Environmental Management Systems:

Do They Improve Performance?

NATIONAL DATABASE ON ENVIRONMENTAL MANAGEMENT SYSTEMS

Project Final Report: Volume I

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Chapter 1. Why Study EMSs?

INTRODUCTION

Over the past decade, increasing numbers of businesses, government facilities, and other organizations have implemented formalized environmental management systems (EMSs) to manage the environmental aspects and impacts of their activities. From the introduction of the ISO 14001 international voluntary standard for EMSs in 1996 to the end of 2001, at least 1,645 U.S. businesses and other facilities were registered as conforming to this standard, and registrations were increasing at well over 50% per year.[1] Worldwide, an estimated 36,765 organizations were registered.[2] Many more organizations implemented EMSs similar to the ISO 14001 model without seeking certification, and still others had developed EMSs of their own design – in some cases more limited than the ISO model, but in others, systems that they considered more sophisticated and effective. Several of the major motor vehicle manufacturers have mandated that all their first-tier suppliers implement certified EMSs; and all U.S. federal agencies were directed by a presidential executive order to implement EMSs at facilities for which EMSs would be appropriate.[3]

To their advocates, EMSs offer the possibility of a more flexible, more effective, and less costly approach to environmental protection than the current "command and control" regulatory framework: a "new generation" of environmental policy, described by some as a "voluntary" approach to environmental management (OECD 2000, Mazurek 1998, Andrews 1998), by others as "management-based regulation" (Coglianese and Nash 2001), and by still others as a "reflexive" approach to environmental law (Gallagher 2002, Orts 1995, Teubner 1983). To skeptics, however, EMSs represent a practice that at best still has great variability in its implementation, has not yet demonstrated environmental performance results that are consistently equal or superior to regulatory requirements, and may or may not fulfill its promise over time as market pressures change (e.g. Krut 1998, Morrison et al. 2000).

If a business or government agency says that it has an EMS, what does that mean? If it has a "third-party audited" or an "ISO 14001 certified" EMS, does that mean something more? More specifically, does the existence of an EMS, or of third-party auditing or ISO certification, represent evidence

- of superior environmental performance compared to other organizations with similar activities?

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[1] The ISO Survey of ISO 9000 and ISO 14000 Certificates: Eleventh Cycle, up to and including 31 December 2001, http://www.iso.ch/iso/en/prods-services/otherpubs/pdf/survey11thcycle.pdf

[2] Id.

[3] Executive Order 13148, April 22, 2000

- of <u>good</u> environmental performance, such as compliance with environmental regulations?
- of continual <u>improvement</u> in environmental performance, and in compliance with environmental regulatory requirements, whether or not they are initially good?
- or at least of <u>more effective management of its environmental responsibilities</u>, such as monitoring and reporting requirements and other administrative functions, than other organizations without such a system?

Some might argue that a business's decision to develop a formalized system for managing its environmental impacts and responsibilities is its own affair, and that the public's only legitimate interest is in whether it complies with its statutory and regulatory responsibilities, not how it organizes internally to do so.

For many reasons, however, there is an important public interest in answers to these questions:

First, many businesses choose not only to adopt an EMS, but to publicly promote the fact that they have done so, implying that this provides evidence of good environmental management. Does it, and should regulatory agencies and the public therefore assume that organizations with an EMS are practicing better environmental management than others?

Second, ISO registration represents not simply an internal benefit to the organization, but conferral of a form of added public legitimacy. It claims to represent audited verification of the organization's commitment to compliance with all environmental regulations and other commitments, to prevention of pollution, and to continual improvement. Can outside stakeholders of these organizations – customers, investors, lenders and insurers, governments, the community in which the organization operates, and the general public – act confidently on the basis of such claims?

Third, some federal and state environmental agencies now confer positive public recognition on organizations that have implemented EMSs. Is such recognition warranted?

Fourth, some federal and state agencies have granted increased regulatory flexibility – such as decreased frequency of inspection, reduced vulnerability to some types of penalties, more generic "bubble"-type permits, and negotiated terms of enforcement settlements – based in part on EMS implementation. Do the effects of an EMS justify such concessions?

Fifth, many federal and state agencies are now investing staff resources in promoting EMSs, and in providing technical assistance to organizations to implement them; and many government agencies are themselves now spending significant costs and staff effort developing EMSs themselves. Is this an effective use of limited personnel and other agency resources, and should more or less resources be committed to it?

In summary, advocates argue that an EMS provides real benefits, both environmental and economic, to the user organization as well as to the public. A facility with an EMS, they argue, can demonstrate more reliable performance, can document its reporting requirements more efficiently and thus be inspected more quickly, and will have procedures for more consistently reducing the frequency of accidents, spills, and other environmentally damaging events. Such a facility will also identify more opportunities to improve its environmental performance beyond compliance, and to reduce unregulated environmental impacts such as energy and water use. It thus reduces its own cost and liability as well as environmental impacts and risks to its surrounding community. At the same time, it reduces government's inspection and enforcement costs, allowing government to redirect scarce regulatory resources toward higher-risk facilities. Are these arguments correct? If so, EMSs represent an important innovation for achieving public policy goals as well as for the organizations that choose to introduce them.

A LONGITUDINAL, COMPARATIVE STUDY

The National Database on Environmental Management was designed to provide preliminary answers to these questions. Conceived as a pilot study, it was specifically designed to collect *facility-level* data, because such data are necessary to examine actual changes in environmental performance and are also the building blocks out of which any broader generalizations about corporate environmental performance must be constructed. It also is the first EMS study using longitudinal comparative-case analysis in real time, to examine the performance of facilities before, during, and after EMS implementation. For each facility, the research team administered a baseline protocol capturing three years' retrospective data, in order to establish the environmental performance levels prior to EMS implementation. They then administered an EMS design protocol, which elicited data on the EMS implementation process as well as its substantive content (such as specific environmental aspects, impacts, determinations of significance, objectives and targets). Finally, they administered two update protocols at approximately one-year intervals, to capture changes in environmental, economic and other outcomes after implementation of the EMS, as well as refinements to the EMS itself. All data were subject to detailed quality-control procedures, including reconfirming all data with the facilities before final inclusion in the database.

This report documents the results of the five-year NDEMS study. It reports the consequences of EMS implementation by a sample of 83 facilities in 17 U.S. states. All 83 of these facilities provided baseline data; 58 of them also provided detailed data on their EMS design processes and content; 37 also provided detailed initial update data on environmental, compliance, and economic performance during the year after introduction of their EMS; and 22 provided detailed second-update data on their performance approximately one year later. The sample includes organizations in 20 business sectors, varying in size from large, complex facilities to small businesses, and in both business and government ownership. The study was sponsored by the Office of Wastewater Management of the U.S. Environmental Protection Agency, with additional funding provided by EPA's Office of Policy, Economics and Innovation. It was conducted by the University of North Carolina at Chapel Hill in cooperation with ten state environmental agencies and the participating facilities, and with the Environmental Law Institute, the Multi-State Working Group on Environmental Management Systems, the Star Track Program of EPA's Region I, and the Global Environmental Technology Foundation.

RESEARCH QUESTIONS

The primary purpose of this study was to answer the question,

- What effects does the implementation of an EMS have on a facility's environmental performance, regulatory compliance, and economic performance?

The study also shed light on important related questions, including:

- What costs and benefits do facilities experience as a result of introducing (and where applicable, certifying) an EMS, and how do these vary with their characteristics and motivations?
- Do technical assistance and other incentives from governments make a difference? If so, to what kinds of organizations?
- What factors motivate organizations to introduce and certify EMSs, and what differences in facility characteristics and motivation are associated with these decisions?
- To what extent are EMSs themselves similar or different – in their content, their priorities, and their development processes – and is variability itself an important finding?
- Who is involved in developing and implementing an EMS, and what difference does such participation make to EMS outcomes?
- What difference, if any, does third-party auditing and registration make?
- Why have even some non-market organizations, such as municipalities, state agencies, and federal facilities, decided to adopt such systems, and what have they gained from it?
- And finally, how do organizations' commitment to their EMSs evolve over time?

This study provides one set of answers to these questions, based on systematic longitudinal comparison of a sizable sample of facilities over a five-year period before, during, and after implementation of their EMSs. To the best of our knowledge it is the only longitudinal study of this sort yet conducted, and it offers valuable information and insights on why and how EMSs are developed and the consequences associated with them.

Every research study has limitations. The facilities we studied were willing to provide detailed data to us at repeated intervals over a five-year period, and some were also recruited by EPA or their state environmental agencies and received government technical assistance in developing their EMSs. As a result, they are subject to a "volunteer bias:" they may be more compliant, more cooperative with regulatory agencies, and more open to the public and "greener" in their attitudes than some other organizations that might implement EMSs for other reasons. Some of the information in this study also reflects the judgments of the individuals who provided us the information, most often the facility's environment, health and safety (EHS) director, who may also have biases favoring the success of their EMSs.

The number of facilities included is also too small and too diverse to generalize about the practices of all facilities. More intensive, sector-focused studies will undoubtedly fill in some of these other pieces of the puzzle (see for instance Russo 2001 on the electronics industry, and Corbett and Cutler 2000 on the New Zealand plastics industry).

Finally, our results compare EMS practices during a particular time period, as the ISO 14001 model was just beginning to be actively adopted and implemented, and before enough time had passed to expect objective evidence of change in the facilities' environmental outcomes to be evident in government data sets.[4] We would expect that such practices and their results will

[4] EPA's Toxic Release Database (TRI), for instance, has approximately a two-year lag in the data it reports.

continue to evolve in the future, and that later studies will also be able to examine more fully the relationships of EMS implementation to subsequent compliance and performance data.

Such unavoidable limitations, however, are offset by the distinctive benefits of this type of study. A comparative study using volunteer facilities allowed us to collect much more detailed information on each facility than can be gathered by mail or telephone surveys of large numbers of organizations, and to obtain far richer qualitative as well as quantitative information about how their EMSs were developed. These data were further augmented by case studies of a few facilities, to illustrate more specifically the similarities and differences among their experiences. The longitudinal design also allowed us to monitor and interact with these facilities over a more prolonged period of time, through a critical period in the evolution of their management practices, than is possible in one-time surveys and other types of studies.

BACKGROUND: WHAT IS AN EMS, AND WHERE DID IT COME FROM?

An EMS may be defined as:

> **a formal set of policies and procedures that define how an organization will manage its potential impacts on the natural environment and on the health and welfare of the people who depend on it.**

This definition is consistent with the ISO 14001 international voluntary standard for EMSs, which has been adopted by many organizations explicitly and used by many others informally as a framework for their EMSs. This approach frames the EMS as an environmental version of the “plan-do-check-act” management process pioneered by W. Edwards Deming for continuous improvement of total quality management (Deming 1993). It thus conceptualizes environmental management as an ongoing cycle (or spiral, in the sense of continual improvement) of explicit management activities, including

- an explicit statement of the organization’s environmental policy and goals;
- a planning process for achieving them, including identification of specific aspects of the organizations that may impact the environment, objectives and targets for improving them;
- implementation procedures, such as assignment of responsibilities, training, and reporting requirements;
- procedures for monitoring and corrective action; and
- a management review process to refine both the results and the goals and elements of the EMS itself

Many businesses have developed their own environmental management procedures for years, but until recently there had been no trend toward formalizing or standardizing them more generally. Within many corporations, environmental management remained largely the responsibility of a single office responsible primarily for regulatory compliance and risk minimization, such as a Vice President for Environment, Health and Safety, rather than an organization-wide mission for which all managers would be held accountable.

Early EMS prototypes were introduced in the late 1970s and '80s as compliance management procedures, to assure that the various business units of a complex facility or multi-site corporation maintained compliance with environmental regulatory mandates. The proliferation of environmental regulatory requirements in the 1970s produced significant reductions in air and water pollution discharges and major improvements in both municipal and industrial waste management, but they also dominated the attention of both businesses and government, producing a preoccupation with regulatory compliance rather than with integration of environmental considerations into businesses' core functions and management processes (Davies and Mazurek 1998, Andrews 1999). Compliance management often required only that mandated end-of-pipe pollution-control technologies be in place and that required permit applications and monitoring reports be submitted. Environmental management was therefore treated as a necessary but unproductive overhead cost rather than a business opportunity, a regulatory burden which was assigned to pollution-control engineers responsible for end-of-pipe technological equipment rather than a new element of mainstream management functions.

By the mid-1980s many businesses also began instituting environmental auditing practices, some internally and some by third-party external auditors. Auditing was introduced initially for additional compliance assurance by corporate headquarters, especially in response to the Superfund (CERCLA) strict-liability legislation for hazardous-waste dumping in 1980. Banks and insurance companies also began requiring audits for due-diligence management of potential liability for contaminated sites (Smith 1985). These practices expanded rapidly after the Bhopal industrial disaster in 1984 (Hemphill 1995) and the requirement of public reporting of toxic pollutant releases beginning in 1986 (the Toxics Release Inventory, or TRI). TRI documented for the first time the actual quantities of pollutant releases by many major businesses, and thus generated new incentives for the firms themselves to identify and reduce them (Andrews 1999).

During the 1980s another stage of EMS prototypes began to emerge, emphasizing pollution prevention and waste minimization goals in addition to compliance. As far back as the 1960s, a few researchers had argued that environmental impacts were themselves signals of economic inefficiency in production, which should be corrected in the interest of business efficiency as well as society's environmental goals. Kneese and Bower (1979) documented economically-efficient opportunities for pollution prevention in a series of industries during the 1970s, and by 1979 business consultant Michael Royston popularized the idea that "pollution prevention pays" (Royston 1979). A few leading corporations began promoting this idea at about the same time (3M, for instance), and other studies confirmed it (e.g. Sarokin et al. 1985). Pollution-prevention programs and waste-minimization planning, therefore, built on a new recognition that pollutant emissions and discharges represented economic waste and liability to the firm itself as well as environmental damage to the public.[5]

EPA Administrator William Reilly in 1991 began offering modest federal recognition rewards for voluntary industrial initiatives to prevent and reduce emissions (the "33/50" and "Green

[5] Leading examples included 3M's "Pollution Prevention Pays" program, Dow's "Waste Reduction Always Pays" (WRAP), and Chevron's "Save Money and Reduce Toxics" (SMART). (Gottlieb 1995).

Lights" programs). Whether or not due to the additional incentives, the pollution-reduction effort was an important success, and increased the legitimacy of voluntary business initiatives to reduce pollution (Davies and Mazurek 1996). Many businesses during the 1980s also integrated their environmental and health and safety responsibilities under a single EHS vice president, moving beyond the narrow compliance-technology model of the 1970s toward a more managerial approach.

From these several roots emerged a "third generation" of environmental management programs, emphasizing "eco-efficiency": identifying cost-effective opportunities not just to reduce waste discharges but to minimize the use of energy, water, toxic chemicals, and other material inputs (National Academy of Engineering 1994). These initiatives were typically motivated by a combination of perceived threats and opportunities: financial risks under the strict-liability provisions of the new Superfund law on hazardous waste contamination (CERCLA, 1980), risks of reputation damage from the public dissemination of quantitative toxic release information, and concurrent recognition of business opportunities to reduce costs through more efficient use of materials and energy.

By the 1990s, therefore, some business advocates began to champion increased regulatory flexibility or "self-regulation" for businesses that proposed different ways of meeting or exceeding environmental regulatory goals at less cost. Specific proposals included sectoral pollution-reduction "covenants," market trading of emissions permits, third-party certification of environmental performance, "audit privilege" legislation, ad hoc negotiation of regulatory flexibility in exchange for superior environmental performance, and others. Many of the leaders among businesses, advocates argued, had now integrated environmental performance into their core management strategies and activities, and were now both willing and able to achieve equal or better environmental results at lower cost. They now needed and deserved greater regulatory flexibility from some of the rigidities of the regulatory system, they argued, in order to do so.[6] The most visionary of these champions argued on grounds not just of eco-efficient cost reduction, but of the potential for introducing more environmentally benign innovations in production processes and products: for a "greening of business" and even a long-term term shift toward "sustainable enterprise" (Hart 1997).

Finally, in preparation for the United Nations' 1992 "Earth Summit," the World Business Council for Sustainable Development issued a visionary declaration asserting the "inextricable linkage" among economic growth, environmental protection, and the satisfaction of basic human needs, and calling for "far-reaching shifts in corporate attitudes and new ways of doing business" to achieve environmental and social sustainability. Significantly, the WBCSD report posed this goal squarely as a challenge and opportunity for businesses, not just for government. At its initiative, the International Organization for Standardization set up a strategic advisory group to measure "eco-efficiency," whose efforts led to the creation of the ISO 14000 series of environmental management standards (Schmidheiny 1992).

In 1996, the International Organization for Standardization published the final version of an international voluntary standard for EMSs, ISO 14001. Other documents in the ISO 14000

[6] Manufacturers producing a rapidly changing mixture of products, for instance, complained that the delays in securing regulatory approval for environmental permit modifications made them uncompetitive in world markets, and offered to guarantee overall environmental performance better than that required by regulations if they were given advance approval for more flexible permit conditions to remove this burden.

series provided more detailed guidance on many EMS-related topics, such as environmental auditing procedures, life-cycle analysis, eco-labeling, environmental performance indicators, and others. Similar procedural standards, varying in some significant details, were adopted in Great Britain (BS 7750) and the European Union (EMAS, the Eco-Management and Auditing Scheme).

The ISO 14001 standard provided an explicit and closely documented procedural template for EMSs, which could be audited and certified by an approved third-party "registrar" as conforming to the ISO 14001 standard. At a minimum, organizations that adopted the ISO 14001 standard must demonstrate commitments to compliance with all environmental regulations and other requirements, to prevention of pollution, and to continual improvement of their EMS. They also must adopt a written environmental policy; identify all environmental aspects and impacts of their operations; set priorities, goals and targets for continual improvement in their environmental performance; assign clear responsibilities for implementation, training, monitoring, and corrective actions; and evaluate and refine implementation over time so as to achieve continual improvement both in implementation of environmental goals and targets and in the EMS itself.

As of December 2001, an estimated 36,765 facilities worldwide had been certified as meeting the ISO 14001 standard, including 1,645 facilities in the United States. The latter number reflected an increase of well over 50% per year, and more than a five-fold increase since 1998.

The increasing rate of ISO 14001 adoption in the U.S. was bolstered by several business-driven mandates. Some corporations (Honda, for instance) mandated ISO 14001 or equivalent EMSs by all their facilities. In September 1999 both the Ford Motor Company and General Motors announced their intentions to require ISO 14001 certification of all their Tier 1 suppliers' manufacturing sites as well, by July 2003 (Ford) and by the end of 2002 (GM), and to encourage them also to require such certification of second and third tier suppliers. Toyota announced a similar requirement, effective by the end of 2003.

The increase in EMS adoption was also fueled by government encouragement. The U.S. EPA and some state governments adopted policies that encouraged EMS adoption and certification, establishing "performance tracks" or "green permits" with incentives to benefit firms that implemented EMSs.[7] EPA and a few states have incorporated EMS requirements into some "supplemental environmental projects" (SEPs) in negotiated enforcement agreements with firms found to be out of compliance with environmental regulations.[8] In April 2000 President Clinton also issued an Executive Order mandating that each Federal agency implement an EMS at "all appropriate agency facilities based on facility size, complexity, and the environmental aspects of facility operations" no later than December 2005;[9] and the Bush Administration has endorsed rapid expansion of the use of EMSs both by federal agencies and by the private sector.[10]

For all these reasons and others, the implementation and certification of ISO 14001-compliant EMSs continued to increase, both in the United States and worldwide. The questions

[7] http://www.epa.gov/opeihome/performancetrack/, Speir 2000

[8] http://www.epa.gov/compliance/incentives/programs/index.html

[9] EO 13148, April 22, 2000

[10] http://www.whitehouse.gov/ceq/memoranda01.htm

remained, however, what impacts the adoption of environmental management systems and procedures would have on actual environmental performance and compliance. The implementation of EMSs thus offers both an important innovation for evaluation in its own right, and a unique window into the policies, practices, objectives, priorities, and outcomes of environmental management within the participating facilities.

PLAN OF THIS REPORT

Readers may choose to read or skip particular chapters of this report depending on their interests. Readers interested primarily in the results of the analyses may wish to read the Conclusions chapter first, then the chapters that present the more detailed analyses and results that are of primary interest to them (Chapters 6-14), then return to Chapters 2-5 if they become interested in learning more about the background literature, research design, and sample characteristics. On the other hand, researchers may wish to use Chapters 2 and 15 (Further Research Needs) and the Bibliography as background for research in this subject area, and to read Chapters 3-5 to understand more fully the research design and sample characteristics.

Chapters 2 through 5 present background information of several sorts. Chapter 2 provides extensive information on the research literature that has emerged to date, both on EMSs and on more fundamental questions about business decision-making and the environment that frame EMS research. Some more detailed discussion of particular literatures is also woven into later chapters, such as Chapters 6 (Motivations) and 11 (Costs). Chapter 3 documents the history of the NDEMS project and its research design, and Chapters 4 and 5 present detailed information on the demographics and baseline performance characteristics of the facilities included in the NDEMS Baseline and EMS Design databases respectively.

Chapters 6 through 14 present the primary analyses derived from the NDEMS data, including chapters on facility motivations for adopting an EMS (6), similarities and differences in content of EMSs (7), variations in types of EMSs (8), case studies of EMS development (9), environmental performance and compliance changes (10), costs and benefits of EMS implementation (11 and 12), distinctive issues in EMS adoption by government facilities (13), and factors associated with attrition of participating facilities from the study (14).

Finally, Chapter 15 identifies areas of further research needs, and Chapter 16 summarizes the principal overall conclusions from the project. Appendices provide additional information including references cited, a summary of other related assessments of subsets of the NDEMS pilot facilities, and an extensive bibliography of the empirical research literature on EMSs. The project web site (http://ndems.cas.unc.edu) also provides access to the data collection protocols, interim reports, other papers and presentations derived from the NDEMS project, links to other useful information sources on EMSs, and the NDEMS databases themselves (baseline, design, and two updates).

Chapter 2. Literature Review

This chapter presents more detailed background on the research questions that are relevant to the study of EMS implementation, and on the research literature reporting the findings of other investigators that shed light on these questions. In doing so, we seek to discuss more fully the questions that we are addressing, the variety of possible answers to them that should be considered, and the existing bodies of theory and evidence from other studies that are relevant to them.

OUTCOMES

What effect do EMSs appear to have on environmental performance? Previous studies do not provide clear answers to this question.

Self-reported data -- both case-study reports and survey results -- point somewhat consistently to improvements in several facets of environmental performance. In an assessment of the environmental reports of ten of the world's largest pharmaceutical companies, Berry and Rondinelli (2000) found that environmental management practices were beginning to produce positive results, and that considerable progress had been made in waste reduction, resource conservation, hazardous emissions, and ozone depleting chemicals. In a detailed case study of the Alumax aluminum production facility in Holly, South Carolina, Rondinelli and Vastag (2000) also reported marked improvements in waste reduction and recycling efforts at the plant within the first three years of the EMS, with trash generation cut in half. And Ammenberg (2001) found that for one multifaceted case study -- a joint EMS for an industrial district in Sweden comprising 26 small enterprises) -- many performance improvements were identified that were specifically consequences of the EMS, although he also noted that an ISO 14001 certificate per se was no guarantee of such improvements.

A growing number of survey-based studies have also begun to report EMS impacts on environmental performance. Early studies were equivocal, probably because it has taken some time to produce both evidence of impact and larger statistical studies of EMS practices. Melnyk and others (1999), for instance, found that ISO 14001 was more effective at impacting environmental performance than were other voluntary programs. Hamschmidt (2000) surveyed all ISO-certified companies in Switzerland in 1999, and found that 60% of the 158 companies responding (just over 50% of all companies) reported some decrease in materials and energy flows relative to production, but that only 10% of the firms had experienced strong decreases, and 40% either did not measure changes or experienced worse performance. Ninety-two percent of the environmental managers also reported that the EMS had led to an increase in the importance of environmental topics within the companies.

More recent investigations, however, have begun to produce larger statistical studies. Florida and Davison (2001), for instance, reported results from a survey of 580 corporations in Pennsylvania, finding that facilities with EMSs were significantly more likely than others to report recycling, air emission reduction, solid waste reduction and electricity use as evidence of facility-level improvement. Similarly, Mohammed (2000), in a survey of 106 ISO-certified firms in the Chubu region of Central Japan, found that firms claim to manage their natural resource consumption more efficiently after adopting an EMS. And Anton et al. (2002), surveying a sample of Fortune 500 firms, found that a higher-quality EMS leads to lower toxic emissions per unit output, particularly for firms that had higher past pollution intensity. They also found that EMSs result in reductions in both off-site transfers and on-site releases per unit output, though not in hazardous air pollutants per unit output.

Two studies so far have attempted to go beyond self-reported data on performance outcomes, and examined EMS adopters' environmental performance as measured by EPA's TRI (Toxics Release Inventory) database. Matthews (2001) examined TRI data for EMS adopters in the automobile and light truck assembly sector, and reported that facilities with ISO 14001 were not performing significantly better than facilities without the system: she found no differences in toxic waste management between certified and non-certified facilities, and compliance with air permits was similar between certified and non-certified facilities. However, TRI data are reported with a two-year lag time, and it is not clear that her results accurately represented facility performance after EMS implementation and certification.[11] Contrary to these findings, Russo (2001) found that in the electronics industry, ISO 14001 registration significantly reduced toxic emissions in facilities with releases above TRI reporting thresholds, and that an EMS was a significant predictor of improved environmental performance with respect to toxic emissions.

Does introducing an EMS improve environmental performance?

For an EMS to improve a facility's environmental performance, it must influence at last some and perhaps many aspects of behavior in the organization: the attitudes of managers (to include environmental considerations in their calculations), the process of making decisions (promoting wider participation, and more inclusive agendas and priorities), the structure of facility management (by assigning new environmental responsibilities, creating and tracking indicators, etc.), and perhaps even the functions performed by a given facility (by adding environmental stewardship to its missions). Given the challenges often involved in significantly changing any of these kinds of embedded practices, there are many reasons why an innovation such as an EMS might fall short of its champions' aspirations. Their vision may not be shared by real-world participants (who thought they were doing something else), internal factors may prevent implementation (resistance, inertia, etc.), or the expected outcomes (better performance) might be beyond the capacity of program inputs (resources, top management commitment) and outputs (attitudinal and procedural changes) to secure. Within that context, it would be useful to know which (if any) of these possible reasons for falling short of the idealized model are at work.

It is entirely possible that introducing an EMS would make no observable difference at all to a facility's environmental performance. It could be, for instance, that an EMS merely articulates and documents what a facility is already doing, rather than setting "stretch" goals for it. A facility with an EMS that is achieving superior environmental performance may simply be exhibiting a pre-existing management commitment to high performance. Conversely, a low-

[11] In her study, Matthews apparently chose to assume that facilities would have implemented their most cost-effective environmental performance improvements in preparation for initial ISO registration audits, rather than as a result of them; her TRI data (1994-98) did not in fact cover the period after the facilities' ISO certification.

performing facility may simply implement a "paper EMS" – perhaps to satisfy external demands, or to present a more favorable image to the public – without any observable change in performance. Note that even registering as conformant to the ISO 14001 standard does not require actual improvement in environmental performance: only continual improvement in the EMS itself.[12]

Coglianese and Nash, for instance, have argued that

> … to understand better the impact that EMSs have on firms' environmental performance, we should distinguish any improvements caused by the EMS itself from improvements caused by factors other than the EMS, where "management commitment" refers to the overall priority that a firm's top management gives to environmental improvement and serves as a proxy for the various factors that contribute to environmental improvement other than the management system itself. (Coglianese and Nash, 2001:17)

This reasoning, however, overlooks the likelihood that an EMS may serve as a more effective instrument of such a management commitment rather than as an independent cause separate from such a commitment. The most basic required element of an ISO 14001 registered EMS, for instance, is an explicit management commitment to regulatory compliance, prevention of pollution, and continual improvement, publicly documented in an environmental policy statement and implemented through a detailed and ongoing management process.

One of the principal arguments in favor of EMSs is that by establishing more systematic management processes and procedures for managing an organization's environmental aspects and impacts, EMSs will in fact produce improvements in environmental performance. Plausible reasons include the fact that the EMS includes articulation of an explicit top-management commitment to environmental goals, objectives and targets; that the EMS process assigns specific and accountable responsibility for achieving those objectives; that typically those responsibilities are assigned to all relevant managers, not simply to the EHS regulatory compliance staff, thus involving all relevant units and personnel in identifying opportunities for improving environmental performance; and that the continual-improvement cycle itself institutionalizes a process for integrating environmental performance improvement into the core business decision-making and management processes rather than just leaving them to the EHS unit as a cost center.

As a third possibility, however, performance could actually appear to deteriorate following introduction of an EMS. Particularly in the short term (and particularly at the time of audits), EMS implementation might well identify many performance problems that had previously gone undetected – and could now be corrected. Over a longer term, however, post-EMS performance deterioration would probably mean that a facility had adopted a "paper EMS" simply to seek public-image benefits, or perhaps even to divert attention from poor performance to the fact of its having adopted an EMS.

[12] It is difficult to envision a credible argument that an EMS is continually improving if that improvement cannot be observed in the environmental performance for which the EMS purports to set goals, objectives, targets, and monitoring and corrective-action processes, but some U.S. participants in the authorship and interpretation of the ISO standard insist on the distinction (NAPA 2001).

The decision to seek third-party auditing and ISO registration, not simply to adopt an EMS, could further enhance environmental performance by adding the extra pressure of external scrutiny and questioning by independent professionals. It is not yet clear, however, how rigorous or even how consistent the professional norms of such auditors will prove to be. The ISO standards are open to diverse interpretation and judgment on key points, and evidence suggests that different auditors do in fact interpret them in varied ways (NAPA 2001, Ammenberg 2001). Like financial auditors, EMS auditors also face conflicting pressures between the ideals of environmental professionals and their necessary financial interest in obtaining and retaining business relationships with the audited firms. If they take an excessively permissive stance their credibility may be poor, but a highly rigorous position may cause them to lose business to more accommodating competitors (NAPA 2001).

Finally, the performance effects of an EMS may vary depending on the organization's motivation and goals in adopting an EMS. For instance, a facility that introduces an EMS as a tool to improve the overall efficiency of its use of materials and energy – or to improve its management processes more generally – may well achieve greater improvement in environmental performance outcomes than one that uses it merely to satisfy a customer mandate that it have a certified EMS in place, or that wants certification merely to promote its public image.

Does introducing an EMS improve regulatory compliance?

For most facilities, at least in the United States, regulatory compliance has been the most basic indicator of environmental performance used for the past three decades, and the primary preoccupation of their environmental management staff (see discussion in previous chapter). The ISO 14001 EMS standard requires an explicit commitment to achieving compliance with all applicable regulations; and inherent in the EMS process is the production of more detailed and explicit documentation tracking compliance outcomes. There is every reason to expect, therefore, that the introduction of an EMS will focus even greater scrutiny on compliance as a principal measure of environmental performance, whatever other indicators are used.

That said, however, the introduction of an EMS could produce, or appear to produce, any of several different compliance outcomes. An EMS might make no observable difference in outcomes, perhaps because a facility was already doing all it could or was prepared to do to improve its compliance, or because it chose to focus its EMS on improvement of unregulated aspects of its performance (energy or water conservation as cost-saving measures, for instance).[13] In addition, the time frame of this study might be too short to observe significant changes in outcomes.[14] Alternatively, an EMS might in fact improve compliance, due to the EMS's more explicit tracking and documentation of it and to the broadening of responsibility for it to all managers and employees rather than just the EHS staff. Or its compliance in the

[13] This outcome is particularly plausible in the present study, in which the facilities were all volunteers working in cooperation both with the researchers and with their state environmental agencies (some of the states excluded facilities with major recent violations from participation in the study).

[14] Many routine compliance data, such as air emissions and wastewater discharges, are self-reported on a regular basis (e.g. quarterly), but data on actual violations are more variable and often are not recorded until a facility is inspected. For many facilities, such inspections may occur only once every several years, thus making it difficult to determine in the short term whether or not a facility truly has changed its compliance pattern after implementing an EMS.

short term after an EMS was introduced might even appear to worsen, as the more explicit tracking procedures of the EMS identified (and potentially corrected) more non-compliances that previously went undetected. Similar lines of reasoning might apply to the potential effects of third-party auditing and ISO registration, and to the variability of results depending on motivation.

One recent study has addressed this question. Dahlström and Skea (2002) surveyed 843 facilities regulated under Britain's Integrated Pollution Control (IPC) program, and concluded that having an externally validated EMS, certified to the international standard ISO 14001 or registered under the European Union's Eco-Management and Audit Scheme (EMAS), was associated with higher levels of procedural performance by those facilities (such as recording and use of information, plant maintenance and management and training). However, these facilities were neither more nor less likely to suffer from incidents, complaints or non-compliance events than those without. They also were neither more nor less likely to be subject to enforcement action. Therefore, they concluded, reducing the degree of inspection for compliance sites with EMAS or ISO 14001 was unlikely to lead to a better targeting of public resources. Other findings showed that sites with an EMS tended to improve their operator performance more quickly than those without, and that sites registered under EMAS tended to perform better than those certified to ISO 14001.

Do EMSs provide economic benefits to organizations that adopt them?

For many or even most facilities, adopting an EMS may well make no observable difference to their economic performance. The minimum requirements of an EMS allow great discretion to the adopter as to how much effort and detail is required. For some it may be simply a paperwork exercise that involves no more staff time than many other overhead management tasks. For others, most of the costs may be covered by technical assistance from state agencies, university extension programs, trade associations, or major customers. Finally, the economic costs of an EMS may be so closely offset by benefits – in management efficiencies, for instance – or so marginal compared to the dominant economic indicators of the business, that the net result is no observable change. Unless there are significant out-of-pocket costs for consultants, third-party auditors or registrars, or major costs for unanticipated corrective actions necessitated by the EMS, or large specific benefits, the EMS may well have no observable economic effect.

Many advocates of EMSs hypothesize, however, that an EMS is likely to produce increased net economic benefits to adopters. First, EMSs may reduce compliance costs, both by reducing the frequency and magnitude of violations and by making inspection processes less time-consuming.[15] EMSs may also help managers reduce the cost of their environmental programs, both by managing them more consciously and efficiently and by refocusing them on the most effective ways to achieve desired performance outcomes. Rondinelli and Vastag (2000), for instance, found that EMSs led to better record-keeping and scheduling of environmental tests and equipment calibration.

[15] Anecdotal accounts suggest that some businesses have reduced the time consumed by inspection visits from one or two days to a few hours, since an EMS maintains records more systematically and also increases the inspector's confidence that compliance is being carefully self-monitored.

Second, pollution discharges and waste generation represent both direct economic waste and increased economic costs and liabilities to the business (cf. Royston 1979), and to the extent that the EMS achieves more systematic identification and correction of these losses it will produce economic benefits. Facilities with EMSs may also pose lower environmental risk than comparable plants without such systems (Florida and Davison 2001), and managers of EMS plants are far more likely than their non-EMS peers to cite recycling, air emissions reduction, and solid waste reduction as sources of environmental performance improvement.

Third, the EMS can be used to promote "eco-efficiency" more broadly, including not only pollution prevention but more efficient use of all inputs (materials, energy, water, etc.) to production and facility operations, and to substitute less toxic materials for those that carry heavier cost liabilities for their management. Building on the work of Deming on total quality management, for instance, some business scholars have viewed pollution as a correctable defect in the efficiency of the manufacturing process (cf. Elliott 1994, Perigord 1990, Porter and van der Linde 1995a, all cited in Coglianese and Nash 2001: 22-24).

Fourth, introduction of an EMS may serve as a trigger for broader questioning of embedded assumptions and practices, leading to economically beneficial innovations in processes and/or products. This is also particularly plausible for the role of third-party auditors, whose questioning of internal assumptions may prompt more fundamental reexamination of existing practices and thus lead to innovation. Introducing an EMS is intended to broaden the locus of environmental decision-making from the EHS unit to the full range of the facility's activities, products and services, thus engaging far more information about the processes, technologies, and resources needed to make improvements, far more opportunities for cost-effective changes in practices and strategies, and also more potential for innovation as companies search for ways both to prevent pollution and save and make money (Coglianese and Nash, 2001:10). Florida and Davison (2001) and others present evidence that EMSs are often an element of broader initiatives to integrate and improve management more generally, with attendant economic benefits, and that EMS adoption thus appears to correlate with advanced management practices generally.

Fifth, some scholars argue that managers who work aggressively to prevent pollution gain an advantage over competitors (Porter and van der Linde 1995a, 1995b). Hart and Ahuja (1996) report that programs to reduce emissions led to increased profits within two years of initiation among the 127 large firms in their sample, and a small but growing literature suggests similar results in other studies. More recently, Hart and others have argued that firms that focus on environmental and social as well as economic aspects of sustainability – the so-called "triple bottom line" – are more likely to survive and prosper over time than those that focus solely on short-term economic indicators (Hart and Milstein 1999).

Sixth, EMSs may produce subtler but nonetheless real economic benefits through other changes, such as increased engagement and improved morale among employees, improved public image for the organization, relations with suppliers and customers and the surrounding community, and others. EMSs may "draw in" managers and employees who otherwise would be left out. Nash and others (2000), for instance, in a study of the effectiveness of EPA's Star Track voluntary program, found that ISO 14001 had led to the integration of environmental objectives into operating routines, regulatory compliance was formalized as a priority for managers, and in some cases pollution-prevention activities had become part of the responsibility of many employees outside the EHS unit.

Finally, one must note that the firms that introduce EMSs are most likely to be disproportionately those that can reasonably anticipate economic benefits from doing so. Whether that means that other firms would not experience such benefits, or simply that they are less astute in failing to anticipate them, is of course not easy to determine.

Beyond the individual firm, some argue that trade associations, supply-chain relationships and other mechanisms for sharing information can also propagate new and economically beneficial norms for environmental management (Coglianese and Nash 2001; Howard et al. 2000, Nash and Ehrenfeld 1997, DiMaggio and Powell 1991).

Notwithstanding all these arguments for economic benefits, however, it is also plausible that net economic costs of EMS introduction may exceed them. While "paper EMSs" can be produced at very low cost, developing one with any degree of usable detail may involve significant start-up costs – to carry out a full assessment of activities, aspects and impacts, for instance, and to determine their significance and set objectives and targets for improvement – and some continuing real costs of administration. The use of consultants, and the decision to employ external auditors and registrars, add other real out-of-pocket costs. For facilities that have only limited environmental impacts, or that have already captured most of the "low-hanging fruit" of remedying economically inefficient environmental practices, or that are small enterprises in which detailed management procedures and documentation add less value than in larger and more complex organizations, these costs could be greater than the economic benefits realized. For others, intangible benefits may be greater than the costs, but hard to document and to attribute conclusively to the EMS (employee morale and productivity, for instance). For all these reasons, EMS adopters could experience either net benefits, net costs, or no observable change; and the results may vary in part depending on its motivation and use of the EMS.

MOTIVATIONS

One of the central questions surrounding EMS implementation is, why do businesses choose to undertake the costs and effort of implementing such a detailed process and documentation procedure as an EMS? Chapter 6 presents a detailed discussion of hypotheses and of relevant findings from other studies, as well as our own findings. Here we highlight some of the key studies and findings, to illustrate the various factors that appear to be involved.

Motivations for EMS adoption involve several key elements. One is the facility's expectations: what benefits does it expect to gain, and what costs or threats or other problems to reduce, by doing so. A second but different question is what kinds of facilities are most likely to be motivated to adopt EMSs: large or small, public or private, domestic or transnational. Finally, a third issue is what kinds of pressures or drivers are most influential in motivating facilities to adopt, implement, and in some cases register an EMS to the ISO 14001 standard: external pressures versus internal capabilities, and regulatory pressures versus markets, social pressures, or others.

What expectations are most likely to motivate facilities to adopt an EMS?

While some expectations may be specific to particular facilities, several studies have found overlapping rationales for such motivations. These include the quest for improved environmental performance (Nash et al, 2000; Florida and Davison, 2001; Hutson, 2001), improved documentation (del Brio et al, 2001, Hutson, 2001; Morrow and Rondinelli, 2002), improved public relations and/or company image (Nash et al, 2000; Florida and Davison, 2001; Hutson, 2001; Morrow and Rondinelli, 20020, achievement of greater efficiency through improved processes (Hutson, 2001; Morrow and Rondinelli, 2002), the ability to integrate with existing quality systems (Hutson, 2001; Morrow and Rondinelli, 2002), improved regulatory compliance (Nash et al, 2000; del Brio et al, 2001; Morrow and Rondinelli, 2002) and the quest for competitive advantage (Hutson, 2001; Morrow and Rondinelli, 2002). In a survey of 580 corporations in Pennsylvania, firms ranked primary motivations in order from corporate goals to commitment to environmental improvement, state regulatory climate, business performance, and improved community relations (Florida and Davison, 2001). Chin and Pun (1999) found that facilities implemented ISO 14001 EMSs to improve performance and improve market position.

What kinds of facilities are most likely to adopt EMSs?

Early predictions after promulgation of ISO 14001 generally assumed that the main EMS adopters would be large transnational corporations (TNCs). Large TNCs had greater internal resource and management capabilities with which to absorb the administrative costs of EMS introduction and implementation, and they also, it was thought, would have greater motivation for doing so: externally in greater returns from brand image enhancement and international trade, and internally from standardization of procedures and reduction of environmental liabilities across their diverse facilities and business units. Large TNCs, moreover, had been the primary participants in development of the ISO 14001 international voluntary standard, and in the membership of organizations such as the World Business Council for Sustainable Development which championed it. Publicly traded corporations also were more vulnerable to environmental image concerns on the part of investors and the general public. Smaller and privately-held businesses, it was thought, had both less to gain and less internal capabilities to devote to an EMS, and government facilities had no obvious motivations for EMS adoption.[16]

In practice, however, it is entirely possible that facilities other than large TNCs would also be motivated to adopt EMSs. Many SMEs, for instance, are heavily dependent on sales to the large TNCs and might therefore adopt EMSs in response to the pressure of customer expectations (and in some cases, explicit requirements). Facilities facing serious environmental compliance problems or performance inefficiencies might also have far more to gain from introducing an EMS than facilities that had already captured most of the benefits through better management. And if EMSs really did prove to have net economic benefits,

[16] Stenzel (2000), for instance, notes that ISO 14001 was developed by deliberations among large transnational corporations themselves, with four principal motives: to promote sustainable development, harmonize standards and procedures worldwide, promote a new paradigm of self-management as an alternative to traditional government regulation, and forestall further government regulation especially at the international level.

firms in the most tightly competitive sectors might have a greater stake in such benefits than large TNCs with greater slack in their margins.

What factors motivate or influence facilities to adopt EMSs?

A variety of drivers have been found to influence motivations for adopting EMSs. These drivers have been most commonly classified as external or internal to the adopting organization.

One line of such research proposed that environmental innovation is driven primarily by external forces, such as regulatory or market pressures. Porter (1991) in particular has argued that government regulations may serve in practice as a stimulus to both economic growth and cleaner production, if production changes in response to regulation are used as a business asset to gain market advantages over competitors. A subsequent review of the literature concluded that neither positive nor negative effects of environmental regulation on competitiveness were easily detectable (Jaffe et al. 1995). Porter and van der Linde subsequently concluded (1995a, 1995b) that firms seek to maximize “resource productivity” in response to both regulatory and market pressures, enabling them to simultaneously improve both their industrial and environmental performance (Florida et al. 1999).

This latter conclusion led to an alternative line of theory, which proposed that both economic and environmental performance of businesses were driven primarily by internal forces, including management strategy and firm-level resources (Hart 1995, Russo and Fouts 1997, Klassen and Whybark 1999). This “resource-based” view (RBV) of the firm postulated that sustained competitive advantage is driven by the firm’s use of strategic resources -- assets, capabilities, and less tangible knowledge-based advantages such as socially complex organizational processes and reputational assets -- that are rare, difficult to imitate, and have few substitutes.

In an early and insightful article on this subject, Gabel and Sinclair-Désgagné (1994) proposed that poor environmental management was caused not only by market or regulatory failures, with which environmental economists and policy scholars were preoccupied, but by organizational failures on the part of businesses themselves. Framing their argument in the perspective of principal-agent theory, Gabel and Sinclair-Désgagné argued that businesses often recognize the value of environmental goals in principle, but fail to operationalize them throughout the management systems that in fact drive their employees’ behavior: the compensation system, quantification and monitoring of non-financial objectives, internal pricing, horizontal task structuring, centralization vs. decentralization of decision-making, and corporate sanctions of employees for negligence. They argued therefore for increased integration of environmental considerations throughout these corporate management incentive systems.

Hart (1995) proposed that proactive environmental management is itself potentially a strategic resource that can produce competitive advantage, especially for firms whose effectiveness in socially complex skills such as total-quality environmental management commitments, continual improvement, cross-functional management, and interactions with the public allow them to achieve greater economic advantages from pollution prevention, product stewardship, and sustainable development. Russo and Fouts (1997) concurred, examining 243 firms over two years and concluding empirically that environmental performance and economic performance are positively linked, with the returns to environmental performance higher in high-growth industries.

Like Hart and others, Florida et al. (1999) argued that internal organizational factors, not just external pressures, play a fundamental role in the ability of business organizations to adopt advanced environmental practices. Based on a structured field-research study involving over 100 interviews at matched pairs of 11 facilities in several industries, they concluded that organizational resources, and particularly specialized environmental resources, provide the embedded capacity that allows sample facilities to implement environmental innovations. They also found that organizational monitoring systems played a crucial role in the adoption of environmentally-conscious manufacturing practices. Finally, they found that such organizational resources tend to operate best as a system, creating the capacity to respond to both internal opportunities and external events.

Klassen and Whybark (1999) investigated more closely the differences in performance associated with investments in pollution prevention, pollution control, and management systems. They concluded, both theoretically and with empirical confirmation, that investments in pollution prevention produce improvements in both manufacturing and environmental performance, while investments in pollution control merely move pollutants around among different environmental media while adding costs and worsening manufacturing performance. Even proactive environmental policies provided little competitive advantages by themselves: what mattered to economic competitiveness as well as to environmental performance was developing the capability to deploy pollution prevention technologies effectively. These findings concurred with earlier empirical work by Hart and Ahuja (1996) which found that pollution prevention and emission reductions had a positive effect on industrial performance.

What remained to be studied in greater detail, Klassen and Whybark noted, was whether allocating resources to management systems was a precursor to developing strategic organizational resources that favored the effective implementation of pollution prevention technologies (Hart 1995; Russo & Fouts 1997). To invest most effectively in pollution prevention, they argued, firms must develop strategic organizational resources to enable the recognition and deployment of pollution prevention technologies at the plant level, and must then ensure that plant-level personnel are given both the latitude and the incentives to apply these capabilities to environmental issues in manufacturing, regardless of any corporate environmental policy. Environmental management systems offer a potential organizational resource for this purpose, they suggested, but one not yet clearly proven.

In considering motivational drivers for EMS adoption, Melnyk et al. (1999) found that EMSs were generally reactive, and were driven primarily by external pressures such as problems or regulatory requirements.[17] Preliminary results from an empirical study of the use of EMSs in the pulp and paper industry also suggested that factors external to the firm (regulation, market pressure, and community demands) might be the most important determinants of corporate environmental performance (Thornton et al. 2000). And Khanna and Anton (2002), using survey data for a sample of S&P 500 firms, found that the threat of environmental liabilities and high costs of compliance, market pressures, and public pressures on firms with high on-

[17] These data, however, were collected just two years after ISO 14001 was approved, before the major growth in its adoption (only 37 of the 1500 firms they surveyed had an ISO 14001 registered EMS in place at the time).

site toxic emissions per unit output created incentives for adopting a more comprehensive environmental management system. However, they did not find that regulatory and market based pressures had a direct impact on toxic release performance: rather, the effect of regulatory and market pressures on toxic releases appeared to be indirect, by encouraging institutional change as manifested by the increase in EMS quality (Anton, Deltas and Khanna 2002).

Hillary (1999) found additional evidence for the importance of internal capabilities, especially in small and medium-sized enterprises (SMEs). In an analysis of thirty-three separate studies of EMS adoption by SMEs (mainly in Europe and the United Kingdom), she found that the lack of human rather than financial resources was the primary barrier to adoption. Additionally, SMEs were affected by uncertainty about market benefits and had trouble accessing quality information about EMSs. Similarly, Biondi, Frey and Iraldo (2000) showed that SMEs would be more likely to implement EMSs if technical and financial support were provided and if EMS procedures were simplified. Nakumura (2001) also stressed managers' environmental beliefs as a motivation to adopt ISO 14001.

Finally, the presence of other pre-existent advanced management practices, and particularly quality management, was another major influential form of internal capability driving facilities' motivation to adopt an EMS. Several studies found, for instance, that nearly twice as many EMS adopters had just-in-time (JIT) or total quality management (TQM) systems in place than non-adopters (Corbett and Kirsch, 2000; King and Lennox, 2001; Florida and Davison, 2001). This phenomenon was unlikely to have been a coincidence, as past experiences with quality management systems often influenced the adoption and implementation of EMSs (Melnyk et al. 1999, Berry and Rondinelli 2000, Corbett and Cutler 2000). Florida and Davison (2001) also found that facilities with EMSs and pollution-prevention plans in place were nearly twice as likely to be utilizing other advanced management practices and performance-measurement systems as well. Melnyk and others (1999) reported that firms that successfully attained ISO 14001 certification were not only more environmentally responsible, but more efficient and potentially better suppliers. In a study of the New Zealand plastics industry, Corbett and Cutler (2000) reported that preventative approaches and sound internal waste management allowed companies to improve cost-control and other management processes.

What effects do government incentives have?

Many government agencies, both EPA and state environmental agencies, have begun to actively encourage and promote the adoption of EMSs and third-party auditing and registration by regulated facilities. Most have done this simply by general encouragement and informational publicity, such as simplified guides to EMSs and their possible benefits. Some have also provided training programs and technical assistance, especially to small businesses and government-operated facilities. A few have introduced public recognition programs, such as EPA's National Performance Track; and a small number also have offered incentives such as financial assistance or regulatory flexibility to facilities introducing EMSs that satisfied agency criteria. Their assumption is that EMSs will produce improvements in environmental performance and regulatory compliance, and their hope is that such inducements will provide effective incentives to that end.

It is also possible, however, that the benefits of such inducements will be too small to produce the desired outcomes, particularly if the costs of satisfying government criteria are also significant (Fines, 2001). It is even possible that they could be counterproductive, motivating firms to seek public-relations benefits of government recognition rather than more significant improvements in actual performance. More generally, "win-win" opportunities for such truly voluntary agreements with government may be rare, and some managers may use EMSs to avoid regulatory scrutiny (Coglianese and Nash 2001:13-14). Nash and Ehrenfeld (2001), for instance, argued that the presence of an EMS per se, particularly one based on ISO 14001, is not necessarily a good metric for differentiating among firms. And Metzenbaum (2001) has argued that focusing on promotion of EMSs may distract regulatory policymakers themselves from what she considers more pressing needs, such as generating credible and comparable information on actual environmental outcomes.[18]

HETEROGENEITY

It is both common and all too easy to talk about EMSs as though they are homogeneous or at least relatively similar and recognizable systems. Clearly EMSs registered as conforming to ISO 14001 must have certain recognizable common elements and procedures. But ISO 14001 is a voluntary standard, adopted so far by only a small fraction of U.S. businesses and other facilities; and many other organizations would argue that they too have EMSs in place, in some cases more sophisticated than the lowest-common-denominator approach of ISO 14001. What then are the necessary common elements, and what variations should be expected, among EMSs?

Are EMSs relatively similar, or are there significant differences among them?

Even ISO 14001 allows great discretion as to the content, scope and design of a facility's EMS, and as to its decisions about the significance of its various impacts, its priorities and objectives and targets for improvement, its chosen rate of improvement, and other elements. There is no reason to expect that all facilities will interpret the process in the same way or generate identical content.

