



Munich Personal RePEc Archive

Determinants of environmental management systems standards implementation: evidence from Greek industry

Halkos, George E

University of Thessaly, Department of Economics

2001

Online at <https://mpra.ub.uni-muenchen.de/33481/>
MPRA Paper No. 33481, posted 17 Sep 2011 18:59 UTC

Determinants of Environmental Management Systems Standards Implementation: Evidence from Greek Industry

By

George E. Halkos
Department of Economics
University of Thessaly

&

Konstantinos I. Evangelinos
Department of Environment
University of the Aegean

ABSTRACT

This paper employs logistic regression analysis to test a model that predicts the implementation or not of Environmental Management Systems Standards (EMSS) by considering various factors as explanatory variables. The dependent variable is a dichotomous as either implementing or not EMSS by industrial firms. From past experience we identify 15 major variables contributing to implementation of EMSS. A sample of 259 respondents (84 implementing and 175 not) is used to estimate the parameters of the logistic regression model employing maximum likelihood. The results show an overall significant model with 4 of the 15 variables significant. The significance of management perception of environmental issues on their decision to implement EMSS was confirmed with regards to their perception on win-win possibilities. Pressure on companies to improve their environmental performance does not result in higher uptake of the standards. Company's image and size are important factors in its decision to implement EMSS.

Keywords: Environmental Management Systems Standards; environmental performance.

An earlier version of this paper has been presented as:

Determinants of Environmental Management Systems Standards implementation: Evidence from Greek Industry, University of Thessaly, Department of Economics, Discussion Paper Series **01-05**.

Introduction¹

In a globalised and fast-changing economy, companies are faced with increasing pressures, as well as challenges. They need to act fast and be adaptable in order to maintain and improve their market position and fulfill their social responsibilities. Until recently, companies as threats to their business considered environmental issues, while their environmental responsibilities were limited to complying with current regulations. However, some companies are now using environmental issues to strengthen their market position and access new markets. Currently there is a debate about the extent to which ISO14001 and EMAS can help to this end. Thus, even though Environmental Management Systems Standards (EMSS)² are management tools that assist companies to reduce their impact on the environment, they can also facilitate the realization of opportunities arising from dealing with environmental issues. Examples of such opportunities are better energy and raw material efficiencies, the minimization of waste, a better company image and better relations with stakeholders.

However, since companies have only limited financial and human resources to allocate across various investment priorities they have to assess the potential of EMSS implementation for their company before they come to a decision. Some companies may have effective informal environmental management systems in place and the benefits of an EMSS certification to them may be very limited.

This paper will review the costs and benefits of EMSS implementation. It will then discuss the different factors that may affect these costs and benefits and their perception. These include the pressure on companies to improve their environmental performance, the opportunities to companies from their activities with regards to

¹The support of the Greek Institution IKY is acknowledged. An earlier version of the background literature was presented in the 2000 Eco-Management and Auditing Conference.

environmental issues as well as the management perception towards environmental issues. The importance of these factors on companies' decision to implement EMSS will be then assessed using a logistic regression model. This will be based on data collected from two groups of Greek companies; one currently implementing EMSS and another one the intentions of which regarding the standards are unknown.

The paper is structured as follows: First, the various costs and benefits reportedly associating EMSS implementation are presented. A number of factors that may affect these costs and benefits, their perception as well as the company's decision to implement EMSS will be discussed. The statistical method and the empirical results are presented next, leading to some concluding remarks.

Costs and benefits of EMSS implementation

Internal Benefits

The potential for financial savings as a result of EMSS implementation has been explored in a number of papers. Sheldon (1997) notes that cost savings are usually attained through greater efficiency in the use of energy and raw materials. Additionally, minimization of the produced wastes reduces the associated costs of waste management. Dobes (1997) reports that keeping records of inputs and outputs of different production processes can motivate companies to rethink the basic structures and functions of various processes and may result in further cost-savings.

However, it is not clear whether these savings occur only once with the introduction of EMSS or whether they are continuous. There are indications (Burleigh, 1997) that although major financial benefits are usually experienced in the beginning, the introduction of EMSS ensures that the company will avoid unnecessary ongoing costs (O'Laoire and Welford 1994; Welford, 1996). Shah (1996) notes that

² For the rest of this paper we shall use the term EMSS to refer to both ISO14001 and EMAS.

cost reductions might not be applicable in the U.S., as a number of regulatory and management initiatives have already reduced the relative inefficiencies. Similarly, larger companies have usually already dealt with management and cost inefficiencies, thus cost savings are more probable in small- and medium-sized companies. Romanow (1996) notes that companies which have an undeveloped safety, health and environment management programme are likely to benefit more from an EMSS than those companies with fully developed programmes. The possibility of financial benefits as a result of the efficient use of raw materials and waste minimization is suggested by Bird (1995), however she recommends that the implementation or not of EMSS should be examined within the context of costs and benefits derived in the particular organization.

Another important category of benefits of EMSS is 'organizational' benefits. Diller (1997) suggests that the requirement of EMSS for a proactive and systemic approach to environmental impacts promotes the efficient use of management resources. Kosasih and Shobirin (1995) demonstrated such efficiency in an oilfield in Sumatra. More specifically, they note that their EMSS has been cost effective and cost efficient. The use of holistic approaches to problem solving helped the company in finding optimum solutions, thus avoiding the excessive use of human and other resources.

The potential for positive changes of workers' attitudes towards the environment has been suggested as a benefit of EMSS implementation. Nash and Ehrenfeld (1997) support the view that by making each employee aware of his/her contribution to environmental degradation, a re-thinking process may be initiated, which might lead to a change in attitudes.

