

## A MODEL OF SITE-SPECIFIC ANTECEDENTS OF ISO 14001 CERTIFICATION\*

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ISO 14001 constitutes a major dilemma for many American firms. This new standard holds the promise of waste reduction and better process management, but the benefits and costs are very difficult to predict. This study attempts to identify and explain antecedents impacting the decision to pursue certification for some of the first plants certified in the United States. Using data from a large survey of U.S. managers and a Logit analysis, we find the factors influencing management decisions to actively pursue ISO 14001 certification to be distinctly different from those factors influencing management's decision not to pursue certification. For the latter, the decision is economically based; for the former, it is driven by other, more qualitative considerations.

(ISO 14001; ENVIRONMENTAL MANAGEMENT SYSTEMS; DECISION ANALYSIS; SURVEY; LOGIT ANALYSIS)

### 1. Introduction

Beginning in the mid-1990s, two major trends began to shape the practice of operations management in industry. The first was the movement toward the formal certification of processes in support of certain strategic objectives. This movement is best illustrated by the International Organization for Standardization (ISO) 9000 series of certification standards. These standards were introduced to ensure the sites had in place the processes needed to deliver quality output and that these processes were documented, widely understood, and followed.

The second development was that of increased environmental awareness. Beginning with Porter (1991) and subsequently expanded upon by Porter and Van Der Linde (1995), Bonifant and Ratcliff (1994), and Klassen and McLaughlin (1996), managers came to see that improved environmental performance benefited more than just the environment. Rather, there exists a positive linkage between improved environmental performance and improved corporate performance (Gupta 1994). One reason for the presence of this linkage lies in the nature of pollution. Pollution is more than a contaminant of the environment; it is a form of waste. As such, pollution consumes resources (material, labor, equipment, money) without

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generating an offsetting stream of value. Further, it is an indicator of an inefficient process (Kleiner 1991). As a result, any action that tries to reduce the amount of pollution produced by the manufacturing system should also help enhance the firm's overall competitive stance. This position, while making sense conceptually, has received mixed research support. Certain studies have found instances of a negative relationship between environmental investments and returns (Jaffe, Peterson, Portney, and Stavins 1993), while others find a positive association between environmental performance and financial performance (Klassen and McLaughlin 1996; Konar and Cohen 2001).

More recently, these two trends have merged, resulting in the ISO 14001 Environmental Management Systems (EMS) certification standards. Formally adopted in the fall of 1996, ISO 14001 represents a new standard and approach to improved environmental performance (Delmas 2001). There are several features that make this standard noteworthy. First, this standard builds on the presumed success provided by the quality standard, ISO 9000, and its variants, such as QS 9000 from the automotive industry. Second, ISO 14001 is an international standard. As a result, it is hoped that this standard will replace the numerous and often conflicting standards found in various countries across the world (Corbett and Kirsch 2001). Third, ISO 14001 shifts attention from the outcome to processes. Finally, the extent to which the firm is able to successfully adhere to these new requirements must be evaluated by an ostensibly impartial third-party assessor, though self-certification is also an option.

Taking into consideration the growing importance of environmental awareness and certification of systems, this study addresses one primary research question: Why do some sites actively pursue and attain ISO 14001 certification while other sites decide against pursuing ISO 14001 certification?

This research question is examined from a multimethod research perspective (Brewer and Hunter 1989). The findings reported in this article draw primarily from a Logit analysis of survey data focusing on ISO 14001 acceptance, with additional insights from previous research and field studies (Melnik et al. 1999; Sroufe, Curkovic, Montabon, and Melnik 2000).

In this study, we examine the factors influencing the decision to either pursue or not pursue ISO 14001 certification. This study consists of the following major sections. Section 2 reviews the relevant literature and is followed by an introduction to the ISO 14001 certification standard and the reasons for pursuing certification. Section 3 identifies factors influencing the decision to pursue ISO 14001 certification; it also develops the framework underpinning the empirical analysis. Sections 4 and 5 describe the sample, survey, data, and its variables, while Section 6 presents the results of the Logit analysis. Finally, in Section 7, the findings and major insights are summarized.

## 2. Literature Review

By emphasizing environmental systems and processes, ISO 14001 certification should be attractive to firms and in markets that prize internal efficiencies, environmental performance, and corporate image (Delmas 2000). One such market is the European Union, where there is a relatively large number of ISO 14001-certified firms. Market forces are considered by some as one of the major reasons for pursuing environmental certification (Hormozi 1997; Makower 1994; Melnik et al. 1999; Saunders and McGovern, 1993). ISO 14001 certification should also be attractive to customers who value environmental performance (Krut and Drummond 1997; Litsikas 1999). It has been argued that this certification standard can lead to improved risk management, reduced penalties, and fewer environmental inspections (Lally 1998). This standard also gives managers an incentive to improve the processes associated with their sites' environmental management systems. Additionally, there is the promise that, by pursuing ISO 14001 certification, the sites can exploit the benefits offered by enhanced environmental performance (Delmas 2001; Begley 1996; Lally 1998). Overall, these benefits

can be described as “potential.” This uncertainty over the benefits can be attributed to the relatively small amount of time the ISO 14001 certification standards have been available and the unknown effects on operations.

