https://dx.doi.org/10.1016/j.jclepro.2016.08.109

Understanding the Relationships between Environmental Management Practices and Financial Performances of Multinational Construction Firms

Abstract

Growing attention to environmental protection has triggered drastic changes in the corporate practices of construction firms. Several studies have shown that multinational contractors have been relatively proactive in environmental management. However, the financial outcomes of environmental practices are not fully comprehended. Based on information disclosed through environmental reporting, this study examines the relationship between environmental management practices and the financial performance of multinational construction firms. The sample of construction firms is drawn from the Engineering News-Record (ENR) Top International Contractor list. Content analysis was used to extract and measure the degree of proactivity, and stepwise regression was adopted to screen for practices associated with financial performance. The results highlight the advantages and limitations of environmental management practices disclosed in environmental reporting and explore the impacts such practices have on financial performance. Among the environmental practices, pollution abatement on-site has significant impacts on firm short and long-term financial performances of multinational construction firms.

Keywords: Environmental management, financial performance, environmental reporting, multinational construction firm

1. Introduction

Commitment to the natural environment has become an important issue in the 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). 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 system) in the 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).

These studies 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.

A careful distinction needs to be made between the benefits derive from a green construction project and benefits that may or may not be experienced by the construction firm, and similarly for limitations found at the project level versus firm level. A project is in a sense a temporary organization focusing on short-term product completion goals, while a firm is a continuing capacity to create built environments (Winch, 1989), the latter requires accounting for more complex uncertainties in a business environment. Also, developing an environmental strategy entails substantial investment and long-term commitment to market development for firms.

Nonetheless, there are limited studies that empirically examine the potential financial implications of environmental management in construction firms. 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). These approaches are constrained in the way environmental practices are equated with an index score or classification and are thus unable to assess the impact of the different environmental practices of different firms. More detailed assessment of environmental management practices that are not obscured by general labels of the "greenness" or "sustainability" of construction firms could more effectively guide management decisions in investing in specific environmental competencies.

Despite there are some 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 can 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 as 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 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.

Lately, the emergence of sustainability reporting has provided an opportunity for more consistent evaluation of a firm’s environmental practices and performance. The voluntary disclosure of environmental information is a means to portray the social responsibility of a firm, and can also be a useful resource for understanding and anticipate the financial implications of a firm’s environmental management practices as disclosed in the report. However, the implications of disclosed information can be opaque, due to inconsistencies in reporting, the use of vague rhetoric, the provision of anecdotal evidence, and reference to data sources that are proprietary (and hence not publically available) of the reporting firm. The investigation is required to unpack the language firms used in the disclosures and examine for potential financial implications if any.

This study addresses the imperatives to study environmental practices of construction firms owing to its industry’s peculiarities and low innovative characteristics. From a firm perspective, the study attempts to identify the prevalent environmental practices that have been implemented by multinational construction firms through content analysis. Based on the coded practices, the relationship between environmental practices and the financial performance of multinational construction firms will be examined. From the vantage of empirical examination, the findings shed light on the utility and limitations of the data collected from environmental disclosures, explore the relationships between environmental management practices and financial performance, and compare these relationships in the context of construction firms with other studies.

2. 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.

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 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 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).

Despite these drawbacks, 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). The study of environmental management and firm performance must account for the peculiarities and structures that differentiate construction from other manufacturing and service industries. Neglecting this context would lead to insufficient consideration of the uncertainties and interdependencies that impede the efficient application of environmental management practices in construction.

3. Linkage between environmental management and firm 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).

Historically, environmental protection is articulated with additional costs imposed by the 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 the 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, because environmental innovation 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, the traditional view has been notably contested by new theories that well align firm’s competitive advantages with environmental management. Porter and Van der Linde (1995) 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, 1995). 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 resource-based view (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). 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 encompass a comprehensive set of environmental management practices when examining firm performance. Most of these studies underline environmental practices rather than environmental performance as the core that contributes to greater financial performance.

