THE UNIVERSITY OF NORTH CAROLINA
AT CHAPEL HILL

Drivers, Designs, and Consequences of Environmental Management Systems

Research Findings To Date From the National Database on Environmental Management Systems

A Research Compendium

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University of North Carolina at Chapel Hill and the Environmental Law Institute

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Multi-State Working Group on Environmental Management Systems

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EXECUTIVE SUMMARY

PREFACE

This document provides a compendium of research papers and publications that have been produced from the National Database on Environmental Management Systems (NDEMS) as of March 2001.

NDEMS was designed from its outset as a longitudinal study of EMS implementation in real time, and accordingly this work is still very much in progress. Data already collected afford many further topics for useful analysis, and the most fundamental research questions of the project – what changes in environmental and economic performance, compliance, and other outcomes result from EMS implementation – will become answerable only with the analysis of post-EMS update data which are being collected in 2001-02.

It seems useful and timely, however, to provide in one place a collection of NDEMS research products to date. Most of the project's outputs and more detailed documentation can also be found on the NDEMS public Internet site, at www.eli.org/isopilots.htm. Additional materials, such as Powerpoint presentations prepared for several national and international conferences, can be provided on request; some of this material is also available on the project's website. This compendium does not include additional research and analyses that may have been performed from these data by public users of the database (to date there have been over 200 downloads), as there are no feasible means for capturing all such studies.

I. INTRODUCTION

The widespread adoption of environmental management systems (EMSs) by a variety of facilities has the potential to alter profoundly the relationship between their economic and environmental performance. An EMS is a formal set of procedures and policies that define how an organization will manage its potential impacts on the natural world and on the health and welfare of its workers and nearby citizens. When implemented, an EMS represents a commitment and a verifiable process to improve a facility's regulatory compliance, to promote its adoption of pollution-prevention measures, and to assure continuous improvement in its management of its impacts on the environment. Furthermore, by adopting a an EMS, the facility has the potential to discover many opportunities to reduce wasteful uses of resources, thus saving money and otherwise enhancing its economic performance while reducing impacts on the environment.

To date over 950 U.S. facilities have been certified as conforming to the ISO 14001 international voluntary standard for EMSs. Some major businesses have announced deadlines for EMS implementation by all their suppliers, and a presidential executive order has mandated implementation by all appropriate U.S. government facilities. EPA and a number of states have also announced "performance track" initiatives which include EMS implementation mandates.

Environmental regulators in the United States, at both state and federal levels, have been closely watching the development of EMSs. In theory, a facility that adopts an EMS should, over

time, conform with all applicable environmental regulations, and should also achieve continuous improvement in its environmental performance. Because the ISO 14001 standard requires a procedure for identifying and complying with regulations, and provides for voluntary third-party certification of those facilities that have implemented an ISO 14001-based EMS, facilities that have achieved such certification and are in full compliance might be candidates for more flexible application of environmental regulations and inspection and monitoring procedures, and might also be candidates for public recognition for superior performance and best practices – as might some other facilities, perhaps, whose EMSs incorporate identifiable "best practices" without third-party certification. Some government officials therefore see in EMSs an opportunity to reduce the regulatory burdens of facilities, thereby requiring less oversight by government and redirection of government enforcement priorities to more problematic facilities. Other regulators and many environmental groups, however, remain skeptical of the idea that, even once an EMS is adopted, facilities will continue to monitor and properly correct their negative environmental impacts without effective regulatory oversight.

To date there has been little systematic research on the environmental or economic effects of EMS adoption and certification. Such research is essential in order to determine whether either EMS implementation or ISO 14001 certification do, in fact, achieve equal or better environmental results than regulatory compliance alone – and if so, under what circumstances or with what identifiable EMS characteristics. This research is also needed to determine the environmental and economic results of EMS implementation, both for the adopting facilities and on the public.

In 1996, therefore, officials of nearly a dozen states, the U.S. EPA, businesses, universities, and some non-profit organizations formed the Multi-State Working Group (MSWG), to develop a common set of ground rules and data collection protocols for state pilot projects with facilities adopting EMSs, and to pool data on the environmental and economic results into a national, publicly-accessible database, the National Database on EMSs (NDEMS). EPA's Offices of Water and of Reinvention (now Policy, Economics and Innovation) have provided funding to support the creation of this database as well as most of the state pilot projects contributing data to it. Ten participating states and the facilities themselves also have contributed substantial amounts of in-kind staff effort to this project.

Researchers from the University of North Carolina (UNC) and the Environmental Law Institute (ELI) have developed and managed this data collection and research program since 1997, with funding from the U.S. EPA. UNC and ELI have developed a common set of protocols for the pilot projects and are responsible for data quality, the management of NDEMS, and production of the resulting public reports. In doing so, UNC and ELI have developed research questions, formulated hypotheses, and designed detailed data collection protocols. In addition, the research team has conducted training sessions on how facilities should complete the data collection protocols and how state personnel can facilitate the data collection process. UNC and ELI have also performed extensive quality control checks to assure the accuracy, quality, and completeness of the resulting database.

The fundamental question to be answered by this research is, to what extent does the implementation of an EMS change a facility's behavior with respect to each of six primary dimensions:

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

Many other important research questions can also be addressed through use of NDEMS data, and are being addressed as the data become available. For instance, what features do ISO 14001 EMSs have, and how much variation do they exhibit in practice? Which of these differences are associated with superior environmental performance and regulatory compliance, and which might be considered best practices? EMSs allow great flexibility to facilities as to what environmental performance attributes they select for detailed attention, what environmental goals they set for themselves, and other considerations. Examining the implementation process therefore offers real-time opportunities to determine:

- Why organizations choose to implement an EMS;
- What personnel are involved in designing the EMS;
- What environmental aspects and impacts they include in the process;
- How organizations determine the significance of these impacts;
- What objectives and targets they set for improvement of them, and how they set them;
- How they involve and communicate with the public;
- Whether differences in the EMS process affect the quality of the environmental outcomes; and
- How the process of certification affects the outcomes.

The answers to all these questions are important to both federal and state environmental 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 policy-relevant outcomes.

II. STUDY DESIGN

The NDEMS database is 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 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. The baseline database includes detailed, quality-checked data for over 50 facilities representing over a dozen economic sectors in ten states; EMS design data for these facilities are being quality-checked for release in mid-2001; and update data are to be collected and released in 2001-02.

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, of various sizes.

Most importantly, the participating facilities have agreed to provide longitudinal data – before, during, and after EMS implementation – and 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 will allow for a level of detailed, comparative tracking of implementation and change over time that simply 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 being made 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 March 2001 over 200 public users have downloaded NDEMS baseline data, and there is every reason to anticipate increased interest in the EMS design and update data as these become publicly available.

The following sections provide highlights of research findings by the NDEMS research team to date, drawing on data from the baseline and EMS design phases of the database. The most important findings, consistent with the longitudinal design of the study, will become available once the first and second post-EMS update data are collected and compared with pre-EMS baseline data. These are the key priorities for the 2001-2002 NDEMS work plan.

III. FINDINGS: BASELINE DATA

Baseline data analysis has revealed some important and in some cases unexpected characteristics of the kinds of facilities that are implementing EMSs:

- **EMSs are attractive to small and medium sized enterprises (SMEs) and even government agencies, not just to large corporations.** In the early years of ISO 14000 EMS implementation, it was widely assumed that formal EMS procedures would be of interest and benefit only to large corporations, and particularly to multinational businesses engaged in foreign trade. In fact, however, EMSs are being implemented by facilities of all sizes and in many sectors. They include both large organizations and SMEs, both simple and complex operations, across a wide range of economic sectors, and unexpectedly, growing numbers of government facilities – municipalities, local water and wastewater authorities, universities, military installations, and other government agencies – as well as market-driven businesses. The reasons for this interest vary, however, and it is important that policymakers understand these differences (see “Motivations” section below).

- **Facilities implementing EMSs are not idiosyncratically "green" to begin with**. Even among the 50+ facilities contributing data to NDEMS, most were regulated under air, water, and/or hazardous waste statutes, and over 60 percent generated TRI-reportable quantities of toxic pollutants. A dozen major violations and over 75 minor ones had occurred at some of these facilities in the three years prior to adopting an EMS, and pilot facilities also incurred over 50 non-compliances that were reported to their state environmental offices but were not cited as violations. Most of the facilities reported that their violations and non-compliances were related to emission or discharge limits or monitoring requirements. Many of these violations were self-discovered, but a substantial minority were only discovered by auditors or regulatory inspectors . While most were discovered relatively promptly, a significant number of them (16-21) were discovered only after more than two months. All these results suggest potential benefits from more systematic environmental management procedures.
- **Relatively few involve external interested parties.** Most facilities reported that they already involved some interested parties in their environmental management decisions in the three years prior to EMS adoption, but most frequently these were limited to non-management employees, owners and shareholders. About half involved local government agencies, but less than a dozen included environmental or other local citizen groups, community advisory groups, or neighbors. ISO 14000 guidance directs that the views of interested parties be considered in setting an organization's objective and targets: it will be worth examining the extent to which this occurs (see further findings below).
- **Pollution prevention plans make a difference to practice.** Finally, the baseline data suggest clear performance differences between facilities that did and did not have formal pollution prevention plans in place. Facilities that had such plans were far more likely to involve their suppliers and customers in pollution prevention initiatives, to consider pollution prevention in product design and business planning, to use materials accounting, to have pollution-prevention teams and training, and to reward their employees for pollution-prevention initiatives. These differences suggest the potential for similar differences between facilities that do and do not implement formal EMSs.

IV. FINDINGS: MOTIVATIONS FOR EMS IMPLEMENTATION

Why do businesses or other organizations choose to implement a formal EMS, let alone seek third-party certification? It is not a trivial commitment: at the least it requires a significant and ongoing commitment of staff effort, documentation and paperwork, and it may also involve substantial additional costs for consultants and third-party certification fees, let alone for corrective actions, investments in new technologies, and the large intangible costs of organizational change. NDEMS data shed valuable light on these motivations, and particularly on differences in motivations across different sizes and types of organizations:

- **Corporate policies matter.** Eighty-nine percent of publicly traded corporations that adopted an EMS, and 67 percent of privately owned businesses, were either required or encouraged by their parent organization to do so. Also, 78 percent of facilities that had publicly traded parent companies were mandated by their parent company to adopt ISO 14001 EMSs, . This information points to the importance of parent organizations' influences on facility-level ISO 14001 certification decisions. Interestingly, none of the parent organizations of government

facilities had mandated or even encouraged EMS adoption: in these facilities, EMS adoption appeared to occur largely under the leadership of the facility managers themselves and without the support of their parent organization.

- **Regulatory expectations are the strongest external drivers for EMS implementation.** Facilities' motivations to implement and certify EMSs may be influenced by both external and internal factors. Of all the *external* drivers, regulatory expectations – anticipation of regulatory benefits, or desire to improve compliance – had the greatest influence on facilities' decisions to adopt an EMS. The hope of regulatory benefits (for instance expedited and consolidated permitting) was influential for all three types of facilities (publicly traded, privately owned and government operations businesses), although these benefits had yet to be realized.

- **Market forces are also important, but in varied ways.** As might be expected, market forces are a more important driver for businesses than for government facilities, though in both cases, less important than regulatory expectations. They differed, however, in impact among different types of facilities. Customer pressures from both domestic and international buyers were more influential in publicly-traded facilities' EMS adoption decisions than they were in privately owned or government facilities' decisions, and the hope of competitive advantage was more influential in both types of businesses' decisions than in those of government facilities. In contrast, public-relations benefits were reported as highly important by 40 percent of government facilities but only by 29 percent of private ones and 17 percent of publicly traded corporations. These findings are important inasmuch as EPA and some states have hoped that facilities might be influenced to adopt an EMS if government offered them enhanced publicity (e.g. press releases and announcements, media events, pollution prevention awards, and annual conferences).

- **Government assistance matters, especially to government facilities and privately owned businesses.** Perhaps the most important finding related to the various external resource-driver influences is that government assistance programs strongly influenced over 50 percent of private organizations and 72 percent of government facilities to adopt EMSs, by providing aid during their EMS development and implementation. In contrast, publicly traded facilities were largely unaffected by offers of government assistance, in part because they were able to garner support from their parent companies in the adoption of their EMSs.

- **Cost reduction matters, but far more to businesses than to government facilities.** All three types of facilities reported that anticipation of cost reduction was an important motivation for EMS adoption, but it was far more influential for businesses than for government facilities (72 percent of publicly traded facilities, 93 percent of private businesses, 57 percent of government facilities). Business facilities also saw in EMSs the possibility of increasing their revenues, although this motivation was not as strong as was the potential to reduce their costs. Taken together, these results suggest that facility managers consider an EMS as a tool to increase production efficiency, but that government facilities either do not recognize or do not value the potential efficiency benefits of EMSs as highly as do business facilities.

- **For businesses, <u>internal</u> drivers are more important than external pressures.** For both publicly traded and privately owned facilities, *internal* drivers – management capability in general, environmental management capability, internal resources, and organizational culture

– have a greater impact on a facility's EMS adoption decisions than do any of the external drivers. Internal drivers were also an important motivator for 72 percent of government facilities, but slightly less so than compliance (74%). Among other differences, many of the businesses that adopted EMSs already had implemented ISO 9000 quality-management systems, whereas none of the government facilities had done so; and a far higher proportion of business facilities had pollution-prevention plans in place than did government facilities.

