.099)	(0.551)	(0.530)
RDI x Scanning			-1.259*	-0.320		
			(0.696)	(0.713)		
RDI x Innovation					20.326	36.640**
					(18.447)	(17.718)
RDI x Squared innovation					-0.850	-1.519**
					(0.778)	(0.747)
R-squared	0.218	0.227	0.265	0.230	0.237	0.296
Adjusted R-squared	0.098	0.108	-.136	0.094	0.085	0.156
F-statistic	1.814*	1.910*	2.045*	1.694	1.555	2.106**

Note:
Standard errors in parentheses
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

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Hypothesis 3 suggested that regional diversification negatively moderates the relationship between environmental innovation and long term financial performances. Both the linear term and square term of environmental innovation are significantly associated with dependent variable Revenue Growth in Model 12. The negative coefficient of square term environmental innovation denotes a potential inverted-U shaped relationship. The statistically significant ($p<0.05$) and negative effect of the square interaction term in model 12 provide support for hypothesis 3. Yet, this relationship only proven on revenue growth, Model 11 shown no significant interaction effect and the model is not supported at 10% significant level.

6.4 Discussion

The results provide ample evidences on the moderating effects of international diversification towards the relationship between environmental management practices and firm financial performances. Although not a significant effect in all models, the moderating role attributed to a firm's investments in environmental management provides evidence that the financial values of these practices would augment or dwindle in geographic expansion. Overall, the empirical results support the study proposition where internationalization moderates the relationship between environmental management practices and financial performances. Nonetheless, the moderation effects revealed so far are mixed and depend on types of environmental management practices.

Multinationality of a firm not necessarily enhances return from environmental management practices. It would be detrimental for a firm if the coordination and transaction cost of internationalization exceed benefit of deploying such environmental management practices. This study provides guidance to managers to allocate suitable

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resources to develop the firm environmental capabilities in line with firm's degree of internationalization, specifically regional diversification.

To continue with this line of inquiry, the configuration of how regional diversification moderates the curves and influence its slopes and inflection points of environmental management practices and financial performances are further depicted. Figure 6.1 to 6.4 illustrate the moderating effect of RDI on environmental-financial performances. Three curves are depicted in each figure, the curves are plotted based on -1.5, 0, and +1.5 standard deviation of RDI. Bearing in mind, the actual models are too complicated to present with chart, these illustrations are partially represented the relationship of moderator, environmental practice variables and financial indicators, where the effects of other independent variables, ceteris paribus, are not accounted. Therefore, the main purpose of these charts is only attempted to expound moderating effect on the relationship between environmental practices and financial performances, caution should be taken when interpreting the final financial outcome of the models.

As shown in Figure 6.1, a firm should implement proper pollution abatement practices which aligned with their global expansion. For low international diversified firms, moderate level of pollution abatement activities would realize better financial performance (ROA) than low and high pollution abatement. The positive slope at the initial stage is attributed to the increasing competitive advantages acquired, such competitive advantages include improve efficiency, reduce waste and lower the costs of construction. However, diminishing return will impair the profit obtained and the net marginal benefits from environmental protection will decline with increasing costs of pollution prevention activities.

When a firm is highly geographic diversified, it gains better financial performances than less geographical diversified firm at low and high level of pollution

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abatement, as compared with less geographic diversified firm. The capability to access and integrate innovative pollution abatement process that learned from its multiple global markets would translated into greater financial performances for firm that implement low and high pollution abatement level. However, for highly internationalized firm, diminishing return of pollution abatement, impaired learning effect that would slower the adoption experience of pollution abatement activities across regional or country borders, would have hampered the financial benefit. Therefore, the curve does not exhibit a clear inverted-U shape as shown in low RDI curve.

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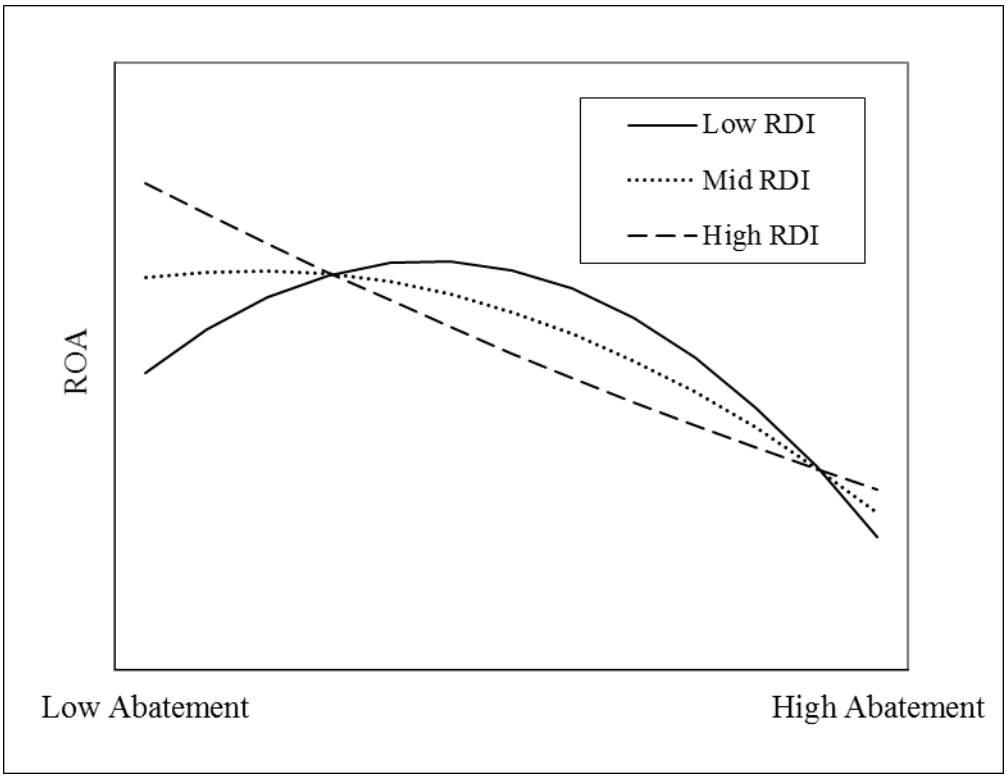

Figure 6.1 Moderating effect of RDI on the relationship between pollution abatement and ROA

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Regional diversification negatively moderates the relationship between environmental scanning and both the short and long term financial performances (ROA and Tobin's Q ratio respectively). The interaction effects are depicted in Figure 6.2 and 6.3. The interactions shown similar trend for both the linear models. For low international diversified firms, the performance is subordinate to highly international diversified firms, while the performances continuously ratchet up and eventually outperform highly international diversified firms as the firm conduct more business and risk surveillance on green market.

The result indicates that low international diversified construction firms are more likely to benefit at high level of scanning than highly international diversified construction firms. Multinational construction firms able to seize the opportunities and avoid threats by scanning on the environmental issues. Nonetheless, when a firm has greater global operation, the incremental governance, information processing and coordination cost to achieve or balance both global coordination and local market responsiveness would exhaust the managerial capacity as well as erode the potential profitability. After all, it is not advisable for highly international diversified construction firms to conduct lesser environmental scanning. In fact, highly geographical diversified firms are particularly salient to the legitimacy spillover over their environmental management issues due to their high global exposure. Foreign affiliates would encounter difficulty maintaining legitimacy if MNE as a whole or any of its other subunits experience legitimacy problems (Kostova and Zaheer, 1999). Therefore, they need to conduct environmental scanning and examine the pro and con of their environmental responses based on sufficient information gathered to prevent escalating public scrutiny and company image tarnishing.

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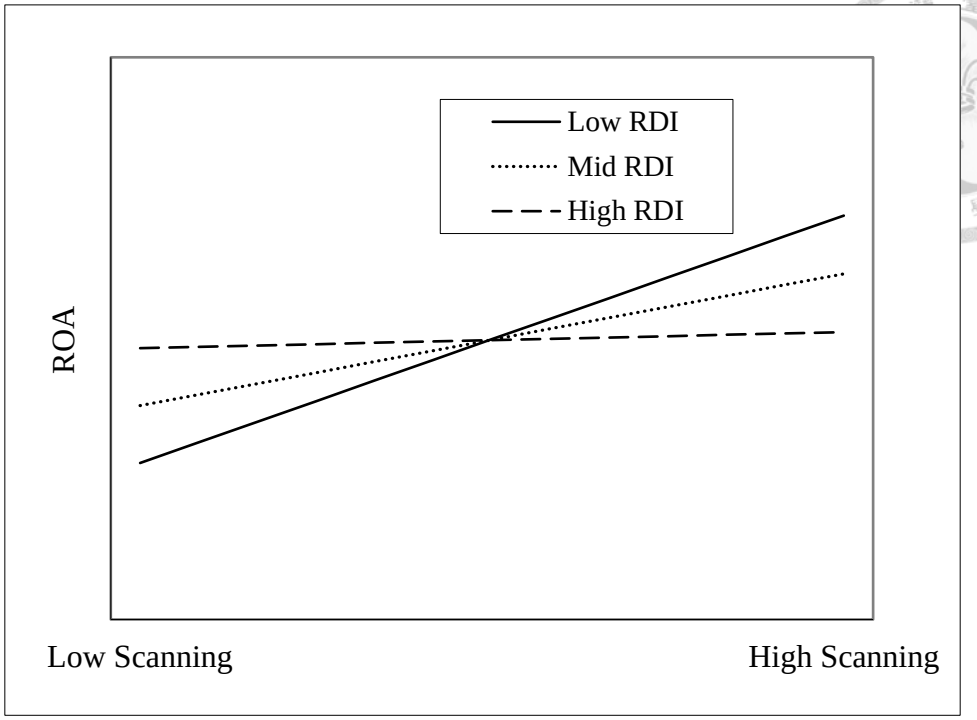

Figure 6.2 Moderating effect of RDI on the relationship between environmental scanning and ROA

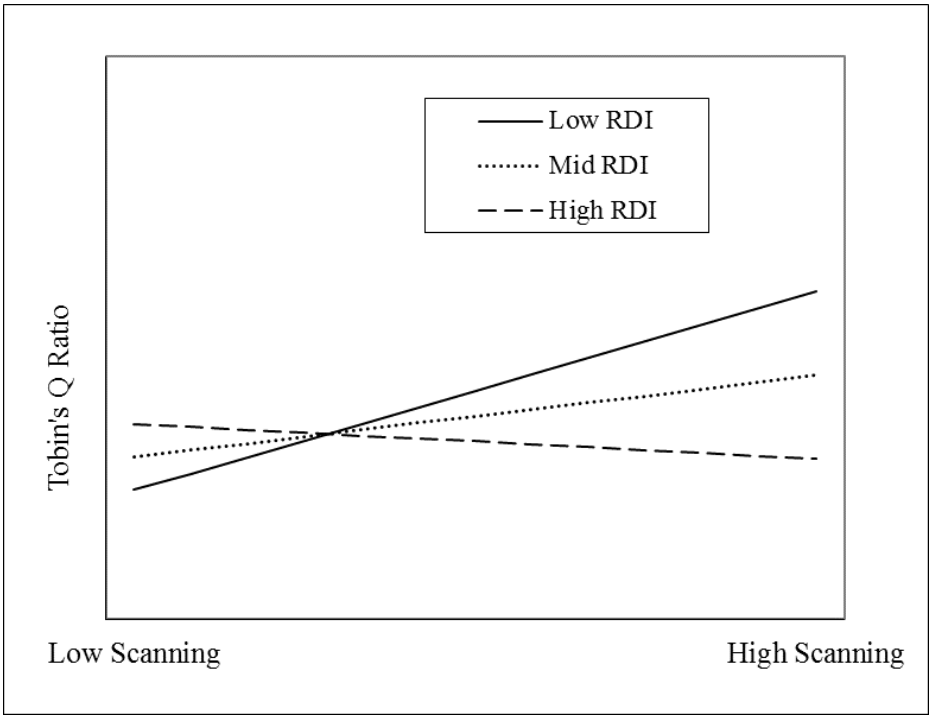

Figure 6.3 Moderating effect of RDI on the relationship between environmental scanning and Tobin's Q ratio

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The result suggests regional diversification negatively moderates the relationship between environmental innovation and long term financial performances (revenue growth). The interaction effects are depicted in Figure 6.4. Low regional diversified firms perform better in low and high level of innovation. On the flip side, high regional diversified firms are less performed in low innovation stage but slowly increase and excel in moderate level of innovation, then the growth rate gradually soften as the level of innovation increased. The results also denote that highly geographical diversified firms gain better financial performance at moderate level of innovation in comparison with low geographical diversified firms.

