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DECOUPLING OF STANDARD IMPLEMENTATION FROM CERTIFICATION: DOES QUALITY OF ISO 14001 IMPLEMENTATION AFFECT FACILITIES' ENVIRONMENTAL PERFORMANCE?

Deepa Aravind
CUNY College of Staten Island

Petra Christmann
Rutgers University - Newark

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Deepa Aravind
Department of Business
City University of New York - College of Staten Island
2800 Victory Boulevard
Staten Island, NY 10314
deepa.aravind@csi.cuny.edu

Petra Christmann
Department of Management and Global Business
Rutgers Business School – Newark and New Brunswick
Rutgers University
111 Washington Street
Newark, NJ 07102
christmannp@rbsmail.rutgers.edu

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ABSTRACT

The literature on certifiable management standards has not paid sufficient attention to implementation of standard requirements in certified firms. Firms that obtain standard certification to achieve the legitimacy benefits of certification may not implement standard requirements sufficiently to realize the standard's intended performance outcomes. We argue that such decoupling of implementation from certification threatens the effectiveness of certifiable standards as governance mechanisms for firms' environmental conduct because standard certification may not accurately signal firms' superior environmental performance to external stakeholders. Empirical findings based on the ISO 14001 standard at the facility level support this view: Quality of standard implementation affects facilities' environmental performance, and environmental performance of certified and non-certified facilities does not differ significantly for the overall sample and low-quality implementers, while high-quality implementers have better environmental performance than their non-certified counterparts. We provide recommendations for increasing the effectiveness of governance systems for firm conduct based on certifiable standards.

International certifiable management standards such as the ISO 14001 Environmental Management System (EMS) are advocated as governance mechanisms for firms' environmental conduct in light of concerns about the ability of national governments to regulate firm conduct in a globalizing world (Rappoport & Flaherty, 1992; United Nations, 1993). These standards specify environmental management practices that are intended to reduce negative effects of firms' operations on the natural environment (Terlaak, 2007). Firms that implement the specified practices can obtain standard certification by passing an audit by independent third-party auditors. Firms can use standard certification to signal their environmental responsibility to external stakeholders such as customers (King, Lenox, & Terlaak, 2005).

Institutional theory (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Tolbert & Zucker, 1983) suggests that firms may be more interested in obtaining the legitimacy and signaling benefits of standard certification than in fully implementing the practices prescribed by the standard in their operations. Recent evidence confirms that despite third-party auditing some firms obtain standard certification without continuously complying with standard requirements and incorporating the prescribed practices in their daily activities (Boiral, 2003; Christmann & Taylor, 2006; Yeung & Mok, 2005) – a phenomenon known as decoupling (Meyer & Rowan, 1977). Such decoupling of certification from implementation raises concerns about the effectiveness of certifiable management standards as governance mechanisms because low quality of standard implementation may compromise the environmental performance benefits intended by the standard.

Our study contributes to the debate on the effectiveness of certifiable standards as governance mechanisms for firms' environmental conduct by theoretically exploring how quality of standard implementation affects certified firms' environmental performance and whether standards are accurate signals of environmental responsibility. We empirically evaluate these issues in the context of the most widely adopted certifiable environmental standard – ISO 14001.

Empirical studies of certifiable management standards have almost exclusively considered the act of certification rather than the implementation of the standards' requirements in certified firms. Studies have addressed questions such as what determines standard certification (Bansal & Bogner, 2002; Bansal & Hunter, 2003; Christmann & Taylor, 2001; Darnall, 2001, 2003) and whether environmental standard certification affects firms' environmental performance (Andrews et al., 2003; King et al., 2005; Potoski & Prakash, 2005b). By focusing only on certification these studies have implicitly assumed that certification is synonymous to implementation. In this study, we explicitly consider how variations in the quality of implementation of certifiable management standards among certified firms affect their environmental performance. We define a certified firm's quality of standard implementation as the degree to which the firm adheres to standard requirements and embeds the activities prescribed by the standard in its daily routines. Low quality implementers decouple standard implementation from certification by failing to continuously comply with the standard's requirements and not using the prescribed activities in their daily operations, while high quality implementers consistently comply with the standard and embed the prescribed activities into their daily routines.

While the third-party monitoring associated with certification reduces the likelihood that implementation is decoupled from certification, weaknesses in the auditing system such as lack of auditor qualification and auditor conflict of interest provide opportunities for firms to obtain standard certification without continuously adhering to the requirements of the standard (Boiral, 2003; Christmann & Taylor, 2006; O'Rourke, 2003). We propose that decoupling standard implementation from certification limits the effectiveness of certifiable standards as a governance mechanism.

To provide a market based governance mechanism for firms' environmental conduct in the global economy (Boiral, 2003; Cashore, 2002; Christmann & Taylor, 2001; Potoski & Prakash, 2004; Rugman & Verbeke, 1998) international certifiable standards need to fulfill dual functions. First, certifiable standards need to be a tool for improving participating firms' environmental performance. They need to specify requirements that result in reductions of firms' impact on the natural environment and provide monitoring and sanctioning mechanisms to assure that participating firms follow these requirements. Second, certifiable standards need to accurately signal firms' environmental responsibility to external stakeholders such as customers. Certification provides information that is intended to allow customers to identify environmentally responsible suppliers at a low cost. This enables customers to incorporate suppliers' environmental responsibility as a criterion in their purchasing decisions and provides market incentives for suppliers to obtain standard certification to signal their environmental responsibility to customers who may prefer to do business with certified firms. Thus, these standards are part of an emerging, mostly voluntary infrastructure, that pressures companies for greater responsibility, accountability, and transparency (Waddock, 2008).

Empirical findings raise concerns about the effectiveness of certifiable standards as a governance mechanism for firms' environmental conduct. Studies have found conflicting evidence on the relationship between firms' certification to standards such as ISO 14001 and their environmental performance and have not found that certified firms experience better environmental performance than non-certified firms (Andrews et al., 2003; Darnall & Sides, 2008; King et al., 2005; Melnyk, Sroufe, & Calantone, 2003; Potoski & Prakash, 2005b). These findings suggest that certifiable standards may not serve the two functions that they need to fulfill to be effective governance mechanisms. The conflicting findings may be due to the fact that the literature has only considered the act of certification and ignored how certified firms' quality of standard implementation can influence their environmental performance. If quality of ISO 14001 implementation affects environmental performance, a relationship between certification and environmental performance may not exist.

We argue that variance in quality of standard implementation across firms can compromise both of the functions that certifiable standards need to fulfill to serve as effective governance mechanisms for firm self-regulation. First, we suggest that variance in the quality of standard implementation results in variations in environmental performance in certified firms. Second, even if certified firms' environmental performance is affected by their quality of standard implementation, standards may still serve their other function of signaling certified firms' superior environmental performance if certified firms have better environmental performance than non-certified firms. We suggest that the inter-firm variation in standard implementation may be sufficiently large to compromise the accuracy of standard certification as a signal of environmental responsibility.

Our results based on a sample of 72 ISO 14001 certified and 72 matched non-certified facilities in the United States indicate that ISO 14001 implementation quality indeed affects certified facilities' environmental performance. We perform our empirical analysis at the facility level because ISO 14001 certification is commonly granted to facilities rather than to entire firms. We further find that while on average certified facilities do not differ significantly in their environmental performance after certification from non-certified facilities, certified high-quality implementers have better post-certification environmental performance than their non-certified counterparts. These results highlight the importance of quality of standard implementation and cast doubts on the effectiveness of governance systems based on certifiable management standards. We discuss the implications of our findings for the design of enforcement mechanisms for certifiable standards, for firms that use certifiable standards to signal their environmental responsibility, and for future research on certifiable standards.

