2012

Learning and innovation in the context of process-focused management practices: The case of an environmental management system

Deepa Aravind
CUNY College of Staten Island

Learning and Innovation in the Context of Process-Focused Management Practices: The Case of an Environmental Management System

Deepa Aravind
The City University of New York - College of Staten Island
Department of Business
2800 Victory Boulevard, 3N 228
Staten Island, NY 10314

Accepted for Publication at
the Journal of Engineering and Technology Management (JET-M)
May 2012

Keywords: Learning; Innovation; Management practice; Change catalysis; ISO 14001

Abstract

Adoption of process-focused management practices has been associated with inertia and rigidity in adopting firms. By drawing on the literature on routines and using survey data from 192 ISO 14001 certified facilities in the United States, I find that change catalysis or a deep form of learning which presents the opportunity for innovation can happen in this context. I also examine the internal and external determinants of change catalysis. By doing so I contribute to a better understanding of how process-focused management practices can be a source of innovation within firms.

1. Introduction

Process-focused management practices like Total Quality Management (TQM), the ISO 9000 quality management system and ISO 14001 environmental management system focus on improving an organization's efficiency by rationalizing, coordinating, and repeating organizational processes. It has been suggested that the implementation of such practices increase resistance to change and decrease firms' ability to adapt (Benner and Tushman, 2003). In general, exploration and innovation are not seen as resulting from the implementation of such management practices (Benner and Tushman, 2002, 2003).

Recent studies of the implementation of a quality management practice, ISO 9000, suggest that it is possible for such practices to act as catalysts for change, which involves an organization being able to go beyond what a practice literally demands (Naveh and Marcus, 2004; Naveh and Marcus, 2005; Naveh *et al.*, 2006). Change catalysis is a deep form of learning or second-order learning and involves using an implemented practice as a springboard for the introduction of innovations and as a catalyst for rethinking the way the organization does business (Naveh and Marcus, 2004; Naveh *et al.*, 2006). These studies found that such exploring, branching out and innovating in new directions (Eisenhardt and Tabrizi, 1995) based on the rules of ISO 9000 allow implementing firms to derive both operational and performance benefits. Other research on exploration and exploitation has also found explorative activities to be related to long-term performance (Auh and Menguc, 2005).

Because of its positive impacts on both operational and business performance of organizations, change catalysis is important and scholars have called for more research on this phenomenon in the context of practices and standards (Naveh and Marcus, 2005). We know little about change catalysis in other contexts and also the factors that affect it. In this study, I seek to

fill these gaps by examining whether change catalysis exists in a novel context, the ISO 14001 environmental management system (EMS) and then studying the determinants of change catalysis in this context. This international certifiable management standard is intended to reduce and manage the environmental impacts of organizations of any size and type across the world. I seek to extend the literature on implementation by investigating whether ISO 14001 can really be the basis for further innovation and what factors affect this outcome.

My findings suggest that in the context of the ISO 14001 environmental EMS, change catalysis can happen and that both the organizational context and external factors affect it. Specifically, I find that benefits of the practice, importance of environmental issues in the firm, focus on process innovation, and customer evaluation and feedback of environmental performance are positively related to this variable in the context of ISO 14001 EMS. I conclude that under the right conditions, implementation of ISO 14001 can be the basis for additional innovation. I also discuss the academic and managerial implications of the study.

2. ISO 14001 Environmental Management System

ISO 14001 was developed and introduced in 1996 by the International Organization for Standardization (ISO), a non-governmental organization based in Geneva, Switzerland. ISO 14001 codifies a set of standard practices to manage the environmental aspects of firms' operations and compliance with its requirements can be certified by independent third-party auditors. It is a generic international standard for environmental management systems and is the backbone of the ISO 14000 family of standards. The ISO 14000 family is primarily concerned with activities that minimize the harmful effects on the environment and achieving continual improvement in environmental performance (ISO, 2004). It provides a framework that is intended to integrate environmental management practices into the daily work routines of firms. 250,972 facilities in

155 countries have ISO 14001 certification as of December 2010 (http://www.iso.org/iso/iso-survey2010.pdf, accessed January 2012), making it the most widely adopted environmental management standard in the world (Marimon, Llach, and Bernardo, 2011).

An organization that seeks to get certification to the ISO 14001 standard should first have an environmental management system in place that conforms to the ISO 14001 requirements. In order to achieve certification, a firm has to identify all its environmental impacts, develop an environmental policy, set goals and targets to reduce the environmental impacts of its activities, communicate the EMS to its employees, train and empower them, document relevant procedures, identify its actual environmental impacts and address any non-conformances. The firm then has to assess its EMS through a management review process and make any necessary changes. To achieve certification, the firm must pass an audit by an accredited independent third-party auditor which assesses the extent to which the firm complies with the ISO requirements. Re-certifications are done once every three years.

With respect to consequences of adopting ISO 14001, some studies have found certification to be linked to environmental performance (Melnyk *et al.*, 2003; Russo, 2001). However, other studies have not found this effect (eg., Darnall and Sides, 2008; King *et al.*, 2005). More recent studies suggest that implementation, as opposed to certification, is what affects environmental performance and have found that the extent of implementation does have an effect on the environmental performance benefits that can be derived out of the system (Aravind and Christmann, 2011; Yin and Schmeidler, 2009). Other than the effects of process-focused management practices on performance, studies have suggested that such practices are associated with stabilizing organizational routines, decreasing variations in organizational processes, and increasing organizational rigidities that prevent any type of innovations other than

exploitative (Benner and Tushman, 2003). In this study I suggest that implementation of ISO 14001 can be associated with change catalysis, a phenomenon that encourages more advanced practices and innovations.

3. Literature review and hypotheses

3.1. Change catalysis

In the context of implementation of management practices, prior research has distinguished between two mechanisms of learning during implementation – *adaptation-in-use*, which is associated with local search for solutions in order to fit the practice to the organization, and *change catalysis*, which is associated with more distant search and the use of the practice as a springboard for the introduction of innovations and more advanced practices (Naveh *et al.*, 2006). Change catalysis is a deep form of learning in which as implementation happens, basic assumptions, models, norms and objectives of the firm are challenged (Carroll *et al.*, 2003) and even involves using the management practice as a "springboard for rethinking the way the organization does business" (Naveh *et al*., 2006, p. 282).

Essentially change catalysis happens when a firm learns when implementing the practice and the practice becomes a catalyst for additional innovation. Naveh and Marcus (2004), in a study of ISO 9000 certified firms, found that one of the firms that they studied kept developing and adding layers to its quality system and that in a few years, the firm had a complex system, of which ISO 9000 was only a part. Link and Naveh (2006) found that using ISO 14001 in daily practice (routinization) and the related articulation and codification of knowledge was positively associated with divergent thinking and experimentation on the part of employees.

Change catalysis has been called 'going beyond' (Naveh and Marcus, 2004) and is comparable to exploration (March, 1991), double-loop learning (Argyris and Schon, 1978), and

revolutionary change (Tushman and O'Reilly, 1996). It is acquired through interaction among individuals and experience, is "often rooted in action" (Edmondson *et al.*, 2001) and is improvisational (Orlikowski and Hofman, 1997). Change catalysis is built on practice-based knowledge and action-based learning (Naveh et al., 2006) and is based more on tacit knowledge rather than codified knowledge. When change catalysis occurs, it becomes a 'trigger' or 'springboard' or 'launching pad' for additional innovation (Greve and Taylor, 2000; Naveh and Marcus, 2004; Naveh *et al.*, 2006).

In the following sections, I review the literature on routines and then develop my hypotheses based on this.

