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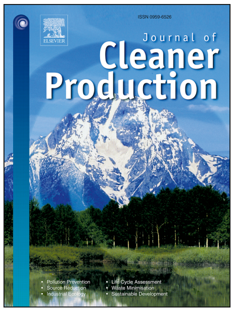

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The linkages between internationalization and environmental strategies of multinational construction firms

Po-Han Chen[1], Chuan-Fang Ong[2], and Shu-Chien Hsu[3]

Abstract

Multinational construction firms have increasingly engaged in more environmental management activities, however the relationship between internationalization performance and environmental proactivity remains unaddressed. The purpose of this study is to explore the linkage between internationalization and environmental strategy. The study posits that firms deploying a higher tier of environmental strategy correlate with higher degrees of internationalization. The sample of construction firms were drawn from the Engineering News-Record Top International Contractor list. Environmental information of each sample member was extracted through content analysis. Based on previous resource-based view studies, a schema of three clusters of environmental strategies was constructed to depict reactive, preventive, and proactive postures in strategic environmental management. Degree of internationalization is measured as investment intensity, geographical extensity, and geographical concentration. The results indicate that construction firms that are proactive in strategic environmental management exhibit greater internationalization up to an extent, where additional proactivity then no longer correlates with further heightened internationalization. In addition, the results present some preliminary findings on how multinational construction firms deploy strategic environmental capabilities, shedding light on internationalization portfolios across developed and developing regions.

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1. Introduction

Following the emergence of sustainability discussions in the late 1980s (Brundtland, 1987), the construction industry has received much attention as a result of its major environmental and social impacts. In the U.S., approximately 43% of carbon dioxide emissions result from the energy services required by residential, commercial, and industrial buildings (Brown and Southworth, 2008), and the construction industry consumes about 40% of materials entering the global economy (Roodman et al., 1995). Owing to the construction industry's severe impacts on the environment, advocates of sustainable construction strive to devise sustainable development concepts to embed into conventional construction practices, and to spur the transformation of organizational management.

Organizational studies in the construction field have paid special focus on environmental management systems and the engineering process (Ahn et al., 2013; Qi et al., 2010; Turk, 2009). While some of these environmental studies discuss the drivers and implementation implications of sustainable construction, seldom did the studies prove that environmental management improves a firm's competitive advantages and performance. As the advantages of green practices remain unclear, practitioners are more likely to hesitate in changing their business environmental orientation, unless coerced by legislation.

On the other hand, the environmental impacts of internationalization have been debated for decades. Recent studies found that multinational enterprises (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 found a high commitment to 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.

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 thus may particularly draw multinational construction firms towards particular environmental strategic settings.

The construction industry has the highest rate of certified ISO 14000 companies 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 in many respects, 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 character is different from other business models due to the limited time frame and often one-off nature of its projects, 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.

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. Such a gap in identifying this causal relationship has left empirical and theoretical ambiguity. A firm's pursuit of a proactive environmental strategy implies both substantial investment and a long-term commitment to market development. Thus a relevant study should examine how firms perform on internationalization based on their environmental strategies.

However, unlike financial reporting, which has many standardized sources of data available, environmental data for construction firms suffers a lack of consensus on how information should be presented. In recent times, an increase in construction firms participating in voluntary environmental disclosure has provided access for scholars to explore corporate environmental practices and performances. Thus now a firm's proactivity in environmental management can be measured and extracted through the content analysis method.

The primary goal of this study is to explore the relationship between environmental strategy and degree of internationalization in multinational construction firms. This study attempts to accomplish a few tasks related to this goal. The study starts with delineating environmental strategies grounded in the environmental management literature of resource-based view (RBV) approach, and construction management. Content analysis has been adopted as the method to extract the environmental practices of multinational construction firms listed in the Engineering News-Record (ENR) publication. These practices are further clustered into environmental strategies to examine their relationship with degree of internationalization. To examine the effects of environmental strategy on different dimensions of internationalization, three internationalization indicators are adopted in this study: investment intensity, geographical extensity, and geographical concentration. Further, based on geographical extensity and concentration, the study investigates whether there are different impacts on a firm's business distribution portfolio across developed and developing regions with similar environmental strategy. The study seeks to answer three questions pertaining to the linkage between environmental strategy and internationalization, the dimension of internationalization related, and how environmental strategy diversify a firm's business portfolio across developed and developing regions.