THE ISO 14001 ENVIRONMENAL MANAGEMENT SYSTEM

The ISO 14001 environmental management system standard was launched in 1996 by the International Organization for Standardization, the world's largest standard setting organization with a membership of national standards institutes from 157 countries. ISO 14001 requirements specify the elements of a generic environmental management system that can be used by firms of any size, in any industry, in any country to manage their environmental impacts. ISO 14001 certification is awarded by independent third-party auditors (also referred to as registrars) that need to be accredited by national ISO member bodies such as ANSI-ASQ in the United States. The generic character of the standard and the possibility to obtain certification in countries around the world have resulted in high adoption rates (Mendel, 2002). With 188,815 certified facilities in 155 countries as of December 2008 (ISO, 2008), ISO 14001 is the most widely adopted environmental management standard in the world.

Some firms adopt an environmental management system and choose not to obtain external certification to a particular standard. Some of them follow the ISO 14001 requirements and self-declare that their EMS meets ISO 14001 standard (Rondinelli & Vastag, 2000). Such an in-house EMS lacks the external verification process to determine if the firm is properly implementing the system and such firms will not gain the signaling and legitimacy benefits associated with external certification to a standard such as ISO 14001 (Bansal & Hunter, 2003). Therefore, many firms with an EMS take the extra step of certifying to ISO 14001.

Like other international certifiable standards that seek to provide market-based governance mechanisms to regulate firm conduct in the global economy, the ISO 14001 standard is designed to be a tool for improving firms' environmental performance and to be a signal of firms' environmental responsibility to external stakeholders. In this section we will discuss these two functions of ISO 14001 and their implications for the environmental performance of certified firms.

ISO 14001 as a tool for improving environmental performance

"The general purpose of [the ISO 14001] standard is to provide assistance to organizations that wish to implement or improve an environmental management system and thereby improve their environmental performance" (ISO, 2004). The requirements established by ISO 14001 are based on rational and systematic management principles that the entire organization needs to subscribe to (Boiral, 2007). The major steps that firms have to follow to obtain ISO 14001 certification include the following (Bansal & Bogner, 2002). First, firms have to review their activities and identify all their environmental impacts as well as applicable environmental regulations. Second, they have to develop a plan to conform to environmental regulations, develop an environmental policy to which senior management is committed, and set specific environmental goals and targets to reduce their environmental impact. Third, firms have to implement their environmental policy and work towards achieving their targets and goals by communicating the EMS to their employees, training and empowering them, and documenting relevant procedures. Fourth, firms have to perform periodic internal audits to identify their actual environmental impacts and address any nonconformance with their goals. Fifth, firms have to periodically assess their EMS through a management review process and make necessary changes. This regular review of their systems, structures, policies, and goals enables continual improvement.

Firms' adherence to the formal requirements of ISO 14001 is expected to lead to changes in their management of environmental issues that can result in improvements in their environmental performance. The establishment of environmental policies and senior management commitment makes protecting the environment an organizational priority. Requirements such as regularly tracking organizations' environmental performance and progress towards the achievement of its environmental goals establish internal feedback mechanisms that contribute to environmental performance improvements. Practices such as the identification of environmental aspects in work practices, development of training programs for employees and management, and documentation of environmental practices help to integrate environmental concerns into daily practice, raise management and employee awareness and involvement, and add more rigor to environmental programs (Jiang & Bansal, 2003). Implementing the ISO 14001 EMS often fosters the adoption of additional environmental practices, such as substitution of polluting and hazardous materials, recycling systems, responsible disposal of waste and residues, and acquisition of clean technology (Gonzalez-Benito & Gonzalez-Benito, 2008; Sroufe, 2003). ISO 14001 implementation can also contribute to better compliance with environmental regulations as the ISO 14001 EMS requires a systematic documentation and follow-up with applicable environmental regulations (Potoski & Prakash, 2005b).

Studies have shown that external monitoring is essential for effective firm self-regulation through voluntary standards because in the absence of monitoring or sanctions poor environmental performers have incentives to free-ride by adopting the standard but not changing their behavior (Christmann & Taylor, 2006; King & Lenox, 2000). ISO 14001's third-party audit system provides a monitoring mechanism that is intended to ensure that certified firms comply with the ISO 14001 requirements. The third-party audit is intended to assess the extent to which firms comply with ISO requirements and to help spot opportunities for improvement (Jiang & Bansal, 2003).

Both ISO 14001's requirements and its third-party audit system are intended to ensure that certified firms are reducing the negative impact of their activities on the natural environment.

Several empirical studies have indeed shown a positive relationship between ISO 14001 certification and firms' environmental performance (Melnyk et al., 2003; Potoski & Prakash, 2005a; Russo, 2001) or regulatory compliance (Kwon, Seo, & Seo, 2002; Potoski & Prakash, 2005b). For example, ISO 14001 certification was found to reduce wastes in production processes (Melnyk et al., 2003) and toxic emissions (Russo, 2001). Potoski & Prakash (2005a) showed that certified facilities reduced pollution emissions more than non-certified facilities. Furthermore, ISO 14001 certification was found to reduce the time facilities spend out of compliance with environmental regulations in the U.S. by about 7 percent (Potoski and Prakash, 2005b) and ISO 14001 certified facilities in Korea have less environmental violations than non-certified facilities. (Kwon et al., 2002).

ISO 14001 as a signal to external stakeholders

Institutional theory suggests that in order to survive, organizations must conform to institutional pressures from their external environment such as those from regulatory agencies, industry associations, non-governmental organizations and other stakeholders even if conforming to such pressures may have little to do with technical efficiencies (Meyer & Rowan, 1977; Scott, 1987; Tolbert & Zucker, 1983; Zucker, 1987). Such conformance to institutional pressures provides enhanced legitimacy to these organizations (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Meyer, Scott, & Deal, 1983; Tolbert & Zucker, 1983; Zucker, 1987). Firms that adopt organizational practices for legitimacy reasons rather than for efficiency reasons often decouple implementation from adoption by not incorporating these practices in their daily activities (Meyer & Rowan, 1977). Decoupling enables organizations to enhance legitimacy in the eyes of external stakeholders while minimizing the uncertainties of incorporating the new practices on the existing technical activities of organizations (Meyer & Rowan, 1977).

Firms have incentives and opportunity to decouple ISO 14001 implementation from certification. Decoupling allows firms to gain the legitimacy and signaling benefits of ISO 14001 certification without incurring the higher costs and potential organizational disruptions of high quality implementation. Because firms obtain certification to standards such as ISO 14001 primarily to satisfy external institutional pressures from customers that require or prefer their suppliers to be certified (Christmann & Taylor, 2001; Gilbert & Rasche, 2007; Jiang & Bansal, 2003) many suppliers are more interested in obtaining certification to signal their environmental responsibility than in implementing the ISO 14001 EMS to achieve the intended environmental performance benefits.

High quality implementation of ISO 14001 results in higher costs and greater organizational disruptions than low quality implementation. High quality implementation requires considerable commitments of time and resources such as ongoing maintenance of the EMS and updating of its documentation, continuous training of employees and managers, and regular reviews and internal audits of environmental issues, all of which are costly (Delmas, 2002; Yeung & Mok, 2005). Indeed, many firms realize that more resources in terms of time, cost, and skills are required to develop and maintain the EMS than was initially expected (Balzarova & Castka, 2008). Furthermore, many managers believe that ISO certification adds more bureaucracy and constraints to their firms' activities (Boiral, 2003; Boiral & Sala, 1998). For example, some managers perceive that many administrative tasks required by the ISO system such as documentation contribute to decreased productivity and operating smoothness (Boiral, 2003). Such perceptions lead to internal resistance to ISO implementation and thus will likely contribute to low quality implementation. Thus, firms have incentives to symbolically implement the standard and pursue only the minimum quality of ISO 14001 implementation necessary to pass the certification audit.