3.2. Literature on routines

An organizational routine is "a repetitive, recognizable pattern of interdependent actions, involving multiple actors" (Feldman and Pentland, 2003, p.96). Routines have been characterized as a source of inertia and inflexibility (Hannan and Freeman, 1984). Routinization is the degree to which a practice or technology has become part of an organization's regular operating procedures (Cooper and Zmud, 1990; Zmud and Apple, 1992; Real and Poole, 2005) and is associated with persistence in routines. Routinization calls for maintenance of documentation and adherence to documented procedures that help employees in organizing their work and enable better communication (Naveh and Marcus, 2004). There is an emphasis on doing activities in some standard fashion repeatedly (Sitkin *et al.*, 1994) thereby adhering to routines and allowing for incremental learning, with the potential for continuous efficiency improvements (Benner and Tushman, 2002; Levinthal and March, 1993; March, 1991). ISO 14001 procedures are intended to help firms manage their environmental impacts and are aimed to reduce variability in environmental processes which results in homogeneity in how various

tasks are performed in a firm (Levinthal and March, 1993). This type of routinization has been said to be the key to coping with complexity (Gilson *et al.*, 2005) and represents first-order, rather than second-order learning. Scholars have suggested that the focus on "measuring, improving, and rationalizing organizational processes" (Benner and Tushman, 2003: 240) and the resulting routinization might result in resistance to change and competency traps (March, 1991).

One way to overcome this problem is to not stop at routine implementation but to go beyond that by learning from the system and using the system as a stepping stone for more advanced practices. Even though routines have traditionally been regarded as unchanging and a source of inertia (Hannan and Freeman, 1984) and mindlessness (Ashforth and Fried, 1988), more recent research indicates that routines are a source of organizational learning and can be a source of flexibility and change because they are not mindless, but effortful, emergent accomplishments (Feldman, 2000; Feldman and Pentland, 2003; Howard-Grenville, 2005). This is because the performative aspect of routines (the other aspect of routines is the ostensive aspect, which is the routine in principle, or the abstract idea of the routine) involves learning by "people doing things, reflecting on what they are doing, and doing different things (or doing the same things differently) as a result of the reflection" (Feldman, 2000, p.625). Particular courses of action that employees take are, to various extents, improvisational, based on reflective self-monitoring (Feldman and Pentland, 2003). Thus organizational routines can include double loop learning (Feldman, 2000: 625). This research suggests that routines are full of life and are not simply inert as originally thought (Feldman, 2000). A process like change catalysis can help bring forth these characteristics of routines (Sitkin *et al.*, 1994). Implementing firms therefore

have the opportunity to go beyond mere routinization to embrace learning, flexibility, and innovation.

Certainly, not every firm will have the ability or willingness to routinize a management practice or innovate based on it. Some firms may just not have the ability or the willingness to do a proper implementation. Other firms may implement well, routinizing the practice, while still other firms may be able to go beyond and innovate. What enables some firms to go beyond mere routinization and undergo deep learning or change catalysis presents an interesting question. This study aims to move towards a better understanding of this in the context of ISO 14001.

A recent review identified organizational context in which routines operate as an important but under-researched factor that shapes the use of routines and whether and how they change over time (Parmigiani and Howard-Grenville, 2011). Such changes in routines are the basis of or result in change catalysis. For example, Feldman (2003) found that whether an envisioned change in routine was consistent with people's understandings of how the organization worked had an important influence on whether the routine would change. Howard-Grenville (2005) identified one aspect of organizational context - embeddedness of the routines. This is the degree to which the use of a routine overlaps with the enactment of other organizational structures such as technological, coordination and cultural structures as having an influence on whether routines are performed flexibly and whether they change over time. Other research suggests that favourable organizational conditions can result in better implementation (Naveh and Marcus, 2005). Based on these observations, I examine three factors within the organizational context as determinants of change catalysis in the context of ISO 14001. They are 1) benefits of the practice, 2) importance of environmental issues in corporate strategy, and 3) process innovation capability. In addition to organizational factors, I also consider a key external

factor, namely, customer evaluation and feedback of environmental performance of the firm. External pressures as sources of changes in routines have been suggested in the literature (Feldman and Pentland, 2003) but have not been sufficiently explored in the literature. Hence it is important to study this aspect further. The importance of considering context-specific factors such as these in studies on routines has been acknowledged in the literature the reason being that routines are highly context-specific (Parmigiani and Howard-Grenville, 2011).

These four factors considered here are important in the case of change catalysis in the context of ISO 14001 due to the following reasons. First, in the case of technology implementation, it has been suggested that if no benefits are realized or if very few benefits accrue to a firm by using the practice, there would not be sufficient incentives for the firm to use the practice (Edmondson *et al.*, 2001) or use it as a forum for learning and innovation. This can also be extended to the case of process-based practices such as ISO 14001. Realization of benefits of a practice would increase the chances of a practice being used as a catalyst for change. Second, environmental issues are very often not regarded as mainstream to a firm's operations and are often overlooked. However, there are firms where the environment is accorded a lot of importance and in some are incorporated into firm strategy. If more importance is given to environmental issues, there would be better likelihood of using ISO 14001 EMS regularly and as the basis for more explorative learning. Third, focus on process innovation capability is likely to be important in this context because firms with this capability are likely to have a broader knowledge base which is likely to enhance the ability to engage in explorative learning (Lavie *et al.*, 2010). Fourth, customer requirement is one of the main reasons firms seek certification of their EMS (Jiang and Bansal, 2003; Christmann and Taylor, 2006). Without this, many companies would not even consider certifying to the standard. However, in some cases,

customers are more deeply involved and provide evaluation and feedback on the environmental performance of firms. Hence considering the impact of this factor on change catalysis is important. In the next section, I will consider in more detail the effects of these four factors on change catalysis and develop my hypotheses.

3.3. Internal factors affecting change catalysis

3.3.1. Benefits of certification

Certification to the ISO 14001 standard is said to provide several benefits to the firm, such as improved compliance with environmental regulations, improved environmental performance, improved corporate image, access to export markets, improved employee awareness, and improved internal procedures (Heras *et al.*, 2009; Vastag and Melnyk, 2002).

The possibility of using routines (such as those related to ISO 14001 implementation) within firms is improved when routines are related with success in achieving goals and is lessened when they are related with failure (Cyert and March, 1963). Inferior performance or lack of benefits will not be tolerated by employees whereas performance improvement will aid implementation success (Edmondson *et al.*, 2001). If employees see that ISO 14001 is useful in providing a variety of benefits to the firm, they are more likely to use it as a base for all kinds of issues they face when performing their routines. They are likely to use the practice in novel ways and try to learn more from the practice by developing new knowledge based on the practice itself. There is likely to be improvisation and the learning process here is likely to be more unpredictable and emergent from evolving practice since a practice that is new to the firm is being implemented.

Here I suggest that when employees recognize higher benefits from the implementation of ISO 14001, they are more likely to use the system to facilitate exchanges of both tacit and

explicit knowledge to solve some of their issues. This would result in richer exchanges of knowledge and the generation of more ideas and employees are more likely to use the system in innovative ways. Hence,

Hypothesis 1: Benefits of the implementation of ISO 14001 is positively related to using ISO 14001 as a catalyst for change.

