Journal of Environmental Planning and Management
Vol. 51, No. 3, May 2008, 421–445

Routledge
Taylor & Francis Group

The ISO 14001 environmental management standard in Japan: results from a national survey of facilities in four industries

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(*Received May 2007; final version received October 2007*)

Since establishment of the ISO 14001 environmental management system in 1996, Japanese facilities have led the world in numbers of certifications. This research utilises survey data from more than 1700 Japanese facilities as well as follow-up interviews to identify the determinants of ISO certification, to examine the differences between early, recent and in-process certifiers, and to understand how ISO 14001 certification affects various environmental and managerial outcomes in Japan. Findings show that ISO certified facilities are larger and report higher levels of environmental management capacity. In addition, early certifiers are more likely to have established voluntary environmental agreements and are more active in international trade and business. Findings also provide evidence that while many facilities believe that ISO 14001 certification is excessively costly, they also report that certification has resulted in the establishment of new energy efficiency and waste reduction targets and higher target levels. Nevertheless, evidence indicates that certification does not generally result in longer-term outcomes such as post-certification adjustment of non-regulated targets.

Keywords: ISO 14001; EMS; voluntary programme; Japan; facility environmental behaviour

1. Introduction

Since the 1980s, governments and industry associations have significantly increased their promotion of and reliance on voluntary environmental policies as a means of encouraging firms to establish management and operational practices that reduce pollution and increase material and energy efficiencies. The term 'voluntary policy' now encompasses a wide range of programmes that employ explicit or implied regulatory and market incentives to obtain commitments from polluters in service and manufacturing industries to reduce the environmental damage for which they are responsible. The prevalence of voluntary policies and programmes is representative of a broader shift toward more flexible instruments and away from standards-based regulation.

Although voluntary environmental policies are often created outside the regulatory and legislative processes (Baggott 1986, Glasbergen 1998, Labatt and Maclaren 1998), research has shown substantial variability in their rates of adoption and effectiveness. Some voluntary programmes result in pollution abatement beyond that required for compliance (Arora and Cason 1996, Konar and Cohen 1997, Khanna and Damon 1999,

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ISSN 0964-0568 print/ISSN 1360-0559 online

DOI: 10.1080/09640560801979683
http://www.informaworld.com

Bjørner and Jensen 2002, Potoski and Prakash 2005a), others do not (King and Lenox 2000, Gamper-Rabindran 2006). Governments may prefer voluntary systems because administrative costs are lower and the political complexities typically encountered with traditional forms of legislated regulation are higher. The willingness of firms to incur the costs associated with adopting and implementing a voluntary environmental initiative is generally understood to be a function of the economic, regulatory, informational or societal benefits that they receive (Andrews 1998, Delmas 2002, Khanna and Anton 2002, Lyon and Maxwell 2004, Rivera *et al*. 2006). Therefore, the effectiveness of a voluntary policy depends upon competent design that clearly links substantive incentives and disincentives to the environmental behaviour of firms.

ISO 14001 is a global voluntary environmental standards programme (EMS) instituted by the International Standards Organization in 1996. The standard is an internationally recognised system for the improvement of organisation-level environmental performance through the minimisation of harmful environmental effects and continual improvement (ISO 2006a). Since its establishment, Japanese industry has led the world as the most enthusiastic adopter of ISO 14001, both in terms of the number and percentage of certified facilities. Prior research has demonstrated that much of the explanation for high rates of adoption lies not only with the characteristics of the facility, but also with Japan's long-term experience with voluntary policy, encouragement through administrative guidance, and efforts by Japanese industry to improve its environmental image (Welch *et al*. 2004, Welch and Hibiki 2003, Welch and Schreurs 2005). Despite this, little in-depth knowledge exists about the process of adoption and integration of ISO 14001 by Japanese industry. Using survey and interview data that were collected as part of a national study of Japanese manufacturing facilities in 2002, this paper seeks to add to knowledge about the determinants of ISO 14001 certification in Japan and the effects that certification has had on environmental changes in the firm.[1] Of particular interest is the examination of differences in internal characteristics, external pressures and voluntary environmental activities undertaken depending upon the stage of adoption – some facilities were early adopters, others were more recent, others were currently undergoing certification, and still others were non-adopters.

After this introduction, the paper is divided into five sections. The next section presents some information about the ISO 14001, its history and some general information on environmental policy in Japan. The following section examines the relevant voluntarism literature, while the next section gives an explanation of the data, methods and variables used in the analysis. There is then a look at the descriptive statistics of the survey data and findings from regression analyses. Findings from a series of interviews are presented that provide further insights into the determinants and outcomes of certification. The paper concludes with a discussion of the implications of the findings.

2. ISO 14001 in Japan

The diffusion of the ISO 14001 environmental management system in Japan has taken place within a broader context of recent environmental policy and 'green' corporate initiatives. Since the 1990s, the Japanese government has enacted a number of laws that have sought to strengthen national environmental regulatory efforts, project a greener international persona, and establish Japanese environmental leadership at a global level (Welch and Schreurs 2005). For example, the Basic Law for Environmental Protection, the Basic Environmental Plan and the Law for Promoting the Measures to Arrest Global Warming were all enacted in 1993, 1994 and 1999, respectively. In addition, the Japanese

government has sought to enhance Japan's environmental research capacity, environmental educational effort and global environmental leadership during the past decade (Schreurs 2002). For example, Japan hosted a number of international environmental conferences, including the Third Conference of the Parties to the Framework Convention on Climate Change where the Kyoto Protocol addressing greenhouse gas emissions was formulated (Tsuru 1999, Schreurs 2002).

Similar to the governmental initiatives, Japanese companies have also recently made concerted efforts to portray a more environmental image and have often promoted their global leadership in energy efficiency, air pollution control and recycling. Despite clear environmental strengths, Japanese corporations have often been accused of fostering environmentally damaging construction projects and business activities in Japan and abroad. In the 1990s, Japanese companies and corporate groups became more active promoters of environmental activity, including green marketing, and established new environmental offices and voluntary environmental programmes (Welch and Schreurs 2005). Therefore, ISO 14001 certification represents one additional opportunity to demonstrate environmental commitment and leadership for both industry and government.

ISO 14001 articulates a set of required steps that organisations must undertake prior to successful certification: definition of an organisational environmental policy; identification of environmental aspects production and service activities; the establishment of clear environmental objectives and targets; the creation of plans for implementation, actual implementation, monitoring and evaluation, and periodic management review (Glover Ritzert 2000, Delmas 2002).[2] Certification and continued compliance with the standard also requires that facilities undergo a series of third party audits (Delmas 2002, King *et al.* 2005).

ISO 14001 certification is typically an expensive undertaking that encompasses substantial direct and indirect costs; Andrews *et al.* (2006) found an average direct cost of $40,000 in the US (for other estimates see Delmas 2002). The organisation typically bears the entire financial burden of certification because most governments do not provide subsidies. For example, survey findings in this study show only negligible specific financial assistance by the parent firm or by local, provincial and national governments for facility certification. Nevertheless, adoption levels of ISO 14001 have consistently been higher in Japan than in other nations, and they continue to rise (ISO 2006b), indicating that benefits to certification must still be evident, even if the level or characterisation of benefits may have changed over time.[3]

ISO 14001 is now the most widely adopted EMS in the world with over 90,000 facilities officially recognised (ISO 2006b). Although the number of certifications in Japan continues to grow, its proportion of total world certifications has held constant since about 1999 at about 20% (Table 1). As of December 2004, nearly 20,000 of the world's 90,000 ISO 14001 adopters were Japanese; the next closest nations in terms of global share

Table 1. ISO adoptions in Japan and the world, 1999–2004.