Coglianese and Nash (2001:5) propose that EMSs vary along five key dimensions: the ambitiousness of the environmental objectives they require managers to establish, the trustworthiness of the EMSs they specify, the level of monitoring they call for, the type of sanctions they impose on firms that do not measure up, and the transparency of the EMS and of the organization's performance to the public. The future of environmental policy, they argue, should therefore be guided not only by research about whether EMSs achieve socially desirable outcomes – and under what conditions – but also by an understanding of how differences in key characteristics of EMSs affect organizational performance.

The role of stakeholders in the EMS process may also be an important potential source of differences among EMSs. Stakeholders can fall into several categories: employees, suppliers, organized environmental advocacy groups, communities surrounding manufacturing facilities,

[18] The ISO 14001 EMS standard does not require public disclosure of environmental performance outcomes, let alone disclosure in a form that is comparable to other facilities.

and others. In general, studies appear to show positive relationships between facilities adopting EMSs and their stakeholders. Hillary (1999) found that the relationship between firms and stakeholders improved in the presence of an EMS. Delmas (2001) also found that stakeholder involvement affected the competitive advantage of the EMS: the greater the involvement of external stakeholders in the EMS process, the stronger the perceived competitive advantage.

With regard to specific stakeholder groups, employee involvement and empowerment appears to be particularly important to EMS success. Rondinelli and Vastag (2000), in their study of the Alumax facility, found that employees became more aware of environmental aspects, regulations and impacts not only in the workplace, but also at home and in the community. Additionally, these employees increased their commitments to both waste reduction and recycling inside and outside of the plant. Kitazawa and Sarkis (2000) found that in three very different ISO 14001 certified facilities, employee empowerment, their ability to make suggestions, and management's ability to involve them in decision-making were each vital to the success of source reduction programs. In a study of Spanish industry, del Brio and others (2001) found that employee training was one of the important factors for ISO 14001 success.

Another important range of stakeholders includes those up and down the "value chain" of production, particularly major suppliers and customers. Melnyk and others (1999) asserted that little attention was devoted to environmental problems along the supply chain, but other and more recent studies have suggested that firms that are concerned with the environmental performance of their business partners and EMSs have positive effects on supplier performance. In a survey of Mexican auto suppliers, for instance, Hutson (2001) reported that ISO 14001 was the first formalized management system most Mexican auto suppliers had put in place, and that the vast majority would not have implemented the system without the explicit mandates of the major automakers who were their principal customers (Ford and General Motors). Ninety-six percent of these suppliers also believed they would derive benefits from the implementation of the EMS.

Corbett (2002) also showed that management practices were "imported" through the supply chain, in a study which extrapolated from his earlier findings on the international diffusion of the ISO 9001 quality-management standard. Using macro-level certification data, and comparing it with survey results from over 5000 firms in nine countries, Corbett presented evidence that management practices originally adopted by firms in one geographic region were imported by suppliers in other countries exporting to that region. Other firms in these suppliers' countries then tended to adopt similar certifications and management practices and to trigger other, more traditional single-market diffusion mechanisms. Such findings are consistent with other work such as that of Garcia-Johnson (2000), who described the export of environmental practices by chemical companies to their overseas subsidiaries and suppliers through the Responsible Care© program.

Finally, since the Bhopal industrial disaster of the mid-1980s, the communities surrounding industrial and other facilities have come to be recognized increasingly as important stakeholders in facilities' environmental management practices and even in their right to operate. This relationship has been noted in a few EMS studies and for the most part has been shown to be positive. According to Mohammed (2000), the adoption of ISO 14001 in Japan caused firms to consider more explicitly the role of local people in a facility's day-to-day operations, and also helped to enhance the environmental awareness of the community.

Similarly, Florida and Davison (2001) reported that firms with EMS and pollution prevention programs in place were more involved with their communities in multiple ways. Facilities with EMSs in place were almost three times as likely to involve the community in environmental activities and setting environmental priorities, and twice as likely to involve government in these processes, than other facilities. Facilities with EMS and pollution-prevention programs were also more likely to participate in environmental activities with the local community such as environmental education programs, recycling efforts and Earth Day events. Such facilities reportedly devoted more than twice the financial resources to environmental activities compared to other manufacturing sites, and over 72% of these facilities reported that their relationship with surrounding communities had improved over the previous five years.

CONTINUAL IMPROVEMENT

A core requirement of the ISO 14001 standard for EMSs, and a central principle of its Deming-based philosophy, is that EMSs and indeed all management systems are to achieve continual improvement over time, with each revolution of the "plan-do-check-act" cycle or spiral. Any EMS certified as conforming to the ISO standard must demonstrate this outcome, and many others are based on this model even if not externally certified to it.

A distinction is made by some authors of the ISO 14001 standard between continual improvement in the environmental management system and improvement in actual environmental performance. In this view, the only requirement of ISO 14001 is continual improvement of the environmental management system itself, not necessarily in actual environmental performance (cf. NAPA 2001). From the perspective of ordinary logic, it would seem unsupportable to claim that an EMS is continually improving if that improvement is not also evident in the organization's environmental performance; but given the authors' interpretation, it is important to examine separately the evidence of continual improvements in the EMS itself and in environmental performance, compliance, and other outcomes.

Do EMSs improve or erode over time?

There is still great uncertainty as to what is an appropriate minimum standard for continual improvement, whether any such standard will be achieved, and whether it will have any consistent meaning across different facilities and observers.

It may be, for example, that after the relatively intensive effort and commitment devoted to their initial introduction and implementation, EMSs become simply a standard operating procedure or paperwork process delegated to the EHS unit for oversight, with little further change – positive or negative – in its influence on the facility's overall management and operation. It may continue to be used, but only for monitoring to guard against slippage in compliance rates or other indicators considered important. Continual improvement in this model would mean simply maintenance of the system and incremental improvements to routine management.

Alternatively, it is possible that the EMS could be used as a driver for far more fundamental change. In this model, continual improvement could mean that with each cycle of its review, the EMS process would be used to set new and more ambitious objectives and targets for environmental performance improvement, or to broaden the scope of the EMS to include additional operations and business units of the facility or additional unregulated aspects and impacts, or even to begin looking at such questions as improving the impacts of the facility's inputs and products as well as its processes over their entire life cycles. Each cycle would stretch the facility's goals farther, from incremental and operational to more and more strategic improvements in the facility's environmental, social and economic sustainability. This approach would appear to be the most consistent with the larger vision of the WBCSD authors who championed its creation (Schmidheiny, 1992), and of other proponents of sustainable enterprise in the business management research literature (e.g. Hart and Milstein 1999).

On the other hand, it is also plausible that EMSs will exhibit gradual attrition over time, as they become bureaucratized and their initial champions are promoted, their organizations restructured, and their parent firms merged, acquired, or spun off. Many scholars view the organizational innovation process not as a continual-improvement process but as a form of "punctuated equilibrium," in which new innovations are introduced with great effort and transaction costs but then are assimilated and show gradually diminishing and more marginal returns over time, until they are either ignored or replaced by some new system introduced with another major upheaval (cf. Downs 1972, Kingdon 1984). Some facilities may choose not to maintain or renew their ISO registrations, or may even discontinue use of the EMS. Others may lose interest in setting new objectives and targets, or satisfy themselves with ever more marginal improvements in environmental performance (recycling in the cafeteria, for instance, rather than introducing a more fundamental change in production processes or products to phase out toxic chemical usage).

Since the ISO 14001 standard was only promulgated in 1996, and it has taken some years to achieve widespread adoption, there is not yet solid empirical research literature on this question. It is now becoming timely to conduct such studies, however, as increasing numbers of firms develop multi-year experience with EMSs and as ISO-certified EMSs complete repeated surveillance audits and initial three-year re-certification processes.

Do environmental performance, compliance , and other outcomes continually improve over time?

In the context of improvement or attrition in the EMS itself over time, what changes in actual environmental performance, compliance, and other outcomes do EMS adopters exhibit? One can envision an entire spectrum of plausible answers, from increasingly aggressive and strategic improvements to gradual erosion in the rate of improvement as "low-hanging fruit" is harvested – that is, as the easiest and most cost-effective improvements are adopted, leaving only more expensive or difficult changes for consideration – or worse, as more difficult economic conditions or erosion of regulatory inspection and enforcement create incentives for slackening of environmental commitments that are not associated with short-term financial benefits.

As in the case of EMSs themselves, the recent occurrence of widespread EMS introduction has precluded reliable empirical research on this question in the past, as have time lags and other quality-assurance issues in government databases on environmental compliance and performance data. With multiple years of EMS experience, some improvements in availability of government data on these indicators, and some concurrent increases in corporate environmental reporting and disclosure, such research is becoming more timely and feasible.

CONCLUSION

In summary, the existing research literature suggests that EMS adoption and implementation presents a series of important and interesting questions for research, both about business decision-making for environmental management and about the efficacy and appropriateness of public policies seeking to influence that behavior.

Critical issues such as how facilities develop EMSs, what factors are influential in their development and what the specific outcomes of their efforts look like are yet to be addressed. To date very few researchers have ventured into business or government facilities to examine EMSs in detail. Thus, there exists limited knowledge about how EMSs differ in practice, and whether certain EMS designs are more prevalent or more effective in their outcomes than others. Questions about how EMSs are created, and whether different types of EMSs lead to different levels of environmental performance, remain to be answered. The NDEMS pilot study seeks to address this gap.

Overall, the body of empirical literature on EMSs is still quite limited. While the studies discussed above are a valuable start, all have limitations. Many are case studies, most rely on self-reported judgments, and some of the larger surveys were performed too early to capture clear evidence of post-EMS impacts. With the exceptions of a few of the case studies, none present longitudinal data on EMS development and results over time, and many (case studies in particular) were constrained by very small samples.

The widespread introduction of formal environmental management systems into the practices of businesses that affect the environment offers a unique opportunity to observe both the processes and the environmental and economic consequences of these initiatives, and to compare similarities and differences across different firms, sectors, sizes, and other characteristics. From a public policy perspective, it offers an unusual opportunity to look at the achievement of environmental and economic objectives through the eyes of the businesses whose actions are critical to those outcomes, rather than merely through the perspective of government agencies themselves. At the same time, it should also shed light directly on environmental policy questions such as the practical issues involved in improving regulatory compliance, environmental performance, cost-effectiveness in monitoring and reporting, and other issues.

Understanding the relationship between EMS adoption and actual environmental performance is critically important to future environmental initiatives at both the federal and state level, both voluntary and mandated. What matters, moreover, is not merely the fact of EMS adoption but the likelihood that key elements of some EMSs are more likely associated with superior environmental performance than EMS adoption per se. Understanding the motivations that contribute to the facility's decisions to voluntarily reduce its environmental impacts, both regulated and non-regulated, is also critically important. If the findings turn out to show that well-designed EMSs do contribute to achieving superior environmental performance, government officials might appropriately consider policy changes both to encourage the wider introduction and certification of EMSs, and more importantly, to facilitate more effective and less costly means of achieving high environmental performance opportunities that EMSs may identify.

Chapter 3. NDEMS History and Study Design

When the National Database on Environmental Management Systems project was conceived in 1997, there had been no systematic research on the adoption of environmental management systems by facilities, nor on ISO 14001 certification; most of the literature cited in Chapter 2 did not yet exist. Such research was perceived as essential by many federal and state environmental agencies, however, both to answer the questions posed in Chapter 2, and more generally, to determine the environmental and economic results of EMS implementation on the facilities themselves, on public policy questions such as the appropriate uses of favorable government recognition and regulatory flexibility and the use of EMSs by government facilities, and on the public. In this chapter we summarize the history and research design of the NDEMS project.

HISTORY OF THE PROJECT

With the publication of the ISO 14001 standard in 1996, many environmental regulators recognized that there was an essential need for information about how ISO 14001 EMSs would affect the environmental, economic, and regulatory performance of regulated organizations. In 1996 environmental officials of nearly a dozen U.S. states and USEPA created an informal "multi-state working group on EMSs" (MSWG) to share state experiences with facilities implementing EMSs, particularly those adopting the ISO model or similar approaches. From the start, the MSWG also included representatives of environmental and business organizations and of the academic community.

Early in their discussions, state MSWG members decided that they could all learn more from a systematic comparative study of EMS adopters in all their states and elsewhere than merely from *ad hoc* individual case experiences within their own jurisdictions. They agreed therefore to cooperate in collecting and pooling longitudinal data documenting environmental, economic and regulatory performance before and after EMS implementation, as well as the EMS implementation process itself. USEPA's Office of Water offered funding to support pilot programs in ten states to collect such data, and also to fund a national database to design common protocols, assemble and analyze the data, and make the results and the data themselves – minus identifying information for individual facilities – available to the public on the Internet. The University of North Carolina at Chapel Hill agreed to host this project through a cooperative agreement with EPA, in cooperation with the Environmental Law Institute and the participating states. The database subsequently became known as the National Database on Environmental Management Systems (NDEMS).

The participating states agreed to take responsibility for recruiting facilities willing to contribute data to the project, and the NDEMS research staff – in discussion with the state pilot project managers and the MSWG – developed a common set of ground rules and protocols for data collection. Each state recruited between four and fifteen cooperating organizations. In addition to these state pilot projects, USEPA also sponsored several additional sets of ISO 14001 EMS pilot cases, including two focusing on municipalities and a third concentrating on the "Star Track" program in EPA's New England regional office, which had already begun working with facilities that were adopting EMSs. From these various sources, it was envisioned that NDEMS would ultimately comprise data for an estimated 80 to 100 comparable records of EMS implementation experiences, and perhaps ultimately more.

During the first two years of the project, the research group developed a common set of protocols for the pilot projects, as well as ground rules for treatment of confidential business information, public disclosure procedures, and other concerns. UNC and ELI identified research questions, formulated hypotheses, and designed, peer-reviewed, and pilot tested detailed data collection instruments. They also began developing the necessary coding, quality-assurance, and electronic database management procedures necessary to manage the data once they were collected. In addition, they conducted training sessions for facilities on how to complete the data collection instruments, and for state personnel on how to facilitate the data collection process. The facility and state training process took place on location in participating states and was completed in October 1998.

The NDEMS database was designed as a longitudinal study of EMS implementation in real time, using site-specific facilities as the principal unit of analysis. It consists of a three-year retrospective baseline database on pre-EMS facility characteristics and performance, an EMS design database including detailed information on the substantive characteristics and design procedures of EMSs, and two update databases documenting changes in a range of measures of performance at annual intervals subsequent to EMS implementation. Extensive quality control was performed on each set of data collected to ensure data quality and completeness, including reconfirmation of all data with the facilities themselves before final inclusion in the database. Figure III-1 illustrates the timeline for data collection in NDEMS.

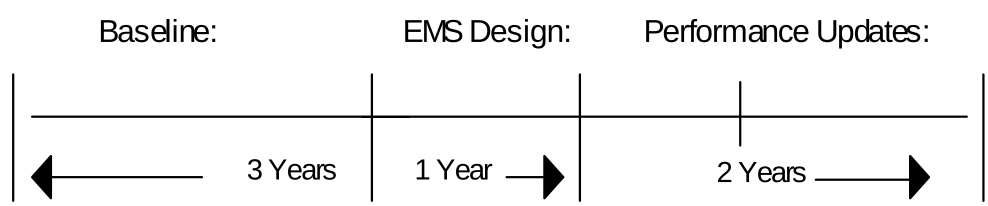

Figure III-1. Timeline for data collection in NDEMS.

The Baseline Database includes detailed, quality-checked data for 83 facilities representing approximately 20 economic sectors in seventeen states. Baseline data collection began in 1998, and after careful quality checking and assurance, initial data were released in mid-2000. EMS design data were collected beginning in late-1999, and were quality-checked and released to the public in mid-2001. The EMS Design Database includes data from 61 facilities. The first set of update data were collected beginning in late 2000, and after quality checking, data from 37 facilities are now in the First Update Database. Collection of a second round of update data began in mid-2000, and the Second Update Database contains quality-checked data from 30 facilities. Final versions of the Baseline, EMS Design, First Update, and Second Update Databases in NDEMS will be released to the public on the NDEMS web site in early-2003. The attrition of facilities from the study during the period of research is treated in more detail in Chapter 14, and can be attributed to a variety of causes including changes in resources available for participation, changes in facility ownership or management, and facility closure or other catastrophic events.

Through the cooperation of the pilot facilities, EPA, the states, and other pilot program sponsors, NDEMS and the resulting research offer an unusual opportunity to examine the implementation of EMSs in many kinds of organizations across multiple states and in different environmental conditions. The pilot projects include not only manufacturing plants but also agricultural operations, municipalities, local water authorities, military bases, and other kinds of facilities. They include both large and small operations, and a diverse range of ownership patterns: publicly traded, privately held, and government facilities.

Most important, the participating facilities agreed to provide longitudinal data – before, during, and after EMS introduction – in a standardized format, so that information contained in NDEMS is as consistent and comparable as possible both among states and facilities and over time. The importance of this consistency cannot be over-emphasized, as it allows for a level of detailed, comparative tracking of implementation and change over time that cannot be produced by other research methods, such as individual case studies or mail surveys, which constitute much of the other emerging research literature on EMSs. The NDEMS database thus provides a unique resource for both researchers and policymakers who seek to understand the changes produced by EMS adoption, and the consistency or variability of those changes across implementing organizations.

The NDEMS data and all related outputs of this research program – data collection protocols, guidance documents, research papers and publications – are available on a public web site as they are completed, so that they can also be analyzed by other researchers and interested users. As of September 2002 over 400 such users had downloaded NDEMS data. The web address is http://ndems.cas.unc.edu/, and it also provides links to related government and academic programs. NDEMS data and analyses have been used most frequently by interested businesses, but also by government agencies and researchers around the world, and also allows benchmarking and other comparisons with facilities that were not included in the NDEMS study.

During the course of the NDEMS study, several interim reports and a growing number of research reports and public presentations were released. The first project public report (March 1999) described the purpose of the study, the participating state programs, and included initial demographic information about the participating facilities from the Baseline Database. The second project public report (June 2000) provided a preliminary report on the findings from the Baseline Database, a progress report on EMS Design data collection, as well as two vignettes from case studies of individual facilities that were in progress at the time. A compendium of research findings to date was compiled and released in March 2001; included in the compendium were papers presented by research team members at several conferences that reflected the findings from the Baseline and EMS Design Databases, as well as additional case study reports on individual facilities. Several additional publications have since been completed, and others are forthcoming; a list of these is included in the Appendices to this report.

DATA COLLECTION PROTOCOLS

The fundamental questions around which the study was originally designed was, to what extent does the implementation of an ISO 14001 or other environmental management system change a facility's behavior with respect to each of six primary dimensions:

1) Environmental Performance
2) Regulatory Compliance
3) Economic Performance (costs and benefits)
4) Pollution Prevention
5) Interested Party Involvement
6) Environmental Condition Indicators

While these six dimensions lay at the heart of the research design, many more detailed subsidiary questions were also of interest. What features would ISO 14001 EMSs have, and how much variation would they exhibit in practice? How different would ISO 14001-based EMSs be from other EMSs? What personnel would be involved in designing the EMS, and what difference might this make? What environmental aspects and impacts would be included in EMSs, and how would their significance be determined? What objectives and targets would facilities set for improvement, and how aggressive would they be? And how would facilities choose to involve and communicate with the public in the EMS process?

Within each of the six primary performance dimensions listed above, the protocols were designed to elicit information answering more detailed questions as well:

1. Environmental Performance

- Does the adoption of an ISO 14001 EMS change the facility's use of environmental performance indicators (for example, does it choose to pay attention to additional unregulated environmental performance measures?)?
- Does environmental performance improve after the adoption of an ISO 14001 EMS, with respect to either regulated or unregulated aspects?

2. Regulatory Compliance

- Does the facility's regulatory compliance record change as a result of the adoption of an EMS?
- Does the number and nature of "near-misses"—that is, instances where a facility was nearly out of compliance but discovered the event and rectified it before a non-compliance occurred—change as a result of the adoption of an EMS?
- Does the number of non-compliance events not reported to regulators—that is, instances where a facility was out of compliance but discovered the event and rectified it without informing regulators—change as a result of the adoption of an EMS?

- Does the adoption of an EMS allow facilities to remove regulatory burdens by moving down in "regulatory status"—for example, by moving from a large quantity generator to a small quantity generator or non-generator of hazardous wastes?

3. Economic Performance (Costs and Benefits)

- Does the adoption of an EMS change the firm's use of economic performance indicators (for example, by identifying environment-related costs and benefits more explicitly for management attention)?
- To what extent does the adoption of an EMS change a facility's use of advanced environmental and materials accounting techniques?
- What economic costs and benefits—both direct and indirect—does a facility accrue as a result of EMS adoption?
- Given the costs of EMS design, implementation and certification themselves, is the payoff of EMS adoption positive or negative?

4. Pollution Prevention

- How does the adoption of an EMS change a facility's use of pollution prevention techniques?
- Do significant changes in environmental performance after EMS adoption result from greater use of pollution prevention practices?

5. Interested Party Involvement

- How does the involvement of outside parties, such as environmental NGOs and the general public, change as a result of the adoption of an EMS?
- What benefits does this involvement provide (e.g. ideas not otherwise considered, more positive community and customer relations, greater legitimacy for outcomes)?
- What effects does this involvement have on the decisions made by facilities?

6. Environmental Condition Indicators

- How are indicators of local, regional, and global environmental conditions incorporated into the design of a facility's EMS?
- How does the use of environmental condition indicators change as a result of the adoption of an EMS?

7. Relations and Correlations

As the data were collected, relations between the categories were also to be explored. For example:

- Are the outcomes of the significance determination and objectives and targets different depending on whether interested parties were involved during a facility's EMS design process?
- Do facilities with EMSs certified by independent registrars show greater environmental performance improvements than those with uncertified EMSs?

- Is there a relationship between a facility's compliance history and the type of EMS it designs?
- Does state agency involvement change the nature of the EMS a facility designs? Specifically, are significant aspects and impacts different? Are objectives and targets different?
- Does public involvement change the nature of the EMS a facility designs?
- Does it matter what kinds of personnel had responsibility for EMS design? For example, how does the involvement of the environment, health and safety manager, plant manager, or corporate mandates affect the design and performance of the EMS?
- Does the nature and performance of a facility's EMS differ depending on whether the facility employs environmental consultants in their EMS design process?

The answers to all these questions are important to federal and state policymakers, as well as to the public and to businesses themselves, as they seek to verify what contributions EMSs do in fact make (and under what circumstances) to environmental performance and other outcomes.

RESEARCH DESIGN

To answer the questions posed above, the research team created and field-tested a series of detailed data collection protocols for use by each pilot facility, to ensure that data were collected in as comparable a manner as possible. State and USEPA agency personnel participating in the pilot project also were trained in the protocols' content and use.

Data collection

Because the main purpose of the research was to determine how the adoption of an EMS might change a facility's performance, data were collected on each pilot facility at each of several points in time—baseline, EMS introduction, and subsequent performance monitoring—as they moved through the EMS introduction and implementation process. Since the facilities in the sample had different adoption dates for their EMSs and moved through the process at different rates of speed, these timelines were not identical for each facility.

During the baseline stage, data were collected on basic facility demographics and other characteristics, and on environmental, regulatory, and economic performance over the three years prior to EMS introduction. The protocols requested historical information on any pre-existing elements of EMSs, and on the facility's environmental performance, compliance, pollution prevention, and economic performance during this pre-EMS period. Facilities were asked to answer each question based on documentable environmental data that were maintained in their environmental records, in the hope that by referring to environmental records, recall errors would be minimized. Because this research was in important respects exploratory, many open-ended questions also were used to capture a broad range of facility perspectives and issues as seen through their own eyes rather than merely through predetermined categories fixed by the researchers.

Baseline data on historical performance were seen as particularly crucial to this type of research, in that without them one would risk misinterpreting both the magnitude and the validity of changes attributable to introduction of an EMS. Most facilities that chose to adopt formal EMSs, especially those willing to serve as pilot facilities in a very public data collection process, might already be leaders in pollution prevention and environmental compliance, and be using the EMS simply to document and institutionalize those changes. In fact, some participating states barred the participation of facilities that had a history of significant compliance problems, with the result that some facilities that might otherwise show more dramatic changes due to EMS introduction were not included in the study. Given these issues, careful baseline data collection over several prior years was essential to avoid grossly under- or over-estimating the potential benefits of an EMS to a broader cross-section of organizations.

The second stage of data collection was the EMS design process. The instruments designed for use in this stage collected information on each facility's EMS itself, and on the process and choices involved in its introduction. This protocol was designed to capture information on how each facility designed and implemented its EMS, what its actual content was (for instance activities, aspects, impacts, significance determinations, objectives, and targets), who participated in its design and development, and the costs and benefits of introducing (and where relevant, certifying) its EMS. To augment our understanding of the data, research staff also conducted on-site case studies at six participating facilities, meeting with the staff who had designed and participated in the EMS process and touring the facilities themselves.

Finally, the third-stage protocols requested two rounds of update data at one-year intervals after EMS introduction. These included data on environmental, regulatory, and economic performance after introduction of the EMS, comparable to those collected for the three-year pre-EMS baseline period, as well as any information on further completion or revisions to the EMS itself.

Sample Constraints and Comparison Groups

One of the major research design challenges to this project was the expected "upward bias" in the sample of facilities participating. First, all pilot facilities necessarily were volunteers, and therefore limited to those willing to open their environmental records and decision processes to the researchers and to state or federal pilot program managers. These might likely be facilities that already had strong pride and confidence in their performance and active and positive relationships with government agencies already. Second, UNC and ELI had no control over how the participating states and EPA recruited and selected pilot facilities from the pool of volunteers. Most of the states advertised the project in state business journals and environmental agency newsletters, and interested facilities contacted state personnel to express interest in participating. Some states then selected all interested facilities to be part of the pilot program, whereas others excluded applicants that had poor compliance records.

To encourage facility participation, some states also offered varied incentives, which might affect state and facility comparability. Many states pledged to provide favorable publicity, and some states offered grant money or free technical assistance by state personnel to participating firms. A few also offered participating facilities the possibility of regulatory flexibility as an incentive for their participation. For example, one state offered grants to offset the financial burdens of pilot project participation. Another state offered its facilities an "enforcement waiver policy" stating that if violations were discovered during the course of a facility's pilot project participation, they would be forgiven so long as they were not criminal and did not pose imminent public danger. A third state offered cost savings for consolidated reporting requirements and electronic reporting options. In contrast, other states offered no subsidies or regulatory flexibility in any form.

Finally, some of the sponsoring states and EPA offices were themselves active participants in pilot facilities' EMS design processes. Almost all the states provided EMS design and implementation training to participating facilities in some form. Some pilot-program managers held periodic meetings with all project facilities as well, so that facility representatives could learn about each other's EMS implementation successes and failures. Most states also assigned key state environmental agency personnel – typically from their pollution-prevention staff – to work closely with each facility during its EMS design process. The result of these influences may well be some homogenization of the EMSs produced by pilot-program facilities owing to the common influences of state pilot-program participation requirements and state technical-assistance intervention.

To address this concern, the research team sought to recruit a paired sample of "control" facilities to the database as well. One type of control group would include facilities that implemented ISO 14001-based EMSs but did not receive state assistance, to obtain an indication of the effects of state intervention on facilities' EMS design and implementation. The second control group was envisioned to include facilities that had implemented EMSs but were not following the ISO 14001 standard, to allow comparisons between the ISO model and other types of EMSs. Finally, a third type of control envisaged was a group of facilities of similar sizes and sectors to the pilots but which had not implemented any form of an EMS, to permit comparisons between EMS and non-EMS performance.

Such "controls" were not a perfect solution to the problem, since even "control" facilities must be willing at least to cooperate with the researchers and to share comparable data. We expected therefore that a self-selection process would occur in control group recruitment as well, since facilities with relatively superior environmental performance would more likely see value in allowing us to study their environmental performance and in benchmarking themselves against others. In practice, however, it proved impossible to recruit more than a small handful of such facilities, and not enough to present statistical comparisons between these and the other facilities in the database. In the end, only four control facilities completed the first set of protocols, providing data representative of their baseline periods, and these data are included in the NDEMS Baseline Database.

Despite this limitation and possible biases in the sample, the facilities in the NDEMS database provide a rich range of similarities and differences for consideration both by policymakers, other researchers, and interested public readers, and by other businesses considering EMS adoption. They have provided a level of detail and records of longitudinal changes in environmental management practices that is virtually unique in the literature of this subject, and we acknowledge with deep appreciation their generosity with both their time and their experience and information.

PILOT PROGRAM SUMMARIES

Many factors may affect a facility's EMS implementation and subsequent performance. The most obvious influence is a facility's internal structure and management. Outside factors, however, may also be important, and state and other government involvement may specifically play important roles. It is therefore important to report how each of the ten participating states and USEPA structured their pilot programs, the types of incentives the states offered to their pilot facilities, and the level of assistance the states provided once facilities committed to the program. These factors are described below.

State Projects

Arizona

The Arizona Department of Environmental Quality (DEQ) recruited three facilities, and a fourth Arizona facility participated as part of USEPA's Municipality Project. DEQ began recruiting its pilot facilities by placing advertisements about the program in a state business journal and DEQ newsletters that were sent to over 4,000 subscribers. Also, DEQ staff made speeches about the project at various association meetings. Seven interested facilities contacted DEQ to express interest, and a selection committee was convened to review the potential candidates. The committee consisted of both DEQ officials and staff from the Attorney General's office, as well as local air quality personnel. The committee excluded three of the seven candidates from the pilot project due to compliance problems. Three of the remaining facilities committed to participation and signed a memorandum of understanding (MOU) with all of Arizona's regulatory agencies.

As an incentive for facility participation, Arizona offered its pilot facilities enhanced publicity through DEQ press releases and announcements, as well as regulatory flexibility in the form of an "enforcement waiver" policy. This policy stated that if a violation were discovered during the facility's pilot project participation, penalties would be waived so long as it was not criminal and did not pose imminent danger, and so long as the facility took immediate steps to disclose, correct, and remedy the non-compliance. An additional incentive for facilities to participate in Arizona's pilot program was that DEQ offered pilot facilities first opportunity for any future regulatory flexibility opportunities that the state might offer.

ADEQ took a hands-off approach to managing its pilot project facilities' EMS development compared to other participating states. DEQ did not require an ISO-based EMS, although all the participating facilities chose to implement an ISO (or ISO-based) EMS. In addition, facilities designed and implemented their own EMSs with only limited state-sponsored assistance. DEQ offered one formal EMS design training for its participating facilities and held periodic group meetings to help pilot facilities complete the data collection surveys. During the meetings, the state assisted the facilities in designing their EMSs, if needed. DEQ encouraged its facilities to hire their own EMS consultants if additional assistance was required. Because Arizona's pilot program was relatively small (three facilities), the program director was able to provide individual facility technical assistance. While DEQ encouraged involvement of interested parties from outside the facility during the EMS development and implementation process, it did not require it.

Arizona withdrew from the pilot program in 1999 due to changes in funding priorities. Baseline and EMS Design data for two Arizona facilities are included in NDEMS and in this report, but none of the Arizona facilities continued with the project through the Update stage.

California

The objectives of the Cal/EPA pilot project (as specified by state law) were to evaluate whether and how the use of an environmental management system (EMS) by a regulated entity increases public health and environmental protection over the present regulatory system, and whether and how the use of an EMS provides the public greater information on the nature and extent of public health and environmental effects than information provided by the present regulatory system.

Interested-party involvement was an important component of California's pilot project and was anticipated in all its pilot projects. Meetings with stakeholders began in 1998 and sought to define how best to involve interested individuals, communities, organizations, academics, business and government. Based on stakeholder recommendations, two Working Groups, one in Northern California and one in Southern California, were established in 1999. Also, Local Working Groups for individual pilot projects were encouraged. Several workshops were conducted to involve stakeholders directly in the development of pilot project selection criteria, pilot project work plans, and data collection protocols. In addition to the stakeholder workshops, Cal/EPA issued a public notice, opened a 30-day comment period and held two public hearings in May 2000, one in Southern California and one in Northern California. Prior to selecting the pilot projects, state, regional and local environmental enforcement agencies also were contacted to ascertain the compliance histories of the project candidates.

The California Environmental Protection Agency (Cal/EPA) initially recruited seven facilities to participate in its EMS pilot project, and eventually added three more. State personnel spoke at several industry conferences about the program and facilities' potential participation, and published a white paper that was widely circulated for industry and interested party comment. After interested facilities contacted the state, staff members held individual meetings with facility representatives to further discuss the program's intent and requirements. Cal/EPA and USEPA also conducted a joint project with the Metal Finishers Association of Southern California to implement EMSs at two metal finishers, using an EMS template developed by USEPA for use by small- and medium-sized enterprises.

Cal/EPA provided its pilots with enhanced publicity through Cal/EPA press releases and public announcements. It also worked with its pilot projects to develop regulatory efficiencies in monitoring and reporting, audits and inspections, permits, and application of the self-disclosure policy. Several facilities sought regulatory efficiencies in the form of consolidated reporting and consultative inspections. While Cal/EPA did not offer grant money to all of its facilities, it made grant money available to one pilot facility for EMS training.

A team of state advisors assisted participating facilities both in the EMS development process and in completing the data collection protocols. The advisors represented the offices of water, air, solid waste, and toxics. Staffing consisted of several Cal/EPA project managers who were "teamed" with one or two facilities each to provide individual assistance. While Cal/EPA did not sponsor EMS design training, its own trained project managers assisted their pilot facilities in designing their EMSs on an individual basis. Because of the specific information requirements of its state legislation, Cal/EPA also created supplemental data protocols to be used only in the California pilot projects. A primary purpose of the California Protocols was to answer whether and how an EMS provides greater environmental information to the public than that provided by the current regulatory system. The California Protocols also sought information on whether and how pilot EMSs met or exceeded environmental regulatory requirements.

Illinois

The Illinois Environmental Protection Agency (IEPA) invited representatives of 50 facilities to a meeting at which IEPA representatives described the ISO 14001 EMS pilot project. Five of the facilities present at this meeting decided to participate, and five additional facilities were recruited through individual IEPA–facility contacts. The Illinois EPA was interested in recruiting exemplary facilities to its pilot, so a minimum standard of compliance with existing environmental regulations was required of all participating facilities. Illinois ultimately recruited thirteen facilities to participate in the pilot program.

A number of benefits were offered to Illinois facilities as incentives to participate. One benefit was enhanced publicity, including a kick-off press conference to recognize participating facilities and periodic press releases describing pilot facility activities. Another was IEPA technical assistance in the areas of stakeholder involvement and risk communication, as well as individual assistance from IEPA staff in pollution prevention and in completing the research protocols. A trained staff member was assigned to work with each pilot facility in completing the research protocols.

Pilot facilities were also provided opportunities to attend presentations on specific aspects of EMS design and to meet regularly to share ideas. Finally, pilot facilities were offered the potential for regulatory flexibility through IEPA's Regulatory Innovation Pilot Program (RIPP), in which companies entered into 5-year Environmental Management System Agreements (EMSAs) with IEPA. EMSAs provided facilities with opportunities for self-permitting or self-reporting through the use of their EMSs in lieu of certain specific Illinois requirements.

Indiana

Indiana Department of the Environment (IDEM) participated in the NDEMS program to try to determine whether EMS implementation would lead to increased pollution prevention, compliance, and communication between facilities and stakeholders. IDEM recruited three facilities, initially by sending a postcard that described the project to approximately 10,000 businesses; approximately 250 facilities subsequently expressed interest, 18 completed applications (and several others completed applications at a later time). Since IDEM chose to focus its pilot program on the manufacturing industry and public utilities, all non-manufacturing facilities were excluded. Of the remaining candidates, IDEM did compliance checks and excluded any with major violations on their past environmental records.

IDEM required that facilities implement an ISO 14001-based EMS in order to participate; because of this requirement, several of the Indiana pilot facilities intended to seek ISO 14001 certification. Interested party participation was also a requirement for Indiana pilot facilities, as an element of their grant agreement with IDEM. Specifically, IDEM directed that each participating facility must convene a stakeholder work group including representation of specific categories of interested parties (such as academia, environmental groups, other businesses, and local government).

As an incentive for facilities to participate, grants of $8,000 were given to each participating facility based on facility progress. Like most other states, Indiana also offered pilot facilities enhanced publicity through IDEM press releases and public announcements. In addition, pilot facilities were offered recognition via the Governor's annual pollution prevention awards if a facility implemented pollution prevention as part of its EMS. Unlike some other states, Indiana did not offer any specific form of regulatory flexibility to its pilot facilities. However, IDEM stated that flexibility might be possible in the future, and subsequently worked with the U.S. EPA to develop the National Performance Track Program.

IDEM did not assign a "point person" for each of its participating facilities, but individual assistance was provided if requested. IDEM also held quarterly meetings to discuss EMS design and program experiences.

New Hampshire

In New Hampshire a decision was made to focus on ISO 14001 EMS development with tenants of a single industrial park in the seacoast region. All tenants were invited to participate, and five chose to do so; in a second round of recruitment, the invitation was broadened to cover the entire New Hampshire seacoast area, and three new participants joined the pilot program at that point. Four of the eight facilities eventually dropped out, leaving four completing the data protocols. In New Hampshire, maintenance of a minimum level of compliance with environmental laws and regulations was required of participating facilities, although past compliance difficulties did not necessarily prevent participation.

A number of benefits were offered to participants as incentives to participate. The most significant benefit was the opportunity to attend state-sponsored EMS design training provided by an experienced ISO 14001 consultant. In addition, facilities could receive one-on-one technical assistance from New Hampshire Department of Environmental Services (DES) staff on issues such as pollution prevention, stakeholder involvement and EMS design, as well as in completing the data collection protocols. As a further benefit, ISO EMS awareness-level training was provided both to state staff and to potential stakeholders. Finally, participants received enhanced publicity through press releases and recognition events.

North Carolina

North Carolina initially recruited firms that had existing relationships with state Department of Environment and Natural Resources (DENR) staff, through programs such as the Governor's Award for Environmental Excellence. Six firms initially agreed to participate; one subsequently dropped out when a corporate decision was made to close the plant, leaving five. Two others dropped out due to fiscal constraints in the midst of completing the EMS Design Protocol. In later rounds of recruiting, three additional facilities, including two publicly owned treatment works, were added. A minimum level of compliance with existing environmental laws and regulations was expected of participating firms.

Benefits offered to participating facilities included enhanced publicity, and trained DENR staff provided assistance in completing the research protocols as well as in EMS design and pollution prevention. . In one case a DENR staff person took up residence within a pilot facility and proved instrumental in developing its EMS. Finally, regular meetings of pilot participants were held to share experiences with ISO 14001 EMS development. Technical presentations by outside experts were often provided at these meetings.

Oregon

Oregon Department of Environmental Quality (DEQ) recruited facilities using public meetings, mailings, and informational advertisements. Fifteen facilities expressed potential interest, though six subsequently declined to proceed further; of the remaining nine DEQ selected four, of which three completed the project (the fourth later ceased operations). DEQ's selection criteria included the presence of a mature EMS, satisfactory compliance history, cooperative working relationship with DEQ staff, willingness to share their EMS performance data with the public, and good potential for program success. Each of Oregon's EMS pilot project facilities also was a participant in the state's Environmental Management Systems Incentives Project (EMSIP). Oregon's pilot program did not require ISO 14001 certification, but did require that facilities seeking higher-tier EMSIP recognition use ISO principles as a foundation for their EMS development.

Incentives for participation included enhanced publicity and gubernatorial recognition for facility achievements. Participating facilities also were offered regulatory incentives or benefits commensurate with the level of their achievement: DEQ's Green Permits legislation authorized the state to waive state regulations, and to seek waivers of federal regulations, for facilities that achieved environmental results superior to those otherwise required by law.

Stakeholder involvement and dialogue regarding the facility's environmental performance were also key ingredients in Oregon's Green Permits program, which included all these facilities. DEQ staff were trained in organizing stakeholder involvement, and also in ISO 14001 lead auditor training. Oregon's pilot facilities also participated in a formal DEQ advisory committee, and met periodically to share their EMS design and implementation experiences, and learn about other EMS design experiences.

Pennsylvania

The Pennsylvania Department of Environmental Protection (DEP) identified potential pilot facilities through various DEP programs, including regional pollution prevention roundtables and the Governor's Awards for Environmental Excellence, and invited 46 facility EHS managers to an initial recruitment meeting. Compliance with existing environmental laws and regulations was not explicitly required, but all those who have agreed to participate are known to be good corporate citizens. Benefits offered included enhanced publicity, individual technical assistance by ISO-trained state staff, and opportunities to attend presentations, training sessions, and joint meetings to share progress and ideas. Three facilities agreed to participate, and two Pennsylvania facilities submitted completed Baseline data. However, these two facilities did not continue on in the NDEMS study beyond the Baseline phase of data collection.

Vermont

Vermont recruited facilities through a mass mailing to regulated facilities across the state offering free EMS design training. The state did not require a minimum level of regulatory compliance as a prerequisite to participation, nor did it require them to implement an ISO 14001-based EMS.

The most significant benefit offered to participants was the opportunity to attend state-sponsored EMS design training, by an experienced ISO 14001 consultant-trainer and specifically designed to assist small and medium-sized facilities. Facilities met regularly with the trainer as they learned about and engaged in the step-by-step process of designing and implementing an ISO 14001 EMS. These meetings also provided pilot facilities with the opportunity to meet regularly together to share ideas and experiences. Pilot facilities also were offered on-site technical assistance technical assistance by Vermont Agency of Natural Resources staff on EMS design and pollution prevention. As an added incentive, Vermont offered a waiver of the state's requirement to develop a three-year, facility-level pollution prevention plan if pollution prevention was addressed in a participating facility's EMS.

Twelve facilities expressed interest, but many facilities in the original pilot group did not follow through and develop an EMS. It appears that for some, the benefits of an EMS did not outweigh the costs involved. Nine Vermont facilities ultimately participated in NDEMS, but only four completed the EMS Design data collection process, and only three completed the First Update.

Wisconsin

Wisconsin's Department of Natural Resources (DNR) facilities included two subgroups, ISO pilot facilities per se and cooperative agreements. Both the ISO Pilot Program and the Cooperative Agreement Program required that participating facilities implement an ISO 14001 or equivalent EMS that was certified by a third party auditor, and both also required facilities to gather data on their EMS design and implementation. The DNR's primary motivations for implementing both programs were to test new strategies for determining companies' environmental performance and to develop innovative ways of improving the effectiveness and efficiency of regulatory strategies.

DNR's recruitment process included personal invitations from the Governor and DNR Secretary to some 400 major air sources and other regulated businesses as well as more widespread publicity. Forty-nine facilities requested additional information, in-person meetings were held at eleven companies, and ultimately five ISO pilot and three cooperative-agreement facilities participated in NDEMS data collection.

ISO pilot facilities received no regulatory incentives for participation, but Cooperative Agreement facilities received discretion in regulatory innovation and enforcement for "detect and correct" violations. In return, DNR required that participating Cooperative Agreement facilities involve stakeholders in their EMS design and implementation, and that participating facilities demonstrate "superior environmental performance" beyond levels required for regulatory compliance. Finally, the Cooperative Agreement Program required that each participating facility sign an enforceable agreement; ISO Pilot facilities were not required to do so. The Department of Commerce provided an additional incentive for facility participation, offering customized training grants of up to $5,000 towards each pilot facility's ISO EMS design and implementation; recipients must become ISO 14001 certified. In addition to regulatory flexibility, DNR provided enhanced publicity, as well as DNR staff assistance (if needed) in organizing stakeholder involvement.

U.S. EPA's National Municipalities EMS Initiative

U.S. EPA's Office of Wastewater Management and Compliance funded and managed an additional pilot program focusing solely on municipalities. Nine public-sector organizations from seven states participated in the first round of this project, and eleven in eight states during subsequent rounds. Several municipalities chose to develop EMSs for their wastewater treatment facilities; others included a corrections facility, an electricity generating facility, and a waste management facility. Each adopted an EMS based on ISO 14001.

The municipal EMS pilot program was administered for EPA by the Global Environment and Technology Foundation (GETF). Municipalities were recruited through existing contacts as well as through an announcement on GETF's earlier *globeNet* internet site (now the Peer Center, http://www.peercenter.net/). Participating municipalities were promised extensive training and public recognition, but were not provided any additional financial incentives. Applicants were screened through an interview process that included both the municipality's environmental management staff and its political leadership, since a pledge for commitment of resources for two years was required. Applicants were not screened for compliance history. Participating facilities were provided with extensive technical information on ISO 14001, as well an intensive initial three-day training session and follow-up training and discussion meetings every six months. The municipalities were also able to communicate with each other through an "intranet" set up by GETF.

USEPA and GETF encouraged municipalities to involve external interested parties in the EMS design and implementation process, but did not require it and did not directly support interested party involvement.

U.S. EPA Region 1's "Star Track" Initiative

U.S. EPA's Region 1 funded and managed an additional pilot program that provided data to NDEMS. The Star Track Certified Environmental Performance program promoted better environmental performance through environmental management systems and third-party certification. Star Track was a voluntary program that required a comprehensive compliance audit, an environmental-management systems audit, an independent, third-party review of audits, and an environmental performance report. With the advent of the National Environmental Performance Track program, EPA New England's Star Track program was retired. The annual Environmental Performance Reports (EPRs) produced by the eleven former Star Track facilities can be found in an archive maintained by EPA Region 1 at the following web address: http://www.epa.gov/region1/steward/strack/epr.html. Four Star Track facilities provided complete Baseline data to NDEMS, and three provided complete EMS Design data.

LIMITATIONS

The NDEMS database has valuable potential for investigating many sorts of questions concerning EMS implementation. Its limitations, however, should also be noted.

First, the database consists of a heterogeneous group of 83 facilities, enough to document many important similarities and differences but not enough to produce statistically conclusive generalizations about entire industrial sectors or about the performance of all EMS adopters. For many of the analyses, the number of facilities for which data are available is less than 83, since not all facilities responded to all the data requests. The facilities are also volunteers, which almost certainly implies some bias in the sample toward favorable performance. That is, these facilities are proud enough of what they are doing that they are willing to share their data with us, and to cooperate with their state environmental agencies.[19] On many questions the data report the perceptions and assertions of individuals in each facility, albeit individuals responsible for the EMS implementation process and carefully quality-checked with them, not all of which can be independently verified with documentary evidence.

Second, in this type of study the research process itself may influence EMS implementation in directions other than those the facility would have pursued on its own. For instance, state technical assistance to pilot facilities could have influenced them to focus more on compliance and pollution prevention than on unregulated aspects such as energy or water conservation, product stewardship, or others – or even to have prepared a more detailed EMS than they would otherwise have produced. Even the mere completion of the NDEMS research protocols may have influenced facilities to pay more attention to considerations on which they provided answers than they would have had they not been participating in the pilot study – an example of the so-called "spotlight effect," similar to the effects of more intensive compliance monitoring and of leading questions in other research areas.

Third, the facilities may not all have provided complete information. Participating facilities have been extremely generous about sharing data with this project, but in at least a few known instances they have found it necessary to withhold specific data elements to protect confidential business information, and there may be additional unknown instances as well.

Fourth, facility-level data on U.S. implementation practices do not by themselves answer all important questions about the value and effectiveness of EMSs. Some important EMS-related decisions and practices may require investigation at the firm or corporate level, and international comparisons are necessary to determine whether similar or different motivations and practices occur in facilities located in countries other than the United States. Examples include the possibility that European facilities registering EMSs to the EMAS standard may show stronger performance than firms registering only to the ISO 14001 standard, or that Asian businesses may be motivated more strongly than U.S. facilities to use ISO registration as a factor in competition for U.S., European and Japanese business customers.

More generally, Coglianese and Nash (2001:223-24) have argued that companies respond differently to environmental pressures:

[19] Whether they were proud of it because it resulted from EMS adoption or simply because it represented high environmental performance due to management leadership more generally is also an important distinction to consider. In fact, some participating states barred the participation of facilities that had a history of significant compliance problems, with the result that some facilities that might otherwise show more dramatic changes due to EMS introduction are not included.

> In many firms, the natural environment is still only a peripheral factor in business decisions. It is rarely discussed except in the context of regulatory compliance. The environmental manager's primary function is "chief compliance officer" who makes sure permits are up-to-date and control equipment is operated as specified so business managers will not have to concern themselves with the environment at all. But for other firms, … the environment has assumed an altogether different importance. Environmental performance is viewed as a business need. Managers are attuned to various external and internal actors who value environmental performance. EMSs are a part of many such companies' environmental programs. (pp. 223-24).

Because of this diversity of responses, they argue, results for firms that volunteer for government environmental initiatives involving EMSs may not be strong predictors of environmental performance improvement among a wider range of facilities:

> Firms that volunteer … do so because of some preexisting commitment to improving their environmental performance and thus are less likely to implement these systems merely in token ways. (p. 18).

This is an important concern. There are however at least three responses to it. First, it is not necessarily true that volunteer facilities all have a pre-existing commitment to environmental performance improvement. Some may simply assume that they can reap inexpensive public-relations benefits from such initiatives. Not all the initial participants in the present study, for instance, completed the process, and this attrition may itself be an indicator of the range of variation among facilities.

Second, some facilities that decline to participate may also have highly effective systems in place, but choose not to participate either because their production processes involve highly competitive proprietary information, or because their priorities center more on production and operating efficiency and innovation per se than on any inducements state initiatives could provide.[20] It is not clear therefore that the self-selection process works only to select high-commitment facilities and to exclude low-commitment ones.

Finally, even if participation in such initiatives does involve some degree of self-selection for more cooperative and environmentally committed facilities, one can nonetheless gain important insights from them into both the achievements and the variability of their processes and outcomes. Their achievements may provide empirical evidence of what the implementation of an EMS can accomplish. Conversely, if even facilities such as these show only modest results, or considerable variation among them, one probably should not expect greater uniformity or superiority of performance among the larger universe of facilities.

Moreover, with the help of such volunteer facilities, one can in fact develop a far deeper appreciation of the details and differences in practice that need to be better understood in order to reach wise judgments about the uses of EMSs, and about the uses of public policies to

[20] Several facilities with strong environmental performance reputations declined to participate in the NDEMS study and in related state agency initiatives for just these reasons, and the point has also been made about government environmental incentive programs more generally by speakers for several other well-regarded firms. See e.g. Fines (2001).

encourage them. This is a particularly appropriate and timely purpose for a longitudinal pilot study such as the present one, over a five-year period in the early phase of ISO 14001 dissemination.

SUMMARY

The NDEMS project began with an ambitious research agenda and enthusiastic financial and in-kind support from federal and state programs. Over time, the research questions and protocols were refined, and four separate databases were developed to contain Baseline, EMS Design, and First and Second Update data. The scope of the study was also refined, emphasizing more thorough investigation of a smaller number of facilities that participated in the state and federal pilot EMS programs, and focusing also on a smaller number of the highest-priority research questions. The original longitudinal design was preserved, permitting researchers to investigate changes over time in environmental performance and compliance with implementation of an EMS. Four facilities not participating in one of the state or federal programs also participated in the NDEMS Baseline data collection and provided complete Baseline data. In collaboration with GETF, available Baseline and EMS Design data for Peer Center municipalities were incorporated into the NDEMS database as well.

Chapter 4. Facility Demographics And Baseline Performance

The NDEMS database includes a diverse cross-section of industrial sectors. Eighty-three (83) facilities completed the NDEMS baseline data protocol, and the demographic information collected included the primary function of the facility, its size, its ownership, its relationship to larger organizations, whether it produced or marketed products internationally, and the character of the community that surrounded it.[21] Data were then collected on the facilities' regulatory requirements, on their environmental and economic performance over the preceding three years (as measured by facility performance indicators), and on their regulatory compliance histories. In addition, facilities were asked to report on their prior management practices – both general and environmental – and on their inclusion of outside parties in environmental management decisions.

This information provides important descriptive information on the characteristics of the facilities examined in this study. In some cases it also reveals findings that are significant and useful in their own right, such as the association between the use of formal pollution-prevention plans and many other indicators of good environmental management practices.

BASELINE DEMOGRAPHICS

Primary Business

The NDEMS pilot facilities represent approximately 20 industrial and functional sectors. The majority (53 facilities, or 64%) cited some form of manufacturing as their primary business function. Of the rest, 25 percent (21 facilities) were local, state, or federal government facilities, and eleven percent (nine facilities) represented non-manufacturing sectors. Several classified their primary business as "other," but provided descriptive information indicating that their business function in fact fell within one of these categories.