- **Organizational culture is a powerful influence.** Most facilities of all three types hoped that EMS adoption might improve their employees' participation in their environmental management activities, and all three reported that their organizational cultures affected their decision to adopt an EMS. Indeed, for privately owned and government facilities, it was the *most* powerful internal driver. While it is easy to dismiss these findings as being overstated, as some environmental managers may likely romanticize the organizational culture in which they work, adopting an EMS generally requires substantial investments in capital and human resources. Should these investments conflict fundamentally with the organization's philosophy of doing business, the facility will be less likely to undertake such an endeavor.

Two additional aspects of motivation for EMS adoption merit further exploration in future research. First, while EMS adoption occurs at the facility level, many facilities' decisions about their environmental management strategy are made at the corporate level. Thus, a key question for future research is what factors influence parent organizations to mandate or encourage EMS adoption in their facilities – and for that matter, by their suppliers – and how these factors might differ from facility-level adoption decisions.

Second, these results are for a relatively small number of facilities that participated in the pilot programs. What is important to know is how these facilities and their parent organizations differ from the far larger number of facilities that do not adopt an EMS, and from facilities that adopt an EMS but do not participate in government-sponsored programs. Because states imposed compliance criteria on their participation, for instance, it is likely that pilot facilities have compliance records that are better than average. In order to achieve these better-than-average compliance records, resource-based theory suggests that these facilities and their parent organizations have *greater* internal capacities than other enterprises. If this suggestion is correct, then technical assistance may be even *more* relevant to encourage EMS adoption among the broader population of U.S. facilities, especially for privately owned businesses and government facilities.

V. FINDINGS: EMS DESIGN PROCESS

How is an EMS actually developed and implemented, and how does the process of EMS development affect its content and consequences?

- **Environment, Health and Safety (EHS) managers and staff are almost always the drivers of the EMS design process.**
- **Cross-functional work teams that address environmental management appear to be one of the most important organizational benefits resulting from EMS adoption.** Non-EHS management personnel, such as production and operations managers, are often invited to participate in cross-functional teams to design the EMS. The result is often to spread

awareness, legitimacy, and responsibility concerning environmental management far more widely among the facility's managers, and to integrate environmental considerations more extensively into all the organization's core business functions and management perspectives, and in the process, in some cases to improve the organization's management more generally as well. However, non-management workers are less often invited to participate in the EMS design process.

- **External stakeholders are rarely invited to participate in the EMS development process.** ISO 14000 guidance documents direct that the views of interested parties be considered in the selection of objectives and targets, but in practice (except when required by state environmental personnel as a criterion for participation in the pilot program) very few facilities have used EMSs' flexible approach to engage the advice of external stakeholders in their quest to improve environmental performance. External stakeholders – local government, community groups, neighbors –, moreover, are rarely invited to participate at all.
- **Significance determination is based more on managerial judgments than on formal rating procedures, and compliance is heavily weighted.** Many facilities use formal scoring procedures to determine significance, such as two-tiered systems which combine scores on environmentally focused impacts such as severity, probability and duration with scores on management-related impacts such as legal requirements, business and technical feasibility and community image. The outcomes of these formal rating procedures, however, are typically used only as a starting point: final determinations are more frequently based on managerial judgments or consensus-based decisions by managerial teams, and in some facilities exclusively so. In a sizeable number of facilities, legal and compliance issues are weighted more heavily so that compliance is assured to be a predominant consideration.

VI. FINDINGS: EMS CONTENT

What does an EMS actually contain and represent? This research is still in progress, as not all NDEMS facilities' data have yet been finalized and quality-checked, but analyses based on relatively complete data for 40 facilities suggest the following preliminary findings:

- **Scope of the EMS: The size and complexity of facility or operation for which an EMS is implemented varies greatly, and may or may not include all the most environmentally significant activities.** The scope of an EMS may range from a small business conducted in a single building to a complex organization operating diverse processes with many environmental impacts on large or multiple sites. The choice of EMS scope can therefore lead to great differences in what activities, products and services are actually included within the EMS. To the interested observer, therefore, it is essential to examine what range of the organization's facilities and sites, activities, products, and services is actually included in the scope of the EMS, and whether any that may have significant environmental impacts have been excluded.
- **Activities: There is great variation in the way environmental "activities" are characterized, and in their level of detail.** ISO 14001 guidance directs that an organization should identify the various activities, processes, products or 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." In practice, most

EMSs address only facility-related activities and processes; few include products or services. The majority focus on production processes and other broad on-site operations and business functions; a significant but smaller number break their activities down into more specific processes and equipment operations, and a few list as environmental activities specific chemicals used. A few also define their environmental activities as specific resource uses and waste streams, which to others are more appropriately described as environmental aspects or impacts. This suggests that as yet, many U.S. organizations implementing EMSs may be focusing only on site-specific production and support activities, and are not (yet?) viewing the procedure through the broader lens of life-cycle analysis, product stewardship, and other longer-term sustainability goals.

- **Aspects: There is considerable variation in the characterization, specificity and detail of environmental aspects.** ISO 14001 guidance directs that the organization should identify all the environmental aspects of each of its activities, products and services, including all those that the organization "can control and over which it can be expected to have an influence." The majority of EMSs we have examined interpret environmental aspects as including more detailed actions associated with each activity, which could directly cause environmental impacts. Others, however, simply duplicate their activity lists as their environmental aspects, and some identify their activities, aspects and impacts far more generically, to the extent that it is difficult for a reader to determine how this information could be used to plan with any specificity for performance improvements.
- **Impacts are most often described generically, and rarely include consideration of positive impacts.** ISO 14001 guidance directs that the organization should identify as many as possible of the actual or potential environmental impacts associated with each aspect of its activities, either positive or negative. The overwhelming majority of facilities identify impacts in 15-20 generic types, such as pollutant discharges and natural resource utilization, without specification of their details or quantification of their magnitudes. A few also include impacts on cultural resources, pathogens and vectors, or harm to occupational health and safety; a few also identify other concerns such as compliance, liability, risk severity and frequency, and money among their impacts. Importantly, the overwhelming majority of facilities address only adverse impacts of their activities on the environment: only a few also identify positive environmental impacts of their activities, which could in many cases be equally important targets for protection and increased investment.
- **Significance Determination: There is great variation in facilities' judgments about the significance of their environmental impacts, as well as in the procedures used to determine significance.** ISO 14001 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. In practice, there is considerable variation in facilities' judgments about the significance of their environmental impacts, as well as in the procedures used to determine significance. 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 oily rags 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

snow-blowers or oily rags, let alone designate them as significant. The ISO 14001 standard appears 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.

- **Objectives and Targets: At least four distinct approaches to setting objectives and targets could be identified.** ISO 14001 guidance directs that in light of its significant impacts, the organization should set performance objectives for implementing its environmental policy goals, and specific and measurable targets and dates for achieving progress. These objectives and targets should be periodically reviewed and revised, and should take into consideration the views of interested parties. In practice, facilities set at least four distinct types of objectives and targets, which can be characterized as performance-oriented, project-oriented, management activity-oriented, and compliance-oriented.

  From a public policy perspective, arguably the "best" objectives and targets are those that set quantified and monitorable measurements for improvement of specific types of environmentally significant impacts, and some EMSs do this very well. A second common type of target is specified not in terms of quantifiable performance improvement, but in terms of completion dates for specific projects that may be expected to produce environmental performance improvement (though the actual performance target for the improvement often is not specified). A third frequent type of target includes management activities that were not directly linked to measurable performance improvement targets, such as employee training and communication programs, studies of options for possible process changes to reduce impacts, and even ISO 14001 certification itself (stated by several facilities as a target). A fourth category includes objectives that specify merely the 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. For some facilities, regulatory compliance improvement appears to be the dominant or even sole category of objectives and targets.

  Only very rarely do the EMSs we examined include identifiable objectives and targets related to life-cycle analysis or other product stewardship goals. Most facilities focused their EMSs on pollution prevention or jointly on pollution prevention and compliance objectives.

- **Target dates typically include only relatively short-term objectives, when they are specified at all.** In the EMSs we examined, target dates fall without exception into three categories: already accomplished (a few cases), the coming year (2000-01), or "continuous" or "ongoing" (as for instance in maintaining compliance). None mention any objectives or targets for two to five years or further into the future. This finding suggests, at least for the facilities included in this sample, a dominant preoccupation with immediate priorities, with limited if any linkage to longer-term strategic commitments to continuous improvement.

In future research, using update information obtained from the pilot facilities one and two years after these initial data, it will be important to try to learn whether or not objectives and targets 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 "continuous improvement" in environmental performance are important.

VII. FINDINGS: OUTCOMES OF EMS ADOPTION

Primary findings on the outcomes of EMS implementation and certification will be determined in the third phase of the NDEMS database and research program, with data from the post-EMS update protocols which can be compared with baseline performance measures and practices. Outcomes will be identified for changes in environmental performance, compliance, economic performance, pollution prevention, stakeholder relations, and use of environmental condition indicators, as well as changes in managerial and organizational effectiveness.

VIII. FINDINGS: BENEFITS OF EMS ADOPTION

Primary findings on the benefits and costs of EMS implementation and certification will be determined in the third phase of the NDEMS database and research program, with data from the post-EMS update protocols.

IX. FINDINGS: CHANGES IN EMS DESIGN, COMMITMENT, AND OBJECTIVES OVER TIME

Findings on changes in the facilities' EMSs themselves over time, and in their priorities and outcomes, will also be determined from data collected in the post-EMS update protocols. Observation so far suggests that such changes are likely, and that they may have important effects on the evolution of environmental management practices and outcomes over time. Such trends have great importance for public policy initiatives that are predicated on the assumption that EMS procedures will consistently maintain and improve environmental performance, compliance, and other outcomes. A distinctive and important contribution of longitudinal research such as NDEMS is to identify these evolutionary tendencies in EMS practices and thus increase understanding of the stability and reliability of EMS-related performance outcomes over time.

X. CONCLUSION

The NDEMS database provides a unique source of longitudinal information on EMS implementation and its consequences by a substantial number and variety of facilities. It is the only database that has the capacity to obtain this information systematically, and it is already providing valuable insights into what actually occurs in the EMS design and implementation process and into the potential consequences for performance outcomes and associated public policy questions. NDEMS is also available publicly on line, and its data are being actively sought out by interested users not only from the research community but also from businesses and government.

With continued support for its post-EMS update data collection phase, the NDEMS database will provide a unique and rare resource for understanding empirically the relationships between EMS procedures and environmental and other performance outcomes, and the implications of these effects for public policy issues such as design of performance-track and regulatory flexibility initiatives, "best practice" features of EMSs for special recognition and

promotion as enhancing environmental performance, credence to be given to EMSs and certifications, and design of EMSs for government facilities themselves.

XI. NDEMS PUBLICATIONS AND PRESENTATIONS

Andrews, R. N. L.; Darnall, Nicole; Gallagher, Deborah; and John Villani. 1998. *Environmental Regulation and Business "Self-Regulation:" Effects of ISO-14000 Environmental Management Systems on the Environmental and Economic Performance of U.S. Businesses*. Paper presented at the annual meeting of the Association for Public Policy Analysis and Management, New York, October 29, 1998.

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Andrews, R. N. L.; Amaral, D.; Darnall, N.; Gallagher, D.; Keiner, S.T.; Feldman, E.; and Mitchell, M. 1999. *The National Database on Environmental Management Systems (NDEMS): Data Management and Research Program.* National Research Summit on Environmental Management Systems, sponsored by the Multi-State Working Group on Environmental Management Systems in cooperation with the Brookings Institution and the U.S. EPA, Washington, DC, November 2, 1999.

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Keiner, Suellen Terrill. 2000. *The National Database on Environmental Management Systems.* Presentation to ISO Technical Committee 207. Stockholm, Sweden.

Darnall, Nicole. 2000. *Signaling "Green": The Influence of Institutional and Organizational Pressures on Facilities' Environmental Strategies.* Paper presented at the Twenty-Second Annual Research Conference for the Association for Public Policy Analysis and Management Fall Conference: "Doing and Using Public Policy Analysis and Management Research", November 2-4, 2000, Seattle, Washington.

Gallagher, Deborah Rigling. 2000. *Many Shades of Green: Discovering the Types of Environmental Management Systems that Facilities Develop.* Paper presented at the Twenty-Second Annual Research Conference for the Association for Public Policy Analysis and Management Fall Conference: "Doing and Using Public Policy Analysis and Management Research", November 2-4, 2000, Seattle, Washington.

Andrews, R. N. L. 2000. *World Experience With Environmental Management Systems.* Presentation to the CEO Forum on Environmental Management Systems, 62nd Anniversary Forum of the Faculty of Commerce and Accountancy, Thammasat University, Bangkok, Thailand, November 24, 2000.