	1999	2000	2001	2002	2003	2004
Japan	14106	22897	36765	49449	66070	90569
World	3015	5556	8123	10620	13416	19584
Japan%	21.4	24.3	22.1	21.5	20.3	21.6

Source: Japan Standards Association (2006).

were China at 8862 (9.8%), Spain at 6473 (7.1%), and the United Kingdom at 6253 (6.9%).

The extent to which ISO 14001 certification actually leads to environmental improvement has received some attention by researchers; however, some findings indicate positive effects of certification (Potoski and Prakash 2005a) while others are more tentative (Andrews *et al*. 2006). Recent findings by King *et al*. (2005) indicate that while it might be too early to tell, ISO 14001 certification appears to be associated with the establishment of an EMS, and while the existence of an EMS is associated with improvement in environmental performance, ISO certification is not.

3. Literature

Key determinants of adoption behaviour of voluntary environmental initiatives can be separated into two main categories: internal characteristics of the organisation such as size, management capacity and commitment, and external factors such as economic incentives and regulatory coercion.

Numerous studies on adoption of voluntary policies have found that the size – number of employees or size of the budget – to be an important, if not often the most important, determinant of firm adoption (Arora 1995, Videras and Alberini, 2000, Rivera *et al*. 2006). Larger organisations are more likely to have greater resources to draw on that enable them to better identify, evaluate and implement voluntary environmental opportunities. Larger firms may also be more likely to benefit from voluntary adoption as they may be more visible to external stakeholders and may be more able to 'self-promote' their own accomplishments to customers and regulators. Specifically, with respect to ISO 14001, researchers have consistently found size to be an important indicator of certification (King *et al*., 2005, Potoski and Prakash 2005a). In line with much of the literature, it is expected that larger facilities are more likely to be early adopters of ISO 14001. Similarly, it is expected that those facilities which are better endowed with resources dedicated to environmental management – human and financial resources as well as specific environmental structures and decision making authority – will also be more likely to be early adopters of ISO 14001. Higher levels of these types of dedicated resources probably result from greater prior experience with regulatory demands, stronger facility level environmental commitment, and a greater diversity of environmental outputs that require dedicated allocation of resources.

Attitude, beliefs and values are characteristics of individuals in organisations that are rarely examined, but they are potentially important determinants of voluntary environmental behaviour. This construct would include such factors as the level of perceived responsibility and accountability to society for environmental performance and beliefs about the extent that environmental management systems could deliver improved environmental benefits. Recent work by Rivera and de Leon (2005) shows that the background and knowledge of top decision makers are associated with decisions of hotels to adopt voluntary environmental programmes. Presumably these factors contribute to the beliefs and attitudes of the range of decision makers in an organisation. This construct recognises that attitudinal factors represent determinants of adoption that are separate from desires to improve the public environmental image of the facility for a particular audience of customers, regulators or other external stakeholders. The current study expects that facilities reporting higher levels of social responsibility and better attitudes toward environmental management systems will be more apt to certify earlier.

Prior research has theorised clear links between the likelihood of voluntary policy adoption and the expected level of economic benefits (Segersen and Miceli 1998, Delmas and Terlaak 2001). Economic benefits can manifest themselves through the establishment of a preference system for ISO certified facilities; certification may act as a signal to outside entities that enables special access to resources or special treatment. Potoski and Prakash (2005b) point out that ISO 14001 certification may signify ''joining the club and adhering to its standards'' (p. 235). Although club membership is costly, it also provides certain benefits such as business access to other club members and recognition by regulators and customers. King *et al*. (2005) theorise that certification ''reduces 'information asymmetries' between suppliers and potential buyers'' (p. 1092). Information asymmetries that extend across national borders may be particularly high, making ISO 14001 certification a possible mechanism for communicating environmental quality to potential business partners. King *et al*.' s (2005) research finds strong evidence in support of the theory. Some find that more export oriented Japanese facilities are more likely to become ISO 14001 certified (Welch *et al*. 2001), while others show that facilities adopt ISO 14001 to facilitate international trade (Chan and Li 2001).

Firms may also volunteer as a means of signalling the quality of their environmental practices to potential customers or investors (Lyon and Maxwell 2004). Prior research has shown that adoption of a voluntary programme may attract investors who are seeking firms that can potentially exploit future market opportunities (Hamilton 1995, Khanna *et al*. 1998, Khanna and Damon 1999) or because their voluntarism is indicative of environmental practices that lower investment risk (Williams *et al*. 1993, Khanna and Damon 1999). Firms may also volunteer to satisfy consumer demands for evidence of environmentally responsible behaviour or products (Williams *et al*. 1993, Arora and Gangopadhyay 1995, Arora and Cason 1996). Hence, facilities that voluntarily adopt ISO 14001 may be searching for sources of competitive advantage, new market and capital opportunities or customer recognition. This study expects that facilities will be more likely to undergo early ISO 14001 certification when they are more dependent on international trade and when they perceive higher benefits of ISO certification to their own economic competitiveness, they will be more likely to seek certification.

The literature on voluntary environmental behaviour also shows regulatory pressure to be an important determinant of adoption and compliance (Segerson and Miceli 1998, Videras and Alberini 2000, Potoski and Prakash 2005b). The regulatory benefits to voluntarism could include reduction of regulatory pressure, reduced reporting requirements or pre-emption of future regulations (Arora and Cason 1996, Khanna *et al*. 1998, Clemens and Douglas 2006, Decker 2003). In Japan, regulatory considerations involve both national standards and a long-established system of highly decentralised local pollution control agreements, which are negotiated between a company and the local government for a specific facility when it is constructed or expanded (Tsutsumi 2001, Welch and Hibiki 2003). Local agreements in Japan are widespread, but because not all facilities have adopted them they are often considered to be voluntary. Moreover, the agreements often require substantial commitments to pollution reduction that extend beyond national level regulations, commitments which are monitored by local government to varying degrees depending on the location (Welch and Hibiki 2002). As a result, the regulatory environment in Japan includes both traditional command and control regulations as well as a strongly embedded system of voluntary agreements. National regulations in Japan are similar to traditional coercive pressures on firm adoption behaviour generally described in the literature. However, because local pollution control

agreements are negotiated locally and facility specific, their development by a facility may represent a certain level of experience with ISO-like activities. For example, pollution control agreements typically require the identification of environmental aspects, development of a pollution control plan, implementation of the plan and some level of external oversight. As such, pollution control agreements represent one type of quasi-environmental management system and facilities experienced with their implementation may be more able and more likely to become ISO 14001 certified.

Finally, to distinguish between early adopters, later adopters and non-adopters, it is also important to account for some of the environmental activity that might have been undertaken as a result of ISO 14001. Such environmental activity variables might include the number, type and level of non-regulated environmental performance targets, the extent to which the facility allows public disclosure of environmental information and the breadth of environmental activity. The study expects that ISO 14001 will be associated with higher levels of all of these, especially targets and breadth of environmental activity. An adoption model would also need to recognise that certification rates vary across industries.