There has been an on-going argument amongst members of the scientific community since the beginning of 90's. Porter and van der Linde (1995) support the view that stricter environmental regulation can lead companies to think of innovative methods and technologies, and amend basic principles, functions and processes of their organizations in a way that will result in better environmental results as well as financial benefits. Wally and Whitehead (1994) suggest that these so-called win-win strategies might be the exception rather than the rule. But whether many or few, the win-win strategies are more likely to occur through the systemic approach of EMSS. The 'plan, do, check, rethink' approach of EMSS, as well as involvement of all the personnel from the top down is ideal for the sparking of innovative win-win strategies³.

Legislative compliance was the major driving force for companies seeking certification to ISO14001 in Goodchild's survey (1998). Similarly, in a survey on Green Business Clubs (Business in the Environment, 1998), legal compliance issues were the most significant among the issues for which companies sought practical help. Undoubtedly, legal compliance is amongst the first in the agendas of managers. It is also a milestone requirement of ISO14001 and EMAS systems, which guarantee the level of environmental improvement required by legislation. In fact EMSS are designed to help companies to proceed beyond compliance with appropriate laws. To this extent they reduce the possibility of non-compliance as well as the risk of liabilities (Diamond, 1997). However, this benefit is preventive and thus difficult to quantify.

³ Thorsen's case study (1997) demonstrated that EMSS promoted employee participation, which in turn resulted in process innovation, with both environmental and economic benefits.

External Benefits

The notion of external benefits is used to notify that these benefits are dependent on factors outside of the companies such as the environmental awareness of the customers and their willingness to buy 'green' products rather than to say that they are of limited importance. In fact these are amongst the most important driving forces for the adoption of EMSS. They may include strategic new competitive strengths and advantages as well as the key for access to new markets.

Arora and Cason (1996) looked companies' participation in EPA's 33/50 Program and found that companies have an incentive to compete in environmental quality. They suggest that regulators can exploit this incentive in order to improve environmental performance. That was found to be particularly true for heavy polluters and companies with close contacts with their final customers. Other researchers (e.g. Barrett, 1991) suggest that when a company can be efficient in the reduction of its environmental costs it may over comply in order to gain competitive advantage. Specifically this company can drive the regulatory authority to impose stricter environmental standards, which would be relatively more expensive for other companies putting them in a disadvantaged position.

A competitive advantage may also be available since companies implementing the standards can gain access to new segments of the market trading more 'environmentally friendly' products. Though the EMSS 'label' cannot be used for the promotion of products or services, it can be used for the promotion of the company and the organisation that sells these products and services. Considering the amount of money spent for commercial purposes, and the increased environmental awareness of consumers (ENDS, 1998) the potential advantage of EMSS as a contributor to public image will be the deciding factor for the adoption of these systems (Diller, 1997). At

the same time, public surveys demonstrate that ethical businesses have a better corporate image (Grimshaw *et al.*, 1998) and that there is an increasing demand for green products (ENDS, 1998).

Even for the companies producing intermediate products, the requirement from their customers to adopt EMSS can be a strong incentive. Such a requirement can be made because some companies are committed to buy from registered suppliers. Additionally, when customers know the environmental impacts of their suppliers' production activities, they can more easily evaluate the environmental impacts of their production processes (Diller, 1997).

The reinforcement of environmental commitment both to employees and shareholders is very important. The employees' image of the organisation for which they are working can be of great significance. Similarly, financial institutions increasingly consider environmental performance as an essential indicator of both the potential and the risks of an investment. Chemical companies get insurance discounts for participating in the 'Responsible Care' programme. To this extent, the insurance industry could consider participation in EMSS as an assurance of less environmental risk and thus reduce insurance premiums for the participating companies.

Cost of Implementation

The cost of implementation will vary depending on a number of quantitative and qualitative characteristics of the company. Most important of these characteristics are the size, the complexity of their operations, the existence of other management systems, the availability of human and information technology resources, as well as other environmental initiatives undertaken in the past (Sheldon, 1997). The existence of other management systems can substantially lower the cost of implementing

EMSS. There are numerous examples (see Shah, 1996) of companies that already had quality systems in place and found it easier to implement EMSS. These companies have good communication systems, are familiar with establishing, reviewing and correcting their policies, have experience in training their employees and have a proactive approach to management. This argument is even stronger for those companies that have informal environmental management systems in place and want to implement either ISO14000 or EMAS. Diamond (1997) presents case studies of companies that already had an environmental management system in place and therefore found it easier and less expensive to fulfill the extra requirements of ISO14000 systems that were not covered by their system.

It is important to note, however, that the possibility of cost-savings due to energy and raw materials efficiency and waste minimization programmes will be lower for those companies that had a well organized environmental management system in the past and vice versa. Thus companies with very inefficient management systems should expect high rewards for implementing an EMSS, but they will have to pay the price in terms of the high cost of implementation (Hunt and Johnson, 1995). Furthermore, some companies have found their quality, health and safety management systems to overlap with the environmental one. In these cases an integration of the different components into one would probably reduce the overall cost and complexity of the system, and also enhance its effectiveness (Hermann and Kleinsorge, 1995).

Potential Environmental Benefits of EMSS

In a survey conducted in 1995, top USA manufactures, consultants and registrars were asked to identify the strengths and weaknesses of implementing ISO14001 in their own or their clients' company. The fact that there is 'no guarantee of an actual and continuous improvement in reducing environmental impact'

(Burdick, 1997; p. 86) was perceived as one of the major weaknesses of the system. This criticism is based on the fact that EMSS do not set specific limits on energy and raw material usage or on waste production, other than those imposed by national regulations. Companies implementing any of these schemes have to comply with legislation and maintain any agreements, voluntary or otherwise, that have been undertaken. According to ISO14001 the organization has to be committed to continual environmental improvement and prevention of pollution. EMAS, on the other hand, requires that the level of environmental impact does not exceed those levels corresponding to the economically viable application of the best technology. However, for both standards the objectives and policy of the company is not subject to any scrutiny. What are required are the components of the corresponding standard to be in place, without examining the content of these components or the actual results. Under the EMSS scheme individual companies set their own policies, objectives and targets on environmental conduct and performance. Thus two companies in the same sector and of a similar size could both be registered to an EMSS while significant differences exist in their emission levels and the impact of their business on the environment.