Nonetheless, cost and differentiation advantages are the two main competitive advantages that translate proactive environmental management practices into better financial outcomes. 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). The degree to which environmentally proactive firms can 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 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, the 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 LEED building experience to participate in a building project and addition charge premium on the owner for LEED certified building.

However, 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 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, the 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.

4. Environmental reporting 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 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 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 signaling 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). 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 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.

5. Methods

The study focuses on two primary research questions: (1) what types of environmental management practices are disclosed in the environmental reporting of multinational construction firms, and (2) which of these reported environmental management practices are associated with the short-term and long-term financial performance of the firms. 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. For the sake of reporting consistency, the sample excludes construction firms from developing countries, most of them are based in China, to avoid misrepresentation. Out of the 225 contractors listed, 54 firms fulfill the inclusion criteria. The selected firms, home country, and continent-of-origin are shown in Table 1.

5.1 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

Table 1. Sample of firms

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

Daewoo E&C	HOCHTIEF	OHL	URS
Hyundai E&C	Bauer	SANJOSE	

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 to 2011 would be chosen. When an environmental report is not available, or data is scarce, additional information is sourced from environmental web pages. Documents containing environmental data of individual contractors in the sample were collected through their respective websites.

The content analysis follows the procedures described by Walls et al. (2011). The first stage involved creating the coding instruments from a small sample consisted of a coding form and a codebook that attached sample excerpts for scoring. The process of developing the coding instrument is an iterative process with multiple revisions and pretests on the excerpts that emerged and matched with the scoring scheme. The coding items and scoring scheme are supported by previous relevant research and literature in environmental management and sustainable construction. In this study, three raters manually performed the content analysis, and before the real assessment, training was carried out iteratively to ensure each rater's proficiency in the coding instrument.

5.1.1 Measures of environmental management practices

The coding sheet contains 32 coded items. For descriptive and interpretation purposes, the coded items from content analysis 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 2.

Two principles are followed in assigning the scoring metric. First, firms that have made genuine and significant environmental investments are difficult to imitate. Therefore management is more likely to offer the strongest possible quality signals, which are specified, quantifiable, and externally monitored (Toms, 2002). The scoring of items in this study follows this presumption and would assign a higher score for disclosures that are specified, quantifiable, and externally monitored, but would assign a lower score for less substantive, more rhetorical disclosures. Second, for the measurement scale of each item, an appropriate scheme of categories or levels should be exhaustive, mutually exclusive, and comprised of appropriate levels of measurement (Neuendorf, 2002). Therefore, each item is designated with a different scale that best suits the nature of the report content and classification. Unless stated otherwise, the scoring of the items in this study followed these assumptions. A score of zero is given when an item is not addressed in the reporting.

Standardized average scores are further computed as a remedy to the variability of different metrics. For some complex concepts, the standardized score of coded items was summed up and represented with a single construct that would be more meaningful in the analysis. Thus, 32 coded items were ultimately reduced to 17 variables.

By Wagner et al. (2001), a theoretical curvilinearity relationship might appear between process and product operational practices with financial performance. To account for this possibility, squared terms of items 10 – 15 (refer Table 2) were also incorporated into the analysis. The final number of environmental management practice variables amounted to 17 linear term variables and six squared term variables.

Since the presence of squared term variables is only sensible if they are positive values, standardized summed scores for these six 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.