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RESEARCH FRAMEWORK AND PRELIMINARY FINDINGS

Environmental Regulation and Business "Self-Regulation:" The Effects of ISO 14001 Environmental Management Systems on the Environmental and Economic Performance of Businesses[1]

November 1998

Andrews, Richard N. L.; Darnall, Nicole; Gallagher, Deborah; and John Villani[2]

I. INTRODUCTION AND BACKGROUND

The widespread adoption of environmental management systems (EMS) by businesses has the potential to alter profoundly the relationship between their economic and environmental performance. An EMS is a formal set of procedures and policies that define - sometimes in great detail - how an organization will manage its potential impacts on the natural world and on the health and welfare of the people that depend on it. When adopted and implemented, an EMS has the potential to move a facility beyond compliance with environmental regulations, toward a dynamic, continual process of operational and organizational redesign, with the objective of continually reducing the facility's adverse impacts on the environment. Furthermore, by adopting an EMS of this type, it is likely that the facility will discover many opportunities to reduce wasteful uses of resources, thus saving money while improving the environment.

Some businesses have experimented with EMSs for many years, but until recently there has been no major trend toward widespread adoption, perhaps due to the perceived lack of an economic rationale. In late 1996, however, the International Organization for Standardization (ISO) published the final version of an EMS standard, called ISO 14001. An organization that adopts an EMS that conforms to the standard can be certified as conforming to it by a third party "registrar." Publication of the standard has generated great interest in the business community, since in some international markets certification will likely be viewed as a prerequisite for commerce, while on the domestic front certification may be required or encouraged for many suppliers by their customers, including both business purchasers and government procurement officers.

Environmental regulators in the United States, both at the state and federal levels, have been watching this business interest closely. In theory, a facility that adopts an ISO 14001 EMS should, in the long run, conform with all environmental regulations without the threat of punishment by regulators, since the standard requires a procedure for identifying and complying with regulations; and it should surpass regulatory standards for many regulated activities. Some government officials therefore see in ISO 14001 an opportunity to make many regulations more self-enforcing and thus less demanding of formal enforcement actions by government. Other regulators and most environmental groups, however, remain skeptical of the idea that facilities will properly monitor and correct their negative environmental impacts without effective

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regulatory oversight. For this reason, these groups argue that regulatory scrutiny of ISO 14001-certified facilities should never be reduced.

To date there has been little if any systematic research on the adoption of environmental management systems by facilities, and almost no research on ISO 14001 certification. Such research is essential both to answer the questions posed above—whether EMS implementation and certification do in fact achieve equal or better environmental results than regulatory compliance alone—and more generally, to determine the environmental and economic results of EMS implementation, both on the subject firms and on the public.

II. HISTORY OF THE PROJECT

Regulators have recognized that there is a need for answers to questions about how ISO 14001 EMSs will affect the environmental, economic, and regulatory performance of organizations. In 1996 officials of nearly a dozen U.S. states formed an informal "multi-state working group" (MSWG) to develop a common set of ground rules and protocols for pilot projects with businesses that were contemplating EMS certification, and to pool their data on the environmental and economic results. From the start, the MSWG also included representatives of environmental and business organizations and of the academic community. A second group of states, partially overlapping the membership of the MSWG, was funded by the USEPA's Office of Water to carry out pilot projects. As of now, these two groups comprise some fourteen states, each of which is developing between five and fifteen pilot projects with cooperating businesses. Thus, with common data collection methods, a database of at least eighty comparable case studies on ISO-14001 implementation will be generated, and perhaps ultimately far more.

Our research group at the University of North Carolina, in cooperation with the MSWG and the Environmental Law Institute (ELI), has participated in the design of these projects over the past eighteen months with the support of USEPA. We have participated in the development of a common set of protocols for the pilot projects, and have been given responsibility for the management and integration of the data base and production of the resulting research reports. As part of our role, UNC and ELI have developed research questions, formulated hypotheses, and designed detailed survey instruments. In addition, we have conducted training sessions on how facilities should complete the survey instruments and how state personnel can facilitate the data collection process. The facility/state training was completed in October 1998 and took place on location in participating states. Data collection began in the summer of 1998, and will continue for at least two years.

Through the cooperation of the pilot facilities and the many states themselves, this project offers an extraordinary and in many respects unique opportunity to examine the implementation of environmental management systems in many kinds of organizations across multiple states and environmental conditions. The pilot projects include many manufacturing facilities but also agricultural operations, municipalities and local water authorities, military bases, and other kinds of organizations, both large and small. Through these pilot projects, researchers will be able to observe closely the EMS design and implementation process, the auditor certification process, and the environmental and economic performance data generated by facilities. Most importantly, the pilot project managers and participating facilities agree that data will be collected in a

standardized manner, so that information generated through the projects will be consistent and comparable between states and among pilot facilities.

III. RESEARCH QUESTIONS

The fundamental research question to be answered with this research is, to what extent does the implementation of an ISO 14001 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 lie at the heart of the research design, however, many more detailed subsidiary questions are also of fundamental interest. For instance, an extremely interesting and important basic question is what will ISO 14001 EMS documents look like, and how much variation will they exhibit in practice? The ISO 14001 standard allows great flexibility to facilities as to what environmental performance attributes they select for detailed attention, what environmental goals they set for themselves, and other considerations. Examining the implementation process therefore offers real-time opportunities to determine why firms choose to implement an ISO 14001 EMS in the first place; whether it is done only at a facility level or corporation-wide; what personnel are involved in designing the EMS, and how they do so; what environmental aspects and impacts they include in the process, and how they determine the significance of these impacts; what objectives and targets they set for improvement of them, and how they set them; how they involve and communicate with the public; and how the process of certification itself affects the outcomes.

The survey instruments allow us to capture detailed variation in each of these areas. So, a typology of ISO 14001 EMS types based on the dimensions outlined above will be possible, as well as other classification schemes that are not yet determined. While a typology will be useful in itself, it will be critical to the later stages of our research, when we hope to correlate performance changes with EMS type and EMS design parameters.

Within each of the six primary performance dimensions listed above, we are examining more detailed questions:

1. Environmental Performance

a) 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?)?

b) Does environmental performance improve after the adoption of an ISO 14001 EMS, with respect to either regulated or unregulated aspects?

2. Regulatory Compliance

   a) Does the facility's regulatory compliance record change as a result of the adoption of an EMS?

   b) 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?

   c) 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?

   d) 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)

   a) 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)?

   b) To what extent does the adoption of an EMS change a facility's use of advanced environmental and materials accounting techniques?

   c) What economic costs and benefits—both direct and indirect—does a facility accrue as a result of EMS adoption?

   d) Given the costs of EMS design, implementation and certification themselves, is the payoff of EMS adoption positive or negative?

4. Pollution Prevention

   a) How does the adoption of an EMS change a facility's use of pollution prevention techniques?

   b) Do significant changes in environmental performance after EMS adoption result from greater use of pollution prevention practices?

5. Interested Party Involvement

   a) 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?

   b) What benefits does this involvement provide (e.g. ideas not otherwise considered, more positive community and customer relations, greater legitimacy for outcomes)?

   c) What effects does this involvement have on the decisions made by facilities?

6. Environmental Condition Indicators

   a) How are indicators of local, regional, and global environmental conditions incorporated into the design of a facility's EMS?

   b) 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 are collected, relations between the categories will also be explored. We anticipate that there may in fact be interesting and important differences in results from case to case depending on factors involved in the design and implementation processes. For example:

a) Are the outcomes of the significance determination and the setting of objectives and targets processes different depending on whether interested parties were involved in a meaningful way in EMS design?
b) Do facilities with EMSs certified by independent registrars show greater environmental performance improvements than those with uncertified EMSs?
c) Is there a relationship between a facility's compliance history and the type of EMS it designs?
d) 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?
e) Does it matter what kinds of personnel had responsibility for EMS design? For example, how does the involvement of the environmental manager, health and safety manager, plant manager, or corporate mandates affect the design and performance of the EMS?
f) Does the nature and performance of a facility's EMS differ depending on whether the facility employs environmental consultants in their EMS design process?

IV. RESEARCH DESIGN

To answer the questions we pose above, UNC and ELI have created and field tested a series of detailed data collection protocols (survey instruments) for use by each pilot facility, to ensure that data are collected in as comparable a manner as possible. State agency personnel who are participating in the pilot project have also been trained in the surveys' content and use.

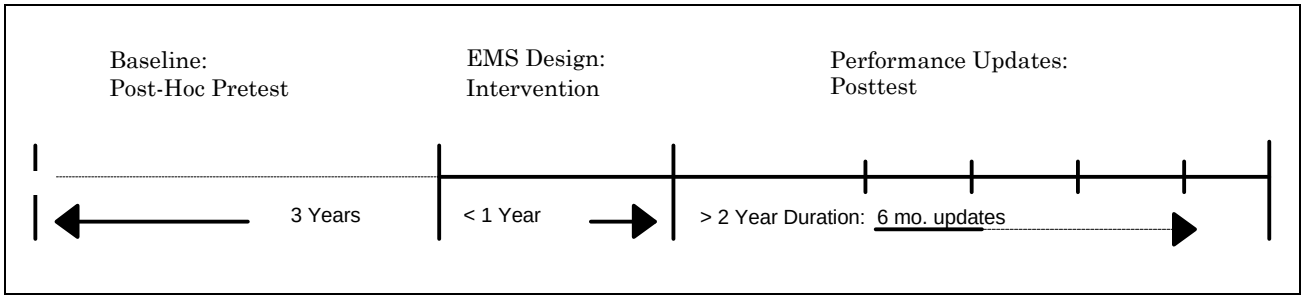
Data collection

Because the main objective of the research is to demonstrate how the adoption of an EMS changes a facility's performance, data are being collected on each pilot facility at each of several points in time—baseline, EMS introduction, and subsequent performance monitoring—as they move through the EMS introduction and implementation process. The research thus follows a pre- and post-test quasi-experimental design, as shown in Figure 1 below.

During the baseline stage, we are collecting information on environmental, regulatory, and economic performance over the three years prior to EMS introduction. The survey will obtain specific historical information on the facility's environmental management system, environmental performance, compliance, pollution prevention, and economic performance. In addition, industrial and demographic data will be collected to ensure that specific facilities are suitable for comparison during the analysis phase. Because much of this research is exploratory, open-ended questions help to capture a broad set of facility issues. However, respondents are asked to answer based on documentable environmental data that are maintained in its environmental records, in the hope that by referring to environmental records, recall errors will be minimized.

The baseline data on pre-EMS performance are particularly crucial to this type of research, in that without them it would be easy to misinterpret both the magnitude and the generalizability of changes attributable to introduction of an EMS. Many facilities at which EMSs are being introduced, for instance, and particularly those willing to serve as pilot facilities in a very public process, may 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 themselves barred the participation of facilities that had had significant compliance problems, for perhaps understandable reasons given their regulatory issues, but with the result that some facilities that might show more dramatic changes due to EMS introduction are not included among the pilots. Given these issues, careful baseline data collection over several prior years is essential to avoid grossly under- or over-estimating the potential benefits of an EMS to a broader cross-section of businesses.

Figure 1. Research Design



The second stage of data collection is the EMS design stage. The instruments designed for use in this stage collect information that will enable us to characterize and categorize each facility's EMS itself, and the process and choices involved in its introduction. Since there is great flexibility in the ISO 14001 standard, this step is also critical and of great interest. This survey will capture firm-specific information on how each facility implemented its EMS and why such an implementation strategy was adopted, using both open- and closed-ended questions. In addition, the survey will capture information on the facility's costs and perceived benefits of introducing and certifying an EMS.

The third stage of data collection, performance updates, is the final stage of the survey design. The survey will be administered every six months for at least two years following EMS adoption, to elicit update data on environmental, regulatory, and economic performance so that significant deviations from the baseline can be evaluated. It will also obtain information on each facility's EMS implementation changes, environmental compliance status, and pollution prevention activities.

Sample Constraints and Comparison Groups

One of the major research design issues we face is an upward bias in the sample of facilities to be studied. First of all, all pilot facilities necessarily are willing volunteers, and therefore limited to those who are willing to open their environmental records and decision

processes to the researchers and state agencies—probably those who have strong pride and confidence in their performance already. Second, UNC and ELI have no control over how the participating states recruit and select pilot facilities from the pool of volunteers. Most of the states advertised the project in a state business journal and environmental agency newsletters, and interested facilities contacted the state personnel to express interest in participating. Some states then selected all interested facilities to be part of the pilot program, whereas others (e.g. Indiana and Oregon) excluded interested facilities which had poor compliance records.

To encourage facility participation, some states also offered varied incentives, which may affect state and facility comparability. Some states, for instance, offered participating facilities the possibility of regulatory flexibility as an incentive for their participation, while other states pledged to provide favorable publicity and a few offered grant money or free technical assistance from state personnel to participating firms. For example, Indiana and some other states offer grants to offset the financial burdens of pilot project participation. Arizona offers its facilities an "enforcement waiver policy" stating that if a violation is discovered during the course of a facility's pilot project participation, it will be forgiven so long as it is not criminal and does not pose imminent public danger. California offers a somewhat different incentive, in the form of cost savings for consolidated reporting requirements and electronic reporting options. Other states, such as Indiana, New Hampshire, and North Carolina, offer no regulatory flexibility in any form.

Given these selection biases, the pilot firms clearly are not a representative random sample of all firms that affect the environment. In general, we may expect that better-than-average facilities have been more likely to volunteer as participants, and that states also have tended to select better-then-average organizations as pilots.