While the independent audits associated with ISO 14001 certification reduce the likelihood of decoupling certification from implementation, several weaknesses in the ISO 14001 auditing system combined with the standard's lack of specific performance requirements provide opportunity for firms that do not comply with ISO 14001 requirements to obtain certification. First, some auditors lack the business and technical knowledge of specific industries (O'Rourke, 2002; Seddon, 1997; Swift, Humphrey, & Gor, 2000; Van Der Wiele & Brown, 1997; Yeung & Mok, 2005) that is required to discover non-conformances during the on-site audit. This problem of auditor qualification is exacerbated by the fact that ISO 14001 prescribes design elements of an EMS that leave "significant room for … interpretation" (Nawrocka & Parker, 2009: 603) rather than setting specific performance targets. Such process requirements complicate verification of compliance and increase the importance of auditor expertise as the criteria on which auditors base awarding certification cannot be objectively measured. The fact that firms seeking certification play a vital role in the auditing process by providing documentation to external auditors increases concerns, because some firms take actions to provide the appearance to auditors that they use ISO standards in their daily operations when they actually do not (Boiral, 2003; 2007). Less qualified auditors may uncritically accept the internal report prepared by firms (Yeung & Mok, 2005). The resulting differences in audit rigor allow firms to pass an audit carried out by one auditor while they would fail if a different auditor performed the audit (Boiral, 2003; Yeung & Mok, 2005). Thus, even if an audit concludes that a firm has properly implemented the EMS the substantive performance of the audited firm (in terms of how they implement the standard's requirements) may be poor (Power, 1997: 60).

Second, auditor independence is essential to assure unbiased certification, but ISO 14001 auditors are selected and paid by the firms seeking certification. Firms may be inclined to select or continue business relationships with auditors who will provide the desired certification (Moore, Tetlock, Tanlu, & Bazerman, 2006; Swift, et al., 2000). This creates a potential conflict of interest for auditors, who may not fail undeserving companies because this would lead to a loss of clients (Moore et al., 2006; Seddon, 1997).

Third, the ongoing nature of complying with ISO 14001 diverges from the periodic nature of certification and recertification. Compliance with management system standards requires ongoing active utilization of the management system. ISO 14001 certification and recertification audits are scheduled periodically at pre-announced dates. These audits occur only every three years with less extensive pre-announced bi-annual or annual surveillance audits. Critics contend that auditing involves visits to factories that are too infrequent to evaluate normal day-to-day operations and the duration of the audit itself is too short to identify more than the most obvious problems, missing many important issues (Boiral, 2003; O'Rourke, 2002, 2003).

These problems in the ISO auditing system raise a more fundamental question about ISO's commitment to setting meaningful standards and assuring rigorous auditing of certified firms.[1] Critics of the ISO system contend that the stakeholders involved in the development process of ISO 14001 represent primarily the interests of industry, while key stakeholders representing the groups heavily impacted by the standard are excluded from the process (Balzarova & Castka, 2008; Gilbert & Rasche, 2007). As the outcomes of the standard development process reflect the interests of the participating stakeholders it has been argued that the ISO 14001 standard reflects the interests of industry in an undemanding standard (Ecologia, 2002) that may not be accompanied by rigorous auditing mechanisms. Such an undemanding standard with lax auditing would allow firms to easily gain certification to signal their commitment to environmental responsibility to external stakeholders.

[1] We would like to thank the editors and one of the reviewers for bringing this line of argument to our attention.

Studies have shown evidence of decoupling implementation from certification for the ISO 14001 standard and for the similarly designed ISO 9001 quality management system standard. Boiral (2003) showed how ISO 9001 adoption resulted in ritual behavior for the purpose of demonstrating superficial conformity to the requirements of the standard particularly around the time of the certification audit. Boiral (2007) found that ISO 14001 is mostly ceremonially adopted by firms, that is, certification to ISO 14001 is only loosely associated with firms' actual practices. Others found variance in the implementation of ISO standards in facilities in the United States and China (Aravind & Christmann, 2007, 2008; Christmann & Taylor, 2006).

Decoupling ISO 14001 implementation from certification will likely jeopardize the environmental performance benefits intended by the standard. Certified firms that only symbolically implement ISO 14001 without using the prescribed practices in their daily operations may not make the changes in managing their environmental issues that are required to improve environmental performance. Hence certification may not be an accurate signal of environmental responsibility for all certified firms. Indeed, many empirical studies have found that ISO 14001 certification does not lead to superior environmental performance. Studies have found that adoption of environmental management systems improves environmental performance, but that ISO 14001 certification does not add value beyond establishing an EMS (Andrews et al., 2003; King et al., 2005). A study found that ISO 14001 certified pulp and paper plants did not perform better than non-certified facilities (Barla, 2007). A recent meta-analysis (Darnell and Sides, 2008) showed that empirical evidence on the environmental performance benefits of ISO 14001 certification is inconclusive. This lack of a positive relationship between ISO 14001 certification and environmental performance is consistent with low-quality implementation of the ISO requirements in a large number of firms.

Examining how firms' quality of ISO 14001 implementation rather than their certification affects their environmental performance can shed more light on the causes for these insignificant findings.

HYPOTHESIS DEVELOPMENT

Our hypotheses address how the quality of ISO 14001 implementation in certified firms affects the two functions that certifiable standards need to fulfill to be effective governance mechanisms for firms' environmental conduct in the global economy – improving firms' environmental performance and providing an accurate signal of firms' environmental responsibility to external stakeholders. Our first hypothesis proposes a link between quality of ISO 14001 implementation and environmental performance in certified firms. Our subsequent hypotheses test the accuracy of ISO 14001 as a signal of superior environmental performance by comparing the environmental performance of ISO 14001 certified and non-certified firms.

The importance of standard implementation

Not much is known about the relationship between quality of ISO 14001 implementation and firms' environmental performance. Barla's (2007) finding that environmental performance differs widely among ISO 14001 certified pulp and paper plants is consistent with the argument that certified firms vary in their quality of standard implementation and that quality of implementation affects their environmental performance. Only few empirical studies have explicitly considered variations in standard implementation among certified firms. These studies have looked at the determinants of implementation quality (Christmann & Taylor, 2006) and the relationship between implementation quality and managers' perceptions of benefits from standard adoption (Yin & Schmeidler, 2009). Yin & Schmeidler (2009) find that managers in certified facilities with low quality of ISO 14001 implementation believe that ISO 14001 does not result in environmental performance benefits. While this finding is consistent with the argument that quality of implementation affects environmental performance it may also be due to a general negative perception of ISO 14001 by these managers. A positive relationship between quality of practice implementation and realization of the practice's intended performance benefits has been found in the context of another management practice – Total Quality Management (TQM) (Ahire, Waller, & Golhar, 1996; Claver & Tari, 2003; Douglas & Judge, 2001; Rao, Raghunathan, & Solis, 1999).

ISO 14001's requirements are intended to change firms' management of environmental issues in ways that improve environmental performance. Rondinelli & Vastag (2000) concluded that following the spirit of the ISO 14001 guidelines results in attitudinal, managerial and operational changes that provide environmental performance benefits through waste reduction and pollution prevention. However, these improvements in environmental performance are contingent on the proper implementation and continuous use of the ISO 14001 practices. A firm that implements ISO 14001 symbolically with minimal changes its daily operations is not likely to experience the performance benefits intended by ISO 14001. Thus, we can expect that a firm's quality of ISO 14001 implementation is positively related to its environmental performance.

Hypothesis 1: The higher a firm's quality of implementation of the ISO 14001 requirements the better the firm's post-certification environmental performance.

