

The Strategic Use of Decentralized Institutions

Exploring Certification with the ISO 14001 Management Standard



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**THE STRATEGIC USE OF DECENTRALIZED INSTITUTIONS: EXPLORING
CERTIFICATION WITH THE ISO 14001 MANAGEMENT STANDARD**

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In this article, we respond to calls by previous researchers to clarify the function of decentralized institutions by analyzing the strategic motives of individual actors. We investigated an important type of decentralized institution, certified management standards, and theorized that firms use these institutions to reduce problems that might arise with exchange partners that lack information or fear opportunism. We tested this theory using the pattern of certification with the ISO 14001 management standard.

Scholars have long suggested that understanding of decentralized institutions such as norms, codes of conduct, and industry standards could be advanced by greater consideration of the varying strategic motives of the agents that might interact with these institutions (DiMaggio, 1988; Granovetter, 1985; Ingram & Silverman, 2002). Yet most research on decentralized institutions has downplayed strategic considerations and instead emphasized the importance of coercive, normative, and mimetic forces (Scott, 1995). In this article, we examine the role of strategic action in shaping the function of an important class of decentralized institutions: certified management standards.

Across the globe, more than 600,000 companies have obtained certification with various management standards (ISO, 2002). Prominent standards include the OHSAS 18001 standard for health and safety management, the International Organization for Standardization's ISO 9000 and ISO 14000 management standards, and the Eco-Management and Audit Scheme (EMAS). Yet, despite their importance, the function of these institutions remains poorly understood. Certified management standards specify sets of internal organizational management practices and create systems for certification. They do not constrain the quality or nature of business outputs (e.g., services, products, or by-products). Why firms choose to certify, how certification influences behavior, and how outsiders interpret certification remain largely unknown.

Certified management standards are classified as private decentralized institutions because participation is voluntary and because diffuse actors, rather than a central authority, provide rewards for participating or sanctions for not participating (Ingram & Silverman, 2002). Most research on certified management standards has drawn from the literature on norms to hypothesize that institutional pressures drives adoption of certified management standards (Delmas, 2002; Guler, Guillen, & Macpherson, 2002; Mendel, 2002). The distinguishing

element of these decentralized institutions—the existence of a means of certifying compliance with a set of practices—has been little considered. When it has been addressed at all, certification has simply been used as a convenient mechanism for measuring the adoption of the specified practices (Corbett & Kirsch, 2001; Delmas, 2002; Guler et al., 2002). In only a few studies have researchers argued that certification might influence the function of management standards (Anderson, Daly, & Johnson, 1999; Jiang & Bansal, 2003; Bansal & Hunter, 2003).

In this article, we extend theory by directly evaluating certification as a critical determinant of the function of management standards. Drawing on previous research, we observe that asymmetrically distributed information can harm all parties to an exchange (Akerlof, 1970). We propose that the symbolic act of certifying with a management standard reveals credible information about otherwise hidden organizational attributes and behaviors. Choosing whether to employ this symbolic act, we argue, entails strategic consideration of the information needs and strategies of other actors. Following this logic, we hypothesize that managers will be more likely to seek certification when they expect potential exchange partners to lack information or fear opportunism. We further hypothesize that certification reveals credible information about the use of particular management systems, efforts at performance improvement, or an organization's performance relative to the performance of others.

Empirically, we explore certification with the ISO 14001 environmental management standard. Sponsored by the International Organization for Standardization (ISO), the ISO 14001 standard specifies a set of environmental management systems and practices, including the development of environmental objectives and policies, the provision of training and documentation, delegation of responsibilities, and internal performance audits (Delmas, 2002). It also creates a system for third-party auditors to certify compliance with the standard.

The choice of ISO 14001 as the setting for our research had three important advantages. First, owing to the availability of government data on firm environmental practices, we could better separate factors that influence the adoption of environmental management systems and practices from those that influence the decision to certify with ISO 14001. Second, the standard is applicable to a diverse group of organizations, thereby allowing a comparison of adoption across numerous firms, industries, and regulatory settings. Finally, the practical impact of ISO 14001 remains a source of interest and discussion. In testimony before the U.S. Congress, members of the standard-setting committee expressed differing expectations about its function. Some suggested that certification would help “to distinguish companies that are doing the bare minimum from those that are committed to environmental excellence (Freeman, 1996: p3),” while others suggested that the program might provide direct operational advantages (Collins, 1996; Morella, 1996).

THEORY AND HYPOTHESES

Certified management standards include two fundamental elements. First, they codify a set of standard practices. Second, they provide a certification system that allows organizations to communicate the use of these practices. Most analyses of certified management standards have conflated the adoption of management practices and certification (Corbett & Kirsch, 2001; Delmas, 2002; Guler, Guillen, & Macpherson, 2002). Although it seems reasonable that certification indeed reflects the adoption of specified practices, the opposite logic does not hold. Firms that do not certify may still adopt some or all of the practices. Adoption is an internal act that can be kept secret and private. Certification, in contrast, is a fundamentally public act because it entails submitting to an independent and public audit.

We theorize that firms use the public act of certification to reduce information asymmetries between suppliers and potential buyers. Asymmetric information—information about an exchange that is distributed unequally—often harms all parties to that exchange (informed and uninformed alike). Akerlof (1970) illustrated this result with an example from used car sales. He envisioned a market in which sellers knew the quality of their vehicles but buyers did not. He hypothesized that if buyers could not acquire credible information, they would be unwilling to pay more for (reportedly) high-quality cars. Sellers, he argued, would then have no incentive to provide high-quality vehicles and would withdraw them from the market.

Akerlof considered a case in which asymmetric information makes it hard for buyers to identify desirable suppliers, thus creating what is termed a “selection problem.” A second type of asymmetric information problem, the “monitoring problem,” occurs when asymmetric information makes it difficult for a party or parties to an exchange to know if agreements have been met. For example, Ford Motor Company was unable to observe whether Bridgestone-Firestone was maintaining the process controls necessary to ensure that their tires would not fail when used (O'Rourke, 2001). Breakdown in quality management practices during a strike at one plant led to the production of faulty tires and resulted in severe losses for both companies (O'Rourke, 2001).

Observation of responses to both the selection problem and the monitoring problem provide interesting insights into strategic behavior because their solution may require the informed party to consider the information needs and opportunism concerns of the less-informed party and act to alleviate these problems. We elaborate some possible elements of this strategic behavior in the section below. We hypothesize that suppliers will be more likely to certify when

buyers (1) are less able to acquire information about the supplier or (2) have greater reason to fear opportunistic behavior on the part of the supplier. We further hypothesize that certification will provide credible and valuable information to buyers, and we hypothesize what this information might be.