2. The Resource-based View of Competitive Advantages

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 assumption 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 prominent theoretical paradigm extending 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 position, firms can gain the competitive advantages of lower costs, preempting the competition, and staking out more secure future positions through strategic environmental capabilities such as pollution prevention, product stewardship, and sustainable development.

In essence, studies on proactive environmental management often discussed competitive advantages in terms of cost reduction and differentiation. Cost reduction 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 in 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 upon the presence of complementary assets such as absorptive capacity, innovation capability, and commitment to pollution prevention (Christmann, 2000; Delmas et al., 2011).

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 its point of uniqueness is valued by customers. Through competitive preemption, product stewardship can create a base from which to build reputation and differentiate products by establishing the firm as an early mover in new green product domains (Hart, 1995).

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

3. Environmental Strategies and Internationalization

Based on the competitive advantages of environmental strategies that have been outlined in previous sections, this section describes how environmental strategy can be linked to different drivers and barriers in internationalization contexts.

A firm's approach to environmental strategy may lie along a continuum from "reactive" to "proactive." A reactive strategy is related to 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, a 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 environmental capabilities might hinder their own 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 domestic counterparts (Vernon, 1998). Firms facing greater uncertainty in the business environment are more likely to deploy and develop proactive environmental strategies (Sharma et al., 2007). Firms following a reactive strategy intend only to meet minimum customer and stakeholder expectations. Without committing extra resources, they lack required capabilities to resolve the state of uncertainty and complexity of the general business environment (Aragón-Correa and Sharma, 2003). When facing heightened risks of foreignness in new markets abroad, firms that anticipate and respond, rather than just react to uncertainty, are therefore more likely to deploy its capabilities to develop a proactive environmental strategy.

MNEs require 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 legitimacy spillover; foreign affiliates will encounter difficulties maintaining legitimacy if an 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 interests 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 the regulatory sphere and managerial vision. Buysse and Verbeke (2003) found that firms that view themselves 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 metrics for success. These capabilities, which usually complement proactive strategies, 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) found that it is necessary for an international firm to adopt ISO 14001 standards to facilitate internal coordination on environmental issues and attain environmental legitimacy in various jurisdictions when firms have greater international scopeBansal and Hunter (2003)Bansal and Hunter (2003)Bansal and Hunter (2003). Furthermore, environmental proactive firms are associated with the 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 markets.

When an MNE that pursues a 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 be more capable of fulfilling customer needs in an international market that seeks stronger environmental performances. The greater range of environmental products or services provided by an environmentally proactive firm would contribute to the firm’s differentiation advantages in the international market.

Based on different internationalization contexts, environmentally proactive firms should outperform reactive firms in internationalization when facing foreignness and the legitimacy problem. In addition, with their greater capabilities, proactive firms are more competitive in international markets. Thus, multinational construction firms with higher levels of environmental strategy may be presumed to be associated with greater degrees of internationalization.

Proceeding from this proposition, the study attempts to investigate questions pertaining to how multinational construction firms would likely 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, what dimension(s) of internationalization is affected by environmental strategy? (iii) Does the environmental strategy adopted by a firm influence its business distribution portfolio across developed and developing regions?

4. Method

4.1 Samples

The sample of multinational contractors was drawn from ENR Top International Contractors 2012 (ENR, 2012). Only publically listed firms with available financial data and environmental reporting published online were included in this study. Out of 225 contractors listed, 63 firms met these qualifications for inclusion in the sample.

4.2. Measures

4.2.1. Environmental Strategy

In order to construct an environmental strategy typology, the content analysis method has been adopted to analyze the environmental information published by each construction firm. Due to our groups' language proficiency, only reports in English and Mandarin were included. The environmental data were gathered from sustainability reports, corporate social responsibility reports, online annual reports, and public information on company webpages.

Our main targets were environmental reports published in 2011. Since not all firms annually report on their environmental activities, if a report for 2011 was missing, the report produced closest to that year was chosen. When an environmental report was not available or data was scarce, additional information was sourced from environmental webpages. For our sample, the documents containing environmental data of individual contractors were collected through their respective websites.