Signaling accuracy of ISO 14001

ISO 14001 can only be an effective governance mechanism for firm self-regulation, if ISO 14001 certification is an accurate signal of firms' environmental responsibility, i.e. if ISO 14001 certified firms are better environmental performers than non-certified firms. Even if Hypothesis 1 is supported and implementation quality affects environmental performance certified firms may still have better environmental performance than non-certified firms. Our next set of hypotheses addresses this issue.

The two functions of ISO 14001 provide conflicting predictions about the signaling accuracy of ISO 14001. On the one hand, adopting ISO 14001 requires firms to implement an environmental management system that should improve their environmental performance. Thus, ISO 14001 certified firms may have better environmental performance than non-certified firms that may not have such EMSs in place. On the other hand, institutional theory suggests that ISO certified firms are primarily interested in the legitimacy and signaling benefits of ISO certification rather than its potential environmental performance benefits. These firms will likely implement the standard symbolically and fail to integrate the ISO EMS in their daily operations, but do the minimum required to pass the certification audit. The failure to use the ISO EMS in daily operations suggests that differences in environmental performance between certified and non-certified firms may not exist.

The signaling accuracy of ISO 14001 certification may additionally be compromised because some firms implement an EMS to manage their environmental impact without obtaining certification to the ISO 14001 standard (King et al., 2005). Thus, some non-certified firms realize the environmental performance benefits of an EMS, which also reduces the environmental performance gap between certified and non-certified firms.

This discussion leads to two competing hypotheses:

Hypothesis 2a: ISO 14001 certified firms have larger environmental performance improvements after certification than non-certified firms.

Hypothesis 2b: ISO 14001 certified and non-certified firms do not differ in their environmental performance improvements after certification.

The accuracy of ISO 14001 certification as a signal of environmental responsibility may hinge on firms' quality of implementation. Certified firms that pursue high quality implementation and use the ISO EMS in their daily operations may derive environmental performance benefits from EMS implementation and thus, may exhibit superior environmental performance compared to their non-certified counterparts. Certified firms that pursue low quality implementation may not gain the environmental performance benefits intended by the ISO 14001 EMS. Therefore, these firms' environmental performance may not differ from their non-certified counterparts.

Hypothesis 3a: ISO 14001 certified firms with a high quality of implementation have larger environmental performance improvements after certification than non-certified firms.

Hypothesis 3b: ISO 14001 certified firms with a low quality of implementation do not show a difference in environmental performance improvements after certification relative to non-certified firms.

RESEARCH DESIGN AND METHODOLOGY

We tested our hypothesis using data from ISO 14001 certified facilities in the United States. We conducted our analysis at the facility level as ISO 14001 certification is mostly granted at the level of individual facilities such as plants. Our sample is cross-sectional which provides variance in the motivations for certification, which we expect to result in differences in the quality of implementation across certified facilities. For example, firms in the automotive industry face coercive pressures from their supply chain partners to obtain certification (King et al., 2005), which may make low quality implementation more likely, whereas in other industries such pressures may not exist possibly resulting in higher quality implementation. The United States provides an ideal research setting for our study as facility level data on environmental emissions is available.

We obtained data from multiple sources. Some of our measures are based on a mail questionnaire survey, since data on the implementation of ISO 14001 in facilities cannot be obtained from public sources. We also used secondary data from sources such as the United States Environmental Protection Agency's Toxics Release Inventory (TRI) database, the United States Census Bureau, and the Dun and Bradstreet (D&B) Million Dollar Database to either construct measures or triangulate survey-based measures.

Sample and Data Collection

This study is part of a larger research project on ISO 14001 implementation for which we collected data from ISO 14001 certified facilities in the United States. We identified ISO 14001 certified facilities from the Spring 2006 edition of QSU Publishing Company's *ISO 14001 Worldwide Certified Company Directory* (QSU, 2006), the most comprehensive database of certified facilities in the United States. This directory contained information such as facility name, address, SIC code, date of certification, and name of the individual responsible for ISO 14001 for 5284 facilities. We restricted the mailing sample for our research project to 600 randomly selected facilities from the QSU directory to ensure that we were able to perform adequate follow-up to achieve a good response rate for our questionnaire survey. For this study on the relationship between ISO 14001 implementation and environmental performance we were only able to consider those 266 of the 600 facilities that obtained initial certification between 1998 and 2002, because for facilities that were certified outside of this timeframe we were not able to obtain environmental performance data for three years before and three years after their initial certification from the TRI database.[2]

[2] We had usable TRI data for the years 1995 to 2005. 2005 was the last year for which TRI data was available at the time of analysis. We chose 1995 as our earliest year because in this year a large number of chemicals were added to the list of chemicals for which facilities must report their releases to the TRI. Therefore, the information on TRI releases for years prior to 1995 is not comparable with TRI release information from 1995 onward.

The target respondent for our survey was the individual at the facility who is responsible for ISO 14001. We initially identified this individual from the QSU database (where it was available) and made phone calls to each facility in our mailing sample to confirm the identity of this individual and to obtain the name of the person for those facilities where the listed individual was no longer in charge or that did not have a name listed in the database. Our respondents were mostly facility-level Environmental, Health, and Safety (EHS) Managers or Quality Managers. The average management experience of our respondents is 14.9 years. Like other studies on ISO standards (e.g., Boiral & Roy, 2007; Gonzalez-Benito & Gonzalez-Benito, 2008; Melnyk et al., 2003) we used a single-informant approach. Such an approach is likely to result in reliable and valid data if the informant is carefully chosen (Campbell, 1955; John & Reve, 1982). Our chosen target respondent – the person in charge of ISO 14001 – is likely to be the most knowledgeable individual at each facility and thus is the most appropriate person to complete our questionnaire.

We developed our questionnaire based on existing literature on certifiable management standards, implementation of such standards, and environmental performance (e.g., Christmann & Taylor, 2006; Kassinis & Vafeas, 2006; Klassen & Whybark, 1999; Naveh & Marcus, 2005; Naveh & Marcus, 2004) and incorporated feedback from managers obtained in interviews and pre-tests. We discussed the initial version of our questionnaire during personal interviews with four facility environmental and/or quality managers in the U.S. who were responsible for the ISO 14001 system at their facility. These managers also provided us with extensive written feedback on the survey questions. After making changes based on their suggestions we conducted a pilot study with a shortened version of the questionnaire containing our key measures with managers who attended a regional meeting of the *American Society for Quality* in September 2006. Based on their feedback and results from this pilot study, we designed the final version of the survey.

We based our survey administration on the tailored design method which has been shown to improve response rates to mail surveys (Dillman, 2000). We conducted the first mailing of our survey in October 2006, and performed two follow-up mailings in December 2006 and January 2007. Of the 600 mailed surveys 13 were undeliverable due to incorrect addresses, and of the remaining 587 surveys 199 were returned completed yielding a response rate of about 34 percent. For those 266 facilities that were certified between 1998 and 2002 we achieved a slightly higher response rate of about 38 percent (101 completed surveys were returned). These response rates compare favorably with other studies on ISO standards that achieved response rates of 10.35 percent (Melnyk et al., 2003) and 31.4 percent (Boiral and Roy, 2007). Of the 101 facilities certified between 1998 and 2002 that returned surveys, 72 had three years of pre-and post-certification TRI data available and could be included in our empirical analysis. The mean size of our respondent facilities was 545 employees with the number of employees ranging from 25 to 2700.

