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Using ISO 14001 to Promote a Sustainable Supply Chain Strategy

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ABSTRACT
Formally adopted in 1996 by the International Organization of Standardization, ISO 14001 represents a voluntary international environmental standard, which will likely be adopted by a vast majority of corporations. Its major focus is on the structure, implementation and maintenance of a formal environmental management system. Despite its international acceptance, ISO 14001 is surrounded by controversy and criticism. The literature is clearly divided in its assessment of ISO 14001, which is viewed as a variant of total quality environmental management or a paper-driven process of limited value. In this study, case-based research is used to address the competing views of the standard to show that ISO 14001 registration can be leveraged across the supply chain into a competitive advantage. By looking at ISO 14001 registered firms, we compare different amounts of integration and sustainability in the supply chain. We then posit several research propositions to provide an empirical framework for the impacts of ISO 14001 on supply chain design and how it will evolve in the future. Copyright © 2010 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

SUPPLY CHAIN MANAGEMENT REPRESENTS A SIGNIFICANT PARADIGM SHIFT OF MODERN BUSINESS MANAGEMENT BY recognizing that individual businesses compete no longer as solely autonomous entities, but rather as supply chains (Lambert and Cooper, 2000). This same paradigm shift is taking place on social attributes in that a company's environmental impact goes far beyond the manufacturing of a product or delivery of a service. Other supply chain members play an important part in the life cycle and total environmental impacts of a product. Traditional ways of dealing with environmental issues in a reactive, ad hoc, end-of-pipe manner have proven to be highly inefficient. Only a properly implemented environmental management system (EMS) and

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sustainability strategy can provide protection from short-term thinking, which does not have long-term benefits. Yet, daily details can impede an organization's long-term sustainability goals unless some formal EMS clearly sets the requirements as a standard for daily activities (Logsdon, 1985; Carpenter, 1991; Willig, 1994; Bhat, 1998; Angell and Klassen, 1999; Melnyk *et al.*, 2001; Curkovic, 2003; Darnall *et al.*, 2008). The difficulty for many firms starts with defining their own sustainability goals and then integrating these goals into their strategy and supply chain (Handfield *et al.*, 2005). The Institute of Supply Management (ISM) defines sustainability as 'the Triple Bottom Line – the integration of social, environmental, and economic objectives' (ISM, 2008). While this definition is generalizable, its ambiguity can be a hindrance to firms looking for a standardized approach to measuring and monitoring the bottom line.

Supply chain design is integral in order for an organization to accomplish its EMS and sustainability goals. Choosing to partner with suppliers that have policies supporting an organization's EMS is at the heart of effectively implementing a sustainability strategy. Supply network structure can help support such a strategy and be characterized as emphasizing non-power based relationships and inter-firm coordination as well as the informal social systems that are linked through a network of relations (Chen and Paulraj, 2004). However, in a study by A.T. Kearney and the Institute of Supply Management, only around 60% of the 25 Fortune 100 companies surveyed had a documented corporate sustainability strategy, and only 36% had a formal sustainability strategy for the supply chain management organization (Cooling, 2007). This same study states that the goal of a sustainable supply chain on the whole is to move away from goods and services that negatively impact the environment, and instead foster a marketplace that embraces environmental principles. The question for many companies is how to develop internal controls that meet environmental needs of their own processes and the needs of the supply chain. The more companies purchase from sustainable suppliers, the greater the integration of sustainable practices throughout a supply chain. Such activity stimulates the supply chain to take proactive measures that will increase their chances of working with responsible, economically viable organizations. A registered EMS is one way in which firms can move toward sustainable supply chain design.

Holt (2004) examined the supplier management activities undertaken by 149 UK based organizations and found that only 49% even considered environmental issues in purchasing, and all but one did so as only a secondary consideration. Only 28% used formal green purchasing guidelines, and outreach programs were the amongst the least frequent actions undertaken, with only 15% running workshops for suppliers and 12.5% actually visiting suppliers to assist them to improve environmental performance. Supply chain design will require organizations to develop a process that will formally leverage the supply base into a competitive advantage by supporting environmental management (Green, Morton, and New, 1998) or a sustainability strategy.

Such a systematic approach to environmental management is at the heart of a formal assessment process such as ISO 14001. The standard was designed to achieve a full integration of environmental and business management and enable companies and their supply chains to take a more proactive approach towards managing environmental issues (Willig, 1994; Bhat, 1998; Lally, 1998; Montabon *et al.*, 2000; Corbett and Klassen, 2006; Vachon and Klassen, 2006; Linton *et al.*, 2007; Gonzalez-Benito and Gonzalez-Benito, 2008; Kannan *et al.*, 2008; Vachon and Klassen, 2008). Registrations issued worldwide are estimated at more than 130 000. There are now companies in over 130 countries that have endorsed the ISO 14001 standard. By the end of 2008, there were over 8000 registered sites in the US alone (Peglau, 2008). During the past few years, Ford Motor Company, General Motors and Chrysler have told all of their suppliers with manufacturing facilities to become ISO 14001 registered (Briggs, 2007). This requirement has affected thousands of production and non-production suppliers (Zuckerman, 2000, 2001; Wilson, 2001, 2002; Briggs, 2007). In 1999, Former President Clinton signed an executive order that declared that all federal facilities are to have a fully implemented EMS by the end of 2005. This decision alone affected 16 departments of the executive branch. Furthermore, according to the Environmental Protection Agency (EPA), an organization convicted of a noncompliance is entitled to a reduced penalty if it can show that it had an effective EMS in place (e.g. ISO 14001) at the time of the violation (Abarca, 1998; Bhat, 1998; Lally, 1998). It has also become an order qualifier in the European Union, and Japan actually has the most registered sites, with over 21 000 (Shin and Chen, 2000; Darnall, 2006; Darnall *et al.*, 2008). ISO 14001 is rapidly becoming the nationally and internationally accepted environmental standard.

A major reason for the increasing acceptance of ISO 14001 involves the perceived benefits associated with the registration process. The benefits are related to the direct advantages of an effective EMS and sustainability

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strategy combined with the potential of keeping current and obtaining new business. The likely benefits include the following: improved environmental performance, improved internal management methods, improved stakeholder satisfaction, avoiding a potential non-tariff trade barrier, competitive advantage in certain markets, fewer regulatory inspections, reduced overhead costs, probable reduction in regulatory noncompliance and associated fines, improved access to capital and reduced capital costs, reductions in insurance costs and improved company image (Beagley, 1996; Handfield *et al.*, 1997; Abarca, 1998; Darnall, 2006; Albuquerque *et al.*, 2007; Darnall *et al.*, 2008; Gonzalez-Benito and Gonzalez-Benito, 2008). Additional benefits should include an increased capacity to go beyond waste reduction and ad hoc approaches to more proactive approaches to measuring and managing sustainable systems.

Despite the perceived benefits, ISO 14001 is surrounded by uncertainty, controversy and criticism (King *et al.*, 2005; Potoski and Prakash, 2005a, 2005b). A widespread criticism of the ISO 14001 program is that it is not connected directly enough to environmental performance. For example, a registered company can still have substandard processes and waste streams because registration does not tell a company how to improve efficiency and pollute less (Mroz, 1997; Abarca, 1998; Montabon *et al.*, 2000; Landon, 2003). Registration also does not require that firms demonstrate compliance and that their stakeholders are satisfied (Clark, 1999; Scott, 1999; Vastag *et al.*, 2004; Curkovic *et al.*, 2005). Additionally, a focus on documentation has forced some managers to view ISO 14001 as another documentation-driven process for bureaucrats to approve, and the paper-trail itself becomes a liability for non-compliance issues.

An examination of this international environmental standard was inspired by recent visits to a number of manufacturing facilities. Comments from managers in our study mirror previous findings in the literature. Some say it has hindered the firm, while others praise its process improvements to the firm and its suppliers. Others are undecided on ISO 14001 and its impact on supply chain design or performance.