The industries contributing the largest number of facilities to the NDEMS database were the electric, gas, and sanitary services industry (eleven facilities) and the machinery and computer equipment industry (nine facilities). Table IV-1 reports the overall distribution of primary business functions.

[21] Eight additional facilities provided baseline data to NDEMS. These particular records, however, were mostly incomplete and have not been included in this chapter.

TABLE IV-1: PRIMARY BUSINESS FUNCTION

(Total of 83 facilities)

Primary Business	Number of Facilities	Percent of Facilities
Electric, Gas, And Sanitary Services	11	13%
Industrial And Commercial Machinery And Computer Equipment	9	11%
Chemicals And Allied Products	8	10%
Electronic And Electrical Equipment And Components	8	10%
Fabricated Metal Products	7	8%
Primary Metal Industries	5	6%
Other Manufacturing	18	21%
National, State and Local Facilities	17	21%

Facility Size and Structure

Fifty-one percent of the participating facilities were medium to large sized enterprises (>300 employees), while 30 percent employed less than 100 employees. Table IV-2 presents statistics on facility sizes.

TABLE IV-2: FACILITY SIZE

(Total of 83 facilities)

Number of Employees	Number of Facilities	Percent of Facilities
< 20	3	3%
20 – 49	8	10%
50 – 99	14	17%
100 – 299	16	19%
300 – 999	28	34%
> 1000	14	17%

Facilities also were asked to describe their organizational structure, specifically whether they were publicly or privately held and whether they were part of a larger organization. Thirty-four percent of the facilities (or their parent organizations), were privately held; 40 percent were publicly traded, and 26 percent were local, state, or federal government facilities. A large majority, 71 percent, reported that they were part of a larger business or government organization. Table IV-3 presents data on facility ownership, and Table IV-4 shows the distribution between independent facilities and those that were part of a larger organization. Publicly traded and government facilities were more likely to be affiliated with larger organizations ($p \leq 0.01$) than were privately held facilities.

In later chapters, we compare differences in EMS design and development efforts among other variables, between independent facilities and those that were part of a larger organization. For example, facilities that are part of a larger organization may have different motivations for adopting an ISO-model EMS than independent facilities, and they may face distinctive issues associated with being part of a large organization, such as centrally determined priority-setting, cost-accounting, or decision authority. On the other hand, independent facilities may have fewer resources to draw upon when building and implementing their EMSs than facilities that can draw on larger organizations.

TABLE IV-3: FACILITY OWNERSHIP

(Total of 83 facilities)

Facility Structure	Number of Facilities	Percent of Facilities
Privately Held	28	34%
Publicly Traded	33	40%
State/Local/Federal Government	22	26%

TABLE IV-4: FACILITY STRUCTURE

(Total of 83 facilities)

Facility Structure	Number of Facilities	Percent of Facilities
Part of Larger Organization	59	71%
Independent Facility	24	29%

Foreign Production and Marketing

A sizable number of these facilities or their parent organizations conduct business internationally. The affiliate parent organizations of 34 facilities (41 percent) made products in countries other than the United States, and six engaged in production on a worldwide basis. Twenty-four carried out production at other sites in North America (including Canada, Mexico, or both); 23 made their products in Europe; 18 in Asia; and 19 in South America. Eleven facilities listed Australia and ten listed African states as countries in which affiliate or parent firms engaged in production.

Many facilities (or their parent organizations) also marketed their products abroad. Sixty-four percent (64%) marketed their products outside of the United States, and 43 percent marketed their products worldwide. By regions, 45 organizations marketed products in Europe; 41 in Asia; 40 in North America; 34 in South America; 26 in Africa; and 25 in Australia.

In later chapters, we explore whether foreign production or foreign marketing influence facilities' motivations for adopting ISO 14001. This question is particularly relevant because many more facilities in Asia and Europe have achieved ISO 14001 certification than in the United States, and it is possible that facilities' international business relationships motivate them to seek certification.

Facility Location

Most participating facilities were located in small to medium-size cities. Only 14 percent reported that they were located in cities with populations of 500,000 or more; 18 percent were located in small towns of less than 5,000. Table IV-5 summarizes the population of communities surrounding the facility.

TABLE IV-5: POPULATION OF SURROUNDING COMMUNITY

(Total of 83 facilities)

Population	Number of Facilities	Percent of Facilities
< 100	4	5%
100 – 4,999	11	13%
5000 – 19,999	14	17%
20, 000 – 49,999	17	21%
50,000 – 199,999	22	27%
200,000 – 499,999	4	5%
500,000 – 1,999,999	8	10%
> 2,000,000	2	2%
No data provided	1	1%

The NDEMS Baseline Protocol asked facilities to characterize the community in which they were located. The largest proportion of facilities (47 percent) characterized their neighborhoods as commercial or industrial areas. Approximately 35 percent of the facilities were located in areas that could best be described as mixed use or residential. The remaining 18 percent characterized their location as rural.

Existing Management Systems

Facilities were asked to report on both general and environmental management-systems experience during the three-year baseline period. Facilities were also asked to indicate which features of an ISO 14001 EMS were already in use at their site during this period.

Non-environmental Management Programs

Of the 83 pilot facilities that completed the baseline protocol, 73 percent had some type of non-environmental management system in place prior to joining the pilot program. Publicly traded facilities were most likely to have implemented one of these systems ($p \leq 0.01$), as were facilities with greater than 100 employees ($p \leq 0.01$).[22] In many cases, however, these other

[22] Throughout our analyses we found that ownership by a publicly traded firm and a workforce of more than 100 employees were mutually related to differences in EMS behaviors and practices of these facilities. These results may be confounded by the fact that facilities with fewer than 100 employees were less likely to be part of publicly traded firms ($p \leq 0.05$) than of privately held or governmental facilities. Furthermore, facilities owned by publicly traded firms were also more likely to have more than 300 employees ($p \leq 0.05$). While these results are not surprising, they may cloud the underlying implications of reported findings.

management systems were themselves relatively newly adopted: most had only just been introduced, and the median number of years since adoption of any such system was only 1.5. Table IV-6 shows the incidence of such systems.

TABLE IV-6: DISTRIBUTION OF NON-ENVIRONMENTAL MANAGEMENT SYSTEMS

(61 facilities)

Non-environmental Management Systems	Number of Facilities	Median Years Implemented
ISO 9000	38	1
Total Quality Management	29	0
Materials Accounting	25	0
Just-in-Time Inventory	20	0
OSHA Voluntary Protection	8	0
Other	16	0
At least one of the above	61	1.5

Participation in Voluntary Environmental Management Programs

Prior to joining the pilot program, 49 percent of the facilities participated in at least one other voluntary environmental initiative (VEI) program. Differences in participation were similar to those found in management system adoption: publicly traded facilities ($p \leq 0.01$) and larger facilities were more likely ($p \leq 0.01$) to have participated, but in all cases such participation had begun only in the previous year. Table IV-7 shows the numbers of facilities participating in each of the most widely recognized VEI programs.

TABLE IV-7: DISTRIBUTION OF VEI PROGRAM PARTICIPATION

(41 facilities)

Environmental Management Program	Number of Facilities	Median Years Participation
State-run Program	16	0
EPA's 33/50 Program	16	0
EPA's Green Lights Program	10	0
Charter for Sustainable Development	4	0
Responsible Care	4	0
CERES Principles	1	0
Other (not listed in Protocol)	21	0
At least one of the above	41	0

Future chapters will explore the relationship between facility size and ownership and EMS outcomes. We expect results of these analyses will provide additional insight into these results.

Although a number of facilities in the chemical industry contributed baseline data, only 37 percent participated in the CMA Responsible Care Program.

Existing Environmental Management Techniques

Facilities were asked to check off all environmental management techniques or programs that were already in use at their site, and 83 percent of the 83 facilities reported that they had used some environmental management techniques or programs during the baseline period. On average they also had used them longer (1.9 years median practice) than they had used non-environmental management systems or participated in VEIs. Publicly traded facilities were most likely to have employed these techniques ($p \leq 0.05$), and also were more likely to have utilized more than one management technique during the baseline period ($p \leq 0.01$). Although facilities of all sizes appeared to have used these techniques, larger facilities were more likely than small ones to have employed more than one of these practices ($p \leq 0.01$). The numbers of facilities using the various types of environmental management techniques, and median years of practice, are shown in Table IV-8.

TABLE IV-8: FREQUENCY OF ENVIRONMENTAL MANAGEMENT TECHNIQUES

(69 facilities)

Environmental Management Techniques	Number of Facilities	Median Years of Practice
Waste Minimization Planning	56	5
Pollution Prevention Planning	49	4
Compliance Auditing	44	2
Annual Environmental Report for Internal Use	34	0
Environmental Best Management Practices	27	0
Annual Environmental Report Made Public	18	0
Environmental Accounting System	15	0
Risk Assessment System	15	0
Total Quality Environmental Management Adopted	11	0
Life Cycle Analysis Performed	7	0
Other Techniques/Programs	15	0
At least one of the above	69	1.9

As Table IV-8 shows, the most common environmental management techniques already undertaken by these facilities were waste minimization planning, pollution prevention planning, and compliance auditing. Note also that while 34 facilities prepared annual environmental reports for internal use, only 18 also prepared such reports for the public.

Pollution Prevention Activities

The NDEMS baseline protocol also requested somewhat more detailed information on specific pollution prevention practices already in use, and defined, “pollution prevention” as synonymous with source reduction (that is, not including end-of-pipe pollution control technologies).[23] Ninety percent (90%) of the 83 facilities reporting indicated that they were engaged in pollution prevention activities, and a few provided detailed insights into their practices. For example, some used cross-functional teams representing more than one division or area of specialization; at least three included engineers or scientists; and three reported that their teams included business areas such as cost reduction, sales and marketing, and/or research and development. Five facilities reported that they offered pollution prevention training on an annual basis, six offered this training to all facility employees, and two others reported using training for specific categories of employees. Moreover, 16 facilities reported that they rewarded employees for pollution prevention activities, generally including both monetary or recognition awards, as well as token gifts such as items with company logos (t-shirts, hats), or gift certificates.

Significantly, more than half these facilities (representing 48 percent of all facilities) also involved their suppliers in pollution prevention activities, and more than half (representing nearly 45 percent of all facilities) also were already considering pollution prevention in product design. Both these findings imply the recognition of important environmental performance linkages and influences beyond the individual facility, both up and down the manufacturing value chain. Table IV-9 shows the pollution prevention activities reported.

TABLE IV-9: POLLUTION PREVENTION ACTIVITIES

(71 facilities)

Pollution Prevention Activity or Tool	Number of Facilities
Have Formal Pollution Prevention Plan	40
Involve Suppliers in Pollution Prevention	40
Consider Pollution Prevention in Product Design	37
Provide Pollution Prevention Training	37
Use Pollution Prevention Teams	34
Involve Customers in Pollution Prevention	30
Consider Pollution Prevention in Business Planning	27
Reward Employees for Pollution Prevention	27

Pollution Prevention Plans

Of the 71 facilities that reported pollution prevention activities, 40 (representing 48% of all facilities) already had formal pollution prevention plans. Only 21 of those 40 facilities were located in states that require pollution prevention plans, suggesting that many had motives other than state requirements for introducing such practices.[24] Publicly traded facilities were more likely than privately held or government facilities to have a formal pollution prevention plan in place ($p \leq 0.05$), as were facilities with more than 300 employees ($p \leq 0.10$). Facilities

[23] This definition is consistent with USEPA usage, but more restrictive than the "prevention of pollution" used in the ISO 14001 standard.

[24] One other facility reported that it did not have a formal pollution prevention plan, even though such plans were required in its state.

that had employed multiple environmental management techniques (cf. Table IV-8) were most likely to have adopted formal pollution plans ($p \leq 0.01$).

A comparison across all categories of tools and activities for the 71 facilities that had engaged in some pollution prevention activities reveals that the 40 facilities with formal pollution prevention plans were more likely to engage in most types of pollution prevention activities than were those facilities that had no pollution prevention plans. Consideration of pollution prevention in product design and involvement of customers in pollution prevention activities were used as frequently by facilities without a formal pollution prevention plan as by facilities that had such a plan in place. The numbers of facilities with and without formal pollution plans that utilized specific pollution prevention activities during the baseline period are presented in Table IV-10.

TABLE IV-10: POLLUTION PREVENTION ACTIVITIES – FACILITIES WITH AND WITHOUT FORMAL PLANS

(71 facilities)

Pollution Prevention Activity	Formal Pollution Prevention Plan (40 facilities)	No Formal Pollution Prevention Plan (31 facilities)	$p \leq$
Consider Pollution Prevention in Business Planning	22	5	0.01
Use Pollution Prevention Teams	25	9	0.01
Provide Pollution Prevention Training	27	10	0.01
Involve Suppliers in Pollution Prevention	27	13	0.05
Reward Employees for Pollution Prevention	19	8	0.10
Involve Customers in Pollution Prevention	20	10	--
Consider Pollution Prevention in Product Design	24	13	--

Gap Analyses

Almost half of the NDEMS participants (37 facilities) had performed a "gap analysis" to discover which elements of their pre-existing EMS practices did or did not meet ISO 14001 specifications. It is unclear whether the other 44 facilities that responded to this question did not perform such gap analyses because they were not planning to seek ISO certification, or did not do so for other reasons.

Pre-existing Environmental Management System Elements

Facilities were asked to provide information on specific EMS elements that were already in place during the baseline period. Seventy-seven percent (77%) reported having at least one element of an ISO 14001 EMS already in place during the baseline period. Facilities with more than 300 employees were most likely ($p \leq 0.05$) to have developed at least one of these EMS features. Facilities owned by publicly traded firms also were more likely to have developed at least one of these features than privately held or government facilities ($p \leq 0.05$). Facilities that participated in voluntary environmental management initiatives, and those that utilized multiple environmental management techniques, also were more likely to have introduced at least one of these features than were those that did not ($p \leq 0.05$, $p \leq 0.01$ respectively). Additionally, facilities that had established formal pollution prevention plans were also more likely to have introduced at least one feature of an EMS before or during their baseline period ($p \leq 0.01$). Specific EMS elements were reported with the following frequencies:

TABLE IV-11: FREQUENCY OF USE OF FEATURES OF CURRENT EMS

(64 facilities)

Features of Current EMSs	Number of Facilities
At least on element of an ISO 14001 EMS	64
Top management defined environmental policy	42
Established procedure for identifying legal (regulatory) and other requirements	40
Established procedure for receiving communications from external interested parties	34
Established documented environmental objectives and targets	29
Responded to relevant external communications from interested parties	29
Identified aspects with potential for significant environmental impacts	28
Documented communications received from external interested parties	28
Set timeframe for achieving objectives and targets	25
Had document that described the core elements of their EMSs	25
Documented procedures to monitor key characteristics of its operations and activities	25
Planned method for achieving objectives and targets	22
Trained employees to be aware of operation of the EMS	22
Conducted internal audits of their EMSs	20
Organization's top management reviewed EMS periodically	16
Hired external auditors to perform audits of EMSs	13

More than half of these facilities had an environmental policy (66 percent), established procedures to identify regulatory requirements (63 percent) or procedures for receiving communications from external parties (53 percent). Note also that 78 percent of these 64 facilities reported use of more than one feature of ISO 14001 EMS during or prior to their NDEMS baseline periods.

Like the other forms of management systems discussed previously, these EMS elements appear to represent relatively new innovations for most facilities. The median number of years these EMS elements had been in use was greater than one year for only two elements: environmental policies, and procedures to identify regulatory requirements (2 years and 1.5 years, respectively). Twenty-eight percent (28%) of the facilities had developed several of the "core" elements of an ISO 14001 EMS (environmental policy, identified regulatory requirements, identification of environmental aspects and impacts, established environmental objectives and targets and either a time-frame or a method by which to realize these environmental objective and targets). Facilities in the electronic and other electrical equipment and components sector (SIC 36) were significantly more likely than other business sectors to have developed these “core” EMS elements ($p \leq 0.05$).

Regulatory Requirements

Eighty-three percent of the 83 facilities submitted baseline data covering regulatory requirements, and many facilities had more than one regulatory requirement.[25] The most common were state air permits (44); Form R reports for EPA’s Toxic Release Inventory (39); RCRA large-quantity hazardous waste generators (37); and discharge permits for publicly-owned wastewater treatment plants (POTWs, 31). Twenty-eight currently held NPDES wastewater discharge permits, but only nineteen held state water permits, and most were not required to pretreat their wastewater discharges. Relatively few of these facilities were subject to regulations covering waste treatment, storage, and disposal facilities (4) or Tier II stormwater requirements (8); fourteen had not held air permits within the three-year baseline period..

[25] One facility was not subject to any permits or other regulatory requirements during its three baseline years.

TABLE IV-12: APPLICABLE REGULATORY REQUIREMENTS

Regulatory Status Category	Current	1 Year Ago	2 Years Ago
RCRA:			
Large Quantity Generator	36	37	35
Small Quantity Generator	20	21	19
Conditionally Exempt Small Quantity Generator	8	6	7
Treatment, Storage, or Disposal (TSD) Facility	4	4	4
Air:			
State Air Permit Holder	44	44	42
Clean Air Act Major Source	23	23	23
Clean Air Act Minor Source	9	8	8
Water:			
State Water Permit Holder	19	19	18
Required to Pretreat	20	22	21
NPDES Permit Holder	28	28	27
Tier I Stormwater Permit Holder	18	16	15
Tier II Stormwater Permit Holder	7	7	8
POTW Discharge Permit Holder	30	31	29
Other:			
TRI Reporter	38	37	39
Potentially Responsible Party under Superfund	12	12	13
Regulated under Safe Drinking Water Act	11	11	12
Subject to Underground Storage Tank Regulations	21	23	23
Regulated under TSCA	25	26	26

Changes in Regulatory Status during Baseline Period

As shown in Table IV-12, changes in regulatory status during the three baseline years were common across all types of regulatory programs, though the changes were not dramatic. The majority of facilities did not experience such changes: overall, 36 percent (25) of the 69 reporting facilities reported changes in regulatory status. More than two thirds of the facilities that did change status during this period (69 percent) decreased their level of regulation (for instance, moved from being a large quantity to a small quantity generator of hazardous waste). Half of the facilities that reduced their status eliminated a specific requirement altogether. Interestingly, positive changes in regulatory status were also more frequently observed ($p \leq 0.05$) at facilities that reported having identified their regulatory requirements prior to or during their baseline periods.[26]

[26] There is no statistical difference between the frequency with which facilities of differing sizes reported having identified regulatory requirements – as defined in section 2.F – during their baseline periods.

Emissions

Sixty-six facilities reported information on specific emissions for which they were regulated. The median number of regulated emissions per facility was six. The maximum number of emissions reported by a facility was 105; the minimum reported by a facility was zero. As Table IV-13 shows, more than half of the facilities had less than ten regulatory requirements, and only nine facilities had more than 20.

TABLE IV-13: NUMBER OF REGULATORY REQUIREMENTS PER FACILITY

(66 facilities)

Number of Regulatory Requirements	Number of Facilities
More than 30	7
20–30	2
10–20	15
Less than 10	37
None	5

Table IV-14 shows that most of these emissions were regulated under the federal or state Clean Air and Clean Water Acts, and a number through sewage pretreatment requirements.

TABLE IV-14: REGULATORY REQUIREMENTS BY ENVIRONMENTAL MEDIUM AND TYPE OF PERMIT

(66 facilities)

Regulation	Release/Emissions Requirements
Clean Air Act (Federal or State)	383
Clean Water Act (Federal or State)	273
Department of Transportation	1
Local Air Requirement	34
Local Pretreatment Program Requirement	123
Local Solid Waste Disposal Requirement	2
RCRA	12
TRI/SARA	26
Other	4

Changes in Permitted Emissions and Permit Limits

The quality of data varied greatly from facility to facility and emission to emission. Of the 66 facilities reporting permitted emissions, 60 reported actual permit limits and 54 reported both permit limits and actual emissions levels. Others reported only permit limits or emission levels for specific emissions. Each emission was evaluated for change based on reported data. If data for a specified emission was available for all three baseline years, change was evaluated starting with the earliest baseline year and moving to the last baseline year.

These results were then evaluated at the facility level. If data were reported for all reported permit limits and there was evidence of an increase or decrease in any permitted emission or permit level, the increase or decrease was coded "1". If data were reported for all reported permit limits and emission levels and these were unchanged, a "0" was noted for increase or decrease. If all permit limits and emission levels were unchanged, but data were missing for one or more years, increases or decreases were undeterminable.

Few of these facilities (17 percent) reported changes to regulatory permits during their three baseline years. A quarter of the facilities were not able to provide some of their past permit limits for one or two years of the baseline period, changes in permit limits for these facilities were not able to be determined. Of the ten facilities that reported changes in their permit limits, seven had reduced permit limits and six had increased limits, including three facilities that had both increased and reduced permit limits for different types of emissions.

Although only ten facilities had changes in their permit limits, 46 facilities reported increases in actual emissions during their three baseline years. A similar number (47 facilities) – including 43 of the same facilities that also had increases – experienced decreases in actual emissions during the baseline period.

Involvement of Interested Parties

For the purposes of this research, two categories of "interested parties" were defined and distinguished:

Inside interested parties: any individual or group within a facility who is not responsible for the design of its EMS and may be concerned with or affected by the facility's environmental performance

Outside interested parties: any individual or group not associated with a facility who is concerned with or affected by the facility's environmental performance. Examples include local non-governmental organizations, neighborhood associations, community groups.

Seventy-six percent of the facilities reported involving at least some of these interested parties in environmental decision making during their baseline periods. Table IV-15 describes the types of parties involved.

TABLE IV-15: INTERESTED PARTIES INVOLVED IN ENVIRONMENTAL DECISIONS

(63 facilities)

Type of Interested Party	Facilities Involving This Interested Party
Non-management Employees	34
Owners and Shareholders	40
Local Government Agencies	26
Environmental Groups	10
Local Business Interests	10
Local Emergency Planning Committees	10
Local Citizen Groups	9
Unions	8
Community Advisory Boards	7
Others	13

Table IV-15 indicates that these 63 facilities most frequently involved interested parties within their organizations. However, nearly two-thirds (63 percent) also involved at least one category of outside party. They were most likely to have involved owners and shareholders (64 percent) and almost half (43 percent) also involved non-management employees.

Few facilities, however, had involved local citizen constituencies: groups or community advisory boards: less than 16 percent involved environmental or other citizen groups, community advisory boards, or even the Local Emergency Planning Committee, and only two facilities reported involving their neighbors or customers. We were unable to determine whether the facility could have contacted such groups but chose not to, or whether such groups simply were not present in the facilities' communities. These facilities' involvement of such organizations is further examined below.

Formal Stakeholder Groups

Only ten facilities (17 percent) reported that they had established formal stakeholder groups to provide comments or otherwise interact with their management or staff. Government facilities were more likely than publicly traded or privately held facilities ($p \leq 0.01$) to have established these groups.

Additional characteristics of the ten facilities with formal stakeholder groups included the following:

Eight of the ten facilities involved their formal stakeholder groups in the design and modification of existing environmental management systems;

Four of the ten facilities involved their stakeholder groups in the implementation of an existing environmental management system; and

Six of the ten facilities involved their stakeholders in major operational decisions that have potential environmental impacts.

Although the majority of facilities (53) had not established a formal stakeholder group during the baseline period, because a number of the states in this project are requiring their pilot facilities to establish formal stakeholder groups, these numbers are expected to change. Future chapters explore the involvement of these groups in the design of these facilities EMSs.

Public Inquiries

Nearly 98 percent of the 83 facilities reported having had to respond to public inquiries during the baseline period. Table IV-16 reports the frequency of responses to public inquiries by the facilities. These data suggest that less one-fourth (20) of the facilities received more than ten public inquiries per year.

TABLE IV-16: INQUIRIES PER YEAR FROM OUTSIDE PARTIES

(Total of 83 facilities)

Frequency of Response to Public Inquiries	Number of Facilities
More than 100 times per year	6
51 – 100 times per year	3
11 – 50 times per year	11
2 – 10 times per year	28
0 –1 times per year	33
No inquiries	2

Potential Changes in Public Involvement

More than 90 percent of the facilities (76 facilities) reported that they intended to change their involvement with outside parties. Of these, one-third planned to institute or expand formal procedures for such involvement. Table IV-17 reports responses to this question.

TABLE IV-17: PLANS TO CHANGE INTERESTED PARTY INVOLVEMENT PROCEDURES

(83 facilities)

Plans for Interested Party Involvement	Number of Facilities
Plan to either institute formal procedures for interested party involvement or elaborate on existing procedures	25
Do not plan to change stakeholder involvement procedures	30
Unsure	19
Do not foresee involving stakeholders in the future	2
Did not provide this information	7

BASELINE ENVIRONMENTAL PERFORMANCE

Environmental Performance Indicators

More than 85 percent of the 83 facilities reported that they had already developed some environmental performance indicators (EPIs). Table IV-18 provides the total and median number of EPIs developed at these facilities.

TABLE IV-18: EPI DATA SUMMARY

(71 facilities)

EPI Characteristic	Number Reported
Total facilities reporting use of EPIs	71
Total EPIs Reported	819
Median number of EPIs per 71 reporting facilities	6

Seven broad categories of EPIs were distinguishable in this analysis: materials use, sustainability & recycling, wastewater production & quality, air releases, waste generation & disposal, natural resource use, and spills & releases. Facilities reported diverse indicators within several of these categories (for instance air releases, materials use and sustainability/recycling). Table IV-19 illustrates some of the indicators reported within each category.

TABLE IV-19: INDICATORS TRACKED

(71 facilities)

Indicator Tracked	Category
Calcium usage	Materials Use
Squeeze cast die lube	Materials Use
Acres Reforested: Natural	Sustainability & Recycling
Styrofoam packing recycled	Sustainability & Recycling
Effluent Mercury	Wastewater Production & Quality
Wastewater produced	Wastewater Production & Quality
NOx	Air Releases
HAP Emissions	Air Releases
Hazardous Waste	Waste Generation & Disposal
Solid Waste (non-hazardous)	Waste Generation & Disposal
Electrical Consumption	Natural Resource Use
Incoming Water	Natural Resource Use
Environmental Spills	Spills & Releases

More than half of the facilities tracked indicators that measured waste generation and disposal (85 percent), air releases (54 percent) and natural resource use (52 percent). Most (83 percent) tracked indicators in more than one category. The median number of indicator categories tracked, however, was only three: not evidence of especially comprehensive systems for tracking environmental performance.

It is noteworthy that 92 percent of the facilities that lacked EPIs were either privately held or government facilities. Further analysis of these baseline data reveals several associations between EPI development and facilities' prior management practices. Facilities that had begun using environmental management techniques, established general management systems, or participated in a voluntary environmental management initiative prior to or during their baseline periods were more likely to have developed EPIs than were those that had not ($p \leq 0.01$ in all three cases). Almost equally significant, facilities that had identified environmental aspects and impacts of their operations during their baseline period, and those that had established environmental objectives and targets, were also more likely to have developed EPIs than those that had not introduced these two EMS features ($p \leq 0.01$, $p \leq 0.05$ respectively).

Finally, facilities that had involved outside parties in their baseline environmental management procedures were more likely to have EPIs in place than those that had not ($p \leq 0.05$).

Significant Changes in Environmental Performance

The Baseline Protocol did not define a significant change in facility EPI performance. Instead, each facility was asked to report whether a particular change in its environmental performance was considered significant for that facility, either in terms of the resources required to accomplish that change or in terms of the regulatory or other consequences of that change.

Of the 64 facilities that reported changes in their EPI data during the baseline period, 40 (63 percent) reported at least one significant change in EPI performance during their baseline years.[27] More than 150 EPIs were reported to have shown significant changes in environmental performance during this period. Significant changes were reported more frequently by facilities with fewer than 100 employees or more than 300 employees ($p \leq 0.10$). Fewer reports of significant EPI changes were observed at government facilities than at publicly traded or privately owned facilities ($p \leq 0.10$).

The median number of significantly changed EPIs per facility was three. The actual distribution of the changes is shown in Table IV-20.

TABLE IV-20: FREQUENCY OF EPI SIGNIFICANT CHANGES

(40 facilities)

Number of Significant Changes	Number of Facilities
1	10
2	8
3	8
4	4
5	4
6	1
7	1
11	1
13	1
16	1
21	1

Among the 40 facilities reporting significant changes in their EPIs, three did not provide data on how these changes were accomplished. The significant changes that were reported are distributed across different types of changes in practices and procedures. The three most common types of significant changes in EPIs resulted from modifications to operating practice, process, and the product itself. Table IV-21 shows the actions that were reported to have been associated with significant changes in EPIs.

[27] Seven of the 71 facilities reporting on use of EPIs did not provide data on any changes in EPI data during the baseline period.

TABLE IV-21: ACTIONS ASSOCIATED WITH EPI SIGNIFICANT CHANGES

(37 facilities)

Type of Significant Change	Number of Facilities
Operating Practice Modifications	57
Process Modifications	65
Product Modifications	26
Raw Materials Modifications	15
Inventory Control	10
Spills Control	4

REGULATORY PERFORMANCE

For purposes of this research, the NDEMS protocols defined "violation" as a non-compliance either discovered by environmental agency personnel or reported to agency personnel, which resulted in a formal enforcement action against the facility. "Formal enforcement action" was defined as a notice of violation (NOV), administrative order, civil action seeking civil penalties, or referral for a criminal prosecution for violation of an environmental requirement.

Eighty-three percent of the 83 NDEMS facilities reported data on baseline violations,28 and six of these facilities (nine percent) reported a total of 23 major or significant violations during their baseline period. Two facilities had seven major violations apiece, one facility had four, another had three, and two facilities had one major violation each. All but one of the facilities that reported major violations also reported minor violations. Twenty-five of the 69 facilities (36 percent) had minor violations, with a total of 117 minor violations among them. Most of these facilities (76 percent) reported fewer than five minor violations; three reported more than ten apiece. The median number of minor violations reported was two.

More than one-third of facilities reporting violations (9 facilities) reported monetary fines associated with their violations. For those facilities reporting fines, the average (mean) fine totaled approximately $70,970; the median fine reported was $4,500.

During the three baseline years, ten of the 26 facilities that had either major or minor violations also had repeat violations. There were a total of 40 repeat violations, but more than one-third of the repeated violations (14) happened at just one facility. One facility had seven repeat violations, two other facilities had four repeat violations each, two additional facilities had three repeat violations, and at each of the other four facilities only one or two violations recurred.

Analysis of the demographic variables previously discussed sheds little light on differences in the occurrence or frequency of violations. No significant differences between the observed occurrence of a violation nor their frequency were found between facilities in different sectors or of different sizes. Facilities without prior management

[28] Ten facilities participating in the EPA study of municipal EMS adoption completed a modified baseline protocol and were not specifically asked about the number or type of violations at their facilities.

experience – either general, or specific to environmental management practices – were no more likely than facilities with this baseline experience to have reported violations.

Environmental Medium and Violation Types

The data show that, for the 26 facilities reporting either major or minor violations during their three baseline years, the most common medium in which violations occurred was water. Violations in other environmental media or programs were also reported but were less common. Table IV-22 presents these violations broken down by environmental medium or other regulatory program.

TABLE IV-22: MAJOR AND MINOR VIOLATIONS BY ENVIRONMENTAL MEDIUM

(140 violations reported by 26 facilities)

Environmental Medium	Number of Major and Minor Violations	Median Number of Violations
Water Requirements	74	1.5
Air Requirements	24	0.5
Hazardous Waste Requirements	23	0.0
Other Requirements	19	0.0

Table IV-23 presents the same violations broken down by types of violations. As the table shows, several types of violations were reported. Emission or discharge violations were observed most frequently; no remediation violations were observed, and production and use violations also were rarely observed. While there is some obvious variation in the total number of violations observed between these types, no significant difference between the types of violations was evident across all NDEMS facilities.

TABLE IV-23: TYPES OF MAJOR AND MINOR VIOLATIONS

(140 violations reported by 26 facilities)

Type of Violation	Number of Violations	Median Number of Violations
Violations of Emission or Discharge Limits	44	0
Violations of Monitoring Requirements	20	0
Testing Violations	14	0
Unauthorized Releases of Pollutants	14	0
Record Keeping Violations	12	0
Storage or Disposal Violations	9	0
Violations of Training Requirements	4	0
Violations of Labeling or Manifests	4	0
Use Violations	1	0
Production Violations	1	0
Remediation Violations	0	0
Other Violations not listed above	17	0

Methods for Discovering Violations

Table IV-24 shows differences in how the 26 facilities discovered their violations. Inspections – either by facility operators themselves or by regulators – were the most common method for detecting violations, and regulatory inspection was the only method of discovery that appeared common for most of these facilities. More than three-quarters (76 percent) of these 26 facilities reported at least one violation discovered by regulators.

TABLE IV-24: DISCOVERY OF VIOLATIONS

(140 violations reported by 26 facilities)

Methods for Discovering Violations	Violations Discovered	Median Number of Violations Discovered
Regulatory Inspection	65	1.0
Routine Operating Procedures or Inspections by Facility Operators	55	0.0
Other Methods	13	0.0
Routine Supervisory or Management Operations	3	0.0
Formal Facility Audits (Internal or External)	0	0.0
No Information on Discovery Method Provided	4	0.0

Times Needed to Discover and Correct Violations

The facilities that reported major or minor violations discovered half of their violations (70) within ten days or less, and half of these 26 facilities discovered at least half their violations within one day or less (Table IV-25). Fully twenty percent of the violations, however, went undiscovered for more than two months, a gap that could conceivably by reduced by an effective EMS.

TABLE IV-25: TIME NEEDED TO DISCOVER VIOLATIONS

(140 violations reported by 26 facilities)

Time to Discover Violation	Number of Violations
1 Day or Less	61
2–10 Days	9
11–30 Days	14
1 – 2 Months	3
More Than Two Months	28
No Information Provided	25

Once violations were discovered, in 64 percent of the cases the facilities were able to correct them within ten days or less, and more than half (58 percent) were correctible within one day or less (Table IV-26). More than 10 percent, however, went uncorrected for more than two months.

TABLE IV-26: TIME NEEDED TO CORRECT VIOLATIONS

(140 violations reported by 26 facilities)

Time to Correct Violation	Number of Violations
1 Day or Less	68
2–10 Days	21
11–30 Days	11
1 – 2 Months	7
More Than Two Months	15
No Information Provided	18

Causes of Violations

Facilities were asked to describe the causes of reported violations (Table IV-27). While unknown factors were most frequently cited as the cause of violations (30 percent), deficiencies in operational procedures (23 percent) and lack of proper monitoring (16 percent) were the next most frequent categories reported.

TABLE IV-27: OBSERVED CAUSE OF VIOLATIONS

(140 violations reported by 26 facilities)

Cause of Violation	Number of Violations[29]	Proportion of Total Violations
Unknown Factors	41	30%
Inadequate Procedures	32	23%
Improper Monitoring	22	16%
Poor Construction/Engineering of Facility or Systems	18	13%
Inadequately Trained Employees	14	10%
Equipment Failure	12	9%
Quality of Raw Materials/Supplies	3	2%
Extreme Weather or Other Event	3	2%
Measurement Error	1	1%
Other/Unclassified	0	0%

Corrective Actions

Facilities were asked to describe the actions taken to remedy the cause of each violation reported. As the data in Table IV-28 show, a diverse group of corrective action categories emerged from these reports. The corrective action taken most frequently to resolve the cause of violations by these facilities could best be categorized as revisions to facility procedures (17 percent). Obtaining required measurements, tests or other documentation (14 percent) and providing training to employees (14 percent) were next most frequently cited.

In later chapters, we will compare the baseline frequencies and types of both major and minor violations with the numbers and types of violations reported in the Update Protocols. Those data may show whether the facilities' new or expanded EMSs are able to reduce the numbers and/or frequency as well as severity of violations. It is important to recognize, however, that implementation of EMSs – especially by some pilot facilities that may not have previously adopted very effective methods for managing their environmental impacts or reducing their pollution – may initially result in an increase, or "spike," in the number of violations discovered during the first few years after an EMS is introduced. Nevertheless, it may be possible to interpret such a spike as a positive sign that the facilities' EMSs are capable of identifying, and possibly preventing, violations that previously went undetected.

[29] The total number of observed factors contributing to violations is greater than the number of violations because in some instances more than one cause was attributed to the violation.

TABLE IV-28: OBSERVED CORRECTIVE ACTIONS FOR VIOLATIONS

(140 violations reported by 26 facilities)

Corrective Action Taken	Number of Violations[30]	Proportion of Total Violations
Update, revise, develop or re-issue procedures	24	17%
Obtain required measurements, tests, or documentation	20	14%
Provide training to employees	19	14%
Install equipment	16	11%
No action necessary – self-correcting	14	10%
Hire additional employees or consultants	9	6%
Secure container or containment area	9	6%
Increase monitoring/maintenance frequency	9	6%
Stabilize operation or process	8	6%
Provide data or documentation to regulators	7	5%
Inspect or repair equipment	7	5%
Discontinue process or use of materials	7	5%
Request new or changed permit	4	3%
Dispose of materials	2	1%
Contain spill or release	1	1%

Update data will also be analyzed to determine whether the entire number of violations eventually decreases at most facilities (after perhaps an initial spike as noted above). If EMSs are operating effectively, the proportion of violations discovered by facility operators themselves may also increase in relation to the number of violations discovered by regulatory inspections. Since ISO 14001 is a system-based management tool, we might also expect the cause of violations to shift from management issues such as procedural deficiencies and training lapses to more operations-focused problems such as equipment failure or measurement error.

Non-compliance and Potential Non-compliance

For purposes of this research, the NDEMS protocols defined “non-compliance” as a non-conformity in fulfilling legal requirements, and “potential non-compliance” as any situation in which a non-compliance might occur without intervening action by the facility. Using these definitions, a little less than half – 39 of the 83 facilities – reported a total of 379 potential or actual non-compliance situations, which they classified as either major or minor in scope.

During their baseline period, 27 facilities reported that they experienced a total of 187 actual non-compliance situations. Only two facilities had more than ten actual non-compliances. In fact two-thirds of these facilities (18) had two or fewer events. As defined in the NDEMS protocols, these actual non-compliance situations represent problems that, although self-reported by the facilities to the appropriate regulatory agency, did not trigger any formal

[30] The total number of observed corrective actions for violations is greater than the number of violations because in some instances more than one action was taken.

enforcement action. This lack of action may have been due to the agencies' policies or guidelines on exercising enforcement discretion and/or to the facilities' prompt voluntary actions to correct them. Table IV-29 shows the number of non-compliances reported and the number of facilities reporting each amount.

TABLE IV-29: FREQUENCY OF NON-COMPLIANCES OBSERVED

(27 facilities)

Number of Non-compliances	Number of Facilities
1	11
2	7
3	2
4	2
7	1
18	1
25	1

In addition to actual non-compliances, 24 facilities (including twelve facilities that also had actual non-compliances) experienced a total of 192 potential non-compliance situations during their baseline period. These potential non-compliances were problems that might have become violations if the facility had not discovered and addressed them. One facility reported 60 percent (116) of the total potential non-compliances. Almost three quarters (17 facilities) reported only one or two potential non-compliances during their baseline period. The total of 192 non-compliance situations – both actual and potential – at 39 facilities involved regulatory requirements for protecting the various environmental media, as presented in Table IV-30.

TABLE IV-30: ENVIRONMENTAL MEDIA AFFECTED BY NON-COMPLIANCES

(379 non-compliance situations at 39 facilities)

Environmental Medium	Number of Non-compliances	Median Non-compliances
Hazardous Waste Requirements	181	0.0
Water Requirements	124	1.0
Other Requirements	49	0.0
Air Requirements	25	0.0

Though the number of non-compliant situations with hazardous waste regulations was greatest, only non-compliance with water regulations appeared fairly common: 60 percent of these facilities reported at least one instance of non-compliance with water regulations. By contrast, an instance of non-compliance with hazard waste regulations was observed for only 33 percent of these facilities.

The most frequent types of non-compliance situations involved exceeding permit limits for emissions or discharges (82) and non-compliances in labeling or manifests (67), as shown in

Table IV-31. As reflected in the median number of non-compliances reported per activity, there was no activity in which more than half of the facilities reported non-compliance.

TABLE IV-31: ACTUAL AND POTENTIAL NON-COMPLIANCES BY ACTIVITY

(379 non-compliance situations at 39 facilities)

Non-compliance Activity	Number of Non-compliances	Median Non-compliances
Exceedances of Emission or Discharge Limits	82	0.0
Non-compliance in Labeling or Manifests	67	0.0
Waste Storage, Disposal or Container Management	64	0.0
Improper Record keeping	49	0.0
Unauthorized Releases of Pollutants	38	0.0
Improper Monitoring	18	0.0
Improper Testing	14	0.0
Training Requirements	13	0.0
Improper Materials Use	2	0.0
Improper Waste Remediation	1	0.0
Production Problems	0	0.0
Other Non-compliance Situations	48	0.0

Methods for Discovering Non-compliance Situations

Over their three-year baseline periods, the 39 facilities discovered more than one-third (141) of their 379 non-compliance situations – both actual and potential – through formal audits. Non-compliance situations were also discovered, but less frequently, by a variety of other methods, as shown in Table IV-32.

TABLE IV-32: DISCOVERY OF NON-COMPLIANCE SITUATIONS

(379 non-compliance situations at 39 facilities)

Methods of Discovery	Number of Non-compliances	Median Non-Compliances
Formal Facility Audits (Internal or External)	141	0.0
Routine Operating Procedures/ Inspections by Facility Operators	112	0.0
Regulatory Inspections	94	0.0
Other Methods	20	0.0
Routine Supervisory or Management Operations	11	0.0
Method of Discovery Not Specified	1	0.0

Though no one method of detecting actual or potential non-compliant situations at the facility appears to be common for these facilities, the discovery of so many non-compliance situations by formal facility audits and the facilities' own routine operating procedures or inspections by facility operators (67 percent) demonstrates the importance of facilities instituting routine checks of their operations and conducting audits so they can quickly detect and correct conditions that might otherwise cause regulatory violations and/or environmental consequences.

Time Needed to Discover and Correct Non-compliance Situations

In contrast to the short time facilities needed to discover and correct most violations during the baseline period (see Tables IV-23 and IV-24), the greatest proportion of potential and actual non-compliance situations experienced during the baseline years at these facilities were discovered more than two months after occurrence.

TABLE IV-33: TIME NEEDED TO DISCOVER AND CORRECT NON-COMPLIANCE SITUATIONS

(379 non-compliance situations at 39 facilities)

Time Period	Discovery of Non-Compliance	Correction of Non-compliance
1 Day or Less	110	138
2–10 Days	23	60
11–30 Days	16	81
1 – 2 Months	14	36
More Than Two Months	157	38
Unknown Discovery Time	59	26

Although many non-compliance situations went undetected for some time, the majority of these problems (52 percent) were corrected in less than ten days. If the facilities' new or expanded EMSs are truly able to improve their environmental performance, we would expect to find significant reductions in the number of non-compliance situations that continue to go undetected for such long periods. During the baseline, for more than a quarter of these facilities, at least half of their non-compliance situations went undetected for more than two months. Data from the Update Protocols will demonstrate whether EMSs effectively enable facilities to discover potential or actual non-compliance situations more quickly than was possible during the baseline period.

BASELINE ECONOMIC PERFORMANCE

Prior Use of Economic Indicators

Fifty-five percent (55%) of the NDEMS facilities had developed economic impact indicators (EIIs) prior to or during their baseline periods. Among these 46 facilities, a total of 215 economic indicators were reported. The median number of EIIs reported per facility was four. The frequency of use of economic indicators is shown in Table IV-34.

TABLE IV-34: FREQUENCY OF USE OF ECONOMIC INDICATORS

(46 facilities)

Number of Economic Indicators	Number of Facilities
1	7
2	10
3	4
4	9
5	2
6	3
7	4
8	1
9	1
11	1
12	1
13	1
14	1
17	1

For the most part, economic indicators were categorically analogous to environmental performance indicators. Facilities reported indicators that could be identified in 10 distinct categories. Table IV-35 illustrates some of the indicators reported within each category.

TABLE IV-35: ECONOMIC INDICATORS TRACKED

(46 facilities)

Indicator Tracked	Category
Wood Transportation and Disposal	Waste Generation & Disposal Costs
Wastewater Treated	Wastewater Production & Quality Costs
Chemical Cost	Materials Costs
Precious Metals Recovered	Sustainability & Recycling Costs
Air Emissions	Air Releases Costs
Natural Gas Costs	Natural Resources Costs
Environmental Costs	General Costs
Labor	Personnel Costs
Health Insurance	Insurance Costs
Permit Fees	Penalties & Fees

Significant Changes in Economic Indicators:

Significant changes in economic indicators were reported by half of the 46 facilities during the baseline period. In total, 45 significant changes were reported. The median number of significant changes per facility was one. The breakdown is presented in Table IV-36.

TABLE IV-36: FREQUENCY OF SIGNIFICANT CHANGES IN ECONOMIC INDICATORS

(23 facilities)

Number of Significant Changes	Number of Facilities
1	12
2	4
3	3
4	4

In future chapters, we will examine update data on economic performance indicators in an effort to determine whether there is evidence that EMSs contributed to reducing or increasing costs at these facilities.

SUMMARY

The baseline data analyzed in this chapter provide a useful snapshot of the diversity of facilities that are now implementing environmental management systems. These data suggest that in addition to large multinational corporations, both privately held and public-sector facilities also have chosen to introduce EMSs, though they bring varying levels of management-systems experience and resource capabilities to the endeavor. They also suggest important potential differences in performance to be investigated that may be associated with facilities' prior experiences with management systems in general, pre-existing pollution-prevention and environmental management practices, compliance history, and other factors.

The following chapter sets the stage for these investigations by examining the demographic and performance characteristics of those facilities that reported EMS design data to NDEMS.

Chapter 5. EMS Design Data: Facility Demographics And Performance Characteristics

Sixty-one of the 83 NDEMS facilities that reported baseline data (73 percent) also provided data on their EMS processes and content.[31] These facilities were located in 15 states.[32] All of them had developed, or were in the process of developing, ISO 14001-based EMSs. This chapter summarizes the demographic and prior performance characteristics (regulatory, environmental and economic) of this sample, using many of the same characteristics that were discussed in the preceding chapter. In a later chapter we will also examine differences between facilities that continued to participate in the study and those that did not provide design and update data.

BASELINE DEMOGRAPHICS

Primary Business

The majority of the 61 facilities reporting EMS design data were manufacturers, with 66 percent (40 facilities) citing some form of manufacturing as their primary business function. Of the rest, 20 percent (12 facilities) were local, state, or federal government facilities, and fourteen percent (nine facilities) represented non-manufacturing sectors.

The industries contributing the largest number of facilities to the NDEMS database were the electric, gas, and sanitary services industry, with eight facilities, along with the machinery and computer equipment industry, with seven facilities. Table V-1 reports the breakdown of the primary business functions in these 61 facilities.

[31] This includes 9 municipalities that completed the EMS Design protocol in addition to the 52 NDEMS pilot facilities.

[32] Arizona, Alabama, California, Connecticut, Indiana, Illinois, Maine, Massachusetts, Michigan, New Hampshire, North Carolina, Oregon, Texas, Vermont and Wisconsin

TABLE V-1: PRIMARY BUSINESS FUNCTION

(Total of 61 facilities)

Primary Business	Number of Facilities	Percent of Facilities
Electric, Gas, And Sanitary Services	8	13%
Industrial And Commercial Machinery And Computer Equipment	7	11%
Electronic And Electrical Equipment And Components	6	10%
Fabricated Metal Products	6	10%
Chemicals And Allied Products	5	8%
Other	17	28%
National, State and Local Facilities	12	20%

Facility Size and Structure

More than half (59 percent) of the participating facilities were medium to large-sized enterprises (>300 employees). Fifteen (25 percent) employed less than 100 employees. Table V-2 presents statistics on facility sizes.

TABLE V-2: FACILITY SIZE

(Total of 61 facilities)

Number of Employees	Number of Facilities	Percent of Facilities[33]
< 20	2	3%
20 – 49	5	8%
50 – 99	8	13%
100 – 299	10	16%
300 – 999	24	39%
> 1000	12	20%

Nineteen of the EMS design facilities or their parent organizations were privately held; 26 were publicly traded; and 16 were local, state, or federal government facilities. A large majority, 75 percent, reported that they were part of a larger business or government organization. Publicly traded and government facilities were more likely to be affiliated with larger organizations ($p \leq 0.05$) than were privately held facilities.

Foreign Production and Marketing

A sizable number of these facilities or their parent organizations conducted business internationally as well as in the United States. The affiliate parent organizations of 28 facilities (46 percent) made products in countries other than the United States; of these parent organizations, five engaged in production on a worldwide basis. Nineteen carried out

[33] Total less than 100% due to rounding.

production in North America (including Canada, Mexico, or both); 21 made products in Europe, seventeen in Asia and in South America respectively. Ten facilities listed Australia and nine listed African states as countries in which affiliate or parent firms engaged in production.

Many facilities marketed their products abroad. In fact, 39 of the 61 facilities or parent organizations (64 percent) marketed their products outside of the United States, and 21 of these facilities (34 percent) marketed their products worldwide. By regions, 36 marketed products in Europe, 34 in Asia, 33 in North America, 30 in South America, and 22 in Africa and in Australia respectively.

Facility Location

Most participating facilities were located in small to medium-size cities. Only nine (15 percent) were located in cities of 500,000 or more, and thirteen (21 percent) in small towns of less than 5,000. The largest proportion of facilities (44 percent) reported that they were located in commercial or industrial areas. Approximately 36 percent described their location as mixed use or residential areas. The smallest proportion (20 percent) characterized their location as rural.

Existing Management Systems

Facilities' prior management experience may be particularly important as they begin to develop their EMSs since many of the ISO 14001 requirements are systems-based and build on previously formulated models. General and environmental management system experience of these facilities is detailed in the following section, and comparisons are made based on several of the demographic variables described above.

Non-environmental Management Programs

Nearly three quarters (72 percent) of these facilities reported some type of prior experience with non-environmental management systems. Publicly traded and privately held facilities were more likely than government facilities to have implemented one of these systems ($p \leq 0.01$, $p \leq 0.10$ respectively), as were facilities with greater than 100 employees ($p \leq 0.01$).[34] However, the median number of years since implementation of these prior systems was only years 1.5 years.

Participation in Voluntary Environmental Management Programs

Prior to joining the pilot program, almost half of these facilities (49 percent) participated in voluntary environmental initiative (VEI) programs. Differences in VEI participation were similar to those found in management system adoption: publicly traded facilities and larger

[34] Throughout this chapter we find that ownership by a publicly traded firm and employment of more than 100 individuals are mutually related to differences in the behaviors and practices of these NDEMS facilities. These results may be confounded by the that fact that facilities with fewer than 100 employees are less likely to be part of publicly traded firms ($p \leq 0.10$) than are privately held or governmental facilities. Furthermore, facilities owned by publicly traded firms are also more likely to have more than 300 employees ($p \leq 0.10$). While these results are not surprising, they may cloud the underlying implications of reported findings. Future chapters will explore the relationship between facility size and ownership that we expect will provide additional insight into these results.

facilities were more likely to have participated in these programs ($p \leq 0.05$, $p \leq 0.01$ respectively); such participation was also relatively recent (median duration just over half a year).

Existing Environmental Management Techniques

Eighty percent of these facilities had previously used some environmental management techniques. The facilities appeared to be more familiar with these management strategies (2 years median practice) than with formal management systems or voluntary environmental management initiatives.

Consistent with previous comparisons, publicly traded facilities were most likely to have employed these techniques ($p \leq 0.10$), and were also more likely to have utilized more than one management technique during the baseline period ($p \leq 0.01$). Facilities with more than 300 employees also were more likely than smaller facilities to employ one or more of these practices ($p \leq 0.05$).

Pollution Prevention Activities

Nearly 90 percent of the facilities reporting EMS design data were involved in pollution prevention activities during their baseline period (Table V-3) Nearly 60 percent of these facilities involved suppliers in pollution prevention activities during the baseline period, and 53% reported already considering pollution prevention in their product designs.