To test hypotheses 2 and 3 which require comparing the environmental performance of ISO 14001 certified and non-certified facilities, we constructed a sample of 72 non-certified facilities that were matched as closely as possible to the 72 certified facilities in our sample in terms of industry membership, location, and facility size. For each of the 72 certified facilities we used the NAICS (North American Industry Classification System) Code and location information in the TRI database to identify potential matched facilities that were in the same industry and located as close as possible. We matched facilities by location based on the state in which facilities were located and further set a criterion that each matched facility should not be more than 150 miles from the corresponding certified facility. Then we used the QSU database to eliminate those potential matches that were ISO 14001 certified. We further compared the size of each certified facility in our sample (measured as the number of employees) to the closest non-certified facility in the same industry. We obtained size information for the non-certified facilities from secondary databases including Hoover's and Manta. If a large size discrepancy between a certified facility and its closest matched non-certified facility existed, we compared the size of the next closest non-certified facility until we found a facility of similar size. Using industry membership as a matching criterion allows us to control for factors that affect the environmental performance of all facilities in an industry such as technological advances, changes in federal government regulations, or other stakeholder pressures. Using location as a matching criterion controls for factors that affect the environmental performance of all facilities located in the same region such as regional (state level) environmental regulations. Using facility size as a matching criterion allows us to control for any differences in environmental performance as a result of possible economies of scale in the management of environmental issues.

Assuring data quality

We took several steps to assure the quality of our survey data and to minimize common methodological problems of using survey data such as common method variance (Campbell & Fiske, 1959; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, we adopted measures to reduce social desirability bias (Podsakoff et al., 2003), which should increase truthfulness of responses. We guaranteed anonymity to respondents and reduced evaluation apprehension by assuring respondents that there are no right or wrong answers. We also aimed to develop survey items that are factual rather than perceptual and that are based on objective behavior rather than on subjective attitudes. For example we asked respondents whether they use ISO documents in daily practice rather than asking them how useful they perceive these documents to be. Second, to avoid respondents misunderstanding the survey questions we avoided vague concepts, kept questions simple and precise, and decomposed questions with more than one possible interpretation to simpler, more focused questions. Third, we avoided problems of common method bias (Campbell & Fiske, 1959;

Podsakoff et al., 2003), that are frequent in survey research that relies on collecting independent and dependent variables from the same respondent at the same time, by using survey data only for our independent variables and using the TRI database to construct our dependent variables. In addition, we used secondary sources to obtain or triangulate some of our control variables.

Representativeness of Respondents

We performed three tests to ensure that our ISO 14001 certified respondents were representative of our mailing sample. First, a comparison of respondents to non-respondents showed that these two groups of facilities do not significantly differ in terms of facility size (number of employees) and that our respondents are representative of our mailing sample in terms of industry membership and location. We found no differences in response rates across two-digit SIC industries and states in which facilities are located. Second, a wave analysis showed that a self-selection bias, which makes facilities with certain characteristics more likely to respond to our survey, is unlikely to exist. Wave analysis assumes that non-respondents are more similar to late respondents than to early respondents (Fowler, 1993). A comparison of responses to our first mailing and to our third mailing revealed no significant differences in the levels of the variables included in our study or in the relationships among these variables. Third, respondents are representative of our mailing sample in terms of environmental performance. A t-test indicated that respondents and a sample of non-respondents did not significantly differ in terms of their change in toxic releases after certification (based on three year average annual releases before and after ISO 14001 certification from the TRI database).

Measures

The appendix lists definitions and data sources for our measures. For multi-items measures we show Cronbach's Alpha coefficients in the diagonal of the correlation matrix in Table 1.

Insert Table 1 about here

Independent variable. We measured quality of implementation of the ISO 14001 on a continuum, ranging from low to high quality of implementation. We based our measure on items used in previous studies (Christmann & Taylor, 2006; Naveh & Marcus, 2005; Naveh & Marcus, 2004). Since implementation of ISO 14001 requires many different activities, our measure consists of five survey items relating to different aspects of ISO 14001 implementation (e.g., use of ISO 14001 documents in daily practice, taking corrective actions, preparation for the audit). Please see the Appendix for a complete list of the items included in this measure. While each of these items captures a different activity associated with ISO 14001 implementation, all these activities are interrelated as part of the EMS. Therefore, we expect that a facility's quality of implementation will be consistent for all these activities, e.g. facilities will not take corrective actions based on ISO 14001 audit findings if the EMS is not part of their regular routine. An exploratory factor analysis with varimax rotation yielded one factor that all the five items loaded on, which indicates that quality of implementation is a unidimensional construct. The Cronbach Alpha of 0.81 exceeds the recommended cutoff of 0.7 (Nunnally & Bernstein, 1994), indicating internal consistency of the items. Our measure is the average of the five survey items. A low score indicates low quality of implementation and a high score indicates high quality of implementation.

Dependent variable. Environmental performance can be operationalized by different measures, such as environmental reputation, compliance with environmental regulations, and emissions. For this study we needed to select an environmental performance measure that is likely to be directly affected by ISO 14001 implementation and for which data is available at the facility level.

As a facility's quality of ISO 14001 implementation is not transparent to outsiders it is not likely to affect environmental reputation. Measures of compliance with environmental regulations such as fines are episodic (Russo, 2001) and do not therefore reflect the continuous nature of the relationship between EMS implementation and firms' environmental performance. Compliance measures also depend on enforcement that may be uneven across states and industries contributing to noise. To overcome the limitations of these measures we operationalized environmental performance using toxic emissions at the facility-level from the TRI database (Kassinis & Vafeas, 2006; Klassen & Whybark, 1999), which is commonly used in academic research. The TRI database is a publicly available database compiled by the U.S. Environmental Protection Agency (EPA). It contains information on the quantity of toxic chemical releases for approximately 650 chemicals. Facilities in the U.S. that employ ten or more full-time equivalent employees and that manufacture, process or otherwise use at least one of these toxic chemicals in excess of the threshold quantity are required to report their releases (EPA, 2006).

From the TRI database we obtained total chemical release information (both on-site and off-site emissions) for all reporting facilities for each year from 1995 to 2005. Because a few additional chemicals were added to the TRI after 1995, we based our calculations for all years only on the 1995 list of core chemicals (i.e. all chemicals for which release data was included in the TRI database in the year 1995), which makes release information comparable across years.

The dependent variable employed in our test of Hypothesis 1 is post-certification environmental performance measured as the logarithm of reverse-scored average annual total TRI releases for each certified facility in the three years after obtaining initial certification. Using three-year average releases smoothes out the effects of one-time events such as accidental spills. The measure was reverse-scored because lower releases mean better environmental performance and using logarithms of the TRI releases reduces the effects of extreme observations.

To test hypotheses 2 and 3 about the differences in improvement of environmental performance between certified and non-certified facilities we measured the improvement in post-certification environmental performance relative to pre-certification environmental performance calculated as the percentage reduction in three-year average annual total TRI releases after certification. Positive numbers indicate reductions in TRI emissions, i.e. improvements in environmental performance, while negative numbers indicate increases in emission, i.e. decreases in environmental performance. For each of the non-certified matched facilities we based our calculations on the same calendar years that we used to construct the measure for the corresponding ISO 14001 certified facility. This allowed us to control for exogenous factors that affect the environmental performance of all firms' in an industry in a given year such as changes in environmental regulations or technological advances. To reduce the effect of outliers, we winsorized this variable (Barnett & Lewis, 1994; McNamara, Haleblian, & Dykes, 2008) at the 98th percentile. However, our results do not change substantially when unwinsorized data is used.