The study answers whether the reward would outweigh the costs associated with introducing environmental innovation for multinational construction firms. For less geographical diversified firms, Kleinschmidt and Cooper (1991) argument is tenable, where non-innovative products perform well due to close-to-home effect, highly innovative products are conducive to financial performance since they offer opportunities for product advantage and differentiation, while moderate innovative products thwart revenue growth because neither they produce competitive product differentiation products nor they beneficial from the close-to-home effects.

Since the costs of developing new innovation are similar whether the product or service is offered to one market or to many, being more international allows a firm to achieve greater returns from innovation by economies of scale (Hitt et al., 1997). Therefore, when construction firms expand globally, their innovative environmental products or services would strengthen their revenue growth. However, transaction, coordination and communication costs escalated with degree of internationalization (Hitt et al., 1997; Lu and Beamish, 2004). The ability to offset associated costs would key to financial success of firms with moderate level of innovation and highly geographical

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diversified firms. Nevertheless, with greater level of firms' innovation and internationalization, the complexity to manage both product and geographically diversity increases considerably and would resulted in inferior financial performance. The result does not suggest to reduce firm's investment in environmental innovation. Although they may not receive any direct economic payoff for their investments, innovation is necessary for firms to remain competitive (Kafouros et al., 2008; Teece, 1986).

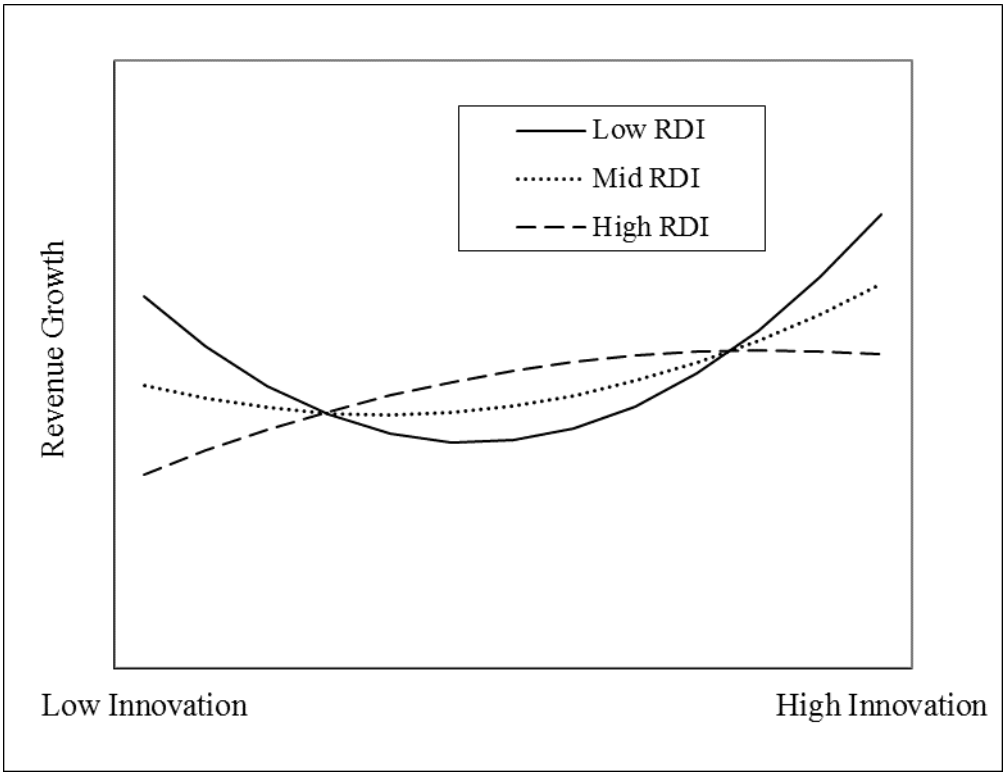

Figure 6.4 Moderating effect of RDI on the relationship between environmental innovation and revenue growth

This study provides guidance for multinational construction firms to allocate resources for environmental strategy across multiple regions. MNEs that engage heavily in foreign operations must carefully monitor the costs and the benefits of environmental management practices when launching in different global market regions. There is no

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simple answer whether a firm should deploy their resources to develop their environmental competency in line with their expansion into international business, yet managers and researchers should delve into the potential downside of excessive environmental management practices and degree of internationalization to keep firm's financial performance at an optimal level.

Although the curves in Figure 6.1 to 6.4 shown that firms' regional diversification might attenuate financial profit generated from environmental management practices, some firms may be able to shift the curve upward and to the right if they have the absorptive capability to create and maintain their competitive advantage in different regional markets. The generation of competitive advantage from proactive environmental strategy is largely fuelled by the firm's absorptive capacity (Delmas et al., 2011).

Besides, care must be taken in interpreting the calculation to achieve optimal financial performances as shown in Table 6.5 and 6.6. These performances are calculated based upon the average environmental management variables for all the firms in the sample, which comprised of top multinational construction firms in the world. Thus, the coefficients of the formula are sensitive to the samples, and the findings are more suitable to imply on large construction firms that actively seek international expansion.

6.5 Summary of Findings

This chapter reveal the moderating effect of regional diversification RDI on the relationship between environmental management practices and financial performance of multinational construction firm. Stemmed on RBV, transaction cost and learning perspective, two hypotheses have been examined, and the findings are shown as below:

1. Regional diversification negatively moderates the relationship between environmental scanning and both short term financial performances ROA and long

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term financial performance Tobin's Q ratio. When RDI increased, the slope of the curvature ROA-scanning and Tobin Q-scanning will drop.

2. Regional diversification positively moderates the relationship between squared term of pollution abatement on-site and short term financial performance ROA.
3. Regional diversification negatively moderates the relationship between squared term of environmental innovation and long term financial performances revenue growth.
4. MNEs that engage heavily in foreign operations must carefully monitor the costs and the benefits of environmental management practices when deploy in multiple global market regions.

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CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Research Findings and Implications

This study highlights the financial and internationalization implications of environmental management practices in the context of construction firms. Given the peculiarities of construction firms and the difficulties in obtaining environmental information in the construction industry, very few studies have examined the interplay between environmental management and business performance from a firm-level perspective. This study examines the available environmental information through content analysis of firm environmental disclosures and unpacks the information with theoretical support. Through the content analysis, total 38 types of environmental management practices have been discovered. Among these coded practices, every firm in our samples reported their corporate environmental policies and about 95% reported on their environmental initiative. There are some coded items not disclosed by most of the sample firms, such as internal communication (31% reported), engage with shareholder (33% reported), and engaging with industry associations (34% reported). Through the content analysis, the study success to reveal prevalent construction practices employed by multinational construction firms. These information is useful for future work to conduct further analysis on environmental management of construction firms. This study successfully achieves the five objectives mentioned in Chapter 1. Besides, there are theoretical and managerial implications from the findings reported in Chapter 4 to Chapter 6.

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7.1.1 Implications of Environmental Strategies on Internationalization

Based on RBV theory, three environmental strategies emerged from the clustering, which are reactive, preventive, and proactive in strategic environmental management. These classification is useful in delineating the competitive advantages embedded under complex configuration of bundles resources. As presented in Chapter 4, this section answers three research questions:

(i) Does environmental strategy have any influence on the internationalization of a multinational construction firm?

(ii) If environmental strategy has impacts on internationalization, in which dimension that internationalization is affected by environmental strategy?

(iii) Does the environmental strategy adopted by a firm would influence its business distribution portfolio across developed and developing regions?

In concert with previous studies that highlight entering international construction market as an impetus of environmental management (Turk, 2009; Zeng et al., 2003), this study provide empirical evidence on the relationship. The results suggest firms with higher level of strategic environmental management are associated with higher degree of internationalization, but only to an extent that firms pursuing preventive strategy would have higher degree of internationalization (DOI) than those using reactive strategy, while firms pursuing proactive strategies have limited impact on DOI. In addition, three DOI variables, RDI, NSI, and FSTS have been adopted to explore the relationship with environmental strategy. Among these three variables, NSI shown the strongest linkage with the environmental strategy, and follow by RDI, whereas FSTS is insignificantly associated. The results simply imply geographical factors are more important than investment intensity in the interplay between DOI and environmental strategy. The study admits there is inadequacy in the DOI variables used, further study is required to construct

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a more meaningful and comprehensive indicator on DOI to affirm the validity of this study. Nevertheless, the study postulates environmental strategy plays a great role when a firm deploy in multiple countries. Besides, in comparison with reactive and preventive clusters, proactive firms also exhibit greater geographical portfolio focus in developed countries when compare to their deployment in developing countries. Thus, environmental strategy adopted by a firm would influence a firm's business distribution portfolio.

In term of managerial implication for construction firms, three suggestions have been pinpointed in Chapter 4. First, construction firms that adopt reactive strategy would likely to lag behind in international expansion. Second, although the importance and demand of environmental competency towards multinational construction firm varied across their markets in developed and developing countries, environmental capability is a source of competitive advantages in the process of internationalization. Third, firms that adopt proactive strategy might not be outstanding in the scale of internationalization but they can focus on environmental sustainable business through invest more in developing environmental innovation. Besides, proactive firms can target developed countries as their main markets which impose stringent environmental regulations.

7.1.2 Implications of Environmental Management Practices on Financial Performances

Drawing upon the most commonly disclosed information found in the reporting, stepwise analysis differentiates those environmental management practices that are associated with financial performance from those that are inert, enabling comparisons as well as revealing limitations of the research. The findings provide valuable information on the environmental management practices that have been implemented and disclosed by

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multinational construction firms. Alongside accounting data, environmental reports can be a reliable source for investors to interpret a firm's condition and make informed investment decisions.

Five environmental management practices have been revealed to significantly associated with financial performances. These practices include pollution abatement on-site, environmental scanning, management systems and procedures, environmental innovation, and stakeholder engagement. Generally, the findings are concurred with RBV theory, where environmental competency is a form of competitively valuable organizational capability, that would translate competitive advantages such as cost advantages, and differentiation advantages etc, into financial profits.

With respect to short-term and long-term financial implications, this study reveals five environmental management practices associated with financial performance, but the practices present different forms of relationship. The study generally supports the view that proactive environmental management practices perform better in business. Echoing previous studies, environmental scanning, EMS (management systems and procedures) and stakeholder engagement are found to have linear positive impacts on financial performance. Nonetheless, the inverted U-shaped curvilinear relationship (pollution abatement on-site) and U-shaped curvilinear relationship (product innovation) highlight that there are optimal points of financial benefit. For pollution abatement on-site, excessive implementation can adversely impair financial performance. On the other hand, high and low innovation firms are more likely to generate greater revenue growth than moderately innovative firms. These findings can assist managers of construction firms in determining the key environmental management practices that are able to enhance their competitive edge and financial performances. In addition, firms require to focus and invest resources in these specific environmental competencies to improve their profits.