TABLE V-3: POLLUTION PREVENTION ACTIVITIES

(53 facilities)

Pollution Prevention Activity or Tool	Number of Facilities
Have Formal Pollution Prevention Plan	30
Involve Suppliers in Pollution Prevention	31
Consider Pollution Prevention in Product Design	28
Provide Pollution Prevention Training	32
Use Pollution Prevention Teams	25
Involve Customers in Pollution Prevention	20
Consider Pollution Prevention in Business Planning	20
Reward Employees for Pollution Prevention	22

Pollution Prevention Plans

Of the facilities that reported pollution prevention activities, 57 percent had formal pollution prevention plans. Only 14 of these facilities were located in states that require pollution prevention plans. Publicly traded facilities were more likely than privately held or government facilities to have a formal pollution prevention plan in place during the baseline period, as were facilities with more than 300 employees ($p \leq 0.05$, $p \leq 0.10$ respectively). Facilities that had employed one or more multiple environmental management techniques were most likely to have adopted formal pollution plans ($p \leq 0.01$).

A comparison of the tools and activities these facilities had engaged in during their baseline periods reveals that the 30 facilities with formal pollution-prevention plans were more likely to have engaged in almost all types of pollution prevention activities than were those facilities that had no pollution prevention plan. However, facilities without a formal pollution prevention plan were no less likely to involve their customers in pollution-prevention initiatives than were facilities that had such a plan in place. The numbers of facilities with and without formal pollution plans that utilized specific pollution prevention activities during the baseline period are presented in Table V-4.

TABLE V-4: POLLUTION PREVENTION ACTIVITIES – FACILITIES WITH AND WITHOUT FORMAL PLANS

(53 facilities)

Pollution Prevention Activity	Formal Pollution Prevention Plan (30 facilities)	No Formal Pollution Prevention Plan (23 facilities)	$p \leq$
Consider Pollution Prevention in Business Planning	18	2	0.01
Use Pollution Prevention Teams	21	4	0.01
Provide Pollution Prevention Training	25	7	0.01
Involve Suppliers in Pollution Prevention	24	7	0.01
Reward Employees for Pollution Prevention	18	4	0.01
Consider Pollution Prevention in Product Design	21	7	0.05
Involve Customers in Pollution Prevention	15	5	--

Gap Analysis

More than half the facilities (32) had performed a "gap analysis" to discover which aspects of their existing EMSs did or did not meet ISO 14001 specifications. Answers to the EMS Design protocol indicated that of the 27 facilities that did not perform such gap analyses, 16 facilities (59 percent) were planning to seek ISO certification.

Features of Current Environmental Management Systems

Seventy-seven percent of the facilities that provided EMS design data reported having at least one element of an ISO 14001 EMS already in place during the baseline period. Facilities with more than 300 employees were more likely to have developed at least one of these EMS features than were smaller facilities ($p \leq 0.10$).

Facilities that participated in voluntary environmental management initiatives and those that utilized multiple environmental management techniques were also more likely than those who had not to have established at least one of these features at their sites ($p \leq 0.05$ and $p \leq 0.01$, respectively). Facilities that had established formal pollution prevention plans were also more likely to have at least one feature of an EMS during their NDEMS baseline period than were those only involved in pollution prevention activities ($p \leq 0.05$). Specific EMS elements were used with the following frequencies:

TABLE V-5: FREQUENCY OF USE OF FEATURES OF CURRENT EMSS

(61 facilities)

Features of Current EMSs	Number of Facilities
At least on element of an ISO 14001 EMS	47
Top management defined environmental policy	33
Established procedure for identifying legal (regulatory) and other requirements	32
Established procedure for receiving communications from external interested parties	25
Established documented environmental objectives and targets	23
Responded to relevant external communications from interested parties	22
Identified aspects with potential for significant environmental impacts	22
Had document that described the core elements of their EMSs	22
Documented communications received from external interested parties	21
Set timeframe for achieving objectives and targets	20
Planned method for achieving objectives and targets	19
Documented procedures to monitor key characteristics of its operations and activities	17
Conducted internal audits of their EMSs	17
Trained employees to be aware of operation of the EMS	15
Organization's top management reviewed EMS periodically	14
Hired external auditors to perform audits of EMSs	11

More than half of the facilities that had at least one element of an EMS in place during their baseline period had the following features: an environmental policy (70 percent), established procedures to identify regulatory requirements (68 percent) and procedures for receiving communications from external parties (53 percent). Nearly 80 percent of these facilities reported use of more than one feature of ISO 14001 EMS during or prior to their NDEMS baseline periods. The median number of years these facilities had used these EMS features, however, was greater than one year for only two of these EMS elements: environmental policies and procedures to identify regulatory requirements (2 years, respectively).

Still, nearly one-third (14 facilities) had developed several of the "core" elements of an ISO 14001 EMS (environmental policy, identified regulatory requirements, identification of environmental aspects and impacts, established environmental objectives and targets and either a time-frame or a method by which to realize these environmental objective and targets). Interestingly, facilities in the electronic and other electrical equipment and components sector (SIC 36) were more likely than other business sectors to have developed these "core" EMS features ($p \leq 0.10$).

Regulatory Requirements

The number of applicable regulatory requirements varied only slightly over their three-year baseline period for the 51 facilities that reported requirements. As with the larger baseline sample, many facilities had more than one regulatory requirement.

The most common types of regulatory requirements were state air permits (33 facilities), Form R reports for USEPA's Toxic Release Inventory (27 facilities), RCRA large quantity generators (26 facilities), and POTW discharge permits (24). Less than half (22 facilities) currently held NPDES permits, most are not required to pretreat their discharges; and only thirteen facilities currently held state water permits. On the other hand, requirements for waste transport, storage, and disposal (TSDs) (2 facilities), and Tier II Stormwater (7) were not frequently applicable to the NDEMS facilities, and some (12 facilities) had not held air permits for the past three years. One facility was not subject to any permits or other regulatory requirements during the three baseline years.

Changes in Regulatory Status during Baseline Period

Changes in regulatory status during the three baseline years were common across all types of regulatory programs, though change was not extreme and few consistent patterns were evident. One-third of the 51 reporting facilities showed a change in regulatory status during their baseline periods, and a number of programs saw both increases and decreases (typically by one facility) over the three-year period. More than one-third of the facilities that changed status during this period (35 percent) decreased the level of regulation, and almost half of the seventeen eliminated a specific requirement altogether. No consistent differences were found between facilities that reported reduced regulatory requirements and those that did not based on demographic or prior management experience variations.

Emissions

Seventy-nine percent of the 61 facilities reporting information on their EMS design process also provided baseline data on specific emissions for which they were regulated (48 facilities). The median number of regulated emissions per facility was seven. The maximum number of emissions reported by a facility was 105; the minimum reported was zero. Most of these emissions were regulated under the federal or state Clean Air and Clean Water Acts, and a number through sewage pretreatment requirements as well.

Changes in Permitted Emissions and Permit Limits

Of the 48 facilities reporting permitted emissions, 46 reported actual permit limits and 43 reported both permit limits and actual emissions levels. Others reported only permit limits or emission levels for specific emissions. Each emission was evaluated for change based on reported data. If data for a specified emission were available for all three baseline years, change was evaluated starting with the earliest baseline year and moving to the last baseline year.

These results were then evaluated at the facility level, as described in the previous chapter. Few of these facilities (13 percent) reported changes to regulatory permits during their three baseline years. More than one quarter (30 percent) of the facilities were not able to provide some of their past permit limits for one or two years of the baseline period; changes in permit limits for these facilities were not able to be determined.

Of the six facilities that reported changes in their permit limits, four had reduced permit limits and four had increased limits, including two facilities that had both increased and decreased permit limits for different emissions. Although only six facilities had changes in their permit limits, during their three baseline years 36 facilities reported increases in actual emissions levels and 36 facilities reported decreases in actual emissions levels. Most facilities (33) reported both increased and decreased emission levels. Of the three facilities reporting only one directional change in emission levels, two reported decreased emission levels and only one reported only increased emission levels.[35]

Interested Party Involvement

As noted in an earlier chapter, a number of the states participating in the NDEMS project required their pilot facilities to engage outside stakeholders in their EMS design process. It is particularly relevant, therefore, that we examine the baseline behavior of those facilities that contributed EMS design data to NDEMS.

Of the 61 facilities, 77 percent reported that they involved some interested parties in their environmental management decisions during their three baseline years, Table V-6 describes the types of parties involved:

TABLE V-6: INTERESTED PARTIES INVOLVED IN ENVIRONMENTAL DECISIONS

(47 facilities)

Type of Interested Party	Facilities Involving This Interested Party
Non-management Employees	28
Owners and Shareholders	31
Local Government Agencies	20
Environmental Groups	9
Local Business Interests	8
Local Emergency Planning Committees	7
Local Citizen Groups	7
Unions	6
Community Advisory Boards	3
Others	10

Types of Interested Parties Involved

Table V-6 indicates that in general, during the baseline period these facilities relied heavily on interested parties within their organizations. However, 60 percent also involved at least one category of outside parties in their environmental decisions. The facilities were most likely to involve owners and shareholders (66 percent); more than half (54 percent) also involved non-management employees.

Few facilities, however, involved local citizen groups or community advisory boards, or even the Local Emergency Planning Committee. We were unable to determine whether the

[35] All permitted emissions were neither increased nor decreased: most of the observed emission levels were unchanged.

facilities did not attempt to consult these groups or whether groups of this nature simply were not present in the facilities' communities or were unwilling to participate in the process.

Formal Stakeholder Groups

Only eight facilities (17 percent) reported that they had established formal stakeholder groups, and only four of these facilities indicated that these groups had provided comments or otherwise interacted with their management or staff concerning environmental issues. Government facilities were more likely than publicly traded or privately held facilities to have established such groups ($p \leq 0.10$).

Public Inquiries

All but one of the 61 facilities had to respond to public inquiries during the three baseline years, but only 26 percent were subject to more than ten inquiries per year (Table V-7).

TABLE V-7: INQUIRIES PER YEAR FROM OUTSIDE PARTIES

(Total of 60 facilities)

Frequency of Response to Public Inquiries	Number of Facilities
0 – 1 times per year	23
2 – 10 times per year	21
11 – 50 times per year	10
51 – 100 times per year	3
More than 100 times per year	3
No inquiries	1

Potential Changes in Public Involvement

Of the 55 facilities reporting baseline data on potential changes to outside party involvement, more than one third (22) planned to institute or expand formal procedures for involvement of interested parties. It will be interesting to note how the plans of these facilities bear out during EMS design and implementation. Also worth noting will be how and whether the substantial fraction of facilities without well-defined intentions during their baseline periods (25 percent) choose to involve outside parties.

BASELINE ENVIRONMENTAL PERFORMANCE

Environmental Performance Indicators

Of the 61 facilities that provided EMS design data, 51 (80 percent) reported that they already had developed environmental performance indicators (EPIs). Table V-8 provides the total and median number of EPIs developed at these facilities.

EPIS TABLE V-8: EPI DATA SUMMARY

(61 facilities)

EPI Characteristic	Number Reported
Total facilities reporting use of EPIs	51
Total EPIs Reported	655
Median EPIs (51 facilities)	7

Further examination of these baseline data, reveal several associations between EPI development and facilities' prior management practices. Facilities that had begun environmental management techniques, established general management systems, and participated in a voluntary environmental management initiative prior to or during their baseline periods were more likely to have developed EPIs than were those that had not ($p \leq 0.01$ in each case). Facilities that had identified environmental aspects and impacts of their operations during the baseline period, and those that had established environmental objectives and targets, were also more likely to have developed EPIs than those that had not introduced these EMS features ($p \leq 0.01$, $p \leq 0.10$ respectively). Finally, facilities that had involved outside parties in their baseline environmental management considerations were more likely to have EPIs in place than those that had not ($p \leq 0.05$).

Significant Changes in Environmental Performance

Of the 51 facilities that had developed baseline EPIs, five did not provide data on changes in their EPI performance. Two thirds of the 46 facilities that did (67 percent) reported at least one significant change in EPI performance during their baseline years. More than 130 EPIs were observed to have significant changes reported in their environmental performance during this period. The median number of significantly changed EPIs per facility was three.

Among the 30 facilities reporting significant changes in their EPIs, three did not provide data on how these changes were accomplished. The significant changes that were reported are distributed across different types of associated changes in practices and procedures. The three most common types of changes in practices associated with significant changes in EPIs were process modifications, operating practice, and product modifications.

REGULATORY PERFORMANCE

Of the 51 facilities that reported compliance data from their baseline period,[36] two reported a total of five major or significant violations. One facility had four major violations, one facility had a single major violation. Seventeen facilities had minor violations – including both facilities that had major violations – with a total of 85 minor violations among them. Aside from one facility that had 30 minor violations and another that had 13, the facilities had less than ten minor violations each. Ten facilities each reported only one or two minor violations.

[36] Eight facilities participating in the EPA study of municipal EMS adoption completed a modified baseline protocol and were not specifically asked about the number or type of violations at their facilities.

Less than one-third (5 facilities) reported monetary fines from these violations. The mean amount levied by regulators on these facilities was $2,445; the median fine was $1,000.

An examination of demographic variables previously discussed sheds little light on differences in the occurrence or frequency of violations at these facilities. No significant differences between the observed occurrence of either violations or their frequency were found between facilities in different sectors or of different sizes. Facilities without prior management experience – either generally, or specific to environmental management practices – were no more likely than facilities with this baseline experience to have reported violations.

During their three baseline years, six of the seventeen facilities that had either major or minor violations also had repeat violations. There were a total of 28 repeat violations, although half of these repeated violations (14) occurred at just one facility. Two facilities each had four repeat violations, and the remaining three facilities reported one, two and three repeat violations respectively.

Environmental Medium and Violation Types

The data show that for the seventeen facilities reporting either major or minor violations during the three baseline years, the most common types of violations occurred in connection with either air or water requirements. Table V-9 presents these major and minor violations, broken out by environmental medium.

COMPLIANCE TABLE V-9: MAJOR AND MINOR VIOLATIONS BY ENVIRONMENTAL MEDIUM

(90 violations reported by 17 facilities)

Environmental Medium	Number of Violations	Median Number of Violations
Water Requirements	67	1.5
Air Requirements	14	0.5
Hazardous Waste Requirements	7	0.0
Other Requirements	2	0.0

Emission or discharge violations were observed most frequently; production and labeling violations were rarely observed, and no remediation or use violations were reported. No significant difference between the types of violations was evident across these NDEMS facilities.

Methods for Discovering Violations

Table V-10 shows the different ways that these facilities were able to discover both their major and minor violations. These data show that during the baseline period, inspections – either by facility operators themselves or by regulators – were by far the most common method for detecting violations. Regulatory inspection was the only method of discovery that appears common for most of these facilities; almost two-thirds (10 facilities) reported at least one violation discovered by regulators.

TABLE V-10: DISCOVERY OF VIOLATIONS

(90 violations reported by 17 facilities)

Methods for Discovering Violations	Violations Discovered	Median Violations
Routine Operating Procedures or Inspections by Facility Operators	55	0.0
Regulatory Inspection	27	1.0
Routine Supervisory or Management Operations	3	0.0
Other Methods	3	0.0
No Information on Discovery Method Provided	2	0.0
Formal Facility Audits (Internal or External)	0	0.0

Times Needed to Discover and Correct Violations

The majority of violations reported by these facilities were discovered and corrected in one day or less, although more than 14 percent were not discovered and corrected for more than two months (Table V-11).

TABLE V-11: TIME NEEDED TO DISCOVER AND CORRECT VIOLATIONS

(90 violations reported by 17 facilities)

Time	Discover Violations	Correct Violations
1 Day or Less	58	61
2–10 Days	5	9
11–30 Days	7	4
1 – 2 Months	3	3
More Than Two Months	13	8
No Information Provided	4	5

Causes and Corrective Actions

While unknown factors were most frequently cited as the cause of violations (40 percent), a lack of proper monitoring (18 percent) and deficiencies in operational procedures (16 percent) were the next most frequently noted.

The corrective action taken most frequently to resolve the cause of violations by these facilities was to obtain required measurements, tests or other documentation (18 percent), and to provide training to employees (18 percent). Updating, revision or re-issue of facility procedures was also frequently cited as corrective action.

Non-compliance and Potential Non-compliance

About half of the 61 facilities submitting design data reported a total of 322 potential or actual non-compliance situations during the baseline period, which they classified as either major or minor in scope.

During the baseline period, 22 facilities reported that they experienced a total of 143 actual non-compliance situations. One facility had 58 actual non-compliances, and another facility had 25 actual non-compliances; together these two facilities accounted for more than half the total number of non-compliances. Aside from one other facility with eighteen non-compliance situations, the remaining nineteen facilities had less than ten non-compliances each.

Nineteen facilities (including eleven facilities that also had actual non-compliances) also reported a total of 179 potential non-compliance situations during the baseline period. These potential non-compliances were problems that might have become violations if the facility had not discovered and addressed them. One facility reported a total of 116 potential non-compliance situations, and two reported more than ten apiece (eighteen and fifteen, respectively). However, the remainder (16 facilities) reported fewer than ten potential non-compliances, the majority (10 facilities) reporting only one apiece.

In Table V-12 the total 322 non-compliance situations (both actual and potential) are broken down by environmental medium or regulatory program. Non-compliance situations for hazardous waste requirements were most frequently cited; non-compliance situations for water requirements were the only other category involved at more than half (60 percent) of these facilities.

TABLE V-12: ENVIRONMENTAL MEDIA AFFECTED BY NON-COMPLIANCES

(322 non-compliance situations at 30 facilities)

Environmental Medium	Number of Non-compliances	Median Number of Non-Compliances
Hazardous Waste Requirements	174	0.0
Water Requirements	110	1.0
Air Requirements	20	0.0
Other Requirements	17	0.0
Unknown	1	0.0

The most frequent types of non-compliance situations involved exceeding permit limits for emissions or discharges (78) and abnormalities in labeling or manifesting (65). Non-compliance with regulated materials use, production and waste remediation was infrequently observed.

Methods for Discovering Non-compliance Situations

Three quarters of the non-compliance situations (75 percent), both actual and potential, were discovered through formal facility audits or routine operating procedures/inspections by facility operators. Non-compliance situations were also discovered, but less frequently, by a variety of other methods (Table V-13).

TABLE V-13: DISCOVERY OF NON-COMPLIANCE SITUATIONS

(322 non-compliance situations at 25 facilities)

Methods of Discovery	Number of Non-compliances	Median Number of Non-compliances
Formal Facility Audits (Internal or External)	138	0.0
Routine Operating Procedures/ Inspections by Facility Operators	105	0.0
Regulatory Inspections	67	0.0
Other Methods	6	0.0
Routine Supervisory or Management Operations	5	0.0
Method of Discovery Not Specified	1	0.0

Time Needed to Discover and Correct Non-compliance Situations

Almost half of these non-compliance situations (48 percent) went undetected for more than two months. These situations were concentrated in less than one-third of the facilities, which took longer than two months to identify at least half of their non-compliance situation. In contrast, the largest proportion (40 percent) identified at least half their non-compliances in one day or less.

TABLE V-14: TIME NEEDED TO DISCOVER NON-COMPLIANCE SITUATIONS

(322 non-compliance situations at 30 facilities)

Time Needed	Discovery of Non-compliance Situations	Correction of Non-compliance Situations
1 Day or Less	103	126
2–10 Days	19	58
11–30 Days	12	71
1 – 2 Months	13	36
More Than Two Months	154	30
Unknown Timeframe	21	1

Many of these non-compliance situations (126) were corrected very quickly: more than two-thirds of the facilities (20) corrected non-compliances within ten days of discovery.

BASELINE ECONOMIC PERFORMANCE

Prior Use of Economic Indicators

Most (64 percent) of the NDEMS facilities reporting EMS design data had developed economic impact indicators (EIIs) prior to or during their baseline periods. Among these 34 facilities, a total of 163 economic indicators were reported. The median number of EIIs reported per facility was four.

Significant Changes in Economic Indicators:

Significant changes in economic indicators were reported by more than half of the 34 facilities during the baseline period. In total, 36 significant changes in EII values were reported. The median number of significant changes per facility was one (Table V-28).

TABLE V-28: FREQUENCY OF SIGNIFICANT CHANGES IN ECONOMIC INDICATORS

(19 facilities)

Number of Significant Changes	Number of Facilities
1	11
2	2
3	3
4	3

SUMMARY

The results of the analyses in this chapter illustrate the baseline demographics and performance history of the facilities that provided EMS design data to NDEMS. While a more in-depth investigation of potential differences between this sample of facilities and all NDEMS participants will be presented in a future chapter, the results presented here do not indicate any systematic differences between these two groups. Though this group appeared to receive smaller fines during their baseline periods ($p \leq 0.10$), these results on the whole indicate that the facilities analyzed in this chapter are an acceptable representation of all NDEMS facilities.

As was noted in the previous chapter, these facilities included diverse business sectors, sizes (measured by employment), ownership types, and prior management systems experience. Many of the facilities that submitted EMS design data also appear to have previously developed a number of the core elements of EMSs, and had already begun to track at least some kinds of environmental performance indicators.

On the whole, the most striking characteristic of this sample is the diverse nature of the facilities' business sectors, sizes and prior experiences. While such a wide range of facility characteristics makes interpretation of EMS design characteristics challenging, it also provides an opportunity to evaluate patterns of consistency between these varied facilities, which is an important consideration in evaluating the public policy implications of EMS adoption.

Chapter 6. Motivations for EMS Adoption: Government and Other Influences[37]

INTRODUCTION

What motivates facilities to introduce an EMS, and what role do government incentive programs – voluntary environmental initiatives (VEIs), such as the EPA and state pilot programs – play in influencing them to do so? This chapter examines the factors cited by NDEMS facilities as influencing their decisions to adopt an EMS.

Over the last thirty years, many U.S. organizations are better managing their environmental activities, although a relatively small proportion of them have chosen to participate in VEI. Little is known about the factors that influence organizations to participate in a VEI and how these motivations differ among various types of enterprises. Previous studies have considered aspects of these decisions (Arora and Cason, 1996; King and Lenox, 2000; Welch, Mazur and Bretschneider, 2000; Khanna and Damon, 1999) as well as attributes of firms' decisions to employ industry codes of conduct (Nash and Ehrenfeld, 1996; Howard, Nash and Ehrenfeld, 2000). These studies, however, only consider either large publicly traded organizations or all types of organizations in aggregate (for example, they include publicly traded, privately owned, government or non-profit operations together), without making distinctions among them. Yet different types of organizations are participating in VEIs, and little is known about their similarities and differences. These prior studies, moreover, evaluate only the external factors that motivate organization's participation decisions. But multiple internal capabilities are likely to play an important role (see for example Cordano and Frieze, 2000; Rugman and Verbeke, 1998; Sharma, 2000; Russo and Fouts, 1997; Welford, 1992; Egri and Herman, 2000; Sharma and Vredenburg 1998; Andersson and Bateman, 2000; Klassen, 2000; Hart 1995, 1997; Christmann, 2000; Florida, 1996). As such, a deeper understanding of organizations' prior internal capabilities seems key in examining the rationales for why different organizations participate in a VEI.

This study addresses these issues by taking an integrative approach, exploring both the external and internal factors that comprise the participation decisions for three types of organizations: publicly traded, privately owned and government enterprises. The first half of this study relates institutional theory to an organization's decision to join a VEI, to assess the

[37] Nicole Darnall led the effort devoted to this chapter. An earlier version was published in Darnall, N. (2003), 'Motivations for participating in a voluntary environmental initiative: the Multi-state Working Group and EPA's EMS pilot program,' in S. Sharma and M. Starik (eds.) *Research in Corporate Sustainability*, Boston: Edward Elgar Publishing. She acknowledges the helpful comments and suggestions from Sanjay Sharma, Mark Starik, Richard N.L. Andrews, Mark Milstein and Deborah Rigling Gallagher, and is particularly grateful to Daniel Edwards, Jr. for his skillful data assistance and thoughtful observations.

external factors that encourage participation. This analysis is then coupled with an examination of the resource-based view of the firm (RBV) to consider the internal factors that influence participation. These two theoretical contexts are then applied to discussion of the three types of organizations to hypothesize how various external and internal factors affect their participation decisions differently. The second half of this study explains the research methods used to test the differences between facility-level decisions to participate in a VEI that encourages environmental management system (EMS) adoption. Using data from the National Database on Environmental Management Systems (NDEMS), the results show that basic organizational capabilities are embedded in their decisions, although some types of organizations possess greater levels of these capabilities than others. The study ends with a discussion of the theoretical implications of this research.

External Participation drivers

External drivers comprise all factors outside an organization that influence its routines and competencies (Aldrich, 1999) and motivate it to participate in a VEI. While multiple theories have emerged which define the factors that influence firms to appear and behave similarly, DiMaggio and Powell's framework (1983) has gained substantial prominence in organizational studies. The authors suggest that three types of external pressures (coercive, mimetic and normative) shape organizational isomorphism.

Coercive pressures are the formal and informal forces exerted on organizations by institutions on which they are dependent. They include regulatory forces, market pressures such as mandates upon suppliers and demands from customers, and cultural or societal expectations, while mimicry refers to the actions taken by organizations to model themselves on other enterprises (DiMaggio and Powell, 1983). Normative pressures are related to professionalism and psycho-emotional factors (Bansal and Roth 2000), and a result of networks such as industry associations and educational processes. When these networks are formalized they have a greater influence on organizational isomorphism.

Building on this framework, recent studies have considered this neo-institutional paradigm by examining the motivators for organizations' decisions to behave in an environmentally proactive manner. They suggest, for example, that regulatory pressures influence organizations' environmental actions (Henriques and Sadorsky, 1996, 1999; Hart, 1995; Jaffe et al., 1995; Hoffman, 2000; Khanna and Damon, 1999; Porter and van der Linde, 1995; Welch, Mazur and Bretschneider, 2000; Arora and Cason, 1996). These pressures come in various forms and include coercive mandates to adopt specific control technology, to apply for operating permits, to monitor and report on its media-specific environmental discharges, to allow regulatory audits of their environmental activities, and to address any emissions violations, potential violations or legal implications of non-compliance. To the extent that organizations can influence the formation of regulation, managing their environmental impacts may serve as a signal to lawmakers to increase restrictions for industry as a whole (Salop and Scheffman, 1983) or to preempt more stringent environmental regulation (Welch, Mazur and Bretschneider, 2000; Lutz, Lyon and Maxwell, 2000). There may also be informal regulatory benefits from participating in a VEI, including increased recognition by government officials and improved relations with regulators.

Regulatory pressures are also taking on a new shape as EPA and states expand their basket of VEIs. Increasingly regulators are offering technical assistance grants as incentives for organizations to participate in VEIs and achieve their environmental goals (Davies et al., 1996). The EPA and Multi-State Working Group on Environmental Management Systems' (MSWG) EMS Pilot Program, EPA's Performance Track Program and EPA's Region I Star Track Program are just a few examples of VEIs that offer participants technical assistance as incentives for participation in programs that encourage EMS development. While still operating as an institutional pressure, these regulatory incentives are less coercive than is the traditional regulatory regime, and as such may lead to greater variation in organizational responses (Jennings and Zandbergen, 1995).

Prior literature also emphasizes the importance of market pressures on organizations' environmental change (Arora and Cason, 1996; Hoffman, 2000; Bowen, 2000; Khanna and Damon, 1999; Konar and Cohen, 1997). Market pressures refer to the interplay of all potential buyers and sellers involved in the production, sale or purchase of a particular commodity or service. Markets include consumers, customers and competitors who are influencing companies to proactively manage their environment management strategies (Hoffman, 2000). As information has become more readily available about companies' environmental activities, customers and firms have increasingly considered the environment when making their purchasing decisions (Arora and Gangopadhyay, 1995; Marshall and Mayer, 1991). Some firms, for example, may seek only to do business with factor suppliers that have adopted certified EMSs, as doing so helps to ensure that their final product is more environmentally conscious (Bowen et al., 2001; Darnall, Gallagher and Andrews, 2001; Darnall et al., 2000). By participating in a VEI suppliers may better satisfy these market demands.

Finally, social pressures also influence organizations' environmental actions (Klassen and McLaughlin, 1996; Henriques and Sadorsky, 1996, 1999; Arora and Cason, 1996; Konar and Cohen, 1997; Welch, Mazur and Bretschneider, 2000; Garrod and Chadwick, 1996; Hoffman, 2000). These pressures are derived from an organization's external constituents that must be actively managed in order to develop effective and successful operating strategies (Hoffman, 2000). Constituents include environmental groups, citizens groups and the media, and can mobilize public sentiment, alter accepted norms and change the way people think about the environment and the role of the organization in protecting it (Hoffman, 2000). Social drivers have gained increasing attention since the 1980s due to the heightening influence of stakeholders on organizational strategy (see for example, Klassen and McLaughlin, 1996; Henriques and Sadorsky, 1996, 1999; Arora and Cason, 1995; Konar and Cohen, 1997; Welch, Mazur and Bretschneider, 2000; Garrod and Chadwick, 1996; Hoffman, 2000; Muoghalu, Robinson and Glascock, 1990; Hamilton, 1995). Part of this changing focus may be due to highly publicized stories of catastrophic environmental disasters such as the nuclear accident at Three Mile Island, the Union Carbide toxic gas leak in Bhopal, and the *Exxon Valdez* oil spill, which have personalized the importance of organizations' environmental management activities (Rajan, 2001).

The basic premise of all of these institutional views is that organizational tendencies toward conformity with external influences lead to *homogeneity* among organizations' behavior (Oliver, 1997). The organization is thus cast as a passive participant that responds to external pressures and expectations. This view is criticized, however, by researchers who argue that organizations are dynamic and evolving, and can respond to external pressures in a variety of ways based on the resources and capabilities that they possess (Oliver, 1997; Perrow, 1986).

As such, an understanding of an organization's prior internal capabilities may identify important factors that affect why different organizations participate in a VEI.

Internal participation drivers

The resource-based view of the firm (RBV) suggests that external factors, while important in shaping organizational strategy, do not necessarily lead to valuable resources (Barney, 1986). Instead, an organization's competitive strategies depend significantly on its specific capabilities (Sharma and Vredenburg, 1998) and its ability to put these proficiencies to routine productive use (Grant, 1991; Collis and Montgomery, 1995; Russo and Fouts, 1997). These capabilities include less tangible knowledge-based advantages such as socially complex organizational processes and reputation based assets (Barney, 1991; Rumelt, 1984, 1991; Penrose, 1959; Wernerfelt, 1984; Oliver, 1997) and are necessarily path dependent in that they are a function of unique organizational actions and learning that accrue over a period of time (Barney, 1991; Hart, 1995).

Applied to environmental management, RBV informs why enterprises might also participate in a VEI. Recent literature in this area can be categorized into two frameworks. The first framework consists of studies that focus on 'human capital' as capabilities that foster environmental action. This framework emphasizes the importance of managerial attitudes and views (Cordano and Frieze, 2000; Sharma, Pablo, and Vredenburg 1999; Sharma and Nguan, 1999), managerial interpretations (Sharma, 2000), environmental values and leaders (Egri and Herman, 2000) and environmental champions (Andersson and Bateman, 2000). In each case key individuals influence management decisions and explain in part why organizations engage in particular environmental activities.

A second framework focuses on 'higher-order learning processes' as capabilities, which are triggered by environmental responsiveness (Sharma and Vredenburg, 1998; Hart, 1995; Christmann, 2000) and continual improvement strategies (Hart, 1995; Russo and Fouts, 1997; Florida, 1996; Rugman and Verbeke, 1998; Sharma and Vredenburg, 1998). This framework focuses on actual management practices and suggests that in order to engage in environmental management practices that rely on higher-ordered learning proficiencies, basic capacities must first be in place (Hart, 1995; Christmann, 2000). For example, to achieve greater levels of internal environmental competency and efficiency (such as product stewardship) an organization must first be proficient in basic environmental capabilities (such as pollution prevention) (Hart, 1995). Organizations that adopt environmental strategies without these basic-level competencies lack the capabilities to support them and are less likely to achieve their organizational goals (Christmann, 2000).

While 'foundational' proficiencies are necessary to lead to competitive advantage, they are not sufficient. Competitors will over time replicate effective learning systems (Sharma and Vrendburg, 1998), and for this reason organizational competencies must be continually improved (Sharma and Vredenburg, 1998; Russo and Fouts, 1997; Hart, 1995) in order to generate a stream of innovations and achieve competitive advantage (Sharma and Vredenburg, 1998). Organizations that possess continual improvement processes, moreover, are more competent at transferring general basic capabilities and generating momentum to encourage commitments in environmental management (Klassen, 2000; Hart, 1995), and achieve proactive environmental change (Lawrence and Morell, 1995; Florida, 1996; Andrews et al., 2001).

An organization's environmental management proficiencies—in both RBV frameworks—depend on its ability to allocate resources toward achieving basic competencies (Russo and Fouts, 1997; Aragon-Correa, 1998; Arora and Cason, 1996). As an organization allocates its resources towards producing a product or service, efficiencies are gained, thus creating slack. Slack allows an organization to pursue innovative projects because they buffer it from the uncertain success of these projects, thus fostering a culture of experimentation (Bowen, 2000). Slack resources also provide a foundation for environmental management by creating opportunities for organizations to develop their internal capabilities and assist them in moving beyond compliance (Bowen, 2000; Arora and Cason, 1996; McGuire, Schneeweis and Sundren, 1988; McGuire, Schneeweis and Branch, 1990; Lawrence and Morell, 1995; Hart and Ahuja, 1996; Waddock and Graves, 1997). More specifically, managers that possess greater levels of discretionary slack (Sharma, 2000) have a greater ability to attempt costly or risky environmental investments (Henriques and Sadorsky, 1996; Ahmed, Montagno and Firenze, 1998).

These two RBV perspectives—the 'human capital' and the 'higher-order learning process'—are complements in that organizational leaders are likely to champion the basic organizational activities that are embedded in the more sophisticated environmental actions which the second framework describes. Data constraints limit this study to considering only the second structure and its role in organizational decisions to participate in a VEI. Within this framework, continual improvement capabilities, environmental management resources and access to resources emerge as factors that may affect organizations' participation decisions.

While organizations' internal resources and capabilities may be controlled by the enterprise itself, different types of organizational structures may affect the enterprise's ability to access them. Various types of organizations, moreover, are also likely to respond differently to the institutional pressures exerted on them. It is thus important to address how external and internal drivers for VEI participation differ among varying types of organizations.

Organizational differences and hypotheses for VEI participation

The population of organizations that are choosing to participate in VEIs varies along many dimensions including size, structure, resources and other factors. However, one key distinction that can be made among the population of enterprises is in the goals that they aspire towards, especially among for-profit organizations—both publicly traded and privately owned—and government organizations. This difference accounts for many broader distinctions that can be hypothesized about the external and internal drivers that motivate organizations to participate in a VEI.

For-profit organizations

Neo-classical economics suggests that both publicly traded and privately owned organizations operate with the goal to increase profits. Ownership in the publicly traded organization is widely dispersed among many shareholders, who themselves do not make the daily decisions about prices, output, employment and other factors. Instead, managers supervise routine operations. Such an arrangement creates a 'separation' in organizational goals, as shareholders wish to maximize their shareholder revenues and managers wish to ensure their job security by maximizing sales (Browning and Browning, 1992). This separation, however, does not diminish the publicly traded organization's ability to increase profits, as managers enjoy some degree of discretion insofar as they are able to achieve a minimum-profit constraint (Baumol, 1976; Alchian and Demsetz, 1972).

Privately owned firms, in contrast, are owned by one or a handful of individuals who operate the business. For these companies, the owner(s) is often engaged directly in decisions concerning which inputs to use, whom to hire or fire and what price to charge for their product. This structure creates a tighter ‘coupling’ between the organization’s ownership and profit-focused goals.

As resources enter either type of for-profit firm, they are allocated toward achieving operational efficiency (Browning and Browning, 1992). If allocated efficiently, the company has a greater opportunity to grow and generate slack resources. There are differences, however, in firms’ abilities to achieve this end, which largely rest on their structural variations. Publicly traded organizations are generally larger than private businesses and are more likely to have a parent company with multiple facilities and divisions. Because of their larger scale of operations, publicly traded firms are also more likely to have a greater market share and greater access to resources for environmentally innovative behavior (Greening and Gray, 1994; Russo and Fouts, 1997; Bowen 2000).

In contrast, the vast majority of privately owned organizations are small and medium-sized enterprises. Because of their smaller presence in the marketplace, private companies are less likely to have the same level of market share and access to resources than are publicly traded firms. The combination of all these factors suggests that private companies will have more modest internal capabilities that support environmental action than do publicly traded firms.

H1: Publicly traded organizations have stronger internal environmental capabilities than do privately owned organizations prior to participating in a VEI.

An organization’s modest internal resources may be moderated, however, by external regulatory drivers. These drivers include government assistance programs in pollution prevention, management system training, environmental monitoring and continual improvement, or government grants to hire consultants. Access to these programs may facilitate privately owned organizations’ decisions to participate in a VEI, because they are less likely to have the higher-order learning processes and capacities to manage their environmental activities.

H2: Privately owned organizations are more influenced by the availability of environmental technical assistance programs than are publicly traded organizations when deciding to participate in a VEI.

Because of their profit-focused goals, market pressures are expected to influence both types of for-profit organizations similarly. There is one exception, however. With their greater market share, publicly traded companies are more likely to have operational units in foreign countries and do business with international customers. For this reason, they also are more likely to be influenced by the demands of international customers.

H3: Publicly traded and privately owned organizations are influenced similarly by all market drivers (except international customers' pressure) when deciding to participate in a VEI.

Finally, as noted earlier, larger-scale organizations generally have greater access to resources. Publicly traded organizations are generally larger than privately owned companies and more likely to have parent companies that can support their facility-level environmental management activities.

H4: Publicly traded organizations have greater access to resources prior to participating in a VEI than do privately owned enterprises.

Government organizations

The generalized view of the government organization is that it exists for the purpose of increasing public welfare. It thus operates differently from the for-profit firm. In making its operational decisions, the government enterprise not only considers the benefits to the organization of its action or inaction, but also the benefits to society. Because of its societal interest, the government organization is more likely than is the for-profit firm to invest in activities that attempt to improve social well-being (Stokey and Zeckhauser, 1978).

Government's ability to improve public welfare, however, is often confounded by the diverging goals between and among its owners, political appointees and managers. Government's ownership is widely dispersed among taxpayers, voters and interest groups who influence the legislative process but do not manage the resulting public programs. Instead, political appointees oversee program implementation while career officials manage the details (Levine and Kleeman, 1992; Ingraham and Rosenbloom, 1990). Both political appointees and career officials have an incentive to ensure their job security, and do so by increasing their political capital and cultivating relationships with influential political actors, rather than pursuing exclusively the goal of increasing social well-being (Wilson, 1989; Kettl, 1993; Blais and Dion, 1991; Levine and Kleeman, 1992; Ingraham and Rosenbloom, 1990). This structure creates a similar (although more extreme) 'separation' in the goals of government enterprises than is seen in the publicly traded firm, and tends to produce goals that are complex and varied and which often conflict with public welfare ideals (Kettl, 1993). It also creates a tendency for government officials to focus on inputs rather than outcomes (Behn, 1981), which further separates the goals of political appointees and career officials from those of the voters, taxpayers and interest groups.

This scenario is further complicated because of government's not-for-profit structure, lengthy documentation procedures and fewer performance criteria (Kettl, 1993). These factors make it difficult for government entities to remove career officials who do not confine their self-interests. Once created and institutionalized, moreover, government operations are difficult to disassemble and the threat of their demise is small, which allows self-interested managers to persist and flourish (Wilson, 1989; Blais and Dion, 1991). Fiscal rules, moreover, restrict more efficient government enterprises from keeping their surplus revenues (Wilson, 1989). Such a structure encourages organizational inefficiencies that are less tolerated by the for-profit firm and hampers government's ability to achieve its social and legislative goals (Kettl, 1993).[38]

Governments' capacity to garner resources also differs from the for-profit organization. The resources available to governmental organizations are derived from the taxpayers and the legislative process, and while the number of taxpayers is vast the resources available to these entities has become progressively more constrained. Since the early 1990s, U.S. voters have become less and less willing to accept additional tax burdens and government's fiscal budgets have become increasingly reduced (Gordon and Milakovich, 1998).

The combination of government's less efficient resource allocation and reduced access to resources hampers its ability to develop assets, capabilities and less tangible knowledge-based advantages that facilitate VEI participation. In the absence of a competitive advantage environment, moreover, government organizations have fewer reasons to invest in developing these capabilities (Kettl, 1993).

H5: Compared to publicly traded and privately owned organizations, government entities have weaker internal environmental capabilities prior to participating in a VEI.

While RBV might suggest that investments in developing internal proficiencies will lead to greater organizational efficiencies, this efficiency argument is undermined because government managers are motivated to maximize their political capital and because government organizations often do not retain the benefits of such efficiencies. For these reasons, the pressure exerted on government organizations to participate in a VEI is more likely to be derived from external factors such as regulatory and social pressures. This is expected to be true for all external drivers except market drivers, as government organizations are less affected by market pressures because of their not-for-profit status.

H6: Government organizations are more likely to be influenced by external pressures (other than market pressures) than internal pressures when deciding to participate in a VEI.

H7: Market pressures exert less influence on government organizations' decisions to participate in a VEI than they do for profit-oriented organizations.

Similar to privately owned companies, government organizations' more modest internal resources may be moderated by external factors including government assistance programs such as those described earlier.

[38] Some researchers have identified similarities among quasi-government institutions and publicly traded organizations. Similarities are evident, for example, between public utilities and for-profit utility providers as well as between the U.S. Postal Service and its for-profit competitors. The characterization offered here, however, emphasizes the differences between traditional government and for-profit firms, and while there are no doubt exceptions to the traditional view, the differences between the goals and revenue sources for government and for-profit firms create inherently different incentive structures for them. The literature on these arguments is voluminous. See, for example, Blais and Dion, (1991); Niskanen, (1971); Tullock, (1965); Borcherding, (1977); Miller and Moe (1983); Kettl, (1993); Wilson, (1989).

H8: Government enterprises, like privately owned organizations, are more likely to be influenced by the availability of environmental technical assistance programs than are publicly traded organizations when deciding to participate in a VEI.

Finally, traditional regulatory pressures are expected to have similar influence on all three types of organizations (Henriques and Sadorsky, 1996). Regardless of an organization's goals, it must address its regulatory compliance or risk the burdens of more intensive regulatory scrutiny and the threat of being sanctioned or shut down. For these reasons, all organizations are expected to seek regulatory relief if it is possible. By better managing their regulatory pressures, moreover, all organizations have the potential to change their relationships with regulators by moving from a highly coercive regulatory regime to a more cooperative one, which is expected to be attractive for all three types of enterprises.

H9: All three types of organizations—publicly traded, privately owned, and government—are influenced similarly by traditional regulatory pressures when deciding to participate in a VEI.

METHODOLOGY

In this chapter, we apply these hypotheses to the decisions of the EMS Pilot Program facilities to introduce EMSs. The facility data included in this analysis are for all pilot program participants that had contributed complete baseline and EMS design data to NDEMS as of June 2002 for the measures of interest. This sample consists of 55 NDEMS facilities (88 percent), and is comprised of 27 publicly traded, 20 privately owned and 8 government operations.

Measures

External drivers

Regulatory drivers were measured by six variables. The first five variables represent traditional regulatory pressures and focus on regulatory compliance. They are measured by whether the organization had incurred at least one environmental compliance violation, non-compliance and/or potential non-compliance during the three years prior to participating in the VEI.[39] These variables were coded as dichotomous responses, 1 if yes and 0 otherwise. In addition, pilot managers reported – using a three-point ordinal scale of high, medium, low[40] – whether they participated in the pilot program because they believed that doing so would improve their compliance with environmental regulations. Finally, two incentive-based regulatory drivers were also included. Using the same three-point ordinal scale (high, medium,

[39] A violation is defined as any environmental non-compliance that resulted in a formal enforcement action against the facility. Similarly, a non-compliance is any non-conformity in fulfilling environmental regulatory requirements that resulted in no enforcement action.

[40] Actual NDEMS data employ a four-point scale ordinal scale (high, medium, low and not applicable). Because of the lack of strong distinction between low and not applicable pressures, these responses were collapsed into a single category.

low), pilot facility managers reported (1) whether they participated in the pilot program in hopes that doing so would lead to regulatory benefits in the future, and (2) whether government assistance programs (including technical assistance, small grants for EMS design training and consultant support, and periodic meetings in which facility managers could share their participation experiences) made participation in the pilot program attractive.

Market drivers were measured by eight variables, all of which were based on facility managers' perceptions. Pilot managers reported on a three-point ordinal scale (high, medium, low) whether they participated in the pilot program because they believed that EMS adoption (1) was being pressured by domestic customers, (2) was being pressured by international customers, (3) may be a valuable marketing tool, (4) may provide a competitive advantage, (5) was increasingly being supported by environmental management professionals, (6) was being pressured by shareholders, (7) might reduce their costs, (8) might increase their revenues. While including information about facilities' factor supplier pressures would also be relevant to include, NDEMS does not contain these data.

Social drivers were the last category of external drivers considered and were measured by the number of public inquiries each facility received about its environmental activities during the three years prior to participating in pilot program. Responses were coded in three ordered categories: less than 10 inquiries per year, between 11 and 50 inquiries per year, and greater than 50 inquiries per year. In addition, pilot managers reported on an ordinal scale (high, medium, low) whether they participated in the pilot program because they believe that (1) outside interested parties were pressuring them to do so and (2) it may be a valuable public relations tool.

Internal capabilities

To measure an organization's continual improvement capabilities, facilities were asked whether they had implemented either Total Quality Management Principles (TQM) prior to EMS implementation or ISO 9000 quality management systems (QMS). The latter measure is a more advanced form of a continual improvement capability that is certified by independent auditors, while TQM is a more basic form. These variables were coded 1 if yes and 0 otherwise.

Facilities' environmental management proficiency was measured by whether they had engaged in any pollution prevention activities prior to adopting an EMS. In addition, a second and more advanced form of pollution prevention capability – whether or not facilities had adopted a formal pollution prevention plan prior to participating in the VEI – was also included (Henriques and Sadorsky, 1996). Both variables were coded 1 if yes and 0 otherwise.

Finally, facilities' slack resources were measured by three variables. The first, facility size (employees), was coded in three ordered categories: less than 100 employees, between 101 and 299, and 300 or more employees. While a more precise measure of organizational slack would have incorporated specific information about discretionary slack (Sharma, 2000) or separated the effects of slack from societal visibility (Bowen, 2000), such data unfortunately were not available. The two parent organization measures also were included to measure slack resources because implementation of environmental initiatives in multi-plant organizations depends on the incentives and the resources available to facilities (Bowen, 2000). It was first determined whether the facilities had parent organizations, and if so whether the parent organization provided EMS adoption assistance (financial support, technical assistances or support from sister facilities). Also considered was whether the parent organization provided their facilities with a template to follow during EMS implementation. Both measures were coded as dichotomous variables, 1 if yes and 0 otherwise.

Responses were grouped by the external and internal drivers described above for each of the three types of facilities. Because two types of responses were elicited—ordinal and discrete—the data were evaluated independently rather than by employing an index. In addition to evaluating the statistical results of the three-point ordinal responses, these data also were assessed by combining high and medium responses and comparing them to low responses. This additional comparison was performed because external and internal pressures that have a moderate or high influence are more likely to prompt organizational action than are factors with low influence.

Data comparisons were performed using Fisher's exact test for contingency tables. This nonparametric approach was employed because the NDEMS sample was necessarily small and as such typical parametric approaches lead to poor approximations and model misspecification (Hess and Orphanides, 1995; Stokes, Davis and Koch, 1995). As the sample size increases, the results from the Fisher's exact test converge to Chi-square. Fisher's exact test was used to determine the strength of the association between each participation driver and the three different facility types.

In adjusting for sample size, Fisher's exact estimates highly conservative *p*-values. For this reason, in addition to conventional levels ($p<0.05$) more liberal levels of significance ($p<0.10$) are also reported (Grusky, 1959; Rice, 1988; Kahn and Goldenberg, 1991; Hirota et al., 1999; Beirle and Konisky, 2000). Two-tailed statistical tests were performed on all comparisons.

RESULTS

Facility descriptions

The descriptive statistics show that publicly traded and privately owned enterprises were largely manufacturing operations (SIC codes 2000-3999), as seen in Table VI-1, although there were a few non-manufacturing facilities (mainly in the electric services industries) that also chose to adopt an EMS.[41] Of the government facilities, five were local governments. The others consisted of two national government facilities and a university.

TABLE VI-1: NUMBERS OF SAMPLE ORGANIZATIONS BY INDUSTRY TYPE

Facility Type	Industrial Type		
• Publicly Traded Facilities (27)	25 = manufacturing	3 = electric services	—
• Privately Owned Facilities (20)	18 = manufacturing	1 = electric services	1 = engineering services
• Government Facilities (8)	5 = local government	2 = national government	1 = university

[41] The sample size constraints unfortunately restricted an extensive examination of the types of industries that these facilities comprise.

Prior to participating in the pilot program almost all of the publicly traded companies were marketing their products (96 percent) and producing their goods internationally (85 percent), as seen in Table VI-2. This contrasts with the privately owned companies, which were more subdued in the international arena. Sixty-five percent of the privately owned companies were marketing their products internationally and 30 percent were involved in international production prior to participating in the pilot program. As might be expected, the government facilities were much less involved in the international arena.

TABLE VI-2: NUMBERS OF SAMPLE ORGANIZATIONS INVOLVED IN INTERNATIONAL PRODUCTION AND INTERNATIONAL MARKETING[a]

Facility Type	International Production	International Marketing of Products
• Publicly Traded Facilities (27)	85% (23)	96% (26)
• Privately Owned Facilities (20)	30% (6)	65% (13)
• Government Facilities (8)	0% (0)	25% (2)
Facility Total (55)	62% (24)	75% (41)

[a]Some facilities were engaged in both international production and foreign marketing of their products, while others were involved in one but not the other. A few facilities were not involved in either international activity.

Finally, all three types of facilities were certifying their EMSs to ISO 14001 while participating in the pilot program, although certification occurred at different rates. Sixty-seven percent of all publicly traded facilities were certified or were in the process of seeking ISO 14001 registration and 75 percent of privately owned facilities were doing the same, as shown in Table VI-3. In contrast, 50 percent of the government facilities were registered or were seeking registration. Other differences were related to the influence of facilities' parent organizations. Compared to single-facility operations, about half as many pilot facilities that belong to a larger organization (73 percent as compared to 50 percent) have certified their EMS to ISO 14001. Parent organizations, as noted earlier, are hypothesized to be an important influence on facilities' access to resources, and are a topic for discussion in the following sections.

TABLE VI-3: SAMPLE'S RELATIONSHIP WITH ISO 14001

Facility Type	Facility with Parent Organization			Single Facility		Total ISO Certified[b] Facilities
	Total	*ISO 14001*	*Parent Requires or Encourages EMS*[a]	*Total*	*ISO 14001*	
• Publicly Traded (27)	96% (26)	69% (18)	85% (23)	4% (1)	0% (0)	67% (18)
• Privately Owned (20)	65% (13)	77% (10)	62% (8)	35% (6)	33% (2)	75% (15)
• Government (8)	62% (5)	40% (2)	20% (1)	38% (3)	66% (2)	50% (4)
Facility Total (55)	***80% (44)***	***73% (30)***	***73% (32)***	***18% (10)***	***50% (5)***	***67% (37)***

[a]EMS may or may not be ISO 14001 certified.

[b]Denotes those facilities that were certified to ISO 14001 or were seeking third party certification to ISO 14001. Facilities that declared 'self-certification' or did not utilize third party registration were excluded from these counts.

External drivers

Table VI-4 summarizes the factors that affect facilities' rationales for EMS adoption. The table describes the influences of the external and internal pressures on participation decisions for the three types of pilot facilities.