Asymmetric Information and Opportunism

A common finding in many bodies of research is that exchange partners are likely to have less information about parties that are more physically distant (Allen, Lee, & Tushman, 1980; Hamilton, Godfrey, & Linge, 1979; Katz & Tushman, 1979). Distance reduces information transfer through its direct effect on transfer costs and by its association with other restricting factors (Mariotti & Piscitello, 1995). For example, distance may reduce the number of shared information links and so prevent receiving parties from checking the veracity of information through redundant sources (Lane & Bachman, 1996). Distance may also reduce the frequency of interaction and so reduce the propensity of parties to develop reputations as credible sources (King, 1999). Empirically, numerous studies in various social settings have documented that the transfer of credible information between two parties decreases rapidly with increasing physical distance (Allen et al., 1980; Hamilton et al, 1979). Given the propensity for physical distance to reduce information transfer and increase asymmetric information, we expect:

Hypothesis 1. The more an organization's potential buyers are physically distant, the greater the propensity for the organization to certify with the ISO 14001 management standard.

Aside from physical distance, social, cultural, and institutional distance can reduce information transfer and increase information asymmetries (Caves, 1982). One explanation is that a shared culture or belief system facilitates the processing of transferred information (Hofstede, 1980). Studies have shown that cultural and physical distance increases the difficulty

and cost of selecting and monitoring foreign suppliers (Buckley & Casson, 1979; Hamilton et al., 1979; Kogut & Singh, 1988). Such “liability of foreignness” is one of the central tenets of international business theory (Zaheer, McEvily, & Perrone, 1998). Following this tradition, we argue that information asymmetries should be especially high in international supply relationships.

Hypothesis 2. The more an organization’s potential buyers are located in foreign countries, the greater the propensity for the organization to certify with the ISO 14001 management standard.

Transaction cost theory suggests that firms structure relations with their buyers to reduce the threat of opportunism. Yet, as demonstrated by Argyres and Liebeskind (1999), a firm is usually constrained to choose a single governance structure for a set of transactions, and these structures are often suboptimal for part of the set (e.g., ancillary or future transactions). For example, a buyer’s investment in relationship-specific assets may increase the risk of supplier hold-up and thus encourage the use of a long-term supply contract with a supplier. Once in place, however, this contract may increase the threat of other types of opportunism (Grossman & Hart, 1986). For example, suppliers with long-term contracts may no longer be motivated to improve their performance because they are no longer disciplined by the high-powered incentives of market competition (Rotemberg, 1991; Williamson, 1985). Since supplier environmental performance is unlikely to drive governance structures, we hypothesize that an ongoing vertical relationship¹ between a buyer and a supplier will increase the risk of supplier moral hazard and thereby raise the need for buyers to monitor the supplier’s environmental

¹ Joskow (1988) coined the term “vertical relationship” to capture both vertical integration and long-term contracts between suppliers and buyers. He showed that such relationships occurred more frequently when suppliers or buyers needed to invest in relationship specific assets and therefore could not easily switch to new exchange partners (Joskow, 1988; Williamson, 1985).

performance. In addition, an ongoing relationship will increase the impact of such moral hazard by raising the spillover damage to the buyer's reputation.

The greater managerial authority provided in vertical relations might be presumed to facilitate this necessary monitoring. Empirical evidence suggests, however, that the monitoring benefits of vertical integration are often small and contingent (Zenger & Hesterly, 1997). Eccles and White (1988) discovered that buyers preferred outside suppliers because intrafirm suppliers were thought to make lower-quality goods. Lafontaine and Masten (2002) found that monitoring difficulties prevented trucking companies from using contracts with company drivers that might have induced them to choose the best routes. In their review of the literature, Zenger and Hesterly (1997) argued that vertical integration had allowed superior monitoring in only a few large organizations. Thus, research suggests that on net, ongoing vertical relationships increase the need for monitoring and the benefits to certification for both parties.

Hypothesis 3. The more an organization has ongoing vertical relationships with its buyers, the greater the propensity for the organization to certify with the ISO 14001 management standard.

The Information Content of Certification

Our proposition that certification serves as a vehicle to solve information asymmetries with exchange partners rests on an assumption that certification provides some real information about an organization. Thus, at the least, our theory requires that the symbolic act of certification remains coupled to the actual implementation of the prescribed practices. Numerous researchers have shown that the decoupling of symbol from substance represents a real risk for norm-like institutions. For example, Westphal and Zajac (1994) found that the symbolic adoption of long-term incentive programs was disconnected from the actual use of

these incentives; in a later study, they found similar decoupling for stock repurchase programs (Westphal & Zajac, 2001).

The third-party audits required by certified management standards reduce the risk of decoupling, but as demonstrated by recent scandals in cost accounting, third-party certification does not guarantee honesty, nor does it prevent changes in practices after certification. If decoupling becomes too frequent, certification will no longer provide real information for differentiating underlying organizational attributes—thereby invalidating the basis for our information-based theory of the strategic use of certified management systems. Thus, to fully test the appropriateness of our analysis, we must empirically demonstrate that ISO 14001 at least reveals the existence of a functioning environmental management system (EMS) in an organization.

Hypothesis 4. Organizations that certify with the ISO 14001 management standard are more likely to have a functioning environmental management system.

Often the practices specified in a certified management standard are presumed to have a connection with some other desired behavior or outcome. Although certified management standards do not typically require improvement in some performance dimension, certification may still convey information on performance improvement to exchange partners if, for example, ISO 14001 conveys real information about the existence of an internal environmental management system (EMS), and if an EMS leads to improvement. An EMS requires a company to develop environmental objectives and policies, provide training and documentation, delegate responsibilities, and perform internal performance audits (Jiang & Bansal, 2003). Such systems may directly facilitate improvement; they may change incentives of agents within the organization and alter their behavior (Grossman & Hart, 1986); or they may reveal underlying organizational differences in improvement preferences.

Certification cannot reveal precisely when an organization has adopted an environmental system. Organizations may adopt an EMS and then later seek certification to convey this information to exchange partners. Alternatively, they may adopt or substantively modify an EMS to gain certification. Without knowing the extent of knowledge possessed by exchange partners, we cannot stipulate in our theory whether certification reveals information about the existence of a previously adopted performance improving EMS, or reveals information about a recently adopted or enhanced EMS. If certification is used to monitor improvement among exchange partners, however, it must provide one of these two types of information. To the extent that certification provides the former information, we should expect the existence of an EMS to be associated with performance maintenance or improvement, and that (as stated in Hypothesis 4) certification with ISO 14001 reveals the existence of this EMS. To the extent that certification provides the latter information, we should expect to see that ISO 14001 certification is itself associated with performance maintenance or improvement.

