

**MEASURING ENVIRONMENTAL STRATEGY: CONSTRUCT DEVELOPMENT,
RELIABILITY AND VALIDITY**

JUDITH L. WALLS

jlwalls@bus.umich.edu

Assistant Professor
John Molson School of Business
Concordia University
1455 de Maisonneuve Blvd. W.
Montreal, Quebec, Canada H3G 1M8

PHILLIP H. PHAN

pphan@jhu.edu

Professor of Management
Carey Business School
Johns Hopkins University
10 N. Charles Street
Baltimore, MD 21201

PASCUAL BERRONE

pberrone@iese.edu

Assistant Professor
IESE Business School
University of Navarra
Department of Strategic Management
Camino del Cerro del Águila, 3
28023 Madrid, Spain

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ABSTRACT

This paper applies an inductive approach to develop a measure for environmental strategy grounded in the natural-resource-based view. Through content analysis, we identify six “environmental capabilities” that form components of a reliable, multidimensional construct of environmental strategy. We verify the reliability of this construct through exploratory and confirmatory factor analysis, establish convergent and discriminant validity by comparing it to other measures often used via a multi-trait, multi-method matrix, and establish predictive validity using regression analysis. Our work demonstrates that the inconsistent results in prior work are because many studies ignore the empirical difficulties of marrying the theoretical connection between the firm’s resource base and its environmental strategy. We contribute to the field by deriving a measure of environmental strategy that is congruent with the natural-resource-based view, a dominant theoretical paradigm for the intersection between strategic management and environmental sustainability. Implications for practice and research are discussed.

INTRODUCTION

Consideration of the natural environment has become an increasingly critical element of a company's long term strategy. This has been driven in part by changes in the regulatory and institutional environment but more fundamentally by a shift in perceptions of managers and consumers over the importance of environmental issues in the production and consumption of goods and services. As a result, many companies have shifted from taking a reactive view of environmental issues to more proactive approaches (Hoffman, 1999). Accordingly, companies are building unique environmental capabilities that can drive competitive advantage in the manner put forth by the natural-resource-based view or NRBV (Hart, 1995).

As research in this area has proliferated, a heterogeneous range of environmental strategy measures has emerged, and this has led to inconsistent approaches in formulating theoretical models and selection of estimation techniques. For instance, studies have tended to blur the line between environmental *management* variables such as certification, practices, initiatives and technologies and environmental *performance* variables such as the impact of the firm's activities on the natural environment (Claver-Cortés et al, 2005). Often, researchers have relied on the NRBV to assume that environmental strategy can be proxied by environmental performance measures for it to be linked to financial performance (e.g. Hart & Ahuja, 1996; King & Lenox, 2002; Russo & Fouts, 1997). This approach nevertheless conflates cause and effect and the resulting inconsistent operationalization of the environmental strategy construct has led to a lack of empirical consensus, for example, on the relationship between environmental strategy, environmental performance and financial performance (Claver-Cortés et al, 2005). As a result, it has been difficult for researchers to compare and replicate studies, and build and refine theory and models in this field.

The central research question of this paper, therefore, focuses on the environmental construct, its definition, operationalization and measurement in a manner that is congruent with the NRBV. We use grounded theory and inductive analysis to investigate this question. A second objective is to assess the internal reliability and content, convergent, discriminant and predictive validity of the environmental strategy measure developed in this paper and several popular proxy measures used in the field. We test these formally using exploratory and confirmatory factor analysis, a multi-trait, multi-method matrix, and regression analysis.

In doing so, we aim to contribute to the literature in environmental strategy by closing the gap between empirical approaches and theoretical notions of the NRBV. We identify six specific environmental capabilities that form a multidimensional construct of environmental strategy. We show that this measure is reliable and valid and find that both reactive and proactive environmental approaches by firms are able to predict value creation. Our findings have implications for both scholarship and practice in the field of environmental strategy.

THE NATURAL-RESOURCE-BASED VIEW

A corporate environmental strategy can be defined as set of initiatives that mitigate the impact of a firm's activities on the natural environment through "products, processes and policies such as reducing energy consumption and waste generation, using ecologically sustainable resources, and implementing an environmental management system" (Bansal & Roth, 2000: 717). To understand how the firm's environmental strategy creates economic value, researchers have increasingly turned to the natural-resource-based view as the dominant theoretical paradigm (Hart, 1995; Sharma & Aragón-Correa, 2005). It is an extension of the resource-based-view of the firm, which emphasizes that internal resources or capabilities, when valuable, rare, inimitable

and without equivalent substitutes, can lead to sustainable competitive advantage because they are path dependent, causally ambiguous and socially complex (Barney, 1991).

In the case of environmental strategy, such capabilities can show up as continuous improvement to lower costs (tacit), integrating stakeholders to preempt competition (socially complex), and a shared vision of sustainable development that secures a firm's future position (rare) (Hart, 1995). Capabilities can be developed sequentially (Wernerfelt, 1984), or, when related to environmental strategy, concurrently because of the path dependence and social embeddedness of environmental issues (Hart, 1995). In the literature, an environmental strategy that bestows competitive advantage is described as: future-oriented and going beyond compliance regulation (Aragón-Correa, 1998); implementing pollution prevention technologies through product and process (re)design or adaptation (Marcus & Geffen, 1998; Christmann, 2000); and, is reflected in managerial and corporate values and integrated into management systems and business strategy (Hart, 1995; Russo & Fouts, 1997). As a first step towards integration and reinvention of a business' interface with the natural environment developing "environmental capabilities" may allow firms to lower production costs, create a first-mover advantage, integrate across functions, learn and innovate (Christmann, 2000; Hart, 1995; Russo & Fouts, 1997; Sharma, 2000; Sharma & Vredenburg, 1998; Shrivastava, 1995).

Researchers argue that firms invest in capability development because interfirm differences create differential rents (Peteraf, 1993). Yet, capabilities consist of specific processes that are common across firms (otherwise the RBV is not generalizable) as integrated business functions and expertise or reconfigured existing resources (Eisenhardt & Martin, 2000). Hence, it should be possible to identify common capabilities in firms that adopt proactive environmental strategy approaches.

METHODS

We took a grounded theory approach (Glaser & Strauss, 1967) to inventory the environmental capabilities among firms. We focused our search on U.S. firms in the S&P500 index and in primary and manufacturing industries (SIC<5000) for whom environmental issues are particularly salient (Hart & Ahuja, 1996). Our final sample consisted of 184 firms in 22 industries by 2-digit SIC code.

First, we conducted a holistic search of companies' environmental activities and used inductive analysis to identify the types of skills firms developed to strategically address their environmental impact. We analyzed skills within and across firms (Eisenhardt, 1989) and created indices to examine the data (Glaser & Strauss, 1967). We then looked for commonalities across firms and mapped existing themes (Miles & Huberman, 1994), sorting and re-sorting them until common dimensions emerged and until we reached a point of theoretical saturation so that no additional themes or dimensions were generated (Glaser & Strauss, 1967). We then returned to the literature (Eisenhardt, 1989) and conducted a more extensive search of the natural-resource-based view to identify types of environmental capabilities firms developed. We used factor analysis to determine whether these capabilities were indeed dimensions of an *environmental strategy* construct (Bartholomew et al, 2002; Fabrigar et al, 1999). We finally tested for reliability and validity of the construct via a multi-trait, multi-method matrix (Campbell & Fiske, 1959) and used regression analysis to establish predictive validity (Kerlinger & Lee, 2000).