Another challenge to the validity of this research is that some of the sponsoring states are themselves active participants in pilot facilities' EMS design processes as well. Almost all the states are providing EMS design and implementation training to participating facilities in some form, and are holding periodic meetings with all project facilities as well so that facility representatives can learn about each other's EMS implementation successes and failures. Some states also have assigned key state environmental agency personnel—typically from their pollution-prevention staff—to work intimately with each facility during its EMS design process. Given such involvement, it is not clear how closely the EMSs developed by such pilot facilities will resemble those that would be developed by non-pilot facilities.

To partially mitigate this selection bias, we have received funding to examine a range of "control" facilities as well. That is, we plan to recruit three types of "non-pilot" facilities to determine more accurately the effects of EMS introduction. The first type of control group will include facilities that implement ISO 14001 EMSs but that do not receive state assistance. By studying this group, we will be able to obtain some indication of the effects of state intervention on facilities' EMS design and implementation. The second group of control facilities will include facilities that have implemented EMSs but are not ISO 14001 certified. The inclusion of this set of facilities as a second control group will allow comparisons to be made between facilities with certified and non-certified EMSs. Finally, we plan to recruit a control group of similar types of

facilities that have not implemented any form of an EMS, so that we can draw comparisons between EMS and non-EMS facilities.

Such "controls" are not a perfect solution to the problem, since even control firms must be willing at least to cooperate with us and share comparable data. In general, we expect that a self-selection process will occur in control group recruitment as well, since facilities with relatively superior environmental performance will more likely see value in allowing us to study their environmental performance. Motivating the control facilities to complete the surveys will also be a challenge, since the survey questions request information that some facilities may consider confidential to their business operations. Given the upward bias of both the experimental group and the control sample, there may be important limitations on the extent to which our findings can be generalized to businesses in general. However, we do have a diverse set of industries represented in the sample and a variety of facility sizes, and this should allow us to shed useful light on both the commonalities and the variability that can occur in EMS implementation practices, on the factors that motivate even the "best" firms to introduce them, and on the interactions between participating firms and state agencies and the public.

V. RESEARCH SIGNIFICANCE

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 variables that contribute to the facility's decision to reduce its environmental impacts, both regulated and non-regulated, is critically important to future environmental initiatives at both the state and federal level, both voluntary and mandated. The outcome of this study will afford environmental agencies a better understanding of the opportunities and constraints to environmental performance and compliance improvement within the integrated context of an ISO-14001 environmental management system. Government officials may thus be able to incorporate incentives into future policy that better encourage environmental compliance and improved performance while minimizing costs both to businesses and to government itself.

VI. OPPORTUNITIES FOR BROADER RESEARCH ON EMS IMPLEMENTATION

The survey data may thus shed valuable light on many issues associated with EMS implementation at the level of the kinds of facilities that have agreed to participate in these comparable pilot studies. At the same time, however, the phenomenon of EMS implementation offers rich opportunities for additional kinds of research that go beyond what these data and pilot

cases by themselves can accomplish. Over the past several months, the MSWG and we have also cooperated in arranging a series of regional research roundtables—at the University of North Carolina, Harvard, Stanford, Northwestern, and at least one still to come at Carnegie-Mellon—to broaden interest in these research opportunities and to encourage interest by additional scholars. In spring 1999 a national research discussion is also being planned at the Brookings Institution in Washington, D.C., and in November 1999 we hope to bring these questions also to the annual meeting of the Greening of Industry Network which will be held next year in Chapel Hill.

Examples of these broader research questions are listed below. We invite discussion and additional suggestions from APPAM members as to how we might most effectively build a broader network of interested researchers and initiatives in this domain of inquiry.

1. Business Uses of EMS
    a) Are EMSs used by firms to anticipate and prevent problems?
    b) What differences in the benefits and costs may arise between facility-level and corporation-wide implementation of EMS procedures? Are there some benefits and efficiencies that can only be captured through corporation-wide implementation?
    c) Are EMSs used by firms to make strategic decisions? If so, how?
    d) Does the use of an EMS affect capital decisions?
    e) What is the impact of EMS implementation on customers? On suppliers?
    f) Is there a link between EMSs and financial accounting systems (e.g. “green accounting”)?
    g) Is there a relationship between regional conditions such as markets, labor and/or government incentives and EMS adoption by businesses?
    h) Is there business value in third party certification?
    i) How is the experience of U.S. businesses with EMSs similar to or different from experiences of firms operating in other countries, including the experience of overseas branches of U.S. firms themselves?
2. The ISO 14001 standard and its implementation
    a) Does the ISO standard adequately incorporate non-regulated but important environmental considerations such as biodiversity and ecosystem management principles?
    b) Is the ISO approach compatible with a supply-chain approach to product stewardship?
    c) Will the implementation of ISO-compliant EMSs help executives reposition their enterprises on issues such as product stewardship and industrial ecology? Under what conditions?
    d) Does the introduction of an ISO-compliant EMS help or hinder product development?
    e) What can be learned from broader comparisons of ISO-14001 EMS introduction in the U.S. and in other countries, and of ISO-compliant EMSs with the European Union’s somewhat comparable EMAS (“Eco-Management and Auditing Scheme”) procedure?
3. Public Policy Issues

a) What sorts of regulatory flexibility might prove appropriate in the context of an effective EMS, and with what conditions?
b) How do EMSs fit into the broader environmental policy debate over requirements for scientific and economic justification of regulatory policy, and burden of proof?
c) Do government, business and interest groups act and interact more or less productively in EMS implementation processes than they do in regulatory proceedings? What lessons does this offer for policy and procedural improvements?

We welcome your suggestions, questions, research interests, and discussion.

International Standards for Environmental Management Systems: A Future Promise for Environmental Policy?[3]

November 1999

Deborah Rigling Gallagher, Nicole Darnall, and Richard Andrews[4]

ABSTRACT

This paper addresses the issue of what potential merits ISO 14001 environmental management systems (EMS) may have to business operations and public policy. It evaluates the EMS structure and applies it to a study that examines approximately eighteen U.S. facilities and government facilities that are designing and implementing ISO 14001-based EMSs. Facilities' specific EMS components are assessed to determine the extent to which EMSs are designed to ensure that facility-level environmental management is likely to lead to larger private and public gains than those obtained via the current environmental regulatory regime. Finally, we consider internationally certified EMSs and their future promise for public policy.

I. INTRODUCTION

Businesses are increasingly adopting the global environmental management system (EMS), ISO 14001, in order to more effectively and efficiently manage their environmental impacts. This voluntary system, as well as all EMSs, has the potential to provide facilities with a structure to minimize their environmental impact, ensure compliance with environmental laws and regulations, and address wasteful uses of natural resources. For these reasons, EMSs may greatly affect the environmental performance of facilities that adopt them and subsequently impact their financial performance, as well.

There are numerous types of EMSs. The ISO 14001 EMS, however, has emerged as the most widely accepted international standard for environmental management and has the potential to harmonize EMSs worldwide. EMSs certified under the ISO 14001 standard conform to an internationally negotiated standard which was developed by the International Organization for Standardization (ISO), and employ a systematic structure to identify, mitigate, and prevent environmental harm. These systems can be certified by an independent third party to ensure that their structure conforms to the ISO standard. Finally, the ISO 14001 standard requires that certified facilities commit to ongoing continuous improvement of their EMS and thus have the potential to reduce their environmental impacts significantly over time.

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Only recently could facilities have their EMSs certified, as the final version of the international EMS standard was published in late 1996. Since then, over 10,000 facilities around the world have had their EMSs certified. In the United States, approximately 450 facilities have received ISO certification and within the next year this number is expected to increase by approximately 50 percent. While businesses are increasingly adopting these systems to better manage their environmental impacts, little is known about the potential these systems have for environmental protection, social welfare, and future public policy.

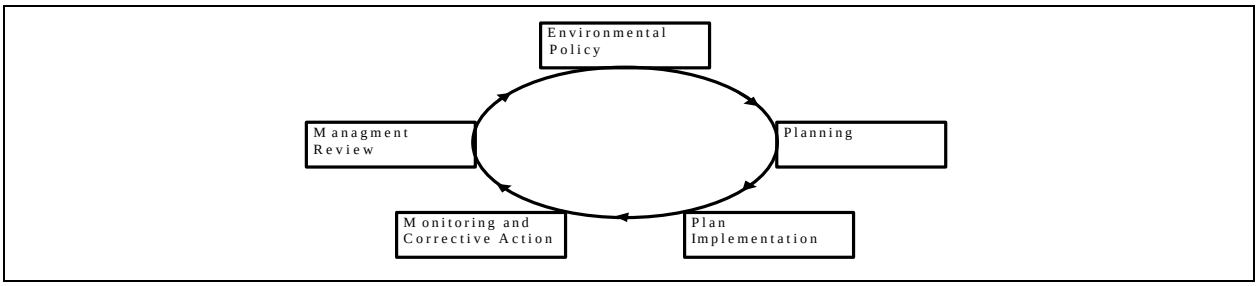
This paper confronts these issues by first defining an ISO 14001 EMS and how it affects business operations and the environment. Then it evaluates a cross-section of eighteen U.S. facilities in nine states that are designing and implementing ISO 14001-based EMSs. We then evaluate facilities' specific EMS components and analyze the extent to which EMSs are designed to ensure that facility-level environmental management is likely to lead to measurable private and public gains.

Finally, we consider internationally certified EMSs and their future promise for public policy. If these systems show benefit to social welfare, they may be attractive to employ as a complement or even an alternative to some aspects of current environmental regulatory mandates. An important question for investigation is the extent to which voluntary implementation of ISO-certified EMSs produces results superior to those mandated by federal and state environmental regulations, or whether its results depend on "innovation in the shadow of regulation"—that is, on the continued and effective presence of those regulatory mandates as well. It is conceivable that for facilities that implement a certified EMS, government monitoring might be replaced by more efficient and effective procedures for self-monitoring and reporting; and perhaps even that some modifications in permit requirements might also achieve environmentally superior as well as more economically efficient and competitive results.

II. WHAT IS AN EMS?

An EMS is a management structure in which organizations can assess their environmental impacts. It creates a system to assess, catalogue, and quantify facility environmental impacts, not simply activity by activity, but throughout an entire facility, firm, or other organization. The goal of EMS adoption is to help organizations ensure that their operations articulate and achieve specified environmental goals, normally including at least compliance with environmental laws, management of other major environmental risks and liabilities, and potentially positive environmental improvements as well. An EMS supplies the framework to do so by creating a systematic structure (as shown in Figure 1) to adopt a written environmental policy; to identify all environmental aspects and impacts of their operations; to set priorities, goals and targets for continuous improvement in their environmental performance; to assign clear responsibilities for implementation, training, monitoring, and corrective actions; and to evaluate and refine implementation over time so as to achieve continuous improvement both in implementation of environmental goals and targets and in the EMS itself.

Figure 1. Environmental Management System Loop



An EMS is thus a formal set of procedures and policies that define—sometimes in great detail—how an organization will manage its potential impacts on the natural environment and on the health and welfare of the people who live in it. When implemented, an ISO 14001 EMS will, in theory, assure that the facility adopting it not only will be in conformance with all environmental regulations, but may also surpass the regulatory standards for some regulated activities and may achieve improvement in nonregulated impacts as well. ISO facilities that are able to reduce their environmental impacts beyond regulatory standards may also lessen their environmental reporting burdens and the costs associated with them. These costs are significant as the annual cost to business of environmental regulation is approximately $400 billion (Hemphill 1995). Because of the ISO structure, certified facilities may be better able to redesign their operating structure, substitute unregulated for regulated inputs, and eliminate some regulated processes altogether, so that they are no longer subject to some costly regulatory mandates. In the process, it is likely that the organization will discover new opportunities to prevent rather than merely control their pollution, and to reduce wasteful uses of resources, thus saving money while improving the environment. It may also discover opportunities to manage the organization as a whole more effectively.

For all these reasons, some businesses consider ISO 14001 certification as an opportunity to send a strong signal to regulators about their commitment to minimize their impact to the natural environment. If compliance is ensured, then facilities that adopt a certified EMS have minimal threat of punishment by regulators. For this reason, U.S. environmental regulators are trying to evaluate the businesses that adopt these systems to determine their potential for future regulation.

III. ISO 14001 EMS ADOPTION IN PRACTICE

As part of the government evaluation, officials representing more than twenty states formed the Multi-State Working Group on Environmental Management Systems (MSWG), which also includes participants from the federal government, environmental and business groups, and universities. Over the past three years, ten MSWG states as well as EPA Region I (through its StarTrack initiative) have adopted pilot programs that provide a variety of benefits, such as technical assistance, financial grants, enhanced publicity, and regulatory flexibility to facilities that adopt ISO 14001-based EMSs. In exchange, pilot facilities have agreed to provide data on their EMS development process to the National Database on Environmental Management Systems (NDEMS). The development of this database, which is a joint research effort between

the University of North Carolina at Chapel Hill (UNC) and the Environmental Law Institute, is funded by the U.S. Environmental Protection Agency (EPA). The database is housed at UNC.