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7.1.3 Implications of Moderating Effects

Stemmed on transactions costs, resource-based view, and organizational learning perspectives, this study established the importance of regional diversification as moderator in the relationship between environmental management practices and financial performances. The results partially supported regional diversification moderate the relationship between environmental management practices and financial performances. The following findings have been observed in the study:

(i) Regional diversification negatively moderates the relationship between environmental scanning and short term financial performance ROA (Hypothesis 1a) and long term financial performance Tobin's Q ratio (Hypothesis 1b).

(ii) Regional diversification positively moderates the relationship between process-related pollution abatement practices and ROA (Hypothesis 2)

(iii) that regional diversification negatively moderates the relationship between environmental innovation and long term financial performance, Revenue Growth (Hypothesis 3)

The above results are noted as partially supported because the interaction effects only manifested in one of the two indicators used for respective short and long term financial performances. None of the interaction terms are significant in both financial variables for the hypothesis testing. Nonetheless, internationalization manifests sophisticated influences on the environmental management practices and financial performances. Regional diversification can be either positively or negatively moderate the relationship, and it depends on whether the benefits of internationalization outweigh the costs of internationalization. Previous study highlights global contractors are found to be more proactive in environmental strategies than their local counterparts (Park and Ahn, 2012), however the study did not provide theoretical framework as well as empirical

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evidence on how and why environmental management related with internationalization. In this study, the relationships are posited to moderate by regional diversification due the cost-benefit of transactions costs, resource-based view, and organizational learning.

It is essential for managers of construction firms pay more attention to environmental competency as well as their international diversification. Internationalization might attenuate the financial benefit of environmental management as governance costs can rise rapidly to a point at which the governance costs exceed any internalization benefits when growing number of internal transactions that increases with the number of foreign subsidiaries established by a firm (Hitt et al., 1997). Three theories are invoked in this study, for instances, transaction cost focuses on effective governance structure in the multinational transaction, RBV underscore the contribution of firm's resources and capabilities to generate competitive advantages, and organizational learning allows construction firms to acquire new knowledge through interacting with new cultures, demographics, regulations, and technologies. Transaction cost associated with internationalization can be leveraged with competitive advantages accrued from firm's resources, capabilities and learning effects. Therefore, construction firms must carefully monitor the costs and the benefits of environmental management practices launched in their different global market regions.

7.2 Limitations of the Study

The findings present here are not a definite conclusion and subjected to a few limitations. First, the samples drawn from ENR represent the top multinational construction firms in the world. It is unclear whether the findings could be applied to construction firms with smaller firm sizes and internationalization scopes. Besides, these firms conducted projects with different delivery methods, it implied that the firms might only involves in separate

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design stage, construction stage, or operation stage, or in a more complex delivery option such as Engineering, Procurement and Construction (EPC), turnkey, or build–operate–transfer. Hence, the study does not limit it finding implication merely on contractor or builder, but construction firms in general.

Another constraint is the limitation imposed on the content analysis method. The content analysis relied on environmental reports, but each firm reported environmental practices and performances in different breaths and details that best served their own stakeholders. Therefore, the evaluation might not completely reflect the actual firm's environmental capability. Besides, this study is one of the first attempt in construction management literature that adopt content analysis to collect firm's environmental management information. The validity of coding instrument used and the other findings from this study is subjected to further validation from future study.

Considering the small sample size adopted in the study, the results are sensitive to firm that included into the study. Therefore, the results and findings should be approach with cautious, and to be further validated in future study.

Third, the study approaches to internationalization by taken the dimensions of investment intensity, geographical concentration and extensity, while there are other aspects of internationalization that have not been considered in the study. For examples, the study has not capture the activities configuration to portray how the foreign direct investment are conducted, whether internalized, sub-contracted or joint venture. Forth, while the socio-economic environment of each developed and developing country is peculiar and sophisticated, this study might have oversimplified the difference within and across developed and developing regions. Nevertheless, in a modest way, the study provides a stepping-stone for future researches to further explore environmental

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management and internationalization in the construction industry, and improve the confidence of results reported here.

Generally, another factor that might hamper confidence of the results is related to the poor environmental information disclosed by the construction firms. These items are usually associated with inconclusive results. Therefore, missing disclosures can result in drawing inaccurate scoring that does not truly represent the firm's real behavior and affect the results of the regression analyses. On the other hand, some coded items may actually be trivial to the cost structures of construction firms, though they are commonly disclosed in environmental reporting. The costs and benefits of these environmental management practices may be less decisive and thus unable to manifest any relationship to financial performance, or otherwise unsuitable measurement adopted for the coded items might render insignificant result. In addition, the content analysis assumes the disclosed information are genuine and reliable, any attempt of greenwashing would impair the validity of results.

In addition of those constraints of content analysis that been spelled out earlier, the study focuses on top multinational construction firms in the world with public environmental disclosures. Thus, the findings are specifically applicable to multinational construction firms, which have greater firm size and are active in transnational operations. In comparison to firms that operate domestically, due to their visibility, multinational construction firms generally put greater emphasis on environmental management, as well as deliberately participate in stringent international codes of conduct. The differences in market scope and firm size constrain the generalization of the findings to construction firms with smaller sizes and operating only within the firm's home country. Although the previous study denotes green construction firms would have outperformed conventional firms (Lu et al., 2013), this study implication is more suitable to limit itself to firms that

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manifest greater concern on environmental or social sustainability issues. Rigorously, the findings should cautiously approach from exploratory rather than confirmatory perspective. It is recommended more future works conducted on these scopes to enhance overall reliability and validity.

7.3 Recommendations for Future Work

For more rigorous and holistic study in this topic, there are a few recommendations for future work which is necessitated to verify as well as improve the works in this study:

1. The research study can be further extended to collect more sample size and broader firm samples that cover different sizes of construction firms. Besides, the relationship between environmental strategy and internationalization should consist of samples with broader range of degree of internationalization. The implication is more generic if the samples are not comprised mainly top construction firms across the world.
2. One of the limitation associated with content analysis is the credibility of disclosure made by the firms, the environmental disclosures might be a firm's attempt to greenwash rhetorically or those that genuinely committed in environmental protection. Since there is not much study of environmental-financial relationship in construction industry, other qualitative or quantitative data collection approach can enhance the reliability and validity of the findings. Besides, the content analysis frameworks and coded items used in this study can be adopted for future study to justify the predictive validation.
3. Broader context of firms' existing resources and capabilities and their existing business strategies should be accounted together with the environmental management system deployed by respective firm. Such a focus might lead to very

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different normative implications regarding the design and implementation of environmental management system as well as financial implications.

4. Some scholars have argued adopting merely single dimension of internationalization measurement would lead to narrow scope of internationalization. Therefore, further refinements on internationalization variables are needed in future research. For example, adopt a finer-grained measure of FSTS according to the distribution of sales based on regions or specific countries. Besides, composite measure of internationalization also can be adopted to investigate the relationship between internationalization, environmental management, and financial performances.
5. There are varies internationalization contexts which would influence the final financial outcomes. It is important to consider how internationalization of construction firms took place and implemented, for instances, internal governance structures, modes of entry, and application of managerial capabilities. Through inclusion of these variables as control, it will render better understand why some firms is profitable from environmental management while others are not.
6. Finally, it is recommended future study should consider the non-linear relationship between internationalization, environmental management, and financial performances. Besides, longitudinal study would be recommended to better capture the long term financial effect further and assess the causality of the hypothesized relationship.

In a nutshell, this study provides theoretical support and empirical evidences on the linkages between environmental management, internationalization, and financial performances. Besides, it also contributes to the growing body of evidence that environmental sustainability is becoming increasingly vital to the operations of

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construction firms, and proper strategic environmental management can enhance a firm's competitive advantage in the global market.