The above discussion is summarised by the following model:

ISO Adoption = (Size, Environmental Management Resources, Attitude and Perspective, Economic Benefits, Regulatory Pressure, Environmental Activity, and Industry)

4. Data and methods

This paper utilises data from a written survey of managers in private sector Japanese facilities administered under the auspices of the National Institute for Environmental Studies, the research institute for the since renamed Ministry of the Environment in Japan between March and May, 2001. The data were collected according to the standard Dillman (2000) method of survey administration. The sample frame included ISO adopters and non-adopters in four industries: electronics, electrical power, electric machinery and chemical manufacturing. A total of 3227 facilities were selected from two separate sources. First, the names and contact information for all 1515 ISO adopters were obtained from the Japan Accreditation Board for Conformity Assessment (2006), which is the primary ISO accrediting body in Japan. Second, a size-stratified random sample of non-adopters was selected from the Japan Statistics Bureau's List of Manufacturing Facilities, subsequent to removal of ISO adopters (1999).[4] Of the 1515 surveys sent to ISO adopters, 1237 (82%) returned completed responses and of the 1712 non-adopters surveyed, 481 (28%) provided usable responses. A total number of 1718 responses were received. Among respondents, approximately 48% classified themselves in the electric machinery industry, 25% in chemical, 8% in electronics and 9% in the electrical power industry. The remaining 10% were not classified because they claimed that their main product line was not in one of the four industries.

Survey response bias may be an issue because only 'greener' and more regulatory compliant facilities may have chosen to return completed surveys. Poorly performing ISO adopters and non-adopters may have self-selected out of the study. To partially assess response bias, the study compared facility size of certified respondents and non-respondents with the population of respondents and non-respondents in each industry. Analysis showed that certified respondents do not differ statistically from certified non-respondents. Although it is still possible that non-certified non-respondents differed

significantly from non-certified respondents in ways not captured by size, it was not possible to test it statistically because the data are not available. Nevertheless, because response bias may be an issue in this study, care should be taken when interpreting the results.

In addition to the survey data, a series of interviews were also conducted of ISO adopters. Twenty-one facilities were randomly selected from the respondents.[5] Selection was stratified along two dimensions: industry and experience with ISO certification renewal. Ten facilities were selected at random from the electric machinery industry, five from electronics and five from the chemical industry. Although the electric power industry was not of primary interest in this study, one facility was selected at random from the 10 largest power producers in Japan for the interviews. Stratification by ISO recertification experience was carried out to roughly distinguish earlier adopters from later adopters. Half of the facilities chosen, including the electric power facility, had had experience with renewal, half had not. Of the 21 selected facilities, 15 agreed to be interviewed: six chemical manufacturing, five electrical machinery, three electronics, and one electric power facility. Interviews were conducted between February and March 2002; all interviewees comprised personnel from each facility's environmental management division. Each interview lasted approximately two hours and was divided into four parts: basic information including certification history and primary products, expected benefits of ISO 14001 prior to adoption, decision-making processes that lead up to the facility's commitment to adopt ISO 14001, and managers' evaluations of the economic and other benefits that have resulted from adoption. Questions were open ended and personnel were encouraged to provide detail and examples to accompany many of their statements and observations.

The paper next examines the descriptive statistics used in the analysis to identify trends and associations that are useful for gaining a baseline understanding of the survey content and responses. After, results from both dichotomous adopt/non-adopt probit and ordered probit models are presented. The dependent variable in the ordered probit estimations is the timing of ISO certification: early certified facilities, more recent certified facilities, facilities currently undergoing certification and non-certified facilities. By choosing timing of certification, it is possible to examine whether different facility characteristics and external factors were important for early versus later adopters and non-adopters. It is also possible to examine whether voluntary targets and other activities that are supposedly spurred by ISO 14001 are more evident for early adopters, where the EMS has been established longer, than for later adopters and non-adopters. It is recognised that the analysis of cross-sectional data limits the extent to which causality can be inferred from the statistical associations. However, the inclusion of qualitative findings from interviews with facilities provides further support for inferences about associations found in the regression estimations.

4.1. Descriptive statistics

To better understand the distribution of size and organisation type of facilities that responded to the survey, first, five separate categories of certification were established. The five categories included: early certifiers, recent certifiers, current certifiers, non-certifiers and adopters of other environmental management systems. Facilities were considered to be 'early certifiers' if they had received their ISO 14001 certification prior to 1999. 'Recent certifiers' had received certification within the two years prior to the survey, 'current certifiers' were in the process of becoming certified when the survey was conducted, and 'non-certifiers' had either considered adoption and dropped the idea or had never

considered adopting ISO 14001. The fifth category was checked by facilities if they indicated adoption of a different EMS than ISO 14001. The last row of Table 2 provides column totals for the five different categories. In this sample, early adopters outnumber all other categories, while non-certified facilities represent only 35% of the total sample. Table 2 shows that branch manufacturing facilities (in italic) make up the greatest portion of all facilities (942, 55%) and that approximately 82% of all branch manufacturing facilities (771) in the sample were either already certified or were undergoing certification.

Table 3 provides a frequency table showing that most of the facilities surveyed are small- to medium-sized (85% are under 1000 employees) and that these facilities make up the vast majority of all certified and 'in-process late adopter' entities in the sample. By contrast, about half of the non-adopter facilities have fewer than 50 employees. The difference in size distribution probably indicates that the high cost of ISO 14001 certification outweighs the possible benefits that certification provides for small facilities.[6]

As is noted above, the level and rate of adoption of ISO 14001 in Japan have consistently been higher than in other nations. To help to understand if the high rate of certification was due to government provided subsidies, facilities were asked a series of questions about the percentage of the ISO 14001 certification costs paid by the parent firm, facility, province and municipality. Results showed that while 85% of the time facilities

Table 2. ISO 14001 adoption status by organisation type.

Organisation Type	Early certifier (pre-1999)	Recent certifier (1999–2002)	In process certifier	Non-certifier	Other EMS	Total[a]
Independent Company	94	72	11	31	3	211
Corporate headquarters	98	135	45	57	7	342
Branch manufacturing facility	*414*	*357*	92	69	10	942
Branch non-manufacturing facility	28	29	44	18	23	142
Branch administrative facility	5	7	6	6	9	33
Other	10	11	12	5	0	38
Total	649	611	210	186	52	1708

Note: [a]This total is 10 observations fewer than the total number of survey responses due to missing values for organisation type.

Table 3. ISO adoption status by number of employees.

Employees	Early certifier (pre-1999)	Recent certifier (1999–2002)	In process certifier	Non-certifier	Other EMS	Total[a]
Fewer than 50	27	43	23	92	14	199
50–299	*138*	*277*	72	52	22	561
300–999	*303*	*241*	91	38	11	684
1000–4999	166	46	22	4	4	242
5000 or more	13	2	1	0	1	17
Total	647	609	209	186	52	1703

Note: [a]Discrepancies between Tables 1 and 2 are the result of additional missing values for the total employee variable.

paid all of their own costs, the parent firm paid all of the certification costs in 2% of the cases and some combination of facility, parent and government were involved in cost sharing in 13% of the cases. However, respondents reported that only in 1.4% of the cases did provincial or municipal governments provide financial assistance, and that in none of those cases did the contribution exceed 20% of the total costs. It appears that direct financial government assistance played only a small part in spurring certification rates in Japan.

Table 4 provides descriptive statistics for the variables used to measure the five constructs presented in the previous section – size and resources, attitude and perspective, economic benefits and competitiveness, regulation and environmental activity – across four different categories of certification. Descriptive statistics for the 'Other EMS' category are not included in this Table because the study is only interested in ISO responses from this point forward in the paper. While the specific questions used in the analysis are presented in Appendix 1, the following paragraphs integrate descriptions of the measures used with observations about the empirical findings.