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

Two principles were 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 follow this presumption and would assign a higher ranking for disclosures that are specified, quantifiable, and externally monitored, but would assign a lower score for less substantive, more rhetorical disclosure. A score of zero would be given when the item is not addressed in the reporting. Second, for the measurement scale of each item, an appropriate scheme of categories or levels should be exhaustive and 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 report content and classification.

The scores of each item were standardized before computing the summated scales in order to remedy the variability of different metrics used in the coding. The inter-rater reliability across the three raters was measured with intraclass correlations (ICC) and internal consistency Cronbach's alpha. The ICC values ranged from 0.860 to 0.957 and the alpha value ranged from 0.892 to 0.957, thus affirming the high reliability of content analysis.

Previous studies have used many domains to configure environmental strategy. However, there is little congruence on the exact domains across the various studies. The present study attempted to match construction environmental management with key concepts in the RBV environmental management literature. Six domains of environmental practice were borrowed from previous research in environmental management studies of the construction industry (Christini et al., 2004 ; Fergusson and Langford, 2006 etc) and RBV theory (Buysse and Verbeke, 2003; Walls et al., 2011 etc). These six domains include (i) management systems and procedures; (ii) external environmental reporting; (iii) green innovation; (iv) stakeholder engagement; (v) operational practices; and (vi) managerial vision. The study assessed several aspects of the validity and reliability of the variables. First, the dimensionality of each domain was examined by exploratory factor analysis using maximum likelihood extraction (with eigenvalue>1), and coding items with factor loading below 0.4 were omitted. Second, internal the consistency of each variable was examined by computing Cronbach's alpha, which should be greater than 0.7.

The first domain is "management systems and procedures," which evaluates the development of formal written environmental plans, participation of top management executives, formal environmental organization structure, reporting level, and environmental training. The results of the factor analysis revealed that 5 coding items were loaded on single factor with eigenvalue >1, and Cronbach's alpha = 0.748.

The second domain is "external environmental reporting," which evaluates whether the environmental reporting complies with international reporting standards and includes external auditing. The internal consistency of two coding items returned a Cronbach's alpha of 0.770.

The third domain, "green innovation," designates the organizational competencies of delivering green products and sustainable construction services. After exploratory factor analysis was performed using a quartimax rotation method, two factors emerged with eigenvalues greater than one. Out of 5 coding items, one of the items was omitted due to poor loading factor. Then, the first factor was labeled "innovation capability" (Cronbach's alpha = 0.819) and the second factor labeled "product stewardship" (Cronbach's alpha = 0.697). "Innovation capability" is related to (1) the general innovativeness of a firm in updating existent or implementing new production technologies and equipment and (2) their investment in research and development (R&D) in environmental technology. "Product stewardship" covers the design and procurement capability of a firm to conduct life cycle analysis and manage its green procurement system.

The forth 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, 2003). Six categories of stakeholder groups are evaluated in the content analysis, namely governments, NGOs, industry associations, international agreements, suppliers, and shareholders. The six items loaded on single factors with eigenvalue >1 (Cronbach's alpha = 0.714).

The fifth domain is identified as "operational practices," which is related to functional pollution prevention practices carried out by the firm throughout the construction and routine operations. There are 9 coding items and they are loaded on two factors with eigenvalue greater than 1 after quartimax rotation. The first factor was labeled "pollution prevention in office" (Cronbach's alpha = 0.832) and the second as "pollution prevention on-site" (Cronbach's alpha = 0.834).

Lastly, a single coding item is used to measure "managerial vision." 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 a sustainable development strategy. The managerial vision was evaluated based on the extent that environmental issues are integrated in long-term business planning.

The six domains above produced eight variables, and these variables were subjected to cluster analysis. The clustering followed the procedures laid out by Kabanoff et al. (1995) to avoid the influence of outliers. First, the initial cluster centers were specified at -1, 0, and +1 standard deviation for each variable. Then K-mean clustering was conducted to form three groups of environmental strategies, following Buysse and Verbeke (2003) 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 1).