5.1.2 Reliability and validity

The study assessed several aspects of the validity and reliability of the content analysis and as well as the variables used. For the inter-rater reliability across three raters, intraclass correlations (ICC) and internal consistency Cronbach's alpha were assessed. The ICC values ranged from 0.833 to 0.956 and the alpha value ranged from

Table 2. List of Coding Items and constructs of environmental management practices

Items	% not reported	References
(I) planning and organizational practices		
1. EMS governance structure (α =		Darnall (2006),
0.74) (α =	0%	Montabon et al.
0.74)	35%	(2007), Walls et al.
a. Corporate environmental policies	24%	(2011), Christmann
b. Senior environmental executive	65%	(2000)
c. Formal organizational structure	20%	
d. Reporting structure level	65%	
2. Level of ISO 14001 certification	19%	
3. Internal communication	13%	
4. Environmental training programs		
5. Surveillance of risks and business	65%	
opportunities		
6. Address environmental issue earlier than	57%	
competitors [a]	15%	
7. Year of EMS first been certified [a]	15%	
8. Managerial vision (long-term commitment)		
9. Environmental research and development		
(II) product-related operational practices		
10. Adopt life cycle analysis	24%	Walls et al. (2011),
11. More likely to adopt new product	4%	Amara and Landry
innovation [b]		(2005)
(III) process-related operational practices		
12. Pollution abatement in office (α =		Sev (2009), Christini
0.82)	24%	et al. (2004),

a. Energy efficiency	46%	Aragón-Correa et al. (2008)
b. Water efficiency	39%	
c. Waste reduction		
13. Pollution abatement on-site (α =	11%	
0.82)	26%	
a. Energy efficiency	11%	
b. Water efficiency	7%	
c. Efficient use of materials	54%	
d. Emission control	24%	
e. Noise control		
f. Efficient use of land and preserve biodiversity	28%	
14. Logistics and transportation arrangement to reduce fuel consumption	26%	
15. Green procurement policies		
(IV) communicational practices		
16. External reporting (α =		Walls et al. (2011), Buysse and Verbeke (2003), Qi et al. (2010)
0.77)	50%	
a. Environmental reporting is externally audited	30%	
b. Environmental reporting meets international reporting requirements		
17. Stakeholder engagement (α =	24%	
0.70)	48%	
a. Government /public agencies	35%	
b. Non-government organization	52%	
c. International agreements	65%	
d. Suppliers		
e. Shareholders		

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

0.863 to 0.957 across each variable, signify high reliability of the content analysis. 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, the unidimensionality of each construct was evaluated with maximum likelihood factor analysis, and all the constructs were confirmed to be loaded on a single factor with an eigenvalue greater than 1. Third, the internal consistency of each construct was examined by computing Cronbach’s alpha, and the values are greater than 0.7.

5.2 Control variables

To address firm-level considerations, many studies in environmental management consider firm size effect. The natural logarithm of some employees is used to measure firm size in the study. Another firm-level variable considered is revenue growth of a firm, which here depicts the difference in revenue from 2009 to 2011. A number of employees and revenue over 2009-2011 were extracted from the Datastream database.

5.3 Financial Performance

The dependent variables comprise of different aspects of financial performance, and all the data are extracted from the Datastream database. 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 returns on sales (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 depends 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. Also, revenue growth and market-based measure, Tobin's Q ratio are selected to examine long-term financial performance from the environmental practices, denoted by Tobin's Q ratio and revenue growth. 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 can 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 by the continent of origin.

5.4 Analysis

The study conducted preliminary analyses on the overall environmental proactivity on firm financial performance and the correlations between the classification of environmental management practices and financial performance. The overall scores for each environmental management practice classification were computed by summing up the underlying items. The former analysis proceeds with K-mean clustering to determine the environmental proactivity of the firm, with reactive versus proactive clusters in environmental management. Analysis of variance (ANOVA) was conducted to test whether the differences in financial performance are statistically significant across the two clusters of firms.

After the preliminary analyses, hierarchical stepwise regression analysis was conducted by entering all the variables for environmental management practices. The stepwise selection assists in screening for those environmental practice variables that appear to significantly impact financial performance. Control variables are included in the first stage of the stepwise regression to isolate the variable's effect on the financial performance variable.