Regulatory drivers

Of the external drivers, all three types of facilities reported that traditional regulatory pressures had the greatest influence on their decisions to adopt an EMS. Between 32 percent and 75 percent of each type of facility had experienced a violation, non-compliance or potential non-compliance in the three years prior to participating in the pilot program. Most of the facilities, moreover, adopted an EMS to improve their compliance with environmental regulations, as between 85 and 100 percent of them reported that the possibility of compliance improvement had either a high or moderate influence on their EMS adoption decisions.

TABLE VI-4: FACTORS INFLUENCING PARTICIPATION

Drivers	Facility Type								
	Publicly Traded (n=27)			*Private (n=20)*			*Government (n=8)*		
	H	M[a]	L	H	M[a]	L	H	M[a]	L
EXTERNAL DRIVERS:									
Regulatory Drivers									
1. # Violations[b]	32%	–	68%	37%	–	63%	25%	–	75%
2. # Non-compliances[b]	48%	–	52%	30%	–	70%	75%	–	25%
3. # Potential Non-compliances[b]	35%	–	65%	35%	–	65%	38%	–	62%
4. Improve Compliance	44%	37%	19%	50%	35%	15%	75%	25%	0%
5. Potential Regulatory Benefits	30%	33%	37%	25%	45%	30%	75%	0%	25%
6. Environmental Technical Assistance	4%	7%	89%	40%	15%	45%	25%	63%	12%
Market Drivers									
1. U.S. Customer Pressures	15%	22%	63%	10%	15%	75%	0%	0%	100%
2. International Customer Pressures	15%	22%	63%	10%	5%	85%	0%	0%	100%
3. Potential Marketing Tool	33%	33%	33%	20%	30%	50%	0%	0%	100%
4. Increase Competitive Adv.	37%	52%	11%	35%	40%	25%	0%	25%	75%
5. Environmental Professionals Support EMSs	5%	32%	64%	10%	25%	65%	0%	25%	75%
6. Shareholders/Owner Pressures	13%	13%	74%	10%	5%	85%	0%	0%	100%
7. Potential Cost Reduction	46%	27%	27%	40%	50%	10%	37%	25%	38%
8. Potential Revenue Increases	14%	50%	41%	11%	37%	53%	0%	0%	100%
Social Drivers									
1. # Stakeholder Requests	7%	15%	78%	10%	15%	75%	15%	43%	43%
2. Stakeholder Pressures	0%	5%	95%	0%	0%	100%	0%	0%	100%
3. Improve Public Relations	15%	26%	59%	20%	55%	25%	38%	25%	38%
INTERNAL DRIVERS:									
Continual Improvement Capability									
1. Total Quality Management Principles	56%	–	44%	25%	–	75%	12%	–	88%
2. ISO 9000	67%	–	33%	50%	–	50%	0%	–	100%
ENVIRONMENT MANAGEMENT CAPABILITY									
1. Pollution Prevention Activities	93%	–	7%	95%	–	5%	62%	–	38%
2. Pollution Prevention Plan	70%	–	30%	50%	–	50%	25%	–	75%
Resources									
1. # Employees	74%	19%	7%	45%	20%	35%	50%	0%	50%
2. Parent Organization Exists	96%	–	4%	65%	–	35%	62%	–	38%
3. Parent Organization Offers EMS Financial or Technical Support	96%	–	4%	75%	–	25%	40%	–	60%
4. Parent Organization Provides EMS Template	69%	–	31%	25%	–	75%	0%	–	100%

Note: Sums of percentages that do not total 100 percent are due to rounding.

[a] '–' represents a dichotomous variable.

[b] Represents a discrete variable equal to 0 if facility had no occurrences and 1 if the facility had 1 or more occurrences.

Consistent with Hypothesis 9, traditional regulatory drivers affected all three facilities' decisions similarly, and there was no statistically significant difference between them (see Table VI-5). There were two exceptions, however, which relate to non-traditional regulatory factors. Despite the high pressure that facilities perceive from environmental requirements, the influence of potential regulatory benefits motivated government facilities' EMS adoption decisions more than they did for publicly traded and privately owned facilities ($p<0.02$). It is unclear why these differences exist, but they may be due to the slightly higher number of regulatory non-compliances and potential non-compliances that government facilities experienced prior to participation (75 percent). While regulatory benefits have yet to be realized, pilot facilities had anticipated that they would come in the form of expedited and consolidated permitting. Some facilities also hoped that regulators would waive some state and federal regulations if they achieve environmental results that are superior to those otherwise required by law.

TABLE VI-5: STATISTICAL DIFFERENCES OF INDIVIDUAL DRIVERS[a]

Drivers	Statistical Differences (*p* value <, two-tail test) between:	
	Govt. & For-profit Facilities	**Publicly Traded & Private Facilities**
EXTERNAL DRIVERS:		
Regulatory Drivers		
Regulatory Benefits	0.02	—
Environmental Technical Assistance	0.01	0.01
Market Drivers		
Marketing Tool	0.01	—
Competitive Advantage	0.01	—
Increase Revenues	0.02	—
Social Drivers		
Stakeholder Environmental Requests	0.09	—
Public Relations	—	0.05
INTERNAL DRIVERS:		
Continual Improvement Capability		
TQM	—	0.04
ISO 9000	0.01	—
Environment Mgt. Capability		
Pollution Prevention Activities	0.03	—
Pollution Prevention Plan	0.07	—
Slack Resources		
# Employees	0.10	0.05
Existence of Parent Organization	—	0.01
Parent Organization Provides EMS Template	0.05	0.02
Parent Org. Offers Financial/Technical Support	0.02	0.08

[a] Table only includes variables for which at least one comparison was statistically significant.

Perhaps the most important finding related to regulatory drivers is the role that government assistance programs played in influencing privately owned and government facilities' participation decisions. These programs influenced 55 percent of private organizations and 88 percent of government pilots. In contrast, only 11 percent of publicly traded facilities were motivated by receiving aid ($p<0.01$). These differences support Hypotheses 2 and 8 and suggest that privately owned and government facilities were more influenced than were publicly traded facilities by the availability of environmental technical assistance programs.

Market drivers

In general, market pressures had only a moderate influence on all facility-level decisions and there were no statistically significant differences between publicly traded and privately owned facilities. These findings partially confirm Hypothesis 3, which suggests that while all market drivers influence both types of organizations similarly, they differ in the level of pressure experienced from international customers. Despite the fact that publicly traded facilities operate more in the international domain ($p<0.01$) than do the other facility groups, publicly traded facilities did not experience greater pressures from international customers than did privately owned organizations.

Market drivers are less relevant, however, to government facilities, and confirm Hypothesis 7. These differences are statistically significant ($p<0.01$) across two dimensions—that implementing an EMS in the VEI was expected to be a useful marketing tool and that it might help them gain a competitive advantage. For publicly traded and privately owned facilities, these two pressures had a greater influence on their participation decisions. The other market drivers lacked statistical significance because publicly traded and privately owned facilities also reported them to have a lower relative influence on their EMS adoption decisions.

Additionally, publicly traded and privately owned facilities saw in EMSs the possibility of increasing their revenues (64 percent and 48 percent respectively) and reducing costs (73 percent and 90 percent reported them as high or medium influences), which suggest that these facility managers were considering an EMS as a tool to increase organizational efficiency. In contrast, government facilities only considered half of the efficiency argument. That is, they reported that while reducing costs was an important factor in their EMS adoption decisions, the possibility of increasing revenue was not. Part of this difference may be ascribed to the fact that for-profit organizations derive their revenues from sales, while government organizations are funded through the political process, which generally appropriates funding based on political and legislative factors rather than efficiency arguments.

Social drivers

Social drivers were the least influential of the external drivers for all three types of facilities. While government facilities received more stakeholder inquiries than the other two types of facilities ($p<0.09$), all facilities reported that social pressures had little influence on their EMS adoption decisions. It is worth noting, however, that when designing the VEI, regulators had hoped that the pilot program facilities might be influenced to adopt an EMS if they were offered benefits in the form of enhanced publicity (that is press releases and announcements, media events, pollution prevention awards and highly advertised annual conferences). It appears that increased public relations opportunities did moderately influence all pilot participants' EMS adoption decisions, although less so for publicly traded organizations ($p<0.05$).

Internal drivers

When considering the differences among for-profit facilities, statistical variation in their internal drivers was more prevalent. For government facilities, moreover, while the overall influence of internal drivers was an important factor, regulatory drivers appear more important to their decision to participate in the pilot program, as was anticipated by Hypothesis 6.

Continual improvement capability

In evaluating facilities' continual improvement capabilities, prior to EMS adoption many publicly traded (67 percent) and privately owned facilities (50 percent) had ISO 9000 capabilities in place. Because of this preexisting capability, EMS implementation likely demanded fewer internal resources and was more easily integrated into the facilities' management practices (Sarkis and Kitazawa, 2000). This is a stark contrast to government facilities ($p<0.01$), of which none had in place a certified QMS prior to EMS adoption.

The resource-based view of the firm advises that because TQM practices are a more basic form of the principles embodied in ISO 9000, facilities should adopt TQM practices prior to ISO 9000. In fact, publicly traded facilities have adopted TQM practices at greater rates than privately owned facilities ($p<0.04$). There is no statistical difference, however, between ISO 9000 certification rates by publicly traded and privately owned facilities, despite the fact that ISO 9000 requires additional expertise to implement. Customer requirements for ISO 9000 have no doubt disrupted the natural progression of implementing TQM prior to ISO 9000. Indeed, for those facilities that were not pressured by such influences, simply following the TQM principles may have been sufficient to satisfy their continual improvement needs.

Because of ISO 9000's relatively high prevalence in publicly traded and privately owned facilities, an additional investigation was done to determine its relevance to facility decisions to participate in the pilot program. Environmental managers in five facilities (three publicly traded and two privately owned) were interviewed. They reported that their preexisting ISO 9000 QMS offered a foundation upon which to integrate their EMS. These facility managers all confirmed that in making their decision to participate in the pilot program, they believed that by utilizing their QMS they could reduce the transaction costs of participation, because they were higher up the learning curve in documenting their internal operations. All five facilities, moreover, integrated their EMS into their QMS, so as to formalize their environmental goals as a component of their quality-focused production (see Darnall, Gallagher and Andrews [2001] for fuller discussion).

Environmental management capability.

With respect to facilities' prior environmental management capability, most of the publicly traded and privately owned facilities had engaged in pollution prevention activities prior to EMS adoption (93 and 95 percent, respectively) while only 62 percent of government facilities had done so ($p<0.03$). When considering whether facilities had adopted a formal pollution prevention plan prior to adopting an EMS there is a statistical difference between the three types of facilities, although all three types of facilities actually had pollution prevention plans. Engaging in pollution prevention activities demonstrates a basic level of environmental management capability, whereas a formal pollution prevention plan requires additional levels of organizational commitment, capabilities and transaction costs. As such, fewer of the pilot facilities had these capabilities in place prior to EMS adoption.

Slack Resources.

In comparing facility sizes, 74 percent of publicly traded facilities had over 300 employees and 7 percent had less than 100 employees. Privately owned and government facilities were more diverse, however, in that between 45 and 50 percent of them, respectively, had 300 or more employees. These differences are statistically significant ($p<0.05$). Facilities also differed in whether or not they had parent companies in that almost all of the publicly traded enterprises (96 percent) belonged to larger organizations, while 65 percent of privately owned (p<0.01) and 62 percent of the government facilities had parent organizations. Finally, of those organizations that had parent companies, publicly traded facilities were more likely than privately owned facilities to receive financial or technical support from them (p<0.01) and government facilities were less likely than for-profit organizations to receive this support (p<0.05). Similarly, publicly traded facilities were more likely than either privately owned facilities (p<0.02) or government facilities (p<0.05) to have their parent organization provide them with an EMS template that offered them guidance during EMS implementation. These findings support Hypothesis 4 that publicly traded facilities have greater access to resources prior to participating in the pilot program than do privately owned and government enterprises.

Collectively, the internal driver results offer insight on publicly traded facilities' internal capabilities, as these enterprises had greater overall access to resources and proficiencies that support EMS adoption. They also confirm Hypotheses 1 and 5, which proposed that publicly traded facilities have greater internal capabilities that support VEI participation than do privately owned facilities and government facilities. Government facilities, moreover, had the lowest internal capabilities to support their VEI participation.

In summary, the empirical results offer support for the nine hypotheses, as described in Table VI-6.

TABLE VI-6: SUMMARY OF FINDINGS

Hypotheses:	Evidence Offered
H1: Publicly traded facilities have stronger internal environmental capabilities than do privately owned facilities prior to participating in a VEI	Yes
H2: Privately owned organizations are more influenced by the availability of environmental technical assistance programs than are publicly traded organizations when deciding to participate in a VEI.	Yes
H3: Publicly traded and privately owned facilities are influenced similarly by all market drivers (except international customers' pressure) when deciding to participate in a VEI.	Yes
H4: Publicly traded facilities have greater access to resources prior to participating in a VEI than do privately owned and government enterprises.	Yes
H5: Compared to publicly traded and privately owned facilities, government entities have weaker internal environmental capabilities prior to participating in a VEI.	Yes
H6: Government facilities are more likely to be influenced by external pressures (with the exception of market pressures) than internal pressures when deciding to participate in a VEI.	Yes
H7: Market pressures exert less influence on government facilities' decisions to participate in a VEI than they do for profit-oriented facilities	Yes
H8: Government enterprises, like privately owned organizations, are more likely to be influenced by the availability of environmental technical assistance programs than are publicly traded organizations when deciding to participate in a VEI.	Yes
H9: All three types of facilities—publicly traded, privately owned, and government—are influenced similarly by traditional regulatory pressures when deciding to participate in a VEI	Some

Discussion and implications

This study begins to explain the occurrence of VEI participation by exploring why facilities participated in EMS adoption in the context of the EPA/MSWG EMS pilot program. It extends previous research by evaluating how motivations vary for different types of organizations, emphasizing that both external and internal organizational-level factors comprise participation decisions.

The results of this analysis, while somewhat limited due to sample size constraints, underscore the importance of the U.S. environmental regulatory system as a motivator for VEI participation for all facility types. They also support Henriques and Sadorsky's suggestion (1996) that the presence of the regulatory system itself fosters facilities' decisions to consider environmental management goals as part of their profit generating goals.

The regulatory system, however, while traditionally coercive has recently begun to incorporate incentives for good behavior through the use of VEIs (Davies et al., 1996). This change has created a more cooperative institutional arrangement for organizations that choose to participate in voluntary programs (Jennings and Zandbergen, 1995). It also has resulted in greater variation in the influence that different regulatory incentives have on facility-level decisions to participate in a VEI. More specifically, publicly traded facilities were influenced less by regulatory incentives, while privately owned facilities were influenced moderately and government facilities were influenced greatly by them.

This variation is also likely due to an interaction between external drivers and facilities' internal capabilities. Publicly traded facilities, for example, had stronger internal capabilities that fortified their EMS adoption decisions, making external resources such as government assistance less relevant to them. As such, a greater understanding of organizations' prior internal capabilities appears to be an important factor in examining the rationales for why the different organizations participate in a VEI.

In examining these interactions, a relevant issue that this study brings to the fore is the embedded nature of organizations' internal capabilities and their relationship with external resources. Consistent with previous research, this study shows that continual innovation (Hart, 1995; Sharma and Vredenburg, 1998) and basic environmental management capabilities (Hart, 1995; Christmann, 2000) are embedded in facilities' decisions to employ advanced forms of environmental management such as EMS development in a VEI. Interestingly, while some of the facilities in this study were lacking in these prior capabilities, they relied on external assistance from regulators to fortify their internal capacities, thus enabling them to participate in the pilot program.

As cooperative arrangements between regulators and organizations expand, additional research is needed that explores the interaction between external and internal pressures on environmental change. While several researchers have recognized the importance for such integration of institutional and RBV (Rugman and Verbeke, 1998; Henderson and Mitchell, 1997; Christmann, 2000; Oliver, 1997), the field is ripe for additional explanation and empirical examination. In exploring these issues further, we may better understand the relationship that emerging regulatory arrangements have for organizations' internal capabilities, and whether they may create competitive advantage for the enterprises that utilize them. As future research emerges, it will also be interesting to know how the experiences of U.S. organizations differ from other types of enterprises in different countries.

Finally, in considering future research on EMSs, two additional topics merit future exploration. First, while EMS adoption occurs at the facility level, many facilities' decisions about their environmental management strategies are made at the corporate level. Evidence of this corporate-level influence is seen in the descriptive statistics above: 75 percent of the publicly traded facilities adopted their EMSs because of corporate mandate, and 15 percent more did so because they were encouraged by their parent company. Thus, a key question for future research on EMSs is what factors influence parent organizations to mandate or encourage EMS adoption in their facilities and how they might differ from facility-level adoption decisions.

Second, the results of this study apply to facilities that participated in the EPA/MSWG's EMS pilot program. Future research should study how these facilities and their parent organizations differ from facilities that do not adopt an EMS and whether they differ from facilities that adopt an EMS outside a voluntary environmental program. It is likely that the pilot facilities, because of the program's environmental compliance requirements for participation, had compliance records that were better than average. In order to achieve these better-than-average compliance records, these facilities and their parent organizations were likely to have greater internal capacities than did non-participating enterprises, which suggests that the availability of external resources may be even more relevant for participation by the broader universe of organizations.

There is still much that can be learned about the voluntary environmental management activities that lead to an organization's decision to participate in a VEI. The information presented here provides a framework for exploring these decisions by integrating both the external and internal factors that influence organizational decisions (see Figure IV-1), and offers preliminary evidence about how these factors vary for different types of enterprises.

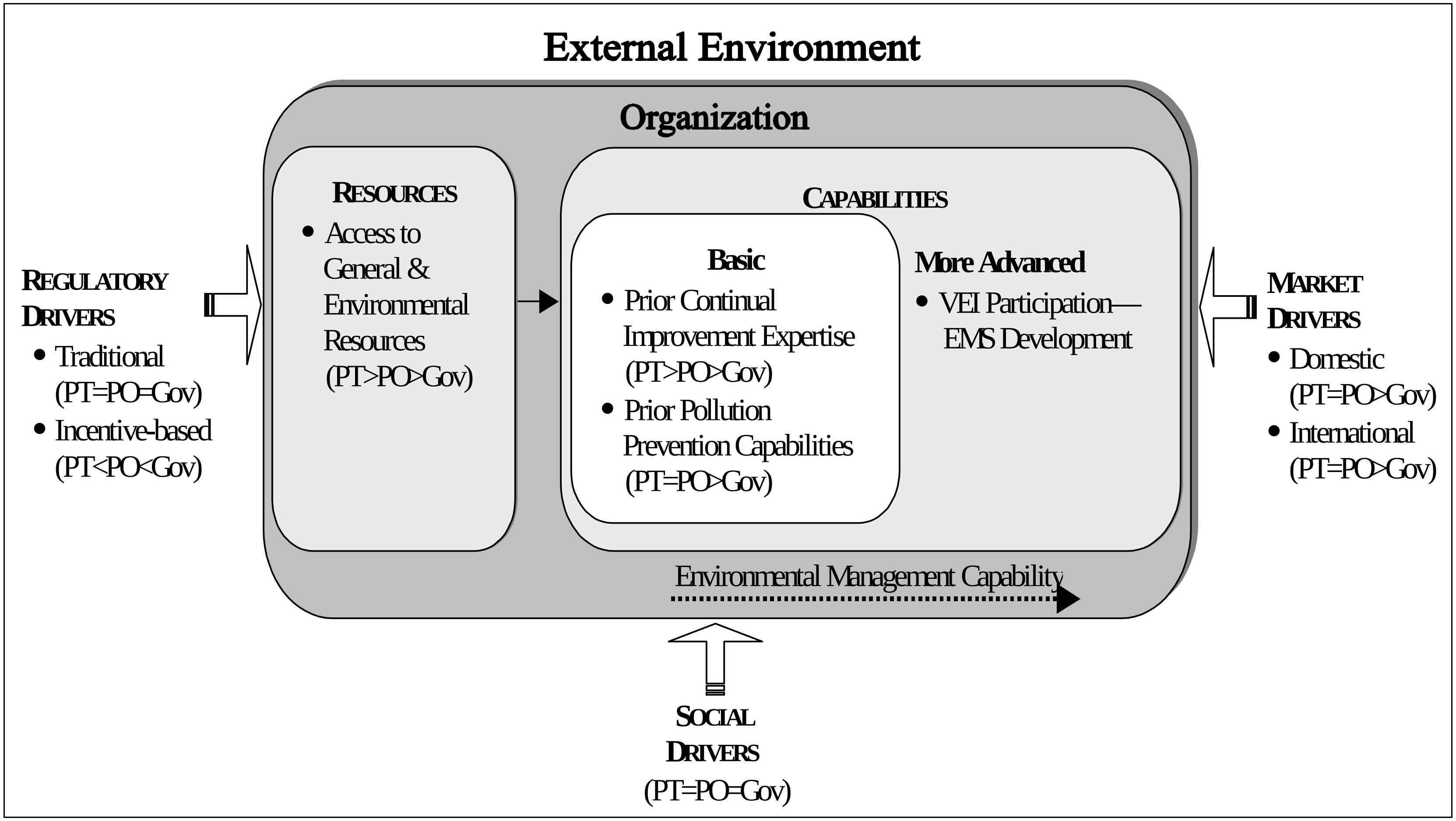

Figure VI-1: Interaction Among External Pressures, Organizations' Basic Capabilities and their Higher-Level Environmental Management Capabilities

('PT' = Publicly traded facility, 'PO' = Privately owned facility, 'Gov' = Government owned facility)

Chapter 7. Similarities and Differences Among Environmental Management Systems

INTRODUCTION

What substantive content and performance does an EMS represent? Adoption and registration of an EMS are voluntary actions, representing at least a desire to signal a commitment to good environmental management practices (Darnall, 2000, 2002). The actual design and content of the EMS, however, are highly discretionary. If an organization wishes to conform to ISO 14001, its EMS must include certain required elements, such as a published statement of environmental policy including explicit commitments to regulatory compliance and prevention of pollution as well as to continual improvement, and a detailed series of planning, implementation, and review procedures. Even within the framework of the ISO standard, however, the scope and content of the EMS, the significance and ambitiousness of its objectives and targets, and other choices are all up to the organization itself. As the introduction to the standard itself states explicitly,

> It should be noted that this International Standard does not establish absolute requirements for environmental performance beyond commitment, in the policy, to compliance with applicable legislation and regulations and to continual improvement. Thus, two organizations carrying out similar activities but having different environmental performance may both comply with its requirements. (ISO 14001:1996, p. vii).

An EMS in practice, therefore, may be focused solely on assuring regulatory compliance or on incremental management improvements, or on pollution prevention, "eco-efficiency" (reducing costs associated with waste of materials and energy), product stewardship, or more visionary goals for environmental sustainability (Gallagher, 2002). If it does not choose to follow the ISO template, it may focus on whatever aspects and objectives of environmental management the organization's officials wish to emphasize.

What then does it signify that a facility has a formal EMS, or even that it has an EMS that is registered as conformant to ISO 14001? What should the CEO of the firm, or a customer or insurer or investor, or a government regulator or interested citizen infer from the existence or registration of an EMS?

This information matters, both to businesses themselves and to their external stakeholders. Unlike previous procedures, such as registration of quality-management systems (ISO 9002), an EMS does not represent merely business-to-business information about product quality or characteristics. Rather, it represents information about environmental performance and regulatory compliance that is important to external as well as internal stakeholders. To corporate-level decision-makers it has implications for regulatory exposure, liability, and reputation based on the practices of its subsidiaries, and some major firms have begun mandating EMS adoption and registration by their suppliers as well.[42] Regulatory agencies also have begun to adopt programs rewarding EMS adoption and registration with favorable public recognition, and in some cases with technical assistance and increased regulatory flexibility.[43] And both consumers and interested citizens want to know what credence they should give to business signals claiming to represent superior environmental performance: does an EMS represent a reliable indicator of good environmental management, or merely "greenwashing" to draw attention away from poor performance?

This chapter provides an empirical comparison of the EMSs of 58 facilities that shared detailed data with the National Database on Environmental Management Systems (NDEMS). Specifically, it compares the scope of the EMS (what range of facilities, activities, products and services were included in the EMS); the environmental activities, aspects, and impacts covered; the significance determination process; and the objectives and targets selected for improvement. Most of the facilities had adopted the ISO 14001 model for their EMSs, and approximately two-thirds of them stated that they had obtained or intended to seek ISO 14001 registration. For all of them, the ISO standard provided a widely available benchmark for comparison of similarities and differences in current practice as to what an EMS contains and means.

THE ISO 14001 FRAMEWORK

The ISO 14001 standard specified a continuous, cyclical process for the design of environmental management systems, consisting of five elements: environmental policy development, environmental planning, implementation and operation, monitoring and corrective action, and management review (Figure 1).

The research reported here focuses on the second element of the EMS process, the environmental planning procedure, in which an organization identifies the environmental aspects and impacts of its activities, sets objectives and targets and dates for management action, and designs its EMS to implement them. This is a crucial stage in the EMS process, which should provide evidence both of the consistency or variance in implementation across organizations, and of the extent of commitment actually being made to improvement in environmental management. What activities are included in the scope of the EMS? What environmental aspects and impacts of these activities do they consider? Which do they determine to be significant, and by what processes and criteria do they decide this? What objectives and targets do they set for improving them? Answers to all these questions must be documented to achieve ISO 14001 conformance, and are important in any case. They provide a valuable source of evidence both for the meaning of the EMS and for the organization's environmental management commitments and priorities.

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[42] Many of the major automobile manufacturers, for instance, have both implemented ISO 14001 EMSs in their own facilities and mandated them for their direct suppliers.

[43] See e.g. www.epa.gov/performancetrack, state regulatory flexibility "green tier" programs in Oregon, Wisconsin and others, and state recognition programs in a growing number of states.

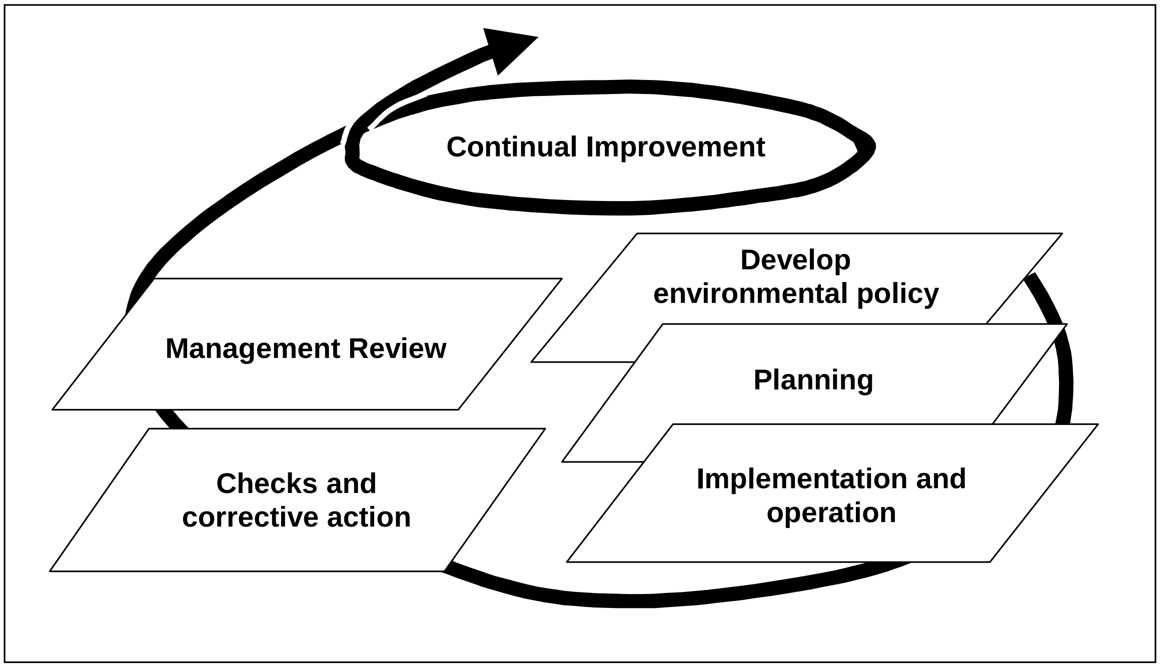

Figure VII-1. Cyclical Process for the Design of Environmental Management Systems

ISO 14001 set out a specific sequence of steps for this procedure, and its companion ISO 14004 guidance document offered additional non-binding direction as to how to carry it out (Figure VII-2). The implementing organization must begin by deciding the <u>scope</u> of the EMS: will it include the entire firm, all operations at a particular site, or just specific functions? Then it should identify the various "activities, products or services" that are included within that scope, distinguishing them in such a way that they are "large enough for meaningful examination and small enough to be sufficiently understood."

Second, the organization should then identify all the "environmental aspects" of each of these activities, products and services. An environmental aspect refers to "an element of an organization's activity, product or service which can have a beneficial or adverse effect on the environment, such as a discharge or emission, consumption or reuse of a material, or noise."

Third, the organization should identify the actual or potential environmental impacts associated with each aspect of its activities. An impact refers to "a change, which takes place in the environment as a result of the aspect, either positive or negative, such as contamination of water or depletion of a natural resource."

Fourth, the organization should evaluate the <u>significance</u> of each of the environmental impacts, using both environmental criteria (for instance the scale, severity, probability, and duration of the impact) and other business concerns (such as regulatory or legal exposure, difficulty and cost of changing the impact, concerns of interested parties, and public image).

Fifth, in light of its significant impacts, the organization should set performance objectives and measurable targets and dates for achieving improvement in them. These objectives and targets should be "quantified where practicable," and "should also take into consideration the views of interested parties."

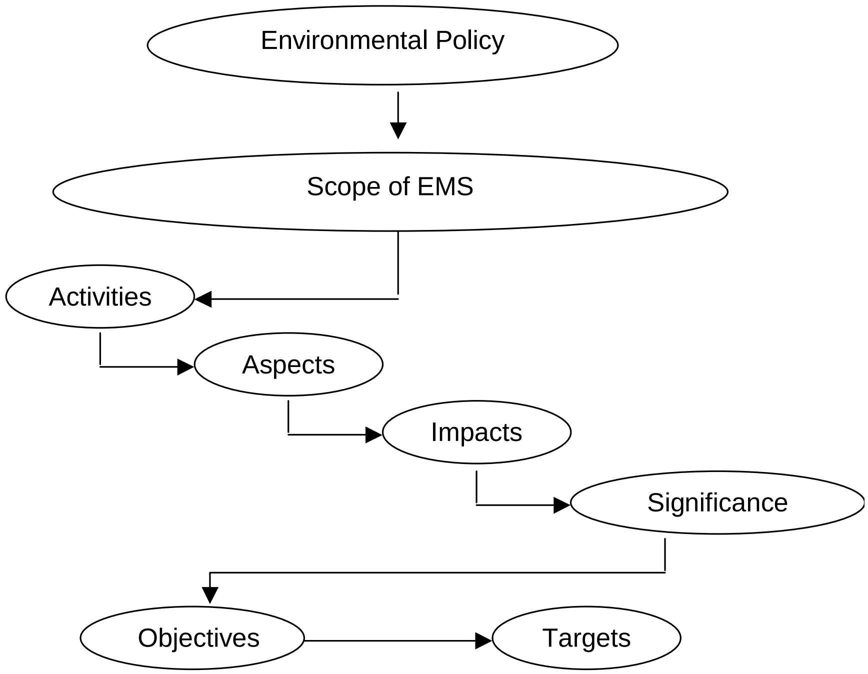

Figure VII-2. EMS Design (Planning) Process

This framework identifies procedural steps quite specifically, but it allows great discretion to each organization to determine the actual content, priorities, and implementation pace of its EMS. One should therefore expect considerable variance in the results. Some variations understandably arise from differences in numbers, kinds, and complexity of operations included in the EMS; in scale and physical extent of the facility; and in the environmental conditions in which it operates, which would in turn lead to differences in environmental significance. Other variations may arise from differences in perceptions and priorities on the part of those developing the EMS, such as environment, health, and safety (EHS) managers, cross-functional teams, non-management employees, consultants, and community and NGO stakeholders if they are involved.

Many interesting and important questions can be asked of these kinds of data. For example:

- Do implementing organizations demonstrate a reasonably similar understanding of each of the terms and steps (activities, aspects, impacts, significance, objectives, targets)? How much variation occurs even in the content and organization of the documents?
- How systematically or superficially do different organizations carry out these steps, and with similar or different levels of detail, allowing for understandable differences in the size and complexity of the facilities?
- Do they use similar or different methods, and similar or different criteria, for assigning significance to particular impacts?

- How similar or different are these documents in their sense of proportion and significance? Do they show similar or different senses of significance or proportion about apparently similar environmental impacts?
- What kinds of objectives and targets do the organizations choose to set? Do they focus, for instance, on environmental performance improvement beyond or in addition to compliance, or merely on better regulatory compliance assurance? Do they focus on quantified improvements in environmental performance and compliance indicators, or merely on intermediate management-improvement actions that might hopefully contribute to better performance? On one-time projects, or on continual improvements toward aggressive objectives for performance improvement?

The comparison that follows is based on a detailed comparative content analysis of EMS environmental planning data from 58 facilities included in the National Database on Environmental Management Systems (NDEMS) that have implemented ISO 14001-based EMSs.[44]

Data were drawn from responses and supporting documents from facilities in 17 U.S. states, representing more than a dozen economic sectors. They included both private-sector businesses (72%) and public-sector organizations such as military bases and wastewater treatment plants (28%). They ranged in size from major manufacturers, electric utilities, and branch plants of large multinational corporations to small independent businesses such as electroplaters and auto parts suppliers. Seventy-nine percent were subsidiaries of larger organizations; 26% were small or medium-sized facilities of less than 100 employees. For most of these facilities the data included detailed documentation of both their activity-aspect-impact-significance assessments, and their objectives, targets and dates.[45] Figure VII-3 shows some of the key characteristics of the facilities as a group.

FINDINGS

Scope of the EMS

The size and complexity of the organization that was covered by an EMS varied greatly, and might or might not include all the most environmentally significant activities.

Within the group examined in this study, EMSs included small businesses conducted in a single building, large but relatively well-defined manufacturing processes on single sites, complex facilities that included many diverse functions and operations on large and heterogeneous sites (military bases, for instance), and organizations operating similar processes at more than one site. To understand an EMS one must begin, therefore, by identifying what domain of activities, products and services it actually covers. ISO 14001, for

[44] Responses were coded independently by two experienced observers, then checked by a third; disagreements were discussed and then recoded by each, then discussed again to resolve any remaining disagreements.

[45] As of the date of their submission of this information to NDEMS. In the majority of cases this was November 2000, with additional submissions and opportunities for updates through September 2002.

instance, clearly states that the scope of any application of its standard must be clearly identified.

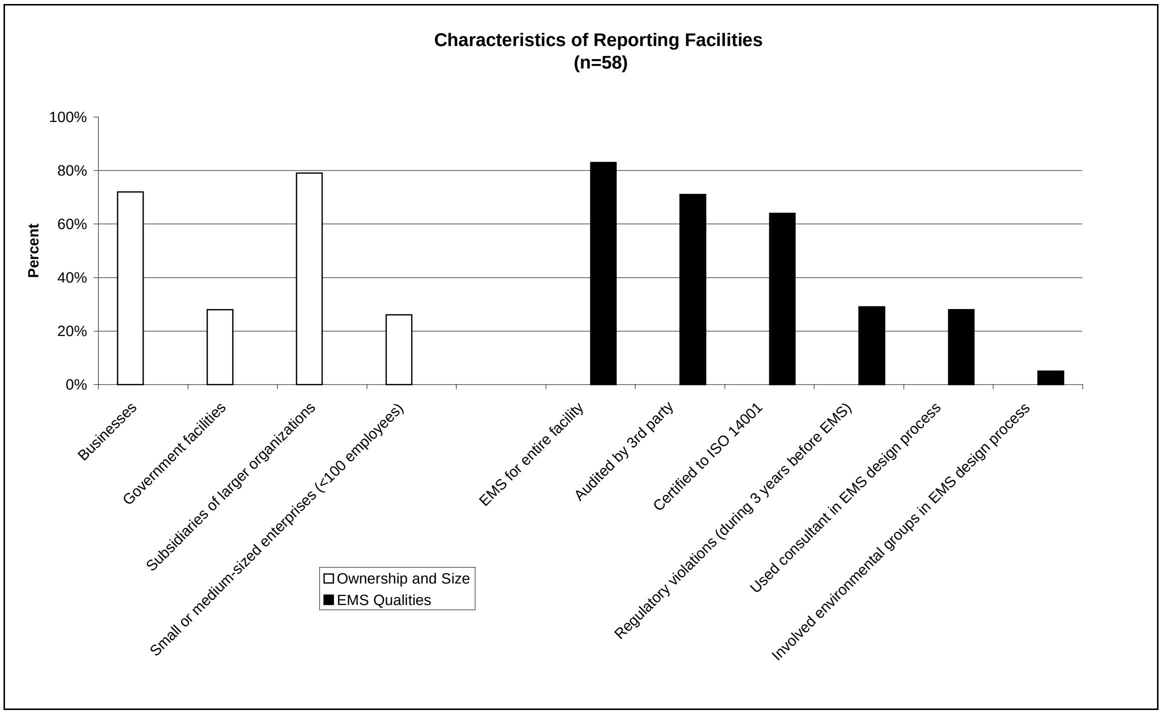

Figure VII-3. Characteristics of Reporting Facilities

The choice of EMS scope led to considerable differences in what activities, products and services are actually included within the EMS. For instance, one facility that was in fact a large and diversified organization chose to carry out an EMS only for its laboratory activities. In other cases, an EMS may not include some functions that are on the same site but are managed by separate contractors. These are perfectly acceptable uses of an EMS, to improve management of specific environmentally important functions, and from a management perspective there may often be legitimate reasons to introduce an EMS for specific functions rather than for an entire facility. But the fact that one function has an EMS does not mean that the organization as a whole is subject to systematic environmental management and performance improvement.[46] It is important therefore that any auditor or user of an EMS begins with a clear understanding of its actual and intended scope, and that that scope not

[46] In another case, a major airline (not one of our pilot facilities) registered its headquarters building—not its aircraft or airport operations, its maintenance and repair functions, its catering services, or any of the other major activities through which an airline might be expected to exert its dominant impacts on the environment—yet then widely publicized its EMS registration. In another case (also not one of our pilot facilities), the cover photograph of the annual report of a large corporation prominently featured the words “ISO 9002” and “ISO 14001,” even though only a small fraction of its constituent facilities were in fact registered to ISO 14001. Such practices are prohibited by ISO rules, but they occur.

overlook important impacts resulting from activities or functions that are not included within it.[47]

In short, an important first question in examination of any EMS should be, "What is the scope of the EMS, and does it include all of the organization's most important environmental activities, aspects, and potential impacts?"

Activities, products and services

Facilities focused their EMSs predominantly on their production and operations activities, and to a lesser extent on their uses of materials and energy. Few included their products and services.

A key element of the ISO 14001 EMS procedure is the systematic identification of the facility's "environmental aspects," which the ISO standard defines as "elements of an organization's activities, products or services that can interact with the environment." (ISO 14001:1996:3.3, *emphasis added*). ISO 14004 guidance directs that an organization should identify the various activities, products and services that are included within the scope of the EMS, distinguishing them in such a way that they are "large enough for meaningful examination and small enough to be sufficiently understood" (ISO 14004:1996(E):8). In principle, such a procedure might logically encompass not only a facility's production processes and operating functions, but also impacts of its raw materials and products and of any other activities or services that might cause significant environmental impacts.

Forty of the 58 facilities (69%) reported information on their activities as a separate category in their process for identifying activities, aspects, impacts, and significance (AAIS). Nine others (16%) listed activities that were identical to their aspects, and 16% did not provide data on their activities. All provided information on their environmental aspects and impacts.

Figure VII-4 shows the broad primary categories of activities and aspects that the facilities considered, and the percentage of facilities that considered each type. At least 48% of the facilities included production-related processes among their activities, and 67% included operations-related processes.[48] Nearly all (97%) considered environmental aspects of their operations, and 65% considered production-related aspects.

Many facilities, for instance, defined their environmental activities in functional or operational terms such as manufacturing, maintenance, construction, housekeeping, grounds keeping, transportation, waste management, and other similar terms. Some broke their activities down into more specific processes and equipment operations: examples included boiler house operations, rinsing, stripping, molding, extrusion, polishing, cleaning, forklift operation, aircraft refueling, airport pavement deicing, grit removal, and many others. A very few even broke their activities down into extraordinarily minute details: for instance drinking fountains, urinals, toilets, showers, janitorial sinks, and shoveling snow. Some listed as environmental

[47] In one facility, for instance, an EMS was done only on operation and maintenance (O&M) functions, yet contemporaneous construction decisions were embedding commitments that would have long-term impacts on O&M.

[48] Note that government functions such as publicly-owned wastewater treatment plants were coded as service operations rather than production unless they were actually producing marketable goods such as biosolids. Twenty-eight percent of the 58 facilities were government facilities. With this proviso, 87% of business facilities and 20% of government facilities included production among their activities.

activities the use of electricity, water, and raw materials, solid and hazardous waste generation, air emissions and wastewater discharges, and land contamination; or even trash, cardboard, and soiled rags.

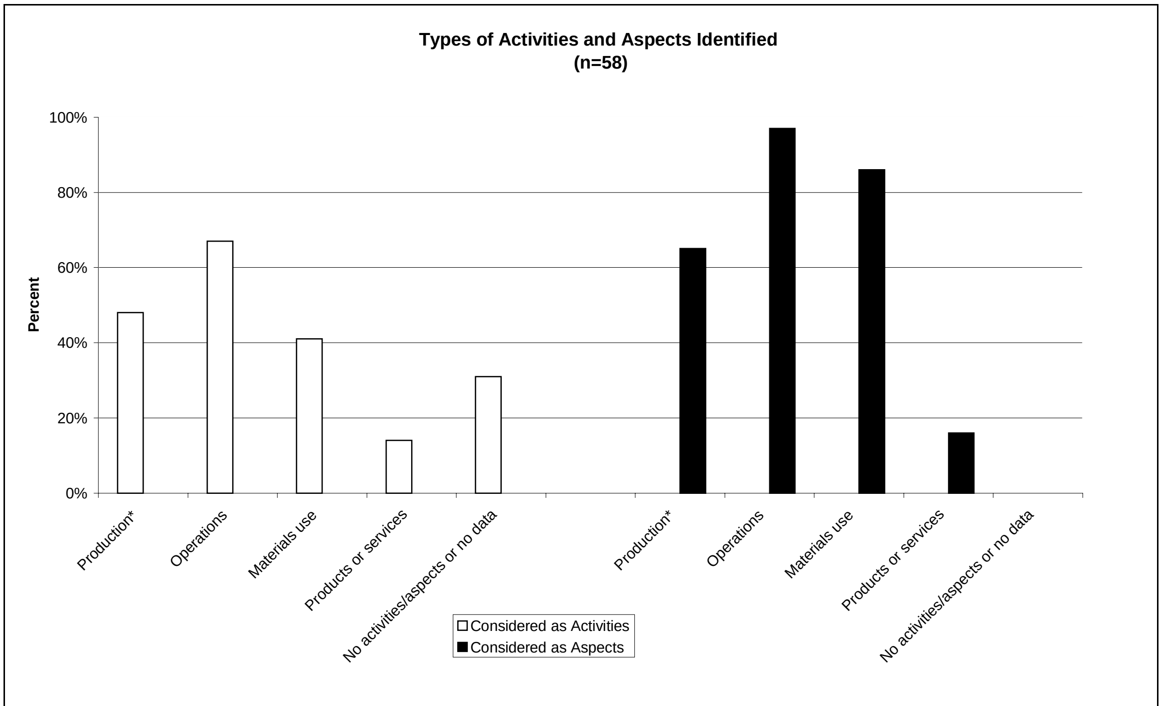

Figure VII-4. Types of Activities and Aspects Identified[49]

Only 60%, however, identified materials uses as activities for consideration, although 86% considered materials uses among their environmental aspects. Examples of materials uses included electricity, water, and various raw materials as well as some specific chemicals such as aluminum sulfate, sodium hydroxide, sulfuric acid, nitric acid, chlorine, cyanide, heavy metals, alcohol, propane, mercury, and others. Those that included materials use included 92% of the facilities that were part of a larger organization, but only 56% of those that were not; they also included 50% of the small facilities, but only 13% of larger ones (p=<0.05).

For some facilities, the products they produce may have far more widespread environmental impacts than the production activities and processes that manufacture them: examples include motor vehicles, pesticides, and chemicals generally, for instance, and undoubtedly many others. The ISO 14001 and 14004 documents specifically recommend, therefore, that the EMS should identify the environmental aspects and impacts of all their activities, products and services. Significantly, however, only 14% of the facilities included products along with their activities, and only 16% included them among their environmental aspects. All these facilities were among those that either were certified or intended to become certified to the ISO 14001 standard; another third of the facilities (34%) also were certified or intended to become certified but did not discuss aspects and impacts of their products.

[49] Note: most public services, such as wastewater treatment, were coded as operations rather than production unless specific mention was made of producing goods such as biosolids for markets. Twenty-eight percent of the 58 facilities were government facilities.

Overall, in short, the facilities in our sample focused predominantly on site-specific operations and production activities, and to a lesser degree on materials and energy use. With very few exceptions, they did not use the procedure to identify or improve environmental aspects of their products.

Aspects

Most facilities identified aspects of their production processes, operations, and materials use that might have environmental impacts, but few paid attention to the potential impacts of their products. Levels of detail varied widely.

ISO 14004 guidance directs that the organization should identify all the environmental aspects of each of its activities, processes, products and services. An environmental aspect refers to "an element of an organization's activity, product or service which can have a beneficial or adverse effect on the environment … [such as] a discharge, an emission, consumption or reuse of a material, or noise" (ISO 14004(E):1996:8). Aspects, in ISO terms, are activities that interact with the environment; impacts are the changes in the environment resulting from that interaction (Tibor 1996).

Not surprisingly, all facilities considered aspects in their EMS design. Over 65% considered production processes among their aspects,[50] and 97% considered aspects of their operations (such as construction, maintenance, waste management, and others); 86% considered environmental aspects of materials use. Only 16% considered environmental aspects of their products, however, and only 12% identified aspects in all of these categories.

Facilities intending to certify to ISO 14001, or even just to use third-party auditors, considered environmental aspects of production nearly twice as often as those that did not.[51] Such facilities also considered environmental aspects of materials use far more frequently than did those that did not intend to do so.[52] Facilities with EMSs that covered the entire facility also considered materials use in aspects more frequently than facilities with less comprehensive EMSs; so did facilities that intended to use third-party audits, and facilities that used a consultant to help identify their aspects and impacts.[53]

The facilities' approaches to aspect identification revealed great differences in levels of detail. Some, for instance, broke their aspects down into very specific sub-activities that might lead to different pollution-prevention or improvement actions. Table VII-1, for instance, shows eight distinct aspects that were identified for one industrial activity, each of which generated different environmental impacts for consideration. "Significance" indicates a judgment by the facility's staff that the aspect or its environmental impact was or was not significant (see further discussion of significance determination procedures below).

[50] As in the coding of activities, some of these organizations were government facilities that did not have market-oriented production functions.

[51] Intended to certify: 78% vs. 43% ($p<0.01$); intended to use 3rd party auditors, 76% vs. 41% ($p<0.05$).

[52] Use 3rd party auditors: 93% vs. 71% ($p<0.05$).

[53] Entire facility: 90% vs 67% ($p<0.10$); used consultant: 100% v 81% ($p<0.10$).

TABLE VII-1. ACTIVITIES-ASPECTS-IMPACTS-SIGNIFICANCE IDENTIFICATION

(Example 1)

Activity	Aspects	Impacts	Significant?
Synthesis	Chemical usage	Raw materials	no
Synthesis	Glassware disposal	Solid waste	no
Synthesis	Glassware cleaning	Cleaning agent disposal	no
Synthesis	Residue from reaction	Solid waste disposal	no
Synthesis	Residue from reaction	Hazardous waste disposal	yes
Synthesis	Cleaning from synthesis	Liquid hazardous waste disposal	yes
Synthesis	Column hardware	Solid waste disposal	no
Synthesis	Heat, oven	Energy use	no
Synthesis	Air emissions	Volatile solvents	no

Note that this facility also used the EMS procedure to discriminate among its impacts, some of which it considered significant in comparison with others, which it did not.[54]

Other facilities, however, identified their activities, aspects and impacts far more generically, to the extent that it was difficult for a reader to determine how this information could be used to plan with any specificity for performance improvements. Table VII-2, for instance, identifies all the elements of the analysis in such generic terms, and with so little specificity, that it adds no obvious value to the user's understanding—even, for instance, to an employee of the organization—of the activities and impacts that could be targeted for improvement.

TABLE VII-2. ACTIVITIES-ASPECTS-IMPACTS-SIGNIFICANCE IDENTIFICATION

(Example 2)

Activity	Aspects	Impacts	Significant?
Facility operations	Air	Environmental impact	Yes
Facility operations	Air	Compliance	Yes
Facility operations	Hazardous waste	Compliance	Yes
Facility operations	Hazardous waste	Environmental impact	Yes
Facility operations	Hazardous waste	Money	Yes
Facility operations	Water	Compliance	Yes
Facility operations	Water	Environmental impact	Yes
Facility operations	Water	Money	Yes

Note that this facility, like some others, also ranked every identified impact as significant, providing no distinctions that might guide users of its EMS as to potential priorities. Such an EMS appears more likely to serve as a formality than a working management tool.

In short, as in the case of activities, aspect identification focused primarily on production, operations, and materials use, with far less attention to aspects of the facility's products and

[54] In this case, using a scoresheet. See further discussion of significance-ranking procedures below.

services. This suggests an important area for potential future attention as part of each facility's commitment to continual improvement.

Impacts

Most facilities considered at least some waste generation, pollution, and natural resource impacts; a minority also considered others such as health and safety or risk. Few considered beneficial impacts. Large facilities and those intending to certify to ISO 14001 considered a broader range of impacts than did others. Government facilities were more likely to consider health and safety and beneficial impacts, and small facilities were more likely to consider risk.

ISO 14001 defines environmental impacts to include "any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services" (ISO 14001:1996:3.4). It focuses on the natural environment, and does not formally include impacts on occupational health and safety although it leaves users free to integrate such additional impacts with the EMS if they wish to do so.

The impacts identification procedure is one of the most important steps – along with setting objectives and targets – in the EMS thought process. In what ways do a facility's activities, products and services actually change the natural environment, for better and for worse, and how significant are these changes?

The overwhelming majority of facilities in this study identified impacts in broad, generic categories, without specification of their details or quantification of their magnitudes. Examples included degradation of air, water, groundwater, or soil quality; use of energy, water, materials, or other natural resources; generation of solid or hazardous wastes, and impacts on landfill capacity; noise; wildlife habitat or endangered species; and in a few cases, cultural resources, pathogens and vectors, or harm to occupational health and safety.

Figure VII-5 shows the percentages of facilities considering each of nine most commonly mentioned broad categories of impacts, as well as statistically significant differences in the consideration of these categories.[55] Not surprisingly, all of the facilities identified impacts associated with their environmental aspects. Of these, 95% identified waste generation as an impact, 93% identified pollution, and 86% identified impacts on natural resources. Large facilities (>100 employees) considered pollution and impacts on natural resources more frequently than did small ones.[56] Facilities that intended to certify their EMS to ISO 14001 also considered natural resource impacts more frequently.[57]

Among the less frequently identified impacts, 62% identified regulatory compliance as a specific impact of concern, 29% identified recycling, and 21% explicitly considered cost.

Interestingly, despite the ISO standard's formal exclusion of health and safety impacts from its framework, nearly half of the facilities (48%) included at least some health and safety impacts, and 17% explicitly considered risk. Government facilities considered health & safety impacts nearly twice as often as did business facilities,[58] and small facilities considered risk nearly

[55] Where breakouts are not shown in the table, no statistically significant variations were found.

[56] Pollution, 98% vs. 80% ($p<0.05$); impacts on natural resources, 91% v 64% ($p<0.05$)

[57] 95% vs. 71% ($p<0.05$)

[58] 75% vs. 38% ($p<0.05$)

three times as often as did larger ones.[59] This appears to represent an emerging advance in EMS practice beyond what was envisioned by the authors and negotiators of the ISO standard.

