

Assessing the effectiveness of US voluntary environmental programmes: an empirical study

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In the last 10 years, there has been an increased interest in improved environmental management. The interest has been made more noteworthy since it is global in nature. Given the global interest in improved environmental management, it is still important to understand how specific business organizations are influenced by the local environment in which they are located. This study examines how US plants have reacted to various programmes and initiatives encountered in the USA. These initiatives, which include Responsible Care[®], 33/50 and ISO 14001 certification, can be viewed as embodying alternative foci (outcome versus process) and procedures (self-assessment versus external assessment). The study assesses the relative effectiveness of four voluntary environmental programmes using data generated from a large-scale mail survey. The results indicate that while all four environmental programmes generate a positive impact on the various dimensions of corporate performance, one (ISO 14001 certification), tends to have a greater relative impact on several dimensions of corporate performance.

1. Introduction

The 1990s have seen an increase in the level of awareness in manufacturing firms and among production managers surrounding the impact and importance of environmental performance. Production and operations managers, engineers, quality, and purchasing personnel are now recognizing that the reduction of environmental pollution and its associated waste streams is not simply good for the environment, it is also good business. Given the increased attention surrounding environmental business practices in the popular press and in academic research, practitioners are still left with the monumental task of deciding when to initiate environmental business practices and whether to get the business involved in a voluntary environmental programme. The increased attention to environmental business practices and the difficulty of making decisions surrounding these practices can be attributed to three recent developments. The first is the recognition that pollution is little more than another form of waste (Porter 1991, Makower 1994, Porter and van der Linde 1995a, b). The recognition of pollution as waste helps to integrate waste manage-

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ment as an extension of Total Quality Management (TQM) and can allow firms to understand costs better while managing processes more effectively and efficiently.

The second development is the increased level of public awareness of pollution. This awareness has come from several sources. The first is from the publicity generated by business magazines. In the USA, for example, *Fortune* now publishes an annual rating of America's most admired firms (Anon. 2001). One criterion used in determining these rankings is the firm's environmental performance. Another source consists of investment advisory groups such as CERES (Coalition for Environmentally Responsible Economies). These groups, while not actually managing investments, attempt to influence investing activities by providing information about those firms that are at the top and bottom in terms of environmental performance. Consequently, they try to encourage investors, especially large institutional investors, to favour those firms that are environmentally responsible and to disinvest in those firms that are not. In addition, a variety of mutual funds restrict their equity holding to 'socially responsible' firms. Such developments have obvious and strong effects on Chief Executive Officers (CEOs) and top management, irrespective of the country in which the company operates.

Finally, managers now have available various environmental programmes for helping them reduce and eliminate pollution. These programmes and initiatives are important because they point to a growing integration of environmental business practices. The attitudes towards the need for enhanced environmental responsibility are global. Yet, the behavioural changes required for a firm and its personnel to become more environmentally responsible are shaped locally. How a firm in the USA pursues environmental responsibility can be expected to be different from how a similar firm in Europe pursues the same goals. These differences reflect not only cultural (reflecting the attitude of the local population) and economic factors (presence of unions, state of the economy), but also the specific types of regulations, programmes and initiatives encountered in local settings. The types of laws, programmes and initiatives found in the USA are, for the most part, different from those encountered elsewhere.

This study focuses specifically on the voluntary programmes and initiatives introduced in the USA to encourage firms and plants to be more environmentally responsible. These range from industry-specific pollution control programmes such as Responsible Care[®] (initially developed by the chemical industry in the USA and now a global programme) to programmes sponsored by various organizations, such as the Environmental Protection Agency (EPA) of the US government. Among the latter are such programmes as 33/50, Green Light, Climate Wi\$e and the Environmental Leadership Programme. Furthermore, there is the newly introduced global ISO 14001-certification procedure for Environmental Management Systems (EMS) (Sayre 1996, Tibor and Feldmen 1996, Hormozi 1997). Finally, there are programmes developed by Occupational Safety and Health Act (OSHA) and other organizations where pollution prevention is linked to another objective such as improved worker safety (as in the case of OSHA's Pollution Prevention Programme). Each programme provides management with different objectives and different metrics for measuring environmental performance; each programme embodies different approaches to the achievement of pollution reduction and elimination. While there is profuse anecdotal evidence supporting these various approaches (Hess 1994, Fairly 1996), there is little empirical evidence that evaluates the relative effects

of these programmes. The present study was designed to provide empirical evidence of the effects of several voluntary environmental programmes.

Before setting out the specific objectives driving this study, an important question should be addressed: why should someone who is not involved with US firms be interested in this study? Two critical needs are fulfilled by such a study. First, the study helps facilitate international comparisons—specifically comparisons between the US and European experiences with environmental management and environmental programmes. The European experiences has been described and studied in several studies (e.g. Freimann and Schwaderlapp 1996, Freimann 1997, Freimann and Schwedes 2000, Hillary 1997, 2000, Steger 2000). This study is intended to increase the richness of the research information as it pertains to the experiences within the USA. Second, the results are generalizable beyond the USA if we view the various voluntary environmental programmes as being defined in terms of universal dimensions such as the focus on outcomes verses processes, a direct or indirect environmental focus, and the nature of internal and external verification of the results. By studying the relative effectiveness of these programmes, we gain insight about the relative impact of the various environmental programmes and gain insights that one can use universally when evaluating progress, or forming environmental initiatives.

Specifically, the paper will address the following research questions.

- What major environmental programmes are available to managers in the USA who are interested in improving the environmental performance of their manufacturing transformation systems?
- What dimensions characterize and differentiate the approaches underlying these various programmes?
- Does participating in a programme significantly affect the performance of manufacturing processes and the firm as a whole?
- Can differences in performance be attributable to the participation in specific voluntary environmental programmes?

The study is not a comparison of findings in the USA to other countries. Instead, it is exploratory in nature and presents initial findings. The research presented addresses the research questions by drawing on data generated by a large-scale survey of managers in the USA and their positions towards environmental management systems (EMS), and voluntary environmental programmes.

The paper is organized as follows. In Section 1, the concept of environmentally responsible management (ERM) is defined at two levels. It is first defined in very general terms—as a corporate management system charged with the task of reducing pollution and environmental waste within the firm. At the second level, US experiences with ERM are explored via a broad-based plant-level survey. This discussion also explores the role of various formal environmental programmes in helping management achieve the objectives of ERM. Ultimately, this discussion concludes with the development and presentation of the unifying conceptual taxonomy that provides a theoretical setting and justification for this study. This taxonomy restates these specific US programmes in broader and more generalizable terms. Section 2 summarizes the basic structure of this study's research methodology, while describing the nature of the survey and the source of the data used for analysis. It also describes the statistical methodology used to analyse the data and addresses the

questions previously identified. In Section 3, the major findings are presented and their implications for ERM and the corporate acceptance of ERM and its objectives are then discussed. Section 4 discusses the broader theoretical and research implications of the findings.

2. Environmentally responsible management: understanding the concept

In focusing the discussion on improved environmental performance within the corporate setting, what is really being addressed is the concept of ERM, which can be defined as (Smith and Melnyk 1996):

A corporate system that integrates product and design issues with issues of production planning and control and supply chain management in such a manner as to identify, quantify, assess, and manage the flow of environmental waste with the goal of reducing and ultimately minimizing its impact on the environment, while also trying to maximize resource efficiency.