With uncertainty surrounding ISO 14001, this new certification standard represents a management quandary. There are some major costs and issues associated with the attainment of ISO 14001 certification. Any potential benefits must be measured against the costs, which are significant and at times more predictable. A significant cost is that of attaining formal, third-party certification. Since this is a relatively new certification process, the costs of attaining this certification are difficult to estimate. Yet, some cost estimates are possible based on ISO 9000 (Docking and Downen 1999), and it has been suggested that parallels can be drawn between ISO 9000 and ISO 14001 (Renzi and Cappelli 2000). Both rely on third-party auditing, and ISO 14001 explicitly builds on the foundations of the ISO 9000 series of standards. As a result, experiences with ISO 9000 should serve as a good indicator of the experiences that can be expected with ISO 14001 (Hormozi 1997). The result is an interesting managerial dilemma: Should a firm undertake certification in a program where costs are significant and front-loaded, while the benefits are uncertain and long-term?

The research presented in this study aims to better understand environmental management systems while simultaneously answering the research question above. To date, we know of no other studies focused on the reasons for NOT pursuing certification early after the release of the standard. Non-adoption is an under-researched strategy in decision sciences that can help explain how firms obtain effective environmental programs without ISO 14001 certification. Much has been published on the reasons why sites should attain such certification (e.g., Chin, Chiu, and Pun 1998; Hormozi 1997). However, little attention has been devoted to studying the reasons sites do not pursue this form of certification. Many American firms are taking a “wait and see” attitude (Litsikas 1999). As an indication of the relative interest of American sites in attaining ISO 14001 certification, consider the following. By December 2002, 10,925 Japanese plants had been certified, while only 2,400 U.S. plants had achieved this status. In addition, the number of U.S. plants certified is sixth overall [behind Japan, Germany (3,700), Spain (3,228), the U.K. (2,917), and Sweden (2,730)] (ISO World 2003). With the number of U.S. certifications lagging other countries, it makes sense to look at firms not pursuing ISO 14001 certification.

### **3. Understanding the ISO 14001 Environmental Certification Standard**

One important task for U.S. multinational firms will be to implement uniform environmental management practices and policies as they are driven by the convergence of national compliance requirements (Rondinelli and Vastag 1996; Guillen, Macpherson, and Muir 2002). How this convergence should be managed is still unclear. Balikov (1995) suggests that EMS standards may serve this purpose best if these types of management systems receive widespread acceptance.

The ISO 14001 environmental standard specifies the structure of an EMS that an organization must have in place if it seeks to obtain certification according to ISO guidelines. These systems can be considered part of a firm’s environmental technology portfolio (Klassen and Whybark 1999) and involve infrastructural and integrative investments (Hayes and Wheelwright 1984; Giffi, Roth, and Seal 1990) that support control and prevention technologies and impact operating practices.

ISO 14001’s EMS standards are process, not performance, standards. These standards do not tell organizations what environmental performance they must achieve. Rather, the standards describe a system that focuses on environmental processes to help an organization achieve its own objectives and targets. The assumption is that better environmental management will lead to better practices, better environmental performance, and credible information about the firm that can be used for environmental differentiation. How management

perceives the costs, risks, and benefits associated with attaining ISO 14001 certification will influence their position on attaining this certification.

ISO 14001 certification can be described as being a relatively new process for firms in the United States. This early stage of development has several important implications for both customers and organizations when viewed from the innovation adoption framework developed by Moore (1999). The adoption of organizational innovations has been well documented (Damanpour 1991; Palmer, Jennings, and Zhou 1993; Wolfe 1994). In a generalizable framework, Moore (1999) identified five major groups of new technology adopters: innovators, early adopters, early majority, late majority, and laggards. One can argue that the first two categories, innovators and early adopters, are the most likely to adopt ISO 14001 soon after the standard was released. These two categories of firms approach the decision of whether or not to pursue ISO 14001 certification using different types of criteria. Innovators are typically drawn to new developments aggressively. They are able to tolerate high risk and accept low payback. Early adopters are people or organizations who are leading edge and are interested in a development such as ISO 14001 because they find it easy to conceptualize, understand, and appreciate the benefits of the new initiative. They are willing to take a chance on the expected payments, rather than the actual benefits currently observed. When studying the acceptance of the ISO 14001 certification process, we are focusing on how a sample of U.S. firms approached this decision within a short period of time after the standard was released.

### 3.1. *ISO 14001 Certification: A Model of the Adoption/Rejection Decision*

ISO 14001 certification can be regarded as a voluntary process of communicating, in a structured manner, information about a firm's EMS to external parties. It can also be regarded as a time-consuming and costly process with "potential" benefits. This status leads to a simple but important question: Why would a firm and its management seek to actively pursue such certification? This question can be addressed by assuming that a firm will pursue such certification under certain conditions, specifically, when:

- The firm feels compelled to do so by economic and market considerations.
- The firm has access to adequate resources needed for such an undertaking.
- The firm has capabilities and skills to attain such certification efficiently.
- The firm has an adequate understanding of the ISO 14001 certification standard and its strategic impacts on the firm (both internally and externally).

Using these ideas, we next develop seven factors and a framework focusing on the ISO 14001 certification decision. These factors are drawn from a comprehensive review of the ISO 14001 literature and extensive discussions with experts in the ISO 14001 certification process. While not all-inclusive, the decision to pursue ISO 14001 certification is influenced by several major factors:

3.1.1. PAST EXPERIENCE WITH THE FORMAL CERTIFICATION PROCESS. There has been a large amount of attention given to the extension of ISO 9001 to ISO 14001, and parallels can be made between the two certification processes (Renzi and Cappelli 2000). The reason for this relationship is that the firm and its personnel are familiar with the requirements for such certification. In addition, there is commonality between the two certification processes, thus contributing to a reduction in the certification cost (Hormozi 1997).