Despite the explicit emphasis on beneficial as well as adverse impacts in the ISO standard, however, less than a third of the facilities (31%) considered favorable or beneficial impacts: the rest considered only negative outcomes. Government facilities considered positive impacts more than twice as often as did businesses.[60] This is an important issue for consideration by other facilities considering adopting an EMS, and particularly for those considering ISO 14001 registration. In most cases, adverse impacts may well be the most important perceived issues for consideration, so that it is appropriate and cost-effective to focus on them. In some cases, however, organizations' activities may in fact have important impacts on the maintenance of beneficial environmental conditions, and it would be a serious omission to fail to identify and target them for continual improvement. Obvious examples include organizations that manage natural lands, waters, forests, and wildlife habitat (including both public agencies and some businesses).[61] Undoubtedly there are many additional facilities whose activities, products, services, and even organized voluntary efforts make positive contributions to environmental sustainability that should be explicitly considered for continual improvement.

In short, most facilities considered the impacts of their activities on waste generation, pollution, and natural resources, a majority considered impacts on regulatory compliance, and a surprisingly large fraction (nearly half) also included at least some impacts on health and safety. However, less than a third specifically identified positive impacts for continued support and improvement. Large facilities and facilities intending to seek ISO 14001 registration paid attention to a wider range of impacts than did those that were not, and government facilities paid more attention to health and safety and to beneficial impacts than did businesses.

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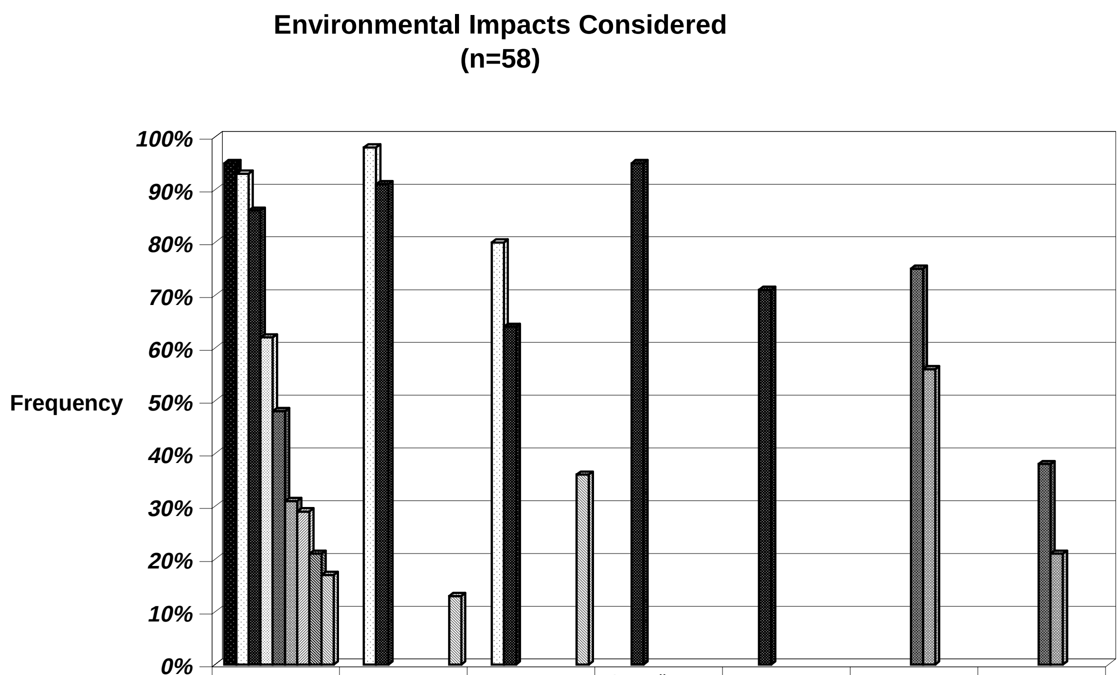
[59] 36% vs. 13% ($p<0.10$)

[60] 56% vs. 21% ($p<0.05$)

[61] One facility also listed its product as a positive impact, because, it said, it makes regulators for boilers and if the product works correctly boilers operate more efficiently.



	Overall	Large	Small	Intending to certify	Not intending	Gov't	Business
Waste generation	95%						
Pollution	93%	98%	80%				
Impacts on Natural Resources	86%	91%	64%	95%	71%		
Impacts on regulatory compliance	62%						
Impacts on health and safety	48%					75%	38%
Included positive (favorable) impacts	31%					56%	21%
Recycling	29%						
Impacts on costs	21%						
Impacts on risk	17%	13%	36%				

Figure VII-5. Environmental Impacts Considered

One important cautionary note is that these statistics represent facilities that reported *at least one* identifiable impact in the specified category. Without a detailed on-site review, it is not possible to evaluate whether or not they have identified *all* relevant impacts in each category, or even all of the most important ones; nor that they have identified them with sufficient precision that the impacts could be better managed. If anything, therefore, these data probably present a more optimistic picture of facilities' use of their EMSs to identify their environmental impacts than might be supported by a more comprehensive analysis.

Significance Determination

Significance meant very different things to different facilities. Nearly three-quarters used a formal scoring system to rank the significance of their impacts, but the factors they considered – environmental impact, regulatory compliance, cost, and others – differed considerably. One EMS may represent a facility that is so thorough in its analysis—or so relatively benign in its overall environmental effects—that it considers even oil-contaminated swabs to be significant environmental impacts, while another may be so focused on major industrial hazardous waste streams or air pollutant emissions—or simply on compliance for regulated impacts—that it has not even thought to identify such aspects as swabs, let alone designate them as significant. Two arguably "similar" facilities may have different EMS design processes and criteria that lead to quite different judgments of significance.

ISO 14004 guidance directs that the organization should evaluate the significance of each of the identified environmental impacts, using both environmental criteria (for instance the scale, severity, probability, and duration of the impact) and other business concerns such as regulatory or legal exposure, difficulty and cost of changing the impact, concerns of interested parties, and public image (ISO 14004(E):1996:9).

Table VII-3 summarizes data reported by NDEMS facilities on their significance-determination processes. Of these, 74% developed a formal scoring system for rating impact significance, while 26% apparently used only managerial judgments – individually or by group process – without a formal scoring system. Facilities with no observed violations developed formal scoring systems more frequently than those that had had regulatory violations, suggesting perhaps a more sophisticated internal management capacity in those facilities than in those that had had compliance problems.[62]

[62] 83% vs. 53% ($p<0.05$)

TABLE VII-3. SIGNIFICANCE DETERMINATION PROCEDURES

PROCEDURE	PERCENT (N = 58)
Used a formal scoring system	74%
Facilities with no observed violations	83%
Facilities with prior violations	53%
Included regulatory compliance as criterion	66%
Facilities with no observed violations	73%
Facilities with prior violations	47%
Facilities planning 3rd party audits	76%
Facilities not planning 3rd party audits	41%
Included cost as a criterion	24%
Identified all listed impacts as significant	16%

Facilities also differed in the factors they considered in determining significance. Two-thirds (66%), for instance, specifically included regulatory considerations in determining significance, while one-third did not; one-fourth (24%) also considered costs in determining significance, while three-quarters did not. Interestingly, facilities that had had no previous regulatory violations, and facilities that intended to introduce third-party audits, both were more likely to consider compliance impacts than were facilities that did not fall into these categories.[63]

Finally, 16% identified all listed impacts as significant, whereas 79% did not (3 responses could not be coded from the information available). In practice, there was considerable variation in facilities' judgments about the significance of their environmental impacts, as well as in the procedures used to determine significance.

At face value this variation is neither surprising nor inappropriate. Facilities vary widely in both their activities and their environmental circumstances, and they design and implement EMSs with varied perspectives and for a variety of reasons. The ISO 14001 was designed to serve as a generic template for use by *all* organizations that believed they could improve their environmental management practices by adopting it, without respect to the actual magnitudes of their environmental impacts. Some of these respondents may have been facilities whose environmental impacts were indeed very significant, not only to themselves, but to their communities and regions, and to the achievement of state, national, or even international environmental goals. Others may have been facilities whose environmental impacts were significant mainly to themselves, to their activities and products and services, and to the values of their managers and the morale of their employees.

If an ISO 14001 EMS serves simply to improve internal management for an organization's own benefit, its judgments of significance are appropriately its own concern. However, to the extent that an EMS is used to signal to external observers the quality of an organization's management practices and environmental performance commitment, its judgments of

[63] No previous violations reported during three-year baseline period before EMS, 73% vs. 47% ($p<0.10$); planning third party audits, 76% vs. 41% ($p<0.05$)

significance should at least be internally consistent, and should address all impacts that an independent observer would also be likely to consider significant.

If external observers are also to rely on an EMS as an indicator of superior environmental performance—for instance, using third-party registration as a basis for government recognition programs or regulatory flexibility—the EMS should also include explicit attention to impacts that are important to external stakeholders, such as the community and government regulatory agencies. As noted in Table 1, only three facilities (5%) involved interested parties external to the organization, such as citizen environmental groups, in the EMS design process. The ISO 14001 standard itself is sufficiently general and process-oriented, and the state of practice at present so diverse, that two arguably "similar" facilities may have quite different EMS design processes that lead to quite different judgments of significance.

Table VII-4 provides five examples of facilities' varied procedures for assigning significance to the impacts of their activities, and of a few of their resulting judgments of significance.

Facilities A and B both used quantitative scoring procedures to rank their impacts. Each, however, also used additional criteria to super-weight regulated impacts. Facility A gave a score of 25 to all regulated impacts (all other impact-based scores were less than eight), and assigned a cutoff value of >7 for ranking other impacts as significant or not. Similarly, Facility B ranked an impact with a score of 334 as significant on the basis of its impact score alone, but not one that had a score of 174; but it then ranked an impact scoring only 39 as significant because it was a regulated activity, even though its actual environmental impact was rated far lower. For this second facility all regulated activities were automatically considered significant. This was a common approach.

In contrast, Facility C ranked all its impacts as significant, for various reasons which were based on qualitative judgments rather than any scoring procedure; Facility D used a worksheet approach but also ranked a large number of impacts as significant, even Q-tip wastes (swabs) soaked with oil or silicone from lubrication; and Facility E was a compliance-focused EMS, whose significance rankings reflected almost exclusively regulatory considerations.

Note also the differences in judgments of significance even about similarly identified types of impacts. Most facilities made distinctions between impacts that they did or did not consider significant, but Facility C (and some others) ranked as significant all the impacts it identified. Only one facility (B) mentioned the environmental impacts of a product among its environmental impacts (this was also representative of the rarity of such judgments among NDEMS facilities as a group). Facility E considered as significant even natural resource depletion due to its toilet usage, while Facility E (and many others) did not consider even its total water usage to have a significant impact on resource depletion. Facility D was also concerned about its sanitary wastewater, but because of potential septic contamination rather than resource depletion.

The intent of these comparisons is not to suggest that any facility is right or wrong in its judgments or its methods for reaching them. Rather, it is simply to document the significant differences that in fact exist among EMSs and among the judgments of significance that they represent. What is significant in the judgment of one facility may not seem so to another.

TABLE VII-4. SIGNIFICANCE RANKING JUDGMENTS AND PROCEDURES (EXAMPLES)

Facility	Activity	Aspect	Impact	Significant?	Basis
A	Mill operations	Effluent discharge	Nutrient loading	Yes	Total rank score = 25
	Mill operations	Scrap board	Decreased raw material use	Yes	Total rank score = 7.7
	Mill operations	Scrap board	Decreased waste generation	No	Total rank score = 7.0
B	Compressors (product)	Compressors (product)	Land	Yes	Impact rating = 334
	Nitric acid stripping baths	Nitric acid stripping baths	Water	No	Impact rating = 174
	pH adjustment	pH adjustment	Water	Yes	Impact rating = 39; permitted activity
C	Oil-soaked rags	Hazardous waste	Release—soil and water	Yes	Hazardous waste is categorically significant
	Municipal trash	Solid waste	Depletion of natural resources	Yes	Solid waste has immediate impact on environment
	Toilets	Wastewater discharge, water consumption	Depletion of nat. resources, POTW contamination	Yes	Semi-controlled potential impact
D	Lubrication	Waste	Q-tips with oil or silicone	Yes	Worksheet: env. and business considerations, frequency, severity, cost
E	Air emissions	Regulated sources	Potential releases to environment	Yes	Stringently regulated
	Air emissions	Unregulated sources	Potential releases to environment	No	Low level of regulation

For a user or reviewer of an EMS, it is therefore essential to ask what impacts have been ranked as significant, and whether or not any impacts that are significant to the public may have been overlooked. ISO 14001 does not require disclosure of this information to the public (though some facilities provide it), but it does direct that the concerns of interested stakeholders be considered in setting objectives and targets. Only a very small minority of facilities as yet appears to have involved external participants in their deliberations about significant impacts.

Objectives and Targets

Facilities set four distinct types of objectives and targets: performance-based, project-based, management-activity-based, and compliance-based. Small and independent facilities on average set more objectives and targets for improvement than did larger facilities and subsidiaries, but their objectives were less often quantified and more often oriented to intermediate outcomes (such as managerial tasks or compliance) than to specific environmental performance improvement outcomes. On the other hand, large facilities and subsidiaries of larger organizations, on average, set a higher proportion of their objectives and targets on actual environmental performance-improvement objectives and on specifically quantified targets for achieving those results.

ISO 14001 defines an environmental objective as an "overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and which is quantified where practicable" (ISO 14001:1996:3.7). An environmental target is a "detailed performance requirement, quantified where practicable, … that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives" (ISO 14001:1996:3.10). ISO 14001 states further that the organization should consider the views of interested parties – along with legal and other requirements, its significant environmental aspects, its technological options and its financial, operational and business requirements – when establishing and reviewing its objectives (ISO 14001:1996:4.3.3).

Fifty-four of the NDEMS facilities reported usable data on objectives and targets. Among them they reported a total of 952 individual objectives and targets, for a median of 11-12 per facility.[64] The mean was higher (17-18), since a few facilities set far higher numbers of objectives and targets. Of the 54 facilities, 81% provided information about specific target dates for implementation of their objectives, and from these data one can determine that 86% of all the objectives and targets reported included specific target dates (month/year) for implementation.

Interestingly, small facilities (<100 employees) set more than twice as many objectives and targets for themselves, on average, than did larger ones (an average of 21 objectives by small facilities versus 9 by larger ones, $p = 0.01$). A similar finding is that autonomous facilities set more objectives and targets for themselves, on average, than did facilities that were subsidiaries of larger organizations (14 by free-standing facilities versus 10 by subsidiaries, $p = 0.10$). These findings suggest that small facilities and autonomous facilities may perhaps be more likely to use the EMS process for active problem-solving throughout their activities, while larger facilities, and those that are subsidiaries of larger organizations, may exercise more screening to improve a few primary organizational priorities. The reasons for these patterns, and their significance for management or policy (if any), are not clear. These relationships might be worth further research.

Third, facilities that had experienced compliance violations set more than twice as many objectives and targets for improvement, on average, than facilities that had not had compliance problems (20 by violators, 9 by non-violators, $p = 0.05$). In particular, small facilities that had had regulatory violations set more than twice as many objectives and targets for themselves, on average, than did all other firms (22 objectives on average for small violators, versus 10 for others). This difference was clearly significant statistically, though it did not mean that the smaller facilities set more objectives and targets that were explicitly performance or compliance related (see below). One possible explanation might be that many of the violations

[64] As with the activities, aspects and impacts, objectives and targets were coded independently by two knowledgeable researchers, and conflicts were then resolved in consultation with a third reviewer.

reported by these facilities were "minor" violations, which often are caused more by careless paperwork or procedures than by violation of emissions standards or of other explicit indicators of environmental performance. Small violators may have had less formalized procedures in place to begin with, and may therefore have used the EMS process to standardize and improve a wider range of their record-keeping and other procedures in order to reduce such violations in the future, even though these improvements do not appear as specifically compliance- or performance-related. Again, however, this possibility deserves further investigation to confirm or refute it.

The facilities' objectives and targets fell into four distinct categories, which can be characterized as performance-oriented, project-oriented, management activity-oriented, and compliance-oriented. Table VII-5 shows the proportions of the objectives and targets that fell into each of these four categories.

TABLE VII-5. TYPES AND PROPORTIONS OF OBJECTIVES SET BY THE FACILITIES

OBJECTIVE TYPES	PERCENTAGE
Objectives related to environmental performance	50%
Objectives related to specific projects	8%
Objectives related to management activities	27%
Objectives related solely to regulatory compliance	15%

In larger facilities a far greater proportion of their objectives and targets were specifically related to performance improvement, rather than simply to management or compliance improvement or to ad hoc projects (50% of their objectives, on average, as opposed to only 29% of the objectives of smaller facilities, $p = 0.10$).

Larger facilities also set a five-fold higher proportion of quantified objectives and targets than did small facilities (50% on average by larger facilities, as opposed to 10% by small facilities, $p = 0.01$). Finally, facilities that were subsidiaries of larger organizations also quantified four times as high a proportion of their objectives and targets as did autonomous facilities (40% for subsidiaries as opposed to 11% for autonomous facilities, $p = 0.10$).

Overall, then, these data suggest a pattern in which smaller and independent facilities tended to use the EMS design process to address a far broader range of objectives and targets for improvement than did larger facilities and subsidiaries, but that many of their objectives were less specifically quantified and more oriented to intermediate outcomes such as managerial tasks or compliance than to specific performance improvement per se. On the other hand, larger facilities, and those that were subsidiaries of larger firms or other organizations, tended to focus their EMSs more specifically on actual performance-improvement objectives and on specifically quantified targets for achieving these results, but also tended not to address as broad a range of potential opportunities for improvement.

It is worth examining examples of these four categories of objectives and targets in more specific detail.

Performance-oriented objectives

If one assumes that the ultimate purpose of an EMS is to promote actual improvement in environmental performance, the objectives and targets one would most like to see are those that specifically address environmental performance outcomes, and that set quantified objectives, targets, and dates for improvement of specific types of environmentally significant impacts.

On average, half of the total number of objectives reported by the facilities related to performance goals (0.497 %). Of the 54 facilities reporting data, 93% of the facilities set at least one objective related to performance, and 50% of the performance objectives included quantified targets and dates. For only one quarter of the facilities (26%), however, were more than 75% of their objectives and targets related to actual performance improvement, and only half were quantified.

Table VII-6 provides examples of some of the most specific and quantifiable performance-oriented objectives and targets, drawn from a number of EMSs. Examples A and B specified precise targets and dates for achieving 10% reductions in hazardous air pollutant emissions and hazardous waste generation. Examples C, D, and E show other forms of performance target quantification, including an index value system used by one facility for measuring energy (and other resource) productivity; Example E shows a quantified target but without clear specification of a target date (this also occurred in some other cases).

TABLE VII-6. PERFORMANCE-ORIENTED OBJECTIVES AND TARGETS

(examples)

EXAMPLE	OBJECTIVE	TARGET	TARGET DATE
A	Reduce hazardous air pollutants by 10%	0.00048 lbs. of HAPs per pound of rubber processed (monthly monitoring)	December 31, 2000
B	Reduce hazardous waste by 10%	3,734 lbs. total (Average = 415 lbs. per month; monthly monitoring)	December 31, 2000
C	Recycle industrial waste (any item that could be disposed of in a sanitary landfill)	Recycle 58% of industrial waste (monthly monitoring)	December 31, 2000
D	Minimize HAZMAT incidents	Reduce trichloroethylene spills to zero	December 2000
E	Increase eco-productivity index for general energy usage	Increase by at least 1.5 points in 2000 and 2001	July 1, 2000
F	Water conservation	Reduce water usage by 5% per million gallons/pounds of product from 1997 level	Not specified

Project-related objectives

A second type of objective and target was specified not in terms of quantifiable performance improvement per se, but in terms of completion dates for specific one-time projects that could be expected to produce environmental performance improvement. What distinguishes these objectives from the previous group is, first, that the actual magnitude of anticipated environmental performance improvement typically is not specified; and second, that the form of the objective is the one-time introduction of a specific change in technology or raw material, rather than a performance goal that could be continually improved further. Of the 54 facilities reporting, 43% had at least one objective related to a project, but one facility devoted over 75% of its objectives and targets to projects.

Table VII-7 shows examples of project-oriented objectives and targets. Examples A, B, and C show substitutions of new materials or processes by specified dates; Examples D and E show elimination of hazardous materials from use (with presumed substitution); Example F shows a target date for substituting a new recycling/appropriate disposal procedure for light bulbs. These project-based targets were equally specific and verifiable as the performance-oriented targets, and lacked only the latter's specific quantification of the actual environmental performance improvements resulting from them.

TABLE VII-7. PROJECT-BASED OBJECTIVES AND TARGETS

EXAMPLE	OBJECTIVE	TARGET	TARGET DATE
A	Reduce disposal costs and future potential liability for cleanup of waste disposal sites	Substitute coolant containing chlorinated paraffin	December 1999
B	Recycle antifreeze	Install antifreeze recycling system	Completed in 1998
C	Reduce mop water sent as waste	Install evaporator with belt skimmer for oil removal	December 1999
D	Eliminate perchloroethylene parts cleaning	100% elimination	June 1, 2000
E	Eliminate use of enamel-based paint and solvents	Eliminate use of enamel-based paint and solvents	Summer 1999
F	Stop landfilling light bulbs	Properly recycle/dispose of all light bulbs	July 30, 1998

Management activity-related objectives

A third category of objectives and targets included management activities that were plausibly steps toward the achievement of environmental performance improvement, either generally or specifically, but that were not directly linked to measurable environmental performance improvement targets. These included for instance employee training, vendor awareness-raising, and communication programs, studies of options for possible process changes to reduce impacts, and even ISO 14001 registration itself (stated by several facilities as a target).

Of the 54 facilities, 70% had at least one management objective and target, and in general almost none of these objectives were quantified. For 9% of the facilities, management-related objectives and targets represented more than 75% of their total objectives and targets. Clearly there is significant room for improvement here, in developing more specific and quantifiable performance objectives and targets for management improvements.

Table VII-8 shows examples of management-activity-related objectives and targets. These sorts of actions can be appropriate and important steps toward environmental performance improvement, but they were both more generally specified and less directly linked to verifiable environmental performance targets than were the previous two categories.

TABLE VII-8. MANAGEMENT ACTIVITY-RELATED OBJECTIVES AND TARGETS

EXAMPLE	OBJECTIVE	TARGET	TARGET DATE
A	Reduce solid waste disposal	Increase employee awareness	December 2000
B	Conduct quarterly safety committee meetings	Conduct 2 meetings	January 1, 2000
C	Assess hazardous materials and environmental awareness survey scores of laboratory workers	See that scores demonstrate improvement over life of the project	Not specified
D	Conduct training for employees regarding recycling	100% of all employees	March 2000
E	Manage vendor activities concerning chemical usage (assure that vendors invited to come to the facility through the Procurement Department are aware of their responsibilities)	Vendor notification sent to all vendors who conduct environmentally impacting operations inside the plant	April 2000

Compliance-related objectives

Finally, a fourth category of objectives and targets included those that specified merely the achievement or maintenance of regulatory compliance, often with a target date of “continuous” of “ongoing” (or not specified) rather than stated as a target date for reaching an improvement level.

Regulatory compliance improvement is one important use of an EMS, but for a few facilities it appeared to be the dominant or even sole category of objectives and targets, with little recognizable attention to continual improvement or to prevention of pollution beyond regulatory requirements. Of the 54 facilities, 50% had at least one objective related to compliance, and on average only one-third of the compliance-related objectives were quantified. For two facilities (4%), compliance-related objectives and targets represented more than 75% of their total objectives and targets.

Table VII-9 shows examples of compliance-oriented objectives and targets. Example A is the most specific, and included a target 50 percent lower than permitted levels by a specified date. The other examples, however, included merely listings of ongoing compliance requirements that the facility was required to meet (including in Example C, for instance, a lengthy laundry list of all the facility’s existing compliance requirements, something not included by most other facilities).

TABLE VII-9. COMPLIANCE-RELATED OBJECTIVES AND TARGETS

EXAMPLE	OBJECTIVE	TARGET	TARGET DATE
A	Decrease CN in wastewater to eliminate violations	CN concentration in effluent from CN oxidation tanks 50% lower than permitted, or 0/60 mg/L	January 1, 2000
B	Comply with FIFRA	Maintain contractor (grounds maintenance) requirements	Not specified
C	Comply with permit for … [34 separate regulatory requirements identified]	PM = 10.82 tons/year, VOC = 1.45 tons/year, pH = 6.0-9.0, … [etc.]	Not specified
D	Continue to implement existing preventive measures and spill response procedures	Maintain preventive and response measures	Not specified
E	Improve wastewater pretreatment quality	Maintain BOD levels in our wastewater discharge less than or equal to 300 mg/l	Ongoing from 11/98

Additional comments on objectives and targets

A few additional observations about the objectives and targets are in order.

First, neither these examples, nor most other NDEMS facilities, included identifiable objectives and targets related to product stewardship goals. Only a very few such initiatives could be clearly identified: for instance, one facility studying alternatives to lead-containing raw materials, a second optimizing its product's life-cycle design, and a third mentioning customer packaging initiatives. One facility mentioned broader watershed-protection planning targets rather than merely facility-specific objectives and targets, but this too was a rare outlier.

Second, the level of detail in the EMS documentation is not necessarily a clear indicator of a facility's level of commitment to improvements in performance beyond compliance. For instance, one facility listed 186 objectives and targets associated with 68 activity-aspect-impact combinations, all of which it judged as significant. However, the objectives and targets were composed primarily of a detailed listing of dozens of routine compliance activities (e.g. "to meet all applicable regulatory requirements at the facility"), with target dates identified simply as "ongoing." This use of the EMS served primarily to document systematically the compliance responsibilities of the EHS staff (to a far greater degree than any other facilities in the sample), in contrast to other EMSs that were more targeted at specific projects for improvement of performance.

Third, all the target dates reported by the NDEMS facilities fell into one of three categories: already accomplished (a few cases), the current year, or "continuous" or "ongoing" (as for instance in maintaining compliance). None mentioned any objectives or targets for two or more years into the future. Many managers would undoubtedly respond that the long term is made up of such successive short-term priorities, and particularly so at the level of specific facilities whose normal preoccupation is simply maintaining or increasing their efficiency, productivity, and market share. Legitimate though it may be, however, it is nonetheless evident that these EMSs so far have focused entirely on short-term objectives and targets rather than including a mix of short- and longer-term objectives and targets.

Fourth, in future research the objectives and targets actually set and achieved by each facility will be among the most important subjects for examination, both by researchers and by government and the public, as an indicator of EMS success. The present study design did not allow us to categorize the relative difficulty/robustness of the various targets and objectives for which environmental performance indicators were reported, nor to identify to what extent these represented “stretch goals” as opposed to easy incremental improvements.

In future research, it will also be important to try to learn whether or not facilities’ objectives and targets do evolve over time toward more strategic and longer-term improvements, or whether they remain oriented to immediate and incremental improvements in compliance and pollution prevention in site-specific production processes. Either outcome may be appropriate in a particular case, but the implications for understanding the full potential and limitations for “continual improvement” in environmental performance are important.

DISCUSSION

This analysis is not intended to praise or criticize any particular facility. Nor is it intended to imply that there is any single correct model of an EMS, or even of an ISO 14001-based EMS beyond the requirements stated in the standard itself, or that all EMSs should look alike. It is intended simply to document and illustrate the range of similarities and differences that exist in current practice. Understanding this range of difference should benefit organizations that may wish to implement such an EMS themselves (or to continue to improve existing ones), and which must therefore address the choices that are illustrated by these similarities and differences. Understanding these similarities and differences is also essential for those in government, in certifying organizations, in other interested parties, and in the public who seek to understand what it may actually mean that an organization has an EMS or an ISO 14001 registered EMS.

If there is any single broad lesson to be taken from this analysis, it is that the content of an EMS—the scope of activities, products and services considered, the aspects and impacts whose significance is identified or overlooked, the objectives and targets selected for improvement, and the organization’s actual performance in achieving them—will probably prove to be more important to examine than the mere existence of an EMS or the fact or absence of EMS registration to ISO 14001. The wide range of variation in practice to date argues strongly against any broad generalization from the mere existence of an EMS (or even of a certified EMS) to an assumption of superior environmental performance. On the other hand, the existence of an EMS (and certainly of an ISO-certified EMS) clearly does constitute a claim that clear information on a facility’s environmental performance and compliance record is easily available to its managers, and could therefore be made available to others if the facility’s managers are willing to do so.

It is therefore reasonable to propose that organizations that wish to capture the benefits that accrue from external legitimacy of their EMS to government regulators, customers, and other interested parties—and not merely from internal cost savings and management improvements—should share more specific information about the content and performance of their EMS than the ISO 14001 standard requires. They may of course choose not to do so if they seek only internal benefits from management improvements, although in so doing they may also risk overlooking the potential value of external suggestions and concerns.

CONCLUSIONS

Facilities have considerable discretion in how they design their EMSs to reflect their environmental goals and objectives and their management priorities and culture. These findings suggest that in practice they exercise this discretion to produce EMSs that differ quite significantly in their interpretations, approaches, and levels of detail, and in their judgments, priorities, and aggressiveness in pursuing environmental performance improvement.

The overall level of detail and complexity of the activity-aspect-impact-significance analyses, and the range of objectives and targets chosen for attention, vary widely. One EMS may represent a facility that is so thorough in its analysis—or so relatively benign in its overall environmental effects—that it considers even snow-blower fuel and oil-contaminated cotton swabs to be significant environmental impacts, while another may be so focused on major industrial hazardous waste streams or air pollutant emissions that it has not even thought to identify such aspects as those considered by the previous facility, let alone to designate them as significant. A third may represent a facility that has achieved or committed to reduce water or energy use, or pollutant discharges or hazardous waste generation, by a significant percentage by a specified deadline; while a fourth may represent a facility that has committed only to stay in compliance, or to achieve unspecified amounts of waste reduction, or to increase employee awareness.

These differences reflect important variations in the process and goals of EMS implementation in different facilities, each of which may have value but for different purposes. For instance, an EMS whose activities and aspects are laid out in a very systematic and concise hierarchy may serve as an efficient management tool for setting objectives and targets to remedy the most obviously significant impacts (or it may merely provide the minimum necessary information for achieving ISO 14001 registration). In contrast, an EMS that contains extensive "laundry lists" of every conceivable aspect may reflect the use of the EMS to encourage and build more widespread employee awareness of all kinds of impacts that could be beneficially improved, whether or not they are the most obviously significant to external stakeholders in their magnitude or risk. From an awareness perspective, an exhaustive list may be better, but from a management perspective a more focused and achievable list may be preferable.

These findings strongly suggest that the <u>content</u> of the EMS—the scope of activities, products and services considered, the impacts whose significance is identified or overlooked, the objectives and targets selected for improvement, and the organization's actual performance in achieving them—will probably prove to be far more important and informative to examine than the mere existence of an EMS or even the fact of ISO 14001 EMS registration.

It is therefore likely that organizations that wish to capture the benefits of registration that accrue from external legitimacy to government regulators, customers, and other interested parties—and not merely from internal cost savings and management improvements—may find it necessary to share more specific information about the content of their EMS than the ISO 14001 standard requires. The fact of ISO 14001 registration should mean that the organization acknowledges that it has such information easily available to share if it is willing to do so. So far, however, with the notable exception of their contributing data to the NDEMS database itself, this sharing of information with outside stakeholders appears to be the exception rather than the norm.

For those organizations that choose to implement an EMS solely for their own internal benefits, however, there is also good reason to believe that it can be a useful and business-justified tool for many management purposes that are chiefly of interest to itself, and perhaps to its customers and vendors, without any necessity for public registration or other forms of external legitimacy. These purposes may include for instance either targeted, project-oriented initiatives to improve environmental management practices in a particularly sensitive department (such as laboratory management); or facility-wide awareness-raising among all employees about the many ways in which improving environmental management can improve management more generally; or development of explicit and consistent training procedures for new employees operating processes that may have significant environmental or health and safety risks; or systematic measures to assure compliance or to reduce costs associated with environmental waste management.

What is most important is that the distinctions among the intended purposes, and related commitments and achievements, of different EMSs be kept clear both to employees and other users of the EMS and to the interested public by those organizations that choose to implement them.

Chapter 8. A Typology of EMSs[65]

INTRODUCTION

Chapter 7 documented many of the similarities and differences among EMSs. Can one take a further step, and characterize an identifiable range of types of EMSs? This chapter proposes that one can distinguish several recognizable EMS types which differ in several key dimensions: in their goals, in the breadth of stakeholder involvement used in their development, and in the extent to which they seek external legitimacy (such as ISO 14001 registration) as opposed to merely internal value. The analysis is based on NDEMS data from the 53 facilities that had provided EMS design data as of the time this analysis was completed.

Facility-level EMSs reflect the unique operating cultures, goals, and levels of experience of the organizations that design them. EMSs may be designed merely to enhance compliance, or in addition to promote pollution prevention or "eco-efficiency" in production processes and operations, or even to promote stewardship of materials, energy, and other environmental impacts and risks throughout the full life cycle of the facility's products ("product stewardship"). They may be designed by a small staff in the facility's environment, health and safety office, or by a broader and more cross-functional working group, or with input from a still larger and more heterogeneous range of employees and even outside stakeholders. And they may be designed to serve differing functions: one may be designed simply for use as an internal management tool, another as a means to achieve external legitimacy.

AN EMS TYPOLOGY

An EMS typology was constructed to compare and contrast the kinds of EMSs that NDEMS facilities built. Within this typology, facility EMSs are described in terms of three dimensions relevant to business and policy scholars, community leaders, regulators and facility managers as they consider the EMSs' structure and content. The dimensions employed to describe facility-level EMSs are based on concepts of goal setting, involvement and legitimacy. These dimensions, shown in a structure delineated by the three axes in Figure VIII-1, include EMS goal, level of external legitimacy, and locus of involvement in EMS design. Each facility's EMS can be located in relation to these three axes and within the three-dimensional space circumscribed by them. Figure VIII-2 shows a set of detailed two-dimensional views of the axes.

Each axis is constructed as a progression toward more involved, ambitious goals, toward higher levels of involvement, and toward increased external legitimacy. Each axis also represents a progression of organizational learning, in which facilities must first develop the capability closest to the origin before they are capable of moving to the second and so on. In the next section, the theoretical basis for each EMS typology dimension is described. In

[65] Research described in this chapter was led by Deborah Rigling Gallagher. David Edwards played a key role in data gathering and analysis.

addition, empirical evidence from NDEMS is presented to confirm the appropriateness of the typology's configuration.

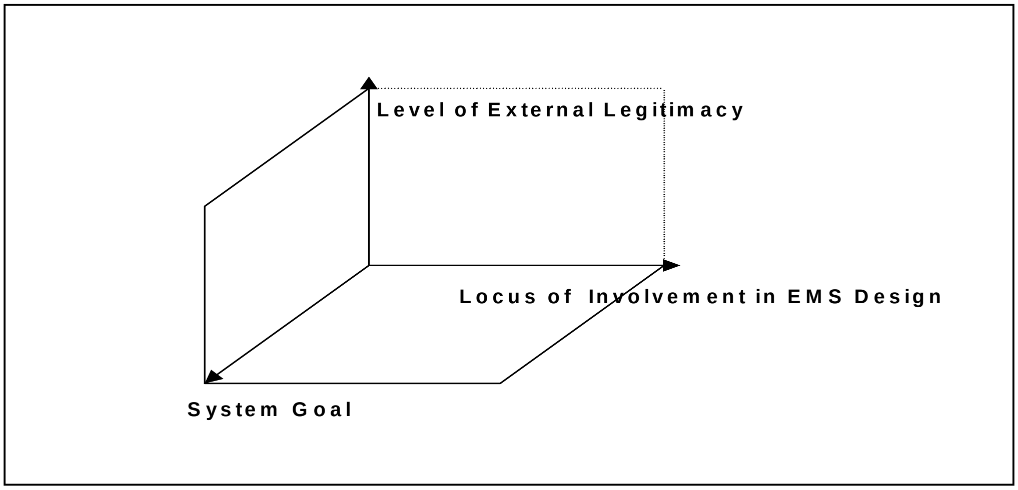


Figure VIII-1: Overall EMS Typology

Locus of Involvement in Design

This dimension represents a progression of possible participants whom a facility may seek to involve in the design, development and implementation of its EMS. Typically a facility's core environmental expertise is located in an office or department of environment, health and safety (EHS). Such offices historically focused on assuring compliance with environmental and health and safety regulations and overseeing the facility's emissions, discharges, waste generation, and pollution control equipment. In many facilities the task of EMS development has been led by this unit's manager, and in some it has been entirely carried out by this staff unit. As a facility becomes more sophisticated with respect to engaging the knowledge and perspectives of actors outside this core EHS group, and more committed to integrating the EMS systematically throughout its business functions, a broader range of participants will be brought into the development of its EMS (Freeman, 1984). An increase in employee involvement in system design and implementation may also improve performance (Hackman and Wageman, 1994, Wehrmeyer, 1996): continual improvement is most likely to occur when the full range of employees with knowledge about facility operations and responsibility for all relevant business functions are involved, because they have far broader and richer knowledge of the kinds of improvements that could be made (Juran, 1989). This involvement empowers more employees thus increases the likelihood of system success.

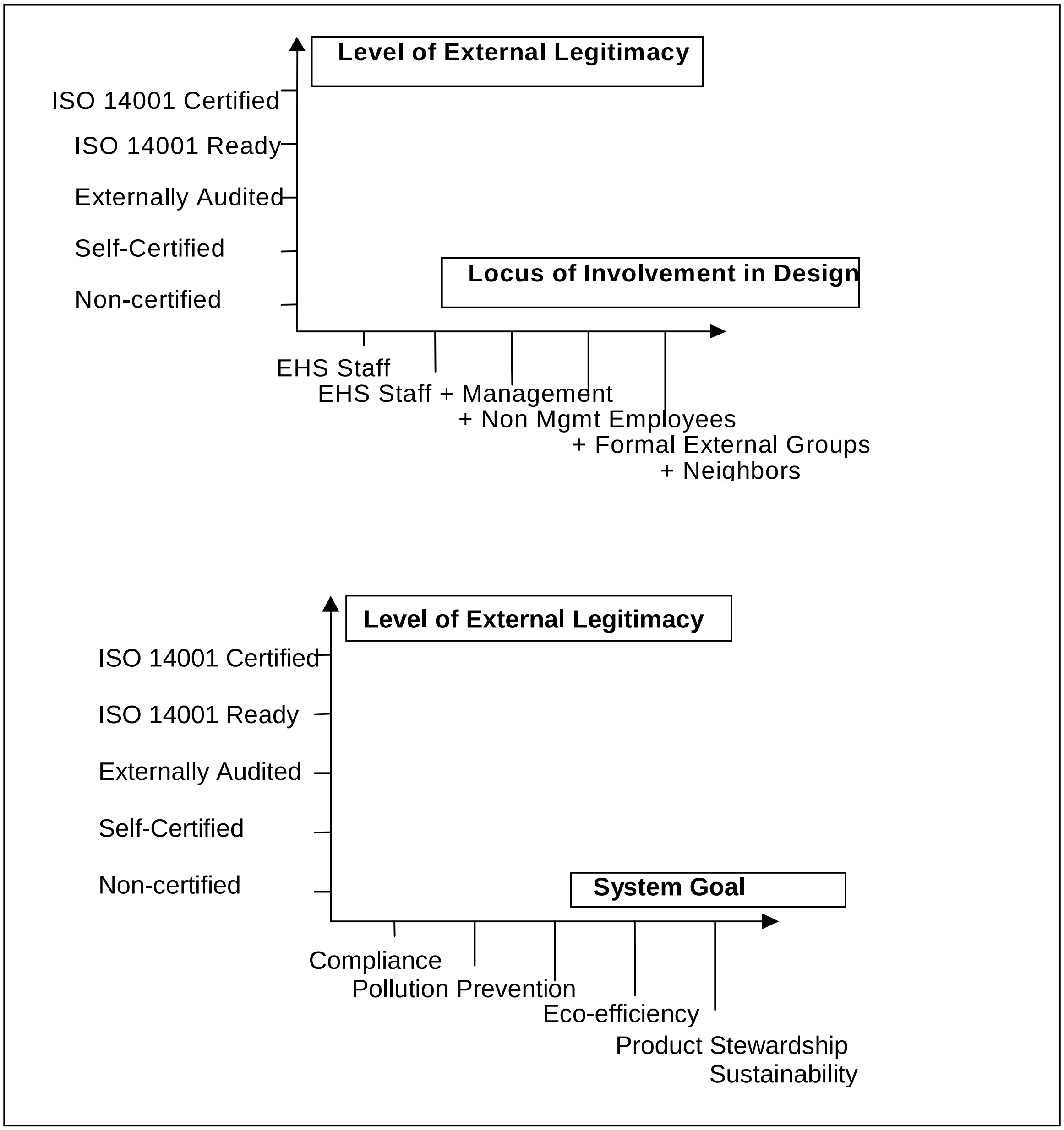


Figure VIII-2: Detailed Two-Dimensional Views

A facility with an environmental management system designed only by the EHS staff is placed at the origin of this axis. This is the traditional locus of responsibility for environmental responsibilities within most facilities. EHS staff typically have established patterns of interaction with, regulators, and may implement their requirements or suggestions or design the EMS on their own with compliance as a goal. In facilities with limited internal resources or expertise for EMS development, consultants may be involved to augment the capabilities of in-house EHS staff.

A facility that also involves non-EHS management employees in EMS development is placed next on the involvement axis. In such facilities the EMS development responsibility is assigned not merely to the core EHS staff, but typically to a working group including managers who are not environmental experts but who know a great deal about each of the business functions that may have environmentally significant aspects. Production engineering, quality managers, and utilities and other operations managers are typically included in such groups; some facilities may also include managers from human resources, finance, and even product design. High-level facility managers and corporate environmental affairs managers may also be involved.

The addition of this type of expertise to EMS design may be beneficial in a number of ways. The facility EMS may be more appropriately designed to fit the particular circumstances, such as those linked to process design, production and product distribution, for example. And when the EMS is implemented it is more likely to have the familiarity and support of a broader range of key managers and be better integrated into the facility's daily work (Wehrmeyer, 1996). Managers actively involved in EMS design will be more able to describe its structure and goals to the employees within their purview and to champion its implementation in daily activities. Finally, there is value in spreading EMS accountability among all facility managers rather than isolating it in the EHS function per se, perhaps in the process reorienting environmental management from an overhead cost function to an element of core business functions, efficiency enhancement and profit-seeking opportunities.

The third point on the axis describes facilities that involve non-management employees as well as managers in developing their EMS. This includes both non-management professionals and hourly wage employees, who may or may not be union members.[66] These employees generally include the full range of workers at a facility, most of whom are not accustomed to being involved in analysis and decision making outside their immediate job responsibilities. Arguably, however, these employees hold the most knowledge about the workings of the facility and potential opportunities for improvement. Their involvement in EMS design serves a number of purposes. First, the day-to-day knowledge provided by this group increases the EMS' suitability to what actually occurs at the facility: the idiosyncrasies of specific processes, practices and equipment are more likely to be addressed. And the involvement of such a group may also increase the chances of successful implementation, by inviting their suggestions and instilling a sense of shared ownership in the resulting initiatives for improvement (Ramus, 1997).

The fourth point on the axis describes facilities that in addition to their internal stakeholders invite input from groups outside their own organization. Such groups may be environmental, business or local government groups with whom the facility may already interact, or whose input facility managers believe will aid in improving the EMS. Examples of groups in this category include non-governmental groups (NGOs) such as the Sierra Club or Audubon Society, and governmental groups such as the Local Emergency Planning Committee (LEPC) or city council. The addition of these groups' perspective about the environmental impacts of the facility provides a source both of additional information about impacts and priorities that

[66] It may also include the involvement of contractors or vendors.

are significant to the surrounding community, and perhaps of additional suggestions for improvements that might otherwise be overlooked.

The final point on the axis represents facilities that seek broader input from unaffiliated individuals such as neighbors. This type of facility-neighbor interaction may be ad hoc as the EMS design efforts unfold, or it may become more formalized in an ongoing community advisory panel (Lynn & Chess, 1994). Most facilities in the past have not engaged interested individuals or neighbors in their environmental management decision processes, in part out of historical attitudes concerning business rights, trade secrets and liability and also because it is difficult to identify them and support their input without the resources of a formal organization such as an NGO. To address this issue, a number of companies, especially those in the Chemical Manufacturing Association's Responsible Care© Program,[67] have set up community advisory panels, which provide a forum for neighborhood and other concerns to be heard (King and Lenox, 2000; Prakash, 2000).

USEPA and state regulators, including a number of the states participating in the NDEMS pilot program, have identified external stakeholder involvement in EMS development as an explicit goal and in some cases even a requirement of participation in the EMS pilot program (see discussion in Chapter 3). In addition, the ISO 14001 EMS standard stated specifically that the views of external parties should be considered in determining the significance of environmental aspects and impacts and in setting objectives and targets for improvement. Recent research studies also suggest that high levels of employee involvement in manufacturing operations may lead to improved performance through the creative initiatives of workers at all levels (Pun, Chin and Gill, 2001; Ramus and Steger, 2000). A recent study of ISO 14001 EMSs also identified improved industrial relations with their communities as a significant benefit of stakeholder involvement in EMS development (Morrison et al, 2000).

Facility data on the internal and external actors involved throughout the EMS design were used to determine the characteristics of facilities' locus of involvement in the process. The EMS design phases examined to determine overall locus of involvement score included environmental policy development, aspect and impact identification, significance determination, and objective and target setting. The level of involvement of EHS staff, management and non-management staff, and formal and informal external groups during key phases of EMS design, were considered in assigning a locus of involvement score to each facility. Three coders first individually examined facility responses to specific research protocol questions and assigned scores. Coders then met to resolve any scoring differences. The level of congruence between coders was almost 100%.

A score of zero was assigned to each phase of the facility's EMS design process if only corporate level EHS managers were involved (that is, no facility-level staff participated). A score of one (1) was assigned if solely EHS staff were involved, 2 if EHS staff and management employees were involved, 3 if EHS staff, management and non-management employees were involved, 4 if EHS staff, management and non-management employees and formal external groups were involved, and 5 if EHS staff, management and non management

[67] Responsible Care was developed in 1985 to improve the chemical industry's image with the public related to environment, health and safety. It provides members with a voluntary code of conduct designed to improve performance. CMA monitors and enforces against member facilities' use of the six-component code, which includes a requirement that facilities communicate with the surrounding community regarding their environment, health and safety activities.

employees, formal external groups and unaffiliated individuals such as neighbors were all involved. Facilities were then assigned an overall locus of involvement score, derived by summing and then averaging scores for the individual phases. Facility scores for level of involvement ranged from 0.5 to 3.75, with a mean score of 2.30 (Table VIII-3).[68]

Results of this analysis show that the NDEMS database includes examples of facilities at each stage on this axis of involvement, and some indications that facilities progress from initial to higher-involvement stages (Gallagher, 2002). NDEMS facilities typically involved EHS staff before engaging the support of non-environmental managers, non-management employees, NGOs and non-affiliated individuals respectively. Only three NDEMS facilities, all of which were explicitly required as pilot program participants to involve external NGOs in the EMS design process, involved external stakeholders without first having involved non-management employees in EMS development.

Level of External Legitimacy

This second dimension of the typology describes differing and increasing levels of external legitimacy associated with an internal, audited, or formally certified EMS. Facilities seeking certification for their EMSs under the ISO 14001 standard are paying for an extra process of external auditing and registration by a third-party organization in order to add external legitimacy for their system. A certified EMS is a signal to regulators, customers, parent corporations and neighbors alike that the EMS conforms to a certain externally defined standard (Darnall 2000, 2002). Companies that achieve ISO certification often advertise this achievement widely, even decorating their facilities with banners attesting to their status.

The progression of this axis reflects the extent of the facilities' pursuit of such external validation and legitimacy. At the first and most limited point on this axis, a facility designs an uncertified EMS, which serves only to improve its internal management procedures. It then may or may not seek to "self-certify" such an EMS by instituting an internal audit process. If it seeks a further degree of external legitimacy for its system, it may also commission an external audit by a qualified environmental management system auditor. At this point the facility is considered "ISO-ready." Under the ISO 14001 EMS framework, the final certification is conducted by a Registrar, which will examine the facility's EMS in detail for specific conformance to the EMS standard (Puri, 1996) and also conduct follow-up surveillance audits at intervals throughout the three-year period of the facility's ISO registration. Registrars are typically engaged for the three-year period of the facility's ISO certification. A registrar first completes an initial audit of the facility's EMS, noting any elements needing improvement. After any needed improvements are made, the Registrar re-audits the facility. When the Registrar determines that the facility's EMS includes all the requisite components and conforms to the ISO requirements, its EMS is registered as conforming to that standard.

From the perspective of public policy, the final point on this axis, certification (registration), appears to signal a higher level of external legitimacy than a facility that is not certified, as the facility's EMS has been reviewed by a presumably independent and competent auditor and certified as conformant to a standard for such processes. Certification is a signal to external

[68] In one case, a score of 0.5 was assigned for an EMS that was developed by corporate staff with only limited facility-level involvement.

actors that a facility's EMS encompasses the administrative requirements of the standard to which it is certified, and is implied by some advocates to mean that its environmental performance may be presumed to be better as a consequence. However, ISO 14001 certification does not guarantee a specific level of environmental performance, nor even assure compliance with environmental regulatory requirements.[69] Issues such as the reliability and consistency of ISO 14001 certifications, their relationship to actual environmental performance indicators, and the differing expectations and assumptions concerning certification by various stakeholder constituencies were addressed in a recent report by the National Academy of Public Administration (NAPA, 2001). Some organizations have chosen not to seek ISO 14001 certification even though their compliance and environmental performance are good, either because of the costs and burden of doing so or because they do not feel they need this extra form of external legitimizing . In short, certification is a clear indicator of a facility's pursuit of external legitimacy for its EMS, but not necessarily of whether its actual performance would warrant greater legitimacy over that of a firm that was achieving high environmental compliance and performance but chose not to seek certification.

Data on facilities' stated certification intentions were used to determine the level of external legitimacy. These data originate from two sections in the EMS design protocol: Section 12, "Environmental Management System Audits" and Section 14, "ISO 14001 Certification." Based on their answers to specific questions in these sections, facilities were assigned scores for level of legitimacy as shown in Table VIII-1.

TABLE VIII-1: LEGITIMACY-LEVEL SCORES

DESCRIPTION OF LEVEL OF LEGITIMACY	SCORE
• Non-certified EMS	1
• Self-certified EMS	2
• Externally audited EMS	3
• ISO14001-ready EMS	4
• ISO 14001-certified EMS	5

The results of this analysis show that NDEMS study facilities appear to follow the level of legitimacy progression described by this typology (Gallagher, 2002). However, a significant number (34 out of 53) of facilities had not chosen (as of the data of the analysis) to pursue the final level of external ISO 14001 certification. Legitimacy-level scores for the 53 facilities ranged from one to five with a mean score of 3.58, as shown in Table VIII-3 below.

System Goal

The final axis, the EMS goal dimension, describes how EMSs differ – and arguably, develop – from limited and mandatory environmental goals such as regulatory compliance to more far-reaching and proactive goals such as environmental stewardship and sustainability. Previous research studies on environmental management by businesses have proposed that facilities

[69] The ISO 14001 standard requires a commitment to compliance, as well as to prevention of pollution and to continual improvement in the performance of the EMS system, but it does not require actual compliance or superior environmental performance as preconditions of conformity registration.

move along a continuum of focus from conformance to voluntary commitment, from compliance with regulations to reduction of environmental impacts (Sharma, 2000). This progression is possible through the acquisition of higher-level capabilities such as open systems functioning and organizational learning (Russo and Fouts, 1997; Sharma and Vredenburg, 1998).

In this study the environmental goals of facilities designing EMSs are placed on a similar continuum, from compliance to sustainability. At the most basic level of environmental commitment and capability, facilities may seek to use an EMS simply to assure compliance with environmental laws and regulations. In most EMS standards the articulation of a commitment to compliance is a minimum requirement for certification. Facilities with more sophisticated capabilities and more farsighted commitment to environmental performance improvement, however, may also use the EMS to achieve higher, more voluntary and more proactive goals.