In general, Table 4 is striking in terms of the trends that appear across the columns, increasing or decreasing, for many of the variables. For example, all of the size and resource measures are clearly correlated with stage of adoption. The 'Number of employees' variable is measured using a categorical survey question in which respondents selected a range of employees working at the facility. 'Environmental labour' is measured as an actual number of full-time equivalent (FTE) employees who spend most of their time

Table 4. Descriptive statistics.

	Means and standard deviations			
	Early certifier (pre-1999)	Recent certifier (1999–2002)	In process certifier	Non-certifier
Size and resources				
Number of employees	3.00 (0.85)	2.49 (0.75)	2.55 (0.84)	1.75 (0.85)
Internal resource capacity	15.17 (3.46)	14.30 (3.48)	14.68 (4.50)	10.75 (3.97)
Environmental labour	6.12 (9.25)	4.34 (7.62)	3.56 (6.23)	0.94 (2.33)
Environmental division	0.92 (0.26)	0.90 (0.30)	0.77 (0.42)	0.28 (0.45)
Environmental decision making	5.39 (2.37)	5.21 (2.46)	4.64 (2.85)	1.55 (2.60)
Attitude and perspective				
EMS attitude	12.52 (1.62)	12.45 (1.73)	12.29 (1.98)	10.41 (2.68)
Facility social responsibility	15.34 (3.43)	15.28 (3.14)	13.98 (1.53)	14.16 (3.28)
Economic benefits/competitiveness				
Percent revenues from Japan	76.76 (26.37)	86.54 (0.28)	90.71 (17.59)	92.33 (17.61)
Competitiveness perception	20.72 (6.40)	21.44 (6.63)	19.51 (8.68)	23.38 (8.78)
Environmental image	5.39 (2.38)	5.32 (1.36)	5.47 (1.42)	4.80 (1.57)
Regulation				
Local voluntary agreement	0.51 (0.50)	0.44 (0.50)	0.33 (0.47)	0.14 (0.34)
Number of regulations	4.69 (2.12)	4.69 (2.06)	5.09 (2.20)	5.89 (1.76)
Civil society demand	9.81 (2.63)	9.48 (2.65)	10.26 (2.89)	8.60 (3.07)
Environmental activity				
Extent of public disclosure	1.98 (3.01)	1.17 (2.32)	1.16 (2.49)	0.50 (1.88)
Number of environmental actions	7.73 (1.93)	6.62 (1.81)	4.61 (2.36)	2.34 (2.21)
Number of non-regulated targets	4.75 (1.82)	3.94 (1.68)	3.54 (2.35)	1.31 (1.96)
Average target level	2.06 (1.95)	1.55 (1.86)	0.77 (1.53)	0.30 (1.05)

on environment related issues. 'Internal resource capacity' is a summative measure of responses to three questions about different types of resources related to voluntary standards – financial resources, human resources and management support (alpha = 0.82). It was also asked whether the facility had a specific environmental division or section, and how often the environmental manager in charge participated in top-level decision making meetings, 'Environmental division' and 'Environmental decision making', respectively. For each of these variables, earlier certifiers score higher than later certifiers and non-certifiers, probably indicating that those facilities with higher capacity are more able and willing to undertake the certification process.

Of the two variables identified under attitudes and perceptions, only 'EMS attitude' shows a consistent downward trend from early certifier to non-certifier. 'EMS attitude' is measured as the sum of responses to two survey questions about the necessity and usefulness of environmental management systems (alpha = 0.80). Although regression analysis will further investigate the association between certification timing and attitude, it may give some confirmation on the importance of attitude on ISO certification. The other variable, 'Facility social responsibility', is also a summed index of responses to three separate questions that measure the extent to which the facility would like to work with government industry and other industry leaders to improve environmental performance (alpha = 0.80).

The three economic benefit/competitiveness variables do not show a similar level of agreement. Reliance on external trade is measured as 1 minus the percentage of total revenues that is accounted for by sales outside of Japan. This measure gives us the percentage of total revenues that come from Japan. Results for this variable clearly indicate that those earlier adopters are more likely than later adopters and non-adopters to report higher levels of reliance on external trade. The statistics are not surprising and were predicted in the literature section above. An indexed measure of the facility's perception that environmental activities contribute to economic competitiveness was also developed: it is a summation of responses to eight questions about the extent to which practices such as reduction of raw materials use, water use and waste production are primarily considerations of economic competitiveness (higher value) or of environmental quality (lower value). Table 4 shows that non-adopters appear to place higher emphasis on economic competitiveness than on environmental quality. However, there is no obvious trend for this variable. Finally, 'Environmental image' is a single measure variable that queries the extent to which the facility perceives a good environmental image to be important for competitiveness. The trend across this variable is also somewhat inconsistent

The survey provides data used in three different regulatory variables. First, facilities were asked whether they had undertaken a voluntary agreement with a local or provincial government. As can be seen in Table 4, voluntary agreements appear to provide a strong indication of the timing of the facility's ISO adoption. Over 50% of early certifiers also stated that they had established a local voluntary agreement, while only 14% of non-certifiers made the same claim. It is possible that the local agreements provide the facilities with the experience and internal capacity to more quickly obtain ISO 14001 certification. It is also possible that the voluntary agreements, which do not always carry the force of law but are often monitored by government and include possible local sanctions for non-compliance, indicate a higher level of strictness of the regulatory environment within which the facility operates (Welch and Hibiki 2002). ISO certification may be one way to demonstrate environmental commitment to local officials and other stakeholders. The final regulatory environment variable, 'Civil society demand', is also a summed measure of responses to two questions about the extent to which the facility perceives private sector

companies to be increasingly accountable to citizens and the Japanese public for its environmental actions (alpha = 0.71). The trend of this variable across the timing of certification is inconclusive.

Environmental activity is represented by four main variables: 'Extent of public disclosure', 'Number of environmental actions', 'Number of non-regulated targets' and 'Average level of voluntary targets'. For all of these variables, there appear to be decreasing trends across the columns from early adopter to non-adopter. 'Extent of public disclosure' is measured as the summation of responses to 10 discrete (1 or 0) questions about information disclosure to the public. It is important to note that disclosure is particularly low, ranging from an average of 0.5 disclosure activities for non-adopters to about 2 disclosure activities for early adopters. 'Number of environmental actions' is also a summative measure of discrete responses to 11 questions about specific environmental activities undertaken by the facility. 'Number of voluntary targets' represents the total positive responses from a list that includes targets to: reduce raw material use; increase use of recycled inputs; improve energy efficiency; reduce water use; reduce waste production; increase product lifetime; and develop environmentally benign products. Finally, 'Average voluntary target level' measures the facility's response to questions about the level of their voluntary targets as compared to other similar facilities in the industry for six pollutants that are typically regulated. Overall, early certifiers seem to undertake more public disclosure activities, environmental actions, and numbers and levels of voluntary targets than later certifiers and non-certifiers.