Underlying this definition is the implicit assumption of a positive relationship between environmental and corporate performance. While ERM defines the ultimate outcome, it does not necessarily define the means of achieving it. How the goals are achieved is strongly influenced by the national setting in which the firm finds itself. At this point, it is useful to examine the US experiences with ERM.

2.1. ERM: the US experience

Much of the recent attention given to environmental business practices began in the late 1960s. Before this time, ERM was either not given any attention or was unpopular and seen only as a constraint and additional cost if pollution was to be eliminated or reduced. In the last 40 years, the US approach to environmental responsibility has been strongly shaped by the activities of four major forces: (1) the government, (2) industrial organizations, (3) industrial leaders and (4) standards organizations.

2.1.1. The government

Since the late 1960s, the government (especially at the federal level) has played a critical role in encouraging environmental responsibility. In the USA, four agencies have been principally charged with this task: the Council on Environmental Quality (CEQ), the Environmental Protection Agency (EPA), the Department of Justice (DOJ) and the Department of the Interior (DOI). Of these four, the EPA has been the lead agency for implementing most environmental protection laws in the USA. It sets and enforces most federal environmental standards and administers most environmental programmes not related to natural resource commodities. The government has long relied on three major tactics for encouraging environmental responsibility: (1) regulations, (2) fines and penalties (for failing to comply with these regulations), and (3) voluntary programmes. These three tactics can be best described as a combination of 'the stick and the carrot', where the first two are the stick and the last the carrot. Since the late 1990s, the government has increasingly relied on the power of the carrot. That is, agencies such as the EPA have encouraged the participation of firms in various programmes and initiatives such as the 33/50. Underlying these various programmes is an effort to show business that being environmentally responsible is not only good for the environment but also for the bottom line.

2.1.2. *Industrial organizations*

Most US firms belong to one or more industrial organizations. For example, Dow Chemical is a member of the Chemical Manufacturers Association (CMA). These organizations exist for a number of reasons, one of which is to protect and promote the interests of its members. Yet, these organizations have increasingly been developing and promoting voluntary industry wide programmes aimed at improving environmental responsibility amongst its members. One prominent example is the Responsible Care[®] programme promoted by the CMA. This programme was a response to the Bhopal, India, incident and was motivated, in part, on the belief that if the chemical firms did not do a better job of managing and reducing pollution voluntarily, then the federal government would further regulate them, thus undermining the ability of management to control their companies (Reinhardt 2000).

2.1.3. *Industry leaders*

This category refers to those firms that have long taken a leadership stance when it comes to environmental responsibility. These are firms where environmental responsibility is viewed as a prime corporate and strategic undertaking. Companies such as Herman Miller, Lucent Technologies, 3M, Anderson Windows, Patagonia and IBM are examples of such US multinational firms. These firms have long pursued a voluntary programme and initiatives aimed at reducing and eliminating pollution.

2.1.4. *Standards organizations*

This is the newest force for change and it includes those bodies such as the International Organization of Standards (ISO), whose objective is to facilitate trade at the international level by introducing and promoting standards. Examples of such standards can be found in quality (ISO 9001) and environmental management systems (ISO 14001).

2.2. *Voluntary initiatives and the US ERM experience*

One approach that has been used by all four forces is that of voluntary programmes and initiatives. At present in the USA, these programmes and initiatives can be categorized as follows.

- *Voluntary industrial environmental programmes*: the first category consists of environmental programmes that are initiated and championed by firms operating in specific industries. The most noteworthy example of this category is the Responsible Care[®] programme. In 1988, the US Chemistry Council launched Responsible Care[®] to respond to public concerns about the manufacture and use of chemicals. Through Responsible Care[®], member companies are committed to support a continuing effort to improve the industry's responsible management of chemicals. Responsible Care[®] is an obligation of membership in the US Chemistry Council, and requires member companies: (1) continually to improve their health, safety and environmental performance; (2) to listen and respond to public concerns; (3) to assist each other to achieve optimum performance; and (3) to report their goals and progress to the public. This category of programmes tends to be primarily voluntary in nature. It also tends to be based on the self-regulation approach to improved environmental

performance. To date, there is significant anecdotal evidence pointing the effectiveness of these programmes (e.g. Hunter 1998, Wood 1998, Foster 1999).

- *Voluntary government-initiated environmental programmes*: in contrast to the preceding category, this category consists of programmes supported by the government, specifically the Environmental Protection Agency (EPA). Examples include the Green Light[®], Environmental Leadership and the 33/50 programmes. The Green Light programme may be one of the best-known environmental programme in the USA (Fiksel 1996), and emphasizes energy conservation as a method of achieving pollution prevention. The programme's goal is to prevent pollution by encouraging US institutions to use energy-efficient lighting technologies. The Environmental Leadership Programme is a voluntary initiative whereby manufacturing firms can apply for recognition by the EPA as an environmental leader. This programme is designed to recognize and encourage top environmental performers—those who go beyond compliance with regulatory requirements to attain levels of environmental performance that benefit people, communities, and the environment. Finally, the 33/50 programme is another voluntary programme that was just being completed before the time that data collection for this study took place. The 33/50 Programme targeted 17 priority chemicals and set as its goal a 33% reduction in releases and transfers of these chemicals by 1992 and a 50% reduction by 1995, measured against a 1988 baseline. The first of the EPA's growing series of voluntary programmes, its primary purpose was to demonstrate whether voluntary partnerships could augment the EPA's traditional command-and-control approach by bringing about targeted reductions more quickly than would regulations alone. The programme also sought to foster a pollution prevention ethic, encouraging companies to consider and apply pollution prevention approaches to reducing their environmental releases rather than traditional end-of-the-pipe methods for treating and disposing of chemicals in waste (EPA 1999). Recent research has suggested that participation in this programme has led to statistically significant decline in toxic releases over the period 1991 to 1993 as well as improved overall environmental performance (Arora and Cason 1995, Khanna and Damon 1999). In these cases, it is the governmental agency, not the firm, which acts as the initiators of these programmes.
- *ISO 14001*: formally adopted in 1996 by the International Organization for Standardization, ISO 14001 represents a new standard and approach to improved environmental performance (Dodds 1997). ISO 14001 shares many common traits with ISO 9001. Owing to its backing by the International Organization for Standardization, it is expected that ISO 14001 certification will become a way for firms to use one standard of practices rather than dealing with conflicting environmental regulations across national borders (Sayre 1996). Like its predecessor, ISO 14001 does not focus on outcomes, such as pollution output, but focuses on processes. Finally, much like ISO 9001, ISO 14001 involves an audit by a third party. The ISO 14001 standards describe the basic elements of an effective EMS. These elements include creating an environmental policy, setting objectives and targets, implementing a programme to achieve those objectives, monitoring and measuring its effec-

tiveness, correcting problems, and reviewing the system to improve it and overall environmental performance (Tibor and Feldman 1996).