3.3.2. Importance of environmental issues in corporate strategy

Consideration of the environment is very important for some firms and they accord high importance to the environment in their corporate strategies. A strong environmental stance is likely to become part of a firm's image and identity that guides the actions of its members (Dutton and Dukerich, 1991). If employees see that environmental issues are an integral part of corporate strategy and identity, they are more likely to pursue strategies that enable them to effectively deal with environmental problems. They are therefore also more likely to make efforts to use ISO 14001 and learn from it. Furthermore, if managers see that the environment is of high importance in corporate strategy, they are more likely to provide the resources necessary for new ideas to take hold and also to support risk taking. Resources facilitate search and experimentation (Lavie *et al.*, 2010; Levinthal and March, 1993). Managers will be flexible and willing to let employees be more creative and give them discretion in innovating based on ISO 14001 requirements. If on the other hand, they perceive that the environment is not a key issue for the firm, managers are not likely to provide resources for experimentation or support risk-taking.

Also, when employees see that the environment is a key aspect of the firm's operations, they are more likely to bring in the environment when solving problems in daily practice.

Environmental problems and their solutions are likely to be part of their knowledge repertoires which can be easily accessed when the need arises. Whenever they perform routines, they are likely to factor in environmental aspects, thereby enhancing the possibility of deeper learning that integrate environmental aspects, resulting in ISO 14001 being used as a catalyst for change. Therefore,

> *Hypothesis 2: Importance of environmental issues in corporate strategy is positively related to using ISO 14001 as a catalyst for change.*

3.3.3. Process innovation capability

Some firms innovate a great deal on their production processes trying to use the best technology and buying the latest equipment. Employees in such a firm is likely to have a better understanding of their production processes and are likely to be more skilled. The firm will have a broader knowledge base which is likely to enhance the absorptive capacity of the firm (Cohen and Levinthal, 1990) and the ability to engage in exploration (Lavie *et al.*, 2010). Access to the latest technologies and processes are likely to provide an organizational context where innovative ideas can flourish and take hold.

Employees having a focus on the firm's processes would possess a greater pool of knowledge to draw upon and greater sharing of this knowledge, enabling more learning and more innovation to happen. A focus on process innovation suggests that members would be very aware of and knowledgeable about processes and related technologies and would factor this in when doing their daily tasks and making decisions. The multitude of actors involves multiple information, goals, and interpretations which suggest that documentation and rigidities related to employees following these documented procedures need not result in routinization and the inertia associated with it.

While it has been argued that process management techniques tend to stabilize and rationalize routines (Benner and Tushman, 2003, 2004), more recent literature on routines suggests that routines can change when actors use the routines flexibly, whether intentionally or not (Howard-Grenville, 2005; Naveh and Marcus, 2005). When this happens, the routines, instead of suppressing variation as suggested by traditional explanations, allow these actors to depart from standard practices and allow for a variety of actual performances. Some of these performances can change or alter routines over time (Howard-Grenville, 2005). Having the capability to innovate in the firm's processes allows employees to have better knowledge and skills and also the ability to operate their routines flexibly.

Based on the above, I suggest that firms with the capability to innovate in its processes would have much greater knowledge for employees to draw upon, enabling deeper learning and more exploratory innovations. Such an environment is therefore likely to be more conducive for ISO 14001 to act as a change catalyst rather than an environment where there is not much focus on process innovation. Therefore,

Hypothesis 3: Process innovation capability is positively related to using ISO 14001 as a catalyst for change.

3.4. External factors affecting change catalysis

3.4.1. Customer evaluation and feedback of environmental performance

As mentioned earlier, customer requirement is one of the main reasons firms seek certification of their EMS (Christmann and Taylor, 2006; Jiang and Bansal, 2003). Some customers do not go beyond requiring their suppliers to be environmentally responsible and mandating environmental certification. However, others are more involved in their suppliers' environmental activities by evaluating suppliers' environmental activities and performance and giving them feedback to improve

their performance. Such deeper involvement by customers is likely to give firms additional motivation to reduce the environmental impact of their activities. This motivation could lead firms to explore new ways to accomplish better environmental management. Such firms are more likely to use ISO 14001 as a base and expand from that base enabling them to adopt innovative approaches that aid them in reducing their environmental impact thereby facilitating improvement in their environmental performance.

The literature on routines suggests that actors vary their actions based on their past experiences (Feldman and Pentland, 2003). This would suggest that if employees perceive that customers particularly value the environmental performance of their organization, they are more likely to modify their routines to take this into account. Also, scholars have argued that sources of innovation can lie outside an organization, among its customers and suppliers (von Hippel, 1988). Valuable learning happens from such external sources (Dodgson, 1993). Customers and suppliers can provide valuable information that can result in innovative products or services. They can also take part in the innovation process. Customer evaluation and feedback of environmental performance can thus result in deeper learning and innovation. If the firm uses ISO 14001 to manage its environmental impacts, firms are likely to use the system as a base from which to innovate based on innovative ideas from customers. Therefore,

Hypothesis 4: Customer evaluation and feedback of environmental performance is positively related to using ISO 14001 as a catalyst for change.

4. Research design and methodology

4.1. Sample

I tested my hypotheses using data from a mail questionnaire survey, since data on the implementation of ISO 14001 in facilities cannot be obtained from public sources (Aravind and Christmann, 2011). My sample consists of ISO 14001 certified facilities in the United States. I obtained a list of 5284 ISO certified facilities in the U.S. from QSU Publishing Company's *ISO 14001 Worldwide Certified Company Directory* (QSU, 2006), the most comprehensive database of certified facilities in the United States. To ensure that I was able to perform adequate follow-up to my survey resulting in a good response rate, I restricted my mailing sample to six hundred randomly selected facilities from the QSU directory.

4.2. Data collection

The target respondent for my survey was the individual at the facility who is responsible for ISO 14001 as this individual is most knowledgeable of the implementation of the system. Such a single-informant approach has been used in other studies on ISO standards (Boiral and Roy, 2007; Melnyk *et al.*, 2003;). I identified the most knowledgeable and appropriate person to complete the questionnaire, the principal methodological solution to using single respondents (Campbell, 1955; John and Reve, 1982). Further, self-reports are not as problematic as some critics maintain if the respondent can validly assess the construct (Crampton and Wagner, 1994). I initially identified this individual from the QSU database and made phone calls to each facility in my sample to confirm the identity of this individual. My respondents were mostly facility-level Environmental, Health, and Safety (EHS) Managers (59.9%) or Quality Managers (13.5%). The average management experience of my respondents is 14.3 years. As I describe in the measures section below I was also able to triangulate some of my survey-based measures with secondary data. More specifically, data from secondary databases allowed me to triangulate approximately 33% of my data.

I discussed my initial questionnaire during personal interviews with four facility environmental and/or quality managers in the U.S. who also provided me with extensive written feedback on the survey questions. After making changes based on their suggestions I conducted a pilot study of a shortened version of the questionnaire containing my key measures with managers who attended a regional meeting of the American Society for Quality in September 2006. Based on this pilot study, I modified some of my items and designed a final version of the questionnaire.

I based the survey administration on tailored design method which has been shown to improve response rates to mail survey questionnaires (Dillman, 2000). After the initial mailing of the survey, I performed two follow-up mailings. 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 33.9 percent, a rate that is comparable to other studies on ISO standards (Boiral and Roy, 2007; Melnyk *et al.*, 2003). Due to incomplete data only 192 of these responses were usable for this study. The median size of my respondent facilities was 200 employees with the number of employees ranging from 6 to 2700. My respondent facilities were on average 5.2 years ISO 14001 certified with a minimum of one year and a maximum of eleven years.

I took several steps to assure the quality of my survey data. First, I took several measures suggested in literature to reduce common method bias (Lindell and Whitney, 2001; Podsakoff *et al.*, 2003). I guaranteed anonymity to respondents and reduced evaluation apprehension by assuring respondents that there are no right or wrong answers. I also took effort when designing my questionnaire items to avoid vague concepts and keep questions simple and precise. Also, the order of the questions was designed such that it neutralizes some of the method biases by controlling the cues prompted by the question context. Furthermore, the items used in this study are part of a large-scale questionnaire, therefore, "it is unlikely that respondents would have been able to

guess the purpose of the study and forced their answers to be consistent" (Mohr and Spekman, 1994: 147). In addition, I reverse-coded some of the items in the questionnaire (Murray, Kotabe, and Zhou, 2005).