6. Results

In the preliminary analysis, firms are classified into either the "reactive" or "proactive" cluster (Table 3). The results of ANOVA analysis indicate there is no significant difference in the financial performance of firms between the clusters (Table 4). The results are reconfirmed by another ANOVA examination on a spectrum with three clusters, ratcheting up the continuum of "reactive" to "proactive", with still no significant difference found in the mean values of the financial performance variables.

Next, Spearman's Rho tests were carried out to investigate the correlations between the four classifications of environmental practices with financial performance. According to the results shown in Table 5, "process-related operational practices" significantly and negatively correlate with ROA and ROS.

Table 3. Clustering of classifications of environmental management practices

Classification	Cluster		ANOVA F
	Reactive	Proactive	
Planning and organizational practices	-4.070	5.088	65.562 ***
Product-related operational practices	-0.949	1.186	45.813 ***
Process-related operational practices	-3.484	4.355	49.719 ***
Communicational practices	-2.344	2.929	27.539 ***
Number of firms	30	24	

Table 4. ANOVA of environmental proactivity clusters and financial performance

Financial performance	Cluster		ANOVA F	Significance p-value
	Reactive	Proactive		

ROA	0.179 (0.945)	-0.223 (0.999)	2.289	0.136
ROS	-0.013 (0.874)	0.016 (1.119)	0.011	0.915
Tobin's Q	0.189 (1.200)	-0.237 (0.544)	2.594	0.113
Revenue Growth 2011-2013	-0.039 (1.062)	0.048 (0.890)	0.102	0.750

Table 5. Spearman's Rho tests of classifications and financial performance

Classification	ROA	ROS	Tobin's Q	Revenue growth
Planning and organizational practices	-0.157	-0.052	-0.121	-0.176
Product-related operational practices	-0.167	-0.074	-0.073	-0.073
Process-related operational practice	-0.405***	-0.287**	-0.182	-0.170
Communicational practices	0.008	0.107	0.181	-0.128

What this analysis so far reveals are that certain clusters of environmental proactivity are neutral towards financial variables, and negative correlations are found between "process-related operational practices" and short-term financial performances. However, these correlations may suffer from omitted variables. Based on the results, we oppose the assertion that construction firms pursuing a high profile of environmental management would inevitably experience better financial performance. It might also be incommensurate with the evidence to proclaim that a green construction firm will necessarily outperform its conventional counterparts. 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. Variance inflation factor (VIF) and bivariate correlation tests have been conducted to detect multicollinearity problem and it is unlikely to occur since correlation <0.5 and VIF <2.

According to the stepwise regression analysis (Table 6), five environmental management practices are significantly associated with these financial performance variables.

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

ii. Adopt life cycle analysis (LCA): Construction firms may adopt LCA to evaluate the environmental impacts created by buildings and assemblages from 'cradle to grave' or from 'cradle to cradle'. The measurement also includes the adoption of well-known green building standards that implicitly or explicitly embed the idea of LCA. The results indicate that a high level of LCA adoption is more likely to be devalued in market valuation as denoted by Tobin's Q ratio.

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

iv. 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.

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 in most of the models, except later revenue growth is not necessarily preceded by previous growth. Overall, all the models generated high F-statistics and low p-values, indicating all the models are jointly significant.

Table 6. Stepwise regression analysis

	Short-term	Long-term

	ROA	ROS	Tobin’s Q	Revenue Growth 2011-2013
Constant	-0.892	-1.926 **	2.027	-3.287 **
	(-0.865)	(0.897)	(1.530)	(1.272)
<u>*Control variables*</u>				
Revenue Growth 2009-2011	0.88 ***	0.468 *	0.897 ***	0.143
	(0.258)	(0.267)	(0.254)	(0.293)
Log Employee	0.158 *	0.264 ***	0.204 **	0.244 **
	(0.089)	(0.093)	(0.095)	(0.098)
<u>*Stepwise selection*</u>				
Squared pollution abatement on-site	-0.004 ***	-0.004 ***	-0.003 **	-0.004 **
	(0.001)	(0.001)	(0.001)	(0.001)
EMS governance structure	0.071 *	0.111 **		
	(0.042)	(0.043)		
Adopt life cycle analysis			-0.299 **	
			(0.132)	
Stakeholder engagement			0.069 *	
			(0.039)	
Squared adopt new product innovation				0.011 *
				(0.006)
R-squared	0.334	0.283	0.364	0.202
Adjusted R-squared	0.28	0.224	0.298	0.137
F-statistic	6.147 ***	4.832 ***	5.502 ***	3.096 **