- *Voluntary programmes where improved environmental performance is a secondary benefit*: in the previous three categories of programmes, improved environmental performance is the desired and primary outcome of these programmes. In contrast, this category of alternatives focuses on another set of outcomes. For example, the programmes run by OSHA and the Resource Conservation and Recovery Act (RCRA) focus on improving the safety of the environments in which the employees work. In 1965, the US Congress passed the Solid Waste Disposal Act, the first federal law to require safeguards and encourage environmentally sound methods for disposal of household, municipal, commercial, and industrial refuse. Congress amended this law in 1970 and 1976 by passing the Resource Conservation and Recovery Act (RCRA). The primary goals of RCRA are: (1) to protect human health and the environment from the potential hazards of waste disposal; (2) to conserve energy and natural resources; (3) to reduce the amount of waste generated, including hazardous waste; and (4) to ensure that wastes are managed in an environmentally sound manner. It can be argued that any action that improves safety will also impact environmentally related activities such as pollution prevention and reduction. The reason is that increased pollution (either through exposure to or the handling of it) negatively contributes to such objectives.

While these four categories of programmes share some important similarities (e.g. they are all voluntary in nature and promote environmental business practices), they also exhibit some differences. One way of understanding these similarities and differences is to examine the various traits (dimensions) underlying these four categories of programmes. It can be argued that the four categories represent different 'mixes' of traits. With research involving voluntary environmental business programmes being relatively new, both the traits and the programmes themselves become important to study. When we can identify the most appropriate set of traits, then we can construct and implement more effective and efficient environmental programmes and initiatives.

This study identifies three critical underlying traits.

- *Action focus*: this dimension describes where the focus of management attention is placed when dealing with environmental problems and issues. This can be envisioned as spanning a spectrum that is anchored at one end by an 'Outcome' focus. With this focus, attention is directed towards the outputs of the process and the management of these problems *once* they have been created. For example, the decision to install a scrubber into a smokestack so that particulates can be removed before they reach the open air falls into this category. The other end of the spectrum is anchored by a 'Process' focus. Here, management is interested in identifying, studying and changing the performance of those processes that are responsible for the observed level of pollution. In contrast to the 'Outcome' focus, this approach seeks to eliminate the pollution from being created in the first place. It is a preventative orientation, in contrast to Outcome's reactive stance.

- *Environmental focus*: this dimension describes the extent to which improved environmental performance is the primary (major) focus of the programme or a secondary focus. This trait consists of two levels: direct and indirect.
- *Nature of the results' verification*: the impacts generated by a programme can be evaluated in one of two ways. They can be evaluated internally (internal verification). That is, the firm and its personnel can decide to measure by themselves the various effects (using metrics that are either internally derived or provided by an external source). With this approach, there is no outside verification of the results reported. It is implicitly assumed that the firm has accurately, honestly and completely described the effects. Alternatively, the effectiveness of a programme can be verified by an outside, third party auditor (external verification). The firm is charged with the task of proving to the satisfaction of this external auditor the ultimate impact of the programme. The first approach is easier, less costly and less time-consuming to undertake, while the second should provide more 'credible' results.

Using these three dimensions, we can now comparatively position the four programmes, as shown in table 1. It effectively highlights the similarities and differences present between the four categories of programmes and initiatives. For example, while all four categories are voluntary, ISO 14001 is the only one that requires external verification of the results and the procedures. While three of the four categories of programmes focus on 'outcome' or 'end-of-pipe' results, ISO 14001 is far more process-oriented. These differences and similarities are important because they can influence the performance of those business units using these programmes. By studying the experiences of these business units and the impact of these programmes on firm performance, we can assess the relative effectiveness and efficiency of these programmes. Any differences, in turn, can be interpreted as reflecting the impact of the various programme categories, and the impact of the underlying traits that characterize these programmes.

Factor	Level	Voluntary Industrial Environmental Programmes (VEP)†	Voluntary Government-initiated Environmental Programmes (VEPA)	International Organization of Standards (ISO 14001 (ISO14k)	Voluntary Programmes Environmental Performance Secondary Benefit (VPP)
Action focus	outcome process	✓	✓	✓	✓
Environmental focus	direct indirect	✓	✓	✓	✓
Nature of results verification	internal verification external verification	✓	✓	✓	✓

† These abbreviations will identify the various categories.

Table 1. Four categories of environmental problems.

It would be reasonable to expect that programmes possessing a process focus, where the environmental focus is direct and where there is external verification, have a greater relative impact on firm performance compared to programmes where one or more of these traits is lacking. As a result, one can expect that programmes belonging to the category, 'Voluntary programmes where improved environmental performance is a secondary benefit', will not have as great an impact on performance.

3. Design of the study

The primary data collection method used in this study is based on a large-scale survey, where the unit of analysis was the *plant*. The survey was employed to allow the research team to collect data pertaining to the attitudes of the respondents towards environmentally responsible manufacturing, their plant's environmental management system, and towards voluntary environmental programmes. The survey also helped to identify factors that influence the perceived effectiveness and efficiency of the plant environmental management systems. Next, the structure of the survey and the major attributes of the respondents will be briefly summarized. For more descriptive details of the full survey instrument and the attributes of the respondents, see Melnyk *et al.* (1999).

3.1. Survey design

The survey consisted of five major sections. The first section gathered information about the respondent, their position, professional affiliations (if any), and extent of involvement in various corporate initiatives. The second section focused on the business unit (the basic unit of analysis) and detail about it. This included products manufactured, extent of uncertainty facing the business unit and its personnel, and the status of various initiatives. The third section dealt with the perceived impact of the ISO/QS 9000-certification process on the business unit and its competitive position in the market place. In the fourth section, the respondent was asked to evaluate a series of questions pertaining to ISO 14001. These questions assessed the level of knowledge of the respondent on the ISO 14001 certification process, as well as the factors affecting its implementation and use. The fifth and final section gathered information about the business unit's environmental management system, the effectiveness and efficiency of this system and the types of options used to improve environmental performance.

3.2. Sample and responses

A mailing list of 5000 randomly generated names each were obtained from three professional associations (National Association of Purchasing Management, US Production and Inventory Control Society and one anonymous group), for a total of 15 000 names. The lists were checked for duplicate names, with the few identified being eliminated. Where possible, the associations were asked to provide names of managers who worked for manufacturers (i.e. in the two-digit Standard Industry Code range of 20–39 inclusive). The researchers also worked closely with a major US manufacturer, who provided an additional list of 104 managers at six of their facilities.

Three waves of mailings were sent out, using the modified Dillman (1978) method. The survey was sent out in the fourth quarter of 1997 and responses were received well into 1998. As a result, 1510 usable responses were obtained, for a

response rate of 10.35%. Based on feedback from non-respondents, it is likely that the length of the sixteen-page survey discouraged many potential respondents.

4. Demographic information

To ensure the survey went only to manufacturing firms, the respondents were asked to list the principal products produced in their plants. These responses (open-ended) were recoded into appropriate SIC (Standard Industrial Classification) codes. From the 40-some Standard Industry Codes, 1347 (89.2%) came from the targeted SIC codes, while 110 (7.3%) came from industries out of the target SIC codes, and 53 respondents (3.5%) did not identify their industries. Furthermore, the bulk of respondents (999 respondents or 66.2% of the respondents) were drawn from one of five SIC codes (noted in the brackets).

- Industrial & Commercial Machinery & Computer Equipment (35): 316 respondents.
- Transportation Equipment (37): 198 respondents.
- Electronic & Other Electrical Equipment & Components Except Computer Equipment (36): 179 respondents.
- Fabricated Metal Products, Except Machinery & Transportation Equipment (34): 179 respondents.
- Measuring, Analyzing & Controlling Instruments; Photographic, Medical & Optical Goods; Watches & Clocks (38): 127 respondents.