*H1: The more experience a plant has with ISO 9001 or QS 9000, the more likely the plant will adopt ISO 14001 certification.*

3.1.2. STATUS OF THE EMS. One of the goals of ISO 14001 is to help enhance the effectiveness and efficiency of the firm's environmental management system. As a result, there should be a relationship between the status of the firm's EMS and its interest in attaining ISO 14001 certification. However, the nature of this relationship is not clear. While the presence of a formal EMS is critical, it is not certain whether this factor, by itself, is

sufficient. A factor to be considered is the age of the EMS (i.e., the length of time that the EMS has been in operation). As noted by Litsikas (1999), there is conflicting evidence on this factor. Some firms with a very well-established EMS are very interested in actively pursuing ISO 14001 certification, while others may not see much incremental advantage in ISO 14001 certification. For these latter sites, ISO 14001 may be a marketing ploy or a response to consumer demand. Other firms may be hesitant to pursue ISO 14001 and view certification as forcing a change on their potentially adequate EMS so that processes are in compliance with those demanded by ISO 14001.

3.1.3. **UNCERTAINTY REGARDING ISO 14001.** Given that the ISO 14001 certification process is relatively new, there is uncertainty regarding impacts and the changes it will create. Uncertainty, for the purpose of this study, can be broken down into two major types. The first involves *political uncertainty*. This refers to that level of uncertainty that is attributable to concerns that governmental actions at either the local, state, or national levels may take actions or make changes affecting this certification process. The second type of uncertainty is that of *operational uncertainty*. This category of uncertainty refers to how the firm deals with ISO standards internally. The uncertainty of operational change may be enough of a deterrent for firms considering certification.

*H2: The higher the level of uncertainty, the less interested the firm is in attaining ISO 14001 certification.*

3.1.4. **MARKET FORCES.** One reason for pursuing an environmental certification is market demands (Makower 1994; Melnyk et al. 1999; Saunders and McGovern 1993). This force comes from several different areas. The first is that of the customer—the people who want to buy products from companies who can claim to be environmentally responsible. Firms trying to demonstrate good environmental practices can use ISO 14001 to improve their reputation and externally report or market environmental certification and information. It should be noted that ISO 14001 certification may not be as visible to the end customer as it is to industrial customers, and firms should carefully consider how they will provide credible information regarding environmental product differentiation (Reinhardt 1998) to all customers. The second source of this force comes from international trade. Specifically, the consumers within the European Union may be the most demanding of environmental certifications. After considering the issues of market forces, benefits of certification, and reasons for attaining certification, we posit a positive relationship between all types of customers and EMS certification.

*H3: There is a positive relationship between environmental market forces and ISO 14001 certification.*

3.1.5. **RESOURCE AVAILABILITY.** Attaining ISO 14001 certification is a time-consuming and potentially expensive undertaking. It can be argued that sites must have a certain level of sales and resources before they can consider actively pursuing ISO 14001 certification.

*H4: There is a positive relationship between sales and ISO 14001 certification.*

3.1.6. **NATURE OF CORPORATE OWNERSHIP.** Many firms located in the European Union and Asia are placing a large amount of emphasis on attaining ISO 14001 certification. This emphasis on attaining certification can be expected to be impartable to those sites located in the United States that are either joint ventures with foreign firms or that are owned by foreign firms. The reason for this relationship is that these types of firms may have already adopted the standard in the parent company's home country to meet local demand, and these firms have developed competencies linked to ISO 14001 that render adoption easier in the U.S. Alternatively, publicly owned firms are likely to pursue ISO 14001 certification for many reasons, including a positive relationship between investments in environmental initiatives and stockholder value (Klassen and McLaughlin 1996; Konar and Cohen 2001).

*H5: There is a positive relationship between the nature of corporate ownership (public, foreign, and joint ownership) and ISO 14001 certification.*

3.1.7. PAST EXPERIENCES WITH PROCESS-BASED CORPORATE INITIATIVES. While experience with ISO 9000 is a process-based initiative, our objective is to look at ISO 9000 in isolation. This factor assesses the relationship between ISO certification and experiences with other process-based initiatives. A process orientation is not unique to ISO 14001; it can be found in other corporate improvement initiatives, such as Just-in-Time Manufacturing, Business Process Reengineering, Lead Time Reduction Initiatives, simultaneous engineering, or Design for Environment (Sroufe et al. 1999).

*H6: The more experience a plant has with process-based initiatives, the more likely the plant will adopt ISO 14001 certification.*

These various factors, when taken as a whole, form the nomological framework empirically evaluated in this study. The factors also illustrate that the decision-making process to pursue ISO 14001 certification is a very complex one. This is a process that is influenced by numerous factors, with the nature of these influences yet to be fully determined.

#### 4. Research Methodology

The primary research question is evaluated by using a survey of U.S. managers and their perceptions of ISO 14001 certification. The implementation of a survey allowed the researchers to quantitatively assess the attitudes of the respondents toward environmentally responsible manufacturing, environmental management system, and ISO 14001. The survey was used to identify factors that influence these attitudes and the perceived effectiveness and efficiency of plant environmental management systems. Analysis of the survey data is performed with a Logit model.

##### 4.1. The Survey

The data used in this study were developed and collected in 1997 and 1998 as a part of a research project focusing on Environmentally Responsible Manufacturing and ISO 14001. One of the objectives of this study was to evaluate the attitudes of American managers toward environmentally responsible manufacturing and operating principles, and toward the newly introduced ISO 14001 certification process. Since details regarding the survey's content, validation, and administration have been previously discussed (see Melnyk et al. 1999), we have chosen not to summarize information about its structure and instead discuss the survey administration and resulting sample.