Over seventy facilities are currently participating in this research program, and baseline data are nearing completion for most of these facilities. Further data on the actual design of the EMS have been submitted by eighteen of these facilities as of October 1, 1999, and it is these preliminary EMS design results that are presented here. These facilities are located in nine diverse states (Arizona, California, Connecticut, Indiana, Illinois, Maine, North Carolina, Oregon and Vermont). They are situated in communities ranging from small towns with populations of less than 20,000 (39%) to larger metropolitan areas with populations of over 50,000 (22%). They range from small businesses with less than 100 employees (17%) to larger divisions of multi-national corporations with over 1000 employees (22%). The industries represented include chemicals, electronics, fabricated metals, instruments, machinery, metal finishing, pharmaceuticals, pulp and paper, and transportation. All of them have developed or are in the process of developing ISO 14001-based EMSs.

In analyzing the EMS design information gathered to date, several questions are examined:

A. *What process did facilities employ to develop their EMS?* Were cross-sectional teams of employees and/or managers involved, or consultants, or were EMSs developed solely by facilities' environmental departments? Were outside parties, such as neighbors or local government representatives involved in EMS development efforts?

B. *What process did facilities use to identify the aspects of their operations that have an impact on the environment?* Did representative groups of managers and employees brainstorm together to produce a list of aspects and impacts, or did environmental managers develop the list on their own? How were aspects and impacts analyzed to determine which were significant and thus merited explicit objectives and targets to improve them? Were detailed rating systems used to rank aspects and impacts, or did managers rely merely on their subjective judgments? Were the environmental impacts of products included in the analyses? How were regulatory requirements and the views of external parties taken into account when determining significance?

C. *How is information about the EMS communicated to employees and outside parties?* Is information on facilities' environmental policies and EMSs readily available to all employees? Are all employees provided specific training on the environmental policy and EMS components? And, are meetings held to provide information directly to external stakeholders, or is the information available only on request?

D. *And finally, what do these facilities' EMSs look like?* Do the EMSs address all facility areas? Did facilities' targets and objectives focus primarily on compliance, pollution prevention, or other issues? Were facilities' targets and objectives ad hoc and short-term in nature, or part of a comprehensive and long-term program?

A. Processes Used to Develop EMSs

Ideally, a facility EMS is designed with a high degree of input from facility employees. This level of input is achieved when cross-functional teams of employees are established to develop the EMS. These teams help ensure that the important data-gathering and analysis efforts inherent in EMS development are shared by employees with different expertise and perspectives about facility activities and their potential environmental impacts. Additionally, if employee involvement in EMS design is high, information about the budding EMS is quickly diffused throughout the facility.

Similarly, the value of an EMS as a management tool may be increased if external stakeholders are involved in EMS development efforts. Outside parties are often able to provide a fresh perspective, which may assist in identifying facility activities that may be less obvious to insiders yet have potential environmental impacts.

The eighteen facilities that we studied used a variety of processes to develop their EMSs. Not all of these processes incorporated cross-sectional or multidisciplinary teams. For example, in one facility the environmental manager developed the EMS on his own, and in another EMS development occurred at the company's corporate headquarters. However, most of the facilities we studied did use a team approach to build their facility's EMS.

The facility environmental manager headed all of the facility-level EMS development teams we studied. These teams generally did not include non-management or hourly employees, but were comprised of a group of mid- to upper-level managers. The teams most often included the plant manager, the facility engineering manager and the maintenance manager. In six cases, the team included all members of the facility's senior management team. In eight of the eighteen facilities, representatives from all departments were involved in developing the EMS. Hourly employees were involved in the EMS development process in only three facilities. In these cases facility department managers solicited input from them directly in identifying activities within their departments which had potential environmental impacts.

Consultants were included as members of two facilities' EMS development teams, although many facilities sought consultant advice throughout the EMS design process. State government technical assistance staff were involved with EMS development efforts at six facilities in three states. Sixteen of the eighteen facilities we studied are participating in MSWG member states' EMS development pilot programs, and perhaps because of this they were more likely to include state technical assistance personnel as part of the facility EMS development team than would other facilities. This issue will be explored in future research.

External stakeholder groups were involved in only two of the eighteen facilities' EMS development processes. At one facility, an external stakeholder group was established at the outset of the EMS design process, before the environmental policy had been articulated. At a second, external stakeholder input was incorporated when objectives and targets were being set.

A few of the facilities, however, included broader participation. At one large electronics facility, for example, a contract janitorial employee was added to the EMS development team during the targets and objective setting phase, because the environmental impacts of the facility's

cleaning-material usage was determined to be significant. At another facility, an external stakeholder group was involved throughout the EMS development process. Presentations were provided to the stakeholder group at every step in the process and stakeholders' views were incorporated into the facility's environmental aspect and impact rankings. Facility managers also described the EMS as improved due to their involvement.

In summary, the EMS development teams of these eighteen facilities were headed by the facility environmental manager. These teams often included environmental and engineering staff as well as representatives of senior management. But hourly employees were most often absent, and while government employees and consultants were sometimes included as part of facility EMS design teams, only two facilities sought external stakeholder input.

There are perhaps many reasons why environmental management staff dominated the EMS development process at these facilities. The most obvious is their familiarity with the issues at hand, and the scarcity of facility resources needed to train other employees. However, those facilities that involved a variety of employees in EMS development reported an indirect benefit from that involvement: a heightened awareness of environmental issues among employees and a shared vision for addressing them.

B. Processes Used to Identify Environmental Aspects and Impacts and Determine Significance

Perhaps the two most technically challenging components of a facility's EMS development effort are the aspect and impact identification and significance determination processes. Both components require systematic evaluations of all facility activities that may have impacts on the environment. Large, complex facilities, for example, face the challenge of incorporating multiple product lines and production processes as well as wastewater treatment and disposal, solid and hazardous waste management, shipping, receiving, warehousing, power generation, maintenance and groundskeeping activities into their aspect and impact determination and prioritization processes. Even small facilities are faced with a host of activities, such as production lines, chemical storage, office and equipment cleaning, and office waste management, to examine for their environmental impacts.

The facilities we studied used a variety of processes to identify their environmental aspects and impacts, and to determine their significance. Five of the eighteen facilities used group brainstorming by senior management, departmental management, or environmental, health and safety staff to develop an initial list of aspects and impacts. In half of the eighteen facilities, the environmental manager or environmental staff compiled a list of activities, and from it they derived a list of environmental aspects and impacts. Three facilities asked each department to contribute specific lists of activities relative to their work and to determine the activities' associated environmental aspects and impacts, and one facility invited all employees to contribute a similar list.

Once lists of aspects and impacts were compiled, facilities used a wide variety of formal and informal techniques to evaluate their significance. More than half of the facilities used formal rating systems, complete with scoring sheets and ranking scales. Such systems frequently

involved the application of a two-tiered scoring methodology to assess each aspect and impact. Eleven of the eighteen facilities used some variant of this procedure to analyze their aspects and impacts.

In this two-tiered type of analysis, first-tier scores were derived for each aspect and impact, which incorporated purely environmental effects. These scores were most often based on a combination of severity of impact, probability of impact, and duration or frequency of impact. Second-tier scores were most often based on a combination of compliance, legal or regulatory concerns, community concerns, and judgments of business or technical feasibility. The facilities that employed this type of formal ranking system generally combined the two sets of scores in some fashion (e.g. simple addition or weighted addition) to come up with an overall score for each aspect and impact, which was then used in determining significance.

Facilities that did not employ a formal scoring- or ranking-based system used more qualitative methods such as group brainstorming or managers' judgment. Five facilities used these types of methodologies. Three of the eighteen facilities we studied did not provide information on the techniques they employed to analyze aspects and impacts.

Significance determination was not always a straightforward task, even when formal systems were used to develop scores to assist the aspect and impact ranking process. The final ranking or rating scores did not always point directly to those impacts that could be considered significant. To deal with this issue, three of eighteen facilities specified a certain score as significant at the outset. Four facilities categorized the top ten scores or a percentage of the top scores as significant. And seven facilities weighted legal, regulatory or compliance scores much higher than other considerations, insuring that aspects or impacts having a legal, regulatory or compliance component would be judged significant.

When formal systems were not used to identify and evaluate aspect and impacts, managers' or EMS development team judgment was employed to determine significance. Three facilities used a combination of a formal system to identify and evaluate aspects and impacts and an informal system to determine their significance. Ratings were discussed by environmental or management staff, and significance determination was a consensus process. At one small facility, the company CEO and environmental engineer met with a state technical assistance employee to decide which aspects and impacts would be considered significant. Four facilities have not yet provided information about the process they used to determine the significance of environmental aspects and impacts.

Two of the facilities we studied are notable for the systems and processes that they use on an ongoing basis to identify and evaluate the significance of the aspects and environmental impacts of their activities. The first is an electronics facility, which developed a computer-based analytic tool that incorporates a quantitative methodology for identifying and formally evaluating each of its aspects and impacts. This system is located on the facility's internal web site. The facility's EMS "working group" continually uses this computer-based system to identify and evaluate facility activities that may have an impact on the environment. The quantitative data provided by the system are used primarily to inform the consensus-based process by which the working group operates to determine aspect and impact significance.

The second noteworthy facility is an instruments manufacturing company. This facility requires that all its new products, processes and projects be evaluated using a formal scoring and ranking system to identify any activities that may have impacts on the environment. Direct and indirect impacts of products, processes and projects are considered. Based on these ongoing analyses, if impacts are determined to be significant, products are eliminated and products and processes are redesigned.

In summary, while most of the eighteen facilities used formal systems to identify and evaluate the environmental aspects and impacts of their operations, they were often more flexible in the use of those systems to determine significance. Two-tiered systems, which combined scores on environmentally focused impacts such as severity, probability and duration with scores on management-related impacts such as legal requirements, business and technical feasibility and community image, predominated in these facilities.

However, in a testament to the way in which EMSs in practice reflect individual facility culture, the outcomes of these formal rating systems were rarely used to directly pinpoint the significance of individual aspects and impacts. As was indicated above, only seven facilities of the eighteen we studied took these outcome rankings as given to indicate aspect and impact significance. Rather, the rating system outcomes were used as a more formalized starting point for the informal and formal management decision-making processes. In one case, public comments on the outcome ratings were incorporated into the significance determination. In other cases senior managers' judgments on the ratings served as the final arbiter, or the ratings served as a starting point for a consensus-based process. And finally, in a sizeable number of facilities, legal and compliance issues were weighted more heavily so that compliance remained at the forefront.

C. Communicating Information about EMSs to Employees and the Public

An important component of EMS development and implementation is the manner in which information about the EMS is communicated to employees and to the public. For an EMS to be successful in putting environmental policy into practice and in enabling the facility to reach its specific targets and objectives, all facility employees must be knowledgeable about the system. In addition, the public will likely be less skeptical and perhaps more supportive of a facility's environmental efforts if it is provided information about the EMS.

The eighteen pilot facilities we studied use a variety of methods to communicate information about their EMSs to employees and the public. Generally, overview presentations about the EMS are made to employees in the context of regularly scheduled employee meetings. At these meetings, employees are often provided handouts, which summarize the facility EMS and state the facility environmental policy. One facility provides employees with personal copies of the facility environmental policy to carry in their pocket.

One third of the facilities hold EMS training sessions for their employees. At one facility, employees are tested on their knowledge of the facility EMS after completing its training sessions. Four facilities reported that outside contractors are required to read and sign their

environmental policy before beginning work. Five facilities stated that the facility environmental policy is posted on walls and bulletin boards throughout the facility. Ten facilities reported that their environmental policy is posted in the lobby, on the company's external web site or printed in the company's annual report.

Roughly half of the facilities do not provide information about their facilities' EMS directly to the public, but instead make it available upon request. Only two facilities have held meetings with outside parties to educate them about their EMS and obtain feedback on it. As with incorporating external stakeholder involvement in the EMS development process, it appears that the companies we studied are, at this point, reluctant to develop public outreach programs in which information about EMSs is formally communicated to external parties and feedback on them is obtained.

In summary, while the companies we studied have developed a variety of programs to communicate information about their environmental policy and EMS components to employees, including formal training sessions and meetings, web site postings and personal copies of the facility's environmental policy, most have not developed programs to communicate this information to the public. But a number of companies indicated a willingness to do so. Five of the facilities reported that although they do not have formal programs for public outreach at the present time, they are re-evaluating their policies and considering implementing them in the future.

D. EMS Content and Structure

In addition to incorporating efficient processes for identifying significant environmental issues and for sharing information with employees and the public, for an EMS to be truly effective it must be comprehensive and have a bias for action. It must incorporate all of a facility's environmental issues and comprise a plan replete with targets and objectives for addressing the most significant ones.

We examined the initial lists of facility activities (products, processes, projects and services) in order to understand the breadth of their EMSs, and to determine their relative comprehensiveness. There is good news here. Almost all of the facilities used the EMS design process as an opportunity to thoroughly investigate their activities and to identify those that would have a potential impact on the environment. The exceptions are those facilities that relied too heavily on readily-available, generic aspect and impact templates, and thus bypassed the opportunity to identify their own distinctive impacts in a systematic fashion.