4.1. Background of the respondents

Respondents were asked to indicate their job title. These were recoded into the categories listed in table 2. As can be seen, the respondents have a wide variety of job titles. They occupy positions ranging from presidents and Chief Operating Officers (CEOs) to managers and staff. The purpose of randomly soliciting managers in different levels of the firm and from different functional backgrounds is to capture more information than could be captured in one management level alone.

Information on the functional areas in which the respondents worked was also collected. Of the 18 categories, over 75% of the respondents came from one of four functional areas.

- Purchasing, materials (42.5% of the respondents).
- Manufacturing/production (22.0%).

Stated position	Frequency (no. of observations)	%
Chief Executive Officer	13	0.9
President	12	0.8
Vice-President	169	11.2
Manager	718	47.5
Senior Management	251	16.6
Staff	317	21.0
Not listed	30	2.0
Total	1510	100.0

Table 2. Stated positions of the respondents.

- Quality (8.7%).
- Engineering (5.6%).

Environmental compliance managers represented a very minor part of the data (i.e. 48 respondents or 3.2% of the respondents). At first glance, this distribution of the respondents and their functional affiliations appears to be disturbing in that it is heavily weighted towards purchasing and material management personnel while the environmental personnel have very little representation. Yet, it can be argued that the insights drawn from this sample do have validity and are generalizable.

While environmental compliance managers may understand some aspects of the EMS better than other functional personnel, the extent of a firm's environmental integration is captured when managers from different functional backgrounds understand and provide information about the EMS. The respondents of the survey consist primarily of users (engineers, purchasing managers and manufacturing people) who are able to assess cross-functional ERM impacts and the introduction of environmental programmes as business/strategic decisions.

Furthermore, in the modern firm, cross-functional teams drive many processes. Past research both in the Operations Management and environmental areas (e.g. Melnyk *et al.* 1999, Curkovic *et al.* 2000) has found that purchasing personnel have valuable insights from both their cross-functional participation in product design and operations processes, as well as their materials and parts traditional gatekeeper purchasing role. They are valuable reporters of firm practices and assessors of the effects of changes in firm practices, procedures and systems.

Before leaving this discussion of the sample database and its respondents, it is important to note that the researchers have treated the respondents as key informants of their firms' practices and processes. The survey database, as discussed above, consists primarily of managers in roles where they could expertly observe and report on the practices of their firms and the impact of the various environmental programmes on the resulting performance. These reports, since they are anonymous, can often be viewed as reliable. While it is generally preferred to present and analyse direct quantitative measures of performance, two caveats must be recognized. The first is that these measures may not be readily available and free for distribution. Second, a broad-based anonymous, expert informant survey is generally free of intentional bias and misinformation, since it is easier to refuse to participate than it is to misinform.

5. Assessing the extent of environmental programme adoption

Here we discuss the extent to which the respondents' plants had been involved with the various environmental programmes (table 3). From the information in table 3, several important observations can be made. First, over half the respondents had noted that their facilities had not introduced any of the four environmental programmes targeted in this paper. Of those that had, 262 (36.57%) had only introduced one programme, 191 (26.64%) had introduced two, 226 (31.52%) three and only 38 (5.30%) had introduced all four programmes. This would argue that facilities would tend to introduce only one programme, or no programme at all. If they had multiple programmes, they would be most likely to have all of the programmes except for ISO 14001 (i.e. those having Voluntary Industrial Environmental Programmes (VEPA), Voluntary Government Initiated Environmental Programmes (VEP), and Voluntary Programmes with Environmental Performance as a Secondary Benefit (VPP) com-

Level of usage	VEPA	VEP	VPP	ISO14001	Number of respondents
One programme is present (262)	y	n	n	n	31 (4.33%)
	n	y	n	n	90 (12.55%)
	n	n	y	n	109 (15.20%)
	n	n	n	y	32 (4.46%)
Two programmes are present (191)	y	y	n	n	60 (8.37%)
	y	n	y	n	50 (6.97%)
	y	n	n	y	5 (0.70%)
	n	y	y	n	52 (7.25%)
	n	y	n	y	16 (2.23%)
	n	n	y	y	8 (1.12%)
Three programmes are present (226)	y	y	y	n	204 (28.45%)
	y	y	n	y	10 (1.39%)
	y	n	y	y	6 (0.84%)
	n	y	y	y	6 (0.84%)
All four programmes are present (38)	y	y	y	y	38 (5.30%)
No programmes used	n	n	n	n	793
Total where one or more programmes are present					717

Table 3. Assessment of programme adoption by respondents ($n = 717$).

prised the largest single category of respondents, with 204 observations). Given that it is relatively new at the time of the data collection, it is not surprising that ISO 14001 was the least used programme. Finally, those respondents with facilities involved in ISO 14001 were likely to fall into one or two categories. Either their facilities were likely to introduce it as the *only* environmental programme or the ISO 14001 programme was introduced as a part of a total set (i.e. all four programmes were present). One possible interpretation of this specific result is that it is indicative of the experience and/or commitment of the facilities to ERM. Those facilities that had relatively little experience with ERM might turn to ISO 14001 as a guide for helping them structure and implement an EMS. On the other hand, those facilities that were committed to ERM were more likely to actively pursue ISO 14001 certification because this programme, while new, was viewed as consistent with their

environmental commitments. Basically, those firms more likely to pursue ISO 14001 and who are committed to ERM tend to be environmental leaders, or 'innovators' and 'early adopters' of environmental business practices (Sroufe *et al.* 2000).

6. Assessing the impact of environmental programmes on corporate performance

Underlying our research is the theoretical assumption—the environmental programme being used should influence the operations of environmental activities within the firm. These activities, in turn, should generate certain effects for the firm, as measured along such dimensions as cost, quality, reputation, product design, etc. Consequently, two sets of questions from the survey instrument were included in the analysis. The first established the extent to which the respondent's plants were actively implementing the four categories of environmental programmes. Involvement was evaluated using a dichotomous scale, where 1 indicated that the facility is actively committed to the programme. The concept of being actively committed was defined as either the plant was currently implementing the programme or had successfully implemented the programme. If the plant was not actively committed to a programme, then the facility was assigned a value of '0' for that environmental programme. The descriptive information of firm commitment is summarized in table 4.

Having determined the extent of plant involvement in the four categories of environmental programmes, the next step was to establish the impact of these programmes on overall performance. One way of evaluating the nature of this relationship was to ask the respondents to assess the impact of their environmental management systems on several dimensions of performance. To this end, a section of the survey instrument that focused on performance was used in the analysis. The respondents were asked to evaluate the impact of their environmental management system on 14 dimensions of performance. Some of these dimensions focused on the core strategic areas of competition (cost, lead-time, cost and market position). Others touched on areas such as reputation and customer acceptance. Still others dealt with issues of process/product design and cost/benefit assessment. The respondents were asked to assess the impact of their environmental management system using an 11-point Likert scale (0, strongly disagree; 10, strongly agree). The mean results are summarized in table 5.