Construction firms classified under reactive strategy (23 firms) 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 (2003), the reactive environmental strategy is equivalent to Hart (1995) end-of-pipe approach. The construction firms that adopt a preventive strategy (25 firms) have integrated sustainable construction into their business operations and offer certain green products or services to clients. They focus on pollution prevention in operations, aiming to reap the benefits of "low hanging fruit" offered by such prevention. The preventive strategy is equivalent to Buysse and Verbeke (2003) and Hart (1995) pollution-prevention strategy, which is associated with moderate environmental competencies. Construction firms with a proactive strategy (15 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 have developed the largest scope of green products or services offered to clients.

Table 1. Descriptive statistics of environmental strategy clusters [a]

	Mean of strategy cluster			
	Reactive	Preventive	Proactive	ANOVA F
Management systems and procedures	-2.909	0.658	3.364	28.431***
External environmental reporting	-0.917	-0.080	1.539	11.254***
Innovation capability	-1.294	0.366	1.374	15.063***
Product stewardship	-1.213	0.403	1.189	13.508***
Stakeholder engagement	-3.008	-0.129	4.823	46.241***
Pollution prevention in office	-0.801	-0.427	1.940	6.645***
Pollution prevention on-site	-4.666	1.951	3.902	62.642***
Managerial vision	-0.644	0.217	0.626	10.972***
Number of firms	23	25	15	

[a] Summation of standardized mean values are reported

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

4.2.2. Internationalization

The measurement of degree of internationalization using uni-dimensional and single criterion measure has been roundly criticized for its method variance and measurement errors (Sullivan, 1994). Thereafter, the proponents of multi-dimensional construct have developed a variety of more or less sophisticated indices to conceptualized internationalization. Although multi-dimensional measure is more preferable, it is difficult to obtain complete and reliable data. Alternatively, this study considers the specific conceptual dimensions that underpinning the measurement of degree of internationalization, rather than the construct of index. Ietto-Gillies and London (2009) identified three major dimensions in the internationalization concept: intensity, geographical extensity, and geographical concentration. These three dimensions have been incorporated into the study. The intensity dimension focuses on the proportionality of foreign versus domestic activities. For the geographical aspects of internationalization, the extensity dimension measures the number of countries in which activities take place, while concentration focuses on the degree to which activities are concentrated within the foreign countries. Market and locational advantages deviate across geographic regions due to differences in socio-economic environments (Qian, 2000), and have varying degrees of emphasis on environmental concern (Özen and Küskü, 2009). Therefore, when considering geographical dimensions of internationalization, not only the number of countries should be taken into consideration, but also the geographical concentration or regional effect should be incorporated.

Foreign sales to total sales revenue: For 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.

To compute geographical extensity and concentration, the regional classification system adopted to organize the 2012 Environmental Performance Index data is 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 the World Bank's country classification, thereby ensuring 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 is used as a proxy for geographical extensity.

Regional diversification index (RDI): Geographic regions are substantially different in terms of their socio-economic environments (Qian, 2000). The imperative for regional study underscores the 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 the 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 in regional market i, ln $(1/P_i)$ is the weight that is given to each global market region, and *m* is the number of total regions considered in the computation.

Three NSI and three RDI 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).

4.2.3. Control Variables

The conditions of a firm's home country will influence its strategic environmental responses in host countries (Kolk and Fortanier, 2013; Sharma et al., 2007). These home-country influences on a firm are captured in two ways. First, the environmental governance of the home countries were measured according to the Environmental Performance Index (EPI), published jointly by Yale University and Columbia University in 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, 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 in revenue from 2009 to 2011. Number of employees and revenue through 2009-2011 are extracted from the Datastream database.

5. Analysis method

One-way ANOVA tests were adopted to test whether the means of each of the internationalization variables were statistically significant different across the environmental strategy clusters. In addition, post hoc Tukey's honest significant difference (HSD) tests were performed to further investigate the statistical differences between the pairwise clusters. Next, multivariate analysis of variance (MANOVA) was conducted based on overall internationalization variables (excluding FSTS) and environmental strategy clusters. Control variables were entered into the analysis as covariates and one-way analysis of covariance (ANCOVA) was performed to verify whether each of the dependent variables were still associated with differences among the strategy cluster after the home condition effects and firm size had been accounted for. A similar multivariate analysis of covariance test (MANCOVA) was performed taking all internationalization variables together, except FSTS, and the result was compared with the 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 environmental strategy cluster, the pairwise $RDI_{developed}$- $RDI_{developing}$ and $NSI_{developed}$-$NSI_{developing}$ are used for comparison.