Note: Standard errors in parentheses

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

7. Relationship between environmental management practices and financial performance

Previous studies suggest that environmental management practices or capabilities are positively associated with a firm’s financial output. 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 four 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 production processes and is significantly different regarding 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 pollution abatement in office, logistics and transportation arrangements, and green procurement can be considered subordinate to production given 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 marginal net 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.

Within the class of planning and organizational practices, EMS governance structure is the only variable that demonstrates an impact on the studied firm 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) surveillance of business risks and opportunities in global environmental problems, (v) early addressing of environmental problems, (vi) early certification of EMS, (vii) managerial vision and long-term planning, and lastly (viii) 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; market surveillance (iv) assists management in investment decision-making; research and development (viii) 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.

EMS governance is positively associated with the short-term financial indicators ROA and ROS. 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 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 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.

Both variables attributed to product-related operational practices are significantly associated with Tobin's Q ratios and revenue growth, though they contradict each other regarding the forms and directions of the relationship. The contradiction of results may be attributed to the different scopes framing the practices and the distinct aspects of financial performance indicators to which each practice is associated. 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 a negative impact on Tobin's Q ratio, which implies a lower market valuation. The unexpected loss of market valuation may be interpreted as investor skepticism towards LCA, and green labeling service to be reflected in service fee structure despite pursuit green labeling would incur additional costs. Before drawing a definitive conclusion, further study is required to inspect the reasons behind the adverse relationship between adoption of LCA and market valuation.

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 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.

8. Limitations of content analysis in financial analysis

One of the factors that might hamper confidence of the results is related to the poor environmental information disclosed by the construction firms. According to the content analysis (Table 2), 65% of the sampled firms did not address items 1d, 3, and 17e, while 57% did not address item 7. 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 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. In addition, the content analysis assumes the disclosed information are genuine and reliable; any attempt of greenwashing would impair the validity of results.

9. Conclusions

This study highlights the financial 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 data through content analysis of firm environmental disclosures and unpacks the information with theoretical support. Drawing upon the most commonly disclosed information found in the reporting, stepwise analysis differentiates those environmental management practices that are associated with a 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 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.

On 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. Except LCA, the study supports the view that proactive environmental management practices perform better in business. Echoing previous studies, EMS governance 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 construction firms in determining the key environmental management practices that can enhance their competitive edge.

A few limitations have to be clarified before drawing any definite conclusions. Also 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 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 manifest greater concern on environmental or social sustainability issues. Rigorously, the findings should cautiously approach from exploratory rather than confirmatory perspective.

Notwithstanding, the present study 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.

Acknowledgement

The authors thank for the traveling grant provided by the Kwang-Hua Education Foundation, which covered Prof. Po-Han Chen's collaborative research visit in the Hong Kong Polytechnic University. The authors also thank for the funding support of

Research Institute for Sustainable Urban Development at the Hong Kong Polytechnic University (8-ZJJZ) for the related research works.

References

Ahn, Y.H., Pearce, A.R., 2007. Green construction: Contractor experiences, expectations, and perceptions. Journal of Green Building 2, 106-122.

Ahn, Y.H., Pearce, A.R., Wang, Y., Wang, G., 2013. Drivers and barriers of sustainable design and construction: The perception of green building experience. International Journal of Sustainable Building Technology and Urban Development 4, 35-45.