A second level of this continuum is pollution prevention, in which waste streams are reduced or eliminated at the source rather than simply managed by pollution control technologies and other practices required for regulatory compliance.[70] Examples of pollution prevention include improved operation and maintenance, input substitution, and process redesign. Pollution prevention efforts are often motivated by management decisions to reduce their potential liability for the consequences for pollution, as well as to reduce the costs of practices that are both polluting and economically costly, such as over-use of cleaning chemicals. Some of these practices also form the initial steps toward the third level of the environmental performance goals continuum, eco-efficiency.

The third step on the goal continuum focuses on "eco-efficiency:" that is, on the use of the EMS to achieve more systematically cost-efficient usage of environmental input resources such as electricity and water in product manufacturing or service provision, and to minimize resource use and adverse environmental impacts per unit of production or product value (World Business Council for Sustainable Development, 2000). This step requires more systematic monitoring of additional environmental input, impact and performance indicators than does compliance or pollution prevention, as well as the development of additional knowledge about the impact of resource use and other environmental impacts on both the facility bottom line and the environment.

All three of these initial points on the goals axis typically are limited to site-specific production processes and related operations and services. A fourth level of environmental performance goals expands this focus to include the impacts of the facility's products. Businesses at this point on the continuum may integrate product stewardship considerations into their EMS, including the impacts – and opportunities for environmental performance improvement, such as changes in product design – throughout the product's life cycle, from the raw materials used by suppliers through the production and distribution processes to the risks and consequences of its end use and disposal or recycling by consumers. High-impact materials may be reduced or eliminated from products, and product designs may be

[70] This usage follows USEPA's definition of pollution prevention, which is specifically focused on reduction of pollution at the source. The ISO 14001 definition of "prevention of pollution," defined by negotiations among business stakeholders, includes any measures that prevention pollution releases to the environment, including end-of-pipe control technology.

reconfigured to reduce risks in use and disposal; product take-back programs may be instituted. A product stewardship focus is implemented by the application of technical resources such as design for the environment (DfE), materials accounting or life cycle design (Hirschhorn and Oldenburg, 1991; Hart, 1995). The ISO 14001 standard specifically mentions consideration of products as well as activities and services, and one of its companion guidance documents is devoted entirely to life-cycle analysis.

The final point on the system goal axis, environmental sustainability, represents the ultimate aspiration of early advocates for the ISO 14001 EMS (Schmidheiny, 1992). Environmental sustainability was defined by the World Commission on Environment and Development as development, which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). More recently Ehrenfeld (2000) proposed a working definition: "Sustainability is the possible way of living or being in which individuals, firms, governments, and other institutions act responsibly in taking care of the future as if it belonged to them today, in equitably sharing the ecological resources on which the survival of human and other species depends and in assuring that all who live today and in the future will be able to satisfy their needs and human aspirations." Facilities developing EMSs which look towards environmental sustainability must not merely consider compliance, pollution prevention, eco-efficiency and product stewardship, but must also address intergenerational tradeoffs and quality of life for neighbors and workers, and must measure what has been called the "triple bottom line:" profits, environmental performance and social responsibility (Elkington, 1998).

The progression of the goal axis reflects the historical development of business goals for environmental management over the period since the 1970s. In the 1970s most U.S. businesses focused overwhelmingly on compliance with the growing number of environmental regulations for which they were responsible. Beginning in the late 1970s an increasing number of firms began to institute pollution-prevention programs, and from these to develop more systematic initiatives for eco-efficiency (Royston 1979, Andrews 1999). During the 1980s the engineering community also began to develop and apply more systematically the concepts of life cycle analysis and design for environment, under which manufacturers would take full account of environmental costs throughout a product's life cycle and Germany and some other leading industrial countries began to develop the concepts of extended producer responsibility and take-back requirements for waste packaging and products (President's Council on Sustainable Development, 1996; National Academy of Engineering, 1989). In 1987 the United Nation's World Commission on Environment and Development ("Brundtland Commission") articulated the principle of "sustainable development" as a tripartite goal for integrated economic, social and environmental development patterns (WCED 1987); The UN Earth Summit of 1992 in Rio endorsed this approach as a matter of international policy consensus.

The NDEMS data include facilities at each point on the goals continuum described by this typology (Gallagher, 2002). In no case did a facility describe pollution prevention or waste reduction activities as objectives or targets without having also described compliance-focused activities, nor did facilities describe product stewardship activities without having also includes goals focused on eco-efficiency, and so on. This result lends support to the proposition that the environmental performance goals articulated in EMSs progress from compliance through pollution prevention and eco-efficiency toward more rare and more visionary goals such as product stewardship and sustainability.

Data on facility EMS objectives and targets were used to determine the characteristics of the 53 facilities' environmental management system goal and assign each facility a score. Lists of facility objectives and targets, which ranged from five objectives to over 100 per facility, were used to make this determination. Examples of objective/target pairs are provided in Table VIII-2, below.

Three coders independently examined each facility objective and assigned a score of one to five, then met to compare the results and resolve any differences. Coders made identical coding decisions approximately 90 percent of the time, and in all cases were able to agree on a coding decision after discussing conflicts. Target data provided additional clarification of the specific focus of the facility's improvement priorities, which was helpful in assigning a score to each objective.

TABLE VIII-2: EXAMPLES OF FACILITY OBJECTIVE/TARGET PAIRS

OBJECTIVE	TARGET
• Ferrous chloride waste reduction.	• Pursue and evaluate options for reuse.
• Prevent accidental discharge to storm sewer.	• Purchase mat to cover storm drain and sorbent material for clean up.
• Reduce air emissions.	• Increase vehicle mileage five percent by 2002 through reductions in idling time of vehicles.
• Meet and/or exceed all federal state and local regulations concerning contamination of air, ground and water.	• Maintain 100% compliance.
• Improve hazardous waste management and measurement.	• Develop and implement compliance audits of hazardous waste disposal facilities.
• Develop fuel-efficient product.	• Perform engine fuel consumption lab test.

An objective received a score of 1 (compliance focus) if it described activities necessary to meet regulatory requirements. Words such as permit, comply, monitor, sample, and report, as well as references to specific regulations or laws, indicated compliance-based objectives. An objective received a score of 2 (pollution-prevention focus) if it described actions to reduce the generation of waste, such as source reduction, recycling, materials substitution, leak detection and minimizing spills or overflows, or similar activities not specifically required by a regulatory program. An objective received a score of 3 (eco-efficiency focus), if it described actions related to increasing efficiency in the use of production process inputs such as electricity, water or energy. An objective received a score of 4 (product-stewardship focus) if it described actions which examined the way in which its products were designed, or evaluated the materials incorporated into products. Design for the Environment (DfE) and life-cycle analysis activities were coded as environmental stewardship. Finally, an objective received a score of 5 (environmental sustainability focus) if it described actions to address intergenerational tradeoffs, improve environmental quality beyond the facility boundary in ways not required by regulation, or improve quality of life for neighbors and workers.

The overall rating assigned to each facility's system goal was equivalent to the highest-level capability reached. For example, if facility data indicated 50 compliance related objectives, 20 pollution prevention related objectives and five eco-efficiency objectives, that facility was coded as a "3" on system goal. This coding does not discriminate clearly between facilities that were highly committed to a high-level focus on this continuum and others that might just be pursuing a small number of experiments at that level while still focused primarily at a more limited stage. However, it does reveal useful information about the extent to which facilities have engaged in any initiatives representative of higher-stage performance goals. In addition, some objectives and targets not related to the five categories of the system goal dimension were not included in the system goal scoring process.[71] Facility system goal scores ranged from one to five, with a mean of 2.68, as seen in Table VIII-3, below.

TABLE VIII-3: DESCRIPTIVE STATISTICS OF FACILITY EMS TYPOLOGY DIMENSION SCORES

DIMENSION	N	MIN.	MAX.	MEAN
• System Goal	53	1.00	5.0	2.68
• Locus of Involvement	53	0.5	3.75	2.30
• Level of Legitimacy	53	1.00	5.0	3.58

RESULTS OF TEST EMS TYPOLOGY

Table VIII-4, below, shows the results of a test of the EMS typology, using NDEMS data from 53 facilities.[72] These results show three types: "Middle-Roaders," whose EMSs are not necessarily certified and do not reach for high level system goals nor involve many stakeholders in design; "Efficiency Experts," whose EMSs tend to be ISO 14001 certified and focus on eco-efficiency; and a small, evolving group of "Visionaries," which include environmental sustainability goals in addition to the others.

TABLE VIII-4: EMS TYPES

DIMENSION	MIDDLE-ROADERS	EFFICIENCY EXPERTS	VISIONARIES
• System Goal	2.29	2.48	4.67
• Locus of Involvement	1.73	2.52	2.83
• Level of Legitimacy	1.36	4.45	4.00
• Facilities	14	33	6

[71] For example, some facilities included health and safety-related, communications or general management-related objectives and targets in their EMSs.

[72] This typology test was conducted using a cluster analysis methodology, which is described in detail in Gallagher, 2002.

Middle Roaders

"Middle-Roaders" designed their EMSs, which focused on pollution prevention, most often using EHS staff and facility managers. Most did not seek ISO 14001 certification. Three of the 14 Middle Roaders developed self-certified EMSs, ten built EMSs that were uncertified, and one engaged the services of an external auditor. None of the Middle-Roaders had been certified to ISO 14001 at the time of this analysis. Most Middle-Roaders had few environmental management programs in place prior to beginning the EMS development. Middle-Roaders' environmental management programs before building their EMS typically consisted of pollution-prevention planning or waste-minimization techniques.

For Middle-Roaders, development of an EMS was a way to get a handle on increasingly complex environmental issues and to increase environmental management capacity within the facility. For the Middle-Roader, the EMS was a means to achieve and maintain compliance and to focus on pollution-prevention activities such as waste minimization and recycling. At these facilities, there appeared to be many "low-hanging fruit" to be harvested by the EMS. Examples of objectives and targets from Middle-Roader EMSs are shown in Table VIII-5.

TABLE VIII-5: MIDDLE-ROADER OBJECTIVES AND TARGETS (EXAMPLES)

OBJECTIVES	TARGETS
• 5% Reduction in effluent color	• Wastewater
• 50% reduction of inventory and/or use of hazardous chemicals in the R&D lab	• Determine which chemicals can be reduced or eliminated
• Reduce potential spills from bulk off-loading areas.	• Identify all off loading areas and have procedures written and proper training administered.
• Recycle solvents	• Install hot water parts washer
• Obtain zero NPDES violations due to monitoring frequency criteria	• Reduce number of violations by 50% from the previous year
• Reduce hazardous waste by 10%	• 3,734 pounds total (average 415 ponds per month through monthly monitoring)
• Reduce process water use	• Meet permit requirement (20,000 gpd)
• Reduce hazardous waste generation	• Reduce off-site disposal year-to-year indexed to production

Middle-Roaders generally represent those facilities just beginning to construct environmental management programs, facilities low on the learning curve. Middle-Roaders had limited prior experience in environmental management: most had gained expertise in pollution-prevention planning and waste-minimization within the previous five years. Middle-Roaders relied heavily on their EHS staff to design their EMSs, although some also reached out to facility managers and non-management employees. Middle-Roaders did not appear to design EMSs seeking external legitimacy, but primarily, rather, to increase internal environmental management capabilities. And the EMSs that Middle-Roaders built highlight compliance and the prevention of pollution.

Further tracking would be necessary to tell whether Middle-Roaders benefit from the systems-oriented features of their new EMSs, such as emphasis on evaluating the environmental impacts of their operations, monitoring additional indicators of their environmental performance, and communicating environmental results to management. If they do, Middle-Roaders may perhaps increase their environmental management capabilities as have Efficiency Experts, begin to involve a larger cross-section of facility employees in environmental management activities, and look toward additional eco-efficiency, stewardship and sustainability goals.

Efficiency Experts

The 33 "Efficiency Expert" facilities shared a common goal: to achieve ISO 14001 certification. Some facilities in this group went so far as to describe their pursuit of ISO 14001 certification as a race and certification as winning the race. At least two efficiency-expert facilities reported that their EMS was the first certified within their larger corporation and a model for the others that followed. Another facility reported being the first within its sector to jointly achieve ISO 9001 and ISO 14001 certification. A fourth facility boasted that it was the first municipality in the U.S. to achieve certification.

The majority of efficiency experts, possibly in an effort to minimize time spent on EMS development, did not involve non-management employees and external stakeholders in EMS development. The efficiency-expert group focused on the task of building an ISO 14001-certifiable EMS by engaging primarily the EHS staff and facility managers. Most efficiency-expert facilities shared the experience of one facility, which described its design process as one closely overseen by its management team: "It is the responsibility of any manager of any area of the facility's product manufacturing department to review all products, processes or projects in order to identify all possible aspects and impacts and if necessary to register them."

A majority of efficiency-experts facilities also used their EMSs to build systems and procedures to increase the eco-efficiency of their production processes. These facilities were consistently in compliance with environmental rules and regulations and had long relied on pollution-prevention plans to achieve waste minimization, recycling and input substitution goals. Efficiency experts often had reliable environmental management programs in place prior to designing their ISO 14001-compliant EMSs. For example, many facilities in this group had employed waste-minimization practices and pollution-prevention planning for at least eight years. More than half had used compliance audits for over 10 years. Efficiency experts focused on increasing the efficiency of production processes through more effective use of process inputs, natural resources and energy. Table VIII-6 shows examples of objectives and targets included in efficiency expert EMSs.

TABLE VIII-6: EFFICIENCY-EXPERT

Objectives and Targets (examples)

Objective	Target
• Optimize efficiency of furnace	• Monitor system and propose improvements
• Develop understanding of water usage throughout the plant	• Group formed and assigned project
• Increase eco-productivity index for general water usage	• Increase by at least 1.5 points by 2000
• Use less water purchased from the city	• Use more re-use water in rinses that are not critical
• Reduce energy usage based on annual budgets	• Achieve 10% reduction per engineering department budget
• Proper use of natural resources	• Reduce natural gas usage by using excess steam from co-generation instead of boilers in summer.
• Reduce energy costs	• Increase employee awareness of utility costs
• Reduce potable water use 5%	• None

In summary, EHS staff and managers at Efficiency Expert facilities developed ISO-14001 certifiable EMSs with little assistance from non-management employees and external groups. This group's overarching emphasis on certification led them to institute design processes focusing on efficiency rather than inclusion. They leveraged prior experience in environmental management, and relied on knowledgeable EHS staffs to develop their EMS. And the EMSs that were designed emphasized eco-efficient processes. While compliance and pollution prevention activities were included as objectives and targets in Efficiency Expert EMSs, water and energy use efficiency were emphasized.

Visionaries

Visionary facilities designed EMSs to achieve product stewardship and environmental sustainability goals. Visionaries viewed compliance and pollution prevention activities at their facilities as given. Compliance, pollution prevention and eco-efficient process goals were included in their EMSs, but these facilities' EMSs went beyond eco-efficiency to incorporate system goals focusing on product stewardship issues such as product disposal effects and on examining impacts beyond the facility boundary.

It is worth noting that Visionaries did not necessarily have longstanding environmental management programs to build upon in designing their EMS, as did some of the Efficiency Experts. In fact, one of the Visionaries had only had an environmental manager at the facility for two years prior to developing the EMS. At this facility the environmental management programs used before the EMS was designed included best management practices, pollution-prevention planning and compliance audits. Another facility's prior environmental management practices consisted only of life cycle analysis and environmental reporting. However, these facilities used the opportunity of developing EMSs to incorporate ambitious goals. The Visionaries expressed a great deal of enthusiasm for their EMS and much hope for its role in improving environmental performance. Examples of the objectives and targets that visionary facilities included in their EMSs are shown in Table VIII-7.

TABLE VIII-7: VISIONARY OBJECTIVES AND TARGETS (EXAMPLES)

Objectives	Targets
• Reduce air emissions	• Increase vehicle mileage 5 percent by 2002 through reduction on idling time of vehicles
• Facility commitment to USEPA native landscaping program	• Data not available
• Flexible work hours	• Schedule operations staff based on 10-hour shifts thus reducing the number of commutes by 10%
• Employee incentive program to buy ethanol powered cars	• Data not available

With only six facilities in this group, the Visionaries stand apart from the other facilities in ways other than the characteristics of their EMS goal. The Visionaries built EMSs with the help not only of EHS staff but also of other managers, non-management employees and in one case, assistance from external stakeholders. For example, at one Visionary facility "an environmental committee was formed consisting of a member or members from each department and from the operator level to the foreman and manager level. There was a majority of operators, engineers, and staff people rather than managers and foremen."

Another Visionary facility formed a "…Green Team consisting of Senior Director, Safety and Environmental Affairs, Environmental Specialist, Air Specialist, Environmental Compliance Coordinator, and middle management and Union representatives from each division in the Company that has environmental aspects as part of its operation…" to identify aspects and impacts. A third Visionary relied on "…engineering staff, lab staff…" to identify aspects and impacts, but described the process of objective and targets determination with the statement that the "…entire staff was involved in this effort by breaking into small groups to determine objectives and targets." This Visionary facility also involved local environmental group representatives in identifying aspects and impacts and determining significance. Representatives from these groups "reviewed a draft of aspects and impacts and provided feedback."

All six Visionaries engaged external auditors to assist them in measuring the adequacy of their EMSs, but at the time of this analysis they had not sought or declared an intention to seek ISO 14001 certification, although they did not discount the possibility that they might pursue certification in the future. One facility also provided opportunities for a community group to review the results of the external EMS audits.

In summary, Visionaries saw their EMSs as a means of critically examining processes and products, and considering impacts beyond the facility boundary. Visionaries incorporated environmental stewardship and sustainability goals into their EMSs, but did not forgo compliance, pollution prevention and eco-efficiency. With their enthusiasm for the EMS design process and high hopes for its success, they involved a larger cross-section of facility employees than did the other two groups, and satisfied with externally audited EMSs, they chose not to focus on achieving ISO 14001 certification.

MIDDLE-ROADERS, EFFICIENCY EXPERTS AND VISIONARIES

In summary, three types of EMSs are evident in this sample of 53 facilities: Middle-Roaders, Efficiency Experts and Visionaries. Each EMS type represents a distinctive pattern or subset of facilities introducing EMSs.

Middle-Roaders, Efficiency Experts and Visionaries each focused on a distinctive combination of environmental goals, involved a distinctive set of individuals in EMS design, and sought specific levels of external legitimacy for their EMSs. And each type pursued EMS development by leveraging a distinctive combination of experience and enthusiasm for environmental management. For Middle-Roaders that experience was limited, for Efficiency Experts it was long-held, and for Visionaries enthusiasm mattered most.

Middle-Roaders were relative novices to the environmental management experience, and for them the EMS was not a way to signal the legitimacy of their practices to the outside world, nor a way to reach ambitious environmental goals, but rather a means of maintaining compliance and in the process, improving their environmental management capabilities and achieving cost savings. This EMS type is one to watch over time to determine whether an EMS increases environmental management capabilities.

“Efficiency Experts,” with their emphasis on achieving cost-effective improvements and ISO 14001-certification, represent a second EMS type. Efficiency Experts want to build EMSs as efficiently as possible, and in so doing often forego involving non-management employees and external stakeholders in EMS construction. Efficiency Experts focused on maintaining compliance, continuing pollution prevention progress, and achieving greater production value by implementing eco-efficient processes. And in building their EMSs, Efficiency Experts took advantage of internal environmental management capabilities such as professional environmental staff and long-standing experience in implementing environmental management techniques. Efficiency Experts’ use of such capabilities may be able to leverage these assets to achieve sustained competitive advantage (Wernerfelt, 1984, Hart, 1995).

Finally, for Visionaries the process of designing an EMS served as an opportunity to gather together the collective expertise of environmental staff, facility managers, non-management staff and even external stakeholders. This inclusive process was used to a wider range of ideas and considerations into the EMS development process, and to address more far-reaching considerations such as product stewardship and environmental sustainability. These facilities used externally audited but non-ISO-14001 certified EMSs to achieve compliance, prevent pollution and increase the eco-efficiency of processes, but also to consider objectives such as the effects of employee commuting, the impacts of their products and the plants used to landscape their facilities.

Chapter 9. Case Studies of EMS Development

INTRODUCTION

The previous chapter used cluster analysis of survey data from 53 NDEMS facilities to provide evidence that several distinct types or patterns of EMSs can be identified in practice. This chapter presents case studies of seven facilities, including examples of those that designed and implemented each of the three EMS types. It also illustrates in greater detail the varied mixtures of influences – facility leadership, neighbors, regulatory pressures, business relationships, or other factors – that shaped the differences among these facilities' cultures, EMS design processes, and outcomes.

Six of these seven facilities were EMS Pilot Program facilities, and the seventh agreed to participate in a comparably detailed case study of its EMS development process. The names of the facilities are disguised, by previous agreement to provide confidentiality. The case studies are presented according to the type of EMS designed: Middle-Roader, Efficiency Expert and Visionary. In each case we first describe the facility's physical setting, production processes and facility culture, then summarize the history of the facility's EMS development process to identify internal and external factors that influenced the construction of the EMS. We then discuss their perceptions of the implementation challenges and of the consequences of EMS introduction.

TABLE IX-1: CASE STUDY SUMMARY

Facility	EMS Type	Reported Influences on EMS Design
Kappa Energy Technologies	Middle-Roader	Facility environmental group, facility leadership, consultant
Alpha Manufacturing	Efficiency Expert	Facility leaders, past enforcement history, consultant, customers
Delta Electronics	Efficiency Expert	Environmental group, customers, corporate managers, industrial neighbors
Epsilon Systems	Efficiency Expert	Facility environmental group, corporate environmental staff, customers
Gamma Industries	Efficiency Expert	Environmental engineer, state regulator, facility and corporate leadership
Beta Municipality	Visionary	Senior environmental coordinator, citizens (customers), local manufacturer
Sigma Resources	Visionary	Facility and corporate leaders, employees at all levels, external parties

MIDDLE-ROADER: KAPPA ENERGY TECHNOLOGIES

In Chapter 8, "Middle Roader" facilities were identified as those that generally were relatively new to EMS and other management system procedures, relied on their EHS staff and a mixture of other managers to develop their EMS, and used the EMS process not primarily to seek ISO certification but to improve their regulatory compliance, introduce some pollution prevention measures, and develop their environmental management capabilities. Kappa Energy Technologies was once such facility.

Kappa Energy Technologies

"Kappa Energy Technologies" (KET) is a mid-sized manufacturer of energy distribution transformers located in a small, mostly rural community in northern New England, a community which after a period of decline was making some economic gains due to the presence of firms such as Kappa. The presence of an able labor force and clean water influenced KET's decision to locate there, as did community leadership's lobbying efforts. Kappa has been in operation at this location now for over 30 years. Initially a stand-alone, privately-held company, KET, while still privately held, has become a member of an international holding group of companies headquartered in Europe with manufacturing facilities located across the globe. Kappa employs 350 people in manufacturing, assembly, research and development and technical service. The tree-covered foothills of the distant Green Mountains surround the facility's 200,000 square feet of operations. Residents of nearby communities are concerned about environmental issues and about preserving their area's scenic beauty.

Kappa's Production Processes

Kappa's production processes are organized into ten activity centers. In addition to office support activities, KET's operations include materials procurement, product base manufacturing, laminating, a supply center, product fabrication, shipping, recycling, maintenance, janitorial service and a laboratory. Two boilers operate as part of the supply center to provide energy. Base manufacturing, laminating and product fabrication are the heart of KET's production, utilizing large scale and complex technologies and employing a sizable staff. Base manufacturing operations take pulp and fiber and produce fiberboard, similar to a typical pulp and paper manufacturing operation, but without chemicals. The base components are then laminated using compounds such as styrene and acetone. Laminated sheets are then fabricated into energy distribution transformers, which take all shapes and sizes. The boilers, base making, laminating and product fabrication activities contribute most significantly to KET's environmental impacts. A small research laboratory serves to test product quality and develop recommendations to modify inputs and production processes. Paper, plastics, metal scraps, laminated board scraps and other production by-products are collected for recycling.

Kappa's Facility Culture

Throughout its thirty-year operating history Kappa has emphasized compliance and pollution prevention. Because of KET's location in a region known for its unspoiled environment and environmental advocates, KET's philosophy has been to work hard to minimize waste products and to recycle as much as possible. Its managers also stressed the cost savings that can be achieved through hazardous waste reduction. KET is concerned about maintaining and enhancing its environmental image with the public, regulators and customers and improving environmental performance. Its formal environmental policy commits the company to raising the awareness of employees about environmental consequences of operations through training and communication, exceeding regulatory requirements, minimizing pollution, and achieving cost savings. The policy was developed by Kappa's environmental and safety director, quality-assurance engineer and lab chemist, with review and approval from the executive management committee.

Environmental protection activities had typically been spearheaded by a small group of mostly professional employees at KET, primarily the environmental manager, the recycling shop operator and the lab chemist. A majority of employees had not considered environmental issues in the workplace a primary concern, although many employees would consider themselves environmental advocates. This made the environmental manager's job, one that he had held for just over three years, quite challenging. The institution of an EMS was seen by KET's managers as a vehicle to increase specific employee responsibility and accountability and to increase employee involvement. The facility had recently implemented a total quality management system and become ISO 9000 certified, so managers felt that a similar systems approach to environmental management would be a worthwhile endeavor. To emphasize the connection between the quality management system and the environmental management system, the facility's quality analysis engineer was placed on the core EMS design team.

Kappa's EMS Design Processes

Kappa assembled a small core team consisting of the environmental manager, lab chemist and quality manager to spearhead EMS design and implementation. Together this team had acquired 43 years of experience at the facility. The core team attended a series of workshops on EMS design provided by the state environmental regulatory agency. After surveying production and support activities, the team compiled a list of ten activities with potential to have an impact on the environment and then developed process flowcharts for each of the activities. Using guidelines provided by the consultant who taught the state-sponsored workshops, the team held brainstorming sessions and developed a list of specific aspects and environmental impacts associated with each of the facility activities. As an example, the maintenance and janitorial activity yielded two environmental aspects; the first of these aspects yielded three impacts and the second yielded five. In contrast, the basemaking operations yielded 15 aspects and 31 environmental impacts. The core EMS design team shared its draft and final aspect/impact lists with the facility's management team and received approval to continue with the process.

Armed with a list of activities and associated aspects and impacts, the core team began to determine which impacts were significant, using a rating system suggested by the state's consultant. Impacts that required mandatory compliance automatically received the highest rank score, 25. Each impact was rated according to four environmental considerations (severity, probability of occurrence, duration and scale) using a 1-5 scale, with 1 being low and 5 being high. These four ratings were summed and averaged to develop an environmental score for each impact. Each impact was then rated according to five business considerations (regulatory and legal exposure, difficulty of a change in practices, cost of change in practice, effects of change in practices, and concern of interested parties), again using a 1-5 scale. These five ratings were summed and averaged to develop a business score for each impact. The business score and the environmental score were then multiplied. Impacts with an average score greater than 7.7 were considered significant and given priority for developing objectives and targets. Again the core team checked in with management and received approval to continue. Kappa's significant impacts included water usage, fuel oil usage, electricity usage, paper/supplies usage, trash to landfill, waste paper recycling, raw materials selection, and consumables selection, among others. In all KET identified over 60 significant aspects.

An expanded team was then assembled to develop objectives and targets. Two line employees from the manufacturing floor, a supervisor, the head of engineering, the R&D lab supervisor, the process engineer and the vice president of quality analysis joined the core team for this undertaking. The objective of creating this team was to obtain input from a larger cross-section of the organization. People were chosen who were associated with the aspects producing significant impacts. The core team presented their activity-aspect-impact list and the reasoning behind their significance determinations to the new team, and the expanded group agreed with the core team's findings. The expanded team then brainstormed to develop a list of 50 projects to address significant impacts. The facility had a goal of developing ten or fewer projects with associated objectives and targets that could be completed in a year or less. To hone the list down, each member of the expanded team was given five votes to select the most important projects. Eight were selected for the first year and nine for the second. These projects included efforts to reduce hazardous waste generation, raise employee awareness of environmental issues and develop a compliance program for a new state regulation.

The final step in KET's EMS design process was to train facility employees and ensure ongoing support of upper management. The core team developed and information package was presented to facility managers (vice presidents) and supervisors in a two-hour training session. Materials developed for upper management included information about the history of environmental management systems and their importance. A general meeting was held for all employees, supervisors then trained their employees, and a booklet on the EMS was provided to all employees. Bulletin boards around the facility informed employees about ongoing activities. General awareness training about the EMS was also provided to employees at safety trainings. Upper managers received periodic updates about EMS-related issues and a formal presentation twice per year. While Kappa's did involve a broader group of employees in developing its objectives and targets, its non ISO 14001-certified EMS was largely built by the facility's small core team. In addition, the EMS was squarely focused on compliance and pollution prevention and thus can be characterized as Middle-Roader.

Influences on Kappa's EMS Design

Kappa's Core team was strongly influential in designing the facility's EMS. The three core team members attended training sessions provided by the state environmental agency. Information gleaned from these training sessions, and the advice and templates provided by the consultant conducting them, shaped the way in which the core team led KET to design its EMS. The core team worked tirelessly on EMS design and implementation activities in addition to performing their primary job responsibilities. They worked to obtain input from non-management employees and support from senior managers. The core team's emphasis on pollution prevention and using the EMS to achieve cost savings and increase employee awareness of environmental issues was evident in the EMS that was designed.

Kappa's new Vice President, who had come to his job from one of the company's major customers, also played an important role. In his last job he had been introduced to many facilities that were ISO 14001-certified. What's more, his former employer had been involved in the United Nations Earth Summit of 1992 in Rio and was a major supporter of environmental stewardship efforts. In addition to raising awareness of environmental stewardship concepts, the Vice President was generally an ardent supporter and cheerleader for the core team's efforts. However, he left the details of EMS design to the small, influential core team.

Kappa's EMS emphasized pollution prevention, waste minimization and recycling for a number of reasons. KET had a long-standing recycling ethic, strongly supported by the core team, which sought to continue progress in finding ways to recycle and reuse production byproducts. Second, although the company had not been involved in the issue, a local landfill had been designated a federal Superfund site and in response KET wanted to avoid landfilling its wastes.

Finally, prior experience with management systems also influenced Kappa's EMS design. A sister company had recently received ISO 14001 certification, and KET's Quality Engineer – a core team member who had experience with ISO 9000 certification – was a strong proponent of management systems and influenced the company to develop a highly structured EMS.

In summary, Kappa's EMS – spearheaded by a small core team of environmental management-oriented employees, and focused on compliance and pollution prevention – was representative of the Middle-Roader facilities described in the previous chapter. Like most others of this type, Kappa did not seek to build an ISO 14001-certified EMS. With its limited environmental management expertise, it also did not involve many people outside of its small EHS group in developing its EMS. Finally, it built an EMS that focused squarely on compliance and pollution prevention. With limited environmental expertise and a desire to use the EMS to manage compliance, increase employee awareness and achieve cost savings through pollution prevention efforts, Kappa typified a Middle Roader perspective. It is possible, however, that in future efforts Kappa will leverage its newfound expertise, the enthusiasm of its Vice President for sustainable practices, and increased employee awareness of environmental issues toward further improving its EMS using a larger cross-section of employees and focused on eco-efficiency, product stewardship or sustainability goals.

EFFICIENCY EXPERTS: ALPHA MANUFACTURING, DELTA ELECTRONICS, EPSILON SYSTEMS, AND GAMMA INDUSTRIES

"Efficiency Expert" facilities, as characterized in Chapter 8, typically focused on increasing the efficiency of production processes through more effective use of process inputs, natural resources and energy, and shared a common goal: to achieve ISO 14001 certification. These facilities typically were consistently in compliance with environmental regulations, and most had long relied on pollution-prevention plans to achieve waste minimization, recycling and input substitution goals. The majority of Efficiency Experts relied on their EHS staff and facility managers to develop an ISO 14001-certifiable EMS, and did not involve non-management employees or external stakeholders.

Alpha, Delta, Epsilon, and Gamma provide four examples of the Efficiency Expert type. These four facilities had much in common, although they produce different products: finished metal, computer electronics, automotive electronics, and photographic papers and chemicals.

Each built ISO 14001 certified EMSs that focused on compliance, pollution prevention, and the efficient use of natural resources and energy. They depended on EHS staff and facility management to design and implement the EMS, although Epsilon and Gamma also sought some input from non-management personnel. None of the facilities sought input from citizen stakeholders during EMS development, although Alpha relied on information from professional peers and Delta listened to its industrial neighbors. Alpha and Gamma relied on consultant assistance to design their EMSs; Delta and Epsilon were assisted by their corporate organizations.

Alpha Manufacturing

"Alpha Manufacturing" is a small metal finishing company in the Midwest. Alpha is privately held and family-run and employs 90 people. Its clean and bright 60,000 square foot facility is located in a sprawling industrial park. The park, zoned heavy industrial, sits within the borders of a close-knit suburban town outside a major urban center. Alpha is surrounded by a variety of light and heavy manufacturing facilities and separated by a railroad track from a mostly residential area of small tidy homes and storefronts. Alpha has been in operation in the community since 1980, and moved to its present location in 1995. The local government has placed stringent environmental requirements, beyond those required by the state or federal governments, on all its industrial operations.

Alpha considers itself a model corporate citizen, and several of its managers play leadership roles in local government and in trade associations. When the local government placed stringent environmental requirements on Alpha and other local businesses, the facility managers responded with a proactive stance. Alpha continues to be challenged by these requirements, however, which primarily affect its wastewater treatment process.

Alpha's Production Processes

Alpha's metal finishing production processes are tailored to provide the flexibility needed to meet the changing needs of its customers. At the heart of Alpha's operations are a number of computer- controlled finishing lines, which can be set up to run up to seven different processes at a time. In addition to the finishing lines, Alpha's operations include water recycling, wastewater pretreatment, office support, shipping and receiving, waste disposal, and a quality-assurance laboratory. Alpha maintains a fleet of trucks, which picks up incoming unfinished parts and drops off finished product.

Why Did Alpha Develop an ISO 14001 EMS?

Alpha had used environmental best management practices and pollution prevention and waste minimization planning since the early 1980s, and had been conducting compliance audits since the early 1990s. Prior to being asked by the state to volunteer to be an EMS pilot facility, Alpha also had participated in U.S. EPA's 33/50 program, and in the Strategic Goals program of EPA's Common Sense Initiative. Alpha's experience with the 33/50 program was helpful in that it taught them about participating in voluntary government programs.

Several factors were instrumental in influencing Alpha to decide to develop and certify an ISO 14001 EMS. First, because of its location in a community with strict environmental requirements, the leadership role of Alpha senior management in town government and an encounter with regulators over a non-compliance situation, Alpha decided ten years ago that going beyond mere compliance "just made sense." To Alpha senior management, the development of an EMS and achievement of ISO 14001 certification represented the latest in a series of opportunities to both "do the right thing" and go beyond compliance.

Second, as a Tier I supplier to the automotive industry, Alpha recognized that a market demand for ISO 9000 and QS 9000 certified suppliers was growing and would soon be a requirement. The "Big Three" automakers and other customers were increasingly asking to audit the facility to examine its quality and environmental procedures.

Third, when Alpha began to develop its ISO 9000 system, most of the senior management team felt that developing an ISO 14000 system concurrently would be more efficient than waiting to do so at a later date. Alpha made a decision early on that if they were going to tackle ISO 9000 certification, they would also seek ISO 14001 certification. They thought that Alpha already had in place most of the elements of an ISO 14001 EMS and all that was needed was documentation. When Alpha decided to develop an EMS, management's initial impression was that they would not have to invest many of the company's resources to prepare an ISO 14001-based EMS and become certified. Also, analogous to QS 9000 and ISO 9000 certification, they believed that ISO 14001 certification would soon be an important marketing tool.

Fourth, while the prospect of economic benefits from designing and implementing the EMS and becoming certified were considered, Alpha managers were "not sure about the payback," and asserted that the consideration of an economic payback did not realistically enter into their decision to seek ISO 14001 certification.

Finally, Alpha's president, a former high school teacher, had long been an advocate for forward-looking environmental management practices. His vision was reflected in the company's mission statement, developed prior to embarking on the development of its EMS. The mission statement commits the company to "be a leader in environmental conservation." Alpha's environmental policy statement, developed by all facility managers with the assistance of a consultant, emphasized pollution prevention, continual improvement, and movement beyond compliance.

In developing its EMS, Alpha's goal was to be the first U.S. facility to jointly achieve ISO 14001 environmental management system and ISO 9000 quality management system certification. This was no easy task, and as will be seen below, they required help to carry it out. Alpha was recently certified to ISO 14001, ISO 9000 and QS 9000.

Alpha's EMS Design Process

Alpha's EMS development process was led by its senior management team, including the president, vice president of operations, vice president of technology, quality manager, and other key managers. A consultant assisted in the process and played a leadership role in educating the team about the requirements of ISO, keeping them on track, and refereeing heated arguments. Meetings with plant foremen were scheduled two or three times during the design process; non-management employees were not formally involved in the design process, but were asked for input occasionally. Once the system was designed, all employees took classes on roles, responsibilities and policies. Kick-off meetings were held with groups of employees on each shift where a video on ISO 14001 was shown. Ten to twelve employees were trained as internal auditors.

As a first step, Alpha's Quality Manager used a template to conduct a gap analysis of its environmental management program. One manager described this exercise as "an eye opener," with "surprising results." Management's initial impression had been that they would not have to invest many of the company's resources to prepare an ISO 14001-based EMS and become certified. This initial impression, however, was misleading.

At a kickoff meeting facilitated by their consultant, each of Alpha's senior managers was charged with developing a list of activities (or "actions," as Alpha called them) that had impacts on the environment. Four to six weeks later, the team met again to compare their lists, which were largely based on the managers' personal intuition. At this second meeting, the lists were combined into an overall list of 39 actions. Each action was then rated according to its severity and frequency on a scale of one to ten. In a consensus process that was moderated by the consultant, each action received a final score and was placed on a priority-ranked list of aspects and impacts.

Responsibilities and timelines for addressing each of the top ten significant actions were incorporated into Alpha's EMS. Managers then met regularly with the consultant, generally for an all-day meeting every four to six weeks, to develop the facility's Environmental Systems Manual, which incorporated the required ISO 14001 EMS components. When the manual was completed, a video was produced to train Alpha employees about the new environmental management system. Alpha's objectives and targets included pollution-prevention-focused activities such as increased recycling, as well as eco-efficient programs such as decreasing city water use, reusing water to clean tanks, and increasing the energy efficiency of on-site trucks.

Alpha took approximately 18 months to design and implement its EMS and obtain ISO 14001 certification. This work was accomplished concurrently with designing and implementing its quality system and becoming QS 9000 and ISO 9000 certified. After certification, Alpha updated its employees on the EMS at periodic safety and environmental training sessions. All employees were required to watch custom-made videotapes that demonstrated actual work activities and how these activities could affect the environment. A mandatory annual review meeting was held with all employees to review quality and environmental systems. Alpha' senior managers also reviewed the EMS annually in a series of meetings in which aspects and impacts were revisited and objectives and targets updated. The ISO 14001 certified EMS that Alpha's core team of managers designed focused on eco-efficiency, thus categorizing their EMS as an Efficiency Expert.

Influences on Alpha's EMS Design

There were a number of influences on Alpha as it designed its EMS. These included the forward- thinking leadership of the company's president, the knowledge and experience of their consultant, information from trade associations and from EMS pilot project facilities in their state, past experience with compliance and enforcement, and supply-chain pressures from customers.

Alpha's president was highly involved in environmental issues outside the facility as a member of trade associations and local government boards. He had long been an advocate for achieving environmental results beyond compliance. He was a major player in EMS design efforts at Alpha by directing employee managers to build an EMS that reflected his vision. But while he directed Alpha to look beyond compliance, it was clear that a demand for basic compliance was paramount.

Alpha hired a consultant subsidized by the state environmental agency who played a significant role in EMS design. He attended all EMS design team meetings and facilitated discussions between committee members. He also provided team members with templates for building the EMS, which were closely followed.

Alpha's design also was influenced by information about ISO 14001 from trade associations. Alpha's President, Vice President of Technology and Quality Engineer participated in trade associations. In addition, Alpha's Vice President of Technology attended meetings of state EMS pilot facilities and learned from their EMS development experiences.

Finally, as a Tier 1 supplier to the automobile industry, Alpha was influenced by its customers. It became increasingly evident not only that Alpha would need to build an EMS, but also that its EMS would need to be ISO 14001 certified to maintain its customer base.

Benefits of EMS Adoption

While Alpha's managers would like to obtain future economic benefits in terms of an increased market share due to ISO 14001 certification, they did not expect a return in the near future. As one manager put it, "We were hoping that our customers would be impressed with our certification, but the reality is that they don't even know what it is." Alpha's managers were also hoping that regulators would reduce their monitoring and surveillance requirements for ISO 14001-certified facilities, but again that remained to be seen. However, the relationship between Alpha and regulators, while always cordial, improved throughout the process of EMS implementation and ISO 14001 certification. State regulators considered Alpha's EMS efforts to be a model for other companies to follow, and rewarded and publicized Alpha's efforts.

Besides an improved relationship with regulators, Alpha benefited from adopting ISO 14001 in other ways. In particular, its written environmental policy produced significant benefits. Before the Environmental Systems Manual was in place, environmental programs were not well documented and very little had been written down. With a written environmental policy and programs manual, and the training video that was produced to explain it, all of Alpha's employees had clear information on their specific environmental responsibilities and procedures for carrying them out.

A commitment to continuous improvement, even for a facility that decided ten years ago to go beyond compliance, was also helpful. The plan-do-check-act cycle of the ISO 14001 EMS provided employees and managers the information needed to know when to make changes needed to continually upgrade environmental performance. Feedback from internal and external audits of components of Alpha's ISO 14001 system, and performance data gathered as a result of implementing the system, also were perceived as valuable. The changes made to Alpha's processes and programs after the ISO 14001 EMS was implemented both improved environmental performance and reduced costs.

By far the primary benefit of the ISO 14001 experience at Alpha, however, was an improved and shared understanding of the impacts of Alpha's processes on the environment by all

Alpha employees. This increase in environmental awareness was highlighted by managers across the board at Alpha as a significant benefit. Managers and employees spoke a common language with respect to the environment: no longer did managers and EHS staff have to convince employees that environmental activities were worthwhile. Employees now increasingly viewed environmental stewardship activities as integral to their daily work, and took the initiative to suggest ways to improve environmental performance.

Delta Electronics

"Delta Electronics" is a large electronics facility with nearly four million square feet of operations, approximately 200 departments, and approximately 7,000 employees. In addition to the production departments, many of which require clean-room environments, Delta's facility includes administrative support services, maintenance, chemical distribution, laboratories, shipping and receiving, waste management, waste water pretreatment and energy systems departments. The facility is located in a highly urban/suburban community with between 500,000 and 1,999,000 residents. Its surrounding community consists of light commercial and industrial development, as well as residential homes and offices. Delta has been in operation for over 30 years. It considers itself a model corporate citizen, and Delta employees and managers work hard to maintain a cooperative relationship with local, state, and federal regulators and to demonstrate their commitment to the environment in which it operates.

Prior to participating in the EMS pilot project, Delta had maintained an EMS for more than 25 years, primarily as part of a corporate environmental program. Its parent company believed that incorporating environmental concerns into its management system would create a more efficient operation within all of its facilities and contribute to its overall business objectives. Also, its EMS had helped the organization maintain its reputation of being an environmental leader within its industry. The EMS was developed at the corporate level, and Delta as well as each of its sister facilities had adapted their operations and EMSs to meet the requirements of the corporate provisions. The corporate EMS established the environmental policy, instructions, and practices for facility operations. It also defined managerial responsibilities, assured that environmental considerations were integrated throughout its business operations, and required facilities to provide environmental performance data and information to allow the corporation to effectively monitor its environmental performance worldwide.

In 1997, Delta registered its EMS to the ISO 14001 standard. Prior to this registration, the facility had already participated in several voluntary environmental initiatives, primarily at the local level, including an alternate commute program, a "spare the air" program, and a nickel discharge reduction initiative. It also had participated in OSHA's Voluntary Protection Program and EPA's Energy Star program. These environmental initiatives had little direct influence on Delta's decision to certify its EMS to the ISO 14001 standard, but they did influence Delta, as a result of the positive experiences it had working with regulators, to better manage the facility's environmental impacts.

Why Did Delta Adopt and Certify Its EMS?

Delta's original EMS had been developed primarily in the 1960s, driven by corporate-level pressures. In contrast, its motivation to register its EMS to ISO 14001 was an internal facility-level decision. Indeed, Delta was the first U.S. facility within its corporation to obtain ISO

14001 registration. The primary motivating factor in Delta's decision to certify its EMS to the ISO 14001 standard – and doing so prior to any corporate directive – was that Delta's management believed that registration would benefit the facility's ability to do business at the manufacturing and operational level. Its management also believed that registration to the ISO 14001 standard would assist with integrating its EMS throughout its entire facility operations, thus benefiting its internal activities by creating greater efficiencies within its various facility departments. In doing so, Delta integrated its EMS with its existing ISO 9001 management system so that environmental activities became more of a component of its product development and manufacturing operations, and made ISO 14001 implementation more effortless.

As a result of Delta's decision to register its EMS, its corporate headquarters utilized the experience gained at the Delta facility and other information to design a corporate-wide program to register all of its development and manufacturing facilities to the ISO 14001 standard. Today, overall ISO 14001 registration occurs at the corporate level, thus matching the overall corporate EMS.

Delta's investments in research and development and in innovative technologies also played a less direct role in its decision to register its EMS. Delta had invested heavily in technology development, which assisted in allowing it to operate more "greenly." During product development, Delta personnel routinely considered environmentally conscious product attributes and manufacturing principles. Also, Delta's early investments in "green product" development made it easier for the facility to proceed with ISO 14001 registration, as many of its managers and employees were already familiar with the overall objectives of ISO 14001 albeit not with the standard itself.

External constituencies such as the public, Delta's suppliers, customers, and regulators played much smaller roles in the facility's overall motivation to certify its EMS. Such a decision was a departure from its rationale for adopting ISO 9001, which was largely customer-driven. Delta recognized, however, that because the facility and its parent company operate in a global business economy, in the long run an ISO 14001 registration would support its environmental leadership philosophy. Moreover, registration was believed to enhance Delta's position as a responsible neighbor and as one of the state's business leaders.

Who Was Involved in Developing Delta's EMS?

Delta's ISO 14001 EMS design team, known as its "EMS Core Team," consisted of both Delta managers and employees. Additionally, guidance was solicited from environmental staff at Delta's parent corporation and from its sister facilities. Delta team representatives included a technical manager, a quality manager, quality management department representatives, and a team of environmental engineers. Some of the team members were managers, but most were not. No external interested parties were involved, although Delta hired a consultant to train its EMS Core Team and its quality management team on both ISO 9001 and ISO 14001, how they might work together, and how to most efficiently proceed with ISO 14001.

Delta's ISO 14001 EMS Adoption Process

In implementing ISO 14001, Delta's Core Team invested heavily during its planning stages. It utilized project scheduler software to manage the overall implementation process and keep the Team focused on required tasks and their target dates. The Team also evaluated how several of its sister facilities around the world managed their ISO 14001-registration process to determine what was Delta's best course of action.

Concurrently, the Core Team assessed what Delta needed to do to achieve ISO 14001 registration and then compared these requirements to Delta's existing ISO 9001 quality management system. They then determined what differences existed. Doing so helped the team determine where changes needed to be made, what departments and individuals would be responsible for these changes, and what procedures and documents were already in place to support an ISO 14001 EMS. This comparison process identified three primary areas that Delta needed to modify in order to qualify for ISO 14001 registration: employee communication and awareness, document control, and calibration. As part of the ISO 14001 and ISO 9001 integration process and for consistency, Delta used the same registrar to evaluate and certify both management systems.

The task of identifying the facility's aspects and impacts rested largely with Delta's environmental programs department with review by the Core Team. Based on their combined knowledge of the facility history and its operations, they assessed the facility's activities, products and services and their impacts and determined which ones were significant. Almost all of the aspects that the team identified were being managed within Delta's existing EMS framework. The ISO 14001 aspect and impact identification process expanded the facility's environmental emphasis, however, by providing more focus in considering its impacts to the surrounding community as well as its land use at the site.

In determining the significance of its aspects and impacts, the Core Team utilized a qualitative approach. Four primary factors were considered: the environmental impact of the aspect, its legal/regulatory requirements, corporate environmental requirements, and both the facility's and its parent corporations commitment to be a responsible neighbor. Initially, the team evaluated use of a ranking system to determine significance, but later decided that it was inefficient to utilize based on discussions with managers of its sister facilities who had discouraged against ranking and after some initial efforts at the Delta facility. Instead, the Team employed a consensus-based approach to determine which of its impacts were significant.

Included in Delta's environmental aspects were four that had also been identified previously by its corporate parent. These aspects, along with their respective objectives and targets, had been a part of the corporate EMS for several years before the ISO 14001 standard was developed. Delta and its sister facilities had the flexibility to determine how best to manage these aspects at their respective sites and which procedures would allow them to meet the established objectives and targets most efficiently at the site level. They also had the flexibility to establish more ambitious objectives and targets should they so choose.

Once Delta's significant aspects were identified, the environmental programs department, with review by the Core Team, determined the facility's objectives and targets. As appropriate, individual department managers helped establish responsibility of "owners" of these objectives and targets within each relevant department. Involving department managers in the process helped support the overall targets and assure successful outcomes.

Once the structure for Delta's ISO-14001 based EMS was developed, the EMS Core Team invested heavily in employee training. The Core Team determined the benefits of adoption of an ISO-certified EMS ahead of time and summarized many of these benefits in their training modules. For example, the team evaluated the facility savings if it reduced its energy use by four percent. Then, to make the savings more relevant to Delta employees, the Core Team compared this information to average household energy consumption to determine how many homes per year might be supported with Delta's reduced energy consumption. Similarly, the team showed what an increased amount of solid waste recycling would mean for Delta, its managers, its employees, and the surrounding community. Such comparisons helped to motivate Delta employees and management and to gain their support in certifying their EMS.

The team utilized a three-pronged training strategy. One training strategy was developed for its executives, and a separate training approach was developed for managers. The latter strategy also provided a training module for managers that they present to all facility employees to enhance general awareness of the environment issues and Delta's EMS. This module also served to increase employee ownership of the ISO-based EMS and relevant objectives and targets. The third training strategy provided each of Delta's "ISO Representatives" with EMS auditor training. These representatives are assigned throughout the facility to each manufacturing, development, and support department to help assure proper implementation of the ISO standard, Delta's EMS, and to monitor overall implementation programs.

The team also summarized what was required to achieve registration to the ISO 14001 standard. That is, they determined where the facility presently stood and what work needed to be done. In doing so, the Core Team evaluated Delta's existing Department Operating Manuals and gave Delta managers a format which, when followed, could be inserted into the existing manuals to address individual department EMS responsibilities. This process minimized the amount of time individual department personnel had to invest in the documentation component of ISO 14001 adoption.

As a consequence of the EMS development and certification process, each of Delta's more than 200 departments developed its own required ISO 14001 EMS plan, each of which was designed around the uniqueness of the department, its training needs, its records, and what procedures it must follow. An important advantage of this implementation scheme was that Delta more effectively involved its nearly 7,000 employees in its EMS deployment.

To better monitor and improve its ISO 14001 EMS, Delta also convened a "green managers" team to help determine how to institute proactive management strategies into its product development organizations. The issues and strategies developed through this team were incorporated into the management review process for Delta products and were made a criterion for managerial performance.

Delta's overall environmental performance is reviewed by its senior facility executives, and specific directions for establishing future objectives and targets for activities, products and services are discussed with the Core Team during this review. One change that occurred as a result of these assessments was that Delta's health and safety audits were now more closely integrated into its annual ISO 9001/14001 internal audit program to achieve greater operational efficiency.