Hypothesis 5a. An organization's environmental performance improves following adoption of an environmental management system (EMS).

Hypothesis 5b. An organization's environmental performance improves following certification with the ISO 14001 management standard.

As an alternative to helping buyers monitor whether suppliers improve, certified management standards may help firms communicate superior underlying performance (Ferguson, 1996). Spence (1973) provides one explanation for how certification could be a signal of superior but unobservable performance. Illustrating his idea with an example from education, Spence (1973) argued that a college diploma can help distinguish highly productive workers from less productive workers—even if attending college has no effect on this productivity. He reasoned that people that know they are highly productive may gain a diploma simply to

differentiate themselves. He showed that a college diploma will provide a credible signal of unobservable productivity if two basic conditions are met: (1) attending college is more expensive (in effort and money) for low-productivity workers and (2) employers offer a wage premium for college-educated workers that is sufficient to offset the cost of going to college for the highly productive but insufficient to offset the cost for the less productive.

Spence's model can be directly extended to certification with a management standard. If certification requires less effort and cost for high performers, and if buyers are willing to pay a premium to suppliers with better environmental performance, better performers may choose to certify to signal their superior performance. Empirical research provides evidence that the conditions in many industries may allow ISO 14001 to act as a credible signal. Evidence exists that it is less costly for organizations with better environmental performance to acquire environmental management systems and certify with ISO 14001. Darnall and Edwards (2004) found that organizations with existing pollution prevention activities and greater management system experience can adopt environmental management systems at lower cost. Russo and Fouts (1997) suggested that organizational capabilities are closely tied to environmental performance and that organizations with greater capabilities can more easily adopt proactive environmental management practices. Ferrer, Gavronski, and de Laureano (2003) found that a majority of managers believed that firms with better environmental performance could obtain ISO 14001 certification more cheaply than laggards. Numerous authors have argued that buyers are often willing to pay a premium to suppliers with higher environmental performance (cf. Reinhardt, 1997). Several explanations for this premium have been given. Environmental performance may provide evidence of superior operational performance (Russo & Fouts, 1997). Environmental accidents can cause substantial shortages of important input materials (Slawsky,

2004). Environmental problems occurring at supplying organizations can also damage the reputation of supply chain partners (Reinhardt, 1997).

If organizations use certification as a signal of superior performance, those with high performance should tend to certify. According to Spence's signaling theory, no equilibrium can exist in which poorly performing suppliers (or all suppliers) certify, because this would destroy the credibility of the signal. Thus, if certified management standards act as a signal, we expect better performing organizations to have a greater tendency to certify.

Hypothesis 6. Organizations that certify with the ISO 14001 management standard have higher environmental performance than noncertifiers.

DATA AND METHODS

We tested our hypotheses by examining a sample of 7,899 facilities (generating 46,052 observations in the full panel analysis) drawn from the population of U.S. manufacturing facilities from the year 1995 to 2001. Facility data were derived primarily from the Toxic Release Inventory (TRI) of the U.S. Environmental Protection Agency (EPA) and Dun & Bradstreet's directory of facilities. We also gathered industry-level data from the Bureau of Economic Analysis and the Census Bureau of Foreign Trade. We gathered demographic information from the Internal Revenue Service (IRS) and the Census Department. Our sample is limited by the reporting requirements of the TRI. Facilities must report to the TRI if their manufacturing processes generate waste above certain levels and if they have more than nine employees.

At the time this article was written, the most recent TRI data extended only to 2001, but data on ISO 14001 certification were available through 2002. Because certification with ISO 14001 did not begin in earnest until 1996, we limited our sample to 1996–2002 for the

dependent variables (1995–2001 for the independent variables) in evaluating the propensity of facilities to certify. In analyzing the effect of management practices and ISO certification on improvement, we extended the panel back to 1994 to allow at least a two-year pretest window.

Measures

Dependent variable. The primary dependent variable for our analysis is certification with the ISO 14001 environmental management standard. We gathered certification data from a database of ISO 14001 certified facilities (QSU, 2002a). Certification occurs at the facility level. We coded *ISO 14001 certification* as a binary variable that takes on a value of 1 if a facility was ISO 14001–certified during a particular annual period.

Independent variables. To test Hypothesis 1, we measured the geographic distance from a facility to the nearest major buyer (*distance to buyers*). To calculate this distance, we first used TRI data to gather longitude and latitude information for each facility. We then used the Bureau of Economic Analysis input-output tables to determine the major buying industry (the one accounting for the largest percentage of sales) for each selling industry. For each supplying facility (identified by its four-digit SIC code), we calculated the great circle distance (in miles) to the nearest member of this buying industry. We took the natural logarithm of this measure to reduce its skew.²

To test Hypothesis 2, we measured the degree to which facilities in an industry sold to buyers outside of the United States (*foreign buyers*). This variable measures the percentage of

² To ensure the robustness of this measure, we also calculated an alternative variable that measured the number of such buyers within a 50 mile radius of the facility. Analysis using the natural log of this count variable confirmed the sign and significance of our results.

all goods produced by members of an industry that is shipped to buyers outside of the United States. We used input-output data from the Bureau of Economic Analysis to create this variable.

To test Hypothesis 3, we created two measures of the degree to which an organization has ongoing vertical relationships with its buyers. The first variable captures whether a firm is vertically integrated with at least one of its potential buyers (*vertically-integrated buyer*). To form this measure, we created a binary variable that takes on a value of “1” if a supplier and a potential buyer (as determined by the Bureau of Economic Analysis input-output tables) is owned by the same corporate parent as the focal facility. Our second measure captures industry-level differences in the propensity of suppliers to have vertical relationships with their buyers (*industry vertical relationship*). Research has revealed that industry-level differences strongly influence the tendency for relationship specific investments (Maddigan, 1981). To create a measure of this tendency, we adopted a method similar to that developed by Maddigan (1981) and Balakrishnan & Wernerfelt (1986). First, we used data from the Bureau of Economic Analysis to identify pairs of supplying and buying industries. For each supplying industry, we then used the entire 1996 Dun & Bradstreet database (500,000 facilities) to calculate the percentage of suppliers that were owned by a corporation that also owned a facility in the buying industry. Because the volume of exchanges between industries differs widely, we weighted this percentage using shipment data from the Bureau of Economic Analysis input-output tables. To reduce the skew of our final variable, we logged this weighted percentage value. Thus, *industry vertical relationship* was an estimate of the log percentage of each dollar produced by each industry (each SIC code) shipped to a vertically integrated buyer.