5. Findings

Table 5 presents results from three probit regression estimations. The dependent variable in the first column is a dichotomised ISO adoption variable in which the adoption value is 1 and non-adoption is 0. In the discussion, this variable is called the 'adoption'. The last two columns show results from two ordered probit regressions in which the dependent variable is the stage of ISO adoption – early certifier (3) recent certifier (2), in-process certifier (1) and non-certifier (0). This dependent variable is called the 'certification stage'. A third dichotomous dependent variable was also created in which 1 signifies that certification is complete, while 0 signifies that the facility is either in the process of certifying or has not yet begun the process. This variable is called 'certification' in the discussion. The findings from this probit estimation are not reported in Table 5 because the findings from the 'certification' estimation are basically similar to those found in the other models. However, insights from the 'certification' regression results will be included in the discussion to improve the clarity of the interpretation when there is disagreement in the significance of variables across the three reported models. The independent variables in all three estimations are identical except that the 'Number of voluntary targets' variable in the third estimation is replaced with a set of dummy variables that indicate whether or not the facility has a target for each of seven specified targets. Collinearity diagnostics did not show any problems with the multicollinearity. The sample size for all models drops to 1489 from 1718 due to missing values.

5.1. Resources and attitudes

Beginning at the top of Table 5, the construct for size and resources shows strong congruence in the significance of variables and across the three models. Size, as measured by 'Number of employees', and resources as measured by 'Internal resource capacity',

Table 5. Regression analysis findings.

	Dichotomous adoption probit model	Four-stage adoption ordered probit model	Four-stage adoption ordered probit model with targets
Facility size and resources			
Number of employees***	0.213 (0.096)***	0.167 (0.047)***	0.120 (0.048)***
Internal resource capacity	0.036 (0.021)*	0.023 (0.010)**	0.024 (0.010)**
Environmental labour	0.006 (0.021)	−0.006 (0.005)	−0.003 (0.005)
Environmental division***	0.677 (0.158)***	0.567 (0.102)***	0.490 (0.104)***
Environmental decision making***	0.070 (0.025)***	0.037 (0.013)***	0.030 (0.013)**
Attitude and perspective			
EMS attitude***	0.112 (0.034)***	0.040 (0.019)**	0.022 (0.020)
Facility social responsibility	0.011 (0.022)	0.008 (0.010)	0.009 (0.019)
Economic benefits and competitiveness			
Percent revenues from Japan	0.003 (0.002)**	0.003 (0.001)**	0.003 (0.001)***
Competitiveness perception	0.029 (0.011)***	0.009 (0.006)	0.007 (0.006)
Environmental image***	0.126 (0.054)**	0.079 (0.027)***	0.066 (0.027)**
Regulation and oversight			
Local voluntary agreement	0.358 (0.174)**	0.231 (0.071)***	0.233 (0.071)***
Number of regulations*	−0.038 (0.040)	−0.040 (0.018)**	−0.037 (0.018)**
Civil society demand*** (−)	−0.084 (0.028)***	−0.046 (0.014)***	−0.041 (0.014)***
Environmental activity			
Extent of public disclosure*(−)	−0.031 (0.034)	−0.013 (0.014)	−0.006 (0.014)
Number environmental actions***	0.186 (0.035)***	0.235 (0.019)***	0.214 (0.019)***
Average target level***	0.101 (0.048)**	0.066 (0.019)***	0.069 (0.019)***
Number non-regulated targets**	0.121 (0.042)***	0.074 (0.022)***	
Raw material reduction target			0.069 (0.073)
Recycled inputs target			−0.129 (0.075)*
Energy efficiency target			0.315 (0.100)***
Water reduction target			−0.027 (0.077)
Increase product life target			−0.127 (0.102)
Benign product target			0.025 (0.077)
Waste reduction target			0.830 (0.118)***
Industry			
Chemical manufacturing** (−)	−0.061 (0.218)	−0.344 (0.115)***	−0.389 (0.116)***
Electric machinery	0.663 (0.227)***	0.338 (0.104)***	0.377 (0.105)***
Electronics** (−)	0.394 (0.255)	0.031 (0.151)	0.060 (0.154)
Electrical power*** (−)	0.020 (0.266)	−0.574 (0.165)**	−0.570 (0.168)***
Intercept	−1.002 (0.632)	−3.040 (0.344)***	−3.419 (0.352)***
Intercept2	n.a.	1.602 (0.058)***	1.651 (0.060)***
Intercept3	n.a.	2.446 (0.080)***	2.578 (0.086)***
N	1489	1489	1489
Number adopters	1309		
Number early adopters	n.a.	579	579
Number late adopters	n.a.	569	569
Number in-process adopters	n.a.	161	161
Number non-adopters	180	180	180
Log likelihood	−232.32	−1293.45	−11257.10

Notes: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

existence of an 'Environmental division', and 'Environmental decision making' of the top environmental manager are significant determinants of 'adoption' and 'certification' stages. All signs on the significant coefficients are positive, which indicates that larger and more resource endowed facilities are more likely to become certified earlier, and that the smaller less endowed facilities are more likely to be late comers or non-adopters. The 'Internal resource capacity' variable – human, financial and management resources to implement voluntary standards – is less significant in the adoption equation (column 1) than in the other two models. Further analysis found that the 'Internal resource capacity' variable is not significant in the 'certification' regression analysis, which indicates 'Internal resource capacity' best distinguishes the earliest adopters from the most recent adopters. This finding is also evident in the descriptive statistics shown in Table 4.

The significance of 'Environmental division' and 'Environmental decision making' are organisation structure and decision process variables that are probably related to the size of the facility. Indeed, the correlations between 'size' and 'Environmental division' is 0.43 while the correlation between 'size' and 'Decision making' is 0.34. Larger facilities may have greater need to invest in these resources due to the broader scope and higher complexity of their production related environmental concerns. Moreover, because environmental consequences of manufacturing activities of larger facilities are likely to be more visible to external regulators and other stakeholders, larger facilities may find greater use for environmentally relevant structures and processes. By contrast, the number of dedicated environmental personnel (Environmental labour) is not a significant contributor in this model. This finding is contrary to expectations and it is counter-intuitive, given the descriptive statistics above that early adopters appear to have much higher levels of environmental labour. It is possible environmental labour is a duplicative indicator of size, although the correlation coefficient between 'size' and 'Environmental labour' (0.41) is not excessively high.

Limited support is found for the attitude and perspective construct. Findings show that of the two variables subsumed under the attitude and perspective construct, only 'EMS attitude' is significant in two of the three reported models. Facilities reporting stronger positive attitudes about the usefulness and importance of environmental management systems (EMS) tend to be adopters when compared with non-adopters, while the variable becomes less significant in the order probit estimation for the 'certification' stage. It is probable that non-adopters are less knowledgeable about the specific techniques and potential benefits of environmental management systems, either because they have not examined them carefully or because they have examined them carefully and determined the EMS benefits to be low in comparison with the costs of certification. This conclusion makes sense because non-adopters are typically smaller and less resource rich. While the significant finding for EMS attitude indicates some effect of attitude, none of the regression estimations provide support for the expectation that feelings of social responsibility contributes to certification decisions. Furthermore, even a clear interpretation of the single EMS attitude finding is problematic due to potential for endogeneity, a perennial limitation of analysis using cross-sectional data. For example, it is possible that certifiers report better attitudes *because* they are pleased with their experiences with ISO 14001. Nevertheless, interview findings also found that few facilities undertook certification for reasons of social responsibility; three facilities commented that one reason for certification was to promote emission reduction, four facilities sought environmental leadership, one mentioned that it sought to improve the environmental consciousness of the employees, and one mentioned that ISO 14001 enabled them to better control non-regulated emissions (see Appendix 2, questions 1a, 1b, 1c, and 1d). In sum,

while attitudes toward EMS are probably valid reasons why some facilities undertake certification in Japan, they do not appear to be primary reasons.