Three contact waves were carried out to 15,000 target respondents consisting of the initial mailing of the survey, a reminder postcard, and a secondary mailing of the survey (Dillman 1978). The data were then entered, verified, and coded, and initial data analysis was done beginning in the Fall of 1998 and ending in early 1999.

##### 4.2. The Sample

Mailing lists of 5,000 names each were obtained from three professional associations (National Association of Purchasing Management, American Production and Inventory Control Society, and one group comprised of manufacturing engineers that wishes to remain anonymous) for a total of 15,000 names. After reviewing the lists, any duplicate names were identified and eliminated. Where possible, the associations were asked to provide names of managers who worked for manufacturers [i.e., in the two-digit Standard Industrial Classification (SIC) code range of 20 to 39 inclusive]. The researchers also worked closely with a major American manufacturer, who provided an additional list of 104 managers at 6 of their facilities. After factoring in these adjustments, the result was an initial mailing list of 14,480 names, of which we received 1,453 usable responses, for a response rate of 10.04%. While lower than the 20% that researchers strive to achieve, this response rate was not unexpected

TABLE 1  
*Response Rates by Wave*

Source of Respondents	1st Wave	3rd Wave	Total	% Returned
Anonymous Group	173	136	309	6.18
APICS	435	197	632	12.64
NAPM	301	199	500	10.00
Total	909	532	1453	10.03

*Note.* Second wave was reminder postcard only. Surveys were sent during the first and third waves to approx. 5,000 potential respondents within each professional association for a total of 1,448 sent during each wave. Twelve surveys were returned from respondents who did not indicate association with any of the three targeted professional associations.

TABLE 2  
*Stated Positions of the Respondents*

Stated Position	Frequency (# Observations)	Percentage (%)
Chief Executive Officer	13	0.9
President	12	0.8
Vice-President	169	11.6
Manager	685	47.1
Senior Management	236	16.2
Staff	309	21.3
Not Listed	29	2.0
Total	1453	100.0

given that the extreme length of the 16-page survey discouraged some potential respondents (a view supported by contacting those people who were sent a survey but who chose not to complete it). The overall response rates by wave are summarized in Table 1.

Our goal at the time of the study was to develop a sample that was broad-based and reflected a diversity of industrial settings. The respondents were asked within the survey to list the principal products produced in their plants. These responses (open-ended) were recoded into an appropriate two-digit SIC code by at least three reviewers of the survey data. The respondents came from a wide range of industries. From the 40-some SIC codes, the bulk of respondents (942 respondents or 64.8% of the respondents) were drawn from SIC codes 34 through 38 and include manufacturing firms involved in industrial and commercial machinery, computer equipment, transportations equipment, electronic equipment, measuring equipment, and fabricated metal products. In addition to the diversity in the industrial settings of the respondents, there is diversity in the position of the respondents themselves. As can be seen from Table 2, the respondents occupied positions ranging from presidents and Chief Operating Officers to managers and staff.

## 5. Data Analysis

A Logit model was used for analyzing the data generated by this large-scale survey. The dependent variable was a dichotomous variable where 0 denoted those plants not actively involved in the pursuit of ISO 14001 certification. These firms were not considering certification, considering certification in the future, assessing suitability, or planning to implement. A value of 1 for this variable denoted a plant actively pursuing this level of certification. These firms were either currently implementing ISO 14001 or had successfully implemented certification.

In this study, the primary unit of analysis was the plant or site. Selection of a plant level

analysis reflects the idea that certification is most often carried out at this level and not at the division, or corporate levels. As previously indicated, the primary dependent variable of interest to this study was dichotomous in nature. Of the 1,453 useful responses received, 1,267 respondents (87.2%) indicated that their plants were not actively pursuing ISO 14001 certification during the survey time period. Furthermore, 77 respondents (5.30%) indicated that ISO 14001 certification was either successfully implemented or currently being implemented at their plants; the remainder (109 respondents or 7.50%) chose not to respond. At the time of the study, there were relatively few firms certified in the United States. In 1998, approximately 200 firms had obtained ISO 14001 certification. Alternatively, there were a very large number of uncertified firms. Our sample is biased in that we have a relatively large proportion of the certified firms in our study. The number of firms in our sample that were involved in actively pursuing certification at the time of the survey is not unexpected, given the standard was released within 2 years of the data collection. The purpose of this study is to examine those firms who are some of the first to adopt ISO 14001. A goal for future research is that of a longitudinal study to assess the antecedents for adoption after a longer period of time since the release of ISO 14001.

The initial assessment of the data set used listwise deletion. This approach led to issues with missing data. Given a relatively large reduction in the data set attributable to missing values, we developed a subroutine for replacing the missing values. Recognizing five major methods available for dealing with missing values: listwise deletion, pairwise deletion, replacement by the mean, EM, and regression, we next discuss the methodology used for replacing the missing values. As noted by Vriens and Melton (2002), the first two methods are undesirable because they are expensive and they usually yield biased and inefficient inferences for the parameters of interest. The third method should also be avoided because the procedure distorts the underlying distribution of the data, making the distribution more peaked around the mean and reducing the variance. Examination of the demographic classifiers using a simple chi-square model showed no significant differences between those cases having missing values and the complete cases. This qualified the data for missing value imputation since the cases appeared to be missing completely at random and not missing due to omitted identifier bias.