Data collection

We collected data from corporate environmental and other reports to identify capabilities firms were building to develop an environmental strategy. Annual reports are often useful to study organizational behavior and strategy because they provide comparable sets of data and

represent a public account of an organization's activities (Arndt & Bigelow, 2000; Bettman & Weitz, 1983; Bowman, 1984; Salancik & Meindl, 1984; Staw, McKechnie & Puffer, 1983). Similarly, environmental reports provide comparable sets of data on organizations' environmental activities (Morhardt, 2001). Indeed, the emergence of standardized environmental reporting systems such as the Global Reporting Initiative (GRI), introduced in 2000, has made environmental reports the outlet of choice in which companies cover comprehensive topics and data on their environmental activities.

During our data collection process, we first searched for environmental reports, which 83 of the firms in our sample produced. Not all firms publish environmental reports annually, so if the report for 2003 was unavailable, we chose the environmental report produced in the closest year to 2003. If firms did not produce any environmental reports at all, we searched for this information in other company reports such as annual reports/10-K filings (106 firms) or the environmental pages, products or policy statements (60 firms) on the firm's website. In total, 184 firms had some kind of information about "proactive" and/or "reactive" environmental activities.

We additionally collected secondary data for reliability and validity testing. We focused on two sets of data that are popular in the literature and capture "proactive" and "reactive" environmental approaches but have also been subject to criticism (Entine, 2003; Toffel & Marshall, 2004): Kinder, Lydenberg & Domini (KLD) and the Toxic Release Inventory (TRI). KLD's data has been used extensively in academia for research on corporate social responsibility and environmental sustainability (Graves & Waddock, 1994; Johnson & Greening, 1999; McWilliams & Siegel, 2000; Neubaum & Zahra, 2006; Waddock & Graves, 1997). We used KLD's environmental strengths and environmental concerns data (Appendix A).¹ Each category

¹ KLD also provides data on a number of other social responsibility measures. We used only the measures related to environmental initiatives of firms: "environmental strengths" and "environmental concerns".

was binary to indicate whether the firm performed the activity. We aggregated the category scores for a total respective score of *KLD strengths* (“proactive” environmental strategy) and *KLD concerns* (“reactive” environmental strategy), attributing equal weights to the categories. The maximum possible score was 6 for *KLD strengths* and 7 for *KLD concerns*.

TRI data is another well established and oft-used measure of corporate environmental activity (King & Lenox, 2002; Klassen & Whybark, 1999; Russo & Harrison, 2005). TRI data consists of toxic emissions via air, water, land or underground injection that must be reported to the Environmental Protection Agency (EPA). Since emissions are not the same as harmful exposure (EPA, 2002), some studies have tried to mitigate this shortcoming by weighting emissions, using “reportable quantities” to account for the toxicity levels of chemical agents (e.g. King & Lenox, 2000, 2002; Russo & Harrison, 2005). However, Toffel and Marshall (2004) argued this is also problematic. To account for risks associated to human health and obtain a more precise measure, we weighted chemicals using the Human Toxicity Potential Factor (HTP) developed by Hertwich and colleagues (2001) which measures toxicity in terms of benzene equivalence (for carcinogens) or toluene equivalence (for non-carcinogens). Each of the two measures, one for carcinogenic and one for non-carcinogenic emissions, were aggregated across chemicals at facility level and then to parent company. We next calculated the predicted value of pollution by estimating total waste generation levels using production ratios in the prior year reported by TRI and compared these against actual levels (King & Lenox, 2000, 2002). If actual waste was lower than predicted, the *pollution prevention* measure would yield positive results. The carcinogenic and non-carcinogenic measures were aggregated for a final measure of *pollution prevention* (Berrone & Gomez-Mejia, 2009) to capture “proactive” environmental strategy. In addition, an end-of-pipe *pollution control* (“reactive” environmental strategy)

measure was calculated as a ratio of the sum of chemicals recycled, treated on-site, and transferred to other locations for further treatment divided by the total waste generated by the firm (King & Lenox, 2001, 2002, 2004; Sarkis & Cordeiro, 2001).

We collected data on two dependent variables to establish predictive validity. The first dependent variable was Tobin's Q, using Compustat data to assess *financial performance* (King & Lenox, 2002). Tobin's Q captures a firm's market value based on expectations of future cash flow such as those from environmental activities. We also used Compustat to include standard controls in our regressions, following King & Lenox (2002): *firm size* as a log of assets, *sales growth* as change of sales over the last three years, *R&D intensity* as R&D expenditure over sales, *capital intensity* as capital expense over sales, and *leverage* as total debt over total assets. We added an industry control in the form of *pollution intensity* that ranked 2-digit SIC industries by total amount of toxic emissions, from most (highest score) to least (lowest score) polluting sector (Berrone & Gomez-Mejia, 2009).

For the second dependent variable, we needed a measure of *environmental performance* that did not expose our study to common method bias – in other words, we could not use performance described in environmental reports, nor use either KLD or TRI data. We decided to use environmental performance ratings provided by Innovest Strategic Value Advisors (RiskMetrics). Innovest collects data on companies' environmental (as well as other) activities through company data, in-depth sector analysis, and interviews to develop a rating.² The ratings are based on underlying factors scores; we used the environmental score as our dependent variable that ranged from 1.11 to 8.59 for our data, normally distributed around a mean of 5.20.

² Innovest ratings data has four components: stakeholder capital, strategic governance, human capital and environment. We used only the environment component, which establishes a rating based on board and executive oversight, risk management systems, disclosure/verification, process ("eco-") efficiencies, health and safety, new product development and environmental/climate risk assessment.

Data Analysis

Analysis was conducted in several stages using multiple techniques.

Phase I: Content Analysis. Using content analysis (Holsti, 1969; Miles & Huberman, 1994), we coded text, picture captions and diagrams. Nearly 5,000 items were coded in this manner. To check coding reliability, a random selection of text was coded by a second researcher and yielded a Cronbach's alpha of 91.3%. Via an iterative process (Glaser & Strauss, 1967), we interpreted the content through the lens of the natural-resource-based view to identify capabilities related to an environmental strategy. We coded 21 topics relevant to environmental capabilities ("proactive" environmental strategy) summarized in Table 1. Most of the items coded were converted to a binary format of whether or not the company performed the activity. The binary codes were then aggregated per category. For example, in the case of the "supply chain network", if a firm had a supplier policy and a product stewardship program, but did not have a buyer policy or industrial symbiosis activities the total score was 2 (out of a possible 4). Some items were coded on a sliding scale to convert a number of years, dollar amount, or level of reporting into a scale. These included: history of implementing an environmental program, ISO certification, investment into environmental R&D, long-term environmental commitment and reporting structure (Table 2).

Enter Tables 1 and 2 about here

We further coded information on environmental *compliance* problems companies reported to capture "reactive" environmental strategies and conduct discriminant validity checks. Two topics were coded to this effect: environmental fines/violations and remediation costs. A

scale was developed to reflect the seriousness of the violation and the extent of remediation expenses (Table 3).

Enter Table 3 about here

Phase II: Testing Reliability & Validity. We tested for reliability and validity to verify the congruency of the constructs with the theoretical underpinnings of the NRBV (Hoskisson et al, 1993; Schwab, 1980; Venkatraman & Grant, 1986). We employed exploratory and confirmatory factor analyses to establish reliability (Hoskisson et al, 1993), a multi-trait multi-method approach to verify convergent and discriminant validity (Campbell & Fiske, 1959), and regression analysis to assess the predictive validity of our measure (Kerlinger & Lee, 2000).