As can be seen from table 5, of the four approaches, ISO 14001 certification, on the surface, appears to have a greater impact on performance. In every case and for

	Actively committed	Not committed	Missing
Voluntary Industrial Environmental Programmes	476	950	84
Voluntary Government-initiated Environmental Programmes	404	1008	98
Voluntary Programmes — Environmental Performance Secondary Benefit	473	933	104
ISO 14001	121	1280	109

Table 4. Status of the environmental programme adoption ($n = 1510$).

Environmental management systems with your plant have:	Industrial Voluntary Environmental Programmes	Voluntary EPA Programmes	Voluntary Programmes — Environmental Performance Secondary	ISO 14001
Not adversely affected the position of your company in the marketplace	7.37 (447)	7.34 (378)	7.08 (440)	7.86 (116)
Not compromised the product's acceptability from the customer's perspective	7.28 (446)	7.31 (376)	6.89 (439)	7.74 (116)
Helped enhance the reputation of your company	6.52 (448)	6.53 (380)	6.18 (442)	7.60 (117)
Caused your company to investigate alternative technologies and procedures	6.92 (446)	6.83 (377)	6.46 (439)	7.06 (116)
Significantly reduced waste within the production process	6.01 (446)	5.89 (378)	5.70 (439)	6.87 (116)
Improved its chances of successfully selling its products in international markets	4.86 (442)	4.86 (373)	4.74 (435)	6.40 (114)
Had benefits that have definitely outweighed any costs incurred	5.42 (443)	5.43 (377)	5.19 (437)	5.97 (116)
Placed reasonable demands on the information system and on data requirements	5.36 (444)	5.37 (377)	5.14 (438)	5.73 (116)
Significantly reduced waste within the equipment selection process	5.09 (442)	5.12 (374)	4.97 (434)	5.51 (116)
Significantly improve its position in the marketplace	4.74 (444)	4.75 (377)	4.60 (439)	5.46 (116)
Helped your company design/develop better products	4.84 (448)	4.76 (379)	4.67 (441)	5.38 (116)
Significantly reduced overall costs	4.33 (446)	4.24 (378)	4.09 (439)	5.05 (116)
Significantly improve product quality	4.38 (447)	4.21 (378)	4.18 (439)	4.58 (116)
Significantly reduce lead times	3.52 (446)	3.43 (378)	3.44 (439)	3.94 (116)

The first value is the mean response, while the second is the number of respondents on which the mean is based.

Table 5. Comparison of the impact of various approaches on the impact of environmental management systems and corporate performance.

every dimension of performance, the mean responses for ISO 14001 are higher than those reported for the other three programmatic approaches. What these results point to is that plants actively pursuing ISO 14001 certification appeared to do better in terms of the identified dimensions of performance. However, more detailed

analysis of these findings must be carried before the general findings and the implications associated with them, can be accepted.

6.1. *Assessing the impact of environmental programmes: regression analysis*

One method of evaluating the simultaneous impact of the four programmatic approaches and their interactions on the 14 dimensions of performance is to carry out a series of Ordinary Least Squares (OLS) regression analyses. When testing for normality of the data, the data set suffers from heteroscedasticity as indicated when each of the 14 dimensions of performance failed the Cook and Weisberg (1983) test for heteroscedasticity. Consequently, it was decided to use Variance Weighted Least Squares (VWLS) (Grizzle *et al.* 1969). This technique differs from ordinary least squares in that homogeneity of variance is not assumed. Thus, VWLS is well suited to situations where the data suffers from heteroscedasticity.

Next, 14 sets of analyses were carried out, one for each of the performance measures. To facilitate the presentation and interpretation of the results, the fourteen performance measures are grouped into three sets (table 6) and arranged in the same groups for the remainder of the tables. The measures were assigned to a specific set depending on similarities. For example, the five measures grouped together in the *Strategic Impact* analysis set dealt with areas pertaining to strategic dimensions of competition (e.g. lead time, cost, quality). Similarly, the five measures grouped

Analysis set	Survey question	Variable abbreviation
Strategic impact	significantly reduced overall costs	ACTCOST
	significantly reduced overall lead times	ACTLT
	significantly improved product quality	ACTQUAL
	had benefits that have definitely outweighed any costs incurred	ACTBENE
	significantly improve its position in the marketplace.	ACTPOS
Tactical impact	caused your company to investigate alternative technologies and procedures	ACTALT
	significantly reduced waste within the equipment selection process	ACTWEQIP
	helped your company design/develop better products	ACTPRODS
	significantly reduced waste within the production process	ACTWPROD
	placed reasonable demands on the information system and on data requirements	ACTIS
Reputation	improved its chances of successfully selling its products in international markets	ACTINTER
	helped enhance the reputation of your company	ACTREP
	not adversely affected the position of your company in the marketplace	ACTADVRS
	not compromised the product's acceptability from the customer's perspective	ACTACCP

Table 6. Organization of performance measures into the analysis sets.

together in the *Reputation* analysis set involved areas that influenced or shaped the plant's reputation (either domestically or internationally).

An example of the regression model using one strategic impact variable as a dependants variable is as follows: $ACTCOST (DV) = constant + bvepa + bvpp + bvep + biso14kr + vepavep + vepavep + vppvep + vepais14 + vppis14 + vepis14 + error$. This model is representative of the fourteen sets of analysis reported in this study. Definitions of the variables used are as follows:

bvepa = dummy form of vepa (b stands for binomial)

bvpp = dummy form of vpp

bvep = dummy form of vep

biso14kr = dummy form of iso14

vepavep = interaction of bvepa * bvpp

vepavep = interaction of bvepa * bvep

vppvep = interaction of bvpp * bvep

vepais14 = interaction of bvepa * biso14kr

vppis14 = interaction of bvpp * biso14kr

vepis14 = interaction of bvep * biso14kr

Initially, we ran the full VWLS regression with all first-, second- and third-order interactions and the model was fully specified. Next, for each analysis set, only the main effects and first-order interactions were examined. All further higher order interactions were excluded from the analysis for several reasons, including only one instance of a second-order or higher interaction being significant, difficulty of interpretation, and a lack of a theoretical basis for why such interactions should be of research interest.

The regression results are presented in three tables: table 7 for Strategic Impact Performance Measures; table 8 for Tactical Impact Performance Measures; and table 9 for Reputation Performance Measures. Before examining in detail the results for each analysis set, some general observations about the findings are next discussed. The first is that for all 14 regression analyses, the model χ^2 statistics are significant at the 0.05 level. Further, the goodness of fit χ^2 statistics for all models were insignificant, indicating that, in each case, the model specified by the linear form of the regression equation adequately fit the data.

The second general result is that of the four major environmental programmes, only ISO 14001 and the VEP were found to have significant positive effects on all 14 performance measures. In contrast, the first order interactions generally were not an important consideration. Out of 84 first order interactions (14 regression models * six interaction terms per model), only four interactions (4.76%) were significant. Thus, the findings indicate the need to focus on the main effects. An additional finding involving the main effects is that, in all cases, their impact on performance is positive. That is, if there is a significant relationship (as indicated by the β coefficients), the programmes, irrespective of the type, help improve perceived corporate performance. We next now turn our attention to examination of the findings by Analysis Set.