Ultimately, we decided to use the EM algorithm. This method is similar to the EM-algorithm encountered in SPSS' MISSING VALUE ANALYSIS 11.5 package. That is, the procedure employed uses pattern recognition combined with a maximum-likelihood estimation to generate the resulting missing values. By the use of this technique, we were able to replace the missing values in the dataset with estimates that were consistent with the underlying answering patterns of the respondents. This technique was very effective, but could not replace all missing values. The procedure was unable to identify any consistent pattern for two of the observed responses.

In assessing the previously described framework, the seven constructs were operationalized by using several sets of survey items. The constructs are summarized in Table 3. In reviewing this table, expansion on several of the operational definitions follows.

### 5.1. *Past Experience with the Formal Certification Process*

This construct is captured by two variables: BQS9 and BISO9, and is similar to the ISO 9000 variable used by Florida and Davidson (2001). These two variables are dichotomous in nature and indicated whether or not the plant is either actively involved in the attainment of QS 9000 or ISO 9000 certification or whether it has attained such certification (either one of these conditions had to be attained before the variables for that plant to be coded as a "1"). Both variables were included because both of these quality standards are similar in structure and objectives. Of the 1,453 respondents, 503 were actively involved with ISO 9000 certification, 984 were actively involved with QS 9000 certification, and 443 plants were actively involved with both certification processes.

TABLE 3  
 ISO 14001 Adoption Framework: Operationalization of the Constructs

Construct/Expected Impact	Variables	Definitions
Past Experience with the Formal Certification Process Expected direction of impact = +	<i>BISO9</i> : 0/1: (1 if pursuing ISO 9000 certification or currently certified; 0 otherwise)	Actively pursuing ISO 9000 certification, or currently ISO 9000 certified
	<i>BQS9</i> : 0/1: (1 if pursuing QS 9000 certification or currently certified; 0 otherwise)	Actively pursuing QS 9000 certification, or currently QS 9000 certified
Status of the Environmental Management System Expected direction of impact = ?	<i>PLANTEMS</i> : 0/1: (1 if present; else 0)	Presence of a formal environmental management system at the plant level
	<i>YEARS</i> : 0/1: (0 if EMS in place for 5 years or less; 1 otherwise)	Years the formal EMS has been in existence
Uncertainty Regarding ISO 14001 Expected direction of impact = -	<i>Operational Uncertainty</i> : Positive Integer: (0 . . . 70)	UNCOPR = $\Sigma$ (UNCCHANG + UNCCOST + UNCBENE + UNCEMS + UNCSUPP + UNCINVE + UNCDISC) Uncertainty regarding the cost/benefit of ISO 14001 and internal and external impacts
	<i>Political Uncertainty</i> : Positive Integer: (0 . . . 40)	UNCPOL = $\Sigma$ (UNCFED + UNCSTATE + UNCLLOCAL + UNCINTER) Uncertainty regarding government originated changes to ISO 14001 certification standard
Market Forces Expected direction of impact = +	<i>ENDSALES</i> : All variables are Integer (0 . . . 100)	Importance of sales to end customers
	<i>EXPORT</i> : <i>EUEXPORT</i>	Importance of exports as a % of sales Importance of EU market
Resource Availability Expected direction of impact = +	<i>CSALES2</i> : All variables are 0/1: (1 if in 2nd quartile of sales; else 0) <i>CSALES3</i> : 1 if in 3rd quartile <i>CSALES4</i> : 1 if in 4th quartile	Corporate Size/level of total sales
Nature of Corporate Ownership Expected direction of impact = +	<i>PUBLIC</i> : All variables are 0/1: (1 if yes; else 0)	Publicly owned
	<i>JOINT</i> : <i>FOREIGN</i> :	Joint Venture Foreign Owned
Past Experience with Process-Based Initiatives Expected direction of impact = +	<i>BTQM</i> : Both variables are 0/1: (1 if present; else 0)	Experience with developments such as TQM, Cross-functional systems
	<i>BXFUNC</i> :	

## 5.2. Status of the Environmental Management System

Similar to identifying if a firm has an EMS (Florida and Davidson 2001; Russo 2001), *YEARS*, along with *PLANTEMS*, is used to operationalize the construct, "Status of the Environmental Management System." *YEARS* describes the length of time that the current environmental management system has been in place. It is implemented as a dummy variable,

where 1 indicates that the EMS has been in place for over 5 years and 0 indicates a system in place for 1 to 5 years. Note that 5 years was the median value. The second component of this construct is PLANTEMS, which is dichotomous. A value of 1 indicates that the plant either has a formal EMS in place or that it is actively implementing one.

### 5.3. *Uncertainty Regarding ISO 14001*

We used two measures of perceived uncertainty for this construct. Both are summations of Likert scales. The first, Political Uncertainty (UNCPOL), is a measure of whether or not potential changes to environmental regulations at various levels of government are highly uncertain (high values of UNCPOL) or well known (low values of UNCPOL). The measure of political uncertainty is a summation of the following variables: uncertainty as to potential changes in environmental regulations at the federal level (UNCFED), the state level (UNCSTATE), the local level (UNCLOCAL), and the international level (UNCINTER). The second measure of uncertainty, Operational Uncertainty (UNCOPR), a measure of the perceived effects of ISO 14001 on costs, benefits, and current operations, is uncertain where higher values indicate higher uncertainty. This summated scale involves uncertainty regarding any changes in the ISO 14001 standards (UNCCCHANGE); the perceived effects of ISO 14001 on: costs associated with obtaining certification (UNCCOSTS), benefits (UNCBEBE), changes to current EMS (UNCEMS), reactions by suppliers (UNCSUPP), reactions by investors (UNCINVE), and disclosure of environmental infractions (UNCDISC).