Second, I conducted Harman's single factor test (Podsakoff *et al*., 2003) to test for the extent of common method variance. Multiple factors with eigenvalues greater than 1.0 emerged from this analysis that accounted for a large percent – 71.7% - of the total variance. No single factor accounted for a majority of the variance in the data. Hence common method bias could not account for all the relationships among scale items in my data set and suggests that common method bias is not a serious problem in this study. Thus both the design of the questionnaire and the post-hoc test suggests that common method bias is not a significant issue in this study.

Third, there may be a concern that the person responding to my questionnaire is the person responsible for ISO 14001 at the facility and that this may increase the possibility that this person might answer questions related to ISO 14001 in a favorable light. However, this seems unlikely to be problematic, since I received a wide range of qualitative comments about ISO 14001 from the respondents. Some respondents were very optimistic about the system, whereas others were obviously not satisfied with it and viewed it as burdensome and unnecessary. To illustrate the former, here is a comment from a respondent: "implementation of ISO 14001 not only instilled a heightened awareness of our environmental practices, it became an integral part of every day operations, which has resulted in significant cost savings through process improvements and recycling efforts." To illustrate the latter, here is a comment: "so far, implementation has been little more than an excuse to pay a registrar for 3rd party audits. There have been absolutely no benefits aside from satisfying a customer mandate". These comments show that even though respondents are primarily those responsible for ISO 14001, all of them do

not necessarily hold positive views about the system. Hence this does not appear to be a problem in this study.

Fourth, I performed three tests to ensure that my ISO 14001 certified respondents were representative of my mailing sample. First, I compared respondents and non-respondents in terms of facility size, industry and geographic location and I found no significant differences between the two groups of firms in terms of number of employees per facility and no differences in response rate across two-digit SIC industries and states. Second, since non-respondents tend to be more similar to late respondents than to early respondents (Fowler Jr., 1993), I conducted wave analysis to determine whether a self-selection bias existed. I found no significant differences in the levels of the variables included in my study or in the relationships among these variables between respondents to my first mailing and to my third mailing. Third, I compared the environmental performance of respondents and non-respondents. Using pre-certification and post-certification toxic release information (three year average annual releases before and after ISO 14001 certification) for both respondents and a sample of non-respondents from the Total Release Inventory (TRI) database maintained by the Environmental protection Agency (EPA), I conducted a t-test of the difference in the change of pre-certification and post-certification releases between respondents and non-respondents. The t-test indicated that the environmental performance difference between respondents and non-respondents was not statistically significant. This increases confidence in the representativeness of my mailing sample.

4.3. Measures

I constructed measures from survey items, some of which I was able to triangulate using secondary data sources. Survey-based measures are commonly used in studies that examine process-focused

management practices (Link and Naveh, 2006; Naveh *et al.*, 2006). Measurement and reliabilities of the variables used in this study are given in Table 1.

[Insert Table 1 about here]

4.3.1. Dependent variable

I based the measure for the dependent variable, using ISO 14001 as a change catalyst, on previous studies (Naveh and Marcus, 2004; Naveh and Marcus, 2005; Naveh *et al.*, 2006) that established the reliability of this measure. These studies based their measure on Argote (1999). Items captured included to what extent investment of time and resources in ISO 14001 was a starting point for more advanced practices, was a catalyst for rethinking the way the company does business and as an opportunity to innovate. I used the mean of these three items as my dependent variable.

4.3.2. Independent variables

My independent variables are benefits of certification, importance of environment in corporate strategy, process innovation capability, and customer evaluation and feedback.

Measures for benefits of certification were based on an exploratory factor analysis with varimax rotation of sixteen items. Four distinct factors with eigenvalues greater than 1.00 emerged, explaining 74% of the variance: environmental benefits, relational benefits, market benefits, and internal benefits. Factor scores were used as my measures. Table 1 shows the items that loaded on each factor. The measure for importance of environment in corporate strategy was based on Sharma (2000) and consists of three items such as "my company is an environmental leader in our industry" and "reducing environmental impact of operations is central to our identity". I used the mean of these three items as my measure for process innovation capability.

The measure for process innovation capability consists of four items and is based on (Christmann, 2000). Some of the items are "relative to your major competitors, your facility focuses

on being a leader in process innovation" and "relative to your major competitors, your facility focuses on capital investment in new equipment and machinery". I used the mean of these four items as my measure for process innovation capability.

The measure for customer evaluation and feedback is the mean of two items that assesses the extent to which major customers assess facility's environmental performance through formal evaluations and provide feedback about the results of their evaluations (Christmann and Taylor, 2006).

To demonstrate that my independent variables were distinct constructs, I conducted a Confirmatory Factor Analysis (CFA) using SPSS AMOS 20.0. The results (see Table 2 for the item loadings) revealed good fit to the data, as suggested in the literature (Bentler, 1990; Bollen, 1989): Chi-Squared = 493.432, d.f. = 254, incremental fit index [IFI] = 0.927, comparative fit index [CFI] = 0.925, root mean square error of approximation [RMSEA] = 0.071. All the standardized factor loadings in the model were above 0.61, with most of the loadings in the 0.70s, 0.80s and 0.90s and all were significant ($p<0.001$).

[Insert Table 2 about here]

4.3.3. Control Variables

I controlled for technological change in industry, number of facility employees, facility age, years since certification, and using ISO 14001 in daily practice since these variables could influence the dependent variable.

A rapid pace of technological change in an industry could make it more difficult to implement and maintain management systems as more frequent modification and updates of the documentation are required. Hence, I controlled for the rate of technological change in the industry using a two-item measure based on survey responses. ISO 14001 implementation may require more

effort in large facilities with many employees. Therefore, I controlled for facility size by using the number of employees from the survey responses. Older facilities, as opposed to newer ones, may need to invest more to use ISO 14001 and may find it more difficult to innovate based on the standard. Therefore, I used facility age as a control variable. The amount of time that has passed since obtaining certification would have an impact on the dependent variable and hence I controlled for this. I triangulated the measures for facility size and years since certification using data from the QSU database. I also triangulated the measure for facility age using data from the Dun and Bradstreet database which increases confidence in the use of these measures.

4.4. Data analysis

Means, standard deviations, and correlations for all the variables used in this study are given in Table 3. I used ordinary least squares regression analysis to test my hypotheses. Before performing the regression analysis, I evaluated the likely extent of multicollinearity in my data using some diagnostic tests (Belsley *et al.*, 1980): the largest variance inflation factor is 2.24 well below the recommended cut-off of 10 and the largest condition index is 24.47, below the suggested cutoff of 30, both suggesting that multicollinearity is not a problem in my model. Also, I performed transformations on facility size, facility age and years since ISO certification to satisfy the normality assumption of regression analysis (see Table 1).

[Insert Table 3 about here]

5. Results

Table 4 shows the regression results. In model 1, I included only the control variables. In model 2, I added the independent variables. Adjusted R^2 increased from -0.01 in model 1 to 0.45 in model 2.

Hypothesis 1 suggests that benefits of the implementation of ISO 14001 are positively related to using ISO 14001 as a catalyst for change. This hypothesis is supported. The coefficient for the

factors pertaining to perceived benefits are positive and significant ($p < 0.001$ for environmental benefits, relational benefits, and internal benefits and $p < 0.01$ for market benefits).