There is yet to be any research on the state of EMSs in supply chain management and the roles of customers in driving this by requiring registrations such as ISO 14001. No existing frameworks for the environment and supply chain management stress the importance of relationships, communication, agility, speed and supplier selection, to name a few. Furthermore, no research has focused on the strategic aspects of EMS programs and the use of international standards for supplier selection and supply chain performance. Thus, a lack of consensus exists regarding what effects ISO environmental standards have on sustainability goals and supply chain performance.

Given a lack of research on strategic frameworks and environmental standards, the primary objective of this study is to explore the implications of ISO 14001 adoption within supply chains. The aim is to build theory in sustainability and supply chain management. Before exploring the factors that influence the decision to adopt the international environmental standard, we first review the relevant literature regarding ISO 14001 standards. We then reveal insights from multiple site visits and develop several research propositions. Finally, the article concludes with an evaluation of ISO 14001 and its benefits, and offers suggestions on how sustainable supply chain theory should be expanded for future research.

What Is ISO 14001?

ISO 14001 was published on 1 September 1996, and provides the basic framework for the establishment of an EMS. The International Organization of Standardization (headquartered in Geneva, Switzerland) defines an EMS as that part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining an environmental policy (Abarca, 1998; Corbett, 2006; Darnall, 2006; Darnall *et al.*, 2008). The five requirements of ISO 14001 include formation of a corporate environmental policy and commitment to an EMS, development of a plan for implementation, implementation and operation of the EMS, monitoring and possible corrective action, and top management review and continuous improvement (Lally, 1998; Curkovic *et al.*, 2005; Darnall, 2006; Albuquerque *et al.*, 2007; Darnall *et al.*, 2008). Basically, the corporation must say what it is going to do, how it is going to do it, who is going to do it and by when it is going to get done. More concretely, the corporation must designate responsibility for achieving objectives and targets at each relevant function and level, provide the means for fulfilling the objectives and targets, and designate a time frame

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within which they will be achieved (Clark, 1999; Abarca, 1998; Rowland-Jones *et al.*, 2005; Albuquerque *et al.*, 2007).

The scope of ISO 14001 excludes test methods for pollutants, setting limit values regarding pollutants and effluents, setting environmental performance levels, and the standardization of products. ISO 14001's EMS standards are management tools and process standards. Note that it is not a performance standard. In other words, these standards do not tell organizations what environmental performance they must achieve. Instead, the standards describe a system that will help an organization to achieve its own objectives. The assumption is that better environmental management will lead to improved environmental performance (Tibor and Feldman, 1996; Handfield *et al.*, 1997; Curkovic *et al.*, 2005; Viadiu *et al.*, 2006; Darnall *et al.*, 2008; Kannan *et al.*, 2008).

In designing the ISO 14001 specifications for an EMS, the intent was to create a generic model that could be applied by any type and size of organization. The standards can be implemented within the whole organization or only in specific parts; they are not industry or sector specific. However, it must be emphasized that the implementation of a system alone cannot guarantee environmental excellence or even compliance. Furthermore, ISO 14001 specifically excludes operational health and safety issues, but they are touched upon in certain elements of the standard. Companies are not limited to the content of ISO 14001 when implementing their EMS. These merely represent the minimal requirements for registration against the ISO 14001 EMS standard (Beagley, 1996; Abarca, 1998; Berthelot and Coulmont, 2004; Albuquerque *et al.*, 2007).

ISO 14001 is the only specification standard in the series. This means that a company can only be registered against this standard. As with ISO 9000, registration allows a company to convey to its consumers, investors, insurers, suppliers and government that it has successfully implemented an EMS. To become ISO 14001 registered, an entity can either self-declare or undergo a third party audit. In the case of a third party audit, the auditor is given the discretion to make this recommendation to the registering body (Clark, 1999; Zuckerman, 2000, 2001; Curkovic *et al.*, 2005).

ISO 14001 provides the core requirements for developing and implementing an EMS. All the other documents in the series are guidance standards, intended for use as internal management tools by an organization. For example, ISO 14004 provides practical advice for an organization on implementing and enhancing the EMS. ISO 14004 includes examples, descriptions and options that aid both in the implementation of an EMS and in strengthening its relation to the overall management of the organization (Hale, 1997; Mroz, 1997; Curkovic *et al.*, 2005). Table 1 describes the six groups of standards in the series.

Research on supply chain design and ISO 14001 published in refereed journals is still growing (Beamon, 1999; Kitazawa and Sarkis, 2000; King *et al.*, 2005; Potoski and Prakash, 2005a; Darnall, 2006; Simpson *et al.*, 2007; Cheng *et al.*, 2008). Anecdotal examples of implementation issues exist, but these are isolated and limited to a few companies (Beagley, 1996; Abarca, 1998; Zuckerman, 2000, 2001; Montabon *et al.*, 2000; Landon, 2003; Albuquerque *et al.*, 2007).

Criticisms of ISO 14001

The literature identifies several critical areas of an EMS that are not included in the ISO 14001 requirements (Beagley, 1996; Abarca, 1998; Zuckerman, 2000, 2001; Montabon *et al.*, 2000; Curkovic *et al.*, 2005; Singh *et al.*,

Organizational evaluation	Product evaluation
Environmental management systems	Environmental labeling
ISO 14001 and ISO 14004	ISO 14021–1402X
Environmental auditing	Life cycle assessment
ISO 14010–14012 and ISO 14015	ISO 14040–14043
Environmental performance evaluation	Guide for the inclusion of environmental aspects of product standards
ISO 14031	ISO Guide 64
Terms and definitions	
ISO 14050	

Table 1. Breakout of ISO 14000 series standards

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2008). The main criticisms center on a limited focus on continuous improvement, the cost of registration, the ability of a registered company to still produce large amounts of waste and the amount of seemingly unnecessary documentation.

The concerns and objections to ISO 14001 center on several critical points. First, there is concern that the benefits offered by EMSs such as ISO 14001 may not be sufficient to offset the costs incurred in meeting the requirements of the program (Epstein, 1996; Stanwick and Stanwick, 1998; Theyel, 2000; King and Lenox, 2001; Curkovic *et al.*, 2005; Judge and Elenkov, 2005; Albuquerque *et al.*, 2007; Padma *et al.*, 2008). The second point involves the relationship between environmental and corporate performance. To date, unlike ISO 9000, which focused on quality (and where quality was shown to have a strong impact on corporate performance), there has not been strong evidence that shows that there is a strong positive relationship between improved environmental performance and strong corporate performance (Florida, 1996; Porter, 1991; Porter and Van der Linde, 1995; Rothenberg *et al.*, 2001; Zhu and Sarkis, 2004; Albuquerque *et al.*, 2007). Research and support has also been very limited on the supply chain management's role in improved environmental performance (Min and Galle, 1997; Carter and Carter, 1998; Carter *et al.*, 1998; Green *et al.*, 1998, Min and Galle, 2001; Holt, 2004; Rao and Holt, 2005; Rao, 2002; Melnyk *et al.*, 2003; Corbett and Klassen, 2006; Linton *et al.*, 2007; Kannan *et al.*, 2008; Padma *et al.*, 2008). As a result, many managers are hesitant to pursue EMSs and ISO 14001 registration because they are not sure of the cost–benefit trade-off (Jimenez and Lorente, 2001; Russo and Harrison, 2005; Albuquerque *et al.*, 2007; Darnall *et al.*, 2008). In the steel industry, for example, ISO 14001 is too general to meet the more restrictive requirements forced from EPA regulators. Complying with the standard and duplication of record-keeping is costly and makes it even more difficult to produce steel profitably in the US (Zuckerman, 2000, 2001; Singh *et al.*, 2008). In addition, because ISO 14001 is so new, there is a great deal of confusion and uncertainty surrounding it. Some managers may elect to wait until others have undergone ISO 14001 registration before proceeding or until customers demand it. Finally, there must be diligent documentation and communication, which implies a legal disclosure problem that is far from resolved in the US legal system (Abarca, 1998; Zuckerman, 2000, 2001; Mathews, 2004).