To test Hypothesis 4, we used data from the Toxic Release Inventory to estimate the existence of a functioning environmental management system. Since 1991, as part of their

annual TRI submission, facilities have reported changes they have made to production processes that could reduce waste or control pollution. Facilities also report the sources of these technical changes. *EMS* was a binary variable coded 1 if these sources provided evidence of a functioning environmental management system. Sources of changes that indicated evidence of an operating EMS were (1) internal pollution prevention opportunity audits, (2) materials balance audits, (3) participative team management, and (4) employee recommendations under a formal company program.

To test Hypotheses 5 and 6, we calculated a facility's environmental performance using the method of King and Lenox (2000) of estimating the extent of pollution generation relative to other facilities in an industry. *Environmental performance* was the standardized residual, or deviation, between observed and predicted waste generation given a facility's size and industry sector:

$$\ln(W_{it}) = \alpha_{jt} + \beta_{1jt} \ln(s_{it}) + \beta_{2jt} \ln(s_{it})^2 + \varepsilon_{it} \quad (1)$$

$$\text{Environmental Performance}_{it} = -\varepsilon_{it} / \sigma_{jt} \quad (2)$$

W_{it} was the toxicity-weighted sum of all Toxic Release Inventory waste generated by facility i in year t ; s_{it} was facility size; and α_{jt} , β_{1jt} , and β_{2jt} were the estimated coefficients for industry sector j in year t . Following previous research, we measured toxicity using the inverse of CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) reportable quantities (King & Lenox, 2000). Size was measured as the estimated number of employees working at facility i in year t . We reversed the sign of the residual to reflect the fact that more waste than predicted for a facility represented poorer environmental performance.

Control variables. We created measures to control for some rival explanations for why firms certify with a management standard. Experience with related management standards could reduce the cost of certification or increase awareness of potential benefits. Institutional coercive,

normative, and mimetic pressures could encourage certification. Finally, some facility and corporate characteristics might be an important factor.

Experience with related management practices and standards has been shown to influence the tendency for an organization to certify with ISO 14001 (King & Lenox, 2001). To account for this tendency, we measured two variables. *Responsible Care participant* captured participation in the Responsible Care Program sponsored by the American Chemistry Council, which, like the ISO standards, advocates the establishment of environmental management practices. This binary variable was coded 1 if in a given year a facility was owned by a firm that participated in the Responsible Care Program. The second measure of experience with related management practices and standards was *ISO 9000 certified*, coded 1 for a given year that a facility was certified with the ISO 9000 quality management standard. We gathered ISO 9000 certification data from the ISO 9000 Registered Company Directory of North America (QSU, 2002b).

Coercive forces can influence the propensity to certify. We created several measures to capture coercive pressure from supply chains, waste treatment service providers, regulators, and the public. Supply chain pressure has been greatest in the automobile industry. Ford, GM, and Toyota have all announced that they will give preference to ISO 14001–certified facilities. To capture this pressure, we created *auto supplier*, a binary variable that indicated whether or not a facility sold products to automobile assemblers. Supply chain pressure from waste stream service providers might also encourage facilities to adopt environmental practices and certify with ISO 14001. To capture pressure from waste stream partners, we created another binary variable, *offsite waste transfer*, that indicates whether or not a facility transferred waste to an offsite waste processor. Regulatory and stakeholder pressures could also influence the

propensity to certify with ISO 14001. To account for these pressures, we created several other control variables. *Regulatory pressure*, a measure of the stringency of state-level environmental regulation, was based on the logged aggregate emissions per state over the sum of the gross state product (Meyer, 1995) in four polluting sectors (chemicals, pulp and paper, textiles, and petroleum products). *POTW waste transfer* was a measure of potential regulatory pressure from publicly owned treatment works (POTW), coded 1 for a given year if a facility sent any waste material to a POTW in that year. *Industry waste generation*, the mean of the log of the toxicity-weighted waste generation for all facilities within each four-digit SIC code, was our measure of the degree to which an industry generated toxic waste and thus was likely to be the target of regulation and stakeholder pressure. Research has shown that local stakeholder pressure is related to the affluence of the surrounding community (Walsh, Rex, & Smith, 1993). To measure the *local affluence*, we calculated the annual average local income using IRS data in the facility's five-digit zip code area. Finally, scholars have argued that the Responsible Care initiative could reduce stakeholder pressure on an industry by reducing the likelihood of regulatory action (King & Lenox, 2000). To control for this potential effect, we also measured the annual percentage of the facilities in the industry that participated in the Responsible Care initiative (*industry percentage of Responsible Care facilities*).

Mimetic processes could also influence the propensity of firms to certify with the ISO 14001 management standard (Scott, 1995). We controlled for such pressure in two ways. First, we used year-fixed effects to capture any general temporal change in our sample—including cross-industry diffusion pressures. Second, we measure the extent of diffusion within each industry (four-digit SIC code) to capture industry-specific diffusion differences. For each year,

this variable, *diffusion of ISO 14K*, was measured as the percentage of facilities in our sample in an industry that were certified with ISO 14001.

Foreign corporations may use certification to monitor the behavior of their overseas facilities. Using Dun & Bradstreet's database Who-Owns-Whom, or individual investigation of companies not listed in this data set, we created a binary variable, *foreign owned*, that measured whether a U.S. facility was owned by a foreign parent (coded 1 if the ultimate parent firm was not U.S. owned and 0 if it was U.S. owned).

The size of a facility and the firm to which it belonged could also influence the propensity to certify. We measured *facility size* as the normalized (by industry and year) log of the number of employees at a facility. Size was calculated with Dun & Bradstreet data for 1994 and 1997, and missing years were estimated using TRI reports of year-to-year production changes—for example, 10 percent higher production in 1998 resulted in a 10 percent increase in our size measure. We measured *firm size* as the annual count of the number of facilities owned by a target facility's parent, converted to its natural logarithm to reduce the skew of the distribution.

Table 1 summarizes our measures and provides variable means, standard deviations, and correlations.

 Insert Table 1 about here

Method

To test our hypotheses that firms certify when they expect buyers to have greater need for information or to have a greater propensity to fear opportunism, we conducted two different analyses of the factors influencing the propensity to certify with the ISO 14001 standard. As a first test, we analyzed the full panel using a discrete time random-effects probit model. For each

facility, we predicted certification with ISO 14001. As soon as a facility was certified, it was no longer at risk to certify, and we removed it from the sample. The model was specified as:

$$P_{it} = F(Z) = F(a_i + \mathbf{b}X_{it}), \quad (3)$$

where P was the probability that facility i would certify with ISO 14001 in the next year ($t + 1$).