Content validity was established by coding items to match with theory (Nunnally & Bernstein, 1984). We split our sample to conduct exploratory factor analysis on part of the data set and confirmatory factor analysis on the rest of the data (Bollen, 1989). We employed a factor extraction method (principal factors) with quartimin oblique rotation for the factor analyses to identify whether our *environmental strategy* was a latent construct of the six environmental capability measurement items (Bartholomew et al, 2002; Fabrigar et al, 1999).³

To test convergent and discriminant validity, we used a multi-trait multi-method matrix (Campbell & Fiske, 1959). This approach uses more than one method and more than one trait to check that correlations converge between different methods measuring the same trait, but are not too high with other traits from which they were intended to differ (Campbell & Fiske, 1959). In this approach, a matrix is constructed in which the diagonal entries are reliability scores (Cronbach's alphas) for mono-trait mono-method measures as an indicator of internal reliability.

³ We used oblique rather than orthogonal (i.e. Varimax) rotation to relax the assumption that latent variables be uncorrelated – which is reasonable to expect in the case of environmental capabilities which are often developed sequentially.

These scores should be significantly different from zero as evidence of convergent validity. In addition, validity diagonals are correlations between mono-trait hetero-method values as measures of convergent validity, and these should be higher than the values in adjacent columns and rows in the hetero-trait hetero-method triangles to establish discriminant validity (Campbell & Fiske, 1959).

Predictive validity is a form of criterion-related validity that checks a measurement instrument against an outcome measure, such as via regression analysis (Kerlinger & Lee, 2000). Because the association between *environmental strategy* with firm *financial performance* is generally small (Margolis, Elfenbein & Walsh, 2009) and may be mediated by *environmental performance* (Claver-Cortés et al, 2005), we opted to assess predictive validity against both outcomes. Tobin's Q reflects the inherent value of the firm in terms of future expected gains, and we therefore used no lags in our regression for *financial performance*. To assess predictive validity for *environmental performance*, we allowed for a five-year gap (i.e. data from 2008) to ensure that enough time had passed between when companies develop environmental capabilities, and when they reap the benefits of those investments. Since both the *financial performance* and *environmental performance* outcomes were continuous variables we ran ordinary least square regressions for our models.

RESULTS

Environmental Capabilities

Our content analysis revealed six common “environmental capabilities” across firms: historical orientation, network embeddedness, endowments, managerial vision, top management team skills and human resources. Each of these is analogous to those proposed by the NRBV because they are path dependent and socially complex. Most firms (83.2%) had at least one

environmental capability. Of these, 75.0% of firms stated an environmental vision, 69.0% had endowments and 64.7% engaged in stakeholder management on environmental issues. About half of the firms furthermore had some sort of supply chain network (53.8%), a history of engaging in environmental efforts (52.2%) and top management team skills relevant to the environment (51.1%). The least common environmental capability was human resources (42.4%). We describe how each capability is rooted in the literature and how it was operationalized based on our iterative inductive analysis.

Historical Orientation. A company's path through time and space and the unique historical conditions of its establishment dictates how it acquires and exploits resources, and therefore how well it performs in the future (Arthur, 1989; Barney, 1991). History can bestow firms with competitive advantage: preferential locations, founding conditions, scientific breakthroughs and values and beliefs that dominate the period all contribute to the development of firm specific capabilities.

Environmental capabilities are no different. For example, the development of environmental capabilities often begins as a reflection of the institutional environment at a point in history with a reactive approach of pollution control that later builds up towards a proactive goal of sustainable development (Hart, 1995; Hoffman, 1999). By forming a reactive approach, firms build a foundational capability to address ongoing environmental issues. Having a "foot-in-the-door" in dealing with the natural environment makes it easier to gain support for future environmental projects, especially if past experiences were successful (Cordano & Frieze, 2000). In addition, actively seeking opportunities to improve environmental performance becomes a part of the corporate culture and identity (Sharma, 2000). Firms with a strong history in environmental strategy are more likely to consider the environmental impact of new strategies,

products and processes. They are also more likely to spread environmental values throughout their supply chain in their relationships with buyers, suppliers, consumers and peers. Therefore, the longer a firm's history of having an environmental strategy, the more likely it is to have built environmental capabilities. In our inductive analysis "historical orientation" emerged as a scale of the years since a firm implemented an environmental program.

Network Embeddedness. A network is a set of linkages among organizations characterized by specified relationships based on a) resource transfers such as money, information, power, commitment or personnel, or b) interpenetration of organizational boundaries through shared interest groups (Laumann, Galaskiewicz & Marsden, 1978). Networks are strategically important because they allow firms to respond to their interdependence with the general external environment (Pfeffer & Salancik, 1978; Uzzi, 1999) by having access to the right resources, identifying opportunities, matching expectations and gaining control over information (Burt, 1997; Lenz, 1980). The ability of organizations to generate resources is partly determined by their networks (Lenz, 1980). Because networks evolve over time, they are path dependent and become a capability of the firm (Freeman & Barley, 1990; Lenz, 1980). Networks are furthermore socially complex and difficult to imitate.

Access to networks is particularly critical for corporate environmental strategy because environmental issues are extremely complex and thus require firms to have interdisciplinary skills and coordinate their environmental response with others (Roome, 1992). In terms of environmental strategy, networks fall into two groups: firms along the product supply chain acting as suppliers and buyers; and, other stakeholders such as governments, employees, NGOs, or "any group or individual who can affect or is affected by the attainment of the organization's objectives" (Freeman, 1984: 46). The "supply chain network" has a direct impact on a firm's

production process and therefore also on its environmental performance through engaging with outsiders and sharing information along the product supply chain (Cerin & Karlson, 2002; Marcus & Geffen, 1998). The “other stakeholder network”, on the other hand, influences environmental strategy through social pressure and can determine the type of environmental strategy a firm pursues (Delmas & Toffel, 2008). In response to stakeholder influence, firms can develop specific environmental strategies such as eco-design and ecosystem stewardship (Sharma & Henriques, 2005). By addressing stakeholder concerns, companies develop trust and credibility and build a good corporate reputation, an intangible resource (Sharma & Vredenburg, 1998; Russo & Fouts, 1997). Networking thus represents a socially complex environmental skill that forms a competitive advantage for environmental strategy (Delmas & Toffel, 2004; Hart, 1995; Henriques & Sadorksy, 1999). Our content analysis suggests that “supply chain network” can be measured as a reflection of companies’ engagement with suppliers, buyers, conduct product stewardship efforts, or engage in material exchange (industrial symbiosis) with other companies. In turn, the “other stakeholder network” is a reflection of a firm’s association with governments, NGOs, industry associations, communities, employees, socially responsible investors, and voluntary programs.

Endowments. Firms can build competitive advantage through the accumulation of assets over time. Such endowments become an asset stock for the firm when the resource flows form a consistent pattern of appropriate choices on expenditure to build resources and skills (Dierickx & Cool, 1989). This is a path-dependent process is usually causally ambiguous and can allow firms to achieve strategic goals more quickly than competitors. Asset stocks are also interconnected with other stocks and subject to continual reinvestment to forestall erosion (Dierickx & Cool, 1989). Endowments can appear in the form of physical assets or structures in the form of

organizational slack. Organizational slack is the cushion of actual or potentially accessible resources that allows organizations to respond to pressure, initiate strategic change, champion causes and facilitate innovative or creative behavior (Bourgeois, 1981; Singh, 1986). Slack allows firms to retain earnings for reinvestment, particularly useful if the firm wants to invest in long-term projects such as environmental strategy.