Hypothesis 2 suggests that importance of environmental issues in corporate strategy is positively related to using ISO 14001 as a catalyst for change. This hypothesis is supported. The coefficient for this variable is positive and significant ($p < 0.05$).

Hypothesis 3 suggests that process innovation capability is positively related to using ISO 14001 as a catalyst for change. This hypothesis is marginally supported. The coefficient for the process innovation variable is positive and marginally significant ($p < 0.1$).

Hypothesis 4 suggests that customer evaluation and feedback of environmental performance is positively related to using ISO 14001 as a catalyst for change. This hypothesis is marginally supported. The coefficient for this variable is positive and marginally significant ($p < 0.1$).

[Insert Table 4 about here]

6. Discussion

In this study I examined whether it is possible for process-focused management practices, whose focus is on improving an organization's efficiency, to act as catalysts for change enabling using the practices as the basis for further innovations within the organization. I also examined the determinants of this change catalysis in the context of a management practice that is used to manage an organization's environmental activities, namely, the ISO 14001 EMS. Contrary to what has been suggested in the literature that process-focused management practices such as management standards and TQM hinder explorative activities (Benner and Tushman, 2003; Könnölä and Unruh, 2007), I found that change catalysis is possible in the context of ISO 14001. I found that organizations are able to learn during the implementation of ISO 14001 such that the system becomes a starting point for the introduction of innovations and a catalyst for rethinking

the way the organization does business (Naveh and Marcus, 2004; Naveh *et al.*, 2006). I also found that in the context of the ISO 14001 environmental management system, importance of environmental issues in corporate strategy, process innovation capability, benefits of the practice, and customer evaluation and feedback of environmental performance are positively related to change catalysis.

I contribute to the literature in three ways. First, I found that in a novel context, that of ISO 14001, organizations do use it as a catalyst for change, thereby confirming the findings of a limited number of studies that have examined this issue in the context of another process-focused management practice, namely, the ISO 9001 Quality Management Standard (Naveh and Marcus, 2004; Naveh *et al.*, 2006). These studies found that change catalysis is possible in the context of ISO 9000. In my study, I found that it is possible for another management practice, ISO 14001, to be a change catalyst when firms use it as an opportunity for learning that results in fundamentally different ways of operating, with the potential to result in firm-specific competitive advantages.

Process-focused management practices such as ISO 14001 have been considered as administrative innovations (Henriques and Sadorsky, 2007; Naveh *et al.*, 2006). These are innovations that change an organization's structure or its management processes and are only indirectly related to the basic work activity of the organization and more immediately related to its management (Damanpour, 1987). My findings agree with the line of thinking in this literature that administrative innovations such as these can facilitate learning, organizational change and renewal (Birkinshaw *et al.*, 2008; Walker *et al.*, 2011).

Second, the study goes beyond extant studies on change catalysis which have focused largely on the performance consequences of change catalysis (Naveh and Marcus, 2004; Naveh

et al., 2006) by identifying several factors that lead to change catalysis, in the context of ISO 14001. This finding is important as it unpacks the internal and external contexts that facilitate change catalysis and contributes to a better understanding of this phenomenon. In line with what is suggested in the literature on organizational routines (Feldman and Pentland, 2003; Howard-Grenville, 2005), I found internal and external factors that I examined to lead to change catalysis. I found that benefits of the practice, importance of environmental issues in corporate strategy, and process innovation capability, all part of the organizational context were associated with change catalysis based on ISO 14001. If employees perceive the system as advantageous to the firm in terms of the benefits accrued, they are likely to be familiar with the system and therefore have the ability to use it in multiple and innovative ways to solve various issues. It has been found that this type of familiarity with a practice allows employees to be flexible by adapting rules as and when situations change and also allows them to experiment and improvise (Link and Naveh, 2006). These authors give a sports analogy to illustrate this: when practicing, basketball or football players have set plays or standards. During a game, players can move away from these standards by playing in many different ways to suit specific conditions that develop during the game. Similarly, in an organizational context, ISO 14001 calls for setting of rules and allocation of responsibilities. When the need arises, employees can diverge from this and experiment and improvise thereby enabling them to use the system as a catalyst for change.

With regard to importance of the environment in corporate strategy, firms with proactive environmental strategies, as opposed to those with reactive environmental strategies (Hart, 1995; Russo and Fouts, 1997; Sharma and Vredenburg, 1998) accord a high level of importance for the environment in their corporate strategies. Reactive strategies are a response to changes in environmental regulations and stakeholder pressures whereas proactive strategies give

more importance to environmental issues and involve going beyond compliance and requires the firm to acquire and install new technologies that may lead to the development of competitive capabilities (Aragon-Correa and Sharma, 2003; Russo and Fouts, 1997; Sharma and Vredenburg, 1998). This strategy has been associated with competitive advantage for some firms (Hart, 1995; Sharma and Vredenburg, 1998). This study shows that indeed such a proactive environmental strategy is associated with positive consequences such as learning and innovation which enables a firm to derive additional benefits out of the adopted practice.

Also as hypothesized, I found that the capability to innovate in processes is also positively related – albeit with marginal significance - to change catalysis. Such a capability can be considered a complementary capability (Teece, 1986), particularly, a complementary implementation capability (Christmann, 2000) which is a capability that facilitates the implementation of adopted practices. Having such a capability involves having skilled employees with a greater pool of knowledge and better ability to engage in exploration (Lavie *et al.*, 2010) enabling the firm to learn and use the system as a launch pad for additional innovations.

Moreover, I found customer evaluation and feedback, an external factor, to be positively associated with change catalysis. Thus how much customers are concerned with the environmental performance of their suppliers and their deep involvement in it seems to be associated with innovative practices based on ISO 14001, though with lesser significance. Through the above findings, I contribute to a greater understanding of the phenomenon of change catalysis in the context of practice implementation.

Third, studies have found that process-focused management practices such as ISO 9000, ISO 14001, and Total Quality Management are adopted by some firms but only superficially or ceremonially implemented (Boiral, 2003; Christmann and Taylor, 2006; Yeung and Mok, 2005),

one reason being that these firms adopt these practices not for efficiency reasons, but for enhancing their public image and legitimacy. Also, recent research in the environmental management literature suggests that how a firm implements ISO 14001 affects environmental performance outcomes (Aravind and Christmann, 2011; Yin and Schmeidler, 2009). These studies found that higher the quality of implementation, better the environmental performance improvements. Thus even though some firms ceremonially implement the practice, only if substantively implemented can it affect performance dimensions. This study contributes to this literature by showing that implementation can also affect other consequences, those related to learning and innovation. Thus such management practices need not be relegated to practices with no real impact on the actual work of organizations. On the contrary, this study suggests that change catalysis based on management practices can occur if aided by proper organizational and external contexts. If such practices are used as opportunities for learning, firms would be able to operate in fundamentally different ways enabling them to gain a competitive advantage. This should be an incentive for firms to implement practices like the ISO 14001 EMS.

This research has implications for practicing managers. Managers in a firm seeking the best management practices should keep in mind that they can get more out of such practices by using them as learning tools. Practices like ISO 14001 can act as change catalysts when managers create conditions within firms that allow for deeper learning. Such contexts will enable employees to "rethink actions and assumptions in the context of new concepts" that underlie the practice, which present opportunities for having "new conversations, enact new behaviours, develop new skills, and build new relationships" (Carroll *et al.*, 2003: 595). These new conversations, behaviours, and relationships around the new practice will enable learning and innovation, both of which are very important for staying competitive in the marketplace.