5.2. *Economics and regulation*

Regression findings for variables in the 'Economic benefits/competitiveness' construct support the authors' expectations that facilities that are more engaged in international business will be more likely to be early certifiers. In all models, higher revenues from outside Japan help to explain why some facilities decided to adopt ISO 14001 earlier than others. Interviews with ISO certified Japanese facilities provide further evidence. For example, it was often heard that facilities believed certification to be important for international business and competitive advantage. Some facility representatives specifically mentioned that significant pressure to adopt ISO 14001 comes from the European business community while others mentioned access to trade preferences (Appendix 2, Question 1e and 1f). Because ISO 14001 was established as a global standard, it is not surprising that the more globally integrated facilities would recognise higher potential economic benefits to certification.

Regression estimations showed strong support for the association between 'Economic competitiveness' measure and 'adoption'. Non-adopter facilities did not perceive material and energy reduction, recycling and product life-cycle factors to be important for their facilities' economic competitiveness. This finding does not hold true in the order probit models; this is apparently because differences across all four stages in the 'certification' stage estimation are less pronounced than between adopters and non-adopters. Environmental image as necessary for competitive survival was negatively significant in all three models, indicating that early certifiers perceive environmental image to be a less important factor for competitiveness compared to later-certifiers and non-adopters. These findings suggest that ISO certified facilities are more pessimistic (or perhaps realistic) about the extent to which a positive public environmental image actually results in economic benefits. ISO adopters may believe that the relevant audience is not the public or consumers, but rather other facilities or firms in the supply chain. Finally, interviewees rarely mentioned 'appeal to customers' as a reason for ISO 14001 certification (Appendix 2, question 1g). Hence, it is reasonable to assume that competitiveness motivations for ISO certification are related more to access and participation in international trade and business activities and less to product and production related activities. If so, this finding seems to support other research identifying club goods aspects of ISO as important drivers of adoption (Potoski and Prakash 2005a).

The findings for the two regulation variables – a positive association between 'Local voluntary agreements' and earlier certification and a negative association between 'Number of regulations' and earlier certification – seem, at first glance, to conflict. However, the existence of a prior voluntary agreement with local government probably represents a certain degree of familiarity with voluntary systems. In addition, the existence of a local voluntary agreement may indicate that the facility has developed the knowledge and capacity to effectively respond to opportunities to adopt other types of voluntary environmental agreements. Facilities whose parent companies have already undergone the involved negotiations and whose managers are familiar with the implementation of local voluntary agreement that often go beyond national regulatory standards, may have managerial knowledge and the technological means to more efficiently evaluate and implement ISO 14001 standards. Both of these rationales were treated in the literature section.

By contrast, facilities that are more regulated seem to have delayed their adoption consideration; 'Number of regulations' is negatively associated with speed of certification in the two ordered probit models.[7] There are probably multiple reasons for this result. First, because ISO certification results in substantial investigation of environmental aspects, heavily regulated facilities may be concerned that findings from the investigation would invite further regulatory scrutiny. Second, facilities that face a greater number of regulations typically must respond to a greater number of regulatory bodies or interests. Because the value that the different regulatory interests place on ISO 14001 certification may vary, facilities reporting higher number of regulations may be less likely to adopt ISO because the costs of coordination across agencies are prohibitive. Third, facilities reporting a higher number of regulations may face higher costs. Facilities facing more regulations may have more complex production processes that generate a greater diversity of pollutants, emit pollutants into multiple media or produce by-products that have poorly understood effects. Because ISO 14001 requires identification of all environmental aspects, specification of reduction targets and implementation of management and evaluation plans, it is possible that the difficulty and cost of ISO 14001 certification increases dramatically as the production process becomes more complex. Hence, while the findings on local voluntary agreements and number of regulations may at first appear to be contradictory, they actually represent two different types of contextual effects on facility environmental behaviour.

Finally, with regard to the regulation and oversight construct, the 'Civil society demand' variable shows that facilities reporting higher levels of citizen pressure are more likely to be later certifiers and non-certifiers. Interviews of certified facilities also revealed that broad social pressure was one of the most important reasons for their pursuit of ISO 14001 certification (Appendix 2, question 1h).[8] The facilities were generally unable to clearly articulate the sources of the societal pressure. It is thought that further research should better define the role of external societal pressure in Japan, and perhaps to examine the nature of the link between social responsibility and societal pressure in the private sector.

Overall, these findings in combination with other results on numbers of regulations begin to discern two different adoption functions for ISO 14001 in Japan. Early certifiers may be described as being larger, having more slack resources, being more reliant on international trade and having greater environmental management capacity and more experience with voluntary agreements. These organisations probably enjoy a relatively good environmental image and feel lower pressure from regulators or other stakeholders. Later certifiers and non-certifiers generally hold the opposite qualities.

Before turning to findings on environmental activity, it should be noted that speed of certification varied systematically across industries. In comparison to other industries in the sample, facilities in the electric machinery industry were more likely to report early certification, while those in chemical manufacturing and electrical power generally obtained certification later.

5.3. Environmental activities and certification outcomes

In general, findings presented here support prior research by King *et al.* (2005) that ISO 14001 certification does result in the establishment of parts of an EMS, particularly those elements related to establishment of targets and the level at which targets are set. In all models, early certifiers reported a significantly higher 'Number of environmental actions', higher 'Average target level' for regulated pollutants, and a greater 'Number of

non-regulated targets'. In the two ordered probit estimations, where the 'Number of non-regulated targets' variable was replaced by dummy variables for the type of target adopted, earlier certifiers were significantly more likely to report the establishment of voluntary waste reduction and energy efficiency targets.[9] In addition, the regression estimations show no significant variation in 'Extent of public disclosure' in any of the models, it is possible to conclude that earlier ISO certifiers undertake more environmental activity than more recent certifiers and non-certifiers. While it is impossible to determine whether the association between ISO certification stage and environmental activity is causal, interview findings support the role that ISO 14001 certification plays in fostering new environmental activity.

As presented in Appendix 2 (questions 2, 3 and 4), interviewees were asked a series of questions related to the effects of ISO adoption on environmental practices in their facilities. Most facilities indicated that waste reduction and energy savings targets were established as a result of the ISO certification process. Energy and waste disposal costs are particularly high in Japan; facilities may have greater experience with these types of activities and they may expect higher relative economic returns for new initiatives in these areas. In addition, over half of the facilities mentioned that new or tougher emissions targets for regulated chemical substances were established as a result of certification, while only two admitted that the tougher targets were actually set prior to consideration of ISO 14001 certification. A few facilities did not respond directly to the question (Appendix 2, question 2). With regard to the relative level of all emission targets established, most facilities indicated that they set target levels at or above minimum levels. However, about half of those interviewed indicated that emission targets were set well above industry standards (Appendix 2, question 3). Two facilities did not directly respond to the question.