An effective environmental strategy requires continual and considerable reinvestment (Darnall & Edwards, 2006). Firms that possess long-term endowments can more easily build environmental capabilities because it allows them to invest in technological leadership and exploit opportunities (Aragón-Correa, 1998). In particular, the greater the degree of discretionary slack – that which is within the latitude of managerial action – the more likely it is that managers can address environmental issues (Sharma, 2000). Slack allows flexibility and firms with slack respond in a timelier manner to changes in environmental technologies (Aragón-Correa, Matías-Reche & Senise-Barrio, 2004). Thus, endowments and related slack allow firms to build proactive environmental strategies. “Endowments”, in our analysis, is a combination of the amount of money a firm invests in environmental research and development (scale) and supporting structures such as an environmental management system or an ISO-14001 certified environmental process that would create the necessary slack to maximize the endowment.

Managerial Vision. “Visioning” is the process of projecting a desired future organizational state that, when effectively communicated, empowers followers to enact the vision (c.f. Westley & Mintzberg, 1989). Visionary leadership may result from an individual’s capacity for imagination, inspiration, insight, foresight or sagacity and can be directed to focus on products, processes, the market, the organization or ideals (Westley & Mintzberg, 1989). Visionary leadership benefits company performance, attitudes of followers, creates cohesion

among the top management team and has a positive influence on corporate citizenship (c.f. Groves, 2006). Visionary leadership furthermore positively influences values of social corporate responsibility towards shareholders, stakeholders and the community at large (Waldman et al, 2006). Managerial vision is also important for building internal interdependencies and interrelationship within organizations (Dierickx & Cool, 1989). Vision is particularly important when uncertainty is high and actions are difficult to contract, and managers with strong visions will tend to attract employees with similar beliefs (Van den Steen, 2005).

Visionary leadership is a unique capability because it is not clear if such leaders can be trained. In addition, a complex or internally interdependent organization is difficult for competitors to copy because it cannot be systematically managed or influenced (Barney, 1991; Child, 1972). Environmental strategies require visionary leadership because the success of environmental strategies depends on long-term commitment and investment (Hart, 1995). Vision prioritizes the environment on the corporate agenda; managers champion and direct functional, department and production processes towards environmental goals (Andersson & Bateman, 2000). Our analysis indicates that managerial vision of environmental strategy can be measured in terms of the time dimension of the environmental vision (short or long term goals have been set) and the depth of the vision across the organization (global or not).

Top Management Skills. Managerial skills may be generic (transferable), business or industry related, and firm-specific (such as know-how) used to make operational and strategic decisions that build competitive advantage (Castanias & Helfat, 1991). Superior management skills are a source of economic rent (Penrose, 1959) and difficult for competitors to imitate as they are firm-specific (Barney, 1991). The competitive advantage of top managers comes not just from within the firm, but also through the managers' connections within the business

environment. Evidence suggests, for example, that the ability to network along the supply chain and stakeholders through reciprocal relationships based on trust (*guanxi*) confers competitive advantage (Tsang, 1998).

A successful environmental strategy is likely to require managerial competencies in combination with other firm-specific capabilities (Russo & Fouts, 1997). Implementing environmental strategic initiatives requires tight internal integration and coordination as well as stable external partnerships (Dechant & Altman, 1994), which require a talented top management team. The role of managers in environmental strategy is one of central coordination, integration and connections with others to source for talent, ideas and technologies (Marcus & Geffen, 1998). To do so, environmental managers must have some tenure with the firm and relevant functional experience in environmental issues (Aragón-Correa et al, 2004). In our content analysis “top management team” environmental skills are assessed by whether the environmental manager is on the executive team, and by the reporting level of the environmental manager (a scale of local or facility level, to senior management team or the board).

Human Resources. Human resources are firm-specific capabilities that can also bestow competitive advantage (Barney, 1991). Particularly, human resources can be a unique capability if a firm’s HR practices differ from most of its peers, were developed through trial-and-error (path-dependent), consist of continual investment, and are highly integrated with other firm resources (socially complex), and can not be substituted by planning systems (non-substitutable) (Lee, Phan & Chan, 2005).

Human resources are an important capability for the development of environmental strategies because dealing with environmental issues requires expert knowledge and specific incentives (Wehrmeyer, 1996). Such experience may not necessary rest within the firm, but can

be brought in by hiring professionals or experts. Indeed, the more firms search for talent and ideas externally, the more likely they will be able to build environmental capabilities if they can harmonize the external learning within the firm (Marcus & Geffen, 1998). It is also thought that firms that evaluate managers on environmental performance criteria are more likely to develop environmental capabilities (Sharma, 2000). In our analysis, two processes that firms may have in place appear to be relevant to “human resources” skills for environmental strategy. These include a formal environmental training program and environmental reporting, both of which indicate the presence of HR skills related to the environment.

Construct Reliability

All measurement items of *environmental strategy* were positively correlated (Table 4). Thus, it appears firms adopt distinct environmental capabilities in parallel as suggested by Hart (1995). For purposes of discriminant validity, we also coded data on compliance issues firms faced. Our content analysis shows that 34.2% of firms reported violations, fines or compliance/remediation.

Enter Table 4 about here

The data was randomly split into two samples: a larger sample of 122 observations and a smaller sample of 62 observations to cross-validate the model (Bollen, 1989). We used the larger sample to conduct an exploratory factor analysis, using factor extraction, to ensure we had a large enough sample in case reliabilities were low (Fabrigar et al, 1999). To allow factors to correlate, we used oblique quartimin rotation (Fabrigar et al, 1999). Results are given in Table 5 and indicate that all environmental capabilities load onto a single factor with loadings ranging from 0.52 to 0.81, well above the 0.4 cut-off point typically used in the strategic management

literature (e.g. Finkelstein, 1992). All loadings on the second and third factor were below 0.4. The first factor had an eigenvalue of 3.42 and a Chi-square of 355.78. A scree plot and Akaike Information Criterion (AIC) statistic confirmed that a one factor model was the best fit. An assessment of the raw residuals indicated no problems with correlated residuals or skewed dispersions. Furthermore, the reliability of the factor was high with a Cronbach's alpha of 0.86 and a reliability coefficient Rho of 0.84, well above the 0.7 cut-off acceptable for early stage construct validation (Nunnally & Bernstein, 1994). The smaller sample (n=62) was used for confirmatory factor analysis using factor extraction method, but restricting the analysis to one factor. The results of the confirmatory factor analysis were closely aligned with the findings of the exploratory factor analysis (Table 6), indicating that our measurement appeared appropriate.⁴

Enter Tables 5 and 6 about here

Results of the factor analyses suggest that each of the environmental capabilities is a component of *environmental strategy*. Thus, we developed the *environmental strategy* construct as an aggregated measure of the six capabilities. We attributed equal weights to the dimensions since we had no theoretical reason to believe that one capability was more important than another. The *environmental strategy* measure can thus be described as a formative (aggregate) multidimensional construct (Edwards, 2001) that consists of six environmental capabilities.⁵

In contrast to the *environmental strategy* data, only 32.1% of the firms were marked to have any kind of *environmental strengths* in the KLD database. The internal reliability of the

⁴ We used a factor extraction method because it was more appropriate for our data, but a disadvantage is the lack of goodness-of-fit measures. Post-hoc robustness analyses show our results are consistent with a maximum likelihood confirmatory factor analysis run in EQS. This gave a Comparative Fit Index (CFI) of 0.988 and a Root Mean Square Error of Approximation (RMSEA) of 0.051 confirming that the one factor model is a good fit (Fabrigar et al, 1999).

⁵ Because environmental strategy is a multi-dimensional construct, broader than each of the capabilities, the reliability coefficient reported is that of the overall construct rather than any of the sub-scales which would be expected to be much lower than the overall construct (e.g. Ones & Viswesvaran, 1996; Hanisch et al, 1998).