### 5.4. *Market Forces*

Market Forces are measured by using three dummy variables: EXPORT, EUEXPORT, and ENDSALES. EXPORT measured the percentage of total sales that was destined for export markets, while EUEXPORT measured the percentage of total exports that was consumed by markets located in the European Union. We do not have a measure of sales to industrial customers, but instead use ENDSALES which measures the percentage of total sales that are sold directly to consumers (i.e., the end customers).

### 5.5. *Resource Availability*

This construct is measured by the variables CSALES1, CSALES2, CSALES3, and CSALES4. Because of the variance in sales, it was decided to convert the variables SALES, which was originally reported in dollars in the survey. To alleviate this variation, the data were transformed into a categorical variable (quartiles) to reduce the variance in annual sales, while still maintaining a linear relationship to the dependent variable. This variable was transformed and consists of four levels, where each level corresponds to a quartile of the reported sales for the company, as reported by the respondent. Using an approach suggested by Hampel, Ronchetti, Rousseuw, and Stahel (1986), the first quartile represents the lowest amount of resources available, and the fourth quartile represents the highest amount of resources available. For the purposes of the Logit analysis, the base case was represented by CSALES1 = 1.

### 5.6. *Nature of Corporate Ownership*

Similar research using ownership variables include Florida and Davidson (2001) and Russo (2001). This construct is defined in terms of three dichotomous variables (where 1 indicates "yes"): PUBLIC (publicly traded), FOREIGN (foreign-owned), and JOINT (jointly owned/joint-venture). The base case is represented by the firm being privately owned.

### 5.7. *Past Experiences with Process-Based Corporate Initiatives*

This final construct also reflects previous research by Florida and Davidson (2001) and was evaluated by using two dichotomous variables: BTQM (presence of a TQM system) and BXFUNC (presence of cross-functional teams, programs, or initiatives).

The resulting Logit model is very similar in appearance and structure to a linear regression model. In this study, this model was implemented as a linear or additive model consisting of 7 major constructs and 17 variables. To evaluate the marginal effects of these variables, the Logit model was fitted without a constant.

Operationally, the model had the following structure: DV (certification position) = [Past Experience with the formal certification process (BQS9 + BISO9)] + [Status of the EMS (YEARS + PLANTEMS)] + [Uncertainty Regarding ISO14001 (UNCPOL + UNCCORP)] + [Market Forces (EXPORT + EUEXPORT + ENDSALES)] + [Resource Availability (CSALES2 + CSALES3 + CSALES4)] + [Nature of Corporate Ownership (PUBLIC + FOREIGN + JOINT)] + [Past Experience with Process-based Initiatives (BTQM + BXFUNC)].

Table 4 provides the correlations among the variables used for past experiences with formal certification processes, the status of the environmental management system, and past experiences with process-based initiatives in this study. By focusing on these “operations”-based variables, we are looking for highly correlated variables across constructs outside of uncertainty, market forces, resource availability, or nature of corporate ownership. Eleven of the 15 variables are positive and significantly correlated with YEARS, BQS9, BISO9, BTQM, and BXFUNC lacking a significant correlation. The significant relationships are not that surprising given the large sample size. Summary information of significant correlations for all variables in the study ranged from  $-0.3679$  between CSALES 4 and CSALES1, to one correlation above 0.350 (between EXPORT and EUEXPORT at 0.6791). Overall, the correlations are relatively small and do not indicate problems with highly correlated variables and the need to further combine constructs.

Because of outlier-prone error distributions, it was decided to enhance the efficiency of the Logit procedure in estimating the standard errors by using a robust version of STATA’s Logit model. As a result, the Huber/White/sandwich estimator of variance was substituted for the variance calculated by using traditional methods. The results are summarized in Table 5. To simplify interpretation, the coefficients are reported in the table.

Overall, the Logit model is statistically significant. This model does better at identifying those plants that are *not* pursuing ISO 14001 certification than it does at predicting those pursuing certification. While this model correctly classified over 95% of those plants that did not pursue ISO 14001 certification, it correctly classified just over 55% of those actively pursuing this form of certification.

In reviewing the results presented in Table 5, it is interesting to note that, of the 17 variables analyzed, only 8 were found to have a significant impact on the ISO 14001 certification decision at either the 0.01 or 0.05 level. The six variables making up “nature of corporate ownership,” and “resource availability”—factors previously identified as being potentially important—were found to have no significant influence on this decision at the 0.05 level. For the remaining 3 nonsignificant factors (BQS9, EXPORT, EUEXPORT), the

TABLE 4  
Correlations

Variable	1	2	3	4	5	6
BQS9 (1)	1					
BISO9 (2)	0.309*	1				
YEARS (3)	$-0.066^{na}$	$-0.051^{na}$	1			
PLANTEMS (4)	0.223*	0.167*	$-0.068^*$	1		
BTQM (5)	0.248*	0.228*	$-0.012^{na}$	0.247*	1	
BXFUNC (6)	0.188*	0.221*	$-0.024^{na}$	0.178*	0.359*	1

\*, Correlation significant at the 0.01 level.

<sup>na</sup>, Correlation not significant.