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Appendix A

Top 225 International Contractors List

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RANK 2012	RANK 2011	FIRM	2011 REVENUE $ MIL. INT'L	2011 REVENUE $ MIL. TOTAL	2011 NEW CONTRACTS $ MIL	GENERAL BUILDING	MANUFACTURING	POWER	WATER SUPPLY	SEWER / WASTE	INDUS. / PETROLEUM	TRANSPORTATION	HAZARDOUS WASTE	TELECOM
1	1	**HOCHTIEF AG,** Essen, Germany†	31,870.7	33,774.9	34,225.3	30	2	2	7	3	6	24	0	5
2	12	**GRUPO ACS,** Madrid, Spain†	31,147.5	42,082.9	93,688.7	25	1	13	6	3	5	26	0	4
3	2	**VINCI,** Rueil-Malmaison, France†	18,674.3	52,403.5	50,259.9	13	0	12	2	0	8	51	1	5
4	8	**STRABAG SE,** Vienna, Austria†	17,289.0	20,071.0	12,380.0	23	0	1	2	3	5	49	0	0
5	3	**BECHTEL,** San Francisco, Calif., U.S.A.†	16,700.0	25,005.0	47,216.0	0	0	0	0	0	70	30	0	0
6	6	**SAIPEM,** San Donato Milanese (Milan), Italy†	14,110.1	14,250.8	13,766.5	0	0	0	0	0	97	2	0	0
7	7	**FLUOR CORP.,** Irving, Texas, U.S.A.†	13,526.8	18,684.7	26,900.0	16	1	3	0	0	75	5	0	1
8	4	**BOUYGUES,** Paris, France†	12,608.0	31,656.0	34,915.0	29	0	3	1	1	2	60	1	0
9	5	**SKANSKA AB,** Solna, Sweden†	12,339.4	16,232.6	19,034.0	47	3	2	3	3	5	31	0	3
10	11	**CHINA COMMUNICATIONS CONSTRUCTION GROUP LTD.,** Beijing, China†	9,546.9	46,007.3	74,925.2	4	0	2	0	2	3	89	0	0
11	9	**TECHNIP,** Paris, France†	9,313.0	9,482.0	11,099.0	0	0	1	0	0	99	0	0	0
12	10	**FCC, FOMENTO DE CONSTR. Y CONTRATAS SA,** Madrid, Spain†	8,569.7	16,344.3	26,804.4	29	4	2	3	4	2	50	1	4
13	15	**CONSTRUTORA NORBERTO ODEBRECHT,** Sao Paulo, SP, Brazil†	7,351.0	13,286.0	21,805.0	4	0	9	13	2	21	51	0	0
14	13	**BILFINGER BERGER SE,** Mannheim, Germany	7,146.1	11,839.0	10,861.4	17	0	13	0	1	48	20	0	0
15	34	**SAMSUNG ENGINEERING CO. LTD.,** Seoul, S. Korea†	5,907.3	8,062.3	10,207.0	0	3	8	0	0	89	0	0	0
16	19	**BALFOUR BEATTY PLC,** London, U.K.†	5,805.0	13,530.9	13,530.9	54	0	4	0	3	0	30	0	7
17	18	**CONSOLIDATED CONTRACTORS GROUP,** Athens, Greece†	5,520.6	5,520.6	5,130.4	18	0	1	1	1	56	23	0	0
18	14	**KBR,** Houston, Texas, U.S.A.†	5,382.5	7,071.5	10,128.4	13	0	7	5	0	55	17	0	0
19	17	**ROYAL BAM GROUP NV,** Bunnik, The Netherlands†	5,346.0	9,946.0	8,581.0	45	0	0	0	0	0	55	0	0
20	22	**PETROFAC LTD.,** Jersey, Channel Islands, U.K.†	5,208.7	5,208.7	4,854.6	0	0	0	0	0	100	0	0	0
21	21	**OHL SA (OBRASCON HUARTE LAIN SA),** Madrid, Spain†	4,522.4	6,428.1	10,728.2	17	0	0	2	0	2	80	0	0
22	20	**CHINA STATE CONSTRUCTION ENG'G CORP. LTD.,** Beijing, China†	4,509.6	68,325.5	149,781.8	74	1	1	1	2	0	22	0	0
23	24	**SINOHYDRO GROUP LTD.,** Beijing, China†	4,399.6	18,085.6	20,390.0	3	0	51	7	1	0	36	0	0
24	26	**CHINA NATIONAL MACHINERY INDUSTRY CORP.,** Beijing, China†	4,307.4	5,382.0	20,481.3	1	0	63	15	0	8	10	0	0
25	23	**HYUNDAI ENGINEERING & CONSTRUCTION CO. LTD.,** Seoul, S. Korea	4,248.9	8,599.3	10,203.0	12	0	18	0	0	50	19	0	0
26	40	**ABEINSA SA,** Seville, Spain†	4,129.5	6,032.9	7,364.0	2	1	89	4	0	2	0	0	2
27	60	**PCL CONSTRUCTION ENTERPRISES INC.,** Denver, Colo., U.S.A.†	3,939.2	5,607.7	7,925.1	67	2	2	0	1	17	10	0	0
28	25	**LEIGHTON HOLDINGS LTD.,** St. Leonards, NSW, Australia†	3,921.0	21,203.0	20,065.0	22	0	0	1	4	23	13	1	0
29	35	**JGC CORP.,** Yokohama, Japan†	3,866.0	4,700.0	8,099.0	0	0	0	0	0	100	0	0	0
30	29	**CHINA RAILWAY CONSTRUCTION CORP. LTD.,** Beijing, China†	3,782.0	77,947.0	112,098.3	18	0	0	2	0	0	79	0	0
31	28	**FOSTER WHEELER AG,** Hampton, N.J., U.S.A.†	3,710.7	4,480.7	4,285.8	0	0	23	0	0	76	0	0	0
32	48	**GS ENGINEERING & CONSTRUCTION CORP.,** Seoul, S. Korea†	3,300.0	7,645.0	11,474.2	3	0	10	0	1	80	6	0	0
33	31	**TECNICAS REUNIDAS,** Madrid, Spain†	3,253.8	3,657.7	3,762.0	0	0	6	3	0	91	0	0	0
34	47	**MCDERMOTT INTERNATIONAL INC.,** Houston, Texas, U.S.A.	2,944.0	3,102.0	2,287.0	0	0	0	0	0	100	0	0	0
35	43	**CB&I,** The Woodlands, Texas, U.S.A.†	2,930.4	3,634.7	6,807.7	0	0	1	0	0	98	0	0	0
36	39	**MAIRE TECNIMONT,** Rome, Italy†	2,876.1	3,187.1	2,234.7	0	0	19	0	0	79	1	0	0
37	38	**TECHINT GROUP,** Milan, Italy†	2,875.2	3,031.7	3,742.6	0	0	8	0	1	70	4	0	0
38	16	**LEND LEASE GROUP,** Millers Point, NSW, Australia†	2,853.5	7,466.3	8,087.8	83	1	0	0	0	12	0	0	3
39	33	**CHINA RAILWAY GROUP LTD.,** Beijing, China†	2,826.9	79,851.6	90,316.5	37	1	0	0	0	0	52	0	0
40	41	**DAELIM INDUSTRIAL CO. LTD.,** Seoul, S. Korea†	2,704.0	6,592.0	8,164.0	0	0	3	0	0	92	5	0	0
41	36	**DANIELI & C. O.M. SPA,** Buttrio, Italy†	2,640.0	2,930.0	2,300.0	0	0	0	0	0	100	0	0	0
42	61	**CHINA METALLURGICAL GROUP CORP.,** Beijing, China†	2,623.3	31,528.5	39,553.3	25	1	3	0	0	20	6	0	0
43	42	**KIEWIT CORP.,** Omaha, Neb., U.S.A.†	2,533.0	8,477.0	9,249.0	0	0	26	0	0	51	21	0	0
44	46	**KAJIMA CORP.,** Tokyo, Japan†	2,456.1	16,789.6	17,030.4	50	22	2	0	1	2	20	0	3
45	63	**SK ENGINEERING & CONSTRUCTION CO. LTD.,** Seoul, S. Korea†	2,433.9	5,752.5	8,035.2	6	0	0	0	0	89	4	0	0
46	32	**CITIC CONSTRUCTION CO. LTD.,** Beijing, China	2,417.2	2,730.2	4,474.9	77	0	0	0	0	12	10	0	0
47	44	**GRUPO ISOLUX CORSAN SA,** Madrid, Spain†	2,378.8	4,147.2	8,719.1	0	0	44	4	2	7	16	0	1
48	27	**CHINA PETROLEUM ENG'G & CONSTRUCTION CORP.,** Beijing, China†	2,230.8	3,891.2	1,625.0	0	0	0	0	0	100	0	0	0
49	50	**IMPREGILO SPA,** Milan, Italy†	2,185.2	2,722.6	7,235.9	0	0	1	56	11	0	19	0	0
50	57	**DAEWOO E&C CO. LTD.,** Seoul, S. Korea†	2,170.9	6,098.4	11,506.8	8	0	24	9	0	59	0	0	0
51	49	**OBAYASHI CORP.,** Tokyo, Japan†	2,077.0	15,567.0	12,493.0	38	10	4	12	2	0	30	0	2

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RANK 2012	RANK 2011	FIRM	2011 REVENUE $ MIL. INT'L	2011 REVENUE $ MIL. TOTAL	2011 NEW CONTRACTS $ MIL	GENERAL BUILDING	MANUFACTURING	POWER	WATER SUPPLY	SEWER / WASTE	INDUS. / PETROLEUM	TRANSPORTATION	HAZARDOUS WASTE	TELECOM
52	53	**JAN DE NUL GROUP (SOFIDRA SA),** Capellen, Luxembourg†	2,066.0	2,732.0	NA	3	0	0	0	0	0	97	0	0
53	58	**SEPCOIII ELECTRIC POWER CONSTRUCTION CORP.,** Qing Dao, China	2,019.6	2,178.7	256.0	0	0	100	0	0	0	0	0	0
54	66	**ACCIONA INFRAESTRUCTURAS,** Madrid, Spain†	1,956.9	4,380.6	3,401.7	20	3	9	2	1	1	54	0	0
55	45	**SACYR VALLEHERMOSO,** Madrid, Spain†	1,947.2	5,223.7	8,838.6	23	0	0	11	0	0	66	0	0
56	59	**POLIMEKS INSAAT TAAHHUT VE SAN TIC. AS,** Istanbul, Turkey	1,941.0	1,941.0	213.0	64	0	0	0	0	9	11	0	15
57	55	**VAN OORD,** Rotterdam, The Netherlands†	1,768.1	2,229.5	2,018.9	0	0	3	0	0	25	72	0	0
58	77	**LARSEN & TOUBRO LTD.,** Mumbai, India†	1,659.0	11,018.0	13,135.0	11	0	48	1	3	29	8	0	0
59	65	**ASTALDI SPA,** Rome, Italy†	1,601.9	2,955.5	4,321.4	2	0	9	1	0	2	86	0	0
60	62	**TAISEI CORP.,** Tokyo, Japan†	1,597.0	14,259.0	14,817.0	2	4	0	1	0	0	79	0	0
61	72	**JACOBS,** Pasadena, Calif., U.S.A.	1,586.3	3,477.9	3,829.3	3	0	5	0	0	91	1	0	0
62	71	**CHINA GEZHOUBA GROUP CO. LTD.,** Wuhan, Hubei, China†	1,573.1	6,152.2	10,028.1	12	1	53	14	0	0	12	0	0
63	56	**SAMSUNG C&T CORP.,** Seoul, S. Korea†	1,571.5	6,201.8	10,549.6	12	8	29	0	0	13	38	0	0
64	100	**SEPCO ELECTRIC POWER CONSTR. CORP.,** Jinan, Shandong, China†	1,569.5	4,336.8	965.2	0	0	100	0	0	0	0	0	0
65	141	**KHARAFI NATIONAL KSCC,** Safat, Kuwait†	1,558.0	2,447.0	4,984.0	9	0	68	0	4	19	0	0	0
66	123	**POSCO ENGINEERING & CONSTRUCTION,** Incheon, S. Korea	1,549.4	5,505.1	13,000.4	4	0	62	2	0	21	10	0	0
67	78	**SHANGHAI ELECTRIC GROUP CO. LTD.,** Shanghai, China†	1,546.0	2,013.9	5,217.1	0	0	100	0	0	0	0	0	0
68	64	**SNC-LAVALIN INTERNATIONAL INC.,** Montreal, Quebec, Canada†	1,528.6	2,901.1	NA	11	0	57	5	0	19	8	0	0
69	70	**CHIYODA CORP.,** Yokohama, Japan	1,467.0	2,205.0	6,775.0	0	0	0	0	0	93	0	0	0
70	51	**JOANNOU & PARASKEVAIDES GROUP OF COS.,** Guernsey, U.K.	1,462.5	1,462.5	1,200.0	24	0	8	1	2	3	58	4	0
71	90	**SALINI COSTRUTTORI SPA,** Rome, Italy†	1,432.7	1,854.4	1,902.0	5	0	0	39	0	0	57	0	0
72	76	**TOYO ENGINEERING CORP.,** Chiba, Japan†	1,406.3	1,921.3	3,276.5	0	0	29	0	0	71	0	0	0
73	67	**A. PORR AG,** Vienna, Austria	1,403.0	3,760.8	4,171.1	74	0	0	1	0	0	25	0	0
74	96	**TAKENAKA CORP.,** Osaka, Japan†	1,397.0	11,675.0	10,973.0	11	48	0	0	36	0	0	0	0
75	68	**ARABIAN CONSTRUCTION CO. SAL,** Beirut, Lebanon†	1,387.5	1,433.9	1,118.0	92	0	0	0	0	0	0	0	0
76	85	**CONSTRUTORA ANDRADE GUTIERREZ SA,** Belo Horizonte, MG, Brazil†	1,381.1	4,147.5	6,134.8	1	0	5	4	0	20	70	0	0
77	92	**CHINA NATIONAL CHEMICAL ENG'G GROUP CORP.,** Beijing, China†	1,368.1	6,698.1	10,162.7	0	0	20	0	2	77	0	0	0
78	52	**BESIX SA,** Brussels, Belgium†	1,347.1	2,219.7	2,752.5	54	0	1	0	5	0	40	0	0
79	82	**PUNJ LLOYD LTD.,** Gurgaon, Haryana, India†	1,332.0	2,249.0	2,882.0	29	0	2	2	0	58	7	0	0
80	79	**SHIMIZU CORP.,** Tokyo, Japan†	1,226.6	14,876.3	15,081.3	36	29	9	3	0	18	4	0	0
81	69	**RENAISSANCE CONSTRUCTION,** Ankara, Turkey†	1,196.9	1,300.4	2,061.6	71	8	0	0	0	21	1	0	0
82	84	**ED. ZUBLIN AG,** Stuttgart, Germany†	1,183.0	3,512.0	4,241.0	52	0	1	0	4	0	7	0	0
83	80	**DONGFANG ELECTRIC CORP.,** Chengdu, Sichuan, China†	1,169.7	7,635.6	7,094.5	0	0	99	0	0	0	1	0	0
84	133	**METKA,** Maroussi, Athens, Greece†	1,157.4	1,371.4	392.8	0	0	100	0	0	0	0	0	0
85	143	**COMSA EMTE,** Madrid, Spain†	1,139.0	2,860.8	NA	0	0	0	0	0	0	79	0	21
86	54	**SHANGHAI CONSTRUCTION GROUP,** Shanghai, China	1,109.7	16,682.8	16,909.0	72	0	2	0	0	4	22	0	0
87	87	**PENTA-OCEAN CONSTRUCTION CO. LTD.,** Tokyo, Japan	1,078.4	3,974.5	3,851.8	38	0	0	2	17	3	40	0	0
88	110	**TEKFEN CONSTRUCTION AND INSTALLATION CO. INC.,** Istanbul, Turkey†	1,048.0	1,129.0	1,034.0	4	2	5	0	0	64	25	0	0
89	**	**CHINA GENERAL TECHNOLOGY (GROUP) HOLDING LTD.,** Beijing, China†	995.6	3,178.2	7,848.5	0	0	63	0	0	19	15	0	0
90	102	**TAIKISHA LTD.,** Tokyo, Japan†	980.2	2,309.7	NA	2	49	0	0	0	49	0	0	0
91	86	**CHINA CIVIL ENGINEERING CONSTR. CORP.,** Beijing, China†	968.6	1,054.1	2,860.4	20	0	0	0	0	0	80	0	0
92	115	**CHINA INT'L WATER & ELECTRIC CORP. (CWE),** Beijing, China†	954.6	968.9	1,910.0	1	0	19	54	2	1	22	0	0
93	112	**CGC OVERSEAS CONSTRUCTION GROUP CO. LTD.,** Beijing, China†	912.6	988.3	827.2	3	0	0	19	1	0	76	0	0
94	75	**GAMA,** Ankara, Turkey†	912.6	955.3	1,341.2	1	0	54	27	0	18	0	0	0
95	88	**ENKA CONSTRUCTION & INDUSTRY CO. INC.,** Istanbul, Turkey†	881.7	992.9	1,446.4	26	0	11	1	0	22	40	0	0
96	101	**VEIDEKKE ASA,** Oslo, Norway†	877.0	2,570.0	NA	54	0	3	1	0	0	34	0	0
97	95	**HARBIN ELECTRIC INTERNATIONAL CO. LTD.,** Harbin, China	810.9	810.9	2,835.5	0	0	100	0	0	0	0	0	0
98	108	**JOHN SISK & SON LTD.,** Dublin, Leinster, Ireland†	802.0	1,592.0	1,500.0	69	0	16	0	0	8	7	0	0
99	118	**ZHONGYUAN PETROLEUM EXPLORATION BUREAU,** Puyang City, China†	777.8	2,811.2	2,811.2	0	0	0	0	0	100	0	0	0
100	131	**ANT YAPI CONSTRUCTION, INDUSTRY & TRADE CO.,** Istanbul, Turkey†	772.9	945.2	1,033.4	99	0	0	0	0	1	0	0	0
101	132	**HANWHA ENGINEERING & CONSTRUCTION CORP.,** Seoul, S. Korea†	771.2	2,622.0	4,415.5	2	0	77	2	0	19	0	0	0
102	103	**THE ARAB CONTRACTORS (O.A.O. & CO.),** Cairo, Egypt†	771.0	3,229.0	2,036.0	37	0	0	8	6	1	47	0	0