Klaver and Jonker (1998) emphasise the importance of the introduction in EMSS of tools such as benchmarking and environmental performance indicators. Benchmarking is the comparison of an organisation with the best performing one in the same sector, while performance indicators refer to standardised measurements of the environmental conduct of the organisation in question. These tools would give an incentive to managers to aim at better performance and it will help them to do so by the example of the best performing industry. Moreover, it would give more conclusive evidence to the interested stakeholders on the environmental conduct of the

companies than registration to an EMSS can currently provide, allowing for the reward of good conduct. However, while these tools will give incentives to companies to improve their environmental performances an important element is still missing, before the rewarding of the best is possible. What is needed is a systematic external communication about the environmental improvements. Such communication, which is lacking in ISO14001 while in EMAS it is only limited, should be a two-way communication with external stakeholders. That would give feedback to companies about stakeholders' expectations and preferences and would give stakeholders insights and reliable information on companies' conduct. Such systematic two-way communication combined with benchmarking and performance indicators can really be a 'driver' for companies to deliver substantial environmental improvement.

On the other hand, it should be acknowledged that the prerequisite that organisations should comply at a minimum with environmental regulation is a good starting point for EMSS even if they do not ensure that companies will continue any further than that. Furthermore, the fact that EMSS ensure that environmental issues are incorporated at every level of an organisation can make the management and employees proactive and potentially can lead to changes in the corporate culture. Last but not least, it has been shown that EMSS implementation can reduce the risk to the environment. Specifically, Diamond (1997) presented some case studies from a demonstration project run by the Environmental Protection Agency in the US on benefits of and barriers to implementing environmental management systems. Among the benefits found was the reduction of environmental risks. Even if the quantification of this benefit is difficult, as it is preventive, the participating companies acknowledged it.

The Decision to Implement EMSS

A number of issues arise regarding to companies' decision to implement EMSS. Firstly, it should be noted that the benefits reviewed above have been reported from certain companies implementing EMSS while not from others. This may be due to the fact that in certain cases the conditions for the occurrence of some of the benefits are present while not in others. Specifically, some problems or constraints that can hinder these benefits may or may not be present in companies implementing EMSS. Since the benefits of EMSS implementation can be distinguished as internal and external, it is both the internal characteristics of a company and the external factors that can affect the occurrence and appreciation of some benefits. Thus any attempts to generalize the observations presented above should be made with care.

Another interesting observation is related to the accountability of the benefits as opposed to the costs. Steger (2000) notes:

'...whereas the costs are immediate and (at least in principle) measurable, the benefits are partly long-term and immaterial, which means in other words, that they are hard to measure. The often-quoted positive image factors or increased motivation of employees related to EMS are a case in point. They are perceived benefits, neither measurable nor empirically verifiable. For a researcher it is therefore difficult to assess how far the arguments are merely ex post justifications of the decision to establish an EMS.'

Generally, when financial savings occur it may or may not be easy to account for them. Thus, since accounting systems keep records of inputs (raw materials and energy) it should be easy to account for the difference both prior and after EMSS implementation. On the other hand, Goodchild (1998) noted that in her survey only 45% of those reporting financial savings were able to quantify them. Accounting for

any savings due to waste minimisation is usually more difficult since companies' accounts do not measure these costs separately, although companies are increasingly encouraged to consider such accounting. Similarly accounting for the organisational benefits in monetary terms would be difficult if not impossible since most of these benefits are intangible and cannot be entered into companies' books. However, the importance of these benefits could be great for a company implementing the standards.

Goodchild (1998) suggested that changing employees' culture was considered by businesses of equal importance to cost-savings while employee awareness was increased due to EMSS implementation. However, companies that she had previously asked about their drivers to EMSS implementation did not mention 'employee motivation and morale' as an important one. This demonstrates that managers failed to appreciate the importance of this benefit prior to the introduction of EMSS, which reinforces the fact that some benefits may be difficult to account for or to appreciate.

While accounting for the promotion of innovation due to EMSS implementation has been possible in some instances (Thorsen, 1997) it is unclear if every kind of innovation would be possible to translate into monetary terms. As was discussed earlier, legislative compliance is one of the major drivers for companies seeking to certify to EMSS and has been found to reduce the possibility of non-compliance as well as the risk of liabilities. However, this benefit is preventive and thus would be practically impossible to quantify at a specific company level.

Companies producing intermediate products may have to adopt EMSS since some companies are committed to buying from registered suppliers. Whether the benefit is considerable or not for each of the suppliers depends on how big a part in its business the specific customer plays. Some companies may have to go out of business

if they fail to get certified while others may be affected only minimally. Generally, the benefit of certification for companies that are under pressure by their supply chain customers to implement the standards will equal the turnover that the company in question makes from its customers. This benefit is clear-cut and can certainly be appreciated by the managers of a company.

Aside of the issue of generalizing the findings reported in the review and the accountability of benefits of EMSS implementation there is another issue related to constraints that prevent the full realization of some of the benefits. The removal of these constraints could make EMSS implementation more attractive to companies. Such an example is the creation of a 'green' profile for those companies implementing the standards. Blaza and Chambers (1997) discuss the importance of a two-way communication between companies and the various stakeholders. Thus in order to maximize the benefit related to a 'green' profile, better communication with stakeholders is necessary while stricter verification of the various claims made by companies with respect to their environmental achievements is needed.