We also examined the timeframes facilities set for reaching the objectives and targets they put in place to address their significant aspects and impacts. These timeframes provide an indication of whether facilities, in general, have short-term or long-term views of their environmental management obligations. A majority of the facilities we studied designed EMSs that incorporated relatively short-term objectives and targets. These objectives and targets addressed specific projects that could be completed within a year. For example, facilities reported objectives and targets such as achieving full compliance with regulatory requirements, reducing notices of violations to zero, reducing air emissions, evaluating water or energy usage

or reducing annual use of toxic chemicals. Interestingly, one facility included objectives and targets that had already been reached before the EMS was complete. Perhaps incorporating good news about already completed activities on its list of objectives and targets provided the facility with the motivator it needed to continue the long EMS development and implementation process, or perhaps they viewed the EMS as simply an opportunity for good public relations.

On the other hand, at least four of the eighteen facilities included objectives and targets in their EMS that were either specific long-term projects or components of a multi-year plan. By and large, these facilities had more mature EMSs. For example, one facility, which had its EMS ISO 14001 certified in 1996, described multiple objectives and targets that it designed to promote progress on the facility's long-term plan to minimize the environmental impacts from product design efforts.

Next, we examined the specific nature of the facilities' objectives and targets to gauge whether facilities' EMSs were inclined to embody a primary focus. We wanted to know whether facilities in general tended to focus on single themes like regulatory compliance, pollution prevention or improving relationships with the public, or whether facilities' EMSs tended to be multi-faceted, for example combining regulatory compliance with pollution prevention and employee environmental training.

We found that an equal number of facilities' objectives and targets centered on pollution prevention as on regulatory compliance and that a majority of the facilities focused on both regulatory compliance and pollution prevention efforts. It is apparent from the data that these two types of endeavors go hand in hand at most facilities. But many facilities also focused their efforts on numerous other types of environmental objectives and targets. For example, in addition to compliance and pollution prevention, two facilities also addressed product stewardship. Two others included the development of employee environmental awareness programs in their EMS, along with a dual focus on compliance and pollution prevention. And the facility mentioned above, which included a contract janitorial employee on its EMS development team, also incorporated an objective and target to design and implement an environmentally friendly cleaning program.

Finally, we discovered that over half of the facility EMSs we studied were developed during the past year as part of the MSWG pilot project. Perhaps due to the newness of their systems, or having recently expended considerable resources on designing their EMSs, most of these facilities only committed to a small number of short-term objectives and targets that were focused on compliance and/or pollution prevention. This finding is in contrast with the facilities that possessed older (at least three years in existence) EMSs. In general, the more mature EMSs exhibited environmental objectives and targets that were more varied in substance and more integral to the facilities' long-term environmental plans. To illustrate, one facility with a long-standing ISO-14001 certified EMS incorporated environmental sustainability principles into its EMS, and in so doing moved considerations of compliance to the background and put considerations of long-term product stewardship at the fore.

IV. ISO 14001's Potential in Future Public Policy

These eighteen facilities represent a sample of the 70-plus pilot projects that ten states and the U.S. EPA are sponsoring in designing, developing, and monitoring ISO 14001-based EMSs. Since some of these states are offering regulatory and non-regulatory benefits to facilities that adopt an EMS, and others are considering them, they offer a rare opportunity to study the outcomes of these benefits first-hand as well as to examine the effects of EMS adoption on facility performance in real time.

The landscape of program implementation is diverse, and each of these differences will likely affect facilities' EMS design processes. In some of the MSWG states, facilities receive benefits as an incentive for EMS adoption. Arizona, for example, offers its facilities an "enforcement waiver policy" such that if a violation is discovered during the course of a facility's pilot project participation, it will be forgiven so long as the violation is not criminal and does not pose imminent public danger. California offers a somewhat different incentive, in the form of cost savings for consolidated reporting requirements and electronic reporting options. States such as Indiana and North Carolina have yet to offer regulatory benefits to their pilot facilities, but provide technical assistance, pollution prevention assistance, and other forms of support. A unique feature of Indiana's program is that each pilot facility is required to develop a stakeholder involvement plan, which must be approved by the state, that addresses how it intends to involve stakeholders during its EMS design process. In North Carolina, state staff persons are assigned to each pilot facility to assist in developing its EMS and obtaining ISO certification.

In some other cases, environmental regulators do not offer any benefits for EMS adoption, but instead require it for facilities that have failed to demonstrate compliance, through consent orders and Supplemental Environmental Projects (SEPs). Finally, the MSWG is in the process of developing a preliminary statement on "Public Policy EMSs," which articulates the attributes that EMSs should incorporate when considering them in both government benefit programs (from regulatory relief to various assistance programs) and enforcement actions.

The MSWG and other regulators are moving forward with EMSs as a policy option because, in theory, facilities that adopt ISO 14001 EMSs will in the long run be in compliance with all the environmental legislation and regulations that govern them. For these facilities, the environmental regulatory system may perhaps become less relevant as they embark on a path focused on continual improvement of their environmental management system and upgrading of their environmental goals and objectives. As such, ISO-certified facilities may find themselves ahead of the legislative curve. In our study we saw a glimpse of this as the more mature facility EMSs tended to focus less on strict compliance and more on forward-looking programs such as product stewardship or sustainability. Some government officials therefore see in ISO 14001 an opportunity to make many regulations more self-enforcing, and thus less demanding of formal enforcement actions by government. The argument for self-enforcement is that when specific companies fulfill their social contract with the public, there is less need for government effort to police them. From this perspective, intensive inspection and enforcement efforts should only need to apply to facilities that fail to maintain this contract.

Self-enforcement is gaining the attention of environmental officials, in part, because the traditional environmental regulatory system is fragmented and extremely complicated, the budget for regulatory inspections and audits is seriously under-funded, and both political opposition and a heavy burden of proof on government agencies hampers effective government regulation. The result of this system makes it difficult for regulators to determine which facilities fully comply with the environmental regulations that govern them. Indeed, some observers fail to appreciate how pervasively the major federal and state regulatory programs rely on self-monitoring and reporting even under normal circumstances. For these reasons, some regulators view ISO 14001 adoption as a tool to help ensure compliance because a facility that adopts a certified EMS must, by definition, commit to compliance and have an internal monitoring system to evaluate its environmental aspects and impacts. This argument is even more compelling internationally, since most countries have far less capacity for effective and trustworthy government enforcement than do the United States and a few other leading countries. Thus, *adoption* may be the relevant signal to regulators that a facility fulfills its social contract with the public—that it is in compliance with all environmental laws and working to achieve performance beyond compliance with legal requirements.

While critics argue that the current regulatory system is cumbersome and produces inefficient outcomes, however, it may actually facilitate EMS adoption, and increase the ability for companies to fulfill their social contracts. Indeed, over half of the eighteen facilities reported that one of the most important factors that contributed to their decision to adopt an ISO 14001-based EMS is to improve facility compliance with environmental regulations. And, some facilities report that when the time comes for a regulatory inspection, they find themselves in a much-improved position to provide documentation of their regulatory performance to inspectors. These findings support the idea that EMS adoption develops in the "shadow of regulation," that is, the presence of the regulatory system fosters EMS adoption. Further evidence is seen in the types of objectives and targets that the facilities developed, as over half of the companies focused their goals on compliance issues. So the traditional regulatory system may itself be an important context and incentive for EMS development, at least in the United States.

A key assumption to each of the arguments above is that facilities that adopt ISO-based EMSs decrease their potential harm to the environment more efficiently than via the traditional system alone. This assumption, however, has yet to be proven. Supposing that it is true, then environmental regulators will likely increase their support for widespread EMS adoption. In doing so, issues to consider include encouraging EMS implementation in those facilities at the lower end of the environmental performance spectrum, as well as in better-than-average pilot program facilities. Indeed, EMSs may yield great public benefits when adopted by facilities that have traditionally been out of compliance or at the threshold of non-compliance. These facilities have more "low-hanging fruit" than average- or above average-performing facilities, and thus significant potential for environmental gains through improved compliance and pollution prevention. Additional time is needed, however, to determine the relationship between ISO 14001 EMSs and the environmental performance of facilities that adopt them, as cross-sectional, post-adoption data are not yet available.

Even when these data are available, however, one must draw conclusions cautiously. Cross-sectional results for a modest number of pilot projects that show environmental improvement will be important in illustrating what is possible, but by themselves they do not necessarily mean that every facility that adopts a certified EMS will be in compliance or that the

same results will occur for facilities that are different from those participating in the pilot program. The regulated community is diverse—in industry type, management style, technology use, employee capacity, and other important factors—and facilities often operate at the threshold of compliance. If regulators rely on ISO 14001 EMS adoption per se as a signal of compliance or better-than-average environmental performance, several unintended consequences may result. Indeed, it may become attractive for facilities with poor compliance records to obtain ISO certification so that they are considered "legitimate" in the eyes of regulators, even though they are not necessarily in regulatory compliance. Such patterns have been documented in other voluntary environmental management programs, such as the Chemical Manufacturers Associations' Responsible Care initiative and EPA's 33/50 Program, in which participating facilities were shown to have a *higher* number of EPA enforcement actions than non-participating facilities. The explanation for this disparity is that the facilities that participated in both of these voluntary environmental management programs did so to obtain legitimacy with regulators—by at least *appearing* to change their ill behaviors of the past—and with the public, who had heard word of these facilities' poor compliance records (Klassen and McLaughlin, 1996). Similarly, ISO certification has the potential to offer facilities legitimacy among regulators and the public, even though compliance is not necessarily met.

Conversely, if it turns out that ISO 14001-based EMSs do *not* significantly reduce facility environmental impacts, or improve compliance, regulators may likely abandon their endorsement of them. Such results, however, may or may not influence the regulated community's increasing rates of EMS adoption. For many facilities, important non-regulatory business reasons also motivate them to implement these systems, and such reasons may continue to prompt adoption even if environmental gains are modest and regulatory benefits minimal. All eighteen facilities, for example, indicated that non-environmental considerations such as meeting customer demands, maintaining a competitive advantage, reducing costs, and improving public relations influenced their decisions to adopt an EMS. As additional data become available, we may find that businesses adopt EMSs for many other more compelling reasons than regulatory incentives or even environmental improvement per se.

Finally, considering the various debates of government involvement in facility EMS adoption, two conflicting questions emerge, which will not be resolved here but may cause much future debate. On the one hand, if EMSs result in increased environmental performance, shouldn't government reward their adoption? But on the other hand, if EMSs result in increased environmental performance and competitive advantage, why should government spend public monies to encourage their adoption?

VI. CONCLUSION

The increasing rate of adoption of ISO 14001 EMSs represents an important phenomenon in itself, both for businesses and for public utilities and other government facilities that are choosing to implement them. Among the many recent initiatives toward "voluntary approaches" to better environmental management, they represent in concept the most significant form to date of systematic commitment to continuous improvement in environmental performance by a significant and growing number of facilities and their parent organizations. In addition, this phenomenon represents an opportunity for fresh thought about environmental policy strategies, and about how the goals of those policies might be achieved more efficiently as well as more

effectively and at less public cost for inspection, for enforcement, and for development of additional new regulations to address unsolved environmental problems.

So far there are no clear guarantees that these favorable results will occur, much less that they will occur systematically across business sectors. Even if they do, there is no guarantee that they will occur without at least enforceable environmental standards—and perhaps the threat of the burden of permitting, inspection, and enforcement procedures as well—as a context and incentive for better self-initiated approaches. Nor is there yet clear evidence as to the stability of EMS goals and implementation over time, especially as personnel committed to them change and firms themselves undergo changes in leadership, priorities, financial and market pressures, and even corporate structure and ownership (and for publicly-owned facilities, changes in elected political leadership).

These initial cases offer at least suggestive indications, however, that real benefits can result, both for facilities that adopt EMSs and for the public. We look forward to continuing this line of research, to reporting further as the EMS design data and update protocols on economic and environmental performance are completed, and to discussion and comment from others in the meantime.[5]

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[5] More detailed information about the NDEMS database and related data collection protocols, public reports, guidance documents, and research activities may be found on the Internet at www.eli.org/isopilots.htm.

Environmental Management Systems: A Sustainable Strategy for a Sustainable World?[6]

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ABSTRACT

Over the past several years many business firms worldwide have adopted formal environmental management systems (EMSs) as procedures for systematically identifying environmental aspects and impacts of their operations, setting explicit goals for compliance, performance, and continuous improvement, and managing for them throughout these operations. This procedure has been standardized and promoted by the International Organization for Standardization, at the suggestion of the Business Council for Sustainable Development, as a strategy for achieving sustainable use of the environment by businesses themselves—"governance without governments"—whether or not they are subject to effective government regulation and enforcement.

A timely and important series of questions, therefore, is whether the adoption of formal EMS procedures does in fact produce more sustainable environmental and economic outcomes, and whether the adoption and use of such procedures is itself a sustainable business practice. On what environmental aspects and goals do they focus: regulatory compliance, superior performance, unregulated environmental impacts, sustainability, or others? What benefits and costs follow from the use of EMS procedures: to the firm, to governments and other stakeholders, and to the public? How much do these outcomes depend on the EMS design process: on who is involved in it, on how hard the firm challenges itself with the goals and objectives it sets, on the influence of external incentives and stakeholders? And how sustainable are the EMS goals and commitments themselves across potential changes in management personnel, ownership, market forces, and other forces? Depending on the answers, the EMS procedure offers either a promising approach to more sustainable environmental management, or troubling questions as to how environmental sustainability can be achieved in the emerging global economy.