Albertini, E., 2013. Does environmental management improve financial performance? A meta-analytical review. Organization & Environment 26, 431-457.

Alnajjar, F.K., 2000. Determinants of social responsibility disclosures of US Fortune 500 firms: an application of content analysis. Advances in environmental accounting & management 1, 163-200.

Amara, N., Landry, R., 2005. Sources of information as determinants of novelty of innovation in manufacturing firms: evidence from the 1999 statistics Canada innovation survey. Technovation 25, 245-259.

Ambec, S., Cohen, M.A., Elgie, S., Lanoie, P., 2013. The Porter hypothesis at 20: can environmental regulation enhance innovation and competitiveness? Review of Environmental Economics and Policy 7, 2-22.

Ambec, S., Lanoie, P., 2008. Does it pay to be green? A systematic overview. The Academy of Management Perspectives 22, 45-62.

Aragón-Correa, J.A., Hurtado-Torres, N., Sharma, S., García-Morales, V.J., 2008. Environmental strategy and performance in small firms: A resource-based perspective. Journal of Environmental Management 86, 88-103.

Brown, M.A., Southworth, F., 2008. Mitigating climate change through green buildings and smart growth. Environment and Planning A 40, 653-675.

Brundtland, G., 1987. Our common future: Report of the 1987 World Commission on Environment and Development. Oxford: Oxford University Press.

Buysse, K., Verbeke, A., 2003. Proactive environmental strategies: a stakeholder management perspective. Strategic Management Journal 24, 453-470.

Chen, L., Tang, O., Feldmann, A., 2015. Applying GRI reports for the investigation of environmental management practices and company performance in Sweden, China and India. Journal of Cleaner Production 98, 36-46.

Christini, G., Fetsko, M., Hendrickson, C., 2004. Environmental management systems and ISO 14001 certification for construction firms. Journal of Construction Engineering and Management 130, 330-336.

Christmann, P., 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. Academy of Management Journal 43, 663-680.

Cordeiro, J.J., Sarkis, J., 1997. Environmental proactivism and firm performance: evidence from security analyst earnings forecasts. Business Strategy and the Environment 6, 104-114.

Darnall, N., 2006. Why firms mandate ISO 14001 certification. Business & Society 45, 354-381.

Darnall, N., Henriques, I., Sadorsky, P., 2008. Do environmental management systems improve business performance in an international setting? Journal of International Management 14, 364-376.

Delmas, M., Hoffmann, V.H., Kuss, M., 2011. Under the tip of the iceberg: Absorptive capacity, environmental strategy, and competitive advantage. Business & Society 50, 116-154.

Delmas, M., Russo, M.V., Montes-Sancho, M.J., 2007. Deregulation and environmental differentiation in the electric utility industry. Strategic Management Journal 28, 189-209.

Demaid, A., Quintas, P., 2006. Knowledge across cultures in the construction industry: sustainability, innovation and design. Technovation 26, 603-610.

Dragomir, V.D., 2012. The disclosure of industrial greenhouse gas emissions: a critical assessment of corporate sustainability reports. Journal of Cleaner Production 29, 222-237.

Duriau, V.J., Reger, R.K., Pfarrer, M.D., 2007. A content analysis of the content analysis literature in organization studies: Research themes, data sources, and methodological refinements. Organizational Research Methods 10, 5-34.

Engineering News Record (ENR), 2012. ENR the top 225 international contractors.

Fergusson, H., Langford, D.A., 2006. Strategies for managing environmental issues in construction organizations. Engineering, Construction and Architectural Management 13, 171-185.

Friedman, M., 1970. The social responsibility of business is to increase its profits. New York, 122-124.

Galdeano-Gómez, E., Céspedes-Lorente, J., Martínez-del-Río, J., 2008. Environmental performance and spillover effects on productivity: evidence from horticultural firms. Journal of Environmental Management 88, 1552-1561.