This paper looks at the importance of a number of factors, both internal and external to a company, as determinants in EMSS implementation. First, it examines whether management perception towards environmental issues can affect companies in their decision to implement EMSS. As it was discussed above many of the benefits of EMSS may not be easy to account for in monetary terms which may result in them being underestimated. This is because these benefits would not enter companies' books to offset some of the costs which are payable immediately. Furthermore, as it was previously discussed, companies have not always been able to anticipate all benefits resulting to EMSS implementation. In all these cases, positive management perception towards environmental issues can play an important role in overcoming

such problems and facilitating a decision to implement EMSS. This is the first line of research in this paper.

The second factor that will be looked at is the pressure a company is subjected to from a number of stakeholders or issues in order to improve its environmental performance. Specifically the pressure from consumers, intermediate customers, local communities, legislation, NGOs and the general public in companies' decision to implement EMSS will be examined. In all these cases a company could choose to diffuse this pressure by undertaking a voluntary stance in dealing with environmental issues and demonstrating that through the certification to an EMSS.

Similarly, the opportunities arising for a company as a result of its activities regarding environmental issues will also be looked at. Issues such as energy and raw material efficiency, waste minimization, better access to financial and insurance markets, organizational benefits and better company image are examples of opportunities that a company can be presented with and potentially materialize through EMSS implementation.

Furthermore, the size of the company is another important factor to consider. There are various claims regarding the importance of the size of a company in its decision to implement EMSS. Chapple et al (2001) look at the attributes of firms participating in ISO14001 and suggest that small and very large firms are quicker in obtaining certification compared to the middle range of firms. Hillary (1999) conducted a review of relevant studies on the barriers, opportunities and drivers for small and medium sized enterprises on EMSS implementation. She classifies the barriers as internal and external identifying the former one as lack of human resources, limited information on EMSS and their benefits as well as difficulties in determining the environmental aspects and their significance. She also notes that the

main external barriers of small medium enterprises to EMSS implementation include the high costs involved, uncertainty about their market benefits and lack of sector specific guidance. The impact of the company size is also being evaluated as an important factor to EMSS implementation.

Data

In order to assess the importance of the factors discussed above in companies' decision to implement EMSS a comparison of companies that had decided to implement the standards and those that have not come to such a decision would have to be made. To this extent, two groups of companies were surveyed. The first group was consisted of 101 companies participating in an EU-funded project run by the Greek Ministry of Development for the implementation of EMAS and/or ISO14001. National and EU funds covered the cost of implementation at 50% for ISO14001 and at 60% for EMAS, while the remaining 50% and 40% respectively came from the participating companies. All 101 companies participating in the project received a questionnaire during March 2000, and by the end of June 2000 84 answers had been received. This corresponds to an 83% response rate.

The second group of companies that were surveyed had not implemented EMSS. In order to conduct an accurate comparison it was thought very important to target companies that while had not decided to certify to an EMSS would be closely related to environmental issues. Thus the second group surveyed consisted of those companies that in the latest Census of Greek industry run by the Greek National Statistical Service suggested that had incurred environmental expenditures (capital or current.) This is not to claim that companies that had not budgeted for environmental expenditures could not implement the standards in a way that could make both business and environmental sense. However, companies would normally budget for

environmental expenditures if law requires this⁴. By incorporating the criterion of environmental expenditures we target all the Greek industry with a significant environmental impact as this is defined by current environmental legislation. Identifying the reasons for which these companies have not implementing the standards would shed light on the important factors in companies' decisions.

Overall 392 companies received a questionnaire during spring 2000 with the response rate being above 50%. In order to achieve a high response rate the questionnaire was kept to two pages and consisted of closed questions. The high response rate ensures that any non-response bias is being kept to a minimum. In order to avoid any bias caused by the designing of the questionnaire, the questions used for the comparison were worded and sequenced in exactly the same way in the two questionnaires used. The industrial sectors of the companies surveyed, outlined in table 1, cover the main industrial activities in Greece.

Table 1: Distribution of sample across various industrial sectors

Industrial Sector	Companies implementing EMSS	Companies not implementing EMSS
NACE Code Description		
Chemical	18%	11%
Metallic products	18%	
Food and Beverages	28%	34%
Non-Metal products	9%	13%
Textiles	5%	
Production of furniture	3%	3%

In order to assess the importance of management perception towards environmental issues, in companies' decision to implement EMSS, a number of statements were listed in the questionnaire (as presented in Table2) requesting the

⁴ It is acknowledged that some companies would budget for environmental expenditure because they are proactive. These cases would also be interesting to investigate in order to identify why these otherwise proactive companies have not as yet decided to implement EMSS.

respondent to suggest their company's agreement or disagreement in a 4 point Likert scale (from strongly agree to strongly disagree).

Table 2: Statements on company's views on environmental issues

1	Environmental issues could significantly affect my company's image.
2	Environmental considerations are of high importance in my company's decision-making process.
3	Companies should voluntarily proceed beyond mere compliance with environmental law.
4	Companies' activities for environmental protection are frequently associated with business benefits.
5	The only responsibility of a company is to produce goods. Companies' environmental and social by-products are for others to consider and regulate.
6	A company should be held responsible for any social and environmental problems that it may cause.