6. Results

The relationship between internationalization and environmental strategy is shown in Table 2. The Levene tests have casted doubt on violation of the assumption of homogeneity of variance for a few ANOVA analyses; therefore, the robust “Brown and Forsythe” F-ratio was reported.

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

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

In developed regions, $RDI_{developed}$ and $NSI_{developed}$ have been adopted to investigate the impact of environmental strategy on degree of internationalization. Both the means of $RDI_{developed}$ and $NSI_{developed}$ significantly vary across the strategy clusters at the 10% level. Owing to the small sample size and exploratory purpose, the study does not rule out the possibility of relationship at the 10% level, however the results should be approached with due caution, and further studied for verification.

Table 2. Effects of internationalization under three environmental strategy clusters

	Cluster of Environmental Strategy [a]			ANOVA F,	MANOVA
	Reactive	Preventive	Proactive	Brown-Forsythe	Wilki's λ [b]
$RDI_{overall}$	0.634	0.751	0.652	1.847	
	(0.247)	(0.154)	(0.247)		
$NSI_{overall}$	0.120	0.229	0.161	3.983**	
	(0.088)	(0.186)	(0.120)		
$RDI_{developing}$	0.564	0.649	0.448	2.104	
	(0.292)	(0.257)	(0.337)		
$NSI_{developing}$	0.100	0.191	0.116	4.500**	
	(0.076)	(0.155)	(0.094)		
$RDI_{developed}$	0.481	0.681	0.650	2.762*	
	(0.362)	(0.233)	(0.311)		
$NSI_{developed}$	0.165	0.314	0.261	3.093*	
	(0.154)	(0.269)	(0.191)		
FSTS	0.434	0.489	0.451	0.210	
	(0.282)	(0.292)	(0.311)		
					0.708*

[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 with post hoc Tukey's HSD tests. The results in Table 3 indicate 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 exhibited significant differences in mean values. Therefore, the proactive cluster did not yield a higher degree of internationalization compared to the reactive and preventive clusters. In addition, the pairwise comparison of preventive-proactive on $RDI_{developing}$ has exhibited significant mean difference at the 10% level, albeit no significant difference was detected previously in ANOVA analysis.

Table 3. Pairwise comparison of environmental strategy clusters

Dependent Variable	Pairwise Clusters			Mean Difference (I-J)	Std. Error
RDI overall	Reactive	-	Preventive	-0.117	0.062
	Reactive	-	Proactive	-0.017	0.071
	Preventive	-	Proactive	0.099	0.070
NSI overall	Reactive	-	Preventive	-0.110 **	0.041
	Reactive	-	Proactive	-0.041	0.047
	Preventive	-	Proactive	0.068	0.046
RDI developing	Reactive	-	Preventive	-0.085	0.084
	Reactive	-	Proactive	0.116	0.096
	Preventive	-	Proactive	0.201 *	0.095
NSI developing	Reactive	-	Preventive	-0.092 **	0.034
	Reactive	-	Proactive	-0.017	0.039
	Preventive	-	Proactive	0.075	0.038
RDI developed	Reactive	-	Preventive	-0.199 *	0.088
	Reactive	-	Proactive	-0.168	0.101
	Preventive	-	Proactive	0.031	0.099
NSI developed	Reactive	-	Preventive	-0.149 *	0.062
	Reactive	-	Proactive	-0.096	0.071
	Preventive	-	Proactive	0.053	0.070
FSTS	Reactive	-	Preventive	-0.054	0.085
	Reactive	-	Proactive	-0.017	0.097
	Preventive	-	Proactive	0.038	0.096

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

Thus far, several observations can be made from the ANOVA analysis and post hoc test. Higher levels of environmental strategy adopted by a multinational construction firm is associated with greater degrees of internationalization to an extent such that the preventive cluster outperformed the reactive cluster in internationalization, while the influence of the proactive cluster appears insignificant. The results partially support the proposition that multinational construction firms with higher levels of environmental strategy are more likely to exhibit greater degrees of internationalization. In addition, the type of environmental strategy manifests greater influence on geographical extensity (NSI) than on intensity (FSTS) or concentration (RDI).