TABLE 5  
*Logit Model—Statistical Results*

Constructs	Independent Variables	Coefficient	Robust Std Error	Significance
Past Experience with the Formal Certification Process	BQS9	-0.4611	0.2845	0.105
	BISO9	-0.6193	0.1795	0.001***
Status of the Environmental Management System	YEARS	-0.7465	0.2642	0.005***
	PLANTEMS	2.1377	0.2494	0.000***
Uncertainty Regarding ISO 140	UNCOPR	0.0515	0.1006	0.000***
	UNCPOL	-0.0318	0.0161	0.048**
Market Forces	EXPORT	-0.0047	0.0079	0.552
	EUEXPORT	0.0127	0.0115	0.270
	ENDSALES	-0.0125	0.0041	0.003***
Resource Availability	CSALES2	-0.5107	0.2876	0.076*
	CSALES3	-0.5222	0.3204	0.103
	CSALES4	0.5257	0.2792	0.060*
Nature of Corporate Ownership	PUBLIC	0.1224	0.2237	0.582
	FOREIGN	0.2284	0.2836	0.421
	JOINT	-0.3929	0.6025	0.514
Past Experience with Process-Based Initiatives	BTQM	-0.6598	0.2263	0.004***
	BXFUNC	-0.4993	0.1982	0.012**
	Number of Observations	1451		
	Wald Chi <sup>2</sup> ( <i>d</i> = 17)	404.71		
	Prob > Chi <sup>2</sup>	0.000		
	Log Likelihood	-333.5609		

\*, Significant at the 0.10 level.

\*\*, Significant at the 0.05 level.

\*\*\*, Significant at the 0.01 level.

direction of the relationships with the significant variables was, in most instances, not consistent with the predicted directions.

The first major factor evaluated was that of “past experience with the formal certification process.” Of the two variables that comprised this factor, only one, BISO9, “Past experience with ISO 9000 certification,” was found to have significant impact, and therefore, hypothesis 1 is not supported. However, instead of the positive relationship strongly implied in the literature, the relationship was negative. The results indicate that those plants that have been or that are currently attaining ISO 9000 certification are less likely to pursue ISO 14001 certification at the time of this study. Information from our field studies suggests that firms having difficulty with ISO 9000, or a bad experience with the certification process, were reluctant to subject themselves to the headaches of yet another audit and certification process. Alternatively, some firms with past experience involving ISO 9000 may already have an EMS modeled after ISO 9000 requirements, and simply do not see the need for third party certification.

The variables that make up the factor, “status of the environmental management system,” paint a mixed picture. While the presence of a formal EMS tends to increase the likelihood of a plant pursuing ISO 14001 certification, this increase in likelihood is offset by a negative interest in those plants that have an established EMS of more than 5 years. Taken as a whole, these results would argue that those plants with young, fairly new EMS are more likely to pursue ISO 14001 certification, while those plants that have well-established environmental management systems have less interest in this environmental standard and may even feel their system exceeds ISO standards. While the arguments for or against the relationship

between an EMS and certification are mixed, our results contribute to a better understanding of what is happening with this factor.

While political uncertainty (UNCPOL) was not found to have any significant impact on the likelihood of a plant pursuing ISO 14001 certification, the same could not be said of operational uncertainty (UNCOPR). This factor was found to have a strong positive, rather than the hypothesized negative influence. What this argues is that plants that experience the highest level of uncertainty about ISO 14000 certification, its costs, benefits, and impacts are also the most likely to pursue ISO 14001 certification. The findings, while interesting, need to be better understood. Developing a better understanding of the Logit analysis leverages the field research from our previous studies.

The final finding that does not support the type of relationship originally hypothesized involves market forces and hypothesis 3. Of the variables making up "market forces," only one, ENDSALES, was significant. However, the direction of the relationship was negative. This implies that the more a plant deals with and sells directly to the end customer (or consumer), the less likely it is to actively pursue ISO 14001 certification. Conversely, this indicates that the more the plant sells to industrial customers, the more likely it is to pursue ISO 14001 certification. This result is also supported by our previous field study research.

Hypotheses 4 and 5 involve resource availability and the nature of corporate ownership. Resource availability only weakly supports our claim that firms with more resources are more likely to pursue certification at the 0.10 level of significance. It appears that there are mixed results regarding resource availability, and the nature of corporate ownership does not appear to have a significant impact on ISO 14001 certification.

When assessing the factor "past experience with process based initiatives" and hypothesis 6, there are significant relationships at the 0.05 level with BTQM and BXFUNC. Here, we find the direction of the relationship not consistent with the posited relationship. It appears that, even though a plant may be adept at cross-functional activities, they may not want to take part in ISO 14001 certification. These results are partially supported by the field research in which some firms just didn't want to go through another audit and certification process. This may also suggest that firms more likely to pursue certification are those firms that lack cross-functional integration and look to the ISO certification process to help facilitate process level initiatives.

## 6. Discussion

When the findings generated from both the Logit analysis of the survey and our previous field research are combined, an interesting picture of the ISO 14001-implementation process emerges. The groups of plants who choose *not* to actively pursue ISO 14001 certification are influenced by several distinguishable factors.

Those plants not actively pursuing ISO 14001 certification are driven primarily by economic factors. This assessment indicates lack of compelling, quantitatively-based economic reasons for pursuing ISO 14001 certification. At the time of the survey, these managers see few economic reasons for being ISO 14001 certified. Selling primarily to end customers, these plants may not see any real demand from their customers for this form of certification. Furthermore, the management of these sites see the benefits as being potential and not certain. If these sites have had prior experience with attaining ISO 9000 certification, then they are very aware of the time and resource implications of getting third-party certification. They know that this is not a minor undertaking.