The measurement of the pressure on companies to improve their environmental performance is another major component included in the questionnaire. Specifically companies were requested to indicate the level of pressure (in a range between 'a great deal of pressure' to 'no pressure at all) they experience from a number of stakeholders/ issues to improve their environmental performance. These were the consumers, companies they were supply, local community, legislation, NGOs and their employees

The third set of questions aims to assess the importance of opportunities arising for companies as a result of their environmental activities. Respondents are requested to indicate the importance of a range of potential opportunities: energy efficiency, raw material efficiency, waste minimization, increased management efficiency, increased legal compliance, lower insurance premiums, easier access to financial markets, better training of the employees, increased employee morale and motivation, better organization of environmental issues, better company image competitive advantage, meeting customers requirements/ expectations, better relations

with local communities and environmental protection. A range of possible answers was given ranging from ‘essential’ to ‘not important at all’.

Methodology

These variables were used to develop an ordinal logistic regression model. This method of statistical analysis was preferred over a multiple regression for a number of reasons. First, the dependent variable is ordinal and not continuous. Second, the ordinal logistic regression model is a more appropriate monotone function for our data set in contrast to the least squares criterion of a multiple regression analysis. At the same time, logistic regression was preferred to discriminant analysis as the latter relies on meeting the assumptions of multivariate normality and equal variance-covariance matrices across groups. These assumptions are not required with logistic regression.

Let us now define the distributional properties of the dependent variable⁵, which is a dichotomous variable Y taking the value of 1 with probability Θ and the value of 0 with probability $1-\Theta$. Such a random variable has a simple discrete probability distribution given as

$$\Pr(Y_i, \Theta_i) = \Theta_i^{Y_i} (1 - \Theta_i)^{1-Y_i} \quad (1)$$

Given the mutually independent Y_1, Y_2, Y_n , the likelihood function of (1) is the product of the marginal distributions for the Y_i 's. Specifically,

$$L(Y; \Theta) = \prod_{i=1}^n \Pr(Y_i; \Theta_i) = \prod_{i=1}^n \left(\Theta_i^{Y_i} (1 - \Theta_i)^{1-Y_i} \right) \quad (2)$$

where $\Theta = (\Theta_1, \Theta_2, \dots, \Theta_n)$.

⁵ For more details on the properties and applications of logistic regression see Kleinbaum (1994), Hosmer and Lemeshow (1989), Collett (1991), Kleinbaum *et al.* (1999), Hair *et al.* (1998), Sharma (1996).

In our sample the first n_1 out of n observations implementing EMSS and so $Y_1=Y_2=\dots=Y_{n_1}=1$ while the rest of the observations do not and so $Y_{n_1+1}=Y_{n_1+2}=\dots=Y_n=0$. This means that expression (2) becomes

$$L(Y;\Theta)=\left(\prod_{i=1}^{n_1}\Theta_i\right)\left[\prod_{i=n_1+1}^n(1-\Theta_i)\right] \quad (3)$$

If $X_i=(X_{i1}, X_{i2}, \dots, X_{ik})$ the set of values of the k independent variables X_1, X_2, \dots, X_k specific to individual i then the logistic model assumes that between Θ_i and X_{ij} 's a specific form exists which is given by

$$\Theta_i = \frac{1}{1 + e^{\left[-\left(\beta_0 + \sum_{j=1}^k \beta_j X_{ij}\right)\right]}} \quad i=1,2, \dots, n \quad (4)$$

Obviously β_j are unknown coefficients to be estimated by regression. Replacing Θ_i in (3) we derive the likelihood function as⁶

$$L(Y;\beta) = \frac{\prod_{i=1}^{n_1} e^{\left(\beta_0 + \sum_{j=1}^k \beta_j X_{ij}\right)}}{\prod_{i=1}^n \left[1 + e^{\left(\beta_0 + \sum_{j=1}^k \beta_j X_{ij}\right)}\right]} \quad (5)$$

The regression coefficients β 's of the proposed logistic model quantifies the relationship of the independent variables to the dependent variable involving the parameter called the Odds Ratio (OR). As odds we define the ratio of the probability that implementation will take place divided by the probability that implementation will not take place. That is

$$\text{Odds}(E | X_1, X_2, \dots, X_n) = \frac{\Pr(E)}{1 - \Pr(E)} \quad (6)$$

⁶ Although we assume an unconditional maximum likelihood function that could lead to biased estimates of β 's as our data size is large this potential problem is not so serious.

Instead of minimizing the squared deviations as in a multiple regression, logistic regression maximizes the likelihood that an event will take place.

$$\ln \frac{\text{Pr}}{1 - \text{Pr}} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \quad (7)$$

or

$$P = \frac{1}{1 + e^{-(\beta_0 + \sum_{i=1}^k \beta_i X_{ij})}} \quad (8)$$

where P is the probability of implementing EMSS given the independent variables X_1, X_2, \dots, X_k . Equation (7) models the log of the odds as a linear function of the independent variables and it is equivalent to a multiple regression equation with log of the odds as the dependent variable.

The logit form of the model is a transformation of the probability $\text{Pr}(Y=1)$ that is defined as the natural log odds of the event $E(Y=1)$. That is

$$\text{logit} [\text{Pr}(Y=1)] = \log_e [\text{odds} (Y=1)] = \log_e \left[\frac{\text{Pr}(Y = 1)}{1 - \text{Pr}(Y = 1)} \right] \quad (9)$$

Empirical results

As our main interest is in terms of the main effects we have ignored interactions. As it can be seen from table 3, only 4 of the 15 explanatory variables were found to be statistically significant in influencing the implementation of EMSS.

Working with the most statistical significant variables we derive the logit form of the fitted model, which may be represented as

$$\text{logit} [\text{Pr}(Y=1)] = \beta_0 + \beta_1 \text{Size} + \beta_2 \text{Legislation} + \beta_3 \text{win-win Perception} + \beta_4 \text{Image}$$

where Y denotes the dependent variable as 1 for implementation and 0 for no implementation. The explanatory variables are Size (taking the values 0, 1 and 2 for

small, medium and large firms respectively⁷), Image (better image in the market), win-win perception and legislation. The results of the fitted model are presented in Table 4.