Several organizations in the US have embraced ISO 14001 and numerous other initiatives such as TQEM in a massive effort to improve environmental performance. However, US firms are under the misconception that ISO 14001 registration is the foundation for a TQEM program. Studies that have critically examined ISO 14001 determined that the criteria are really a subset of the requirements for full implementation of a TQEM program. Therefore, the motivation and drive to improve competitiveness can be severely undermined if conformity efforts are not integrated within a broader, all encompassing management framework such as TQEM. Thus, ISO 14001 is only a critical first step in implementing a TQEM system.

Members of the ISO standards committee have agreed with users that the ISO 14001 series is not connected directly enough to performance standards. It is possible to have an ISO 14001 system and still produce waste and be out of compliance. ISO 14001 requirements are such that a reactive organization could become registered. A registered company could have very high levels of inefficiency; however, if the waste was handled in accordance with documented corrective action procedures, the company could still be registered.

The costs and implementation issues such as time and lack of regulation have also been criticisms of ISO 14001 (Hervani *et al.*, 2005; Sebhatu and Enquist, 2007). Even ardent supporters of ISO 14001 have accused the standards of being too costly and time consuming. A company can spend up to 18 months, and seven man years, getting a single site ready for an audit. Registrars can then be on site for up to one week, randomly testing salaried and hourly personnel. The cost of an audit for a small company is approximately $50 000. This does not include training costs, which may range as high as $100 000–$200 000 for a medium-sized facility. The expense to prepare a medium-sized plant for registration could be as low as $50 000, and as high as $1 000 000.

The time also varied from six months to two years. Moreover, the process does not even end when the registration is issued. The process is repeated every three years, with less comprehensive audits occurring every 6 months to a year.

ISO 14001 has been criticized for its failure to assess the extent to which a company's planning processes and environmental requirements are integrated into the firm's overall business planning. This criterion is particularly important for companies evaluating a supplier for a potential long-term partnering relationship. Furthermore, no set of ISO 14001 criteria is developed around the appropriateness of investments (e.g. their timing, degree of activity, level of investment etc.) based on the total needs and strategic position of the company.

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ISO 14001 fails to address a company's approach to selecting data and information for competitive comparisons and world-class benchmarks to support environmental and performance planning. Perhaps more importantly, ISO 14001 does not make any explicitly recognizable provisions for continuous improvement. Companies do not even have to include performance goals (Corbett and Klassen, 2006; Linton *et al.*, 2007; Kannan *et al.*, 2008; Padma *et al.*, 2008).

ISO 14001 does not explicitly address customer-driven organizations. ISO 14001 makes no provisions for how the company uses information gained from customers to improve customer relationship management strategies and practices. However, it is customers who have made ISO 14001 registration the international standard it is. The main reason that companies become ISO 14001 registered is because their customers are demanding it. Earning a registration is attractive because it promises to be a cost-effective way to stay in a stakeholder's good graces or gain a place on a customer's bid list. ISO 14001 registration is often a minimal standard for a company to be registered as a supplier to major industrial customers. Many small and mid-sized companies in the US are complaining that the ISO 14001 system of third-party assessment places the cost squarely on them and they would not even pursue ISO 14001 registration without pressure from industrial customers. Despite a governmental type of source of the ISO standards, ISO 14001 compliance is completely voluntary. The pressure to attain ISO 14001 registration is driven by customers and is not government mandated.

For US multinational firms who wish to compete internationally, ISO 14001 registration is the only recognized international standard for environmental management systems. Furthermore, some industries in the US are standardizing their supplier environmental registration programs based on the ISO 14001 criteria (Zuckerman, 2000, 2001; Singh *et al.*, 2008). As a global and generic guide for the environment, ISO 14001 has spread across all industry sectors and sizes of companies with company image and size noted as important factors for decisions to implement an EMS (Halkos and Evangelinos, 2002). Very little research has addressed whether ISO 14001 will be widely used by practitioners as a consensus model, or even whether it should be. Instead, the literature is composed with conflicting predictions and viewpoints offered by the personal experiences of experts. The champions of ISO 14001 suggest that it will unify countries in their approach to environmental management and will eventually be looked upon more favorably than traditional measures (Hale, 1997). Hammer (1996) argues that small manufacturing firms constitute the largest potential market for ISO 14001, and that the real test of the standards can be measured by adoption rates among these firms, which typically need the most direction in these issues. According to Hammer, the development to watch is what industrial customers do with these standards with regard to their supply chains. Acceptance of the standards will come when conformance or registration becomes a condition for customer requirements (e.g. Ford and General Motors). This suggests that the predisposition of firms to ISO 14001 will most likely influence the adoption rates and, ultimately, the success of these standards. However, no empirically based research to date has examined the views of managers toward ISO 14001 in a supply chain context. This concern forms the major impetus for this study.

The following question then has to be raised: 'If companies have concerns with the outcomes associated with ISO 14001 registration, then why do their customers require it?'. The next section tries to address this question by illustrating the potential for ISO 14001 registration to promote a sustainable supply chain strategy.

ISO 14001: A Means of Achieving a Competitive Advantage?

There are many reasons why EMSs should be potentially attractive to management. First, there is the increasing use of voluntary EMS standards available to help guide development of these types of system. These standards include the UK's BS 7750, and in the US the NSF International's 110 EMS standard, the American National Standards Institute and American Society for Quality Control (ANSI/ASQC) E4 standard, and ISO 14001. Second, there is the potential of an EMS becoming important to supply chain members (Rondinelli and Vastag, 1996; Vachon and Klassen, 2006; Castka and Balzarova, 2008; Padma *et al.*, 2008; Vachon and Klassen, 2008). Third, there is the potential of pollution prevention leading to reduced costs of production and higher profits (Makower, 1994; Russo and Fouts, 1997). Fourth is the increased importance of corporate social responsibility (Wood, 1991; Pava and Krausz, 1996; Waddock and Graves, 1997; Padma *et al.*, 2008). Finally, the development of an EMS may provide firms with a unique environmental resource, capabilities and benefits that may lead to competitive

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advantage (Rumelt, 1984; Klassen and Whybark, 1999b; Hart, 1995; Starik and Rands, 1995; Castka and Balzarova, 2008). While the potential benefits are numerous, there is still a shortage of research that empirically tests EMS relationships.

In the course of interviewing managers and touring manufacturing facilities for a number of recent research projects, the authors have been repeatedly struck by the number of firms who were reluctant to pursue registration, but who now embrace ISO 14001. Many times we were told that a new measurement system, maintenance program or significant improvement in the environment was directly or indirectly due to becoming ISO 14001 registered. What follows is an attempt to re-conceptualize ISO 14001 as a program that can promote a sustainable supply chain strategy and lead to a competitive advantage. We used our observations to help develop a structured interview protocol that addressed many of the issues raised in the literature.

Methodology

The general objective of this study was to explore the strategic supply chain implications of ISO 14001 adoption with the aim of building theory. Since the focus of this research is exploratory in nature (rather than confirmatory), qualitative data collection methods are used. Field-based data collection methods were used to ensure that the important variables were identified. This also helped us develop an understanding of why these variables might be important (Eisenhardt, 1989; Voss *et al.*, 2002). A small detailed sample fitted the needs of the research better than a large-scale survey would have done.

The method followed was similar to the grounded theory development methodology suggested by Glaser and Strauss (1967). In instances where a well developed set of theories regarding a particular branch of knowledge does not exist, Eisenhardt (1989) and McCutcheon and Meredith (1993) suggest that theory building can best be done through case study research. The researchers participating in this project relied primarily on the methods of qualitative data analysis developed by Miles and Huberman (1994), which consisted of simultaneous data collection, reduction, display and conclusion testing. The end result was a series of case studies in which each case was treated as a replication.

Yin (1994) argued that the case research approach is based on analytical generalization, rather than statistical generalization. In a paper, Stuart *et al*. (2002) state that case research is aimed at being not representative, but rather exemplary. This is a very important assumption, as this research does not generalize what is observed to be truly representative of all similar situations. The focus of the research is to identify possible relationships or effects that might occur, and not to describe average effects of the industries.