Findings were mixed with regard to the effect that certification had on longer-term outcomes. Approximately half of all facilities interviewed indicated partial or complete attainment of targets, while about a quarter of those surveyed were non-committal and another quarter either did not respond or were unsure (Appendix 2, question 4). Only four of the facilities (three of which were early certifiers) mentioned that they had either actively adjusted or were considering adjustment of regulated or non-regulated targets (Appendix 2, question 5). Finally, facilities acknowledged that ISO 14001 certification resulted in a variety of benefits – establishment of an EMS (2); emission reduction (4); environmental awareness of employees (1); environmental action that would not have otherwise taken place (1); consideration of non-regulated environmental activity (1); and positive citizen response (Appendix 2, question 6). Of those facilities that mentioned economic costs and benefits (7), only two facilities indicated that they had identified significant sources of cost reduction. By contrast, over one-third of the interviewees mentioned that ISO 14001 incurred excessive costs and that the rationale for certification was not linked to potential economic benefits (6). Overall, findings tend to support the contention that ISO 14001 is an important catalyst to the establishment of some elements of an environmental management system, such as new targets, target levels higher than regulation would require and other management procedures. However, the evidence also indicates that certification does not necessarily result in clear procedures for adjustment and improvement of the EMS, nor is there clear indication of clearly recognisable environmental benefits.

6. Conclusions

This paper sought to examine the factors that influence certification and the certification outcomes of ISO 14001 in Japan. Using survey and interview data, we tested a model that

included several measures for each of five constructs to explain the timing of ISO 14001 certification in Japan: facility size and resources, attitude and perspective, economic benefits and competitiveness, regulation and oversight, and environmental activity. Findings tend to show that facility size and resources are important factors distinguishing certified facilities from non-certified facilities, as well as early certifiers from later certifiers. Regression results also showed that EMS attitude partially distinguishes between certified and non-certified facilities, while perceptions of social responsibility contribute little to explaining timing of ISO 14001 certification. Although interviews did indicate agreement among facilities that external social pressure was an important catalyst for certification, perception of social pressure does not equate to sense of social responsibility.

Organisations that have entered into a local voluntary agreement and those that are more active in international business are more likely to be certified and to have certified earlier. While those facilities that are under more pressure from customers and regulators and those who perceive stronger demand from civil society for environmental action are less likely to be certified. Finally, ISO 14001 certification is strongly associated with environmental activity of the organisation; earlier certified facilities are more likely to report a greater breadth of environmental activity, more non-regulated targets, and stricter targets overall. Interviews tend to confirm that ISO 14001 certification tended to lead to the establishment of much of this activity. However, we found little evidence to indicate that certification led to substantial continuous improvement.

For theory, the findings in this paper tend to provide support for prior work identifying club goods as an important benefit for adoption of voluntary programmes. The benefits that the facility may realise from access to international business opportunities as a result of their certification may outweigh the costs incurred during the certification process. It also appears that ISO certification helps establish important elements of an EMS, such as target identification and establishment. However, the full story appears to be more complex as few of the interviewed facilities reported sustained levels of review and revision. The initial effort that certifiers undertake to put an EMS in place may be substantial, but little evidence exists to show that ISO certification leads to a continuous improvement cycle. Realistically, if the majority of the club goods are realised as a result of certification, and if there is little benefit to substantial continuous improvement actions, there may be little incentive for continuous adjustments and improvements to a facilities EMS that derive from ISO 14001.

Future research should examine the linkages between ISO 14001 certification and the actual establishment of a continually evaluated and improved environmental management system. Such work should also assess the increased costs compared to the increased benefits (if any) associated with continuous changes to the EMS. It is expected that the marginal benefits to continuous improvement activities associated with ISO 14001 will increase at a much slower rate than the marginal costs. This may be particularly if re-certification requires a minimum level of new activity.

Finally, research by King *et al.* (2005) shows that ISO 14001 certification is associated with the establishment of an EMS and EMS establishment is linked to better environmental performance. However, ISO certification may not affect environmental performance. It is possible to interpret the findings in this paper as partially supportive of their work. Facilities that adopt ISO 14001 report some effects, but the continuous improvement cycles that may lead to strong environmental effects are less widely implemented. Moreover, many of the certifying facilities are well experienced in the establishment of voluntary environmental agreements in Japan, which, it can be argued, are one type of environmental management standard. It is possible that facilities that have

previously negotiated local voluntary agreements find that it is not necessary to conduct limited environmental improvements as a result of ISO 14001 certification; they are already strong environmental performers. Although the data available in the survey used in this paper cannot settle this issue, future research should further investigate the ISO 14001-EMS-environmental performance linkage in Japan.

Notes

1. The empirical and theoretical review related to voluntary environmental behaviour primarily targets the firm level of analysis. ISO 14001 EMS is designed for the facility, which may be a smaller sub-unit of a firm. While it is recognised that the facility is often a sub-unit of the firm, findings are relevant to the firm level.
2. The development of the standards actually began five years prior to their publication. In 1991, at the behest of the Business Council for Sustainable Development (a business advisory group initially created to provide private sector input to the United Nations Conference on Environment and Development (UNCED), also known as the Rio Conference), the ISO and the International Electrotechnical Commission (IEC) formed the Strategic Environmental Group on Environment (SAGE) to investigate the need for ISO sponsored environmental management standards. SAGE found in favour of such standards and in 1993, the International Standards Organisation (ISO) established Technical Committee 207 (TC 207) to oversee their development. For additional discussion about the characteristics, rationales and structure of ISO 14001, please see recent research by Delmas (2002), King *et al*. (2005), or Prakash and Potoski (2006).
3. Recent research forecasts that the diffusion of ISO 14001 certification in Japan will soon reach saturation (Viadiu *et al*. 2006)
4. Note that the adopters and non-adopters come from the same population.
5. Non-adopters were not interviewed. The objective of the interviews was to examine whether ISO adoption lead to changes in facility behaviour and decision making over time. They were not designed to compare adopters and non-adopters.
6. It is well recognised that small facility size and limited resources are barriers to ISO adoption in Japan. In response, the Environment Ministry has developed an EMS specifically designed for small and medium-sized facilities.
7. Even though 'Number of regulations' is not significant in the first dichotomous 'adoption' probit model, the coefficient does become significant in the dichotomous 'certification' model. This indicates that regulatory pressure may be more important for distinguishing between those facilities that have already received certification and those that have not.
8. Interviewee comments on the social pressure are interpreted to be indicative of external pressure rather than of some sense of social responsibility. The comments indicate response to rather ill-defined external demands, rather than response to internal desire to set a socially responsible example.
9. These findings are also supported when the types of targets were substituted for the *non-regulated target* variable in the first dichotomous *adoption* model. These results are not reported in Table 5.

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Appendix 1. Survey questions used in analysis

SIZE AND RESOURCES

Number of Employees

Approximately how many full-time employees in facility (fewer than 50; 50 to 299; 300 to 999; 1000 to 4999; 5000 or more).

Internal Resource Capacity, summed measure, chronbach alpha = 0.82 (variables on a seven-point scale from strongly disagree to strongly agree).

My facility has sufficient financial resources to implement voluntary standards.

My facility has sufficient human resources to implement voluntary standards.

Top management in our facility supports the adoption of new voluntary standards.

Environmental Labour

How many full-time equivalent (FTE) employees in your facility spend a majority of their time on environmental issues?

Environmental Division

Does your facility have a specific environmental division or section? (Yes = 1, No = 0).

Environmental Decision Making

How often does the individual in charge of environmental management in your facility participate in top-level decision-making meetings (meeting of top management personnel to

decide strategy and direction)? (seven-point scale from never to always, 0 if no environmental manager).

ATTITUDE AND PERSPECTIVE (all on seven-point scales, strongly agree to strongly disagree).

EMS Attitude, summed measure, chronbach alpha = 0.80

- Establishment of an environmental management system is necessary to achieve high levels of environmental performance.
- An environmental management system provides an effective environmental management strategy.