6.1.1. *Strategic impact*

In the first set, several interesting findings are exposed. The first is drawn from an analysis of the constant. This term indicates that, overall, the environmental man-

Variables	ACTCOST	ACTLT	ACTQUAL	ACTBENE	ACTPOS
VEPA	0.916 (0.020)*	0.384 (0.220)	0.698 (0.047)*	1.592 (0.000)*	0.851 (0.037)*
VPP	0.788 (0.003)*	0.622 (0.010)*	0.980 (0.000)*	0.986 (0.000)*	0.931 (0.001)*
VEP	1.236 (0.000)*	0.875 (0.000)*	1.492 (0.000)*	1.140 (0.000)*	1.381 (0.000)*
ISO 14001	1.550 (0.000)*	1.156 (0.000)*	1.406 (0.000)*	1.497 (0.000)*	1.989 (0.000)*
VEPA*VPP	-0.572 (0.182)	0.024 (0.846)	-0.263 (0.512)	-1.349 (0.003)*	0.270 (0.548)
VEPA*VEP	-0.593 (0.174)	-0.523 (0.144)	-0.613 (0.131)	-0.556 (0.233)	-0.846 (0.062)
VEPA*ISO 14001	1.070 (0.075)	0.286 (0.596)	-0.461 (0.409)	0.423 (0.497)	-0.178 (0.785)
VPP*VEP	-0.216 (0.597)	0.096 (0.777)	-0.370 (0.334)	0.232 (0.603)	-0.319 (0.458)
VPP*ISO 14001	-1.617 (0.005)*	-0.704 (0.127)	0.124 (0.823)	-0.697 (0.271)	-0.495 (0.436)
VEP*ISO 14001	0.168 (0.733)	0.374 (0.348)	-0.242 (0.585)	0.022 (0.968)	0.126 (0.818)
Constant	2.540 (0.000)*	2.103 (0.000)*	2.411 (0.000)*	3.250 (0.000)*	2.480 (0.000)*
Goodness of fit χ^2	7.310 (0.1984)	6.830 (0.2339)	2.93 (0.710)	0.97 (0.9653)	5.020 (0.4138)
Model χ^2	175.820 (0.000)*	154.88 (0.000)*	221.98 (0.000)*	197.39 (0.000)*	254.70 (0.000)*
No. of observations	1268	1268	1268	1262	1267

First number is the coefficient, the second (in parentheses) is the significance.

* Coefficient at the 0.05 significance level.

Table 7. Summary of VWLS analysis for strategic impact performance measures.

agement systems, by themselves and without the intervention from the four environmental programmes, appear to have little positive impact on the five performance measures that make up this set. Here we see the constants range from between 2.103 and 3.25 when they are drawn from a Likert scale that runs from 0 to 10 (where 10 is strongly agree).

As noted, except for one instance, the main effects are all significant—indicating that the four environmental programmes do help to improve the perceived impact of the environmental system on these strategically related dimensions of performance. The one exception is that of VEPA and its impact on lead-time. Second, out of the five measures, focusing on the relative magnitude of the four programmatic approaches (as indicated by the reported β s), we can see ISO 14001 seems to have the largest positive impact on performance for three of the five measures. For the remaining two, VEPA had the largest relative impact on the benefits relative to costs (ACTBENE), while the VEP had the largest impact on quality (ACTQUAL). Finally, interactions were significant in only two instances. In both cases, the effect of the interaction was to offset the positive impacts of the two approaches captured in the interactions.

Variables	ACTALT	ACTPRODS	ACTWPROD	ACTWEQIP	ACTIS
VEPA	1.482 (0.000)*	1.159 (0.004)*	0.823 (0.038)*	0.960 (0.017)*	1.028 (0.006)*
VPP	0.384 (0.224)	1.037 (0.000)*	1.001 (0.001)*	0.957 (0.001)*	0.650 (0.025)*
VEP	1.800 (0.000)*	1.389 (0.000)*	1.738 (0.000)*	1.108 (0.000)*	1.061 (0.000)*
ISO 14001	1.713 (0.000)*	2.001 (0.000)*	2.063 (0.000)*	1.469 (0.001)*	2.208 (0.000)*
VEPA*VPP	-0.453 (0.286)	-0.756 (0.098)	-0.399 (0.344)	-0.554 (0.193)	-0.503 (0.213)
VEPA*VEP	-0.731 (0.095)	-0.843 (0.065)	-0.490 (0.258)	-0.312 (0.480)	-0.128 (0.757)
VEPA*ISO 14001	-0.572 (0.299)	-0.507 (0.454)	0.550 (0.234)	0.246 (0.616)	-0.983 (0.069)
VPP*VEP	-0.050 (0.906)	0.237 (0.592)	-0.531 (0.198)	-0.052 (0.901)	0.061 (0.877)
VPP*ISO 14001	0.072 (0.898)	-0.139 (0.830)	-1.112 (0.021)*	-0.513 (0.312)	0.057 (0.919)
VEP*ISO 14001	-0.857 (0.128)	-0.534 (0.371)	-0.126 (0.795)	-0.209 (0.694)	-1.038 (0.048)
Constant	4.510 (0.000)*	2.581 (0.000)*	3.642 (0.000)*	3.036 (0.000)*	3.355 (0.000)*
Goodness of fit χ^2	9.79 (0.815)*	3.07 (0.6885)*	10.47 (0.0630)*	4.08 (0.5373)*	5.54 (0.354)*
Model χ^2	228.66 (0.000)	209.82 (0.000)	290.88 (0.000)*	210.24 (0.000)	199.70 (0.000)
No. of observations	1265	1268	1267	1257	1262

First number is the coefficient, the second (in parentheses) is the significance level.

* Coefficient at the 0.05 significance level.

Table 8. Summary of VWLS analysis for tactical impact performance measures.

6.1.2. Tactical impact

The results here parallel, largely, the findings observed for Strategic Impact variables. The intercept term, which denotes the effects of the environmental management system in the absence of any intervention from the four programmatic approaches, while relatively low (ranging from 2.581 to 4.510) is higher than what was observed with the strategic performance measures. Similarly, most of the influence on the EMS and subsequently firm performance can be traced to the main effects. However, three instances were observed where the approaches had no significant impact on performance—VPP/ACTLT, and VEPA and VPP/ACTWPROD. In examining the coefficients of the main effects, the main effects are stronger than the strategic main effects coefficients (based on the magnitudes of the coefficients). Furthermore, in terms of relative magnitudes, ISO 14001 appears to exert the largest impact for four of the five measures, with the exception being VEP and its impact on reducing lead time (ACTALT).

Finally, the tactical variable interactions are weaker, than the strategic impact performance measures. There is only one instance in which a significant interaction was observed. This involved the interaction between VPP and ISO 14001. As with

Variables	ACTINTER	ACTREP	ACTACCPT	ACTADVRS
VEPA	0.279 (0.506)	1.194 (0.004)*	0.648 (0.101)	0.574 (0.183)
VPP	1.049 (0.000)*	0.887 (0.003)*	-0.208 (0.487)	0.350 (0.242)
VEP	1.166 (0.000)*	2.198 (0.000)*	0.883 (0.003)*	0.654 (0.039)*
ISO 14001	2.992 (0.000)*	3.398 (0.000)*	2.243 (0.000)*	2.441 (0.000)*
VEPA*VPP	-0.094 (0.833)	0.404 (0.344)	0.075 (0.863)	-0.647 (0.149)
VEPA*VEP	0.215 (0.641)	-0.882 (0.048)*	0.039 (0.926)	0.453 (0.309)
VEPA*ISO 14001	0.203 (0.716)	-0.390 (0.392)	-1.110 (0.019)*	-0.903 (0.080)
VPP*VEP	-0.601 (0.177)	-0.701 (0.087)	0.418 (0.321)	0.078 (0.858)
VPP*ISO 14001	-0.612 (0.283)	-0.766 (0.076)	-0.147 (0.771)	-0.277 (0.526)
VEP*ISO 14001	-0.564 (0.322)	-1.045 (0.012)*	-0.785 (0.080)	-1.155 (0.019)*
Constant	2.725 (0.000)*	3.509 (0.000)*	5.652 (0.000)*	6.000 (0.000)*
Goodness of fit χ^2	3.81 (0.5770)	4.05 (0.5427)	5.86 (0.3202)	5.61 (0.3461)
Model χ^2	255.18 (0.000)*	(0.000)*	(0.000)*	(0.000)*
No. of observations	1257	1271	1264	1267

First number is the coefficient, the second (in parentheses) is the significance level.