The vector X_{it} represented the characteristics of the i th facility in year t . The facility random effects were measured as a_i ³.

The probit analysis allowed us to use the full power of our panel data, but it did not allow us to separate the factors that led to certification from those that led to practice adoption (and might thereby influence certification). It was likely that some factors influenced both the decision to adopt an environmental management system and the decision to certify with ISO 14001. If measures for some of these factors were missing (e.g., an organization's culture), coefficient estimates from our one-stage panel analysis might be biased, even if the analysis included a measure of EMS adoption. Unfortunately, how to correct for such endogeneity in panel analysis remains a largely unsolved problem, and robust solutions are generally restricted to panels of only two periods (Honore & Kyriazidou, 2000). Following previous scholars, we chose to restrict our analysis to a cross-section of our panel data and implement the approach developed by van de Ven and van Praag (1981). This method uses a probit regression to estimate a selection model (adoption of an EMS) and a second probit regression to estimate a choice model (certification with ISO 14001).

³Although the assumptions required for a random-effects specification were not met, this was the most conservative model we can specify. A fixed-effects model would have disregarded all observations in our panel that did not certify with ISO 14001. Furthermore, a fixed-effects specification would prohibit the interpretation of any variables with values that did not vary across groups (or time). To investigate the robustness of our model specification, we also employed a maximum-likelihood proportional hazard model (with an exponential baseline hazard) and a Cox's nonparametric partial-likelihood estimation procedure. We obtained results that were consistent in sign and significance with those presented.

$$P(\text{ISO} = 1) = P(\mathbf{B}\mathbf{x}_i + \upsilon_{1i} > 0) \quad (4)$$

$$P(\text{EMS} = 1) = P(\mathbf{Z}\mathbf{x}_i + \upsilon_{2i} > 0) \quad (5)$$

where \mathbf{B} and \mathbf{Z} were separate coefficient vectors and \mathbf{x}_i was our set of explanatory variables. The two disturbance terms υ_{1i} and υ_{2i} were assumed to be bivariate normally distributed but correlated at a level represented by parameter ρ .

To test our hypotheses about the type of information provided by certification, we used three different analyses: a probit model to analyze whether certified facilities were more likely to have a functioning EMS, ordinary least squares regression analysis to determine if ISO certified facilities had superior performance and, finally, to test if either certification or a functioning EMS were associated with performance maintenance or improvement, a differences model. This last approach vastly reduced the propensity for unobserved organizational attributes to bias estimates and cause spurious findings. Specifically, we estimated:

$$y_{i,t+1} = \mathbf{B}[y_{it}, \mathbf{x}_{it}] + \delta_i + \varepsilon_{it} \quad , \quad (6)$$

where i indexed the facilities, $y_{ij, t+1}$ was a facility's environmental performance, \mathbf{B} was a vector of estimated coefficients, \mathbf{x}_i was a vector of measured facility-level attributes, δ_i was a dummy variable capturing unmeasured facility fixed attributes, and ε_{it} was the error term. Because of the lagged dependent variable, this formulation was prone to autocorrelation. We used a method developed by Anderson and Hsiao (1982) to correct for this potential problem.

ANALYSIS AND RESULTS

Table 2 presents our analysis of certification with the ISO 14001 environmental management standard. Since the largeness of our sample might have inflated the likelihood of rejecting the null hypothesis, we report significance only for the .01 and .001 levels (Sterne &

Smith, 2001). Model 1 presents our discrete time random-effects probit specification for the period 1995–2001. Model 2 presents a probit analysis of cross-sectional data from the year 1995. Model 3 addresses the potential sample selection problem by separating the factors that led to EMS practice adoption from those that led to certification. The first column of model 3 reports estimates of the factors that influenced a facility’s propensity to have a functioning EMS prior to 1995. The second column reports estimates of the factors (as measured in 1995) that affected the propensity to certify with ISO 14001 standard before the end of our sampling period (2002). Given the structure of the selection correction technique, the second-stage estimates were based on data from those facilities that reported an EMS prior to 1995 (reducing our sample to 3,300 facilities).

 Insert Table 2 about here

Testing Our Hypotheses

Across the three models of ISO 14001 certification, we found support for our first two hypotheses. In all three models, we found evidence that the propensity for a facility to certify with ISO 14001 increases with greater physical distance to potential buyers (Hypothesis 1). We found moderate support for the effect of foreign buyers on the propensity to certify (Hypothesis 2). *Foreign buyers* was statistically significant in models 2 and 3, but reached only the 5% level in the panel analysis.⁴ Our inclusion of an industry-level diffusion variable (diffusion of ISO 14K) might account for this decrease in significance. Since *foreign buyers* was an industry- level

⁴ To ensure that this effect was not caused by exports to particularly environmentally sensitive regions, we investigated the effect of exports by region. We could find no evidence that exports to Europe, Australia, Asia, or Central America had a different effect on certification than exports to North America (Canada and Mexico).

variable, any distinguishing industry propensity captured by the variable for diffusion of ISO 14K would tend to reduce its explanatory power.

We found consistent support for our hypothesis that facilities are more likely to certify when ongoing relations could raise concerns about the potential for opportunistic behavior and thereby *increase the need for monitoring (Hypothesis 3)*. The coefficients for both industry vertical relationship and vertically integrated buyer were positive and strongly significant, suggesting that the greater the likelihood that a facility is in an ongoing vertical relationship with its buyers, the higher the propensity for ISO 14001 certification.

Supporting Hypothesis 4, we found that facilities with existing environmental management systems were more likely to certify in models 1–3. Model 4 of Table 3 provides a more direct test of Hypothesis 4 . We used a simple probit regression to test whether facilities that certified with ISO 14001 during the years 1995 to 2001 were indeed more likely to have functioning environmental management systems. Because we had multiple observations of each facility, we corrected for the fact that these observations inflated our degrees of freedom. In direct support of Hypothesis 4, we found that certified facilities were more likely to report evidence of an existing EMS.

Insert Table 3 about here

To analyze whether EMS adoption or ISO certification was associated with improvement (Hypotheses 5a and 5b), we employed a conservative differences specification (see model 5 in Table 3). To form a first difference, we included current performance as a regressor in predicting next year's performance; to form a second difference, we included facility fixed

effects. To allow a pretest window, we extended the panel back one year so that it included 1994–2001. We also included year fixed effects to control for underlying time effects.