Facility Social Responsibility, summed measure, chronbach alpha = 0.80

- Our facility should network with industry leaders to learn more about environmental management.
- Government should provide more administrative guidance/technical assistance to help private sector actors become more environmental (negative scale).
- Industry associations should provide more guidance to help members become more environmental.

ECONOMIC BENEFITS AND COMPETITIVENESS

Percent Revenues from Japan

What percentage of your total revenues are accounted for by sales to Japan? (also asked about revenues from sales to other countries).

Competitiveness Perception

To what extent is each of the following factors primarily an issue of environmental quality or economic competitiveness for your facility? (summed series of questions on a seven-item scale, which ranges from environmental quality to economic competition).

Reduction in raw material use; increase use of recycled inputs; energy efficiency; reduction of water use; reduction of CO_2; reduction of waste production; increase product lifetime; develop more environmentally benign products.

Environmental Image

A good environmental image is important for competitive survival (seven-point scale, strongly agree to strongly disagree).

REGULATION AND ENVIRONMENTAL PERFORMANCE

Local Voluntary Agreement

Has your facility ever entered into a voluntary environmental agreement with a local or state government? (Yes = 1, No = 0)

Number of Regulations

For each of the following types of emissions, indicate whether the emission is regulated for your facility (summed scale).

Dioxins; trichloroethylene; sulphur oxides; soot and dust; nitrogen oxides; BOD or COD; dichloroethylene.

Civil Society Demand, summed measure, chronbach alpha = 0.71

- Our facility is feeling increasingly accountable to the public for business decisions that affect the environment.
- Citizens are increasingly attentive to the environmental consequences of our facility's business decisions.

ENVIRONMENTAL ACTIVITY

Extent of Public Disclosure

Indicate whether your facility discloses information on the following items to the public and other external stakeholders. Information disclosure here means a condition in which information is available in brochures, reports and/or the Internet for perusal and use (summative measure of discrete responses).

Reductions of raw material use; increased use of recyclables; energy use levels; carbon dioxide emission levels; waste production levels; regulated air emission levels; regulated water emission levels; environmental expenditures; voluntary environmental objectives and/or targets; Environmental audit results

Number of Environmental Actions

Indicate whether or not your facility conducts the following (summative measure of discrete responses).

Publishes an environmental policy
Publishes an annual environmental report
Applies environmental considerations to purchasing decisions
Uses lifecycle analysis
Systematically reduces fossil fuel use
Systematically reduces toxic chemical use
Undergoes environmental audits by external third party organisations
Uses eco-labelling
Uses eco-efficiency
Uses PRTR (Pollutant Release and Transfer Register)
Creates separate accounts for environmental countermeasure expenses and other environmental expenses.

Number Non-regulated Targets

For which of the following factors does your facility have specified targets? (summed indicator).

Reduce raw material use; increase use of recycled inputs; energy efficiency; reduce water use; reduce waste production; increased product lifetime; develop environmentally benign products.

Average level of voluntary targets for typically regulated emissions.

Facilities first indicated whether they have a voluntary target for the following typically regulated pollutants in Japan. They were then asked to indicate the level of their facility's voluntary target compared to other facilities in their industry (five-point scale; this measure is a ratio of the sum of all responses divided by the number of responses to give an average level of voluntary targets).

Dioxins; trichloroethylene; sulphur oxides; soot and dust; nitrogen oxides; BOD or COD; dichloroethylene

Appendix 2. Interview questions and responses

Table A1. Facilities interviewed: Electrical Machinery = 5; Electronics = 3; Chemical Manufacturing = 6; Electrical Power Generation = 1. Five were early certifiers and ten were recent certifiers.

1. What factors do you think were the most important contributors to your facility's decision to become ISO 14001 certified? (multiple responses possible)

Factor category	Summarized comments	Facilities indicating importance of the factor
a. Environmental consciousness	To improve the environmental consciousness of the employees.	1
b. Emission reduction	To further reduce emissions of the facility.	3
c. Leadership	ISO 14001 is an opportunity to be an environmental leader in our industry.	5
d. Non-regulated emissions	To enable control over non-regulated emissions.	1
e. International trade	To respond to overseas, especially European customers. Many international clients and suppliers are ISO 14001 certified.	4
f. Competitive advantage	To gain economic advantage through trade access to and preference of trade partners.	4
g. Environmental image	To appeal to our customers on environmental action.	2
h. Broad social pressure	To respond to an increasing societal requests for improved environmental actions by manufacturers.	10
i. Citizen pressure	Citizens are interested in our environmental efforts. To respond to increasing requests from society for environmental action.	1
j. Company principles	To execute the environmental principles of the company and respond to the company request.	4

2. Could you help us understand how ISO 14001 Certification process affected establishment of environmental targets for your facility? We are interested in whether targets for regulated and non-regulated emissions were developed as part of the certification process (multiple responses possible).

Response category	Summary of response comments	Number of facilities responding
Non-regulated targets	Targets for energy saving and waste reduction were established as part of the ISO 14001 certification process.	13
Regulated targets	Targets for emissions of chemical substances were established as part of the ISO 14001 certification process.	8 (3 of which were chemical manufacturers)
	Targets for chemical emissions had been established before ISO 14001 adoption.	2 (both chemical manufacturers)

(*continued*)

Table A1. (*Continued*).

3. How would you describe the level at which your targets are set. Try to compare the level at which your targets are set compared to other facilities in your industry.

Response category	Summary of response comments	Number of facilities responding
No response/not sure		3
Minimum	Practical targets were established.	4
Average	Targets were established at a level that can be described as the average level for the industry.	1
Above average	Targets were set according to industry association recommendations, which are generally stricter than the average level for the industry.	2
High	Targets were established at a higher level than was recommended by the industry association.	4
Very high	Challenging targets were established, targets are beyond standards recommended by industry association.	1

4. To what extent has your facility been able to attain the ISO targets?

Response category	Summary of response comments	Number of facilities responding
No response/not sure		2
Indirect response	Targets improved environmental performance through increasing awareness in our facility.	4
High	Approximately 90% of our targets have been accomplished.	3
Very high	All targets have been accomplished.	4
Detail	Energy reduction target has not yet been accomplished; toxic chemical reductions are nearly accomplished.	2

5. To what extent do you continually adjust regulated and non-regulated targets as a result of ISO 14001 certification?

Response	Number of facilities responding
No response/not sure	11
New, stricter targets are established by our facility every three years.	1
Targets are often revised to stricter standards.	1
Additional, newly identified targets have been established.	1
New, stricter targets are currently under consideration.	1

6. From your perspective, what are the most important outcomes of ISO 14001 certification for your facility? (multiple outcomes possible)

Response category	Summary of response comments	Number of facilities responding
System establishment	To establish the systematic operation of an environmental management system.	2
Emission reductions	To promote reductions of regulated emissions more than would otherwise be attempted.	4

(*continued*)

Table A1. (*Continued*).

Response category	Summary of response comments	Number of facilities responding
Environmental action	As a general impetus for consideration of environmental action in the facility.	1
Employee effects	To improve environmental awareness of employees.	1
Scope of management	To extend environmental actions of the facility to non-regulated emissions	1
Citizen response	The significant and positive response from citizens.	2
Excessive costs	Management of ISO 14001 has required excessive costs. This is coupled with no clear linkage to economic benefits of certification.	6
Cost reductions	We have identified significant sources of cost reduction as a result of the ISO 14001 certification process.	2