Specifically, among the antecedents of change catalysis examined in this study, managers can influence two – process innovation capability and importance of the environment in corporate strategy. But managers have little direct control over the other two – benefits of the practice and customer evaluation and feedback (however, benefits are more likely to occur if the firm implements the practice well so managers should make sure that there are resources and commitment to implement adopted practices well). This study thus suggests that investing in developing innovation capabilities in processes will create a context that supports learning and innovation based on ISO 14001. Further, adopting a proactive environmental strategy and according higher importance to the environment in corporate strategy will enable investing more resources for environmental issues which in turn facilitate search and experimentation (Lavie *et al.*, 2010; Levinthal and March, 1993). When this happens, availability of resources that support innovation in environmental activities and the fact that environmental issues and solutions are more likely to be part of employee knowledge repertoires will support the use for ISO 14001 as the basis for substantial changes within the firm. These changes may allow firms to develop competitive advantages and make them more competitive and profitable in the long run, as indicated by prior research (Naveh and Marcus, 2004; Naveh *et al.*, 2006).

It is worth emphasizing here that even though this study's findings tend to shed a positive light on ISO 14001, the important caveat that needs to be borne in mind is that all adopters of the practice will not automatically gain these positive outcomes. Only those firms that 'go beyond' routine implementation or are able to learn and use the practice as a springboard for more advanced practices will be able to derive these benefits. Such firms will be able to overcome the intertial tendencies that are usually associated with the adoption of process-focused management practices and embrace the potential for practice-related routines to enable double loop learning.

7. Limitations, future research and conclusion

Organizational routines are an important element of organizations (Cyert and March, 1963; Feldman, 2003). The traditional thinking has been that routines are stable and inflexible and are "relatively mindless repetition of actions" (Feldman, 2003: 728). However, more recent research indicates that routines can also be a source of organizational learning, flexibility and change because they are not mindless; but are effortful, emergent accomplishments (Feldman, 2000; Feldman and Pentland, 2003; Howard-Grenville, 2005). In this study, drawing from this literature, I examined factors within the organizational context as well as one factor from the external context that affect change catalysis. Change catalysis is a phenomenon where a firm learns when implementing a practice and the practice becomes a catalyst for additional innovation (Naveh and Marcus, 2004; Naveh et al., 2006), rather than resulting in increasing resistance to change and reduced ability to adapt (or favoring merely exploitative activities to the detriment of more exploratory activities) (Benner and Tushman, 2002, 2003; March, 1991).

Even though I took several measures to reduce common method bias and performed a statistical test to determine its extent, presence of this bias to some extent is a limitation of this study and efforts should be made by future researchers to reduce this bias as much as possible. Also, an interesting extension of this research would be to examine interactions between some of the determinants of change catalysis identified in this study. For example, if a firm has high process innovation capability and it accords high importance to the environment, we could expect higher effect on change catalysis. Interactions such as these should be empirically examined in future studies.

Additionally, a fruitful area of research is implementation of practices such as ISO 14001. There are several studies that have examined adoption of ISO standards and the impact of adoption of such standards on performance (e.g., Darnall, 2006; King et al., 2005). However, even though there are studies on the implementation of administrative innovations such as information systems (e.g., Dong et al., 2008), there are not many studies that examine the implementation of ISO standards (Aravind and Christmann, 2011). This is a serious omission since certification by itself may not have any meaning if firms do not change their behaviours in accordance with the practice. Hence how firms actually implement the practice should be studied. Yet another avenue for future research is to explore other antecedents of change catalysis, thereby contributing to a better understanding of this interesting phenomenon. For instance, agency and power of organizational actors have been suggested as affecting how routines change (Feldman and Pentland, 2003; Howard-Grenville, 2005; Parmigiani and Howard-Grenville, 2011). Agency indicates intentional behaviour by actors involved in the enactment of routines and power indicates the ability of these actors to make changes in routines as part of the routines. These factors could not be investigated in this study but need to be examined in future studies.

Of course, the extent to which learning and innovation happens would differ across firms and therefore the likelihood of using ISO 14001 as a catalyst for change and the extent to which change catalysis occurs would differ across firms. This study is an attempt to understand the contexts where change catalysis is more likely to happen. A conclusion of this study is that under the right conditions, implementation of ISO 14001 can have positive outcomes such as learning and innovation. Therefore implementation of ISO 14001 and other such process-focused management practices deserves more research attention.

Acknowledgements

I would like to thank the Technology Management Research Center (TMRC), Rutgers Business School – Newark and New Brunswick, New Jersey and Resources for the Future, Washington, D.C. for financially supporting this study. I thank Petra Christmann and Fariborz Damanpour for helpful comments on previous versions of the paper. I also thank the editor and two anonymous reviewers for insightful comments on earlier drafts of this paper.

References

Aragon-Correa, J.A. and Sharma, S., 2003. A contingent resource-based view of proactive corporate environmental strategy. Academy of Management Review, 28 (1): 71-88.

Aravind, D. and Christmann, P., 2011. Decoupling of standard implementation from certification: Does quality of ISO 14001 implementation affect facilities' environmental performance? Business Ethics Quarterly, 21 (1): 75-104.

Argote, L., 1999. Organizational Learning: Creating, Retaining and Transferring Knowledge. Kluwer, Norwell, MA, 212 pp.

Argyris, C. and Schon, D., 1978. Organisational Learning: A Theory of Action Perspective. Addison Wesley, Reading, Massachusetts, 356 pp.

Ashforth, B.E. and Fried, Y., 1988. The mindlessness of organizational behaviors. Human Relations, 41 (4): 305-329.

Auh, S. and Menguc, B., 2005. Balancing exploration and exploitation: The moderating role of competitive intensity. Journal of Business Research, 58 (12): 1652-1661.

Belsley, D.A., Kuh, E. and Welsch, R.E., 1980. Regression Diagnostics. Wiley, New York, 320 pp.

Benner, M.J. and Tushman, M.L., 2002. Process management and technological innovation: A longitudinal study of the photography and paint industries. Administrative Science Quarterly, 47 (4): 676-706.

Benner, M.J. and Tushman, M.L., 2003. Exploitation, exploration, and process management: The productivity dilemma revisited. Academy of Management Review, 28 (2): 238-256.

Bentler, P. M., 1990. Comparative fit indexes in structural models. Psychological Bulletin 107, 238–246.

Birkinshaw, J., Hamel, G. and Mol, M.J., 2008. Management innovation. Academy of Management Review, 33 (4): 825-845.

Boiral, O., 2003. ISO 9000: Outside the iron cage. Organization Science, 14 (6): 720-737.

Boiral, O. and Roy, M.-J., 2007. ISO 9000: integration rationales and organizational impacts. International Journal of Operations & Production Management, 27 (2): 226-247.

Bollen, K. A., 1989. Structural equations with latent variables. New York, Wiley, 514 pp.

Campbell, D.T., 1955. The informant in quantitative research. American Journal of Sociology, 60 (4): 339-342.

Carroll, J.S., Rudolph, J.W. and Hatakenaka, S., 2003. Learning from organizational experience. In: Easterby-Smith, M., Lyles, M.A. (Eds.), The Blackwell Handbook of Organizational Learning and Knowledge Management. Blackwell Publishing, Oxford, 696 pp.

Christmann, P., 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. Academy of Management Journal, 43 (4): 663-680.

Christmann, P. and Taylor, G., 2006. Firm self-regulation through international certifiable standards: Determinants of symbolic versus substantive implementation. Journal of International Business Studies, 37 (6): 863-878.

Cohen, W.M. and Levinthal, D.A., 1990. Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, 35 (1): 128-152.

Cooper, R.B. and Zmud, R.W., 1990. Information technology implementation research: A technology diffusion approach. Management Science, 36 (2): 123-139.