KLD strengths (Cronbach's alpha) measure was only 0.24. However, since the measure is based on an unsystematic categorization of environmental initiatives undertaken by firms, there is no a priori expectation for strong internal reliability. The most frequent score was for the 'pollution prevention' category (12.5%). A tetrachoric correlation, adjusted to ensure a positive definite matrix outcome, was conducted since the variables were binary and showed that not all items correlated in the same direction. For example, 'alternative fuel' correlated negatively with 'environmental products' and 'recycling efforts'. On the other hand, some 40.8% of firms scored on at least one *environmental concern* in the KLD database. Internal reliability of *KLD concerns* was much stronger than that of strengths with a Cronbach's alpha of 0.65. The most frequent environmental problem identified by KLD was 'hazardous waste' (26.6%). A tetrachoric correlation, adjusted to ensure a positive definite matrix outcome, showed that not all measurement items correlated in the same direction. For example, 'climate change' was negative correlated with 'emissions' and 'agricultural chemicals'.

The TRI *pollution prevention* and *pollution control* variables were available for about three quarters of the firms. The *pollution prevention* variable, after a log transformation, exhibited a fairly normal distribution but skewed towards positive scores: 69.2% of firms had scores above zero. Internal reliability (Cronbach's alpha) of *pollution prevention* was 0.63, based on its two components of carcinogenic and non-carcinogenic emissions. *Pollution control* ranged from 0 to 1 and had a skewed distribution; the majority of firms (63.0%) had ratios of 0.8 or above indicating that they engaged in treating waste as an end-of-pipe process.

Convergent and Discriminant Validity

Table 7 shows the results of the multi-trait multi-method analysis. The values in parentheses are internal reliabilities (Cronbach's alphas) and these are strongest for the

environmental strategy (0.86), *KLD concerns* (0.65) and *pollution prevention* (0.63) measures. Adjacent to the reliability coefficients are the correlations among constructs using the same measurement instrument (in *italics*). These are hetero-trait mono-method triangles and should have low or near-zero correlations to indicate discriminant validity between the proactive versus reactive environmental approaches of firms. While correlations are low for our *environmental strategy* against the *environmental compliance* measure (-0.06), the same does not hold true for the two other methods. A moderate correlation exists between KLD's *strengths* and *concerns* measures (0.31), and between TRI's *pollution prevention* and *pollution control* measures (0.38).

Enter Table 7 about here

Values in **bold** font are validity diagonals, or correlations of the different instruments measuring similar constructs, that should be significantly different from zero. These values assess the convergent validity of measuring a similar construct in different ways. Strong convergent validity exists between *environmental strategy* and the *KLD strengths* measure. The TRI *pollution prevention* variable, however, does not converge significantly with other proactive measures. Convergence also does not appear to take place among the reactive strategies of *environmental compliance*, *KLD concerns* and TRI *pollution control* which have weak and non-significant correlations. The exception is a significant and negative correlation between *KLD concerns* and *pollution control*. While the pollution control variable is typically considered as a “reactive” environmental approach, this result suggests that firms that implement fewer pollution control strategies have more environmental problems. In this sense, the *pollution control* variable may be seen as a minimal environmental compliance effort, compared to the *KLD concerns* variable that could indicate failure to comply with environmental regulation.

An assessment of discriminant validity was conducted by checking that the bold diagonal values are higher than hetero-trait hetero-method triangles (values in normal font). This is the case for *environmental strategy* and the *KLD strengths* measures. The *pollution control* measure also has mostly larger values than those in the hetero-trait hetero-method triangles. An exception is the *pollution prevention* measure which in all cases has smaller values in the diagonal suggesting a lack of discriminant validity of the *pollution prevention* measure.

Predictive Validity

We ran our predictive validity regressions in stages. The first model used only controls, and subsequent models included each type of environmental measure. Table 8 shows results for the *financial performance* regression and show a negative association with *compliance* and *KLD concerns* (“reactive” environmental strategies). However, there is no association with Tobin’s Q for *environmental strategy* or *KLD strengths* (“proactive” strategies), nor do either of the TRI variables appear to predict *financial performance*. Predictive validity is therefore established for the *compliance* and *KLD concerns* variables.

Enter Tables 8 and 9 about here

The results for *environmental performance* were quite different (Table 9). Both *environmental strategy* and *KLD strengths* are positively associated with *environmental performance* (t+5). In addition, *compliance* is negatively associated with *environmental performance* (t+5), as was *KLD concerns* but the latter relationship was not statistically significant. No associations were found for either of the TRI variables. In particular, predictive validity was strong for our *environmental strategy* construct which more than doubled variance

explained over the controls only model. This variable also had much higher variance explained than other predictors of *environmental performance* such as *compliance* and *KLD strengths*.

DISCUSSION

The goals of this study were to inductively identify a measure of *environmental strategy* that aligned with the theoretical perspective of the NRBV, establish discriminant and convergent validity of this measure against alternatives, and determine the predictive validity of *environmental strategy* for value creation. First, via a content analysis of corporate environmental and annual reports and company websites, we identified 21 topics of environmental skills that could be aggregated into six main themes. Our inductive analysis showcased that in order to build an *environmental strategy*, the majority of companies appear to develop one or several of six capabilities. A historical orientation is important to establish a “foot-in-the-door” towards environmental responsibility on which companies can later build other capabilities. Network embeddedness allows companies to engage in environmental supply chain relationships with suppliers and buyers, and engage in product stewardship and by-product synergy programs. Stakeholder networks also allow firms to develop relations with government organizations, NGOs, businesses and industry, communities, employees, and socially responsible shareholders, and join voluntary programs with respect to environmental issues. Furthermore, companies gain environmental endowments through ISO certification schemes, establishing environmental management programs and setting up environmental research and development initiatives. Companies emphasize visionary environmental leadership through long-term, global commitment. Skills among the top management team are also important with many companies assigning a senior environmental manager to oversee environmental issues and setting up a reporting level that at times reaches as high as the board of directors or even external auditing

agencies. Moreover, successful environmental endeavors require skills from top managers in order to cascade down to lower levels in the firm, promoting a consistent environmental strategy of the firm. Finally, human resources are developed to address environmental issue via specific training programs and reporting systems to track environmental activities along the lines of GRI's standards. Our literature review suggests these six environmental capabilities of the NRBV and our exploratory and confirmatory factor analysis validated this *environmental strategy* measure as a formative multi-dimensional construct in which all six capabilities load onto a single factor.

The second objective of our research was to establish convergent and discriminant validity of our environmental strategy measure with other measures used in the literature via a multi-trait multi-method analysis. Findings indicated that the *environmental strategy* measure correlates reasonably well with the *KLD strengths* variable, suggesting that at least to some extent the KLD measure captures the underlying capabilities firms are building to develop an environmental strategy. Both these measures also have discriminant validity. In contrast, the *TRI pollution prevention* measure does not converge well with our *environmental strategy* measure, nor could discriminant validity be established. Limited conclusions can be drawn from this result. Our interpretation is that while the *TRI pollution prevention* variable captures actual firm behavior, it cannot identify if environmental capabilities are being built. Thus, the *pollution prevention* variable does not appear to be consistent with the theoretical notions of the NRBV. This might be because a time lag may exist between the building of environmental capabilities and actual *pollution prevention* techniques. Alternatively, and more perturbing, environmental strategies may not account for the actual impact of pollutants on human health, an aspect that our *TRI pollution prevention* variable captured. Another explanation could be that environmental

reporting is subject to selective disclosure or “greenwashing” by promoting successful activities but failing to discuss failures, something firms are more likely to do under certain conditions (Lyon, 2007). The selective disclosure argument would partly explain why our content analysis captured many more capabilities than compliance issues (compared to the *KLD concerns* variable, for instance). Certainly, the lack of correlation between *environmental strategy* and *pollution prevention* bears deeper investigation.