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103	105	**GHELLA SPA,** Rome, Italy†	757.0	900.0	534.0	3	0	22	14	1	0	58	0	0
104	127	**QINGJIAN GROUP CO. LTD.,** Qingdao, Shandong, China†	744.9	4,829.9	4,934.8	96	0	0	3	0	0	1	0	0
105	104	**SOARES DA COSTA - GRUPO SGPS,** Porto, Portugal†	744.8	1,114.7	663.0	63	0	2	1	0	1	33	0	0
106	114	**TAV CONSTRUCTION,** Istanbul, Turkey	726.2	772.0	1,311.5	2	0	0	0	0	0	98	0	0
107	99	**BONATTI SPA,** Parma, Italy†	721.0	881.0	1,207.0	1	0	0	0	0	99	0	0	0
108	121	**WORLEYPARSONS LTD.,** North Sydney, NSW, Australia†	718.3	1,299.9	604.1	0	0	3	0	0	96	0	0	0
109	116	**MCCONNELL DOWELL CORP. LTD.,** Hawthorn, Victoria, Australia†	704.2	2,071.3	3,064.7	12	0	27	1	1	25	31	0	0
110	98	**ABB SPA - PROCESS AUTOMATION DIVISION,** Sesto San Giovanni, Italy†	681.2	831.3	139.2	0	0	12	0	0	88	0	0	0
111	94	**ORASCOM CONSTRUCTION INDUSTRIES (OCI),** Cairo, Egypt†	678.4	1,327.5	1,953.4	0	0	19	0	0	35	22	0	0
112	109	**BAUER AG,** Schrobenhausen, Germany†	637.2	891.4	1,097.1	27	3	18	9	3	11	22	0	4
113	74	**IBERDROLA INGENIERIA Y CONSTRUCCIÓN,** Madrid, Spain†	635.0	913.7	943.6	0	0	100	0	0	0	0	0	0
114	83	**SINOPEC ENGINEERING INC.,** Beijing, China	634.9	1,654.6	1,730.7	0	0	0	0	0	100	0	0	0
115	111	**CONTRACTING & TRADING CO. C.A.T. GROUP OF COS.,** Beirut, Lebanon†	613.7	614.2	6,173.7	11	0	1	0	0	58	30	0	0
116	134	**CTCI CORP.,** Taipei, Taiwan†	592.7	1,691.2	2,707.4	0	11	8	0	2	58	22	0	0
117	125	**CHINA JIANGSU INT'L ECON.-TECH. COOP. CORP.,** Nanjing, China†	582.5	1,314.2	1,618.3	86	0	0	8	0	0	6	0	0
118	137	**BLACK & VEATCH,** Overland Park, Kan., U.S.A.†	573.7	1,243.0	1,130.7	3	0	35	39	20	4	0	0	0
119	81	**TREVI FINANZIARIA INDUSTRIALE SPA,** Cesena, Italy†	571.1	689.7	826.3	51	0	0	17	0	0	8	0	0
120	122	**YUKSEL INSAAT CO. INC.,** Ankara, Turkey†	570.4	702.5	1,232.5	32	0	0	9	0	0	59	0	0
121	128	**C.M.C. DI RAVENNA,** Ravenna, Italy†	550.9	1,042.6	1,316.9	3	0	36	18	1	0	42	0	0
122	**	**OAS SA,** Sao Paulo, SP, Brazil†	542.5	3,038.3	16,121.6	3	0	26	13	2	0	56	0	0
123	89	**CHINA PETROLEUM PIPELINE BUREAU,** Langfang City, Hebei, China†	535.4	3,728.6	4,739.3	0	0	0	0	0	97	0	0	3
124	**	**DIA HOLDING FZCO,** Dubai, U.A.E.	521.7	521.7	1,116.9	74	0	11	1	2	0	12	0	0
125	176	**CHINA WANBAO ENGINEERING CORP.,** Beijing, China	507.8	507.8	1,913.8	0	92	2	0	0	0	0	5	0
126	173	**PER AARSLEFF A/S,** Aabyhoej, Denmark†	506.8	1,112.4	1,139.5	0	34	37	2	14	0	14	0	0
127	129	**CHINA GEO-ENGINEERING CORP.,** Beijing, China†	504.0	797.7	773.1	4	0	8	42	5	0	35	2	0
128	182	**NISHIMATSU CONSTRUCTION CO. LTD.,** Tokyo, Japan†	501.8	3,070.0	3,166.8	2	1	1	19	18	0	57	0	0
129	**	**CALIK ENERJI SANAYI VE TICARET AS,** Istanbul, Turkey†	486.3	486.3	873.0	0	0	100	0	0	0	0	0	0
130	171	**IMPRESA PIZZAROTTI & C. SPA,** Parma, Italy†	481.3	1,511.5	1,062.4	48	0	2	3	1	0	46	0	0
131	145	**CHINA DALIAN INT'L ECO. & TECHN. COOP. GROUP CO.,** Dalian, China†	467.5	506.2	276.9	88	0	0	0	0	2	10	0	0
132	146	**CENGIZ CONSTRUCTION INDUSTRY & TRADE CO. INC.,** Istanbul, Turkey†	466.9	1,488.5	712.7	0	0	0	46	0	0	18	0	0
133	135	**E. PIHL & SØN AS,** Kongens Lyngby, Denmark†	464.4	949.2	597.7	15	0	17	0	5	4	58	0	0
134	106	**SSANGYONG ENGINEERING & CONSTRUCTION CO. LTD.,** Seoul, S. Korea†	462.0	1,491.0	1,926.7	21	0	0	0	0	0	79	0	0
135	189	**ALARKO CONTRACTING GROUP,** Gebze/Kocaeli, Turkey	456.7	1,281.9	534.7	0	0	0	0	56	2	42	0	0
136	169	**ONUR TAAHHUT TICARET LTD. STL.,** Ankara, Turkey†	451.0	611.5	595.6	24	0	0	0	28	0	48	0	0
137	**	**THE BABCOCK & WILCOX CO.,** Charlotte, N.C., U.S.A.†	438.8	1,219.6	1,342.2	0	0	100	0	0	0	0	0	0
138	119	**HABTOOR LEIGHTON GROUP,** Dubai, U.A.E.†	434.0	1,757.0	1,440.0	78	0	0	22	0	0	0	0	0
139	164	**BENTINI SPA,** Faenza, Italy†	421.3	479.0	69.6	82	0	0	0	0	18	0	0	0
140	181	**SOCIETA ITALIANA PER CONDOTTE D'ACQUA SPA,** Rome, Italy†	421.1	1,085.9	938.4	0	0	0	16	0	0	76	0	0
141	155	**ANHUI FOREIGN ECONOMIC CONSTRUCTION CO.,** Hefei, Anhui, China	420.8	420.8	237.2	96	0	0	0	0	0	4	0	0
142	130	**MAPA INSAAT VE TICARET AS,** Ankara, Turkey	417.2	543.2	300.0	8	10	0	69	0	0	13	0	0
143	140	**YAPI MERKEZI INSAAT VE SANAYI AS,** Istanbul, Turkey†	410.1	708.8	466.4	7	1	0	0	11	0	81	0	0
144	165	**ECC,** Burlingame, Calif., U.S.A.†	405.9	505.6	1,232.9	62	0	1	2	0	0	26	8	0
145	168	**SHENYANG YUANDA ALUMINUM INDUS. ENG'G CO.,** Shenyang, China	396.7	1,493.0	1,650.7	100	0	0	0	0	0	0	0	0
146	113	**BEIJING CONSTRUCTION ENG'G GROUP CO. LTD.,** Beijing, China†	395.0	5,521.8	8,102.1	87	0	1	0	5	0	8	0	0
147	148	**B.L. HARBERT INTERNATIONAL LLC,** Birmingham, Ala., U.S.A.	393.7	617.4	663.1	100	0	0	0	0	0	0	0	0
148	139	**NATA CONSTRUCTION TOURISM TRADE & INDUSTRY,** Ankara, Turkey†	376.0	911.0	409.0	0	0	0	0	0	0	97	0	0
149	124	**NATIONAL PETROLEUM CONSTRUCTION CO. (NPCC),** Abu Dhabi, U.A.E.	375.9	1,154.9	658.1	0	0	0	0	0	100	0	0	0
150	152	**IRCON INTERNATIONAL LTD.,** New Delhi, Delhi, India	371.3	749.6	803.8	0	0	1	0	0	0	99	0	0
151	154	**CHINA HENAN INT'L COOP. GROUP CO. LTD.,** Zhengzhou, Henan, China	368.5	368.5	456.8	0	0	0	6	0	0	94	0	0
152	195	**LAKESHORE TOLTEST CORP.,** Detroit, Mich., U.S.A.†	367.5	566.4	550.1	30	0	0	10	0	8	52	1	0
153	222	**SHAPOORJI PALLONJI & CO. LTD.,** Mumbai, Maharashtra, India†	360.0	1,450.1	2,120.0	83	0	0	0	0	0	17	0	0