There are some pitfalls to case study analysis, including lack of simplicity or narrow and idiosyncratic theories (Eisenhardt, 1989). A primary disadvantage of the case research approach is the difficulty in drawing deterministic inferences, and there are limitations in terms of the external validity of the study. These limitations are often addressed by using large samples, or using 'before' and 'after' quasi-experimental designs (Cook and Campbell, 1979). However, due to the lack of theory building in the area of environmental management systems such as ISO 14001, it is important to use the case study approach to identify differences among adopters. While causality can never be shown in case studies, analysis of data collected from multiple sites can help support the generalizability of results.

Sample Selection

Cook and Campbell (1979) suggested that random samples of the same population be used in theory testing research. However, the sample selected for qualitative research such as in this study should be purposeful and based on theoretical underpinnings (Eisenhardt, 1989; Miles and Huberman, 1994). The goal of this study is to identify differences that can explain the acceptance of ISO 14001 across a single industry, build theory and find where EMS programs utilizing ISO 14001 fit within existing theoretical frameworks. For the purpose of this study, we wanted to work with companies in a well established industry where ISO registration was prevalent. Thus, automotive industry companies were sought, limiting our efforts to plants having experience with ISO 14001. An initial list of automotive suppliers was generated based on geographic proximity, a web based search of ISO

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registered plants, contacting managers at registered plants and recommendations from these same managers. Companies were identified or added to our sample during the process of conducting the interviews and were based on the recommendations of respondents. The sample in this study include automobile OEMs and Tier I suppliers. These plants and this approach to sampling fits well within Yin's (1994) suggested research design, where replication is achieved by making sure the same methods are applied in each case so that the findings can be compared.

Similar to much of the research in operations strategy, a single industry was chosen (Swamidass and Newell, 1987; Vickery *et al.*, 1993; Whybark and Vastag, 1993; Ahire *et al.*, 1996; Curkovic *et al.*, 2000a, 2000b; Castka and Balzarova, 2008). Focusing on a single industry controls for variance due to industry specific conditions. Industries may also differ in the consensus understanding of the meaning of terms. Controlling for industry effects can compensate for variability between industries, in terms of work force management, general market conditions, degree of unionization etc. Controlling for these industry-specific differences through the focus on one industry means that firm-specific variance is highlighted in subsequent analyses (Flynn *et al.*, 1994; Voss *et al.*, 2002; Castka and Balzarova, 2008).

Restricting the sample permits the control of several variables that often differ between industries, including the scope and complexity of environmental concerns. Within the automotive industry, the types of environmental issue and range of programs used offer sufficient variability for study. This variability within the sample provides a basis for external generalizability. Most importantly, the automotive industry was selected because it has been a leader in implementing progressive environmental management strategies in the US (Zuckerman, 2000, 2001).

An initial idea of the level of ISO 14001 understanding and implementation at each potential firm was obtained through preliminary screening over the telephone. Some of the questions used in making our initial assessment can be found in the appendix. After the initial screening, which also addressed the willingness of the company to participate, nine firms were again contacted and site visits were arranged. The interviews were conducted with at least one manager responsible for the ISO 14001 registration process at each site.

Interview Protocol

Eisenhardt (1989) suggested that a researcher should have a well developed interview protocol before making site visits. A structured interview protocol was used at all site visits. The protocol covered a number of topics relating to ISO 14001 adoption, performance, reasons for adoption, reasons that would change this decision, costs, risks and general descriptive information about the respondents and the site at which the interview took place. Development of the protocol was based on our literature review regarding the criticisms of the EMS standard, and our own observations from previous research studies. Of the nine companies in this study, all of them had a registered EMS and experience with ISO 14001.

Qualitative theory building research is an iterative process (Eisenhardt, 1989; Miles and Huberman, 1994; Yin, 1994). Eisenhardt (1989) suggested that data collection and data analysis should be done simultaneously, where the data from one case is collected and then analyzed before the next replication is performed. The same procedure was followed for this study, where a case was collected and analyzed before moving on to the next case. If needed, any improvements in the protocol were made between replications by collecting data in this manner. Important issues that were raised in early cases were included in the protocol for subsequent replications. This ability to refine and improve upon the protocol between cases is a significant advantage of this type of research. The data collection and analysis are described separately in the following sections.

Data Collection

The primary data collection was done using structured interviews in a field setting. For the purpose of this study, nine plants were visited, which included four automotive OEMs and five automotive suppliers (see Table 2). The plants were located in the Midwestern United States. The plants in this study are part of a larger data collection effort including ISO 9000:2000. For the purpose of this study, we are focusing only on the ISO 14001 plants.

Structured interviews at each plant generally took place with the ISO compliance manager, environmental manager, quality manager, plant managers and/or environmental engineers. A high involvement of plant and

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Plant No.	Company description/respondent job title	Yrs. in position	No. of employees @ location
P1	OEM, sr. manager of environmental compliance assurance	4	2 200
P2	OEM, environmental health services	7	13 000 in region
	Sr. staff engineer in quality assurance department	10	
P3	OEM, ISO compliance coordinator	5	4 000
	Quality systems engineer/ISO process support manager	9	
	ISO and QS process support process	4	
	ISO expert	7	
P4	OEM, environmental specialist	5	5 200
P5	Tier I supplier, environmental health and safety manager	9	900
P6	Tier I supplier, quality manager	11	124
P7	Tier I supplier, environmental manager	6	2 700
P8	Tier I, senior leader environmental health and safety	10	482
	Quality manager	8	
P9	Tier I supplier, quality assurance manager	18	425
	ISO 14000 compliance officer	20	

Table 2. Respondent information

environmental managers is the optimal goal, but this may not be achieved by every study due to practical considerations for all parties. Both environmental managers and plant managers have been used as key respondents in empirical studies for environmental management (Klassen and McLaughlin, 1996; Klassen and Angell, 1998; Klassen and Whybark, 1999a; Curkovic, 2003; Vachon and Klassen, 2006; Castka and Balzarova, 2008; Vachon and Klassen, 2008). With the focus of this study being ISO 14001, the researchers involved needed to interview those managers directly involved in environmental initiatives. When conducting the interviews, the field notes identified responses to all of the protocol questions, answers to other questions that were raised during the interview and plant tour, and other companies we should talk to, and included other information such as company publications.

Data Analysis

The two main components of data analysis included within and across case analysis. Within case analysis helped us examine ISO 14001 in a single context, while the across case analysis served as a form of replication (Yin, 1994), where the constructs of interest in one setting were tested in other settings. One concern was controlling for the effects of the researchers' a priori beliefs as to the reasons why ISO 14001 was embraced. This was accomplished a variety of ways. First, the primary researcher wrote up the field notes prior to coding. The secondary researcher, who also went to the plant, reviewed these notes. By using a variety of secondary researchers, none of whom knew the purpose of the research, a second unbiased person reviewed the notes. Any discrepancies between the primary researcher and the secondary researcher were clarified through follow-up contact with the respondent.

The second step taken was intended to mitigate against confirmation bias. That is, the amount of within case analysis performed before the cross case analysis was limited. Miles and Huberman (1994) note that the acts of coding and data reduction are actually forms of data analysis. In other words, the act of coding could lead to confirmation bias problems in future cases. Therefore, coding for within case analysis was limited to categorizing the individual case on previously identified constructs and identifying interesting new issues to pursue at future sites. We were more open to alternative explanations raised in future replications by avoiding comparisons and model building early in the research.

The between case analysis consisted of looking for patterns of firms' experiences with ISO 14001 across the various organizations. Between case analysis is facilitated by using a variety of tools to reduce the amount of data and to display the data in a meaningful fashion (McCutcheon and Meridith, 1993; Miles and Huberman, 1994;

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Yin, 1994). Data reduction was done primarily through categorization. Categories were developed in two ways. First, a number of categories were formed based on the literature (i.e. costs of registration, risks etc.). Then, concepts that interviewees identified as being related to the usefulness of ISO 14001 were compiled (i.e. proactive management, resource efficiencies etc.). Through a process of combination, renaming and redefining, the data was reduced to main concepts that were most frequently noted as benefits of adopting ISO 14001. These main concepts are used to posit several research propositions. The next section will discuss these concepts and propositions and the results in more detail.