The selective disclosure argument may also partly explain the lack of convergence between the “reactive” measures for which the results were generally weak. For instance, no correlation was found between environmental *compliance* with either *KLD concerns* or TRI *pollution controls*. It is quite possible that KLD is conducting a more rigorous search of firm’s weaknesses when it comes to environmental issues than companies are willing to report. It may also be true that a single environmental problem is captured in more than one *KLD concerns* category thus artificially inflating these scores. For example, a firm that has high emissions may also be breaking environmental regulation for which it would score two hits on the *KLD concerns* category. We found a negative association between *KLD concerns* and TRI *pollution control*. Our interpretation of this result is that the notion of “reactive” environmental strategies may need to be refined further and be coded along a continuum (e.g. Newman & Hanna, 1996) or a combination of approaches (e.g. Aragón-Correa, 1998). After all, there is a difference between failing to comply with environmental regulation (thus scoring on the *KLD concerns* category) and implementing end-of-pipe pollution control equipment with the purpose of ensure regulatory compliance is met (thereby scoring on the *KLD strengths* variable). While an end-of-pipe control approach is not a “proactive” strategy that builds a capability, it can be very effective in

controlling the noxious impact of emissions, the release of hazardous waste and prevent companies from breaking environmental laws.

To determine the predictive validity of our measure, in light of the NRBV, we assessed whether *environmental strategy* was capable of creating value in terms of improved *financial performance* and *environmental performance*. We measured *financial performance* in terms of Tobin's Q to capture a firm's future financial value and *environmental performance* in terms of future environmental scores captured by Innovest, was an independent data set, to avoid common method bias. Our results indicate that "reactive" measures such as *compliance* and *KLD concerns* negatively predict *financial performance*. In contrast, environmental performance is predicted by both "proactive" approaches such as our *environmental strategy* measure and *KLD strengths* and our "reactive" *compliance* measure. Our interpretation is that investors expect companies to engage in some minimal level of environmental proactivity since they "punish" those firms that fail to comply. However, investors do not appear to "reward" companies who are developing capabilities. It may be that capability development is difficult for investors to assess, or that the future outcome of environmental investments is too uncertain to be captured in financial value. In contrast, building environmental capabilities strongly predicts *environmental performance* five years later. Moreover, companies that have compliance issues appear to have worse *environment performance*. This suggests that building environmental capabilities "pays off" at least in terms of value created through environmental improvements. The *pollution prevention* and *pollution control* variables did not appear to predict either *financial* or *environmental performance*. It is thought that *environmental performance* mediates the relationship between *environmental strategy* and *financial performance*. Even so, our results indicate that the relationship between the TRI variables is not significant for *financial* or *environmental*

performance. Our interpretation is that the lack of a common measure of environmental strategy that aligns with the theoretical underpinnings of the NRBV in the past has led to inconsistent results. These preliminary findings clearly show that the choice of measures makes a difference in outcomes and demonstrates the value of our construct validity study as a contribution to this field.

Some limitations of this study should be mentioned. First, the KLD environmental categories are largely zero dominant, thus lacking in variability and highly skewed. Because we limited our sample to large companies in the primary and manufacturing industry for whom environmental issues are salient, 32.1% of firms in our sample had *KLD strengths* and 40.8% had *KLD concerns*.⁶ Therefore, while using KLD data is clearly simpler than collecting and coding information from environmental reports, the KLD variables may nevertheless prove challenging for larger data samples that include smaller companies and non-polluting industries. Second, our study does not track changes in environmental capabilities over time. It may be that the environmental capabilities identified in this study erode in value over time; companies may need to continue to engage in environmental innovation to develop a sustained competitive advantage. This is not something we capture in our work. Nevertheless, our results suggest that capabilities companies built in 2003 had a positive impact on environmental performance in 2008.

Several important implications emerge from this work. From a research perspective, our measure of *environmental strategy* captures capabilities that firms develop to deal with the natural environment. As our measure is consistent with the theoretical perspective of the NRBV, it is an indicative lead indicator of forward-looking strategies companies pursue in order to gain competitive advantage. Thus, this measure has some advantages over lag indicators of past firm

⁶ The full population of firms covered by KLD in 2003 (n=2,963) showed that 88.2% of firms had zero entries for environmental strengths and/or concerns.

behavior captured by external data providers such as KLD and TRI which are not reflective of environmental capabilities per se. Our *environmental strategy* measure may therefore be better able to depict companies at the frontier of environmental strategy and the value this creates. Our results show that this measure is predictive of improved *environmental performance* and that companies with *compliance* problems captured in our analysis have both worse *financial* and worse *environmental performance*. Future research should investigate these associations and delve deeper into possible moderating and mediating effects as well as stability of the measure over time.

A useful outcome to practitioners is that our measure of *environmental strategy* gives guidance on investment in and development of specific environmental capabilities. Firms can effectively enter the environmental strategy space by establishing a history, reaching out to the supply chain network and other stakeholders, invest in environmental endowments, create a managerial vision for the environment, hire top managers with environmental skills or develop these internally, and set up a human resources system that includes environmental training and reporting. Our evidence suggests that these capabilities create value for the firm and they are therefore critical to establishing a competent, competitive and proactive environmental strategy.

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TABLES & FIGURES

Table 1: Coding Scheme and Sample Phrases – Environmental Capabilities

TOPIC	SAMPLE PHRASES
1. Historical Orientation	
History of implementing an env'tal program	"Our commitment to sustainability has a long history", "as early as 1928, our electric subsidiary ... installed electrostatic precipitators to reduce particulate emissions", "adopted its Environmental Policy in February 1975"
2a. Network Embeddedness: Supply Chain	
Supplier policies	"suppliers must be committed to reducing the environmental impact of their designs, manufacturing processes, and waste emissions ... legal compliance to laws on chemicals, waste ... endeavor to reduce or eliminate waste of all types", "suppliers have committed to ... sustainable forest management standard ... certification process requires independent ... audit"
Buyer policies	"products must be designed, engineered, installed and supported to achieve customers' production needs and their EHS objectives", "recycled more than 8 million tires through dealership collection programs", "ISO certification to meet customer requirements"
Life cycle analysis or product stewardship	"implemented a comprehensive product stewardship program to manage EHS issues concerning the chemical content of products, direct materials and packing materials", "product life cycle principles are being applied to acquired products and during the development of new products ...and during the design phase",
Industrial symbiosis activities	"facility recovers starch released during cutting operations, which is then sold to outside companies for further processing and use in products", "unavoidable potato residuals generated during processing are sold as animal feed"
2a. Network Embeddedness: Other Stakeholders	
Government relationships	"cooperate with federal, state and local government agencies in ... developing a cost effective, performance-based environment, safety and health policy", "working with members of Congress ... to urge the U.S. ...not to abandon the rule prohibiting roads from being built in currently protected forests"
NGO relationships	"pipe was donated to three different wildlife refuges in California for use in watershed habitat maintenance", "spent nearly \$300,000 to fund the installation of hack boxes and hack tower material to reintroduce peregrine falcons to the Big River habitats",
Business/industry associations	"participate in the Global Roundtable on Climate Change", "member of the Business for Social Responsibility (BSR)", "participate in conferences, industry-working groups on specific projects such as cleaner transportation"
Community programs	"a statewide initiative to teach young people about renewable energy technologies", "community and environmental commitment through employee volunteerism programs, corporate donation campaigns, and environmental education and curriculum development programs"
Employee programs	"instituted programs to reduce air emissions from employees' vehicles traveling to and from work", "more than 600 ... environmental activities are being undertaken ... by our employees", "actively support employee volunteerism ... donate \$10 for every qualifying hour of volunteer work"
Socially responsible shareholders	"proudly listed in the Dow Jones Sustainability Index, Calvert Social Index and the Domini 400 Social Index", "met with 15 SRI firms", "increased shareholder value through EHS commitment", "CSR analyst meetings"
Voluntary programs	"entered into voluntary cleanup agreements ... with the Department of Environmental Conservation", "joined U.S. EPA Climate Leaders Partnership to work towards a voluntary commitment to reduce greenhouse gases"