Control variables. We included a variety of control variables that likely affect environmental performance independent of the quality of ISO 14001 implementation in our tests of hypothesis 1. Environmental performance in years prior to initial certification is likely to be a major determinant of environmental performance after certification. We included the logarithm of reverse-scored average annual total TRI releases for each facility in the three years prior to obtaining certification in our model to control for this effect. Large facilities can employ scale-intensive abatement technologies and may benefit from economies of scale in emission reduction. Therefore, we controlled for facility size by using the logarithm of the number of employees as reported in our survey. A triangulation of this measure with employee data from the D&B Million Dollar Database showed a high and significant correlation between the two variables (0.61, $p < 0.01$) increasing our confidence in the survey-based measure. Older facilities likely use older equipment and technologies, which may negatively affect environmental performance. Hence we controlled for facility age by using the square root of the facility's age in years as reported in our survey. Facilities in industries with a high rate of technological change are more likely to change their equipment frequently. These facilities are more likely to use the latest environmental technologies in production, which can be expected to reduce emissions. We controlled for the rate of technological change in the industry by using a two-item measure based on survey responses. Community pressures can affect facilities' management of their environmental activities (Kassinis & Vafeas, 2006) which in turn can affect the environmental performance of facilities. Following Kassinis and Vafeas (2006), we used community population density measured as the logarithm of the number of inhabitants per square mile in the county in which the facility was located in the year 2000 obtained from U.S. Census Bureau's database to control for community pressures.

Analytical Method and Preliminary Data Analysis

We used ordinary least squares (OLS) regression analysis to test Hypothesis 1. We verified that all variables included in this analysis conformed to the distributional assumptions of OLS regression. For the variables that were not normally distributed (pre- and post-certification environmental performance) we performed log-transformations to have their distributions approximate normal distributions. Before performing the regression analysis, we evaluated the likely extent of multicollinearity in our data. Low correlations among our independent variables (see Table 1) and small variable inflations factors (VIF) – our largest VIF of 1.13 is well below the recommended cutoff of 10 (Belsley, Kuh, & Welsch, 1980) – both suggest that multicollinearity is not a problem in our data.

To test hypotheses 2 and 3 about the differences in environmental performance improvement between certified and non-certified facilities, we used parametric, independent sample, one-tailed t-tests. While a Shapiro-Wilk test indicated that our environmental performance variable is not normally distributed, our sample size is relatively large (greater than 25) and the sample sizes for our groups of certified and non-certified facilities are equal which suggests that parametric tests are appropriate (Gaither & Glorfeld, 1985). Levene's test for equality of variance indicated that equal variances for the two sub-samples of certified and non-certified facilities cannot be assumed. Consequently, we report results of t-tests that do not assume equality of variances. Results of t-tests that assumed equality of variances were consistent with the unequal variance results we report.

To test hypotheses 2a and 2b, we performed t-tests for the full sample (comparing all certified facilities to all matched non-certified facilities). To test hypotheses 3a and 3b, we divided our sample of 72 ISO certified facilities into two equal sized sub-samples of 36 high-quality (top) and 36 low-quality (bottom) implementers based on their quality of ISO 14001 implementation scores. We assigned each non-certified facility to one of two corresponding non-certified sub-samples depending on the assignment of its corresponding certified facility. We performed separate t-tests for the sub-samples of top and bottom ISO 14001 implementers, i.e. comparing the environmental performance improvement for the 36 facilities in each of our two certified sub-samples to that of the 36 facilities in their corresponding sub-sample of matched non-certified facilities. Table 3 provides descriptive statistics for the full sample and the top and bottom implementer sub-samples. Figure 1 provides a visual depiction of our data.

RESULTS

Table 2 shows the regression results for testing hypothesis 1. Model 1 includes control variables only. In model 2, we added the independent variable quality of ISO 14001 implementation.

Insert Table 2 about here

Hypothesis 1 suggests that higher quality ISO 14001 implementation leads to better post-certification environmental performance. This hypothesis is supported by the data. The coefficient for quality of implementation in model 2 is positive and significant ($p < 0.001$) and including quality of implementation significantly improves the explanatory power of the model ($p < 0.001$).

Table 4 shows the t-test results for the differences in post-certification environmental performance improvement between ISO 14001 certified and matched non-certified facilities for our tests of hypotheses 2 and 3. Hypothesis 2a suggests that ISO 14001 certified firms have higher environmental performance improvements after certification than non-certified firms while hypothesis 2b suggests that such differences do not exist. We find that for the full sample both certified facilities and their non-certified counterparts show decreases in environmental performance after certification (Table 3). While the decrease in environmental performance is smaller for the certified facilities than for the non-certified facilities (i.e. the certified facilities have better environmental performance), our t-test indicates that this difference is not significant (Table 4). This result lends support to hypothesis 2b.

Insert Table 3 about here

Insert Table 4 about here

Hypothesis 3a suggests that after certification ISO 14001 certified firms that pursue high quality implementation have higher environmental performance improvements than non-certified firms. This hypothesis is supported. Results indicate that for the top implementer sub-sample, the difference in environmental performance improvement between certified facilities and non-certified facilities is significant ($p < 0.05$). An examination of the means for the sub-sample (Table 3) indicates that top implementers experience environmental performance improvements whereas their non-certified counterparts see environmental performance decreases.

Hypothesis 3b suggests that after certification ISO 14001 certified firms that pursue low quality implementation will not differ in environmental performance improvements from non-certified firms. This hypothesis is supported. For the bottom implementer sub-sample, the difference in environmental performance improvement between certified facilities and non-certified facilities is not significant.

DISCUSSION AND CONCLUSION

In this study we examined how the variance in the implementation of certifiable environmental standards among certified firms affects the two functions that certifiable standards need to fulfill to be effective mechanisms for governing firms' environmental conduct in the global economy – improvement of firms' environmental performance and signaling firms' environmental responsibility to customers and other external stakeholders. Using the ISO 14001 environmental management system standard as the research setting, our results show that quality of standard implementation in certified facilities affects the realization of the environmental performance benefits intended by the standard. The higher a certified facility's quality of implementation of the ISO 14001 EMS, the lower are its toxic emissions after certification. Our results also show that the inter-firm variance in standard implementation affects the accuracy of standards as a signal of firms' environmental responsibility. Comparing post-certification changes in emissions of ISO 14001 certified facilities with changes in emissions for a matched sample of non-ISO 14001 certified facilities for the same calendar years, we find that these two groups do not differ significantly in their environmental performance. When analyzing the differences between certified and non-certified facilities for sub-samples of top and bottom quality implementers we find that certified top (high quality) implementers have superior environmental performance compared to their non-certified counterparts, while we find no significant difference in the environmental performance between certified bottom (low quality) implementers and their non-certified counterparts.

Implications for the use of certifiable standards as governance mechanism

These results raise troubling concerns for the effectiveness of governance systems for firms' conduct based on certifiable standards. Firms' variance in the implementation of ISO 14001, the most widely adopted voluntary environmental standard, compromises the performance benefits intended by the standard to such an extent that firms' standard certification does not allow customers and other stakeholders to correctly identify environmentally responsible firms. Overall, certified firms do not show significantly higher environmental performance than non-certified firms. Whether ISO certification is an accurate signal for firms' environmental responsibility hinges on firms' quality of implementation of the ISO 14001 EMS. Firms' quality of implementation of the ISO 14001 EMS is not observable by outsiders (King et al., 2005), so that customers and other stakeholders have no way of telling which certified firms are high quality and which are low quality implementers. Thus, customers and other stakeholders can only use ISO 14001 certification as an indication that a firm *may* have superior environmental performance, but they will not be able to tell for which certified firms this is actually the case.

Thus our findings pose a serious threat to the credibility of the ISO 14001 certification system. Without proper implementation the system reduces to a meaningless label that is intended to enhance firm legitimacy in the eyes of external stakeholders. Once those stakeholders become aware that the inter-firm variance in implementation quality threatens the accuracy of ISO certification as a signal of superior environmental conduct, the credibility and legitimacy of the system of ISO 14001 certification may be jeopardized. When stakeholders realize that certification does not allow them to differentiate between high and low environmental performers they will cease rewarding firms that are certified (Terlaak, 2007), thus reducing incentives for firms to obtain certification. For example, the loss of standard credibility may result in customers ceasing to make ISO 14001 a criterion in their supplier selection. As a result suppliers may cease to see any reasons for obtaining ISO 14001 certification, which would result in lower numbers of certified firms.