I. INTRODUCTION

Over the past several years many business firms worldwide have adopted formal environmental management systems (EMSs) as procedures for systematically identifying environmental aspects and impacts of their operations, setting explicit goals for compliance,

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performance, and continuous improvement, and managing for them throughout these operations. Many businesses have developed their own environmental management procedures for years, but until recently there was no trend toward formalizing or standardizing them more generally. Even within many corporations they 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.

In the early 1990s, however, in anticipation of the 1992 "Earth Summit" in Rio de Janeiro,[8] the Business Council for Sustainable Development proposed the development of an international voluntary standard for environmental management systems by the International Organization for Standardization. The apparent intent was to offer a strategy for achieving sustainable use of the environment by businesses themselves—"governance without governments"—whether or not they were subject to effective government regulation and enforcement. This procedural standard was finalized in late 1996 as ISO 14001; other documents in the ISO 14000 series provide more detailed guidance on many EMS-related topics, such as environmental performance evaluation, life-cycle analysis, eco-labeling, and others.

The widespread adoption of ISO 14001 environmental management systems (EMSs) thus represents at least a philosophical intent to provide a means toward achieving the goal of sustainable development. An important and timely question, therefore, is to what extent (if at all), and under what circumstances, do they achieve this? How does the introduction of a formal procedure such as an EMS change the actual environmental and economic performance of a business (or other organization) that adopts it, and to what extent do these performance changes affect sustainability?

At a minimum, organizations that adopt the ISO 14001 standard accept a responsibility to adopt a written environmental policy; to identify all environmental aspects and impacts of their operations; to set priorities, goals and targets for continuous improvement in their environmental performance; to assign clear responsibilities for implementation, training, monitoring, and corrective actions; and to document their procedures and results, and evaluate and refine their implementation over time, so as to achieve continuous improvement both in their attainment of environmental goals and targets and in the EMS itself. An organization that adopts an ISO 14001 EMS can be certified as conforming to it by an approved third party "registrar." Similar procedural standards, varying somewhat in their details, have been adopted in Great Britain (BS 7750) and the European Union (the Eco-Management and Auditing Scheme, or EMAS).

Significantly, the substantive decisions that make up the content of the EMS are left almost entirely to the discretion of the adopting organization itself. An ISO 14001 EMS can be used to pursue a wide range of self-selected environmental goals and priorities: examples include compliance with regulatory standards, improving environmental performance beyond regulatory minima, reducing unregulated environmental impacts, improving environmental sustainability per se, or others. ISO 14001 does not prescribe substantive environmental performance standards, nor does it direct which of many possible environmental goals should be given priority. It does not prescribe the introduction of specific pollution-prevention or sustainability-

[8] Officially, the United Nations Conference on Environment and Development.

related practices. It does not mandate how fast or how far "continuous improvement" must proceed, nor even how quickly an organization must actually achieve compliance with environmental regulations. Nor does it require that even the EMS itself, let alone the documentation of its achievements or failures, be made public. An EMS is thus a formal set of procedures and of voluntary but internally documented assertions as to how an organization intends to manage its potential impacts on the natural environment and related aspects of its operations.

Two timely and important questions, therefore, are whether the adoption of formal EMS procedures does in fact produce more sustainable environmental and economic outcomes, and whether the adoption and use of such procedures is itself a sustainable business practice. Specifically:

- First, do EMSs in practice focus on strategic priorities for improving sustainability, or merely on short-term, limited improvements in regulatory compliance and pollution-prevention efficiencies? What is the scope of the EMSs: do they represent merely localized, facility-level practices and performance, or corporate-wide adaptation and evolution toward environmentally sustainable patterns of business activity? On what environmental aspects, impacts, and objectives do they focus: on regulatory compliance, on superior performance beyond compliance for regulated aspects, or on unregulated environmental impacts? How far and how fast do EMS adopters commit to improve?
- Second, are the EMS procedures sustainable? Do they represent genuine long-term, organization-wide commitments to continuous maintenance of the procedure, as well as continuous improvement in its outcomes, or merely one-time paperwork exercises? How much do these outcomes depend on the EMS design and implementation process: on who is involved in it, on the motivations and expectations that led to the decision to implement it, on the influence of external incentives and stakeholders, and on the continued presence of its initial champions and participants?
- And third, how sustainable are the EMS goals and commitments themselves across potential changes in management and organizational structure, in ownership (e.g. mergers, spinoffs and buyouts), in political authority (e.g. elected leadership, for public organizations), in market forces (affecting financial and investment assets as well as products), and other factors?

Depending on the answers, the EMS procedure may offer either a promising approach to more sustainable environmental management, or merely continuing unanswered questions as to how environmental sustainability can be achieved in the emerging global economy.

II. ENVIRONMENTAL MANAGEMENT SYSTEMS AND SUSTAINABILITY

A first question must be, if an EMS were to reflect progress toward greater sustainability, how would we recognize it? The meaning of "sustainable development" itself has been the subject of widespread debate, which requires at least brief review.

The term "sustainable development" was first coined and promoted by the United Nations' World Commission on Environment and Development (WCED), chaired by Prime Minister Gro Harlem Brundtland of Norway. The 1987 report of this commission, Our Common

Future, proposed long-term strategies for achieving "sustainable development" (WCED 1987). The core of its definition combined global economic and social progress with respect for natural systems and environmental quality: sustainable development, it argued, meant development that would meet the basic needs of the present generation of humans without endangering the ability of future generations to meet their own needs. The Commission's vision specifically included economic development, ecological sustainability, and social equity as essential, interdependent, and co-equal elements. Unlike many environmental-protection advocates, it focused attention on the dire economic plight of the poorer countries, and urged a renewed commitment to promoting economic growth, particularly in impoverished Africa and debt-laden Latin America. However, it urged that the core elements of that growth be radically redirected from past patterns, policies and priorities, to emphasize less energy-intensive technologies, stabilization of human population levels, intensified conservation of natural systems and energy, and reorientation of technologies toward reduced risks.

The core concepts of sustainability were further elaborated in the Agenda 21 document adopted by most nations at the 1992 Earth Summit. Chapter 30 of that document called for achieving sustainability by promoting clean and efficient production, pollution prevention, and commitment to best practices in industry; using investment as an instrument of sustainability; promoting technological innovations that enhance sustainability; instituting best practices worldwide; and disseminating these practices to suppliers, communities, and small businesses as well, wherever one does business.

The question remained (and remains), how can these concepts be operationalized with sufficient clarity that they can be recognized in the actions of individual businesses, municipalities, and other organizations?

Considering just the environmental element of sustainability, for instance, one could argue that increasing progress toward sustainability follows a sort of "Guttman scale," with each succeeding level both incorporating and transcending the previous levels: from mere compliance with environmental standards, to pollution prevention (incremental internal efficiencies in use and recapture of waste materials and energy), to design for environment (decreasing environmental impacts in the overall use and reuse of materials and energy in production processes), to product stewardship (decreasing environmental impacts throughout the overall life cycle of products, as well as production processes), to strategic management for environmental sustainability per se (for instance, substituting lower-impact services for higher-impact products, and reconfiguring the mix of business activities as a whole toward reduced environmental impacts and renewable levels of resource use), and finally, to the full vision of sustainability, channeling the economic use of sustainably available environmental resources into meeting human needs and wants equitably as well as profitably.

The higher levels of this scale may not even be achievable by all firms as presently constituted: ultimately they are goals for the overall economy and society, which may require the radical transformation or even "creative destruction" of some existing businesses, and their replacement by more sustainable competitors (see the work of Stuart Hart on this point). They may also require approaching sustainability not just from the perspective of enterprises themselves, but also (and perhaps even primarily) from those of sustainable communities and

ecosystems—real environments, in which multiple enterprises interact with people, other species, and ecological processes—and of sustainable economies and civilizations in the aggregate, for which what matters is the overall levels of balance and interaction among extraction and use of materials and energy, landscape transformation, population growth, per-capita material demands and wants, and distributional equity.

One methodology for operationalizing and evaluating the sustainability of business enterprises has been developed by the Dow Jones Company, the Sustainable Asset Management (SAM) Index (www.sustainability-index.com). This methodology requests detailed questionnaire information from CEOs of firms in each of 73 industry groups, supported by company policies and environmental, social, and financial reports and other available documentation, as well as media reports. It defines "sustainable" firms as those (a) in industrial sectors in which the top-ranked company scores at least 20% of the maximum sustainability score and (b) scoring at least 1/3 the score of the top-ranked company in their sector. Market capitalization is also taken into account, so that the index preferentially emphasizes financially significant industries and firms.

The SAM questionnaire covers a wide range of sustainability-related criteria, both general and some specific to each sector. Examples include sustainability policy and strategy, such as organization and responsibilities, policies, stakeholder relations, signed sustainability charters and corporate governance; management of opportunities, such as employee incentives, intellectual capital management, extent of information technology integration, use of strategic planning metrics, sustainability planning, environmental health and safety reporting, and social responsibility reporting; and management of sustainability-related risks and costs, both strategic (as evidenced e.g. by corporate integrated risk management and environmental management systems, world-wide minimum environmental and social standards, and corporate codes of conduct) and operational (evidenced e.g. by environmental health and safety audits, social audits, materials and energy input-output analyses, environmental profit and cost accounting, contingency plans for environmental health and safety incidents, corporate health and wellness programs, controversies related to the treatment of employees, and environmental liabilities).[9]

The SAM index thus covers a wide range of sustainability-related criteria, which the authors assert to be equally weighted across economic, social and environmental factors, and it professes to provide consistent comparisons across firms and major industrial sectors. It clearly provides evidence as to whether reporting firms are thinking about many sustainability-related issues. What is not clear from published information is how the evaluators actually weight and aggregate the many individual information elements that make up these extraordinarily multi-factorial indexes, nor whether all firms in each sector even respond: low performers may perhaps simply choose not to be rated. Nor is it clear how strongly the cumulative performance of all firms in fact achieves greater environmental sustainability: the index is designed for comparisons among responding firms, but not for estimation of aggregate change toward greater or less sustainability. Finally, it does not appear to capture data on many actual environmental or other

[9] Actual indicators range from the existence of sustainability policy statements, annual environmental and social reports, and charter commitments, to other formal procedures and programs (such as best-practice benchmarking, a certified EMS, environmental and social audits, employee health programs, environmental purchasing policies, and expectations of suppliers and contractors), and some industry-specific performance-related policies (e.g. use of closed-loop processes, natural organic materials, and toxic chemicals).

performance levels, except to the extent that these are reflected in corporate annual reports, formal legal penalties or liabilities, or negative press coverage.

A second conceptual methodology for operationalizing sustainability has been developed by The Natural Step (TNS), a non-profit environmental education organization founded in Sweden in 1989 which now operates worldwide (www.naturalstep.org). TNS offers a more substantive and scientifically-based set of principles for environmental sustainability, based on laws of thermodynamics and natural cycles. These include four primary principles:

- Substances from the Earth's crust must not systematically increase in the biosphere. This requires the development of comprehensive programs for metal and mineral recycling, and decreasing economic dependence on fossil fuels, so that these materials and energy resources are not extracted and dissipated faster than they are naturally redeposited and reintegrated in nature.
- Substances produced by society must not systematically increase in the biosphere. This requires reducing economic dependence on persistent human-made substances, such as stratospheric ozone-depleting compounds (e.g. CFC, halons) and synthetic organic chemicals that bioaccumulate in food chains.
- Nature's ecological functions and diversity must not be systematically impoverished by physical displacement, over-harvesting or other forms of ecosystem manipulation. Biodiversity, which includes the great variety of animals and plants found in nature, provides the foundation for ecosystem services which are necessary to sustain life; human harvesting of biotic resources, and landscape transformation, must therefore be limited to levels at which biodiversity and natural resources can be naturally maintained and regenerated.
- Resources must be used fairly and efficiently in order to meet basic human needs worldwide. If the total resource throughput of the global human population continues to increase, it will be increasingly difficult to meet basic human needs as human-driven processes intended to fulfill human needs and wants are systematically degrading the collective capacity of the Earth's ecosystems to meet these demands. To achieve the first three conditions, therefore, both technically and in terms of the social stability and cooperation necessary to accomplish them, it is also necessary to be both efficient in resource use and waste generation, and fair in using them to meet basic human needs worldwide.

The Natural Step thus offers a conceptual approach that articulates more specifically the substantive principles of sustainability than does the SAM index, but it is not itself fully operationalized. It is proposed to be implemented incrementally, beginning with those steps that are easiest and most cost-effective for a particular organization, but nonetheless guided by the overall strategic principles of sustainability. Like ISO 14001, it leaves all specific decisions about priorities, actions, and pace of implementation to the individual organization, but it does offer more specific and fundamental sustainability-related goal categories than does ISO 14001 for evaluating potential options and decisions.