3. Endowments	
ISO certification	“half of our locations are ISO14001 certified”, “all our facilities worldwide are expected to comply with our corporate Environmental Protection Program, which is aligned with ISO 14001”
Environmental management system	“we are using Six Sigma to reduce the amount of wood waste from ‘cut direct’ saws by 50 percent”, “environmental management system being developed at facility by facility basis”
Investment into environmental R&D	“investing \$1.5 billion over the next several years in environmental systems that will significantly reduce emissions of SO2 and NOx at our power plants”, “\$82million in environmental spending”, “invested more than \$4 million on research in the pursuit of a ‘zero-discharge’ water-recycling technology”
4. Managerial Vision	
Long term environmental commitment	“we also set key milestones to be met by 2010”, “new voluntary program to reduce carbon intensity by 2012”, “life cycle management reviews of all existing products must be completed by 2010”
Global environmental vision	“Three regional sustainability reports were published in ... Australia ... Canada ... Latin America”, “revised our sustainable forestry policies and practices to ... promote sustainable forestry on a global level”
5. Top Management Team Skills	
Senior environmental manager executive	“the vice president of the department ... reports to our group president ... who reports directly to Chairman and CEO”, “officers ...Vice President - Environment, Health & Safety and Audit”, “we welcomed ... as Vice President and Chief Sustainability Officer [reports directly to the board]”
Reporting structure (level)	“senior managers are part of the environmental management reporting structure”, “independent assessments by external organizations”, “corporate responsibility committee at board level”, “local facilities are responsible for implementation”
6. Human Resources Skills	
Environmental training programs	“all facilities provide staffing and training initiatives to manage environmental protection”, “conduct extensive personnel training in environmental compliance”, “more than 65% of our workforce has participated in a Lean event”, “trained more than 50 ... scientists on designing environmental sustainability into our new products”, “added an EHS module to our global ... training”
GRI or CERES reporting	“supports the Global Reporting Initiative (GRI) as a comprehensive format for reporting data on economic, environmental and social performance”, “in developing this report, we relied heavily on the guidelines issued by the [GRI]”

Table 2: Overview of Items Converted to Scales

Measurement Item	Scale
History of implementing an environmental program	0: no history 1: 1-10 years 2: 11-20 years 3: 21-30 years 4: > 30 years
ISO certification	0: none 1: some sites 2: all sites
Investment in environmental R&D	0: \$0-\$399mil 1: \$400mil - \$1.6bn 2: > \$1.6bn
Long-term environmental commitment	0: none 1: statement made 2: vision is 5 years or longer
Reporting structure (level)	0: none 1: local/facility level 2: senior mgmt team 3: board or external auditors

Table 3: Environmental Compliance

Conceptual Category	Measurement Items	Scale
Environmental Compliance	Fines & violations	0: none 1: at least one
	Remediation costs	2: present but < \$100mil 3: \$100mil - \$399mil 4: \$400mil - \$899mil 5: \$900mil - \$1.6bil 6: > \$1.6bil

Table 4: Descriptive Statistics and Correlations of Constructs

	mean	s.d.	skew.	kurt.	scale						
A ENVT STRAT	9.03	7.19	0.38	1.88		1	2a	2b	3	4	5
1 Historical orientation	0.89	1.07	1.16	3.65	0-4						
2a Supply chain network	1.00	1.15	0.91	2.80	0-4	0.45					
2b Stakeholder network	2.55	2.52	0.46	1.71	0-7	0.49	0.62				
3 Endowments	1.33	1.19	0.58	2.50	0-5	0.41	0.51	0.62			
4 Managerial Vision	1.22	0.92	0.19	2.13	0-3	0.44	0.42	0.54	0.55		
5 TMT skills	1.45	1.60	0.46	1.53	0-4	0.49	0.46	0.62	0.53	0.43	
6 HR skills	0.59	0.76	0.84	2.21	0-2	0.42	0.55	0.63	0.44	0.47	0.54
B ENVTAL COMPLIANCE	0.65	1.04	1.68	6.19	0-6						
C KLD STRENGTHS	0.42	0.70	1.63	5.14		1	2	3	4	5	
1 Env'tal products	0.05	0.23	3.93	16.46	0-1						
2 Pollution prevention	0.13	0.33	2.27	6.14	0-1	0.17					
3 Recycling	0.05	0.22	4.18	18.50	0-1	0.34	-0.01				
4 Alternative fuel	0.07	0.26	3.35	12.23	0-1	-0.64	-0.10	-0.63			
5 Env'tal communication	0.09	0.29	2.82	8.93	0-1	0.09	0.41	0.12	0.15		
6 Other strengths	0.03	0.18	5.26	28.70	0-1	-0.64	0.10	-0.63	0.38	0.23	
D KLD CONCERNS	0.90	1.29	1.19	3.17		1	2	3	4	5	6
1 Hazardous waster	0.27	0.44	1.06	2.12	0-1						
2 Regulatory problems	0.20	0.40	1.53	3.35	0-1	0.62					
3 Ozone depletion	0.01	0.10	9.43	90.01	0-1	0.58	0.22				
4 Emissions	0.19	0.39	1.58	3.49	0-1	0.65	0.63	0.56			
5 Agricultural chemicals	0.02	0.15	6.56	44.02	0-1	0.33	0.58	0.69	0.36		
6 Climate change	0.17	0.38	1.77	4.14	0-1	0.16	0.33	-0.47	0.37	-0.49	
7 Other concerns	0.05	0.22	4.18	18.50	0-1	0.18	0.07	-0.56	-0.10	-0.60	0.42
E POLLUTION PREVENTION	12.68	30.74	-0.55	2.03							
F POLLUTION CONTROL	0.77	0.28	-1.33	3.72							

Note: n=184 except for Pollution Prevention (n=133) and Pollution Control (n=135).
Tetrachoric correlations were used for KLD measures

Table 5: Exploratory Factor Analysis

Variables	Factor 1	Factor2	Factor3
1. Historical orientation	0.693	-0.039	0.125
2a. Supply chain network	0.759	-0.022	-0.160
2b. Stakeholder network	0.810	0.033	-0.020
3. Endowments	0.581	0.305	-0.041
4. Managerial Vision	0.520	0.235	-0.003
5. TMT skills	0.655	0.014	0.207
6. HR skills	0.723	-0.152	-0.012
Eigenvalues	3.42	0.68	0.10

$n=122$, Chi-square = 355.78, degrees of freedom = 21, Cronbach's alpha = 0.86

Note: factor extraction (principal factor) method was used with oblique quartimin rotation.