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154	120	**NUROL CONSTRUCTION AND TRADING CO.,** Ankara, Turkey†	353.0	649.0	326.3	61	0	0	20	8	0	11	0	0
155	177	**CHINA ZHONGYUAN ENGINEERING CORP.,** Beijing, China	346.9	361.3	NA	1	0	99	0	0	0	0	0	0
156	126	**RIZZANI DE ECCHER SPA,** Pozzuolo del Friuli (UD), Italy†	344.5	494.8	222.3	33	0	0	0	24	0	43	0	0
157	163	**XINJIANG BEIXIN CONSTRUCTION & ENG'G CO.,** Urumqi, Xinjiang, China†	340.6	1,864.6	5,015.8	63	0	0	0	0	0	36	0	0
158	159	**PETROLEUM PROJECTS & TECHNICAL CONSULTATIONS,** Cairo, Egypt†	339.2	982.0	982.0	0	0	0	0	0	100	0	0	0
159	183	**CHINA JIANGXI CORP. FOR INT'L ECO. & TECH. COOP.,** Nanchang, China†	336.4	345.6	580.3	48	0	0	16	0	1	34	0	0
160	161	**KAYI INSAAT SAN. VE TIC. AS,** Istanbul, Turkey†	335.7	388.8	581.8	100	0	0	0	0	0	0	0	0
161	136	**THE SHAW GROUP INC.,** Baton Rouge, La., U.S.A.	333.9	4,032.2	3,696.6	0	0	19	0	0	62	1	18	0
162	166	**TEPE INSAAT SANAYI A.S.,** Ankara, Turkey†	333.0	526.2	405.4	90	4	0	0	0	0	6	0	0
163	**	**DOOSAN ENGINEERING & CONSTRUCTION CO. LTD.,** Seoul, S. Korea	332.3	2,214.0	2,214.0	0	0	1	0	0	75	23	0	0
164	193	**CHINA WU YI CO. LTD.,** Fuzhou, Fujian, China†	329.5	1,022.5	1,188.2	21	4	0	0	0	6	69	0	0
165	211	**GAP INSAAT YATIRIM VE DIS TICARET AS,** Istanbul, Turkey†	328.6	328.6	69.6	30	0	0	0	0	29	41	0	0
166	187	**PAN-CHINA CONSTRUCTION GROUP CO. LTD.,** Beijing, China†	328.4	1,090.2	794.3	100	0	0	0	0	0	0	0	0
167	147	**CONSTRUCOES E COMERCIO CAMARGO CORREA SA,** Sao Paulo, Brazil†	321.8	3,146.4	2,131.8	0	0	6	25	17	4	48	0	0
168	209	**IC IBRAHIM CECEN INVESTMENT HOLDING INC.,** Ankara, Turkey†	320.9	814.8	914.5	92	0	0	0	0	0	8	0	0
169	158	**CHINA HUANQIU CONTRACTING & ENGINEERING CORP.,** Beijing, China†	319.6	2,916.5	6,495.6	0	0	0	0	0	100	0	0	0
170	221	**POSCO ENGINEERING CO.,** Seongnam City, S. Korea†	317.2	764.4	1,437.8	0	3	30	4	0	63	0	0	0
171	170	**ANHUI CONSTRUCTION ENG'G GROUP CO. LTD.,** Hefei, Anhui, China†	301.8	4,033.0	4,511.0	70	6	0	10	2	0	12	0	0
172	184	**SUMITOMO MITSUI CONSTRUCTION CO. LTD.,** Tokyo, Japan†	301.6	3,005.7	3,200.5	26	6	0	0	1	29	38	0	0
173	194	**METAG INSAAT TICARET AS,** Ankara, Turkey	294.6	294.6	521.7	51	0	0	0	0	0	49	0	0
174	197	**SICIM SPA,** Busseto (PR), Italy†	292.3	295.1	785.0	0	0	0	0	0	100	0	0	0
175	199	**RASEN INSAAT VE YATIRIM TICARET AS,** Istanbul, Turkey†	287.2	287.2	163.0	100	0	0	0	0	0	0	0	0
176	185	**AMEC PLC,** London, U.K.†	276.0	827.3	NA	15	0	7	0	0	31	5	0	0
177	186	**GRUPO SANJOSE SA,** Tres Cantos, Madrid, Spain†	272.5	1,012.1	711.5	97	0	2	0	0	0	0	0	0
178	192	**DOGUS INSAAT VE TICARET AS,** Istanbul, Turkey†	269.8	536.2	730.0	10	0	0	0	0	0	90	0	0
179	**	**YENIGUN CONSTRUCTION INC.,** Ankara, Turkey	264.9	264.9	339.0	71	0	0	0	3	0	26	0	0
180	144	**PJSC STROYTRANSGAZ,** Moscow, Russia†	263.0	1,496.0	1,300.0	7	0	0	0	0	93	0	0	0
181	217	**LIMAK INSAAT SANAYI VE TICARET AS,** Ankara, Turkey	262.5	813.5	1,963.0	30	0	0	27	0	0	44	0	0
182	172	**SENER INGENIERIA Y SISTEMAS SA,** Las Arenas (Getxo), Vizcaya, Spain†	258.6	746.2	743.5	0	20	28	0	0	48	4	0	0
183	138	**ELLAKTOR SA,** Kifissia, Greece†	253.3	1,558.3	1,346.0	3	0	3	0	16	0	78	0	0
184	**	**ZHONGMEI ENGINEERING GROUP LTD.,** Nanchang, Jiangxi, China	250.1	250.1	206.2	0	0	0	12	2	0	87	0	0
185	156	**KINDEN CORP.,** Tokyo, Japan†	248.0	5,543.0	5,543.0	52	8	17	8	0	1	10	0	5
186	**	**AECON GROUP INC.,** Toronto, Ontario, Canada†	243.0	2,896.0	2,000.0	6	3	33	0	0	0	55	0	0
187	180	**ARABTEC CONSTRUCTION LLC,** Dubai, U.A.E.†	242.6	1,214.8	2,559.3	100	0	0	0	0	0	0	0	0
188	190	**PREZIOSO TECHNILOR,** Vienne, France†	240.2	415.3	380.0	0	0	8	0	0	92	0	0	0
189	188	**GRAHAM GROUP LTD.,** Calgary, Alberta, Canada	240.0	2,000.0	2,900.0	63	0	0	0	0	0	38	0	0
190	206	**ZHONGDING INT'L ENGINEERING CO. LTD.,** Nanchang, Jiangxi, China†	239.4	239.4	223.1	49	0	2	9	1	0	0	0	0
191	**	**TACA CONSTRUCTION INC.,** Levent, Istanbul, Turkey	238.4	260.4	61.3	100	0	0	0	0	0	0	0	0
192	160	**CH2M HILL,** Englewood, Colo., U.S.A.†	238.1	768.5	1,740.4	25	7	14	1	6	41	0	5	0
193	210	**SUMMA TURIZM YATIRIMCILIGI AS,** Ankara, Turkey†	235.9	235.9	475.4	100	0	0	0	0	0	0	0	0
194	205	**URS CORP.,** San Francisco, Calif., U.S.A.†	233.0	2,266.4	2,291.2	1	10	29	0	0	2	9	1	0
195	214	**ZHEJIANG CONSTR. INVEST. GROUP CO. LTD.,** Hangzhou, Zhejiang, China†	232.9	5,832.4	6,962.0	100	0	0	0	0	0	0	0	0
196	**	**TODA CORP.,** Tokyo, Japan†	232.0	5,798.0	5,155.0	19	65	0	4	0	12	0	0	0
197	**	**ALBERICI CORP.,** St. Louis, Mo., U.S.A.†	231.8	872.6	1,268.9	1	10	0	57	0	33	0	0	0
198	**	**ESER CONTRACTING AND INDUSTRY CO. INC.,** Ankara, Turkey†	228.4	293.0	1,004.0	5	0	0	38	25	0	30	0	3
199	**	**CHINA NATIONAL ELECTRONICS IMP. & EXP. CORP.,** Beijing, China	227.8	227.8	359.2	15	0	7	0	0	17	0	0	28
200	175	**WILLBROS GROUP INC.,** Houston, Texas, U.S.A.†	227.2	1,447.8	NA	0	0	0	0	0	100	0	0	0
201	117	**STFA CONSTRUCTION GROUP,** Istanbul, Turkey	224.8	246.2	480.0	3	0	0	0	1	0	91	0	0
202	157	**ATLAS GROUP,** Ankara, Turkey†	224.0	239.0	217.5	100	0	0	0	0	0	0	0	0
203	203	**CHINA PETROLEUM PIPELINE ENG'G CORP.,** Langfang City, Hebei, China	222.5	246.1	223.6	0	0	0	0	0	100	0	0	0
204	219	**LAYNE CHRISTENSEN CO.,** Mission Woods, Kan., U.S.A.†	222.3	1,089.1	1,037.5	0	0	0	5	0	0	0	0	0

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RANK 2012	RANK 2011	FIRM	2011 REVENUE $ MIL. INT'L	2011 REVENUE $ MIL. TOTAL	2011 NEW CONTRACTS $ MIL	GENERAL BUILDING	MANUFACTURING	POWER	WATER SUPPLY	SEWER / WASTE	INDUS. / PETROLEUM	TRANSPORTATION	HAZARDOUS WASTE	TELECOM
205	202	**JIANGSU NANTONG NO. 3 CONSTR. GRP. CO.,** Haimen, Jiangsu, China†	218.3	3,200.6	3,070.4	100	0	0	0	0	0	0	0	0
206	174	**IREM GROUP,** Siracusa, Italy†	216.0	295.0	NA	0	0	21	0	0	79	0	0	0
207	208	**MORTENSON CONSTRUCTION,** Minneapolis, Minn., U.S.A.	213.2	2,467.6	2,192.0	0	0	100	0	0	0	0	0	0
208	220	**CHINA YUNAN CONSTR. ENG'G GROUP CO. LTD.,** Kunming, Yunnan, China†	210.1	3,844.4	5,138.0	97	0	0	0	0	0	3	0	0
209	200	**NANTONG CONSTR. GROUP JOINT-STOCK CO.,** Nantong, Jiangsu, China†	204.5	1,602.9	1,400.1	33	0	0	1	0	66	0	0	0
210	**	**ELECTRA LTD.,** Ramat Gan, Israel†	200.3	849.0	627.7	100	0	0	0	0	0	0	0	0
211	223	**BETA TEK INSAAT,** Istanbul, Turkey†	198.8	198.8	341.2	26	44	0	0	0	30	0	0	0
212	216	**RENCO SPA,** Pesaro, Italy†	198.1	206.2	101.5	18	0	29	0	0	54	0	0	0
213	**	**KONTEK CONSTRUCTION,** Istanbul, Turkey	194.4	194.4	346.0	100	0	0	0	0	0	0	0	0
214	224	**MAKYOL CONSTR. INDUS. TOURISM & TRADING INC.,** Istanbul, Turkey†	193.0	615.7	403.2	0	0	0	0	0	0	100	0	0
215	**	**JIANGSU NANTONG LIUJIAN CONSTR. GRP. CO.,** Rugao, Jiangsu, China†	190.2	1,996.4	1,682.6	100	0	0	0	0	0	0	0	0
216	213	**M/S. AFCONS INFRASTRUCTURE LTD.,** Mumbai, Maharashtra, India	180.2	461.6	178.2	0	0	0	0	0	0	100	0	0
217	218	**TUTOR PERINI CORP.,** Sylmar, Calif., U.S.A.†	177.8	4,404.0	2,606.7	64	0	2	25	0	0	9	0	0
218	201	**INGENIUM INTERNATIONAL INC.,** Detroit, Mich., U.S.A.†	175.8	175.8	85.2	71	0	0	0	0	0	28	0	0
219	**	**SINOSTEEL EQUIPMENT & ENGINEERING CO. LTD.,** Beijing, China	175.1	1,106.3	1,800.0	0	0	0	0	0	100	0	0	0
220	**	**THE LAUREN CORP.,** Abilene, Texas, U.S.A.†	171.5	223.8	256.3	0	0	18	0	0	72	0	0	0
221	**	**SINOPEC SHANGHAI ENGINEERING CO. LTD.,** Shanghai, China	171.2	394.0	533.2	0	0	0	0	0	57	43	0	0
222	**	**ENERGOPROJEKT HOLDING PLC,** Belgrade, Serbia†	168.5	259.7	270.4	54	0	8	0	0	0	38	0	0
223	**	**MWH GLOBAL,** Broomfield, Colo., U.S.A.†	165.0	468.0	713.0	0	0	0	35	65	0	0	0	0
224	**	**CADDELL CONSTRUCTION CO. INC.,** Montgomery, Ala., U.S.A.	162.8	422.5	339.4	100	0	0	0	0	0	0	0	0
225	**	**WEIHAI INTERNATIONAL ECO. & TECH. COOP. CO. LTD.,** Weihai, China†	152.3	152.3	284.3	49	0	0	8	0	0	42	0	1