For MANOVA analysis, all the dependent variables except FSTS are included. The result of MANOVA analysis for the six internationalization indicators taken together is significant at the 10% level, and overall the model accounts for 29% ($1–\lambda$) 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. These tests are used to investigate the relationship of environmental strategy with internationalization after removing the effects of covariates. For the ANCOVA analysis, all the significant internationalization indicators that were found in the previous ANOVA analysis remained significant and robust. Among the country-level covariates considered in this study, GDP per capita only exhibits significant impact on $RDI_{developed}$ at the 10% level, while EPI has significant impact on $NSI_{overall}$ (10% level), $NSI_{developed}$ (5% level), and FSTS (1% level). Among all covariates considered, the firm-level covariate firm size has greater influence on mediating the relationship between environmental strategy and degree of internationalization than the country-level covariates. Firm size significantly influences all the internationalization indicators (at least 5% level), except FSTS. Revenue growth significantly influences $RDI_{developed}$ at 10% level.

The MANCOVA results suggest that the relationship between environmental strategy and degree of internationalization 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 accounts for 36% variance at the 5% significance level. Thus, incorporating the covariates improve the explained variance between environmental strategy and internationalization.

Table 4. 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	2.16	5.12**	2.35	5.58**	3.57*	3.58*	0.02	0.639**
Covariates:								
GDPCAP	0.20	0.22	0.001	0.05	3.97*	1.84	0.58	0.813*
EPI	0.31	4.92*	1.12	2.41	0.94	7.78**	11.51***	0.804*
Size	14.25***	64.23***	12.84***	51.13***	10.16***	63.64***	0.002	0.422***
Revenue growth	0.75	0.62	0.13	0.26	3.64*	1.11	2.80	0.869

[a] MANCOVA analysis excluded FSTS.
* $p < 0.10$
** $p < 0.05$
*** $p < 0.01$

The paired sample t-tests have been conducted to explore the distribution of business operations in both developed and developing regions within a specific environmental strategy cluster. The results are presented in Table 5. Positive mean difference indicates that geographical extensity or concentration in developed regions is higher than in developing regions, and vice-versa for negative mean difference. Except for RDI in the reactive cluster, the mean differences for 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 in developing regions. Nonetheless, the significant $RDI_{developed} - RDI_{developing}$ paired difference for the proactive cluster denotes that the operation distribution of proactive firms in developed regions not only transcends developing regions in terms of extensity (NSI) but also exhibits greater geographical concentration (RDI) than in developing regions. When comparisons are made across the strategy clusters, the mean differences of RDI and NSI steadily increase from preventive to proactive clusters. Apparently, firms with higher levels of strategic environmental capabilities are more likely to disperse their business distribution portfolio from developing regions to developed regions.

Table 5. Paired sample t-tests for comparison of internationalization within environmental strategy cluster

	Paired comparison	Mean differences	Std. Deviation	t-value
Reactive	$RDI_{developed} - RDI_{developing}$	-0.082	0.354	-1.114
	$NSI_{developed} - NSI_{developing}$	0.065	0.132	2.385**
Preventive	$RDI_{developed} - RDI_{developing}$	0.032	0.274	0.580
	$NSI_{developed} - NSI_{developing}$	0.122	0.146	4.194***
Proactive	$RDI_{developed} - RDI_{developing}$	0.202	0.303	2.575**
	$NSI_{developed} - NSI_{developing}$	0.145	0.118	4.739***

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

7. Discussions and Conclusions

This study explored how construction firms devise environmental strategies for 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 primary ways. First, the study underscores the challenges in obtaining firm environmental information. The study sourced the data through content analysis of firm's environmental disclosure, and successfully constructed environmental strategies rooted in an RBV perspective and on environmental management practices in the construction industry. Three environmental strategies emerged from the clustering, namely reactive, preventive, and proactive strategies. Such classification, also rooted in RBV theory, is useful in delineating the competitive advantages embedded under complex configurations of bundled resources. 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), therefore strategic environmental capabilities could convey sustained competitive advantages to multinational construction firms.