We found that the existence of an EMS in year t was associated with significant increases in environmental performance in year $t + 1$ (Hypothesis 5a). We did not find significant evidence that certification was associated with performance improvement (Hypothesis 5b). Thus, we have strong support that ISO 14001 provides evidence of the existence of a functioning EMS and that these systems are associated with improved performance, but we do not have evidence that certification itself is associated with performance improvement. We should be careful, however, not to commit a type II error and confuse a lack of significance with disconfirming evidence. The short time frame over which most organizations have been certified makes it very difficult to estimate ISO 14001–generated improvements. For now, all we can say is that a facility's certification with ISO 14001 is associated with having an EMS (both logically and statistically), and that having an EMS is itself associated with improvement.⁵

To test Hypothesis 6, we investigated if certification acted as a signal of absolutely higher environmental performance. Our certification analysis (Table 2, models 1–3) provided evidence that firms with *lower* performance had a greater propensity to certify, thereby casting doubt on the view that certification serves as a signal. To confirm this result, we regressed environmental performance on ISO 14001 certification (model 6). We again accounted for multiple observations of the same facility in our panel from 1995–2001. In keeping with previous results, we found that firms that certified with ISO 14001 tended to have *lower environmental performance* than peers in their industry.

⁵ We believe these results are consistent with Potoski & Prakash (2005) who report a positive relationship between ISO 14001 and environmental performance improvement but do not separate out the decision to adopt an EMS from certification.

Comparing the Drivers of EMS Adoption with the Drivers of ISO 14001 Certification

Returning to the analysis presented in Table 2, we could compare the factors that led to adoption of EMS practices with those that led to certification with ISO 14001. In doing so, we found further support for our thesis that certification provides a means of credibly communicating with exchange partners. We also considered the explanatory power of rival theories.

Considering first the effect of our independent variables on the propensity to adopt an EMS, we found no evidence that either the need for information or the fear of opportunism encouraged adoption (see model 3, column 1). We found no significant association between the tendency to adopt an EMS and the potential for asymmetric information (as assessed by the variables distance to buyers and foreign Buyers). This result is consistent with the idea that buyers cannot effectively monitor and reward the adoption of an EMS at a supplier. We also did not find any evidence that the fear of opportunism influenced EMS adoptions. Indeed, we found that suppliers that tended to have ongoing vertical relationships with their buyers (industry vertical relationship and vertically integrated buyer) *were less likely* to adopt an EMS. This result is consistent with our theory that buyers engaged in ongoing vertical relations with a supplier have reason to fear opportunism.

We found evidence (model 3, column 1) that facilities with lower environmental performance were more likely to have environmental management systems—possibly because they have greater need of the performance improvements provided by an EMS. Considering only those firms that already had EMS by 1995 (model 3, column 2), those with poorer environmental performance were more likely to certify with ISO 14001—possibly because

facilities with poorer performance may feel greater need to communicate their efforts to improve. These two adverse selection processes are consistent with our finding that ISO 14001 does not act as a signal of superior performance.

We found that some types of coercive pressure influenced the propensity to have a functioning EMS. Regulators (as assessed by the presence of the variables for regulatory pressure and industry waste generation) and closely connected waste treatment service providers (as assessed by the variables capturing offsite waste transfer and use of a publicly owned transfer facility) influence a facility's propensity to have a functioning EMS. Only for offsite waste transfer did we find consistent evidence of a significant association with the propensity to certify with ISO 14001. In models 1 and 2, we found a significant association between the publicly owned transfer facility variable and ISO 14001 certification, but the results of model 3 seem to suggest that the influence of use of such facilities on EMS adoption caused this finding. For facilities that had adopted environmental management systems (model 3, column 2), we found no evidence that pressure owing to prior use of a publicly owned transfer facility increased the propensity to certify. One interpretation of these results is that regulators and closely connected waste service providers are able to observe the adoption of a functioning EMS and thus do not need the information provided by ISO 14001 certification. The influence of supply chain partners in the auto industry (captured in the variable auto supplier) offers further evidence of this conjecture. These important partners have strong coercive power, but they cannot directly observe internal environmental management efforts. In consistency with this interpretation, we found that being an auto supplier strongly influenced the propensity to certify with ISO 14001, but we found no evidence that it had a positive effect on the propensity to have an EMS.

We found some evidence that ownership structure influenced certification. In two of the models, facilities that had foreign parents were more likely to certify with ISO 14001. One possible explanation for this result is that distant facilities have greater need to communicate their actions to foreign owners. We also found that organizations with more facilities were more likely to certify. This may suggest that facilities in such organizations have greater access to the resources needed for certification, or it may suggest that managers use certification to communicate hidden attributes to corporate superiors.

Finally, we found evidence that overlapping management standards might facilitate the adoption of an EMS, but mixed evidence with respect to their effect on ISO 14001 certification. The variable ISO 9000 certified was significantly associated with EMS use, but evidence of a link between ISO 9000 and ISO 14001 certification was inconsistent. We find that Responsible Care participants were more likely to adopt EMS practices, but we found no evidence that they were more likely to certify with the ISO 14001 standard. Lastly, we find evidence that the more an industry included members of Responsible Care, the lower was a facility's propensity to certify. This may suggest that the institutional structure provided by the Responsible Care program partially substitutes for that provided by ISO 14001.

DISCUSSION

In summary, we obtained evidence that organizations certify with ISO 14001 to reduce information asymmetries with supply chain partners. In particular, we found that suppliers with potential buyers that were distant (Hypothesis 1) or foreign (Hypothesis 2) were more likely to certify. We also found that suppliers were more likely to certify when ongoing vertical relations increased the need among potential buyers to monitor supplier behavior (Hypothesis 3). We found that certification provided information about the existence of an environmental

management system (Hypothesis 4) and subsequent performance improvement (Hypothesis 5a), but it did not indicate superior performance (Hypothesis 6). Thus, we conclude that certification provides buyers with information about an ongoing supplier's performance improvement efforts.

In keeping with the predictions of new institutional theory, we found that the coercive forces of regulation and the mimetic forces of cumulative adoption influenced the propensity to adopt standardized practices and to obtain certification. However, we have shown that certification should not be conflated with adoption. When we used statistical techniques to separate these two actions, we found evidence that coercive regulatory forces influenced practice adoption, but we obtained no consistent evidence that they influenced certification. We also found that ongoing vertical relationships reduced practice adoption but *encouraged* certification. These results strongly suggest that the decision to certify differs from the decision to adopt underlying practices.