Increasing the effectiveness of certifiable standards as governance mechanisms

We do not mean to suggest that it is impossible for ISO 14001 to be an effective governance mechanism for firm self-regulation. Indeed, we find that firms with high quality of ISO 14001 implementation had superior environmental performance than non-certified firms. Thus ISO 14001 *can* be an effective tool for self-regulation *if* firms implement it properly. This suggests that governance systems for firm self-regulation based on certifiable standards need to put more effective enforcement mechanisms in place to ensure compliance with standard requirements in certified firms (Christmann & Taylor, 2006). The effectiveness of enforcement mechanisms can be increased by making changes in the audit system itself and by making auditors more accountable for their work. Changes in the audit system could include unannounced surprise audits to verify that certified firms are using the practices prescribed by the standard in their daily operations and are not receiving and maintaining certification by making last-minute audit preparations. In addition, putting time limits on the relationships between auditors and their clients would alleviate some of the concerns about conflicts of interests that currently exist in the auditor-client relationship in which auditors may not want to be too stringent out of fear of losing clients. The accountability of auditors for their work could be increased by surprise spot-checks of a few certified firms by other auditors. These surprise spot-checks could be initiated by the national accreditation agencies that accredit auditors to certify the standard.

The findings of our study point to one important change in the ISO 14001 audit system that could enhance its effectiveness, an increase in the transparency of audit findings to the public. While the auditor provides the client a complete record of the audit, there is no public record of audit results and certification failures (Stenzel, 2000). Increasing the transparency of audit findings to the public could increase the accuracy of standard certification as a signal of responsible environmental conduct by allowing customers and other stakeholders to obtain more information about certified firms' quality of ISO 14001 implementation. For example, a rating system that provides more information about the quality of implementation in certified firms could be instituted. Similar to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System that provides standards for environmentally sustainable construction, ISO could institute a point system in which firms' level of certification (e.g. Platinum, Gold, Silver, etc.) depends on the number of points obtained during an audit. The number of points could be tied to the certified firm's quality of ISO 14001 implementation. Information about audit failures may also provide important clues about a certified firms' quality of ISO 14001 implementation to external stakeholders. It is estimated that in the United States 30 to 35 percent of facilities fail at their first audit to the ISO 9001 quality management system standard (Nichols, 1993), which is similar in the design and the nature of requirements to the ISO 14001 standards, but that most firms seeking certification eventually attain it. Firms that repeatedly fail their certification audits likely have a lower quality of implementation of their ISO 14001 EMS.

The finding that the ISO 14001 standard is not effective in maintaining a consistent quality of implementation suggests that the standard has not so far been capable of establishing a normative base for firms' environmental conduct. This finding seems to corroborate an early realization that normative behavior cannot be produced through self-interests and market incentives but through intrinsic environmental values (Hoffman, 1991). While such intrinsic ecological values foster a more holistic approach to ecological responsiveness only very few firms possess such values (Bansal & Roth, 2000). Scholars have expressed hope that firms may internalize certifiable management practices such that compliance is driven by intrinsic values rather than by external sanctions and the potential for internal benefits (Terlaak, 2007). However, given that such intrinsic ecological values are currently relatively rare, standard monitoring and enforcement may become even more important to assure that certified firms comply with standard requirements.

Implications for research

Our findings also have important implications for research on certifiable standards by highlighting the importance of considering firms' quality of implementation of certifiable management standards after their certification by independent auditors. Most prior studies have used standard certification as a proxy for the implementation of the practices certified by the standard without considering implementation quality (e.g., Darnall & Sides, 2008; Potoski & Prakash, 2005a; Russo, 2001). Our findings suggest that inter-firm variance in standard implementation quality can explain conflicting findings in prior empirical research. The mixed empirical evidence on the relationship between standard certification and environmental performance may be due to the failure to take into account firms' implementation quality.

Further research could explore the antecedents of firms' quality of implementation of certifiable standards. Our findings indicate that some certified firms behave as predicted by institutional theory by mainly focusing on certification to the standard without changing their internal processes to the extent required to achieve the intended environmental performance benefits of standard implementation. Other firms behave as predicted by the view that standards provide rational and systematic management practices that result in performance improvement in certified firms. We do not know which factors prompt firms to behave in these different ways. Factors that may affect firms' quality of implementation include external factors such as the extent of institutional pressures for certification that they face as well as internal factors such as their motivation for certification or the resources and capabilities that firms possess to implement the standard.

While our study is the first to show a relationship between quality of standard implementation and environmental performance, we are not the first to suggest that ISO auditing may not ensure compliance with ISO standards. It may be a fruitful area for further research to investigate why ISO has not yet made efforts to improve its system of external audits. Future research could explore whether ISO is really committed to improving environmental performance as stated in their documents or whether an alternative institutional explanation for their behavior exists.

Limitations and conclusion

Our study is not without limitations. First, we test our hypotheses in the context of a single management standard, the ISO 14001 EMS standard. However, we believe that the general lessons of our study apply to other standards as well, especially when these standards become a requirement for firms to do business, so that firms adopt these standards not because of intrinsic motivations, but because of coercive pressures. Furthermore, many international standards for firms' social and environmental conduct such as the United Nations' *Global Compact* or the International Chamber of Commerce's *Business Charter for Sustainable Development* are not externally audited. For these standards the issue of symbolic adoption may be even more widespread as they lack an enforcement system to assure firm compliance. Second, implementation should ideally be studied over a period of time (Klein & Sorra, 1996). It would be interesting to investigate whether and to what extent the quality of implementation changes over time at a given facility. Unfortunately, longitudinal data that might allow us to examine these issues is difficult and time consuming to obtain for a large sample of firms, but this may be a worthwhile endeavor for future research. Third, our study uses data from a single country – the United States. However, we do not see any reason to believe that the relationship between the quality of ISO implementation and environmental performance we uncovered in our study is unique to the U.S. What may however differ in other countries is the quality of ISO audits. In particular, concerns have been voiced about the variance in audit stringency among auditors in emerging economies such as China (Christmann & Taylor, 2006; Yeung & Mok, 2005). Thus, in other countries variations in firms' quality of ISO 14001 implementation may be even larger, which is likely to exacerbate threats to the effectiveness of using certifiable standards as a governance mechanism for firms' conduct uncovered in our study.

Despite these limitations our study makes an important contribution to the literature on certifiable standards by highlighting the importance of a variable that has previously not received sufficient attention – the quality of standard implementation. We empirically show that facilities' low quality of standard implementation compromises both functions that certifiable standards need to fulfill to serve as effective governance mechanisms for firm self-regulation in the global economy – improvement of environmental performance and signaling superior environmental responsibility.