Within the group of firms not pursuing certification, there are sites that have well-established environmental management systems. Managements of these plants see little additional benefits to be gained from pursuing ISO 14001 certification. The feeling is that their plant's current EMS are more than adequate to meet the plant's current and future needs.

As a result, plants falling into this first category have taken a “wait and see” attitude toward certification.

On the other hand, there are those plants that have decided to actively pursue ISO 14001 certification. These managers, unlike the preceding group, exhibit a great deal more diversity. There are several different reasons for pursuing ISO 14001 certification. Evidence from our field research suggests that certification is perceived as being the “right thing to do.” These plants are doing so either because of their past proactive experiences with environmental management or because of a corporate culture that emphasizes stewardship and environmental responsibility. These plants are willing to make the investment necessary to attain ISO 14001 certification, without necessarily expecting an immediate economic return on their investments.

The second reason for pursuing ISO 14001 certification is that management perceive this as a way of either implementing a formal EMS or of improving the performance of their current systems. In this latter case, the systems tend to be relatively new and there may be a lack of cross-functional process level activities. This could explain the reason that the Logit analysis generated a situation where PLANTEMS increased the likelihood of pursuing ISO 14001 certification, while the age of the current EMS (particularly if the current system was well established) reduced the likelihood of pursuing certification.

The third reason involves customers. Our results show that end consumers are not driving the EMS certification adoption trend, and sales to end customers has a negative relationship with ISO 14001 adoption. When reviewing our field studies, industry customers emerged as a driving force for sites to make a commitment to obtaining certification. Because management see their customers pursuing ISO 14001 certification, they expect that eventually they will be required to have similar systems in place and to attain the same type of certification (Melnik et al. 1999). Examples of this behavior were encountered when suppliers to Ford began to actively pursue ISO 14001 certification because they saw Ford formally committing itself to having all of its North American manufacturing plants ISO 14001 certified (Anonymous 1999).

Plants making the decision to pursue ISO 14001 certification due to industrial customer requirements or pressures had to first learn more about the standards, its requirements, and its implications. It is in the process of learning more about ISO 14001 that the management becomes aware of the uncertainty surrounding a new certification. The result is that the chain of causality runs counter to the one proposed and tested in this study. This initial chain argued that management would first want to learn about ISO 14001 certification, its requirements, and its potential implications before making the decision to pursue ISO 14001 certification. This chain is consistent with informed decision-making. Instead, the findings indicate that the direction of causality should be reversed. It runs from the decision to actively pursue ISO 14001 certification to uncertainty. Additional support for this counterintuitive finding can be seen when looking at firms that are the first to adopt a new initiative and the results of the operational uncertainty variable. These innovative firms might in principle be willing to try something new *because of* the uncertainty associated with it. This explanation is also consistent with the view that most nonimplementers are relatively ignorant of ISO 14001—a view noted by Litsikas (1999) and reinforced by the evidence generated from our field research.

Before leaving this discussion, it is important to note that, at the time of this study, ISO 14001 certification was in its early stages of adoption in the United States (Corbett and Kirsch 2001). As a result, those firms pursuing ISO 14001 certification may be behaving like innovators, and early adopters (Moore 1999). There does not appear to be enough support to persuade the early majority, late majority, and laggards to pursue ISO 14001 certification. The results of this study provide an opportunity for longitudinal research to explain the transition of manufacturing firms from a position of noncertification, to that of actively pursuing certification long after the release of the ISO 14001 standard.

## 7. Concluding Comments

The results of the study contribute to theory development by providing new and unique insights into ISO 14001 certification. It appears that we can explain why firms choose not to obtain certification, but it is more difficult to explain why some firms are the first to adopt a new environmental standard. Our analysis shows that early adopters of ISO 14001 are motivated by qualitative factors, while the initial nonadopters are motivated by economic factors.

The ISO 14001 certification standard represents a real management issue to most American manufacturing sites surveyed. While it promises improved environmental performance combined with the credibility offered by third-party certification, the benefits offered by ISO 14001 are still perceived as more potential than real. While eagerly accepted by manufacturing sites in Japan, Germany, the U.K., Spain, Germany, and Sweden, ISO 14001 certification has received limited acceptance in the United States. What this study has tried to do is to address a basic question: (1) Why do certain sites actively pursue ISO 14001 certification, while other sites are not interested in this certification?

By drawing on two complementary methodologies, this study has reinforced the view that there is very limited acceptance of the ISO 14001 certification during the time of this study. For those sites that have decided to pursue attaining this new certification, this decision is based on either noneconomic reasons or the expectation that certification will eventually become a requirement of doing business with the plant's industrial customers. It is only after the decision to pursue ISO 14001 certification is taken that management learns more about this new standard and its effects. In contrast, for those sites that have decided not to become ISO 14001 certified, the decision is based on economic grounds—a comparison of the costs (which they know, especially if they have been ISO 9000 certified) and the benefits, which are uncertain. Most of these sites have taken a strong “wait and see” approach to certification.

During the late 1990s, ISO 14001 certification was at an early stage of acceptance. It is possible that, as plants both within and outside of the United States gain more experience with this standard, these attitudes and positions toward ISO 14001 certification will change. As a result, the information presented in this study should be viewed as representing one point in time. There is a need for further research into this topic—research aimed at determining whether the perceptions and decisions made about ISO 14001 have changed and why. Additional research is needed to see if the early adopters of standards outperform other firms within the same industry and if this performance can be sustained. Future research should also address industry effects of attaining ISO 14001 certification and look for evidence of relationships between ISO certification, environmental, and financial performance.<sup>1</sup>

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