Challenges

While Delta managers reported that the ISO adoption process went remarkably smoothly, they did experience several hurdles. Initially, Delta included all of its more than 200 departments in identifying aspects and impacts that were specific to their unique operations and in establishing department-specific objectives and targets. This process quickly became intractable. Difficulties arose over definitions and what should be included in the aspect and impact identification process. Also, individual department managers were more inclined to focus on their own departmental objectives and targets, rather than on facility-wide aspects such as water conservation and energy use and their respective objectives and targets which would affect all facility areas. Should Delta have followed through with this initial approach, it would have had to track every department-established objective and target for each of its more than 200 departments. Recognizing that each of its departments might have ten or more aspects and associated objectives and targets, Delta would have to manage and track 2,000 or more programs facility-wide.

It was quickly determined that this approach was not practical or desirable. The Core Team addressed this hurdle by using their combined facility-wide expertise to evaluate Delta's aspects and impacts and establish objectives and targets across all Delta operations, rather than having every department establish its own. Then, the team brought individual departments into the process when their assistance was required to meet a specific objective and target.

Once Delta's ISO 14001-based EMS was designed, the Core Team encountered several implementation hurdles as well. There was some internal resistance from both department managers and their employees who believed that their current EMS worked well and that the benefits of the ISO adoption process were not evident or relevant to their activities. Others believed that ISO 14001 represented the popular "program of the day" and would pass over time. Finally, there was resistance to ISO 14001's additional documentation requirements.

To overcome this resistance, members of the Core Team met, as needed, with executives and department managers to discuss the benefits of ISO 14001 adoption and how the modified EMS would benefit Delta's operations. During these meetings, the Core Team would review Delta's current environmental impacts and others that the facility was not completely managing. They would point out how the reduction of these impacts could reduce Delta's imprint on the environment, further bolster Delta's image, and potentially save Delta money. These reviews helped increase managers' acceptance for ISO 14001 implementation, which they passed on to their employees.

The Core Team addressed managers' concerns for ISO 14001's documentation burdens by creating templates for each department to follow. Rather than requiring each department to review and update their operations manuals with numerous changes due to ISO 14001 requirements, the team developed forms that articulated each documentation change that was needed. Then, when completed, department personnel simply inserted these forms into the appropriate locations within their existing manuals, thus reducing the time required for implementation at the departmental level.

Considering all of its implementation hurdles, one Delta manager suggested that if he had to do it over again, he would focus more on communication between the Core Team, individual department managers, and employees. To facilitate this, he would consider hiring a professional communications consultant during the initial stages of ISO 14001 adoption to assist with employee awareness and training. Another Delta manager suggested that the process of setting the facility objectives and targets might have been easier if the Core Team had included "owners" of objectives and targets during the initial stages of the ISO 14001 adoption process.

In addition to its implementation hurdles, Delta had to address issues related to its continual improvement process. A unique feature of Delta's EMS was that it is relatively mature. With an EMS already in place for more than 25 years, the facility had for some time factored environmental concerns into its operating procedures. ISO 14001, however, required that Delta focus more formally on continually improving its EMS. This was a challenge, as much of its "low-hanging fruit" had long since been picked. Moreover, because many of Delta's managerial staff had been with the facility for many years, its staff was too accustomed to pre-existing environmental management operating procedures, thus diminishing employees' ability to think creatively to improve the ISO EMS over time.

To overcome these hurdles, Delta executives and employees focused on making its EMS what one Delta manager described as a "living plan." One factor that facilitated Delta's shift of emphasis toward change and continual improvement was that facility management encouraged a work environment where employees had the opportunity to periodically change their job positions. Doing so helped prevent what one Delta employee described as "personnel tunnel vision." For example, one employee changed her job position and assumed responsibility for the alternative commute program, and because her perspective differed from her predecessor's, she was able to incorporate fresh ideas into the program. This strategy helped Delta maintain its continual improvement focus. So, too, did its employee incentive program, which offered employees monetary incentives should their recommended improvement options be implemented.

Delta's Benefits from EMS Adoption

Since the 1970s, Delta has made great strides in improving its environmental performance and philosophy. During the early stages of its environmental management practices, the facility managed its environmental affairs in more of a response-focused manner: on those infrequent occasions when an environmental incident occurred, it would respond and try to manage any impacts as best it could. After adopting its initial EMS, a succession of executives and environmental managers brought with them fresher perspectives and increased environmental awareness and leadership. More recently, its focus shifted to reducing the facility's "environmental footprint," avoiding the occurrence of any incidents, and achieving proactive control of impacts should an incident occur. Thus, when Delta management decided to adopt ISO 14001, many employees did not anticipate significant benefits, as these individuals believed that the facility already had a strong EMS in place.

Since certifying its EMS, however, Delta has reaped numerous additional internal and external benefits.

Internal Benefits

Integration of Environmental Management. Internally, perhaps the most impressive benefit was that ISO 14001 adoption made environmental management a formal responsibility of every employee, from secretaries to senior management: from soda can recycling to duplex printing, aluminum foil recycling, turning off desktop computers at night, turning off lights when not in use, and much more. In 1996, very few people knew where to find Delta's environmental policy. Four years later, about 7,000 employees knew where to find it, knew what it was, and knew how their individual actions contributed to the facility's ability to achieve its environmental goals. As a result, environmental issues were personalized for many Delta employees, thus heightening employee morale and increasing employee support for the facility's business goals.

Document Control. Other internal benefits included improvements in document control, calibration processes, and overall operational control. Each Department Operating Manual now identifies the department's environmental records, who is responsible for them, what form they are in, how long to keep them, and when they should be reviewed and revised.

Retooling. The facility also continued to replace inefficient manufacturing equipment with new tooling. For Delta's product components that require chemical processing, such processing was modified so that many of these components are now sprayed rather than dipped into a chemical bath. These improvements continue to occur as Delta's employees identify additional process changes to use chemicals more effectively and efficiently. In some cases, by changing processes, individual manufacturing process steps may be done concurrently. For example, an operator may place a component into a spray tool, push a button, and manage another task while the automated spray tool completes the job.

Operational Control. ISO 14001 also helped the facility to improve its operational control of environmental processes. Prior to ISO 14001 adoption, operating procedures existed for most on-site EMS-related processes (e.g. wastewater treatment, chemical distribution, waste handling, powerhouse operations, and others). ISO 14001's document control process, however, resulted in greater, more effective control of the identification of these procedures, of processes to control document changes, and for assuring that personnel were informed of procedural changes.

Land use. For years, Delta has maintained on-site orchards. As a result of its ISO 14001 EMS process, the facility broadened its environmental management focus to include both its negative and its positive impacts on land use and open space, which it now evaluates when making changes to its site activities. As a result, Delta has expanded some of its on-site orchards and improved wildlife habitat by removing temporary building structures, re-vegetating the land, and further benefiting the natural environment.

Transportation. ISO 14001 adoption enabled Delta to consider some elements of its activities that were not previously considered key environmental aspects, such as employee transportation. Transportation issues are particularly important to Delta's surrounding community because of the area's air quality concerns. As a result of ISO 14001 adoption, Delta brought more focus to its alternate commute program as a way to help minimize its employees impact on air quality. By offering a ride share program, carpooling incentives, free passes for county light-rail and buses, and numerous other programs, 24 percent of Delta employees now use public transportation and carpooling at least some of the time to get to work. In one recent year alone, Delta was able to increase its employees' use of alternate commute options by more than 50 percent.

Energy Use. Delta also benefited from reducing its energy use, reaping immediate monetary benefits as well. After adopting ISO 14001, Delta continued to achieve more than 4 percent energy conservation each year, and in 1998 alone its energy savings were equal to the annual energy consumed by approximately 1,800 homes. To achieve such energy savings, Delta retrofitted energy conservation technology in some of its operations and promoted efficient energy use in all its activities. Delta encouraged its employees to turn off unused lights, to turn their computers off when not in use, and to use their computers energy saving settings; it also initiated a program to install light sensors throughout its buildings, where appropriate, to turn lights off automatically when not in use.

Vendor Contracts. A final internal benefit of Delta's ISO 14001 adoption was an evaluation of its on-site vendor contracts. Because many of Delta's employees work directly with its on-site vendors, Delta realized that its on-site vendors should be included in its overall ISO 14001-based EMS implementation. Increased emphasis on recycling as part of cafeteria operations, an activity that had been contracted out, helped maintain and improve established glass and plastic recycling programs. These activities, while they may seem tangential to Delta's goal to manufacture electronic components, served to further impress on employees how every element of the facility's operations can potentially affect the environment. Delta's solid waste recycling programs helped the facility to recycle over 70 percent of its annual solid waste each year.

External Benefits

In addition to the internal benefits described above, Delta also reaped several external benefits related to customer satisfaction and marketing:

Customer Satisfaction. While Delta adopted ISO 14001 primarily for reasons other than customer demand, customer preferences are now a factor that the facility considers. Indeed, these preferences play a part in Delta's success in operating internationally. Especially in Western Europe, both large and small customers increasingly are requesting information about Delta's environmental policy and its aspects and impacts. Some potential customers, for example, have begun to require in their purchase contracts that Delta take back its product packaging. Delta's ISO EMS has helped it to manage such requirements, and thus to maintain contracts with some of its customers.

Moreover, some of Delta's customers, while recognizing that Delta is ISO 14001 registered, know that EMSs vary in quality and scope. As a result, these customers are making decisions about whether or not to purchase Delta's products based not just on its certification, but at least in part on the content of its EMS as well (that is, on its aspects and impacts). Because of Delta's ambitious adoption process, its ISO-based EMS largely satisfies customer requests that their suppliers utilize "green" operating procedures and produce environmentally conscious products.

Marketing. Because of these changing customer preferences, Delta has begun to integrate its environmental activities more formally into the marketing of its products. Specifically, Delta's sales division is increasingly using its ISO 14001 registration and strong environmental leadership as selling points for its products and as a means to differentiate itself from its competitors.

Finally, Delta's success in implementing most of its ISO 14001-related goals was due in part to the strength of its preexisting EMS. The maturity of its system benefited Delta by creating an organizational culture of environmental concern. But as noted earlier, the maturity of its EMS was also a challenge because of the difficulty related to continually improving its EMS. Fortunately, Delta executives and managers recognized this, and promoted an organizational culture in which employee change – within and among employee positions and departments –

was encouraged. This culture will no doubt help to assure Delta's future ability both to continually improve its ISO 14001-based EMS and to assure its long-term success as a business.

Epsilon Systems

"Epsilon Systems" is a small manufacturing facility within a larger product-based group (called Systems Products Group, or SPG) of a major international multi-product corporation. The five facilities within SPG are Tier I suppliers of electronic equipment to automotive manufacturers. Epsilon employs just over 50 employees in its manufacturing operations and has received awards from its customers for its product quality and service. The other SPG facilities, which are located across the US and Europe, employ more staff, but Epsilon benefits from being located at SPG's headquarters. Epsilon can draw upon corporate group-level management and technical staff to assist in special projects. This assistance proved to be especially beneficial in designing and implementing Epsilon's EMS.

Epsilon is located in a suburban community in the Midwest. The area surrounding Epsilon is comprised of light manufacturing facilities and research or corporate headquarter campuses of other major corporations. A major interstate highway runs nearby the facility, and there are no residential areas nearby.

Epsilon's Production Processes

Epsilon produces pressure- and temperature-sensing devices for the automobile industry. The facility is organized into a series of small clean-room operations in which the various parts for the devices are made, cleaned and then assembled. Research and development activities also are conducted at the facility. The research and development labs, each housing numerous lab benches, chemical hoods and testing devices, develop prototypes for new products and investigate methods to improve cleaning and assembly processes. A variety of chemicals, albeit in small amounts, are used in these labs. Epsilon's production and research activities create few environmental impacts: air emissions are almost non-existent, for instance, and therefore the facility is not required to have an air emission permit. Small hazardous waste management and wastewater treatment operations are associated with the manufacturing processes.

Epsilon's Facility Culture

Most of Epsilon's 50 employees are engineers, scientists and technicians with an intense focus on the technical details of making Epsilon's products and improving them as necessary. Because of its location at SPG group headquarters, with its large corporate research facility, Epsilon shares production space with research staff, and Epsilon's engineers and scientists can therefore exchange ideas with technical staff from many disciplines. Most of Epsilon's staff have been with the company for nearly ten years. The corporation had met with difficult times recently, however, and lay-offs had stretched staff to take on additional duties.

Epsilon maintains close relationships with its automaker customers, and employees are proud of the awards it has won from them for customer service and quality. It is considered by its customers to be a leader in quality and in environmentally responsible manufacturing practices, and was recently named "Supplier of the Year" by one of its large customers.

Epsilon frequently has participated in and led seminars organized by U.S. automakers on environmentally responsible manufacturing. It participates in an annual environmental fair at the headquarters of one of the automakers, in which suppliers talk about their environmental practices, and it often has been asked to develop presentations to other suppliers' employees and customers on how to incorporate environmental principles into product design and manufacturing.

Why did Epsilon Develop an ISO 14001 EMS?

Epsilon has had an EMS in place for a number of years. In 1998 it was the first U.S. facility within the corporation to become ISO 14001 certified, following a European facility (also a member of SPG), which had been certified in late 1996. Epsilon now serves as a model for other company sites going through the process of ISO 14001 certification.

Epsilon's Environmental Health and Safety (EHS) managers first got the idea to introduce ISO 14001 as a result of interactions with the Big Three U.S. automakers in 1996, although at that time there was no direct supply-chain pressure or requirement to become certified. Group EHS managers had the foresight to proceed early, and used the perception that there would be future pressure from customers to convince senior group- and facility-level management to proceed with EMS development and ISO 14001 certification. Epsilon's prior experience with ISO 9000, in which significant supplier pressure had been applied, fortified this perception. Epsilon had been the first SPG facility to become QS 9000 certified: it was accustomed to piloting programs, and had benefited from implementation of that system. Managers at Epsilon anticipated the possibility of additional resource savings from a similar ISO-based environmental system. All facilities in the corporation subsequently were ISO 9000 certified, and the larger automotive groups such as SPG were certified to QS9000 as well.

Epsilon's EHS managers' perception that the automakers would require certification at some point in the future was thus a significant motivator for Epsilon to design and implement its ISO 14001 EMS, so much so that Epsilon participated in a lobbying campaign to encourage the automakers to require all other suppliers to become certified.

In addition to their anticipation of future supplier pressures, Epsilon also was motivated by its EHS managers' desire to serve as a model for future facilities, and to promote certification as a valuable asset within the corporation as a whole. SPG staff, located at the same campus as Epsilon, had been integral to the success of the first corporate facility to become ISO 14001 certified, an SPG facility located in Europe. Because of this experience they wanted to spread the word about EMSs and ISO 14001 to other facilities. These managers felt that the ISO 14001 certified EMS not only would be a valuable marketing tool with customers, and a way to distinguish themselves from other suppliers, but also would increase the productivity of environmental programs and serve as a framework for reducing environmental impacts. Once Epsilon and its sister facilities in SPG were ISO 14001 certified, the corporation required all facilities within its organization to develop ISO-compliant EMSs. In the judgment of Epsilon's and SPG's EHS staff, the success of their EMS development and ISO 14001 certification efforts were influential in the corporation's decision to take this step. The corporation subsequently published a corporate EMS that included safety components (an "EHSMS"), and corporate EHS staff audit all facilities to this standard biennially.

A third important reason behind Epsilon's decision to become certified was its participation in a corporate-wide effort to apply for the national Baldrige Award in 1993. This award, named for Malcolm Baldrige (U.S. Secretary of Commerce, 1981-87), recognizes companies that "have substantially benefited the economic or social well-being of the United States through improvements in quality and performance excellence." While the corporation ultimately decided not to apply for this award, environmental management systems were put in place at that time to identify environmental aspects and impacts and to set objectives and targets at a corporate level.

During this exercise, corporate-level "Production Process Improvement in Environment" (PPI) teams examined production and process activities in a manner similar to the ISO 14001 aspect and impact process. As a result of the PPI teams' analysis, environmental work teams also were convened at the facility level to address three environmental issues – solvent use in coating, lead reduction, and waste to landfill – which had been suggested by the PPI teams. In the wake of this effort, a case was easily made to Epsilon management that the ISO 14001 EMS was a way to introduce a facility-specific environmental aspect and impact assessment process, and that certification was a way to obtain credit and legitimacy for an effective system.

It should be noted that Epsilon's decision to develop an ISO 14001 EMS and become certified was not motivated by regulatory compliance issues or community concerns. Epsilon had always had an excellent compliance history and good relationships with regulators. And its somewhat anonymous location in a large industrial park and lack of environmental impacts made environmental issues with the community quite low-key. As one Epsilon manager put it, "Nobody knows about manufacturing going on here. They think it's an office building." However, one of the SPG facilities in another state had had compliance problems, and knowledge of this circumstance may have affected the group's positive disposition toward the ISO 14001 EMS as a system that could improve compliance assurance.

Who was Involved in the Development of Epsilon's EMS?

At Epsilon, a steering committee of engineering staff and managers was assembled to develop the EMS. The business manager, EHS manager, environmental engineer, product operations manager and engineering/quality assurance manager were members. The steering committee asked questions and got direct input from non-management and non-engineering staff, such as operators, on an as-needed basis. The environmental work teams, which had been in place since the corporate-driven Baldrige application process, also participated. As the objectives and targets were developed, process engineers and process technicians became more involved. EHS staff from SPG who had been involved in developing the ISO 14001 EMS at the European plant also participated, acting as an in-house consultancy. No outside consultants were used: as SPG's EHS representative explained, "It's best when the facility designs its own EMS, rather than the consultant's."

The corporate environmental affairs staff had a large influence on Epsilon's EMS design. Two employees were especially influential for their vision of what the EMS should look like and of the process by which it should be designed. One was the corporate group (SPG) director of management systems: she had worked with a variety of facilities throughout the corporation to develop quality management systems, was involved in the Baldrige Award effort, and helped design the first EMS to become ISO 14001-certified at a plant in England. The second person, later SPG's Group Manager for Environment and Safety, served as Epsilon's environmental manager during much of the EMS design process and by all accounts worked tirelessly on the project. Steering committee members – all engineers, with a focus on completing a detailed analysis of Epsilon's activities and a highly structured significance- determination process – significantly influenced Epsilon's EMS design. One non-management employee, who had been a member of one of Epsilon's prior-to-EMS environmental improvement committees, was also influential, serving as the EMS's main cheerleader and encouraging employee support and enthusiasm for the project.

Finally, customers influenced the way in which Epsilon designed its EMS. One automaker in particular stated that it would soon require ISO 14001 certification of its suppliers' EMSs and articulated a vision of what those EMSs should include.

Epsilon's EMS Development Process

The EMS steering committee brainstormed together and also with specific process-related groups to develop aspects and impacts. The committee reviewed each process line to determine where the big chemical users or producers were located. They built a large grid which included chemical use, resource use, manufacturing process, emissions to air, water, soil, and effect on flora, fauna and public health, and listed each of the facility's activities on this grid; and from it they identified ten aspects and twelve impacts.

Next, the steering committee supervised a complex scoring system to evaluate aspects and impacts, estimating direct and indirect effects. This tool had been developed by SPG's EHS staff and had previously been used in SPG's ISO 14001 certified European facility. All aspects and impacts were scored, including regulatory requirements, emissions, and waste as well as impacts to human health. Members of Epsilon's pre-EMS environmental work teams had input into this process. When the scoring was complete, a Pareto analysis was conducted and a line was drawn to indicate which items were significant. The committee also defined as significant several functions such as communication, packaging, and inventory control that had been identified as needing improvement during the corporate-driven Baldrige application process.

Once the significant items were pinpointed, objectives and targets were set. Initial objectives and targets were set for high-scoring impacts for which programs were not already in place from the Baldrige application process. If an issue had a high score and still persisted after the core team evaluated existing programs with the potential to deal with it, or if there were no programs in place to address it, objectives and targets were set and a new environmental work team was convened.

The final step in EMS implementation was communicating the benefits of the new system to employees and providing specific training on its components. At Epsilon this took place in steps. First, steering committee members trained Epsilon managers. These managers then put the EMS issue on the agenda in their regularly scheduled group communication meetings. Every employee was given an EMS handbook stating Epsilon's environmental policy, summarizing the EMS structure, and providing information on employee responsibilities and the environmental work teams. More structured training was provided to employees with specific EMS responsibilities. Employee responsibilities also were emphasized by signs placed in the production areas.

Challenges

Because Epsilon's corporate parent had instituted a corporate-level EMS-like process and audits, a and there were no significant regulatory issues as external drivers, it was somewhat difficult for Epsilon's EMS steering committee to obtain manager and employee buy-in for a new system. It was doubly difficult in the absence of a clear understanding at first about the details of ISO 14001. As one manager put it, they had to be convinced that a system to "architect behaviors and increase efficiency in production" would be beneficial. At several points in the EMS design and implementation process, operating managers had to be convinced again to dedicate resources to the effort.

In addition to problems in obtaining buy-in, the EMS steering committee and environmental work teams faced obstacles in developing new objectives and targets. A number of the EMS-driven objectives and targets were simply modifications of existing PPI driven projects. It was also difficult to set meaningful targets when there had been little effort to develop baseline data: it was hard to determine how much had been accomplished and where the new bar should be set. At first the teams set goals such as "reduce use of chemical by 50%," and then went about developing the missing baseline data. Once the EMS had been in place for over a year, the targets began to become more concrete, and the work teams also began normalizing performance measures in relation to production fluctuations.

A final implementation challenge was related to the lack of broad-based employee involvement in development and implementation of the EMS. The environmental work teams charged with shepherding successful completion of the EMS objectives and targets were generally comprised of the same employees as were the pre-existing PPI teams. While the rest of Epsilon's employees were generally aware of and supportive of the system, it remained peripheral to most of their day to day work. To address this issue, the steering committee intended to convene new teams in the future.

Epsilon's Benefits from EMS Adoption

Even given these challenges, Epsilon reaped a number of benefits from the introduction of its ISO 14001 EMS.

First, among Tier I suppliers to the U.S. automotive manufacturers, Epsilon enjoyed the advantages of being a first mover, becoming certified before the automakers required certification of all their suppliers. Epsilon's early EMS implementation and ISO 14001 certification were seen as a way to position itself favorably with its customers as a green, environmentally conscious facility, with the legitimacy that derives from external certification. They also believed that this could translate into an increase in market share: as an ISO 14001-certified firm, they would have an advantage over non-certified competitors who would be playing catch-up. And, further, Epsilon would benefit earlier than their competitors from improved environmental performance and resource savings resulting from the implementation of their EMS.

For example, Epsilon managers cited cost savings in hazardous materials disposal and chemical purchasing as a result of their ISO 14001 EMS. Epsilon's environmental manager indicated that because they put an ISO 14001 EMS in place, hazardous material use was systematically analyzed for the first time, and as a result of this analysis process changes were implemented that eliminated the use of a costly hazardous chemical.

Additional benefits were derived from the systematic analyses inherent in Epsilon's EMS. One of Epsilon's production managers reported that environmental impacts had not been routinely assessed within the company's process reviews, but now were. Because of the EMS, all process reviews now included consideration of environmental impacts, materials usage and pollution. An analysis of electricity use had never before been included in process reviews, but now was examined in all reviews, and electricity costs had declined. One of Epsilon's EMS-driven environmental work teams also was systematically examining water use, in hopes of producing similar results. Another team discovered a way of using waste potassium hydroxide to treat wastewater rather than to discard it, which resulted in cost savings.

Further evidence of the benefits of Epsilon's EMS's systematic environmental analyses was provided when a customer asked Epsilon to open up a production line that had been discontinued prior to EMS implementation. When the line was set up again, Epsilon process engineers applied principles of design for the environment (DfE). The newly configured production process made the same product as before, for the same customer, but with considerably less impact on the environment due to reduced chemical, electricity and water use.

Indirect benefits of Epsilon's ISO 14001 EMS implementation also were reported. While SMG's EHS manager and others indicated that ISO certification was not driven by the goal of improved relations with regulators, one group manager reported that in practice "permit modifications and the like" were now fast-tracked since implementing its EMS. Epsilon's environmental and production managers all indicated that a significant benefit of the ISO certification process was an increase in environmental awareness by company employees and management: no longer were environmental issues considered solely the responsibility of EHS staff. As one SMG EHS manager put it, no longer was it "her project or his regulation, but my job." A production manager indicated that environmental aspects of a process were not even "on the list" before, but were now among the top three considerations. Another manager cited the personal satisfaction of doing the right thing, and the increased focus on the environment as a benefit.

Finally, Epsilon's ISO 14001 certification and its integration of environmental awareness into its business practices were consistent with the overall "greening" goal of the automotive industry to which it supplies its products. A number of Epsilon's automaker customers have stated that environmental stewardship is now a priority and an integral part of their corporate cultures. Some automakers have said directly that they expect the same from the people and companies they do business with, some even going so far as to require ISO 14001 certification. By affirming through ISO certification that they share these values, Epsilon benefits by reinforcing its relationship with customers and its place as a preferred supplier.

Gamma Industries

Gamma Industries is a publicly traded, wholly-owned subsidiary of Gamma Corporation, a large multinational corporation with headquarters in Tokyo, Japan. Gamma's 300,000 square foot plant, the corporation's first manufacturing plant in the U.S., began construction in mid-1987 in an industrial park located near a small town in the Southeast. Gamma began its operations in 1989. Rolling hills and farmland surround the facility. Gamma employs 350 people in its highly automated manufacturing operations, is considered a highly respected company in the community, and has won environmental performance awards from the state environmental agency.

Gamma's Production Processes

Gamma manufactures color negative photographic paper and emulsions. These products are made by applying a multi-layer, light-sensitive coating onto a polyethylene-coated base paper. In addition to various auxiliary and support departments such as office, shipping and receiving, and research and development, three main production processes are employed at Gamma. These are emulsion manufacturing, in which the light-sensitive emulsion is prepared; coating, in which it is applied to paper sheets and dried; and packaging, in which coated paper is slit to various sizes and packaged for shipment. Both the photographic emulsion manufacturing and paper coating processes have potential to produce significant environmental impacts through water and air. Packaging processes have the potential to generate significant solid and hazardous waste. Additional activities with significant environmental impacts include utility boilers (which generate electricity for Gamma), wastewater treatment, and chemical and hazardous waste disposal.

Automated computer-controlled technology is used throughout Gamma's processes. Production rooms are controlled to offer specific environmental conditions. A chemical tracking system is used to account for all chemicals used in manufacturing. The facility houses its own technical support center for quality assurance and some research and development activities. Most research and development activity occurs at Gamma's corporate headquarters in Japan.

Gamma's Facility Culture

Being part of a large international company with headquarters in Japan requires Gamma to make local decisions on day-to-day operations. A management review board, comprising all facility senior managers, is responsible for these decisions. However, international headquarters' staff is involved in long-term strategy and must approve significant changes in production processes. While facility technical and managerial staff and the management review board long supported the development of an EMS and Gamma had begun to develop a system, headquarters required all its facilities to develop EMSs that could be certified to ISO 14001 by 2000. The certification requirement imposed an additional challenge for Gamma, although when the corporation had required all facilities to obtain ISO 9000 certification, Gamma had been the first non-Japanese facility to do so. Gamma's EMS became ISO 14001 certified in 2000, and was used as a model for other Gamma facilities in the U.S.

It is often difficult for Gamma to find employees from surrounding communities to do the highly technical work required, therefore qualified employees are valued and supported by numerous training and educational opportunities. In addition, Gamma has been an active supporter of local colleges. At Gamma, employees often work together on teams. Employees are encouraged to be involved in what is happening throughout operations by regularly participating in involvement teams to exchange ideas and to move on to new jobs within the company as appropriate to learn more about operations. Gamma operates under a total-quality-control philosophy, as do affiliated facilities throughout the world. Total quality control relies heavily on effective systems for statistical analysis of results to improve effectiveness.

Gamma's formal environmental policy, in contrast to those of its sister facilities in Japan, is lengthy and detailed. It stresses compliance and pollution prevention and provides specific guidance to Gamma employees on their environmental management responsibilities. The policy was developed by Gamma's environmental and quality systems engineer with help from a corporate environmental manager and approved by the facility's senior management.

Gamma's EMS Design Process

The facility's standing environmental group was influential in developing the EMS. This group was made up of selected employees from all areas of the facility. Most selected had significant experience within the facility. Many were engineers, and some were non-management employees. One group member, a line operator, had been in his job for over 10 years. The facility environmental engineer developed eighty percent of the initial EMS, by his own estimation, with some assistance from the other core team member, the facility quality engineer. The environmental group members filled in the blanks on the other twenty percent. The group met about once per month during the initial design phase. As the environmental engineer was drafting the EMS he also approached other employees to join the effort. Managers generally approved such participation; in some cases group members were paid overtime to participate. The first few meetings had little structure: they were pure brainstorming with the goal of developing a list of environmental aspects to be analyzed. Gamma did not undertake a formal process of cataloging facility activities, determining related environmental aspects and finally listing associated impacts, but focused throughout EMS development solely on aspects.

Once a list of facility aspects was developed, the environmental group met formally to review and approve them. The senior manager from each area affected signed off on the final aspects. Aspects were then reviewed by the environmental engineer and quality systems engineer for significance, using a procedure developed by the environmental engineer. Under this procedure all aspects were examined for their impact on emissions to air, water or land, for their impact on resources such as water energy or raw materials, and for their impact on society as documented through regulations or potential to create nuisance such as noise or odor. If aspects were governed by the facility's hazardous chemicals disposal or wastewater discharge protocols, they were automatically considered significant. The significance determinations were presented to the facility's management review board, which was comprised of senior managers from every area within the facility. The facility's management objectives and targets were directly related to the significance of its environmental aspects. Significant aspects at Gamma included electricity usage, base paper handling, boiler operation, cardboard disposal, CFC and HCFC usage, drum disposal, and ethyl acetate usage, among others. In all, Gamma identified almost sixty significant aspects.

To begin the development of objectives and targets, significant aspects were first discussed within Gamma's environmental group. The facility environmental engineer then proposed objectives and targets based on current and planned projects. The targets were then revised based on further discussion with the facility environmental group and some research on historical performance. Next, the management review board reviewed and approved them. Final approval of specific targets came from the company president.

Training facility employees on Gamma's EMS took place throughout the EMS development process. An initial kick-off meeting was held with all employees, and during development members of Gamma's environmental group met with their home departments to update them and to obtain input. Once the EMS was completed, overview training was conducted for all employees. All employees also were given a green card with Gamma's quality and environmental policy on the front and back of it. Next, a second tier of training was provided to groups whose jobs had significant impacts, by a state environmental agency employee who had been on site as part of the core team throughout the EMS development process. And finally, the EMS was discussed in periodic safety meetings.

All elements of the facility's quality and environmental management system were reviewed at least annually, and monthly presentations were provided to the management review board to indicate weaknesses of specific elements of the EMS. A discrepancy report was also written to the manager of the affected department to correct the weakness and prevent it from recurring. The following year, this EMS element was reviewed again to ensure that the weakness had been corrected. The review of the EMS occurred as part of Gamma's overall review of its management system, which included quality as well as environmental management components.

Influences on Gamma's EMS Design

A number of influences were evident as Gamma designed its EMS. Local and corporate top management both played roles, as did the influence of a state environmental agency employee. Gamma's corporate culture of inclusion also played a role in designing the process, and finally, Gamma's energetic environmental engineer played an important role in shepherding the process.

Top management's influence on Gamma's EMS came in two forms. First, the corporate directive to construct an ISO 14001-certified EMS by date certain was instrumental in igniting some employees' enthusiasm for doing it first. The corporate philosophy of minimal sharing of information with parties outside the facility influenced the level of stakeholder involvement in Gamma's design process, as did its philosophy of inclusion of employees within the facility. This philosophy helped to create an atmosphere for a large cross-section of Gamma employees to contribute to the EMS design and implementation process. Local top management was also influential. Gamma's president, an ardent environmentalist, strongly supported the EMS efforts and participated in its design to the extent possible. When support for the EMS by some middle managers waned, the President encouraged them to continue and provided his vision of what the EMS could do for the company.

A state environmental agency employee's influence was critical in Gamma's design. His services had been lent to Gamma for the duration of the design process, and he spent multiple days per week on site, teaching employees about EMSs, providing advice to the environmental group, and undertaking the mundane work of documenting policies. He also served as a cheerleader for the project.

Finally, the most important influence on EMS design at Gamma was that of the facility environmental engineer (later a production manager, the promotion a reward for a job well done). He had worked on EMS design at a prior job and had a clear vision of what Gamma's EMS should look like. He shepherded the process, recruited employees to the environmental group, and probably designed over 80% of the EMS on his own.

VISIONARIES: BETA MUNICIPALITY AND SIGMA RESOURCES

Two facilities, Beta Municipality and Sigma Resources, saw the development of their EMSs as opportunities to engage employees and external stakeholders alike in a quest to introduce far-reaching environmental visions. Both facilities involved a variety of management and non-management employees in EMS design. Both invited the public to participate in their EMS development efforts. And both facilities looked beyond compliance, pollution prevention and eco-efficiency to incorporate goals of product stewardship and environmental sustainability in their EMSs.

While these facilities on the surface seem quite unlike each other – one a large municipal government, the other a large electronics manufacturing facility – they had certain characteristics in common. First, each possessed a culture of environmental awareness. Beta described a philosophy in which its employees were to be recognized by the city's citizens – Beta's customers – as environmentally sensitive. Sigma offered its many employees opportunities both to increase their environmental knowledge and to contribute to protecting the environment in the day-to-day enactment of their responsibilities. In addition, neither Beta nor Sigma were interested in building an EMS as a symbol of environmental legitimacy, but rather saw the EMS as a vehicle to increase the environmental involvement and awareness of employees and to design a system to put their environmental vision into practice. To this end neither facility developed a certified EMS, although Sigma, due primarily to business pressures, expected that it might have to do so in the future.

Beta Municipality

"Beta" is a large municipality with 5 departments, multiple subdivisions, and over 1,000 employees. The municipality is located in the Southwest in a highly urban/suburban community with between 50,000 and 200,000 residents living within its 185-square-mile borders. It is surrounded by a number of smaller suburban and rural communities which are adjacent to a large urban center. In the past 10 or more years this area has experienced higher-than-average growth levels and tourism, and such growth is placing increasing demands on the city's operations and on its ability to manage its environmental impacts.

Prior to being asked by the U.S. EPA to volunteer for the EMS Municipality Project, Beta had already introduced a number of environment-related management initiatives that were unusually progressive among municipal governments. It had employed Total Quality Management principles, pollution prevention planning, waste minimization planning, and life cycle since the mid-1990s. It also had participated in both USEPA's Green Lights Program (GLP) and OSHA's Voluntary Protection Program (VPP). While Beta's participation in GLP did not influence its decision to adopt an EMS, its experience with the VPP was particularly influential. The VPP had helped the municipality to develop a framework to evaluate its health and safety issues on an integrated, citywide basis. The result was that Beta was better able to manage its health and safety issues across all its departments and sub-divisions, as well as improve its already above-average health and safety performance. The VPP's citywide management approach facilitated an easier EMS adoption at Beta as the integrated EMS framework was familiar and recognized to produce meaningful results.

Why Beta Adopted an EMS

If not for EPA's EMS Municipality Project, Beta probably would not have adopted an EMS. For municipalities, Beta argues, there is little reason to implement one. EMSs are costly to maintain, require much technical support during implementation, and lack a market driver (that is, there exists no competitive market of suppliers and consumers that is urging EMS adoption). Why therefore did Beta adopt its EMS? Beta maintains that the USEPA project served as both a market driver and a means of cost mitigation. The federal agency provided both the financial and technical support that made EMS adoption feasible, and Beta later received additional support from its state and county government as well, which facilitated its EMS implementation.

However, other factors also contributed to Beta's decision to adopt an EMS. Specifically, these factors were Beta's historical environmental performance, its desire to maintain a low-risk profile, and its desire to be an innovative operator.

With respect to its historical environmental management, the municipality was still in the process of managing environmental errors from the early 1980s, when part of its operations had become listed on EPA's Superfund National Priorities List for hazardous waste contamination. The slow remediation of this site had strained Beta's relationships with both the federal government and its public critics. The municipality's top management believed that adopting an EMS would enable the municipality to better preclude future compliance problems, avoid repeated mistakes, and improve its stakeholder relationships. They also believed that the EMS structure, which focused environmental management on the long term, would provide a vehicle to move Beta forward in all of these areas.

The desire to maintain a low "risk profile" reflected Beta's interest in avoiding any catastrophic environmental events and thus taking a proactive rather than reactive risk management approach. It considered its risk profile an important performance indicator of the municipality's operations and management, and believed that adopting an EMS was consistent with a proactive approach.

Finally, Beta had had a long history of innovation. Its "corporate" management culture involved an openness to trying new management approaches in order to improve upon its current operations. Its commitment to this cultural style was evident in its voluntary participation in GLP and VPP, and was also seen in Beta's management direction. Top-level managers recognized the increasing demands on both the municipality's transportation ways and the environment. To address these problems, they traveled to numerous other cities to determine what innovative strategies might be successfully applied to Beta's operations. Thus, adopting an EMS was consistent with Beta's innovative culture and a logical next step in its environmental management strategy.

Who Was Involved in Developing Beta's EMS?

Beta's EMS design team, the EMS Steering Committee, consisted of three categories of employees: management, non-management environmental experts, and non-management support staff. The management employees included Beta's chief environmental officer, a senior environmental coordinator, and a risk manager. Each of these individuals was involved in all design team discussions.

Two non-management environmental experts, an environmental coordinator and a public affairs officer, also were involved in Beta's EMS design process. Similar to management's participation, the environmental coordinator was involved from policy development to implementation, whereas the public affairs officer took a more specialized role by developing a communications plan to involve and educate the community about Beta's EMS.

Beta also relied on several support staff to assist in the process. An environmental advisor and an administrative assistant created a web site for the municipality's EMS that was accessible to both Beta employees and the public.

Several external stakeholders also influenced the entire design process. The city's Environmental Quality Advisory Board, comprised of citizens who were interested in and advised on Beta's environmental affairs, reviewed the municipality's EMS and provided recommendations for improvement. A publicly traded manufacturing facility, which had already adopted an EMS, also provided Beta with technical information and EMS development software, which Beta was able to borrow and modify to fit its own needs.

Finally, Beta involved employees in each of its five departments and various sub-divisions during the EMS design process. In doing so, the municipality believed that once the EMS was in place, the entire organization would be equipped with the tools to address its environmental issues.

Beta's EMS Development Process

In developing its EMS, Beta formed a steering committee whose members had knowledge of all of the city's five operational departments, their various sub-divisions, and the city's overall environmental management structure. The committee was charged with developing an EMS template that could be applied to each of Beta's operational departments. Once this template was designed, steering committee members created an initial list of the aspects and impacts that were relevant to each department. Then, committee members took both the template and the list to each of the five departments for meetings. Using the steering committee's cursory list as a point of departure, department staff were asked to compile a exhaustive inventory of the divisions' aspects and impacts and to determine their significance. Once complete, the aspects were ranked on a scale of 1 to 5 based on frequency of interaction, potential risk, and compliance assurance. In general, Department employees ranked Beta's impacts that were related to compliance assurance and critical operations as the municipality's greatest management priority.

Once Beta's various departments went through the identification and ranking process, the steering committee trained each division's operational-level personnel about objectives and targets, and each department's personnel were asked to list a minimum of 3 department objectives and targets. Aggregated over Beta's 5 departments and its multiple subdivisions within each department, approximately 90 targets were identified.

Finally, once the EMS framework was in place, the steering committee conducted in-person EMS implementation training at each of its divisions. This training was supplemented with a software program for employee use, which explained each of the various components of an EMS.

Challenges

While the process described above may sound relatively uncomplicated, Beta encountered several hurdles when implementing its EMS, which are likely to be characteristic of other municipalities or other large business organizations like Beta. Bureaucratic inertia was perhaps the greatest barrier to overcome. Beta has a very large operating structure with numerous departments and divisions, and as a result communication among the various departments was not consistent and managers were not always in agreement with one another. To transcend its inertia, Beta had to convince its middle management that allocating their employees' time to adopting an EMS could benefit both Beta and their department's long-term operating goals. To foster this commitment, Beta explored several non-traditional means to fund its EMS-related changes (such as new equipment purchases), such as seeking grants and soliciting state- or county-level assistance, so that it could continue to operate within its existing budget and thus allay middle management's concerns about resources.

An additional hurdle for Beta to overcome was its perception of the ISO 14001 framework itself. Even though Beta was not ISO 14001-certified or seeking certification, the municipality used this standard as a framework for developing its EMS, since it has evolved into a benchmark against which all EMSs are often compared. It found however that ISO 14001 was difficult to apply to Beta's operations. In Beta's staff's perceptions, the ISO standard tended to focus on the facility level and in particular on considerations most applicable to manufacturing entities. Beta however was a large municipal governance organization, with an EMS that covered far more than one "facility." In addition, the standard at face value seemed to emphasize facilities that manufactured "products" that were ultimately produced for sale. However, Beta provided many diverse goods for public consumption. Many of Beta's performance indicators, too, were not addressed in the ISO 14001 standard. For example, Beta considered as part of its EMS various community indicators such as open space, unemployment rates, occupancy rates, and housing prices, all of which were foreign to the average manufacturing facility's EMS and to the ISO standard.

Finally, Beta's customers were taxpayers rather than market consumers, a circumstance which in the municipality's judgment required a management structure very different from the structure that ISO 14001 was designed to address. Beta believed that each of these factors made ISO 14001 less applicable to a public sector organization, and thus very difficult to implement.

A final hurdle for Beta to overcome became apparent when the steering committee first took Beta's EMS template to its various divisions. The specialized language of the ISO 14001 standard (aspects, impacts, significance, objectives, targets) and of EMSs in general was difficult for division employees to understand, and became overwhelming. The result was several unproductive training sessions where much time was absorbed in defining EMS-related jargon and allaying employee anxiety. For this reason, the initial tools that the steering committee developed had to be reworked. All technical jargon was removed and replaced with more familiar terminology and examples, and slick presentations on the U.S. environmental regulatory system were made less formal and substantially abbreviated.

Benefits to Beta of EMS Adoption

While Beta acknowledged that its EMS adoption process was difficult at times, it also reported benefits from its implementation. For instance, adopting an EMS enabled Beta to better evaluate its wastewater discharge process, and thus to further reduce the municipality's environmental impacts: Beta subsequently made several capital purchases and installed additional mitigation equipment.

A second benefit of Beta's EMS was that the municipality better understood the high costs associated with its non-regulated impacts. By minimizing unregulated impacts such as paper usage and emphasizing employee recycling, Beta anticipated saving significant public costs to its budget. For example, as part of its EMS, Beta recently evaluated its copier and printer leasing contracts, and decided that in the future it would use only suppliers who could provide copiers with default settings for double-sided printing.

A final benefit that Beta hoped to reap, in time, was moving the municipality beyond a compliance-oriented mode of operation. That is, Beta hoped that its EMS would help its employees to lower the municipality's emissions to such a degree that its operations would fall well below regulatory thresholds. Doing so would make its environmental strategy more consistent with its proactive risk management policy. A secondary benefit that Beta hoped to realize as part of this management shift was a better relationship with federal and state regulators, which had been strained at times in the past.

Time will tell whether Beta Municipality's EMS is able to achieve all the goals its champions articulated. Even with the hurdles it had had to overcome, Beta's management believed that adopting its EMS was the correct decision, and this decision was aided by EPA's financial and technical assistance. The cost of maintaining its EMS is expensive, however, and will no doubt continue to be a consideration affecting its long-term efficacy.

Sigma Resources

"Sigma Resources" is a large division of an international computer, networking and communications products manufacturing company, with facilities worldwide. Located in the southwestern United States, Sigma manufactures semiconductors and provides regional management and logistics support to the larger corporation. Sigma's operations are located on a 720-acre campus and include a 360,000-square-foot main manufacturing plant (a third of which has clean-room capacity), a 300,000-square-foot, four-story manufacturing support building, and a central utility plant. Sigma employs over 9,000 people.

Sigma is located on the outskirts of a fast-growing city of just under 200,000 about 30 miles from a major metropolitan area. Ranches and suburban tract developments surround Sigma's large campus, but there are no residential areas adjacent to Sigma's facility.

Sigma's Production Processes

Sigma's focus is on semiconductor assembly, testing and product development. Related functions include packaging development and design and marketing. Semi-conductor manufacturing requires significant amounts of ultra-pure water and discharges significant amounts of waste chemicals, particularly ethylene glycol and nitrates, to publicly-owned wastewater treatment works (POTWs). The provision of large volumes of water, especially difficult in the southwestern desert environment, is of paramount concern at Sigma. To help supply the water needed for its operations, the facility has installed innovative reverse-osmosis processes to treat and re-use process water and has begun to re-use water from its on-site waste treatment processes. These two innovations have combined to reduce water consumption at Sigma by 50%.

Semiconductor manufacturing processes, in which wafers are produced and fabricated through a series of steps involving multiple clean-room operations, produce volatile organic compound (VOC) air emissions. Sigma operates under an air emission cap, which limits emissions to an overall facility-wide level. Pre-approvals from the state regulatory agency for changes in manufacturing equipment are allowed as long as emissions remain below the cap. This minimizes the need for permit modifications. Sigma's production processes also generate significant amounts of solid and hazardous waste. Solid waste is produced primarily in cleaning and maintenance operations. Sigma's waste streams are all hard-piped from manufacturing clean rooms to the facility's large waste treatment operation.

Sigma's Facility Culture

Sigma's large campus bustles with the activity generated by its many employees in acres of clean rooms and in the offices where support activities take place. Employees not only produce wafers, but design improved technology and marketing schemes and manage logistics such as transportation and supply networks.

Sigma's parent corporation is considered a world leader in environmental affairs, having implemented many innovations within its environment, health and safety programs worldwide. The corporation, with its environmental management activities headquartered at the Sigma campus, has produced a widely available and detailed annual report since 1992. In keeping with its corporate culture, Sigma keeps detailed records of environmental performance in every area. While on-site environmental management staff at Sigma number only five employees, all of Sigma's personnel are responsible for the environmental impacts of their activities as "owners" of their processes. This is especially true within Sigma's facilities management department, which is responsible for chemical, energy and water supply, wastewater, and hazardous and solid waste management activities.

Sigma's culture of individual environmental responsibility, described by one manager as "cleanliness and leadership," along with a production ethic dependent on exactness and zero tolerance of defects, combine to create an atmosphere in which most employees possess a high level of knowledge about environmental issues. Sigma's environmental programs rely on teams, consistent environmental processes and employee awareness. As a means of thanking employees for their efforts in this area, Sigma has provided employees with a gym entirely funded by the facility's recycling program.

Sigma's EMS Design Process

Sigma had not yet developed a standard, ISO 14001-based EMS. In fact Sigma's parent corporation had only recently declared that all of its facilities would need to develop EMSs and obtain ISO 14001 certification. Until that point, Sigma managers had felt that the additional resources needed to standardize and fully document their environmental management activities would not be well spent. Therefore, the processes described herein relate to the way in which Sigma structured its unique environmental management programs, which included many of the standard components of an EMS.

Corporate environmental staff worked with Sigma environmental staff to develop an EMS manual, with the idea to write down all the procedures that take place within the organization and the associated responsibilities of employees to consolidate information in a recognizable format. Sigma's environmental group also developed a three-tiered auditing program to measure the success of the existing EMS components. Sigma did extensive benchmarking and often brought in people from other facilities to exchange ideas. Environmental management staff members were often placed in jobs within the facilities department to learn how the programs worked in reality and to offer ideas for improvements.

Sigma's environmental program was restructured in the mid-1990s as it entered into an agreement with the USEPA and its state environmental agency to develop a unique permitting and environmental management program under the U.S. EPA's Project XL ("eXcellence and Leadership"). Under this program, Sigma developed flexible programs to address its environmental issues and produce better environmental results. Sigma also incorporated the principles of Design for the Environment (DfE) into its product design and manufacturing operations, and developed a broad reaching community involvement program. The input of community members was incorporated into Sigma's EMS.

Responsibilities for the facility's overall environmental direction under XL and the development of Sigma's EMS manual and auditing program remained primarily with Sigma's five-person environmental management staff, augmented by corporate staff. But facility employees – program and process owners, as they were called – were heavily involved in managing day-to-day operations, documenting environmental results, and offering creative ideas for improving operations.

For example, an engineer described as a facilities systems owner, who was responsible for waste treatment systems such as neutralization, solvent collection, lead and copper waste systems, took on additional environmental management responsibilities. The engineer managed those systems, worked with technicians, and met with the environmental group regularly to review new designs and provide data on progress toward specific output parameters. When problems arose, the "process owners" and environmental staff worked together to solve them.

Another Sigma employee, the hazardous waste "owner" and previously a member of the environmental group, worked with technicians who monitored the flow of waste from production operations, sampled wastes, completed manifests, and shipped wastes. This employee took on the responsibility to analyze the wastes and make recommendations for changes, with input from technicians. He developed detailed roadmaps of Sigma's hazardous waste management systems to track the flow of wastes: solid waste, hazardous waste, and wastewater. This road map, a matrix design, described all waste-management procedures and the resources needed to undertake them. It was included in the EMS manual. When opportunities for recycling certain wastes are considered, waste management employees gathered samples and data on generation rates, met with vendors, and developed specifications for processes. The waste management systems owners then met with materials and procurement process owners to develop new contracts.

Employees were also encouraged to look beyond facility manufacturing operations, to examine effects on the community and to understand the global environmental impacts of Sigma's work. One employee described being given an opportunity to redesign the way carpeting was provided throughout the facility campus, considering the full life-cycle impacts of the carpeting used. Further examples of this farsighted view included a study of employee commuting patterns aimed at decreasing environmental impacts, and the required use of Design for the Environment principles in product design.

The major disadvantage of Sigma's EMS was its lack of integration and coordination. While individual process owners worked hard to improve the environmental performance of their systems, the individualistic nature of responsibilities at Sigma, and the limited resources of the five-member environmental management staff, combined to prevent the system from being knit together in a coherent plan-do-check-act process. However, Sigma's EMS – built by employees at all levels and external parties, with its focus on product stewardship and sustainable practices – can be characterized as an additional example of a Visionary EMS.

Influences on Sigma's EMS Design

Sigma's employees, from managers to waste management technicians, had a significant influence on the design of the facility's environmental management programs and its EMS. Employees' environmental knowledge, enthusiasm and sense of personal responsibility as environmental stewards shaped the form and content of Sigma's EMS.

Corporate environmental affairs staff and management also played a large role in guiding the development of Sigma's EMS. Corporate staff used tools such as benchmarking and "round robin conversations" with interested employees and with external parties knowledgeable about EMSs and environmental management techniques – ISO 14001 registrars, and peers in the computer and networking industries, for instance – to assist in EMS design. Sigma environmental staff applied knowledge gained from participation in environmental and trade organization seminars and conferences and from state and federal environmental agency experts in designing Sigma's EMS. And Sigma's EMS design was influenced by historically difficult relationships with state and federal officials as its business grew quickly, compliance with existing permit criteria became difficult, and permit modifications were not easily obtained.

Finally, corporate environmental staff and company upper management communicated a clear vision that Sigma would continue to be an environmental leader and that employees must rely on values such as cleanliness and personal leadership to do so.

SUMMARY

The facilities described above produce a diverse group of products in a variety of settings, and each facility developed a unique EMS and produced distinct environmental results. For example, Alpha – one of the three facilities that developed an Efficiency Expert EMS – was influenced by past enforcement actions. And Sigma, one of two Visionary facilities, was alone in being inspired by round-robin conversations with professional peers. State regulators cooperatively influenced Middle-Roader Kappa by providing training.

But in many cases these facilities' EMSs were shaped by similar influences. For example, at Alpha, Kappa, Gamma and Sigma, forward-thinking leadership influenced EMS design. Consultants influenced Efficiency Experts Alpha and Gamma and Middle Roader Kappa. Alpha and Epsilon experienced the influence of the supply chain during EMSs design: their customers urged them to design ISO 14001 certified EMSs. At Alpha, Beta, Delta, Epsilon and Kappa, the facility environmental groups greatly influenced EMS design. Finally, Visionary facilities Beta and Sigma both were influenced by external stakeholders from the community in their EMS design efforts.