Results

Based on the data analysis and consolidation, we next summarize the findings and offer several research propositions. These propositions link existing theory to our findings and position testable hypotheses for future research.

Respondents were asked to provide perceptual information at the plant level regarding ISO 14001. The coding of field data confirms many of the main reasons for not embracing ISO 14001 as previously presented in the literature. Reasons for not embracing the new standard are now more generally categorized as risks. These risks are financial, exposure, change management and lagging the competition. These risks are typically more scrutinized by resource constrained plants or by those plants that may choose only to obtain registration after others in the industry have successfully obtained registration. These general categories, listed from the most prevalent to least, confirm many of the pre-existing issues with ISO registration (see Table 3) and support the literature in that cost is still a primary issue on managers' minds.

The data reduction and categorization process created the following six main concepts for pursuing ISO registration listed in order of most prevalent to least prevalent: (1) competition; (2) customers; (3) image/reputation; (4) risk mitigation; (5) resource conservation; (6) cost reduction. Paradoxically, cost reduction and competition are also listed as a reason for registration, but in the reverse order of the risks attributed to not registering.

Costs
- paperwork intensive
- would not seek if costs > benefits
- registration fees
- man hours
- manpower and internal auditing
- doing all the work for registration, costs, time, and we already have an EMS that is working fine, so why pay to register it
- not all of it is value added, only use those portions that are

Exposure
- getting a bad audit
- legal risks uncovered
- potential compliance issues
- fear of documentation that can be used in environmental litigation

Change management
- there is a lack of specifics, which is hard for technical people to implement
- to see through to completion there must be a passion for it (no passion)
- seen many start it without actually completing implementation/registration

Competition
- risk falling farther behind oversees competition who are better at environmental mgt
- not having it would lose business overseas, looks bad for company image

Table 3. Perceived risks concerning registration

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Additionally, data reduction of the benefits these firms received from ISO 14001 registration include the following four categories listed in order of most prevalent to least prevalent: (1) proactive environmental management; (2) resource and cost efficiency; (3) competition and reputation; (4) involvement and communication. These categories also encompass some of the major criticisms of ISO 14001 and again highlight some paradoxical benefits obtained from registration. The following subsections illustrate how companies turned what many perceived as risks of ISO 14001 into a business case for why ISO 14001 registration is beneficial. We then posit several research propositions to provide an empirical framework for the impacts of ISO 14001 on sustainability, supply chain design and how supply chains will evolve in the future.

Proposition 1: Proactive Environmental Management

Some anecdotal examples and case studies have showed that implementing a strategic system without appropriate feedback and performance measurement is the worst action an organization can inflict upon itself (Romm, 1999; Kitazawa and Sarkis, 2000; Rothenberg *et al.*, 2001; Florida and Davison, 2001). The majority of the companies in this study developed metrics for measuring their own environmental performance. Some of these metrics included energy consumption, recyclability content, material waste, material toxicity and emissions. A manager stated that performance measurement came about as a result of the implementation of ISO 14001. Metrics are maintained through the targets that are set within the EMS, and goals are set with measurable objectives (e.g. 20% reduction in energy consumption and hazardous waste generation). They are also tracked against a three year baseline with the goal being continuous improvement. The registration process did not explicitly dictate the metrics, but only required that performance be measured (as defined by the organization). The importance of metrics is evident in any operation and becoming more important within external corporate environmental reporting. Recently, Sebhatu and Enquist (2007) found support for the importance of measurement, ISO 14001 and value creation.

However, some of the companies in this study have not developed a rigorous way to track the performance of their suppliers. OEMs such as P2, P3 and P4 already have their own plants registered and require registration of their suppliers. Even a Tier I claims that 'requiring registration of our suppliers implies that these same things are being measured and hence reduced'. Level of commitment to ISO 14001 should be used to assess the success of an EMS. Basically, customers should try and determine whether the supplier is only doing the minimal amount of work necessary to comply with registration. This Tier I adopted ISO registration to reduce pollution and reduce the overall cost of waste. Thus, a minimum starting point for some supply chain members will include obtaining registration. None of the companies reported dropping suppliers failing to meet environmental performance criteria because they did not track the performance of the suppliers themselves. Registration was simply the single deselecting criterion. A Tier 1 manager at P8 said that the next step would be to develop a sophisticated monitoring system to measure certain metrics for suppliers and that this would likely have to be a supply chain responsibility. Another OEM manager said that ISO 14001 actually affects what types of activity they can perform 'in house' at their plants. Plating and painting of parts are examples of this. This manager does not want to add any processes to their plants that increase pollutants in air emissions or wastewater discharges. They will push waste generating processes onto their suppliers, which then becomes a supply chain issue.

The elements of 14001 helped one plant to understand how their activities interact with the environment and to improve management of these activities in an ongoing cycle. ISO 14001 is a system that provides an overall framework for environmental management. This system helped provide integration of environmental management into overall business management. P7 claims that ISO 140001 made the environment everyone's business. Training is required for all workers so everyone understands the importance and benefits of the standard. ISO 14001 is a commitment to continually improve and goes beyond simply complying with environmental regulations. Pollution prevention is actually achieved by setting and reviewing objectives and targets. ISO 14001 has helped this firm, and several plants in the study to identify and strive to meet the following objectives:

- ✓ exceed compliance in all environmental regulations
- ✓ assign management responsibility for the environmental activities and services provided in all departments and ensure that all employees are aware of their individual responsibilities for acting in accordance to this policy

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- ✓ practice and promote effective pollution prevention in accordance with a hierarchy giving top priority to waste prevention at the source, elimination or reduction of wasteful practices, and recycling
- ✓ maintain good communications with customers and concerned stakeholders, including legislatures, regulators, the public and other organizations with an interest in environmental performance
- ✓ ISO 14001 has brought on major changes from original EMSs, whose focus was on compliance: internal audits of the system will now be performed at least annually for all elements
- ✓ internal audits will be performed by individuals within the organization: the EMS staff will select two individuals, not from within the same group, to perform the internal audit; the ISO 14001 process has created work instructions detailing how the internal audits must be scheduled, planned and implemented (they were done informally before); the third party registration audit will be performed annually (there were no third party audits previously).

The evolution of sustainability within supply chains has highlighted the need for measurement, continuous improvement and relationships to performance (Garvare and Isaksson, 2001; Sebhatu and Enquist, 2007). P1's facilities are required to set environmental objectives and include these in its business plan. The system will help promote efficiency by setting objectives and targets to reduce wasted raw material, disposal costs and natural resource consumption. Some of these same sentiments are echoed by P2, where they make efforts to educate employees about ISO14001. Every month they make publications on announcement boards regarding electricity usage and the amount of recycling for the period. They also post up a list of what types of paper they can recycle. They tell employees to switch off their computers and lights when they are not using them. Although these are small actions, they believe that it does add up. For example, they did not monitor waste disposal before registration. Since the registration process, they monitor waste disposal and electricity use monthly. By keeping records of the disposal amount and monitoring changes in waste, they were able to find what caused the excess consumption. In turn, by monitoring waste they also can monitor some parts of the manufacturing process. This manager's advice was to set realistic goals, and keep it simple. They also recommend if the company has ISO 9000 registration to utilize the existing system and make incremental changes. It then becomes easier to become ISO 14001 registered by not reinventing the wheel. Hence, our first set of research propositions.

RP1A: Plants with ISO 14001 registered and formal EMSs will have higher levels of process and performance measurement, which will be positively related to higher levels of sustainability across a supply chain than plants with nonregistered and informal systems.