TABLE 1
Means, Standard Deviations, and Pearson Correlations for ISO 14001 Certified Facilities[a]

		Mean	SD	1	2	3	4	5	6	7
1	Post-certification environmental performance[b]	3.95	1.36	-						
2	Quality of implementation	5.47	.86	-.14	*0.81*					
3	Pre-certification environmental performance[b]	3.99	1.39	.94**	.03	-				
4	Facility Size[b]	2.53	.45	.13	-.05	.16	-			
5	Facility age[c]	6.02	1.82	.06	-.03	.04	.16	-		
6	Technological change in industry	-.16	.93	-.04	.01	.03	.23	-.12	*0.71*	
7	County population density[b]	2.33	.58	-.20	.25*	-.09	-.07	.01	-.06	-

[a] n = 72
[b] Log-transformed variables
[c] Square root transformation
Cronbach Alphas are reported along the diagonal.
* $p < 0.05$ ** $p < 0.01$

TABLE 2
Results of Regression Analysis[a]

	Dependent Variable: Post-Certification Environmental Performance	
	Model 1	**Model 2**
Independent Variable		
Quality of implementation		.23***
		(.06)
Control Variables		
Pre-certification environmental performance [b]	.90***	.91***
	(.04)	*(.04)*
Facility size [b]	.03	.05
	(.13)	*(.12)*
Facility age [c]	-.01	-.01
	(.03)	*(.03)*
Technological change in industry	.11†	.10†
	(.06)	*(.06)*
County population density [b]	.28**	.19**
	(.09)	*(.09)*
F-Test	107.75***	110.42***
R^2	.89	.91
Adjusted R^2	.88	.90
R^2 Change		.02
F for R^2 Change		14.03***

[a] Values are unstandardized coefficients. Standard errors are in parentheses.
[b] Log-transformed variables
[c] Square root transformation
† $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$ (all two-tailed tests)
n = 72

TABLE 3
Descriptive Statistics for the Full Sample and Top and Bottom ISO 14001 Implementers[a]

	Sample size	Quality of Implementation	Environmental Performance Improvement [b]
Certified Facilities			
Full Sample	72	5.47 *(0.10)*	-0.23 *(0.20)*
Top Implementers	36	6.17 *(0.07)*	0.11 *(0.13)*
Bottom Implementers	36	4.77 *(0.09)*	-0.57 *(0.37)*
Non-certified Facilities			
Full Sample	72	-	-0.59 *(0.28)*
Facilities matched with certified Top Implementers	36	-	-0.79 *(0.38)*
Facilities matched with certified Bottom Implementers	36	-	-0.37 *(0.29)*

[a] Mean values are given. Standard errors are in parentheses
[b] Positive values indicate improvements in environmental performance
Negative values indicate environmental performance degradations

FIGURE 1
Environmental Performance Improvements of Certified Facilities and their Matched Non-Certified Facilities by Quality of Implementation

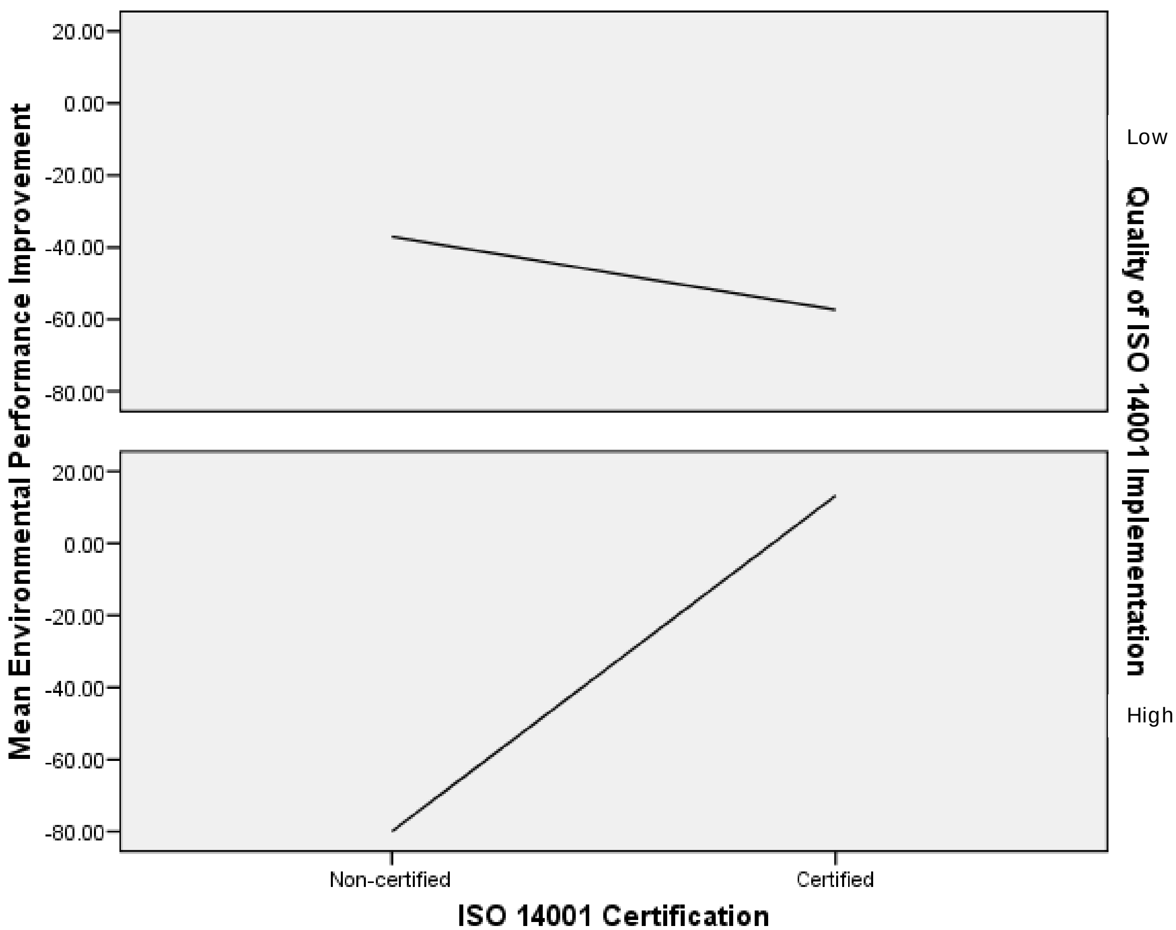

TABLE 4
Independent Sample t-Tests of Mean Differences in Environmental Performance Improvements between Certified and Non-Certified Facilities

	Sample Size	Mean Difference	Standard Error Difference	Significance Level[a] *(t-value)*
Full Sample	72	0.36	0.35	0.16 *(1.02)*
Sub-sample 1: Top ISO 14001 Implementers	36	0.91	0.51	0.04 *(1.79)*
Sub-sample 2: Bottom ISO 14001 Implementers	36	-0.20	0.47	0.33 *(0.43)*

[a] one-tailed tests

APPENDIX: Measures

Construct	Indicator
Post-certification environmental performance	Logarithm of average total annual chemical releases for facility for the three-year period directly following the year of initial ISO certification (reverse-scored). Data Source: TRI Database
Environmental performance improvement	Post-certification reduction in TRI emissions in percent calculated as: (3-year average total annual TRI chemical releases before certification)-(3-year average total annual TRI chemical releases after certification)/(3-year average total annual TRI chemical releases before certification) For calculating this variable for each non-certified facility in the matched sample the same calendar years were used as for the corresponding certified facility. Data Source: TRI Database
Quality of implementation	Survey Items: (rated on 7-point Likert scale) This question pertains to the implementation and perceptions of the ISO 14001 EMS at your facility. To what extent: 1) are the documents created for the purpose of ISO 14001 used in daily practice? 2) has the ISO 14001 system become part of your regular routine? 3) are preparations for external audits made at the last minute? (reverse-scored) 4) is the system regularly ignored? (reverse-scored) 5) does facility management implement corrective actions based on ISO 14001 audit findings?
Pre-certification environmental performance	Logarithm of average total annual chemical releases for facility over a period of three years directly preceding the year of initial ISO certification (reverse scored). Data Source: TRI database
Technological change in industry	Survey Items: (rated on 7-point Likert scale) How would you rate your main product in terms of percent of sales along the following characteristics? 1) Slow changing technology…Fast changing technology 2) Mature process technology…Evolving process technology
Facility size	Logarithm of the number of employees in the facility. Survey question: Approximately, how many employees does your facility have? (Triangulated with data from Dunn and Bradstreet database)
County population density	Logarithm of the number of county inhabitants per mile (2000) county in which facility is located. Data Source: U.S. Census Bureau's Database

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