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Appendix B

Code Form

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Evaluator: _____ Date: _____

Name of Company: _____

Topic	Question	Measurement scale	Score
1. Corporate environmental policies	How well the contractor addresses environmental issues in its corporate policies?	0: Not addressed 1: General rhetoric 2: Commit to regulatory compliance 3: Setting organizational goal / target 4: Invest in clean technology	
2. Standardization of environmental management system	To what extent the contractor standardized its management system in the international operation?	0: Not addressed 1: Limited 2: Partial mandated (some division) 3: Committed to extend to the whole group	
3. Senior environmental executive	Does the contractor assign senior environmental executive to manage the environmental issues?	0: Not addressed 1: Yes	
4. Formal organizational structure	Does the contractor incorporate formal organizational structure for environmental matter?	0: Not addressed 1: Yes	
5. Reporting structure level	To what extent the contractor establishes their environmental reporting structure?	0: Not addressed 1: Facility level 2: Senior environmental executive 3: Board of Directors	

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6. Environmental information is being circulated internally	Does the contractor circulate environmental information internally?	0: Not addressed 1: Yes	
7. Environmental reporting is external audited	Does the environmental reporting audited by external party?	0: Not addressed 1: Yes	
8. Environmental reporting meet international reporting requirement	How well the environmental reporting comply to the international standard?	0: Not addressed 1: Partially comply 2: Highly comply (GRI rating A or A+)	
9. Environmental training programs	To what extent the contractor emphasis on employee training in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of training programs 3: provide details of training programs, and training coverage is being measured and reviewed	
10. Surveillance of the risks and business opportunities for environmental issues	To what extent the contractor surveil the risks and opportunities on environmental issues?	0: Not addressed 1: Written statement, limited coverage and ambiguous endeavour 2: Written statement with limited coverage and endeavour 3: Written statement with broader coverage and more specified endeavour 4: Broad coverage and well specify endeavour	

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11. Address an environmental issue earlier than competitors (establish environmental policy, program, department, etc., EMS excluded)	When was the contractor first embraced corporate environmentalism in operation?	0: Not addressed 1: 1-10 years 2: 11-20 years 3: 21-30 years 4: >30 years	
12. Year of EMS first been certified	When was the first environmental management system adopted?	Write down the year:____ 0: Not addressed 1: 1-3 years 2: 4-6 years 3: 7-9 years 4: >9 years	
13. Environmental R&D	To what extent the contractor invests in environmental R&D?	0: Not addressed 1: General rhetoric 2: Statements with research commitment and outcomes but little explanation 3: Statements with research commitment and well explained outcomes such as showing the advantages and improvement 4: Statement that shows high commitment and detailed research outcomes that aligned with business	

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14. Life cycle analysis (adopt green building standard)	Does the contractor incorporate or provide service of life cycle analysis in the product development?	0: not addressed 1: only statement 2: provide details of implementation, examples	
15. Incorporate environmental impact assessment in the planning of construction	Does the contractor incorporate or provide service of environmental impact assessment in the planning of construction?	0: not addressed 1: only statement 2: provide details of implementation, examples	
16. Include supplier policy in the construction procurement	Does the contractor establish environmental procurement policy in the selection of supplier?	0: not addressed 1: only statement 2: provide details of implementation, examples	
17. Integrate interest between firm and **Government / public agencies** through environmental program	Does the contractor recognize the interest of government / public agencies in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
18. Integrate interest between firm and **NGO** through environmental program	Does the contractor recognize the interest of NGO in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
19. Integrate interest between firm and **Business/industry associations** through environmental program	Does the contractor recognize the interest of business or industry association in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	

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20. Integrate interest between firm and **Community programs** through environmental program	Does the contractor recognize the interest of community programs in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
21. Integrate interest between firm and **International agreements** through environmental program	Does the contractor recognize the interest of international agreements (UN Global Compact, OECD in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
22. Integrate interest between firm and **Customer** through environmental program	Does the contractor recognize the interest of customers in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
23. Integrate interest between firm and **Supplier** (exclude procurement) through environmental program	Does the contractor recognize the interest of supplier in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
24. Integrate interest between firm and **Employee** through environmental program	Does the contractor recognize the interest of employees in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	
25. Integrate interest between firm and Socially responsible **shareholders** through environmental program	Does the contractor recognize the interest of socially responsible shareholder (listed in Dow Jones Sustainability Indices, communicate with shareholders) in regard of environmental issues?	0: not addressed 1: only statement 2: provide details of implementation, examples	

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26. **Energy efficient** practices in office and administration	Using energy saving electronic appliance, air-conditioning and ventilation system etc.	0: no 1: Provide measures 2: Provide measures and publish results	
27. **Water efficient** practices in office and administration	Recycle used water, water conservation of office etc.	0: no 1: Provide measures 2: Provide measures and publish results	
28. **Waste reduction** (reuse, recycling etc.) practices in office and administration	Reduce, reuse, recycle office paper, furniture etc.	0: no 1: Provide measures 2: Provide measures and publish results	
29. Eco efficient **transportation** practices in office and administration	Reduce the need to travel, adopt car-pooling program or clean energy vehicle for employee, teleworking etc.	0: no 1: Provide measures 2: Provide measures and publish results	
30. **Efficient use of energy** in construction and production facility	Low-energy urban development, passive heating and cooling through orientation, using alternative energy sources, choosing materials with low embodied energy, avoidance of heat gain and loss through insulation and additional devices, utilizing energy efficient equipment	0: no 1: Provide measures 2: Provide measures and publish results	
31. **Efficient use of water** in construction and production facility	Potable water reduction, utilizing non-potable water substitution systems, recycling water, designing low-demand landscaping, collecting rainwater	0: no 1: Provide measures 2: Provide measures and publish results	

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32. **Efficient use of materials** in construction and production facility	Adapting existing buildings to new uses, incorporating recycled or reclaimed materials reducing material use by properly sizing the building, selecting durable materials, selecting materials that are recyclable, reducing waste material	0: no 1: Provide measures 2: Provide measures and publish results	
33. **Emission control** in construction and production facility	Minimize greenhouse gas, dust control	0: no 1: Provide measures 2: Provide measures and publish results	
34. Oil and **chemical spill control** in construction and production facility	Monitoring and preventing oil and chemical spill	0: no 1: Provide measures 2: Provide measures and publish results	
35. **Noise control** in construction practices	Prevent and minimize noise emission	0: no 1: Provide measures 2: Provide measures and publish results	
36. **Efficient use of land and preserve biodiversity** in construction and production facility	Using existing built environment, respecting the natural landscape, preventing the expansion of the built environment, prevent erosion, restricting the amount of soil taken off project sites, preserving biodiversity, land recovery after construction, brownfield revitalization	0: no 1: Provide measures 2: Provide measures and publish results	

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37. **Integration with long-term business strategy** (vision and future commitment)	To what extent the management integrate environmental issues in their long-term business planning?	0: No visionary statement 1: Written statement, ambiguous endeavour 2: Written statement with specific endeavour 3: Progress is reviewed and follow-up 4: Conduct long term master planning	
38. **More likely to adopt and implement new environmental innovation either in design, planning, construction process, service or product as compare to competitors. (construction)**	Does the contractor more likely to adopt and implement new environmental innovation in their design, planning, construction process, service or product development? Score is depended on degree of novelty of innovation	0: not addressed 1: implement and adopt well recognized and common environmental technology or method, but new to the contractor 2: adopt new to the market innovation and the main market is national 3: implement and adopt novel and unique environmental technology or method, first in the international market	

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Appendix C

Code Book

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Topic	Sample phrases / Examples / Criteria	Measurement scale
1. Corporate environmental policies	5. XXX works together with and for the benefit of the environment, in harmony with the local people, and in accord with their culture…… a mutual understanding between geographical and cultural contexts and with the economic and social fabric, an integration that favours new development opportunities. 6. Compliance with national and European environmental legislative requirements, as well as continuous improvement…… 7. XXX recognises the environmental impacts of its activities and takes steps to limit them, in particular by using ISO 14001 certification. The Group endeavours to reduce its consumption of natural resources and energy, cut waste and CO_2 emissions, evaluate and limit health and toxicological impacts and preserve biodiversity. 8. XXX's policy is to address the environmental aspects of its operations at all levels. In addition to complying with regulations and anticipating regulatory changes, the Group's companies consider the environmental challenge to be a real and expanding opportunity for business development. R&D efforts focus heavily on improving the environmental performance of everyday life, infrastructure and mobility.	0: Not addressed 1: General rhetoric 2: Commit to regulatory compliance 3: Setting organizational goal / target 4: Invest in clean technology
2. Standardization of environmental management system	4. 65 iso 9001 quality management certifications, 10 iso 14001 environmental management certifications. 5. XXX's environmental performance in North America, the United Kingdom, the Middle East-North Africa region, and Australia is managed, monitored, and improved through our formal EMS programs, guided by the ISO 14001 Standard. Throughout the world, environmental stewardship is encouraged and championed by informal green teams that address sustainability issues in their offices and communities.	0: Not addressed 1: Limited 2: Partial mandated (some division) 3: Committed to extend to the whole group

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	6. Progressively extend the environmental management system (EMS) to all Group companies.	
3. Senior environmental executive	2. Deputy CEO of the XXX group, oversees Group-wide sustainable development initiatives. 3. Infrastructure & Environment Division appointed a Sustainability Business Line Director with responsibility for expanding our global sustainability practice and for leading the development of an internal sustainability program.	0: Not addressed 1: Yes
4. Formal organizational structure	Group Sustainable Development and Quality Safety Environment (QSE) Department Quality and HSE Division	0: Not addressed 1: Yes
5. Reporting structure level	4. At the corporate level, we provide oversight using, among other things, a Balanced Scorecard, while the business segments are empowered with the flexibility to implement in accordance with the business priorities. 5. A Sustainability Board, comprising the XXX Executive Committee, will now be accountable for the sustainability performance of XXX. 6. The Board of Directors has primary responsibility for defining, promoting and overseeing the Group's Corporate Responsibility strategy.	0: Not addressed 1: Facility level 2: Senior environmental executive 3: Board of Directors
6. Environmental information is being circulated internally	Environmental information is published regularly across the whole Group and keeps staff updated on issues such as handling waste materials and any legal changes.	0: Not addressed 1: Yes
7. Environmental reporting is external audited	This report has been independently verified by the BSI for content reliability.	0: Not addressed 1: Yes
8. Environmental reporting meet	We report our sustainability performance according to the Global Reporting Initiative's (GRI) indicators. Our self-declared level of application of the GRI Guidelines is B.	0: Not comply 1: Partially comply