Table 6: Confirmatory Factor Analysis

Variables	Factor 1
1. Historical orientation	0.505
2a. Supply chain network	0.646
2b. Stakeholder network	0.857
3. Endowments	0.761
4. Managerial Vision	0.738
5. TMT skills	0.806
6. HR skills	0.804
Eigenvalue	3.83

$n=62$, Chi-square = 220.71, degrees of freedom = 21, Cronbach's alpha = 0.964

Note: factor extraction (principal factor) method was used, constrained to one factor.

Table 7: Multi-Trait Multi-Method Matrix of Environmental Measures

		A1	B1	A2	B2	A3	B3
Envtal Strategy	A1	(0.86)					
Compliance	B1	-0.06	()				
KLD Strengths	A2	0.51	0.04	(0.24)			
KLD Concerns	B2	0.17	0.11	0.31	(0.65)		
Pollution Prevention	A3	-0.02	0.03	0.10	-0.03	(0.63)	
Pollution Control	B3	0.03	0.13	0.13	-0.18	0.38	()

$n=127$, correlations greater than 0.16 are significant at a 5% level.

Cronbach Alpha's not available for "Compliance" and "Pollution Control".

Table 8: Predictive Validity – Financial Performance (Tobin's Q)

	Controls	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sales Growth (s.e.)	0.008 (0.006)	0.009 (0.006)	0.009 (0.006)	0.008 (0.006)	0.011† (0.006)	0.008 (0.007)	0.001 (0.006)
Leverage	-1.796* (0.788)	-1.838* (0.787)	-1.862* (0.779)	-1.805* (0.791)	-2.008** (0.766)	-0.833 (0.865)	-2.021* (0.844)
Firm Size	-0.117 (0.088)	-0.181† (0.102)	-0.105 (0.087)	-0.100 (0.093)	0.021 (0.097)	-0.067 (0.089)	-0.040 (0.083)
Capital Intensity	-2.104 (2.681)	-2.256 (2.678)	-2.918 (2.675)	-2.152 (2.691)	-3.087 (2.615)	-0.493 (2.760)	1.036 (2.558)
R&D Intensity	6.057** (1.100)	6.038** (1.098)	5.650** (1.103)	6.030** (1.105)	5.593** (1.076)	8.241** (1.816)	5.032** (1.531)
Pollution Intensity	0.031† (0.017)	0.031† (0.016)	0.038* (0.017)	0.033† (0.017)	0.046** (0.017)	0.017 (0.016)	0.023 (0.015)
Environmental Strategy		0.019 (0.015)					
Compliance			-0.179* (0.087)				
KLD Strengths				-0.077 (0.145)			
KLD Concerns					-0.306** (0.102)		
Pollution Prevention (TRI)						0.003 (0.004)	
Pollution Control (TRI)							0.128 (0.389)
Constant	2.332** (0.793)	2.759** (0.865)	2.315** (0.783)	2.193* (0.838)	1.086 (0.873)	1.551† (0.811)	1.613† (0.853)
R-Square	0.391	0.399	0.412	0.393	0.435	0.346	0.323
R-Square Adj.	0.360	0.363	0.377	0.356	0.401	0.291	0.267

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

$n = 125$, except for Model 5 ($n = 91$) and Model 6 ($n = 93$)

Table 9: Predictive Validity – Environmental Performance (Innovest Ratings) (t+5)

	Controls	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sales Growth (s.e.)	0.003 (0.010)	0.009 (0.008)	0.004 (0.009)	0.003 (0.009)	0.005 (0.010)	0.000 (0.012)	0.003 (0.011)
Leverage	-2.796** (1.009)	-2.873** (0.842)	-2.856** (0.989)	-2.809** (0.975)	-2.832** (1.002)	-2.500† (1.319)	-2.030 (1.295)
Firm Size	0.412** (0.116)	-0.030 (0.115)	0.433** (0.114)	0.262* (0.123)	0.532** (0.137)	0.365* (0.140)	0.320* (0.131)
Capital Intensity	6.902† (3.744)	6.050† (3.128)	5.802 (3.698)	7.159† (3.620)	6.197 (3.745)	7.900† (4.664)	6.429 (4.353)
R&D Intensity	0.503 (1.559)	0.362 (1.301)	-0.176 (1.553)	0.623 (1.507)	0.242 (1.557)	-0.070 (3.099)	2.250 (2.607)
Pollution Intensity	0.017 (0.023)	0.008 (0.019)	0.026 (0.023)	0.005 (0.022)	0.028 (0.024)	0.022 (0.027)	0.016 (0.025)
Environmental Strategy		0.131** (0.018)					
Compliance			-0.292* (0.120)				
KLD Strengths				0.576** (0.189)			
KLD Concerns					-0.225 (0.139)		
Pollution Prevention (TRI)						-0.000 (0.006)	
Pollution Control (TRI)							0.556 (0.672)
Constant	1.486 (1.060)	4.476** (0.976)	1.454 (1.039)	2.781* (1.109)	0.406 (1.248)	1.772 (1.276)	1.642 (1.361)
R-square	0.184	0.436	0.222	0.244	0.201	0.169	0.193
R-square Adj.	0.143	0.402	0.176	0.199	0.154	0.101	0.130

† p<0.10, * p<0.05, ** p<0.01

n=126 except for Model 5 (n=94) and Model 6 (n=97)

APPENDIX A: KLD MEASURES

KLD Environmental Strengths categories:

1. **Beneficial Products and Services.** The company derives substantial revenues from innovative remediation products, environmental services, or products that promote the efficient use of energy, or it has developed innovative products with environmental benefits.
2. **Pollution Prevention.** The company has notably strong pollution prevention programs including emissions reductions and toxic-use reduction programs.
3. **Recycling.** The company either is a substantial user of recycled materials as raw materials in its manufacturing processes, or a major factor in the recycling industry.
4. **Alternative Fuels.** The company derives substantial revenues from alternative fuels. The term “alternative fuels” includes natural gas, wind power, and solar energy. The company has demonstrated an exceptional commitment to energy efficiency programs or the promotion of energy efficiency.
5. **Communications.** The company is a signatory to the CERES Principles, publishes a notably substantive environmental report, or has notably effective internal communications systems in place for environmental best practices.
6. **Other Strengths.** The company demonstrates a strong environmental attribute not addressed by KLD’s ratings categories.

KLD Environmental Concerns categories:

1. **Hazardous Waste.** The company's liabilities for hazardous waste sites exceed \$50 million, or the company has recently paid substantial fines or civil penalties for waste management violations.
2. **Regulatory Problems.** The company has recently paid substantial fines or civil penalties for violations of air, water, or other environmental regulations, or it has a pattern of regulatory controversies under the Clean Air Act, Clean Water Act or other major environmental regulations.
3. **Ozone Depleting Chemicals.** The company is among the top manufacturers of ozone depleting chemicals such as HCFCs, methyl chloroform, methylene chloride, or bromines.
4. **Substantial Emissions.** The company's legal emissions of toxic chemicals (as defined by and reported to the EPA) from individual plants into the air and water are among the highest of the companies followed by KLD.
5. **Agricultural Chemicals.** The company is a substantial producer of agricultural chemicals, i.e., pesticides or chemical fertilizers.
6. **Climate Change.** The company derives substantial revenues from the sale of coal or oil and its derivative fuel products, or the company derives substantial revenues indirectly from the combustion of coal or oil and its derivative fuel products. Such companies include electric utilities, transportation companies with fleets of vehicles, auto and truck manufacturers, and other transportation equipment companies. KLD began assigning concerns for this issue in 1999.
7. **Other Concerns.** The company has environmental problem not specifically covered in KLD’s categories, usually an environmental accident.