TABLE 3: Statistical significance of possible explanatory variables

Source	df	Wald X ²	Prob>X ²
Size of company			
-Size	1	3.549	0.060
Pressure on companies to improve environmental performance			
-Legislation	1	3.020	0.082
-NGO (e.g. Greenpeace)	1	0.073	0.786
-Employees	1	0.169	0.681
-General public	1	0.028	0.867
Management perception			
-Importance of environmental considerations in firm's decision making process	1	0.428	0.513
-Win-win perception	1	3.139	0.076
-Companies voluntarily proceed beyond mere compliance with environmental law	1	0.839	0.360
-Responsibility for social/environmental issues	1	0.161	0.688
Opportunities to companies arising from their activities for the environment			
-Energy efficiency	1	0.305	0.581
-Raw material efficiency	1	0.335	0.563
-Management efficiency	1	0.701	0.402
-Lower insurance premiums	1	1.064	0.302
-Better company image	1	3.292	0.070
-General environmental protection	1	0.053	0.817

TABLE 4: Logistic regression results

Regressors	Coeffs	Wald	Sig.	e ^{βi}
- Constant	-2.991	11.312	0.001	0.050
- Size	0.402	3.891	0.049	1.494
-Win-win perception	0.441	3.337	0.068	1.554
- Legislation	-0.428	9.172	0.002	0.652
-Company image	0.441	5.520	0.019	1.555

⁷ The European definition has been used to distinguish between small (0-49 employees), medium (50-249 employees) and large (250 and more employees).

Based on the fitted model and the information provided, we could compute the estimated odds ratio for implementing EMSS for firms, which are interested in a better company image relative to firms, which are not controlling for legislation, size and win-win perception. The adjusted odds ratio equals to 1.555 which means that the odds of implementing EMSS is about 1.55 times higher for a firm which cares for its image than for a firm which does not. The Wald statistic is statistically significant, which indicates that there is statistical evidence in these data that the opportunity arising to companies for a better image due to their activities for the environment significantly increases the probability of implementing EMSS.

We may compute the difference $e^{\hat{\beta}_i} - 1$ which estimates the percentage change (increase or decrease) in the odds $\pi = \frac{\Pr(Y = 1)}{\Pr(Y = 0)}$ for every 1 unit in X_i holding all the other X 's fixed. The coefficient of Size is $\hat{\beta}_1 = 0.402$, which implies that $e^{\hat{\beta}_1} = 1.494$ and $e^{\hat{\beta}_1} - 1 = 0.494$. This means that in relation to the Size the odds of implementing EMSS increase by 49.4% ceteris paribus. Similarly, the coefficient of win-win perception is $\hat{\beta}_2 = 0.441$, which implies that $e^{\hat{\beta}_2} = 1.554$ and $e^{\hat{\beta}_2} - 1 = 0.554$. This means that in relation to the win-win perception the odds of implementing EMSS increase by 54.6% ceteris paribus. Looking at the rest of the variables and in a similar way, we see that for the imposition of stricter legislation and for better company image the odds of implementing EMSS decreases by 34.8% and increases by 55.5% respectively, all the other remaining fixed in each case.

The negative sign in the coefficient for the legislation variable contradicts the original research line. While the background to literature suggests that companies could implement EMSS in order to diffuse any pressure from legislation it appears that companies implementing the standards are under less pressure than those that

have not come to such a decision. A very important observation is that companies in this survey are in the process of EMSS implementation. Thus, had these companies implemented the standards, it would be expected to proceed beyond the requirements of legislation. In such a case it would be unlikely to feel under pressure since they would have proceeded beyond current requirements.

However, since companies in the sample are currently in the process of EMSS implementation such an argument would be invalid. The explanation of this finding lies in a different perception of environmental issues between those companies implementing the standards and those that have not come to such a decision. A different mindset seems to exist between these two groups. Thus, those that do not implement the standards consider environmental legislation as a threat unlike those companies that have decided to be proactive by voluntarily dealing with environmental issues.

The individual statistical significance of the β estimates is presented in the column Wald (Chi-square). The significance levels of the individual statistical tests (i.e. the P-values) are presented in the column Sig (Significance) and correspond to $Pr > \text{Chi-square}$. Note that the constant term and the variable Legislation are significant in all the usual statistical levels (0.01, 0.05 or 0.1). The variables *company image* and *size* are statistically significant at the significance level of 0.05 and 0.1 while the variable win-win perception is statistically significant at a level of 0.1.

The overall significance of the model is given by $X^2=20.319$ with a significance level of $P=0.000$ and 4 degrees of freedom. Based on this value we reject H_0 (where $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) and conclude that at least one of the slope coefficients is different from zero ($X^2_{0.05,4}=9.488$).

To assess the model fit we compare the log likelihood statistic ($-2 \log \hat{L}$) for the fitted model with the explanatory variables with the value that corresponds to the reduced model (the one with only the intercept term). The likelihood ratio statistic for comparing the two models is given by the difference

$$LR = -2 \log \hat{L}_R - (-2 \log \hat{L}_F) = 285.041 - 264.722 = 20.32.$$

Where the subscripts R and F correspond to the Reduced and Full model respectively. This value must be compared with $X^2_{0.05,4} = 9.488$ which implies again a rejection of H_0 .

The Hosmer and Lemeshow value equals to 8.526 (with significance equal to 0.384). The non-significant X^2 value indicates a good model fit in the correspondence of the actual and predicted values of the dependent variable.