* Coefficient at the 0.05 significance level.

Table 9. Summary of VWLS analysis for reputation performance measures.

interactions observed in the Strategic Analysis set, this interaction is negative, off-setting the combined effects of these two environmental programmes.

6.1.3. Reputation

The final analysis set focuses on the impact of EMS and the various environmental programmes on those measures pertaining to the plant's reputation. Of the three analysis sets, the impact of the environmental management system by itself and the various approaches is most evident here. As indicated by the intercept term, the influence of the environmental management system is greatest in terms of its impact on the reputation measures. As with the other sets, the main effects are generally significant. However, there are now five instances where environmental programmes do not have a significant impact on performance. Two of these instances involve VPP and the variables ACTACCPT and ACTADVRS, while the remaining three involve VEPA and the variables ACTINTER, ACTACCPT, and ACTADVRS. Of the four environmental programmes, ISO 14001 dominates. For each of the four measures of reputation, the use of ISO 14001 is responsible for the largest relative improvement in system performance (as indicated by the coefficients). Finally, the

first-order effects display the same patterns previously noted. That is, there is only one significant higher order interaction present (VEPA * ISO 14001). This interaction is also negative, partially offsetting the positive effects of these two programmes.

6.1.4. Summarizing the regression results

Based on the preceding analyses, the effects of the four environmental programmes is most evident as main effects. These results show ISO 14001 is a superior approach in comparison to the other three environmental programmes. For 11 of the 14 performance measures, ISO 14001 generated the largest relative improvement in performance. However, these results do not really address the issue of whether there are any significant differences in effects between the four approaches examined in this study.

6.2. Evaluating the comparative effectiveness of the four environmental approaches

One method of evaluating the comparative effectiveness of these four approaches is to carry a series of pairwise comparisons between the four programmes. The focus

Performance Measure	VEPA versus ISO14001	VPP versus ISO14001	VEP versus ISO14001	VEPA versus VPP	VEPA versus VEP	VPP versus VEP
ACTCOST	1.30	2.75	0.43	0.07	0.40	1.39
Strategic	(0.2539)	(0.0970)	(0.5107)	(0.7977)	(0.5285)	(0.2377)
ACTLT	2.51	1.56	0.75	0.32	0.98	0.24
Strategic	(0.1129)	(0.2124)	(0.3876)	(0.5689)	(0.3219)	(0.6214)
ACTQUAL	1.72	0.83	0.03	0.38	2.98	1.88
Strategic	(0.1893)	(0.3625)	(0.8592)	(0.5377)	(0.0842)	(0.1705)
ACTBENE	0.02	1.01	0.45	1.26	0.66	0.14
Strategic	(0.8808)	(0.3152)	(0.5032)	(0.2616)	(0.4157)	(0.7073)
ACTPOS	3.67	4.54	1.47	0.02	1.02	1.30
Strategic	(0.0571)	(0.0331)*	(0.2250)	(0.8794)	(0.3120)	(0.2551)
ACTALT	0.16	6.28	0.03	4.72	0.43	10.81
Tactical	(0.6856)	(0.0122)*	(0.8678)	(0.0297)*	(0.5115)	(0.0010)*
ACTPRODS	1.87	3.42	1.25	0.06	0.18	0.73
Tactical	(0.1711)	(0.0645)	(0.2635)	(0.8110)	(0.6685)	(0.3925)
ACTWPROD	4.07	4.93	0.41	0.10	2.70	2.80
Tactical	(0.0437)*	(0.0264)*	(0.5207)	(0.7510)	(0.1004)	(0.0945)
ACTWEQIP	0.68	0.99	0.46	0.00	0.08	0.14
Tactical	(0.4084)	(0.3204)	(0.4958)	(0.9951)	(0.7816)	(0.7130)
ACTIS	4.40	10.32	5.6	0.56	0.00	1.04
Tactical	(0.0359)*	(0.0023)*	(0.0179)*	(0.4538)	(0.9465)	(0.3084)
ACTINTER	16.43	12.01	9.98	1.96	2.61	0.08
Reputation	(0.0001)*	(0.0005)*	(0.0016)*	(0.1620)	(0.1060)	(0.7824)
ACTREP	15.01	28.66	6.78	0.31	3.59	10.24
Reputation	(0.0001)*	(0.0000)*	(0.0092)*	(0.5748)	(0.0580)	(0.0014)*
ACTADVRS	11.65	23.00	16.46	0.16	0.02	0.48
Reputation	(0.0006)*	(0.0000)*	(0.0000)*	(0.6876)	(0.8903)	(0.4890)
ACTACCP	8.89	36.01	10.08	2.74	0.17	6.67
Reputation	(0.0029)*	(0.0000)*	(0.0015)*	(0.0978)	(0.6765)	(0.0098)*

First number is χ^2 , the second probability $> \chi^2$.

* 0.05 significance level.

Table 10. Pair-wise test of β -coefficients for the main effects.

of these comparisons is on the main effects, as identified in the before mentioned VWLS regression analyses. The intent of the comparison is to determine if the difference between the β s for a given pair of main effects (e.g. VEPA and VEP) is equal to zero (the null hypothesis). As a result, using this approach, for each performance measure, there are six sets of comparisons. For each comparison, a χ^2 is calculated and evaluated at the 0.05 level of significance. The results of these comparisons are presented in table 10.

The differences among the four approaches are least evident when dealing with the strategic performance measures. For this set, there was only one instance in which a significant difference was observed (VPP versus ISO 14001). For these measures, it does not seem to matter what approach is selected and used. The selection of an environmental programme seems to have a slightly greater effect on the tactical performance measures. Out of the 30 sets of pairwise comparisons, significant differences were observed for eight comparisons. In these eight comparisons, six involved ISO 14001. The remaining two involved VPP, which was outperformed by all three alternative approaches (VEPA, VEP and ISO 14001). The selection of a specific programme had its greatest impact on those measures pertaining to corporate reputation. Out of the 24 sets of comparison, significant differences were observed in 14 instances. For every measure, ISO 14001 outperformed the alternatives. Furthermore, in the remaining analyses, VEP were found to outperform VPP.