RP1B: Plants with ISO 14001 registered and formal EMSs will have higher levels of communication required between OEMs and Tier I suppliers and higher levels of performance across a supply chain than plants with nonregistered and informal systems.

Proposition 2: Resource and Cost Efficiency

There is limited empirical support but strong anecdotal evidence that adopting ISO 14001 can help firms achieve resource and cost efficiency (King and Lenox, 2000, 2001, 2002; Rothenberg *et al.*, 2001; Rajaram and Corbett, 2002). The initial cost for the smaller companies in this study was relatively large, and greater than their experiences with quality investments such as ISO 9000. One manager estimated that 14001 will cost them approximately $18 000 from start to finish (3 years), while a quality system such as ISO 9000 cost them half this. Furthermore, each year the company would incur a maintenance cost of $8000, twice that of a quality system such as ISO 9000. Maintenance would consist of a partial audit by the Registration Accreditation Board (RAB), and a complete audit would ensue every three years (see Tables 2 and 3).

Another manager claims there are greater growing pains for EMS development versus ISO 9000 because of a lack of familiarity of environmental issues. The basic advantages have been lower financial costs, a better understanding of environmental contamination by employees themselves and their managers, a better understanding of environmental laws by employees and the production of contingency plans (because it forces you to look at every aspect of impact and output). This actually reduces liability and counters the criticism that ISO 14001 increases liability because it creates a paper trail for potential non-compliances.

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Even a manager at a large OEM complained that the costs for implementation and registration were high. However, there is still a cost savings and payback period, but the numbers are not competitive with other types of investment that require better ROIs. They still made the investment and attribute the higher costs to a lack of familiarity with environmental issues (versus say quality). Benchmarking within one company indicated that implementation required approximately 3000 man hours per plant for system development alone, plus 2 hours per employee for awareness training. The implementation costs were dependent on the need to support site implementation with external consultants. A brief summary of the most frequently cited costs includes

✓ registration and implementation
✓ consultants
✓ resources involved in documentation
✓ liability in documenting a problem that is uncovered by a third party.

The registrar provides the necessary third party audit of the implemented EMS and is authorized by the RAB to recommend registration based on a satisfactory audit of the facility's program. Typically, the registrar will perform a document review, a pre-audit and a registration audit, which leads to the initial recommendation for registration. Periodic surveillance audits, spaced approximately six months apart, are scheduled following registration to assure that the EMS is established and functioning in accordance with the documented program and with the ISO 14001 standard. Registrar services typically ran to $40 000–65 000 per site over a three year period and are somewhat dependent on plant size and complexity. First year costs were approximately one-half the total three year cost. The smaller companies (P6 and P9) encouraged their customers to allow for self-declaration and compliance rather than actual registration to alleviate some of these costs by not requiring formal registration.

Similar to ISO 9000, cost is again an issue with implementation, but with ISO 14001 the costs are typically higher. A manager at P6 claims that costs could run to about $12 000–15 000 for a company with 100–200 employees. The cost runs slightly higher than an ISO 9000 audit for a similarly sized company due to the complexity of environmental records, explains the manager. The cost of the whole ISO 14001 registration process, beginning with gap analysis and culminating with registration, could run from $40 000 to more than $100 000.

Another manager said the cost for implementation was too overwhelming for their company to handle. The manager made a reference to the 'hedging' out of small businesses in America, and international standards such as ISO 14001 were a means for doing this. He also stated that the issuing agencies have too much to interpret individually and are not consistent. The manager acknowledges that after registration it was allowed to play on a wide open international playing field. However, this 'strong-arming' of the standard was restructuring industry. Industrial OEMs are requiring their suppliers to comply and in turn their suppliers are pressured to do the same. The manager argued that it creates a 'good ole boys network' and it is very expensive to stay in the network because of the enormous maintenance costs. This manager felt that the standard advances larger firms that already had EMSs in place and hedges out smaller companies that are still trying to find their way with EMSs (even though their environmental impact is relatively small).

One of the major criticisms of ISO 14001 is the amount of paperwork involved in obtaining registration. A large number of critics perceive the paperwork as excessive. A major cost for most companies in this study was that significant manpower is invested in the area of document control. A large OEM acknowledged that the costs of registration can lay a heavy burden on smaller companies because of the man hours required for registration and creating/maintaining the documentation. The result was that many plants are forced to produce large manuals of highly detailed procedures, ignoring the fact that personnel performing these tasks may not have been highly trained or closely supervised. Often these manuals contained large sections of material reproduced from other sources. Some managers highlighted the importance of reducing redundancy and enhancing integration for the purposes of reducing implementation costs. Specifically, a P6 manager said that the ISO 14001 documentation requirements can be implemented using the existing processes within their ISO 9000 system and this could save significant resources, especially for smaller companies. Using experiences and tools from the ISO 9000 process is an effective means for less costly and more effective implementation of ISO 14001. Many of the managers also expressed that that getting re-registered for ISO 9000 will one day require ISO 14001 registration as well, further justifying some sort of system integration.

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All the managers expressed that the financial burden of ISO 14001 registration is a daunting task at first glance because of the cost implications. However, all also acknowledged that if plans are taken with a time frame and goals in mind the registration process can be completed in a timely and cost effective manner. The problem that many suppliers face is they do not have a choice and often have a limited time frame to implement ISO 14001; otherwise, they risk losing valuable contracts.

Major risks expressed by managers such as P3 included the idea that registration requires documentation that can be used by other parties in any environmental litigation, and this can also be a burden placed on their own suppliers, which could strain relations. However, a manager expressed less concern with litigation, and said 'In the event of an accident, if it can be demonstrated that the proper precautionary measures had been taken to prevent such an occurrence, it is within the means of the EPA and other environmental organizations to reduce or even eliminate fines. In an instance such as previously stated this could easily save a company hundreds of thousands of dollars, allowing it to more efficiently and effectively focus on cleanup rather than trying to stay in business'.

Another manager said that a properly designed EMS that stems from ISO 14001 creates an environment for more efficiently and effectively identifying opportunities for cost savings, which pays for itself. In other words, the system facilitates policy and even technological changes that reduce total costs on a continuous basis. These improvements and changes allow companies to use inputs such as raw materials or energy more efficiently and offset the costs of reducing environmental impact. ISO 14001 and the registration process helped put into plainer view what later seemed obvious or common sense solutions to many environmental issues.

A P5 manager claimed it really 'leaned out' their current EMS. ISO 14001 required more training for more people and better documentation, and it created better institutional memory. The paper trail that is required for registration combined with the internal auditing requirements has led to several reductions in not only environmental waste, but material waste as well. This 'leaning out' of the manufacturing process has led to several cost reductions that generated very reasonable and competitive payback periods and ROIs. Thus, our research propositions are the following.

RP2A: ISO 14001 registered plants with direct relationships to other registered plants will have higher levels of system investments positively associated with waste reduction and cost efficiency than nonregistered plants.

RP2B: ISO 14001 registered plants with direct relationships to other registered plants will have sustainable practices and projects with better ROI than nonregistered firms.

Proposition 3: Competition and Reputation

Klassen and Johnson (2004) identified distinct elements that link supply chain management with external certifications such as ISO 14001. These linkages involve interactions between the buying firm (OEMs in this study) and its upstream suppliers (Tier Is for example), and is supported by case research in the furniture industry (Handfield *et al.*, 1997; Walton *et al.*, 1998). These studies, combined with a few others (Min and Galle, 1997; Carter and Carter, 1998; Bowen *et al.*, 2001; Brio *et al.*, 2001; Brio and Junquera, 2003; Darnall, 2006; Kannan *et al.*, 2008), only implicitly examine environmental management in the context of the supply chain. Most of the Tier I plants in this study acquired registration due to pressure from customers as reflected in information from P7: 'We have a total business system for managing processes. An EMS, such as ISO 14001, is only one part and is an extension of that system. However, it is an extension that came from a customer requirement, but it was integrated into an overall system'. This same sentiment is supported by P6 and P9 in that registration is seen as a customer requirement and not a competitive advantage. In fact, they just completed registration because they were told by their customer (a large automotive OEM) they had to. They had to ask the customer for more time because they lacked the necessary resources as a smaller company to meet the deadline.