Conclusions and Policy Implications

The model presented above confirms a range of factors that are important in companies' decision to implement EMSS. Before addressing the policy implications of these findings it should be noted that the factors found to be significant are not necessarily the only ones that may affect companies' decision to implement EMSS. This research depicts a quantifiable relation that best describes the interconnections between EMSS implementation and the specific factors, rather than conclusively indicates that these are the only possible factors affecting a company's decision to implement EMSS. As it was previously indicated, some of the variables are closely correlated (especially those coming from the same group) and thus it is possible that

some other variables may play an important role in companies' decision to implement EMSS but their effect is masked by those variables included in the model⁸.

Other variables with the potential to affect EMSS implementation have not directly been considered in this research. Such examples may be the rate of exports and the company profits (Chapple *et al*, 2001), the existence of quality or other management systems (Montabon *et al*, 2000) as well as whether the company is publicly or privately owned. While these variables were not examined directly, at least part of their influence may be reflected by the existing variables. Specifically, variables such as the company size, whether significant opportunities are expected through better company image and generally the pressure, opportunities and management perception can have an influence on other possible variables omitted from the examination. Nevertheless, the explicit examination of these areas (specifically) is recommended for future research.

It should also be stressed that the data is based on what companies claimed without being able to verify their claims against specific actions. While companies may be inclined to present answers that portray a positive image, all possible methodological measures to avoid such bias have been undertaken. These included an assurance of anonymity, an assurance that the results would be statistically processed and a detailed explanation to convince respondents of the value of the study. The high response rate provides an indication that the research was highly regarded. Furthermore, this study is a comparative study examining the differences between those companies implementing EMSS and those not and there are no indications that would suggest that one of the groups might be more inclined to present a positive

⁸ Multicollinearity was detected in some of our explanatory variables. This explains why some of the independent variables appear to be insignificant in our analysis.

image than the other. To this extent, any difference identified should be attributed to real differences between the two groups of companies.

The odds of EMSS implementation for a large company are significantly higher than the odds in a medium company which in turn is significantly higher than the odds of implementation to a small company. This finding regarding the importance of a company's size in its decision to implement EMSS support various claims (e.g. Hillary, 1999; Dasgupta *et al*, 2000; Montabon *et al*, 2000) on the barriers that small-medium enterprises face in implementing the Standards. Common problems reported (Hillary, 1999) at an international level suggest that lack of guidance, limited information and absence of resources are the main barriers for small-medium enterprises. To this extent, information help-lines, leaflets, seminars and co-operation with industrial associations are only a few of the examples of measures that can be used for the promotion of EMSS in small and medium enterprises.

The significance of management perception of environmental issues on their decision to implement EMSS was confirmed with regards to their perception on win-win possibilities. While the scientific debate on the possibility of win-win strategies, which was briefly discussed in the review above, has not been settled, this finding suggests its importance. It is not surprising that companies are more willing to deal voluntarily with environmental issues when they perceive that they will reap some benefits. Policy makers and consultants could promote EMSS implementation by presenting those examples of companies that have achieved these win-win strategies. Furthermore, additional research is needed to pinpoint those sectors and processes that are more likely to result in win-win strategies. This will facilitate the undertaking of voluntary action by businesses in environmental issues.

Very interestingly and contrary to what was indicated in the review and formation of the research lines above, legislative pressure on companies to improve their environmental performance does not result in a higher uptake of the standards. This finding should be treated with care since it could either depict a departure from the literature used for the formation of this research line or could reflect a shortcoming in the measurement used. As far as the latter is concerned indeed it can be claimed that the question regarding the pressure could be considered as threatening in that companies may be reluctant to accept that they are under pressure, and thus it may lead them to provide unreliable answers. However, the measures outlined above assuring companies of confidentiality and explaining the usefulness of the research (backed up with the high response rate) suggests that there is no problem with the reliability of this question. Indeed, what this result indicates is that there is a different mindset between those companies implementing the standards and those that have not come to such a decision. The former do not seem to perceive the requirements of environmental legislation as pressure. That should not come as a surprise given that these companies are willing to proceed beyond legal compliance. Companies that have not come to a decision to implement the standards seem to perceive environmental legislation as a threat to their business. This finding is also in line with recent literature. Specifically, Kollman and Prakash (2001: 417) note:

“... years of stringent environmental laws make industry suspicious of any type of environmental regulation, even of a voluntary nature. Those in industry are on the lookout for hidden dangers.”

Kollman and Prakash (2001) also point that companies that are tightly regulated have usually dealt with any inefficiency and therefore cost-savings are more difficult to achieve compared to companies that are under less legislative pressure.

This is an additional disincentive for companies under strong legislative pressure to implement EMSS, an explanation in line with the results of this research. Nevertheless, this area is recommended for further research to confirm the finding as well as in order to look deeper into it and provide with its underlying reasons.

Companies perceiving their image to be an important opportunity have much higher odds to implement EMSS compared to those that do not hold this perception. This finding is consistent with current literature (e.g. Diller, 1997; Pflieger, 1997) in that better company image and increased competitive advantage have been reported as an important benefit for those companies seeking to implement the standards. It is also consistent with Arora and Cason (1996) noting that companies with close contact to their customers may be more willing to deal voluntarily with environmental issues.