7. Discussion

This paper began by raising four research questions about voluntary environmental programmes in the USA. The first research question involved understanding what are the available environmental programmes, this study focuses specifically on voluntary environmental programmes introduced in the USA. These programmes range from Voluntary Industrial Environmental programmes such as Responsible Care[®] to Voluntary Government-initiated Environmental programmes sponsored by organizations, such as the Environmental Protection Agency (EPA) of the US government. Among the latter are such programmes as 33/50, Green Light, Climate WiSe and the Environmental Leadership Programme. Additionally, there is ISO 14001-the certification procedure for Environmental Management Systems. Finally, there are Voluntary Programmes with Environmental Performance as a Secondary Benefit developed by Occupational Safety and Health Act (OSHA) and other organizations, where pollution prevention is linked to another objective such as improved worker safety. Each of these programmes provides management with different objectives and different metrics for measuring environmental performance and has different approaches for achieving pollution reduction and elimination.

The second research question calls for a better understanding of the dimensions that characterize these environmental programmes. Here we see the various environmental programmes involved in dimensions such as focus on outcomes verses processes, direct or indirect environmental focus, and the type of verification required. Next, we looked at whether the environmental programmes affect performance. After setting up the dimensions of environmental programmes, we then tied these dimensions and the various programmes into their impacts on strategic or tactical performance measures, and reputation.

The third research question asks whether these environmental programmes affect performance. In reviewing the results, the findings paint a somewhat mixed response. For example, the four programmatic programmes are equally effective when applied to strategic impact performance measures. However, the differences are most pronounced when viewed within the context of the reputation performance measures. At first glance, these results would seem to imply that management should be most concerned about the selection of an environmental programmatic approach if their interest is influencing reputation within the marketplace. Yet, these results must be interpreted with care because the reasons (explanatory factors) have yet to be identified. Identifying these factors demands more research into this topic.

One of the primary results of this research is that of the relative effectiveness of the four programmes as they affect strategic performance measures. As noted, no one approach dominates; no one approach is deficient. This is somewhat an unexpected result for several reasons. First, some of the approaches, such as VEP and VEPA, are well established, well regarded and proven. In contrast, ISO 14001 is relatively new and, as a result, has yet to establish the same type of track record. On the other hand, ISO 14001 embodies a very different approach to improving environmental performance. Unlike the other approaches, ISO 14001 focuses on process. As noted by several authors (e.g. Tibor and Feldman 1996, Graff 1997, Clark 1999, Litsikas 1999), by focusing on processes, managers should be better able to identify the sources of environmental waste and then take steps to reduce or eliminate that waste.

The final research question aimed to find differences in performance when comparing the four programmes. Upon reviewing the results, there is a relative equality across the four programmes. The apparent equality of impacts of the four environmental programmes can be explained in one of two ways. The first is that visibility or reputation rather than the type of environmental programme is the critical issue. That is, environmental improvement occurs primarily because of visibility brought to environmental problems. As a result, any environmental programme will do, because the programmes achieve one primary objective—visibility. Alternatively, the lack of significant differences between the four approaches, it could be argued, really reflects the relative newness of ISO 14001. Because ISO 14001 is so new (it was introduced in the Fall of 1996) and because the survey was administered so early in the adoption process (1997–98), what is observed is a lack of familiarity on the part of ISO 14001 adopters combined with too short a time horizon for the benefits offered by ISO 14001 certification to become fully evident. Because ISO 14001 focuses so much on processes, it takes time for the effects to become realized. One way of appreciating this potential time lag is to draw on the parallels that have made with ISO 9000 (Wilson 1999).

Both ISO 9000 and ISO 14001 rely on third party auditing; both are process-oriented; ISO 14001 explicitly buildings on the foundations of ISO 9000. As a result, experiences with ISO 9000 should serve as a good indicator of the experiences that can be expected with ISO 14001. Wacker (1989) has noted that for firms interested in attaining ISO 9000 certification, the substantial costs of certification are incurred over a relatively short time period (at the beginning), while the benefits are generated over a longer period time. More specifically, a US General Accounting Office study found that it took an average of 2.5 years to realize significant bottom-line results attributing to TQM philosophies and methods such as ISO 9000 (Terziovski *et al.*

1999). Applying these experiences to ISO 14001, it can be argued that what is observed are the negative impact of the costs and work of attaining ISO 14001 certification. Should this study be duplicated some time in the future, the advantages of the ISO 14001 approach could be observed. Using the 2.5-year time lag as a guideline, significant ERM benefits can be expected beginning in 1999—further arguing for the need to duplicate data collection and this study.

As previously noted, the differences between the four programmatic approaches is most evident when dealing with the reputation related performance measures. These differences, in most cases, favour ISO 14001. There are several possible explanations for this situation. The first is that these differences are supportive of the assertion made by Litsikas (1999), that attaining ISO 14001 certification can indicate that the firm is truly interested in improving its environmental performance and in reducing the level of pollution. Consequently, attaining ISO 14001 certification helps the firm enhance its corporate image and improve its public relationships. Alternatively, it can be argued that these differences, especially when dealing with the impact on international reputation, are consistent with the objectives of ISO 14001. One objective in introducing ISO 14001 certification was to facilitate trade with Europe and Asia (Graff 1997, Hormozi 1997, Litsikas 1999). As a result, plants that attain such certification should see their reputation (especially when perceived in terms of their international reputation) improve.

Another framework for interpreting these results is to view them within the context of 'economic signalling' (Engers 1987, Black and Bulkley 1988, Bagwell and Riordan 1991, Srinivasan 1991, Cooper 1992, Herbig and Milewicz 1994, Milewicz and Herbig 1996). Signalling is the concept that firms take actions not simply for the sake of internal benefits but also as a form of communication to others. This communication can be directed towards other firms or it can be directed towards 'stakeholders' such as the community, the financial community, or governmental agencies such as the Environmental Protection Agency (EPA). By pursuing ISO 14001, with its requirements for external auditing by a third party and its more formalized demands and requirements, the firm's management can signal (communicating) to these various groups that the firm views environmental responsibility as being an important corporate activity. One of the potential by-products of this economic signalling activity should be an enhanced reputation.

The findings and results generated from this study raise a number of unresolved issues. Unresolved issues are consistent with a field that is still relatively early in its stage of development. However, several findings should be of interest to managers and researchers. The first is that relative to the other approaches, VPP is the least satisfactory of the four approaches. Of the four approaches, it has the least positive impact. This finding makes intuitive sense, since this is a programme where environmental effects are important but secondary (in contrast to the other three programmes). Second, ISO 14001 certification seems to offer the greatest potential for positively affecting both environmental performance as well as corporate performance. Of the four environmental programmes, the impact associated with ISO 14001 certification is the greatest. This potential may reflect the combined effects of external validation and process orientation.

8. Conclusions

The US experience with four types of environmental programmes is not put forth as a comparison to other country experience with similar programmes. Instead, this

study shows the impact of these types of programmes on strategic, tactical and reputation based measures at the plant level of the business. It also shows that care should be given when making decisions about structuring programmes and initiatives aimed at improving environmental responsibility. Programmes where improved environmental performance is a primary consideration, where an emphasis is placed on the process, and where external verification is required tend, to have a greater impact on performance than those programmes lacking these traits. These findings are more generalizable to the USA, and are put forth to show what has taken place within this single national setting. This study also calls for more research into this area. Improving environmental performance is an important issue—an issue that is important globally. It is also an issue that it is at a relatively early stage of development. This study has provided researcher with a theoretical framework for viewing environmental programmes and initiatives and presented some initial findings.

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