Gilley, K.M., Worrell, D.L., Davidson, W.N., El–Jelly, A., 2000. Corporate environmental initiatives and anticipated firm performance: The differential effects of process-driven versus product-driven greening initiatives. Journal of management 26, 1199-1216.

Gluch, P., Räisänen, C., 2012. What tensions obstruct an alignment between project and environmental management practices? Engineering, Construction and Architectural Management 19, 127-140.

González-Benito, J., González-Benito, Ó., 2005. Environmental proactivity and business performance: an empirical analysis. Omega 33, 1-15.

Hamilton, J.T., 1995. Pollution as news: media and stock market reactions to the toxics release inventory data. Journal of environmental economics and management 28, 98-113.

Hart, S.L., 1995. A natural-resource-based view of the firm. Academy of Management Review, 986-1014.

Hart, S.L., Ahuja, G., 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. Business strategy and the environment 5, 30-37.

Hitt, M.A., Hoskisson, R.E., Hicheon, K., 1997. International Diversification: Effects on Innovation and Firm Performance in Product-Diversified Firms. The Academy of Management Journal 40, 767-798.

Horváthová, E., 2010. Does environmental performance affect financial performance? A meta-analysis. Ecological Economics 70, 52-59.

Hoskisson, R.E., Johnson, R.A., Moesel, D.D., 1994. Corporate divestiture intensity in restructuring firms: Effects of governance, strategy, and performance. Academy of Management journal 37, 1207-1251.

Hřebíček, J., Soukopová, J., Štencl, M., Trenz, O., 2014. Integration of economic, environmental, social and corporate governance performance and reporting in enterprises. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 59, 157-166.

Jones, T., Shan, Y., Goodrum, P.M., 2010. An investigation of corporate approaches to sustainability in the US engineering and construction industry. Construction Management and Economics 28, 971-983.

King, A., Lenox, M., 2002. Exploring the locus of profitable pollution reduction. Management Science 48, 289-299.

King, A.A., Lenox, M.J., 2001. Does it really pay to be green? An empirical study of firm environmental and financial performance. Journal of Industrial Ecology 5, 105-116.

Kleinschmidt, E.J., Cooper, R.G., 1991. The impact of product innovativeness on performance. Journal of product innovation management 8, 240-251.

Krippendorff, K., 1980. Content Analysis: An Introduction to Its Methodology. Sage Publications, Incorporated.

Lamprinidi, S., Ringland, L., 2008. A snapshot of sustainability reporting in the construction and real estate sector. Global Reporting Initiative (GRI), Amsterdam, The Netherlands.

Lopez-Gamero, M.D., Molina-Azorin, J.F., Claver-Cortes, E., 2009. The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables. Journal of Environmental Management 90, 3110-3121.

Lu, Y., Cui, Q., Le, Y., 2013. Turning Green to Gold in the Construction Industry: Fable or Fact? Journal of Construction Engineering and Management.

Michael Geringer, J., Beamish, P.W., DaCosta, R.C., 1989. Diversification strategy and internationalization: Implications for MNE performance. Strategic Management Journal 10, 109-119.

Mokhlesian, S., Holmén, M., 2012. Business model changes and green construction processes. Construction Management and Economics 30, 761-775.

Montabon, F., Sroufe, R., Narasimhan, R., 2007. An examination of corporate reporting, environmental management practices and firm performance. Journal of Operations Management 25, 998-1014.

Nam, C., Tatum, C., 1988. Major characteristics of constructed products and resulting limitations of construction technology. Construction Management and Economics 6, 133-147.

Neuendorf, K.A., 2002. The content analysis guidebook. Sage, Thousand Oaks, Calif.

OECD, 2015. Material Resources, Productivity and the Environment, OECD Green Growth Studies, Paris.

Ofori, G., Briffett IV, C., Gang, G., Ranasinghe, M., 2000. Impact of ISO 14000 on construction enterprises in Singapore. Construction Management & Economics 18, 935-947.