References

- Arora, S. and Cason T. 1996. Why Do Firms Volunteer to Exceed Environmental Regulation? Understanding Participation in EPA's 33/50 Program, *Land Economics*, Vol. 72, No.4, 413-432
- Barrett S. 1991. 'Environmental Regulation for Competitive Advantage' *Business Strategy Review*, Vol. 2, 1-15
- Bird WA. 1995. ISO-14000. *Chemical Engineering*, **102(9)**: 94-96
- Blaza A. and Chambers N. 1997. 'Environmental Management Standards: Who Cares?' In *ISO14001 and Beyond: Environmental Management Systems in the Real World*, Sheldon C. (ed). Greenleaf Publishing, Sheffield
- Burdick D. 1997. Industry Cases and Practices: A Recent Survey of Benchmarking Corporate Perceptions of ISO14000 Benefits. In *Moving Ahead with ISO14000*, Marcus P and Willig J (eds), Wiley.
- Burleigh C. 1997. Achieving improvements in production through environmental management systems. In *Environmental Management Systems and Cleaner Production*, Hillary R. (ed). Wiley.
- Business and the Environment 1998. Chemical Companies Get Insurance Discount for 'Responsible Care' Participation, February Vol. IX, No 2
- Business in the Environment 1998. 'Green Clubs surveyed', Issue 12, Summer
- Chapple W, Cooke A, Galt V and Paton D. 2001. The Characteristics and Attributes of UK Firms Obtaining Accreditation to ISO 14001' *Business Strategy and the Environment*, **10**: 238-244
- Collett D. 1991. Modeling binary data, Chapman and Hall, London
- Dasgupta S., Hettige H. and Wheeler D. 2000. What Improves Environmental Compliance? Evidence from Mexican Industry, *Journal of Environmental Economics and Management* 39, 39-66
- Diamond C. 1997. Industry Cases and Practices: Voluntary Environmental Management System Standards' In *Moving Ahead with ISO14000*, Marcus P and Willig J (eds). Wiley
- Diller MJ. 1997. ISO 14001 Certified: To Be or Not to Be... *Chemical Engineering Progress*, **93(11)**: 36-9
- Dobes V. 1997. Implications of Czech cleaner production case studies for EMS' In *Environmental Management Systems and Cleaner Production*, Hillary R (ed). Wiley.
- ENDS 1998. Market advantages for ethical businesses. ENDS report 276

Goodchild E. 1998. The Business Benefits of EMS Approaches' Conference Proceedings, The Eco-Management and Auditing Conference, July 2nd and 3rd University of Sheffield, UK

Grimshaw C, Howard M, Willmott M. 1998. The Responsible Organisation. The roles and responsibilities of the Big Citizens of the 21st Century' The future foundation. A report commissioned by BT

Hair JF, Anderson RE, Tatham RL and Black WC. 1998. Multivariate data analysis, Prentice Hall, Fifth Edition

Hermann F and Kleinsorge P. 1995. Environmental certification of AT&T-GIS in Augsburg, *Germany*' *AT&T Technical Journal*, **74(6)**: 72-78

Hillary R. 1999. Evaluation of Study Reports on the Barriers, Opportunities and Drivers for Small and Medium Sized Enterprises in the Adoption of Environmental Management Systems.' Department of Trade and Industry, Environmental Directorate.

Hosmer DW and Lemeshow S. 1989. Applied logistic regression, John Wiley and Sons, New York

Hunt D. and Johnson C. 1995. Environmental Management Systems. Principles and practice. Chapter 7, McGraw-Hill Book Company

Klaver J. and Jonker J. 1998. The significance of recent EMS standards as an impetus for improvement. *Eco-Management and Auditing*, **5**: 1-5

Kollman K. and Prakash A. 2001. Green by Choice? Cross-National Variations in Firms' Responses to EMS-Based Environmental Regimes' *World Politics*, Vol. 53, 399-430

Kosasih A. and Shobirin M. 1995. Implementing an environmental management system on an oil field operation in Sumatra. *Journal of Petroleum Technology*, **47(1)**: 43-48

Kleinbaum DG. 1994. Logistic regression: A self learning text, Springer-Verlag, New York.

Kleinbaum DG., Kupper LL., Muller KE. and Nizam A. 1999. Applied regression analysis and other multivariate techniques, Duxbury, Third Edition.

Montabon F., Melnyk S., Sroufe R. and Calantone R. 2000. ISO14000: Assessing Its Perceived Impact on Corporate Performance. *The Journal of Supply Chain Management*, Spring 2000

Nash J. and Ehrenfeld J. 1997. Codes of environmental management practice: Assessing their potential as a tool for change. *Annual Review of Energy and the Environment*, **22**: 487-535

- O'Laoire D. and Welford RJ. 1994. Environmental Management at the regional level: the case of the Avoca-Avonmore Catchment Conversion Project and IDAS Trout Ltd.' In *Cases in Environmental Management and Business Strategy*, Welford RJ. (ed). Pitman Publishing
- Pfliegner K. 1997. International voluntary standards – the potential for trade barriers, In ed. Hillary, R *Environmental Management Systems and Cleaner Production*, Wiley
- Porter M. and van der Linde C. 1995. Green and competitive: ending the salemate. *Harvard Business Review* Sept- Oct 120-134
- Romanow GS. 1996. Is the HPI ready for ISO14000? *Hydrocarbon Processing* **75(6)**: 15
- Sharma S. 1996. Applied multivariate techniques, John Wiley and Sons, New York
- Shah GC. 1996. ISO-14000 – To be or not to be? *Hydrocarbon Processing*, **75(3)**: 132
- Sheldon C. 1997. BS 7750 and certification – the UK experience' In *Environmental Management Systems and Cleaner Production*, Hillary R. (ed). Wiley
- Steger U. 2000. Environmental Management Systems: Empirical Evidence and Further Perspectives. *European Management Journal*, **18(1)**: 23-37
- Thorsen N. 1997. Cleaner production through environmental management of process innovations. In *Environmental Management Systems and Cleaner Production*, Hillary R. (ed). Wiley
- Wally N. and Whitehead B. 1994. It's not easy being green', *Harvard Business Review*, May – June 46-52
- Welford R. 1996. Corporate Environmental Management. Systems and Practices. Earthscan.