The second contribution pertains to identifying links between environmental strategy and the internationalization of multinational construction firms. The key research question guiding this paper is whether environmental strategy choice has any impact on the internationalization of a multinational construction firm. The ANOVA results in Table 2 suggest firms exhibiting higher tiers of strategic environmental management are associated with higher degrees of internationalization, but only to an extent that firms pursuing preventive strategies are more internationalized than those using reactive strategies, while firms pursuing advanced heights of proactive strategy do not show any significant impact on internationalization. Among the covariates considered, firm size has a significant effect in moderating the linkage between environmental strategy and internationalization. Albeit in a weaker sense, country-level covariates GDP per capita and EPI, which are related to the ability of a firm's home country to protect the natural environment and to the pressure exerted to adopt environmentally conscious operations, are overall significant and moderate the effect of environmental strategy on internationalization.

In addition, out of the three internationalization dimensions considered, the impact of environmental strategy adoption is evident for geographical extensity, relatively weak on geographical concentration, and insignificant for intensity dimension. The last research question addressed in this study explores the possible influences of environmental strategy on business distribution portfolio across developed and developing regions. The results in Table 5 indicate that firms with greater environmental capabilities are more likely to increase their business distribution portfolio in developed regions. While this propensity might attribute to the higher willingness to pay for environmental products or services in developed countries, what is missing here is a business model that veers focus to population at the "base of pyramid" or developing countries. Indeed, the content analysis has observed several sampled firms' commitment to the local or global environmental initiatives, such as organizing awareness events or funding environmental NGO, nevertheless substantial affordable green construction products or services should also offer to consumer groups in the developing countries. The "base of pyramid" model, as pinpointed by Hart and Christensen (2002), ample market opportunity are forged in low-income population or countries, and disruptive innovation is required so that a more simpler and modest version of environmental products could be adopted by those who originally would be left out from the market.

The identification of a firm's environmental strategy and its global deployment remains an empirical question. That firms adopting a preventive strategy transcend reactive 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 contrast, the proactive strategy cluster did not depict any significant impact on internationalization, contravening expectations. Considering the complexity of internationalization, the unexpected result can be interpreted in two ways. First, proactive firms do not deem geographical business expansion as a major corporate 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 markets that prioritize environmental performance, particularly societies that have greater expendable income and higher willingness to pay. The business distribution portfolios of proactive firms also affirm that proactive firms are more likely to deploy their business operations in developed regions that would provide ample business opportunities for environmental services and products. Second, as Sandhu et al. (2012) contended, while firms' environmentalism by means of pollution prevention is driven by pressures emerging from their international linkages, firms that respond beyond pollution prevention and engage in new green product development are not driven by mere international linkage. Instead such responses emanate from internal resource-based competencies arising out of unique organizational and cultural histories of being socially responsive.

For the three dimensions of internationalization, the investment intensity (FSTS) indicator suffers from a lack of regional data, which rendered the results incomparable to other internationalization indicators for developed and developing regions. Besides, owing to the wide range of 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 measurement (concentration dimension).

The findings presented here are not conclusive and are subject 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. 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 breadths and details that best served their own stakeholders. Therefore, the evaluation might not completely reflect the firm's actual environmental capability. Third, the study utilized investment intensity, geographical concentration and extensity to measure internationalization, while there are other aspects of internationalization that have not been considered. For example, the study did not capture the foreign direct investment configurations of the firms, whether internalized, sub-contracted or joint venture. Fourth, while the socio-economic environment of each developed and developing country is unique and complex, this study might have oversimplified the differences within and across developed and developing regions. Nevertheless, in a modest way, our study provides a stepping-stone for future research to further explore environmental management and internationalization in the construction industry, and to improve the confidence of results reported here.