Porter, M.E., Van der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. The journal of economic perspectives, 97-118.

Qi, G.Y., Shen, L.Y., Zeng, S.X., Jorge, O.J., 2010. The drivers for contractors' green innovation: an industry perspective. Journal of Cleaner Production 18, 1358-1365.

Reichstein, T., Salter, A.J., Gann, D.M., 2005. Last among equals: a comparison of innovation in construction, services and manufacturing in the UK. Construction Management and Economics 23, 631-644.

Reinhardt, F.L., 1998. Environmental product differentiation: Implications for corporate strategy. California management review 40, 43.

Seaden, G., Manseau, A., 2001. Public policy and construction innovation. Building Research & Information 29, 182-196.

Sev, A., 2009. How can the construction industry contribute to sustainable development? A conceptual framework. Sustainable Development 17, 161-173.

Sharma, S., Aragón-Correa, J.A., Rueda-Manzanares, A., 2007. The contingent influence of organizational capabilities on proactive environmental strategy in the service sector: an analysis of North American and European ski resorts. Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration 24, 268-283.

Shen, L.Y., Tam, V.W.Y., 2002. Implementation of environmental management in the Hong Kong construction industry. International Journal of Project Management 20, 535-543.

Shrivastava, P., 1995. The role of corporations in achieving ecological sustainability. Academy of Management Review 20, 936-960.

Tan, Y., Ochoa, J.J., Langston, C., Shen, L., 2015. An empirical study on the relationship between sustainability performance and business competitiveness of international construction contractors. Journal of Cleaner Production 93, 273-278.

Tan, Y., Shen, L., Yao, H., 2011. Sustainable construction practice and contractors' competitiveness: A preliminary study. Habitat International 35, 225-230.

Toms, J.S., 2002. Firm resources, quality signals and the determinants of corporate environmental reputation: some UK evidence. The British Accounting Review 34, 257-282.

Turk, A.M., 2009. The benefits associated with ISO 14001 certification for construction firms: Turkish case. Journal of Cleaner Production 17, 559-569.

van Bueren, E.M., Priemus, H., 2002. Institutional barriers to sustainable construction. Environment and Planning B-Planning & Design 29, 75-86.

Vrijhoef, R., Koskela, L., 2005. Revisiting the three peculiarities of production in construction, Proceedings of 13th International Group for Lean Construction Conference., pp. 19-27.

Wagner, M., Schaltegger, S., Wehrmeyer, W., 2001. The relationship between the environmental and economic performance of firms. Greener Management International 2001, 94-111.

Walls, J.L., Phan, P.H., Berrone, P., 2011. Measuring environmental strategy: Construct development, reliability, and validity. Business & Society 50, 71-115.

Watson, K., Klingenberg, B., Polito, T., Geurts, T.G., 2004. Impact of environmental management system implementation on financial performance: A comparison of two corporate strategies. Management of Environmental Quality: An International Journal 15, 622-628.

Wilmshurst, T.D., Frost, G.R., 2000. Corporate environmental reporting: a test of legitimacy theory. Accounting, Auditing & Accountability Journal 13, 10-26.

Winch, G., 1989. The construction firm and the construction project: a transaction cost approach. Construction Management and Economics 7, 331-345.

Zeng, S.X., Tam, C.M., Deng, Z.M., Tam, V.W.Y., 2003. ISO 14000 and the construction industry: survey in China. Journal of Management in Engineering 19, 107-115.

Zhang, X., Wu, Y., Shen, L., 2014. Embedding "green" in project-based organizations: the way ahead in the construction industry? Journal of Cleaner Production.

Zuo, J., Zillante, G., Wilson, L., Davidson, K., Pullen, S., 2012. Sustainability policy of construction contractors: A review. Renewable and Sustainable Energy Reviews 16, 3910-3916.