The major thrust for getting registered for some of the larger plants was because they were very concerned about falling behind their competitors. In other words, they were imitating their competitors. One OEM said that a major factor for getting registered was because it would make global expansion into 'developing' countries easier. It also is a prerequisite for doing business in industrialized markets such as the European Union and Japan. Unlike the

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larger plants, drivers for registration among the smaller plants had little to do with foreign competition, and more emphasis on eroding market share. Thus both competition and market forces are major pressures for registration. Paradoxically, these causes of pressure to register an EMS lead to potential benefits and competitive advantages that include

✓ enhanced reputation
✓ waste reduction, better resource utilization and lower costs
✓ access to international markets
✓ extensions of EHS responsibilities with a continued emphasis on safety.

'Under no circumstance would they change their decision' was a sentiment expressed by a manager at P3. They would only change their decision if another new standard emerges that is used by their competitors and/or is more effective, with an emphasis placed on imitating their competitors. Furthermore, registration and integration results in lower costs, waste, and pollution. The reduction in costs and pollution is driving the reason for making their suppliers become registered or at least compliant, and this view was shared by most plants. Plants wanting to make sure they have a more stable supply chain can use supplier assessment programs that include ISO registration to help ensure that they are using environmentally responsible suppliers. Most of the smaller companies that were told they needed to be registered were also encouraged by OEMs to place the same expectation on their suppliers. One of the easiest ways for a plant to do this is through working with suppliers that have obtained an industry standard for an EMS, namely ISO 14001.

P8 appeared to be the exception in that they pursued registration before their customers mandated it, not even anticipating it would be required in the future. They simply saw it as a cost saving opportunity for themselves and their suppliers. P2 actually completed registration to support its organization's sustainability strategy of creating 'green' factories. They do not require their suppliers to implement ISO 14001, but they do encourage it. The end result is that most of their suppliers are ISO 14001 registered and support their sustainability strategy goals. P2 emphasized that registration itself, while a good starting point, is not enough. Customers wanting to ensure a greener supply base should also work in house with suppliers. Those making supply chain management decisions will need to plan their sustainability product technology so that it can be fulfilled by the capabilities of their major suppliers. P2 has also provided ISO 14001 training for suppliers for the past 3 years. This was an exception, since the smaller suppliers claimed that the OEMs placed the responsibility of registration squarely on them. P2 believes in true partnerships, in other words long-term relationships with their suppliers. Separating from suppliers has not been an issue yet, due in part to P2's original alignment with suppliers that possessed similar plans and philosophies.

One manager at a large OEM said that for a large global company a 'common' EMS was critical, and ISO 14001 provided them with a standard to work from. At one OEM, 'corporate' holds all plants to the ISO standard. Generally, this company has practices they consider to be well above the ISO standard. Purchasing teams set the requirements for their suppliers and each supplier must at least have an EMS in place. This corporate standard is also found at other OEMs (P1, 7), where the success of ISO registration is seen as an international standard for finding environmentally responsible suppliers.

A manager at P4 said 'ISO 14001 made it possible for us to market to other foreign countries and we would not be the company we are today if it wasn't for the standard'. While discussing the company's position on ISO 14001, P4 mentioned that ISO 14001 was very important to the implementation of OHSAS 18001. OHSAS 18001 is an Occupational Health and Safety Assessment Series for health and safety management systems. The company has made OHSAS 18001 registration mandatory for all plants by the end of the year. OHSAS 18001 is intended to help organizations to control occupational health and safety risks. Some of the benefits associated with this include

✓ potential reduction in the number of accidents, public liability insurance costs, and downtime
✓ increased access to new customers and business partners and
✓ demonstration to stakeholders of the company's commitment to health and safety.

The series was designed to be compatible with other management system standard specifications such as ISO14001 and can be registered via a third party auditor. P4 feels that integrating management systems such as OHSAS

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18001 with ISO 14001 will offer excellent value to the firm and its customers. Thus, our research propositions are the following.

RP3A: ISO 14001 registered plants with direct relationships to other registered plants will have higher levels of customer relationship management and will be positively associated with greater expansion opportunities and image than nonregistered plants.

RP3B: ISO 14001 registered plants with direct relationships to other registered plants will have fewer issues with employee health and reduced numbers of safety incidents than nonregistered plants.

Proposition 4: Involvement and Communication

There is some empirical support for the idea that firms adopting an EMS such as ISO 14001 are more inclined to be innovative through a focus on employee and management involvement (King and Lenox, 2000, 2001, 2002; Kitazawa and Sarkis, 2000; Lapré *et al.*, 2000; Florida and Davison, 2001; Padma *et al.*, 2008). P3 said it is absolutely vital to have the complete support and diligence of upper management or this system will fail. To procure a system without making an effort to sustain it compels it to become a bookshelf system. In other words, it will eventually dissipate and be totally ineffective and a waste of time and money. The requirement of a management review in ISO 14001 helps avoid this situation. As demonstrated by Atkinson *et al.* (2000), successful greening of a business will depend on an appropriate management structure with support and review from senior management. Top management must review the EMS at defined intervals to ensure that it continues to be suitable, adequate and effective in satisfying the requirements of ISO 14001. However, ISO 14001 does not define what information needs to be reviewed. The EMS staff actually gets to decide what information is reviewed. ISO 14001 is not restrictive in that regard.

The shifting of the responsibility of environmental performance to the senior management of the organization and away from the environmental staff emphasizes the importance of improved environmental performance to all employees, said one manager. Transparency and the sharing of information with groups of stakeholders have led to more top management involvement in sustainable activities. Top management support is critical because ISO14001 registration has an open-ended nature. Another manager claims to have seen it started at other plants without actual completion. There is a lack of specificity, which is a challenge for technical people to implement. There must be support by top management to see it through to implementation.

In the case of P2, the company had most of the documentation prior to making the decision to become registered. By comparing the existing procedures to what is required for registration, the employees were able to uncover the gaps in the processes. It enabled them to add value because the ISO 14000 documentation required management support and follow-through. The manager from an OEM at P3 also supports this by adding 'documentation is the key to helping employees find the gaps in business processes and we would not have done this without going through the registration process'.

Most of the plants used the documentation as a way of codifying knowledge and formally requiring management's commitment and involvement. The formalized processes for regulatory changes, compliance issues, waste material and emissions, correction procedures, monitoring and customer satisfaction may seem a burden, but many companies also look at it as a record of lessons learned, thereby adding value. The ability of a plant to document and learn is reflected in the extent to which ISO 14001 is integrated within the plant. Most of the managers said you must be positioned to gain benefits from ISO integration. Specifically, you have to develop the ability to translate registration into internal efficiency improvement and this begins with top management support and employee involvement.

There can be great difficulty responding effectively to change and most companies will only do what is necessary for compliance, not full integration. Alternatively, most of the companies in our study were receptive to change and innovation, where integration of new practices was not only accepted, but part of their culture. The same amount of integration will not be realized if it is limited in its application across multiple product domains. One of the positive outcomes of the implementation process that contributed to higher levels of integration was employee awareness. For example, the formal and management supported training required by ISO 14001 has

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given P4's employees a firm understanding of what they do and how it affects the environment. This has led to new programs, most of which have been initiated by employees and supported by management, attributed to the documentation and training they all received.

Last, ISO 14001 registration can also be leveraged to increase employee motivation. The implementation of an EMS at one organization, which did not previously have a strong record of being environmentally conscious, led to improved employee morale and motivation. First, people care more about the environment than they did in the past. Employees feel better about themselves and their place of work when they feel their products are produced in an environmentally responsible manner. Thus, our next and final research propositions are the following.

RP4A: ISO 14001 registered plants with a direct relationship to other registered plants will have a strong positive relationship between formal communication, training, monitoring/control systems and firm performance.