Our results are robust to a large number of controls and specifications. We included industry and year effects, and we used a two-stage selection model to address potential concerns about unobserved factors that might jointly influence the propensity to have an EMS and to certify with ISO 14001. We conducted robustness tests using alternative measures of important variables, and we set relatively stringent levels for evidence of a significant relationship.

Despite our conservative analysis, there are reasons to interpret our findings cautiously. Scale and chemical emission thresholds for reporting to the Toxic Release Inventory could have caused a sample selection problem. Our sample might have failed to pick up small, less polluting facilities that had certified to ISO14001. We investigated this problem statistically and believe our results to be robust. In particular, using the Dun & Bradstreet data set, we compared our sample with the larger population of facilities. Although we found, not surprisingly, that

facilities in our sample tended to be larger and from more heavily polluting industries, there was no significant difference between our sample and the overall population with respect to ISO 14001 certification. Nevertheless, we believe care should be exercised in extrapolating from our findings in predicting the behavior of firms of all sizes and industries.

Another potential confound is that we measured the existence of an EMS through a facility's report on pollution reduction activities. This practice could have caused a measurement error for facilities that had environmental management systems in place but that did not routinely change production processes or that had made a number of pollution-reducing improvements in the past and did not need to further reduce pollution. Fortunately, the effect of this bias should be conservative, making it harder to find a relationship between adoption of an EMS and improvements in environmental performance.

Finally, ISO 14001 is still in a relatively early stage of diffusion. As more facilities certify, the profile of those seeking certification may change. In particular, as the number of ISO 14001 certifications rises, various institutional pressures may trigger adoption by initial noncertifiers. Although this insight does not contradict our fundamental thesis that the desire to monitor and communicate about behavior is driving certification decisions, it suggests caution in extrapolating discovered adoption patterns to all temporal periods of the adoption process.

CONCLUSION

In this article, we respond to calls for greater use of strategic analysis to understand decentralized institutions. We propose that some decentralized institutions—in particular, certified management standards—may be used to reduce information asymmetries between potential exchange partners. We propose that managers think strategically about how exchange

partners may react in the face of information asymmetries when deciding whether to avail themselves of the certification services provided by a private decentralized institution.

Supporting our theory, we found that firms were more likely to seek certification when their potential exchange partners might lack credible information or fear supplier opportunism. We found that certification provides credible information about hard-to-observe organizational attributes. In particular, we confirm that certification reveals the existence of an underlying management system, and we demonstrate that such systems are associated with performance improvement. We did not find, however, any evidence that the certification process itself leads to improvement or that certification is a signal of superior performance.

Observing this pattern of results, one might be tempted to conclude that, while the adoption of a management system is a meaningful act, certification is a meaningless one. We disagree with such an inference and believe that a more functional and hopeful interpretation is in order. Even if certification is a purely symbolic act, it is an act that provides real information about the existence of a management system. Indeed, our research suggests a type of “reverse decoupling” can occur. In many organizations, performance-improving EMS practices were adopted prior to the existence of ISO 14001. These organizations were able to gain external social and economic rewards for their actions only after ISO 14001 provided a credible mechanism for communicating them. Thus, we see evidence of a kind of decoupling of substance from symbol in which substantial action precedes and for a time exceeds symbolic action. Coupling of symbol and substance then occurs after the emergence of a decentralized institution that allows credible communication.

Our research should not be interpreted to support a simplistic functionalist perspective on decentralized institutions. Our research suggests that ISO 14001 came to perform a functional

role in allowing credible communication between exchange partners, yet this role differed significantly from that expected by many of its framers. In testimony before the Congress of the United States, many of the members of the ISO technical committee (TC 207) claimed that the institution had been designed as a means to credibly differentiate organizations with superior environmental performance (Mazza, 1996). Our empirical analysis directly contradicts the existence of this function for ISO 14001. Thus, our research suggests that, for at least one private decentralized institution, the functionalist goals of its creators have been filtered through the strategic decisions of its users, and the institution's eventual meaning and power have emerged through a decentralized process of decision making.

For policy makers and institutional change agents, our findings suggest a fundamental paradox in the design of certified management standards. Specifically, standards that include beneficial practices may seldom act as market signals. For a certified management standard to be useful as a market signal, organizations with high performance must benefit from certification, while weaker performers must not. If weaker performers gain significant operational benefits from certifying, this condition will not hold. Moreover, if supply chain partners target their incentives to the organizations where improvement can be achieved most easily, they may tend to encourage the worst performers to adopt management practices and certify them to communicate their efforts to improve. Thus, our research suggests a counterintuitive conjecture that the more the practices included in a management standard provide direct operational benefits, the less likely it is that certification will provide a means of signaling superior performance.

We hope that future research will further explore how the use of private decentralized institutions (e.g., certified management standards) interacts with the use of private centralized

institutions (e.g., firm hierarchies). Although our study focuses on the potential of management standards to alleviate asymmetric information among firms, it suggests that management standards may also play a role in reducing information asymmetries within firm hierarchies. The use of firm hierarchy can reduce transaction costs, but it can also increase the risk of certain opportunistic behaviors and consequently elevate the need to monitor the behavior of internal agents (Silverman, Nickerson, & Freeman, 1997; Williamson, 1985). Our analysis suggests that certification is more common in corporations with many facilities and in foreign-owned facilities. This finding may reflect the use of certification as a means of credibly communicating attributes and actions within firms.

In conclusion, the research presented in this article validates the conjecture made by previous scholars that strategic analysis can extend understanding of decentralized institutions. It provides evidence that strategic decisions shape the meaning and function of a certified management standard, and it shows that this realized meaning differs from that expected by some of the institution's creators. Finally, it demonstrates the need for future research to address the varying strategic motives of agents when exploring both the function of other decentralized institutions and the interaction of different institutional forms.