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international reporting requirement		2: Highly comply (GRI rating A or A+)
9. Environmental training programs	4. As part of the Green Team initiative, XXX employees receive training on what they can do to improve the Company's overall environmental performance. 5. In order to sensitise our employees to this issue, regular training sessions are held in which company waste representatives are brought up-to-date on the latest laws and technology so they can pass this information on to the employees. 6. In 2011, 8,063 hours of environmental training were taught in Spain to 1,117 employees through courses and informal discussions in various forms	0: not addressed 1: only statement 2: provide details of training programs 3: provide details of training programs, and training coverage is being measured and reviewed
10. Surveillance of the risks and business opportunities for environmental issues	5. Through our production processes at production facilities and at construction sites as well as in transport, contamination of air and water is possible. We counter such risks through preventative measures in the selection of materials and products, the course of the processes and work instructions as well as through relevant controls. We are insured against any environmental damage that may occur despite these precautions. 6. The responses to those challenges are also business opportunities that Bouygues Construction intends to grasp. A new Innovation and Sustainable Construction department coordinates…… 7. *Not given. 8. Like many businesses in the twenty-first century, XXX faces a complex range of sustainability risks and opportunities that can have a material impact on our business performance in the short, medium and long term. A selection of these risks and opportunities is presented below, alongside actions taken by the Group.	0: Not addressed 1: Written statement, limited coverage and ambiguous endeavour 2: Written statement with limited coverage and endeavour 3: Written statement with broader coverage and more specified endeavour 4: Broad coverage and well specified endeavour
11. Address an environmental issue earlier than competitors (establish environmental	3. In Canada, XXX has had an environmental policy since 1994, and we opened our Office of Aboriginal and Northern Affairs in 1998. 4. 1980 – establishment of Safety and Environmental Protection department	0: Not addressed 1: 1-10 years 2: 11-20 years

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policy, program, department, etc., EMS excluded)		3: 21-30 years 4: >30 years
12. Year of EMS first been certified	*Not given.	Write down the year:__ 0: Not addressed 1: 1-3 years 2: 4-6 years 3: 7-9 years 4: >9 years
13. Environmental R&D	5. As part of the Sustainability Initiative, the office has researched funding possibilities for use on our projects 6. Among the R&D&I projects developed by the Group, highlight the following: "Use of recycled products in civil engineering." Project funded by CITD, "Energy recovery from biomass by gasification Forcarei"…… 7. To guarantee the FaunaGuard's effectiveness, XXX collaborates with renowned marine research XXX. Experts in the fields of marine biology and underwater acoustics are involved to establish which animals respond to which signals under laboratory conditions. Successful experiments have been completed for several sorts of fish, porpoises and marine turtles. 8. For years XXX has been committed to internal research and development. In 2009 alone, over 20 development projects were subsidized at XXX. One particularly important method developed independently by XXX is the BIOPUSTER© method. It is used for waste treatment and significantly reduces pollution from methane gas, proven to be a key contributor to climate change. The BIOPUSTER© method involves blasting oxygen into waste…... Another method developed by XXX helps to conserve groundwater……	0: Not addressed 1: General rhetoric 2: Statements with research commitment and outcomes but little explanation 3: Statements with research commitment and well explained outcomes such as showing the advantages and improvement 4: Statement that shows high commitment and detailed research outcomes that aligned with business

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14. Life cycle analysis (adopt green building standard)	3. We do this by integrating sustainability principles into each step of the project life cycle—from planning, design, construction, and operations to sustaining the project or program over time. 4. XXX's goal is to produce Environmental Product Declarations (EPDs) for our core products. They describe and quantify the environmental impact and performance of XXX products through every phase of their life cycles, covering raw material extraction, component manufacture, transportation and use over their full operating lifetime. We have developed associated Life Cycle Assessment (LCA) tools……	0: not addressed 1: only statement 2: provide details of implementation, examples
15. Incorporate environmental impact assessment in the planning of construction	3. Before the start of the projects, XXX Group conducts the appropriate environmental impact study, choosing the most environmentally friendly option from the choices available. 4. On the basis of the impacts identified in the approved Environmental and Social Impact Assessment (ESIA), an Environmental and Social Management Plan (ESMP) is prepared and submitted to the client for its review and approval. The ESMP describes the proposed measures that the contractor, the client and other institutions will have to implement during construction and operational phases of the project, to ensure compliance with all the socio-environmental requirements identified in the ESIA.	0: not addressed 1: only statement 2: provide details of implementation, examples
16. Include supplier policy in the construction procurement	Green Strategic Procurement Agreements: spent US$31 million last year on green procurement agreements for materials used internally such as office furniture, and developing a similar strategy for project materials such as concrete and steel. This strategy for sustainable procurement is a fundamental component of our decision to select or keep certain contractors. The procurement of construction machinery, equipment, plant and vehicles takes into account the environmental compatibility of the procured items.	0: not addressed 1: only statement 2: provide details of implementation, examples

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17. Integrate interest between firm and **Government / public agencies** through environmental program	In China, XXX supported government activities in the area of energy conservation and environment protection in line with China's 12th Five-Year Plan. Jan Dell, XXX Vice President, Energy & Water Division, has been appointed by the U.S. Secretary of Commerce Gary Locke to serve a 3-year term as a member of the National Climate Assessment Development and Advisory Committee.	0: not addressed 1: only statement 2: provide details of implementation, examples
18. Integrate interest between firm and **NGO** through environmental program	The British subsidiary of FCC Waste Recycling Group, in collaboration with Hertfordshire County Council and the Sue Ryder NGO, is working on a project for social and environmental innovation that the recycling centre in Harpington (UK) represents.	0: not addressed 1: only statement 2: provide details of implementation, examples
19. Integrate interest between firm and **Business/industry associations** through environmental program	XXX Group continued in its participation and involvement in industry associations and CSR forums such as ASEPAM (Spanish Network for the United Nations Global Compact), Club of Excellence in Sustainability, Forética, CSR Commission of the CEOE (Spanish Confederation of Employers' Organisations), State Council of Social responsibility of Companies (CErSE), Pro-Clima Forum Madrid, Fundación Carolina.	0: not addressed 1: only statement 2: provide details of implementation, examples
20. Integrate interest between firm and **Community programs** through environmental program	During 2011 XXX Group launched the second edition of its environmental classes under the slogan "The future of the earth lies in the classroom".	0: not addressed 1: only statement 2: provide details of implementation, examples
21. Integrate interest between firm and **International agreements** through environmental program	The company adheres to the United Nations Global Compact, and the OECD Guidelines for Multinational Enterprises, which makes express reference to the freedoms of association and collective bargaining, are among the guiding principles of its policy.	0: not addressed 1: only statement 2: provide details of implementation, examples

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22. Integrate interest between firm and **Customer** through environmental program	At every stage of a project, we take into account the environmental challenges and offer innovative solutions tailored to the client's technical and geographic needs.	0: not addressed 1: only statement 2: provide details of implementation, examples
23. Integrate interest between firm and **Supplier** (exclude procurement) through environmental program	Our Incident & Injury Free and Employee Excellence Awards recognise outstanding achievements in safety, sustainability, leadership and business performance by not just our employees and projects, but also by our suppliers and project partners. Award categories include: Leadership in Safety; Leadership in Innovation; Leadership in Environmental Sustainability…… Supplier sustainability awareness training developed and delivered to over 200 suppliers in India and China.	0: not addressed 1: only statement 2: provide details of implementation, examples
24. Integrate interest between firm and **Employee** through environmental program	XXX holds an alternative transportation "Try It" week to encourage employees to experiment with different commuting modes, which culminates in Bike to Work Day. All U.S. employees have access to a program to use pre-tax dollars to pay for transit passes.	0: not addressed 1: only statement 2: provide details of implementation, examples
25. Integrate interest between firm and Socially responsible **shareholders** through environmental program	XXX has been a member of the Dow Jones Sustainability Index for ten years, confirming its reputable performance in sustainable development. We also engage with security holders through our reporting to the Dow Jones Sustainability World Index. *Actively communicate with shareholder on environmental issues	0: not addressed 1: only statement 2: provide details of implementation, examples
26. **Energy efficient** practices in office and administration	*Using energy saving electronic appliance, air-conditioning and ventilation system etc.	0: no 1: Provide measures 2: Provide measures and publish results

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27. **Water efficient** practices in office and administration	*Recycle used water, water conservation of office etc.	0: no 1: Provide measures 2: Provide measures and publish results
28. **Waste reduction** (reuse, recycling etc.) practices in office and administration	*Reduce, reuse, recycle office paper, furniture etc.	0: no 1: Provide measures 2: Provide measures and publish results
29. Eco efficient **transportation** practices in office and administration	*Reduce the need to travel, adopt car-pooling program or clean energy vehicle for employee, teleworking etc.	0: no 1: Provide measures 2: Provide measures and publish results
30. **Efficient use of energy** in construction and production facility	*Low-energy urban development, passive heating and cooling through orientation, using alternative energy sources, choosing materials with low embodied energy, avoidance of heat gain and loss through insulation and additional devices, utilizing energy efficient equipment	0: no 1: Provide measures 2: Provide measures and publish results
31. **Efficient use of water** in construction and production facility	*Potable water reduction, utilizing non-potable water substitution systems, recycling water, designing low-demand landscaping, collecting rainwater	0: no 1: Provide measures 2: Provide measures and publish results
32. **Efficient use of materials** in construction and production facility	*Adapting existing buildings to new uses, incorporating recycled or reclaimed materials, reducing material use by properly sizing the building, selecting durable materials, selecting materials that are recyclable, reducing waste material	0: no 1: Provide measures 2: Provide measures and publish results

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33. **Emission control** in construction and production facility	*Minimize greenhouse gas, dust control	0: no 1: Provide measures 2: Provide measures and publish results
34. Oil and **chemical spill control** in construction and production facility	*Monitoring and preventing oil and chemical spill	0: no 1: Provide measures 2: Provide measures and publish results
35. **Noise control** in construction and production facility	*Prevent and minimize noise emission	0: no 1: Provide measures 2: Provide measures and publish results
36. **Efficient use of land and preserve biodiversity** in construction and production facility	*Using existing built environment, respecting the natural landscape, preventing the expansion of the built environment, prevent erosion, restricting the amount of soil taken off project sites, preserving biodiversity, land recovery after construction, brownfield revitalization	0: no 1: Provide measures 2: Provide measures and publish results

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37. **Integration with long-term business strategy** (vision and future commitment)	5. In the future, we will continue to improve corporate governance and information accessibility so as to realize sustainable operations and fulfil CSR with greater effort in all aspects. 6. In the future, we plan to focus on developing and strengthening the programs and systems that will help us further integrate environmental stewardship into our operations…… The following is a list of actions to achieve this goal 7. XXX has set itself the following sustainability targets for completion by 31 December 2012…… Progress against commitments is listed below…… 8. As part of this view to 2020, in 2011 the XXX Group adopted its new Corporate responsibility Master Plan covering the 2012 – 2014 period. The Plan also takes stock of the results of the previous one (2009-2010), strengthening the points in the Plan on which the company can move forward in an even more resolute manner.	0: No visionary statement 1: Written statement, ambiguous endeavour 2: Written statement with specific endeavour 3: Progress is reviewed and follow-up 4: Conduct long term master planning
38. **More likely to adopt and implement new environmental innovation either in**	4. Designed to meet LEED® Gold standards, the facility is a striking, low-lying construction that uses natural earth as a wall and relies on passive energy for heating and cooling.	0: not addressed

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design, planning, construction process, service or product as compare to competitors. (construction)	5. In December 2005, XXX built the first 3-liter house (a house that requires only 3 liters of heating oil per square meter per year) in Korea as an example of a passive house that generates only 20-30% of the cooling and heating costs compared to conventional houses. In September 2006, in our Construction Environment Research Center in Daejeon, we built the first 3-liter apartment house in Korea. 6. The XXX subsidiary Züblin Spezialtiefbau GmbH (Züblin Special Foundation Engineering) uses an innovative sealing method, called BioSealing, for groundwater flow and leakage. * Score is depended on degree of novelty of innovation (創新的程度：企業第一次採用，國內市場第一次採用，國際市場第一次採用) * 在企業眾創新例子請依據中，請依創新程度最好的例子來打分	1: implement and adopt well recognized and common environmental technology or method, but new to the contractor 2: adopt new to the market innovation and the main market is national 3: implement and adopt novel and unique environmental technology or method, first in the international market

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