RP4B: ISO 14001 registered plants with a direct relationship to other registered plants will have higher levels of involvement and communication, which will be positively related to more internal and external integration with supply chain members.

Based on the data analysis and consolidation, we have summarized the findings, posited several research propositions and now offer empirical extensions of our field study findings. The proposed propositions link existing theory to our findings and position testable hypotheses for future research. Future research can build on the existing field studies through qualitative data collection and sample replication in other industries, survey development and data collection across industries and multi-method approaches to multivariate data analysis while testing relationships among the impacts of ISO 14001 on manufacturing plants, supply chain members and elements of performance.

Plant and Supply Chain Attributes

- Measurement
- Continuous improvement
- Communication
- Systems investments
- ROI
- Customer relationship mgt
- Training
- Monitoring & control systems

Relationships to Performance

- Increased sustainability
- Improved firm performance
- Waste reduction
- Increased cost efficiency
- Increased expansion
- Improved image
- Improved employee health
- Reduced safety incidence

Discussion and Conclusion

Many of the espoused criticisms of ISO 14001 by managers seem valid on the surface but may actually mask an underlying strategic position of a plant. This study attempts to demonstrate that companies who fully integrate a formal EMS can reap significant benefits internally and externally in terms of a sustainable supply chain strategy.

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Managers should recognize that individual businesses compete no longer as solely autonomous entities, but rather as supply chains. The environmental impact of one company goes far beyond the manufacturing of a product in that other supply chain members play an important part in a product's life cycle and overall environmental impact. It is hoped by many that the ISO standards for EMSs are a step in the right direction toward better measurement, communication and a supply base network structure that, when properly aligned, becomes a more impactful strategy than any firm can develop on its own.

ISO 14001 does not have to be a non-value-added paper-driven process. However, those companies who see registration as a game to keep business will not obtain the additional benefits seen in more proactive plants where more effort is put into performance and supply chain integration. We found that there were significant differences between plants that install a registered EMS with external coordination and integration. Those plants that see registration as an opportunity to improve their EMS and supply chain integration of environmental standards will be part of a more sustainable supply chain. Supply chain managers wanting to improve the integration of sustainability within their supply base should seek out suppliers that are able to translate registration into internal efficiency improvement. Suppliers with a lesser amount of integration or who do not use ISO registration as a catalyst for change will only do what is necessary for compliance, but not full integration, and should not be sought out by supply chain managers.

The issue of a sustainable supply chain was not explicitly built into the interview protocol. The protocol was developed to be more generic, so that themes from managers could emerge more naturally. It was anticipated that ISO 14001 being forced upon suppliers by their customers would be a common theme and it was. The large OEMs placing pressure on their suppliers to likewise have their suppliers do the same was more prevalent than expected. However, we were struck by the lack of recognition of ISO 14001 to be used as a supply chain design tool by the large OEMs. Sustainable supply chains are more than merely having a number of firms along any supply chain independently adopting ISO 14001. The large OEMs simply dumped registration responsibility squarely onto their suppliers and the OEMs turned their attention to getting their own facilities registered, rather than using it as a supply chain design tool. However, the suppliers appeared to recognize the limitations of this approach by their customers. Several of the suppliers resented the OEM approach and they had the same experiences with QS 9000. These plants mentioned that their customers did nothing in the way of education, coaching, mentoring, collaboration etc., in regards to environmental management. Supplier plants in the study also expressed the need for an industry network so that they could learn about which metrics to use, waste reduction opportunities and potential operational improvements. However, our findings and previous research show (Paul, 1996; Handfield *et al.*, 1997; Min and Galle, 1997; Walton *et al.*, 1998; King and Lenox, 2000, 2001, 2002; Berger *et al.*, 2001; Holt, 2004; Darnall, 2006) that the coaching and mentoring of a sustainability strategy for supply chain design usually needs to be initiated and undertaken by the 'larger' organizations (which are often the customers and in this study the OEMs). Thus, there appears to be a large opportunity to better integrate long-term supply chain design thinking with ISO certification, mentoring of important suppliers and alignment of evolving firm strategies that include sustainable attributes of value chains.

ISO 14000 appears to provide only a foundation for supply chain design because registration itself does not require information exchange, mentoring programs or visiting suppliers to assist them to improve environmental performance. The suppliers in our study suggested that a supply chain design requires a range of activities that go beyond registration in order to support a sustainability strategy. Several managers said that bare minimum includes addressing one's own accreditation to an EMS standard such as ISO 14000 and assessing a supplier's environmental performance by addressing their own accreditation to the same standard. Managers in our study suggested that industry associations or environmental business groups should be used to lead the way in designing supply chains that support sustainability strategies. While the managers in our study did not specifically make suggestions on specific activities, the research literature suggests several key activities that should be included, such as (1) seeking information on environmental aspects of policies, processes and systems from suppliers (Hill, 1997; Min and Galle, 1997; Green *et al.*, 1998; Darnall *et al.*, 2008), (2) imposing specific performance requirements upon suppliers (Handfield *et al.*, 1997; Hill, 1997; Walton *et al.*, 1998), (3) ceasing to purchase from suppliers who fail to meet criteria set (Baylis *et al.*, 1998; Knight, 1995; Clayton and Rotheroe, 1997), (4) ceasing to purchase from suppliers who fail to provide information requested (Handfield *et al.*, 1997; Baylis *et al.*, 1998; Walton *et al.*, 1998), (5) creating outreach activities to share experiences and best practices with suppliers

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(Handfield *et al*., 1997; Holt, 2004), (6) planning your sustainability product technology so that it can be fulfilled by the capabilities of your suppliers (Bowen *et al*., 2001; Ayres and Ayres, 2002; Cooling, 2007) and (7) modeling potential future supply/demand imbalances in critical input materials such as energy, water, packaging, chemicals etc. (Bowen *et al*., 2001; Cooling, 2007; Darnall *et al*., 2008).

The results of this study contribute to theory development by exploring a strategic dimension of sustainable supply chains, positing new research propositions and confirming relationships posited in previous research. It also suggests that future research should take into consideration the strategic position of a plant when assessing the impacts of ISO 14001 or when modeling supplier selection practices that include ISO registration of a supply base. In this study we show that ISO 14001 has the potential, when used under the right circumstances, to improve sustainability across the supply chain. In other words, it is a tool for sustainability. It can be applied across firms so as to tap into the synergies associated with the greening of a supply chain, i.e. better understanding of environmental processes, lower waste, pollution prevention and improved performance. Through the use of qualitative data collection methods, this study also helps to develop theory in a broader context, beyond just specific research propositions. It does this through a better understanding of the ISO 14001 uncertainties, risks, benefits and implications for sustainability within a supply chain. We find that ISO registration does not make for a level playing field and that the level of integration and impact on supply chain sustainability vary. This variance allows for some plants to actually obtain competitive advantages from registration while other plants will always struggle with sustainable development, integration and compliance with registration.

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Appendix. Interview Protocol Questions for ISO 14001 Study

- Date
- Name of respondent(s)
- Name of interviewer(s)
- Company
- Primary product(s)
- Primary customer(s)
- Your job title
- What is the length of time in your current position?
- What are your current job responsibilities?
- No. of employees at this facility and the firm
- What are your company's export sales as a percentage of total sales?
- What % of sales are made to the European Union?
- What are your company's consumer/end user sales as a percentage of total sales?

- What type of environmental system is in place, and what is its role in the planning and execution of the firm?
- What is your understanding of the ISO 14000 standards at this time?
- What is your firm's understanding on ISO 14000?
- How was this decision arrived at?
- What factors influenced this decision?
- Under what conditions would management change this decision?
- What are the benefits you can see being generated by this form of registration?
- What prevents firms from pursuing ISO 14000?
- What was the primary reason for your firm to seek registration or consider registration or implement an EMS and not seek ISO 14000 registration or not need an EMS, or ISO 14000?
- How do you measure performance in your department?
- Do you have any final comments that you would like to make before we finish this interview?
- Are there any other people in this firm you think we should talk with?

Note: managers were asked to explain all of their answers.

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