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TABLE 1
Descriptive Statistics

Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. ISO 14001 _(t+1)	0.01 ^a	0.11	1.00																	
2. Distance to Buyer	2.21	1.29	0.03	1.00																
3. Foreign Buyer	1.42	0.75	0.04	-0.01	1.00															
4. Vertically Integrated Buyer	0.38	0.34	0.01	-0.05	0.27	1.00														
5. Ind. Vertical Relationship	0.60	0.49	0.05	0.08	0.21	0.15	1.00													
6. Environmental Performance	-0.07	0.97	-0.02	-0.02	0.00	0.01	-0.07	1.00												
7. EMS _(t-1)	0.48	0.50	0.04	0.02	0.12	0.02	0.12	-0.11	1.00											
8. Resp. Care Participant	0.10	0.30	0.00	-0.04	0.13	0.15	0.23	-0.04	0.14	1.00										
9. ISO 9000 Certified	0.25	0.43	0.08	0.01	0.17	0.09	0.17	-0.05	0.11	0.12	1.00									
10. Auto Supplier	0.06	0.24	0.09	0.09	0.13	-0.04	0.09	0.00	0.01	-0.06	0.02	1.00								
11. Offsite Waste Transfer	0.84	0.37	0.03	-0.02	0.01	-0.04	0.09	-0.17	0.13	0.04	0.10	0.05	1.00							
12. Regulatory Pressure	0.13	0.02	-0.01	-0.16	-0.07	-0.05	-0.12	0.05	0.01	-0.05	-0.01	-0.05	0.05	1.00						
13. POTW Waste Transfer	0.35	0.48	0.04	-0.03	0.06	0.02	0.06	-0.06	0.12	0.02	0.08	0.07	0.32	0.05	1.00					
14. Industry Waste Gen.	4.87	1.47	0.00	0.00	0.22	0.46	0.14	0.01	0.13	0.24	0.03	0.00	0.04	-0.10	0.04	1.00				
15. Affluence	10.19	0.28	0.01	-0.12	0.05	-0.03	0.01	0.02	0.04	0.02	0.04	0.00	0.05	0.15	0.04	-0.02	1.00			
16. RC Industry	0.09	0.12	-0.02	-0.08	0.29	0.33	0.15	0.00	0.14	0.44	0.08	-0.14	-0.02	-0.09	0.01	0.55	0.02	1.00		
17. Facility Size	0.10	0.94	0.05	0.04	0.01	0.00	0.21	0.00	0.16	0.11	0.16	0.00	0.14	-0.04	0.13	0.00	0.04	0.00	1.00	
18. Foreign Owned	0.04	0.20	0.02	-0.02	0.04	0.03	0.11	-0.02	0.06	0.04	0.03	-0.02	0.04	-0.03	0.00	0.07	0.05	0.20	0.04	1.00
19. Diffusion of ISO 14K	1.53	1.44	0.06	0.06	0.18	0.15	0.58	-0.07	0.14	0.34	0.13	0.10	0.08	-0.13	0.07	0.18	0.00	0.22	0.22	0.13

n = 46052, coefficients > 0.0124 are significant at p > 0.01, coefficients > 0.0154 are significant at p > 0.001

^a 7% of all facilities in the sample eventually certified with the standard.

TABLE 2
Predicting Certification with ISO 14001

<i>Dependent Variable</i> <i>Sample</i>	Model 1	Model 2	Model 3	
	ISO 14001 _(t+1) Panel (95-01)	ISO 14001 _(t+1) 95 Cross Section	EMS 95 Cross Section	ISO 14001 EMS Only
Distance to Buyer	0.04 * (0.01)	0.06 ** (0.02)	0.01 (0.06)	0.07 * (0.03)
Foreign Buyer	0.06 (0.03)	0.12 * (0.04)	0.06 (0.07)	0.21 ** (0.07)
Vertically Integrated Buyer	0.13 * (0.05)	0.20 * (0.07)	0.03 (0.04)	0.26 * (0.10)
Industry Vertical Relationship	0.21 ** (0.06)	0.34 ** (0.08)	-0.14 * (0.06)	0.34 * (0.12)
Environmental Performance	-0.05 * (0.02)	-0.10 ** (0.02)	-0.15 ** (0.02)	-0.17 ** (0.04)
EMS ^b _(t-1)	0.14 ** (0.04)	0.15 * (0.05)		
Responsible Care Participant	-0.13 (0.07)	-0.12 (0.09)	0.21 ** (0.06)	-0.07 (0.13)
ISO 9000 Certified	0.32 ** (0.04)	0.11 (0.07)	0.17 ** (0.05)	0.17 (0.09)
Auto Supplier	0.43 ** (0.11)	0.85 ** (0.14)	-0.22 (0.11)	0.99 ** (0.18)
Offsite Waste Transfer	0.13 (0.07)	0.24 ** (0.08)	0.24 ** (0.04)	0.43 * (0.14)
Regulatory Pressure	-0.55 (1.34)	-0.49 (1.63)	3.97 ** (1.00)	0.23 (2.25)
POTW Waste Transfer	0.10 * (0.04)	0.13 * (0.05)	0.16 ** (0.03)	-0.07 (0.07)
Industry Waste Gen.	-0.01 (0.02)	0.03 (0.02)	0.14 ** (0.02)	0.04 (0.04)
Affluence	0.06 (0.07)	0.10 (0.08)	0.06 (0.06)	0.09 (0.12)
RC Industry	-1.11 ** (0.26)	-1.40 * (0.32)	-0.52 (0.20)	-1.62 * (0.44)
Facility Size	0.16 ** (0.02)	0.19 ** (0.03)	0.17 ** (0.02)	0.20 * (0.04)
Foreign Owned	0.33 ** (0.08)	0.31 * (0.10)	0.06 (0.07)	0.25 (0.14)
Firm Size	0.08 ** (0.02)	0.08 ** (0.02)	0.05 ** (0.01)	0.06 * (0.03)
Diffusion of ISO 14K	1.86 ** (0.32)			
Industry Dummies	included	included	included	included
Year Dummies	included			
Observations	7895(46052)	7899	7899	3300
Rho ^a				0.08
Chi Square (d.f)	919.22(38) **	629.85(31) **		297.50(30) **

** p<0.001, * p< 0.01, + SIC 22 and SIC 39 removed because perfectly predicts no ISO certification.

^a *Rho* is the correlation between the disturbance terms in the selection and certification models. That this correlation is not statistically significant does not preclude the potential for biased estimates in uncorrected analyses.

^b EMS is lagged an additional period to better measure the pre-existence of an EMS. Estimating the model with a single lagged EMS does not change the sign or reduce the significance of any variables.

TABLE 3
Analyzing if ISO 14001 Certification Reveals
Organizational Environmental Attributes

Dependent Variable	Model 4 EMS		Model 5 Environmental Performance _(t+1)		Model 6 Environmental Performance	
ISO 14000 Certification	0.30	**	0.06		-0.18	**
	(0.07)		(0.03)		(0.06)	
EMS			0.08	**		
			(0.02)			
Environmental Performance			0.19	**		
			(0.02)			
Year Controls	fixed effects		fixed effects		fixed effects	
Facility Controls	grouped		fixed effects		grouped	
N	46951		35512		46951	
Facilities	7904		7415		7904	
X ² or F-stat (df)	96.4(7)	**	1845.35(9)	**	59.7(7)	**

** p<0.001, * p<0.01



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