Crampton, S.M. and Wagner, M.A., 1994. Percept-percept inflation in microorganizational research. Journal of Applied Psychology, 79: 67-76.

Cyert, R.M. and March, J.G., 1963. A behavioral theory of the firm. Prentice Hall, Englewood Cliffs, NJ, 332 pp.

Damanpour, F., 1987. The adoption of technological, administrative, and ancillary innovations: Impact of organizational factors. Journal of Management, 13: 675-688.

Darnall, N., 2006. Why firms mandate ISO 14001 certification. Business & Society, 45 (3): 354-381.

Darnall, N. and Sides, S., 2008. Assessing the Performance of Voluntary Environmental Programs: Does Certification Matter? The Policy Studies Journal, 36 (1): 95-117.

Dillman, D.A., 2000. Mail and Internet Surveys: The Tailored Design Method. John Wiley and Sons, New York, NY, 464 pp.

Dodgson, M., 1993. Organizational learning: A review of some literatures. Organization Studies, 14 (3): 375-394.

Dong, L., Neufeld, D. J. and Higgins, C., 2008. Testing Klein and Sorra's innovation implementation model: An empirical examination. Journal of Engineering & Technology Management, 25 (4): 237-255.

Dutton, J.E. and Dukerich, J.M., 1991. Keeping an eye on the mirror: Image and identity in organizational adaptation. Academy of Management Journal, 34 (3): 517.

Edmondson, A.C., Bohmer, R.M. and Pisano, G.P., 2001. Disrupted routines: Team learning and new technology implementation in hospitals. Administrative Science Quarterly, 46 (4): 685-716.

Eisenhardt, K.M. and Tabrizi, B.N., 1995. Accelerating adaptive processes: Product innovation in the global computer industry. Administrative Science Quarterly, 40 (1): 84-110.

Feldman, M.S., 2000. Organizational routines as a source of continuous change. Organization Science, 11 (6): 611-629.

Feldman, M.S., 2003. A performative perspective on stability and change in organizational routines. Industrial & Corporate Change, 12 (4): 727-752.

Feldman, M.S. and Pentland, B.T., 2003. Reconceptualizing organizational routines as a source of flexibility and change. Administrative Science Quarterly, 48 (1): 94-118.

Fowler Jr., F.J.S., 1993. Survey Research Methods. Sage, Newbury Park, CA, 156 pp.

Gilson, L.L., Mathieu, J.E., Shalley, C.E. and Ruddy, T.M., 2005. Creativity and standardization: Complementary or conflicting drivers of team effectiveness? Academy of Management Journal, 48 (3): 521-531.

Greve, H.R. and Taylor, A., 2000. Innovations as catalysts for organizational change: Shifts in organization cognition and search. Administrative Science Quarterly, 45 (1): 54-80.

Hannan, M.T. and Freeman, J.R., 1984. Structural inertia and organizational change. American Sociological Review, 29: 149-164.

Hart, S.L., 1995. Natural-resource-based view of the firm. Academy of Management Review, 20 (4): 986-1014.

Henriques, I.and Sadorsky, P., 2007. Environmental technical and administrative innovations in the Canadian manufacturing industry. Business Strategy and the Environment, 16 (2): 119-132.

Heras, I., Landin, G.A. and Molina, J.F., 2009. Do drivers matter for the benefits of ISO 14001? International Journal of Operations & Production Management, 31 (2): 192-215.

Howard-Grenville, J., 2005. The persistence of organizational routines: The role of agency and organizational context. Organization Science, 16 (6): 618-636.

ISO, 2004. The ISO survey - 2004. ISO, Geneva.

Jiang, R.J. and Bansal, P., 2003. Seeing the need for ISO 14001. Journal of Management Studies, 40 (4): 1047-1067.

John, G. and Reve, T., 1982. The reliability and validity of key informant data from dyadic relationships in marketing channels. Journal of Marketing Research, 19: 517-525.

King, A.A., Lenox, M.J. and Terlaak, A., 2005. The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard. Academy of Management Journal, 48 (6): 1091-1106.

Könnölä, T. and Unruh, G.C., 2007. Really Changing the Course: The limitations of Environmental Management Systems for innovation, Business Strategy and the Environment, 16 (8): 525-537.

Lavie, D., Stettner, U. and Tushman, M.L., 2010. Exploration and exploitation within and across organizations. Academy of Management Annals, 4 (1): 109-155.

Levinthal, D.A. and March, J.G., 1993. The myopia of learning. Strategic Management Journal, 14 (S2): 95-112.

Lindell, M. K. and Whitney, D. J., 2001. Accounting for common method variance in cross-sectional research designs. Journal of Applied Psychology, 86 (1): 114–121.

Link, S. and Naveh, E., 2006. Standardization and discretion: Does the environmental standard ISO 14001 lead to performance benefits? IEEE Transactions on Engineering Management, 53 (4): 508-519.

March, J.G., 1991. Exploration and exploitation in organizational learning. Organizational Science, 2 (1): 71-87.

Marimon, F., Llach, J., and Bernardo, M., 2011. Comparative analysis of diffusion of the ISO 14001 standard by sector of activity. Journal of Cleaner Production, 19 (15): 1734-1744.

Melnyk, S.A., Sroufe, R.P. and Calantone, R., 2003. Assessing the impact of environmental management systems on corporate and environmental performance. Journal of Operations Management, 21 (3): 329-351.

Mohr, J. and Spekman, R., 1994. Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques. Strategic Management Journal, 15: 135-152.

Murray, J. Y., Kotabe, M. and Zhou, J. N., 2005. Strategic alliance-based sourcing and market performance: Evidence from foreign firms operating in China. Journal of International Business Studies, 36 (2): 187–208.

Naveh, E. and Marcus, A., 2005. Achieving competitive advantage through implementing a replicable management standard: Installing and using ISO 9000. Journal of Operations Management, 24 (1): 1-26.

Naveh, E. and Marcus, A.A., 2004. When does the ISO 9000 quality assurance standard lead to performance improvement? Assimilation and going beyond. IEEE Transactions on Engineering Management, 51 (3): 352-363.

Naveh, E., Meilich, O. and Marcus, A.A., 2006. The effects of administrative innovation implementation on performance: An organizational learning approach. Strategic Organization, 4 (3): 275-302.

Orlikowski, W.J. and Hofman, D.J., 1997. An improvisational model for change management: The case of groupware technologies. Sloan Management Review, 38 (2): 11-21.

Parmigiani, A. and Howard-Grenville, J., 2011. Routines Revisited: Exploring the Capabilities and Practice Perspectives. Academy Of Management Annals, 5: 413-453.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P., 2003. Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88 (5): 879.

QSU, 2006. ISO 14001 Worldwide Certified Company Directory. QSU Publishing Company, Fairfax.

Real, K. and Poole, M.S., 2005. Innovation implementation: Conceptualization and measurement in organizational research. Research in Organizational Change and Development, 15: 63-134.

Russo, M.V., 2001. Institutional change and theories of organizational strategy: ISO 14001 and toxic emissions in the electronics industry. In: Nagao, D. (Ed.), Best Papers Proceedings of the Academy of Management, Washington, DC.

Russo, M.V. and Fouts, P.A., 1997. A resource-based perspective on corporate environmental performance and profitability. Academy of Management Journal, 40 (3): 534-559.

Sharma, S., 2000. Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. Academy of Management Journal, 43 (4): 681-697.

Sharma, S. and Vredenburg, H., 1998. Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. Strategic Management Journal, 19: 729-753.

Sitkin, S.B., Sutcliffe, K.M. and Schroeder, R.G., 1994. Distinguishing control from learning in Total Quality Management: A contingency perspective. Academy of Management Review, 19 (3): 537-564.