Finally, this study highlights four 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 a reactive strategy are more likely to lag behind in international deployment. Second, construction firms that wish to expand their businesses globally need to institute basic environmental capabilities as a way to enhance their public images and as a source of competitive strength against their competitors. In developed regions, where environmental practices generally become norms of practice, firms lacking environmental capabilities are more likely to face heightened barriers to entry and public scrutiny. Thus, proper environmental performance monitoring and transparency in environmental reporting would favor the legitimacy to operate in developed countries. Although firms in developing regions could be more relaxed on the environmental requirement, developing environmental capabilities in pollution prevention could still attain the benefits of reduced costs, improved image, and the consequent related advantages over their counterparts. Furthermore, the implementation of low-cost pollution prevention would entail immediate financial benefits from the "low-hanging fruit" of environmental practices (Zeng et al., 2010). Third, firms pursuing a proactive strategy might not be outstanding in the scale of internationalization. Nonetheless, firms pursuing a proactive strategy consider environmentally sustainable business a matter of great importance, and are more inclined to invest in further environmental innovation. In this respect, firms that adopt a proactive strategy could organize their portfolio for deployment in countries where they could exploit their advantages of environmental capabilities and bestow learning opportunities on sustainable construction in the process of internationalization, as well as maintain their markets in developing regions. Lastly, while construction firms with higher environmental capabilities are shifting to the maturing green market in developed countries, little attention has been given to the potential market in developing countries. The study raises a need to further explore a more inclusiveness business model that could offer innovative products and services that are affordable and adaptable to the people from developing countries. By reaching the population at the "base of pyramid", a firm would have opportunity to seize new profit and growth opportunities, and align their environmental capability development with more locational choice throughout its international expansion.

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Table A1. Sample of firms

Australia	Germany	Netherlands
Lend Lease	Bilfinger Berger	Van Oord
Leighton	HOCHTIEF	Royal BAM
WorleyParsons	Bauer	
		Norway
Austria	Greece	Veidekke ASA
A. Porr AG	ELLAKTOR SA	
STRABAG SE	Metka	Portugal
		Soares Da Costa
Canada	India	
SNC-Lavalin	Larsen & Toubro Ltd.	Spain
		Sacyr Vallehermoso
China	Italy	ACS

Shanghai Electric	IMPREGILO	FCC
China Railway Construction	Saipem	OHL
China Gezhouba		SANJOSE
China State Construction Eng.	Japan	Tecnicas Reunidas
China Railway	Toyo Engineering	
Shanghai Construction	Taisei	Sweden
	JGC	Skanska AB
Denmark	Kajima	
Per Aarsleff	Obayashi	Taiwan
	Chiyoda	CTCI
Egypt	Shimizu	
Orascom Construction	Kinden	UK
Industries (OCI)	Taikisha	Balfour Beatty
	Nishimatsu Construction	AMEC
France		Petrofac
VINCI	Korea	
BOUYGUES	Samsung C&T	US
TECHNIP	Doosan E&C	Willbros
	Daewoo E&C	Jacobs
	Hyundai E&C	KBR
	Samsung Eng.	Fluor
	GS E&C	Layne Christensen
	Daelim Industrial	URS

Table A2. Factor loadings of exploratory factor analysis on innovation domain and operational practices domain

	Factor Loading	
Innovation domain	Innovation capability	Product stewardship
Adoption of environmental innovation	0.831	-
Environmental R&D	0.823	-
Life cycle analysis	-	0.727
Environmental impact assessment	-	-
Green procurement system	-	0.614
Operational Practices	Pollution prevention on-site	Pollution prevention in office
Energy efficient practices in office	-	0.709
Water efficient practices in office	-	0.819
Waste reduction practices in office	-	0.813
Efficient use of energy in construction and production facilities	0.756	-
Efficient use of water in construction and production facilities	0.820	-
Efficient use of materials in construction and production facilities	0.672	-
Emission control in construction and production facilities	0.647	-
Prevent and minimize noise emission	0.534	-

Ecology and habitat protection	0.605	-

Notes: maximum likelihood extraction and quartimax rotation were performed

1. Three environmental strategies of multinational construction firms are identified.
2. Environmental proactivity strengthens competitive advantages in internationalization.
3. Firms pursuing reactive strategy would be laggard in internationalization.
4. Preventive strategy promotes network spread in developed and developing countries.
5. Proactive strategy promotes regional diversification in developed countries.

ACCEPTED MANUSCRIPT