Teece, D., 1986. Profiting from innovation: Implications for integrity, collaboration, licensing, and public policy. Research Policy, 15: 295-305.

Tushman, M.L. and O'Reilly, C.A., 1996. Ambidextrous organizations: Managing evolutionary and revolutionary change. California Management Review, 38 (4): 8-29.

Vastag, G. and Melnyk, S.A., 2002. Certifying environmental management systems by the ISO 14001 standards. International Journal of Production Research, 40 (18): 4743-4763.

von Hippel, E., 1988. The Sources of Innovation. Oxford University Press, New York, 218 pp.

Walker, R.M., Damanpour, F. and Devece, C.A., 2011. Management innovation and organizational performance: The mediating effect of performance management. Journal of Public Administration Research & Theory, 21 (2): 367-386.

Yeung, G. and Mok, V., 2005. What are the impacts of implementing ISOs on the competitiveness of manufacturing industry in China? Journal of World Business, 40 (2): 139-157.

Yin, H. and Schmeidler, P., 2009. Why do standardized ISO 14001 environmental management systems lead to heterogeneous environmental outcomes? Business Strategy and the Environment, 18 (7): 469-486.

Zmud, R.W. and Apple, L.E., 1992. Measuring Technology Incorporation/Infusion. Journal of Product Innovation Management, 9 (2): 148-155.

Table 1. Indicators for construct measurement.

Construct	*Indicator*	*Cronbach's alpha*
Using ISO 14001 as a change catalyst	This question pertains to the implementation and perceptions of the ISO 14001 EMS at your facility. To what extent ('not at all' to 'a large extent'): a) was investment of time and resources in ISO 14001 a starting point for other more advanced practices? b) was investment of time and resources in ISO 14001 a catalyst for rethinking the way you do business? c) was investment of time and resources in ISO14001understood as an opportunity to innovate?	0.86
Process innovation capability	Relative to your major competitors, your facility focuses on ('strongly disagree to 'strongly agree''): a) being the first in the industry to try new methods and technologies b) using the latest technology in production c) capital investment in new equipment and machinery d) being a leader in process innovation	0.87
Importance of environment	Importance of environmental issues for your company ('strongly disagree to 'strongly agree''): a) My company is an environmental leader in our industry b) Reducing environmental impact of operations is central to our identity c) Environmental performance is critical for our company's success	0.90
Benefits	Which of the following specific benefits has your facility achieved from ISO 14001certification? ('no benefits' to 'extensive benefits')	
Environmental benefits	a) Improved compliance with environmental regulations b) Improved environmental performance c) Reduced environmental risks d) Reduced cost e) Prevention of environmental problems f.) Discovery of improvement opportunities	0.91
Relational benefits	a) Improved relations with regulatory authorities b) Improved relations with communities c) Improved corporate image d) Improved facility image	0.89
Market benefits	a) Increased customer satisfaction b) Access to export markets c) Increased market share	0.83

Internal benefits	a) Improved internal procedures b) Increased productivity c) Improved employee awareness	0.74
Customer evaluation & feedback	To what extent do your major customers: a) assess your facility's environmental performance through formal evaluations b) provide you with feedback about the results of their evaluations	0.93
Technological Change in Industry	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	0.71
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 QSU database)	-
Facility age	Square root of facility age Survey question: Approximately, in which year was your facility built? (Triangulated with data from Dun and Bradstreet database)	-
Years since certification	Square root of the number of years since initial ISO 14001 certification, based on the response to the survey question: In which year did your facility first obtain ISO 14001 certification? (Triangulated with data from QSU database)	-

All survey items are scaled on a 7-point scale unless otherwise noted.

Table 2. Results of Confirmatory Factor Analysis - Item loadings: Independent variables

		Factors						
No.	Independent variables	1	2	3	4	5	6	7
	Process innovation capability							
1	Relative to your major competitors, your facility focuses on being a leader in process innovation	.755						
2	capital investment in new equipment and machinery	.755						
3	using the latest technology in production	.893						
4	being the first in the industry to try new methods and technologies	.775						
	Importance of environment							
5	Environmental performance is critical for our company's success		.857					
6	Reducing environmental impact of operations is central to our identity		.924					
7	My company is an environmental leader in our industry		.855					
	Environmental benefits							
8	Discovery of improvement opportunities			.767				
9	Prevention of environmental problems			.866				
10	Reduced cost			.639				
11	Reduced environmental risks			.912				
12	Improved environmental performance			.876				
13	Improved compliance with environmental regulations			.739				
	Relational benefits							
14	Improved facility image				.863			
15	Improved corporate image				.819			
16	Improved relations with communities				.790			
17	Improved relations with regulatory authorities				.772			
	Market benefits							
18	Increased market share					.935		
19	Access to export markets					.834		
20	Increased customer satisfaction					.613		
	Internal benefits							

21	Improved employee awareness	.639	
22	Increased productivity	.686	
23	Improved internal procedures	.752	
	Customer evaluation and feedback		
24	To what extent do your major customers: provide you with feedback about the results of their evaluations		.963
25	assess your facility's environmental performance through formal evaluations		.893

Table 3. Means, Standard Deviations, and Pearson Correlations.[a]

	Variables	Mean	sd	1	2	3	4	5	6	7	8	9	10	11	12
1	Using ISO as a change catalyst	3.63	1.34	1											
2	Technological change	4.52	1.37	.01	1										
3	Facility size[b]	2.37	.47	-.04	.22**	1									
4	Facility age[c]	5.37	1.88	.04	-.12	.25**	1								
5	Years since certification[c]	2.21	.50	.05	.08	.25**	.12	1							
6	Environmental benefits	.02	.99	.32**	.12	.16*	.00	.04	1						
7	Relational benefits	.01	1.01	.35**	.01	-.14	.06	.06	.002	1					
8	Market benefits	.01	.99	.17*	.29**	.08	-.04	.19**	-.018	-.01	1				
9	Internal benefits	-.01	.99	.41**	.02	.01	-.02	.06	-.010	.02	.02	1			
10	Importance of environment	4.89	1.40	.27**	.27**	.09	-.07	.17*	.17*	.24**	.04	.04	1		
11	Process innovation	4.93	1.19	.54**	.11	.05	.03	.16*	.20**	.42**	.06	.48**	.47**	1	
12	Customer evaluation	2.23	1.48	.24**	.21**	.05	.05	.08	.02	.16*	.33**	.11	.03	0.17*	1

** $p < 0.01$ level (2-tailed)
* $p < 0.05$ level (2-tailed)
[a] n = 192
[b] log transformation
[c] Square root transformation

Table 4. Results of Regression Analysis.[a]

	Dependent variable: Using ISO 14001 as a change catalyst	
	Model 1	**Model 2**
Control variables		
Technological change	.02 (.07)	-.14* (.06)
Facility size [b]	-.20 (.23)	-.15 (.18)
Facility age [c]	.04 (.05)	.03 (.04)
Years since certification [c]	.17 (.20)	-.16 (.15)
Independent variables		
Environmental benefits		.39*** (.07)
Relational benefits		.30*** (.08)
Market benefits		.24** (.08)
Internal benefits		.41*** (.09)
Importance of environment		.17* (.08)
Process innovation		.12† (.07)
Customer evaluation & feedback		.10† (.05)
F-Test	.37	14.05***
R^2	.01	.48
Adjusted R^2	-.01	.45

[a] n = 192. Values are unstandardized coefficients.
[b] log transformation
[c] Square root transformation
† p<.10 * p<.05 ** p<.01 *** p<.001 (all two-tailed tests)