Using these criteria, one might compare EMS documents for evidence of the extent to which they demonstrate not just basic conformity to ISO 14001 procedures and documentation requirements, nor merely compliance with environmental regulations, nor other ad hoc or short-term environmental aspects of environmental performance, but also a specific focus on aspects, impacts, and performance targets that are specifically sustainability-related. For example:

- Do they reduce mineral and energy use per unit production, and shifts toward increased recycling and renewable energy?
- Do they reduce the use of bioaccumulating synthetic chemicals?
- Do they address opportunities for introduction of closed-loop processes, and reduce use of biotic resources and of landscape transformation?
- Do they increase efficiency of resource use, and address the social and equity aspects of environmental sustainability, both for their workers and customers?
- Do they address sustainability implications throughout the facility's operations, and indeed throughout the supply and use chains of the products it processes?
- Do they consider more fundamental strategic redesign of the enterprise as a whole to achieve more sustainable results throughout its processes, products, and services?
- Do they create a process by which a broader range of managers, other employees, suppliers and customers, and other external stakeholders are drawn into greater commitment to sustainability principles and priorities?
- Do such sustainability impacts receive high priority in the organization's EMS targets an commitments?
- How consistently does the organization adhere to these priorities over time, and through changes in personnel, structure, ownership, and market and other forces that also influence its decisions?

A third methodology for corporate sustainability reporting is the Global Reporting Initiative (GRI), begun in 1997 under the leadership of CERES (the Coalition for Environmentally Responsible Economies) with participation by corporations, non-governmental organizations (NGOs), consultants, accountancy organizations, business associations, universities, and other stakeholders. GRI has recently developed an "Exposure Draft" of guidelines for such reporting, which they are now pilot testing. The goal of these guidelines is to establish a common framework for enterprise-level reporting on the linked aspects of sustainability: the environmental, the economic and the social. It seeks to elevate enterprise-level sustainable development reporting to the level of general acceptance and practice now accorded financial reporting. To ensure the long-term value of these reporting practices, GRI also seeks to develop and advocate greater stakeholder awareness and use of such reports (www.globalreporting.org).

The GRI guidelines, like the SAM index, are aimed at documenting information systematically at the enterprise level. They include environmental aspects of products and services as well as processes, affecting air, water, land, natural resources, flora, fauna, and human health. They also address social aspects such as treatment of minorities and women, involvement in shaping local, national and international public policy, and child labor and labor union issues. Finally, they include economic aspects, especially financial performance but also activities related to shaping demand for products and services, employee compensation, community contributions, and local procurement policies.

Examples of specific environmental performance indicators, for instance, include major stakeholder groups; number, volume, and nature of accidental or non-routine releases to land, air, and water, including chemical spills, oil spills, emissions resulting from upset combustion conditions; indicators of occupational health and safety; total energy use; total materials use

other than fuel; total water use; quantity of non-product output (NPO) returned to process or market by recycling or reuse, by material type and by on- and off-site management type; quantity of NPO returned to land, by material type and by on- and off-site management type; emissions to air and discharges to water, by type; indicators of social and economic aspects of operational performance; and major environmental, social, and economic impacts associated with the life cycle of products and services, with quantitative estimates of such impacts. The guidelines urge that all these indicators be expressed using normalizing factors that would make them meaningful to users of the information, and include comparative data from the two previous years.

In effect, these guidelines provide more substantive and specifically sustainability-related suggestions of the range of environmental (and other) performance indicators that might be addressed in an EMS. The GRI guidelines do not provide guidance for implementing data collection, information and reporting systems and organizational procedures for preparing sustainability reports, leaving these to ISO and other procedural guidance processes. Like both EMS and the SAM index, they also do not present standards for rating sustainability management and performance, but merely for comparing performance incrementally against both the enterprise's own prior-year performance and other enterprises.

III. THE NATIONAL DATABASE ON ENVIRONMENTAL MANAGEMENT SYSTEMS (NDEMS)

To examine the actual performance of enterprises and their component facilities and operations, it is important to try to collect both systematic data across such facilities, and detailed but also comparable case studies of the actual experiences of many types and sizes of enterprises and facilities.

The National Database on Environmental Management Systems (NDEMS) is designed to include data on EMS implementation from 75 pilot facilities receiving state or federal technical assistance to implement EMSs in ten U.S. states, plus approximately 20 non-pilot "control" facilities, using identical data collection protocols for each. The design of the study is a longitudinal comparative-case analysis in real time, including a three-year retrospective baseline, detailed data on EMS content and implementation processes, and at least two years' post-implementation data on changes in environmental and economic performance and other outcomes beyond the EMS design phase, as facilities implement EMSs.

The NDEMS database is specifically aimed to collect facility-level data, which limits its ability to answer some important questions about strategic adaptation of entire enterprises without additional data collection. However, facility-level data do provide important insights at the scale at which real impacts occur to real people, environments, and ecosystems. They also provide important building blocks for more far-reaching assessments of enterprise-level adaptation and evolution, as well as community- and society-wide sustainability.

The goal of the NDEMS project is to determine the effects of ISO 14001 and other environmental management systems on five kinds of outcomes: environmental performance, regulatory compliance, pollution prevention, engagement with stakeholders, and economic performance,. The database includes both private and public-sector facilities, both large and

small businesses, and both simple and complex operations.[10] Facilities included so far represent over a dozen sectors of the economy, including chemicals, electronics, food processing, machinery, metals, pharmaceuticals, pulp and paper, printing, transportation, utilities, federal facilities, and county and municipal governments. Most are implementing either ISO 14001 or similar sorts of EMSs. However, not all are seeking ISO 14001 third-party certification: some believe that for their purposes, internal implementation of an EMS is sufficient and most cost-effective. Their reasons for this decision are of course an interesting and important research question in itself.

IV. PRELIMINARY IMPRESSIONS

We have begun to analyze preliminary data on EMS designs from eighteen facilities from which we have received initial EMS design data submissions. Our first impressions of their responses suggest potentially interesting findings if they hold up across larger numbers of facilities.

First, the responses to the EMS design protocol show that in contrast to early presumptions that EMSs would be adopted only by larger transnational corporations, in fact EMSs are being implemented by facilities of all sizes and in many sectors. These facilities represent eight industrial sectors in nine states, ranging from small and medium-sized enterprises (17%) to large divisions of multinational corporations (22%), and located in communities ranging from small towns (39%) to major metropolitan areas (22%). Not all report direct economic net benefits from doing so, but most believe that it has been a worthwhile process, and several have explicitly stated that they would do it again even though it may not pay for itself on any strict economic basis.

Second, with respect to the EMS design process, most EMS core development teams were headed by the facility environmental manager and were composed primarily of other environmental and engineering staff, occasionally including consultants and representatives of senior management, but rarely either hourly employees or external stakeholders. However, those facilities that did involve a wider variety of employees in EMS development reported a significant additional benefit from the process: a heightened and more widely shared awareness of environmental issues among employees, a shared vision for addressing them, and associated benefits to employee morale.

Third, almost all of the facilities used the EMS aspects- and impacts-identification process as an opportunity to investigate thoroughly all activities and areas of their facilities, and to identify those that would have a potential impact on the environment. A few apparent

[10] Of the initial 55 facilities participating in NDEMS, for instance, 23 facilities or their parent organizations are privately held, 17 are publicly traded and twelve are local, state or federal government facilities (three did not report ownership). Perhaps more importantly, approximately 69 percent reported that they are part of a larger business or government organization. This may prove to be an interesting dimension on which to compare facilities. For example, facilities that are part of a larger organization may have very different motivations for adopting ISO 14001 than independent facilities. The EMSs of independent facilities may be designed very differently than the EMSs of facilities that must report to a larger organization, perhaps because larger organizations exert a greater degree of bureaucratic control over their facilities' EMS design.

exceptions, however, were facilities that may have relied too heavily on readily available, generic checklists of aspects and impacts rather than designing a specific process for their facility, and thus bypassed part of the critical thought process of identifying their own distinctive aspects and impacts.

Fourth, most of the facilities developed formal systems to evaluate the environmental aspects and impacts of their processes, and were quite creative in the use of these systems to determine significance. However, most used these rating-system outcomes only as a starting point for more judgmental decision processes. A sizeable number of facilities explicitly gave greater weight to legal and compliance issues than to other considerations (sustainability, for instance), so that regulatory compliance remained a primary priority.

Finally, over half of these initial eighteen EMSs had just been developed during the past year as state-assisted pilot projects, and most of these EMSs set only a small number of short-term objectives and targets focused on compliance and/or pollution prevention.[11] In contrast, at least four of the facilities—those that had already prepared EMSs on their own, and had had them in operation for at least three years—focused not so much on compliance as on product stewardship and other more sustainability-related objectives and targets.[12] For example, one facility with a pre-existing ISO 14001 certified EMS had explicitly incorporated principles of environmental sustainability into its EMS, and in so doing had shifted its emphasis from short-term compliance improvements to long-term product stewardship.

It will be important to observe whether the newly initiated EMSs of state-assisted pilot facilities evolve over time from compliance toward broader and more fundamental sustainability priorities as well, or whether state assistance proves to have been a structurally biasing incentive in favor of emphasizing short-term compliance improvement over other potential EMS priorities. Comments from a number of business speakers who have implemented EMSs suggest that such evolution does often occur over time, as the process of participating in EMS design and implementation identifies unanticipated business benefits in addition to mere compliance improvement. However, at this point it cannot be assumed.

V. ADDITIONAL RESEARCH NEEDS

It is important to stress that at this point these statements represent only preliminary, suggestive impressions from a small portion of our database, and that even these have not yet been fully analyzed and confirmed. Nor have we yet reached the point of determining changes in actual environmental performance and other outcomes, since those post-implementation data will be collected over the coming two to three years.

These preliminary impressions do, however, help to suggest interesting areas for closer analysis as well as for additional investigation.

[11] Interestingly, one facility even included objectives and targets that had already been reached before the EMS was complete—perhaps to use early and easy successes to build momentum for further implementation, or perhaps simply to use the EMS document for good public relations.

[12] Two of the eighteen addressed product stewardship, two others included the development of employee environmental awareness programs as specific objectives and targets, and one incorporated an objective to design and implement an environmentally friendly cleaning program.

First, the database needs to be completed, including both the rest of the EMS design data and, importantly, post-implementation data on actual environmental, economic, and other changes in outcomes. The questions we are investigating should also be replicated for additional numbers and types of facilities, to increase the reliability of the findings and the range of comparative information. They should also be augmented with more detailed on-site case studies, to flesh out more fully the decision processes and outcomes of EMS adoption. And they should clearly be replicated for facilities in other countries as well, to compare national and cultural differences in the uses of these procedures. Some of these case studies could well be different facilities of the same parent corporations whose U.S. facilities we are studying; others should be facilities that do not share that common influence, and which might therefore reveal important differences in processes and outcomes rooted in different national jurisdictions, economic systems and cultures.[13]

A second and broader set of questions concerns corporate-level use of EMSs. Are there strategic motivations for introducing consistent types of EMSs throughout an entire corporate structure, not just at the level of individual facilities, and even requiring them of its suppliers or customers as well? Do such initiatives produce additional or different benefits from those available at the facility level? Examples might include changes in corporate-level full cost accounting systems, which could not be altered at the facility level alone, or changes in the strategic configuration of an entire firm to achieve overall reductions in resource extraction or in emission and discharge loadings to the biosphere.

A third set of questions concerns the process of third-party auditing and certification. What is the competence of the providers of these services? What standards and criteria do they use to support or withhold certification? How consistent are these criteria across certification providers? And what are the practical incentives to these firms to apply stringent or lenient standards for certification, and the resulting dynamics of the third-party certification services industry over time?

Finally, a fourth and longer-term set of important research questions concerns the stability or evolution of EMS goals and commitments over time. A stated commitment of EMS adoption is to continuous improvement in environmental performance. However, it is also possible that such commitments would not survive either the replacement of the individuals who made and implemented the original commitments, or changes in competitive pressures in either product or investment market conditions, let alone the changes in priorities and internal organization that often accompany a corporate takeover or buyout (or in the case of a public-sector facility, a change in elected political authorities). Just in the two years in which we have begun building our database, for instance, several of our intended participating firms have experienced such changes, with real consequences for their EMS processes. In some cases the change in management has reinforced and strengthened commitment to EMS implementation, but in others it has had the opposite effect. The implications are fundamentally important to the credibility and sustainability of any EMS commitment to continuous improvement in

[13] A significant number of NDEMS facilities or their parent organizations, for instance, conduct business internationally as well as in the United States. Many produce products in countries other than the United States; many also market their products abroad.

environmental performance and sustainability. These issues need careful and ongoing study if EMSs are to be trusted as a "voluntary" approach to achieving public environmental goals.

VI. DISCUSSION

How and when then do EMSs connect to sustainability, and what can we learn about businesses' commitment and progress toward sustainability by examining their EMS documents and processes?

First, we must recognize that the fact of EMS adoption by itself provides no clear or continuing evidence of commitment even to significant improvements in environmental performance, let alone to sustainability per se. EMS guidance leaves the content of environmental goals almost entirely to the discretion of the implementing organization. We can and must therefore examine whether or not the EMS itself, and the commitments it represents—for instance the organization's written environmental policy statement, the aspects and impacts identified, and the priorities and targets selected for action—reflect any specific commitments to sustainability, or merely to more immediate objectives such as regulatory compliance. We can also learn something about how far and how fast EMS adopters commit to push themselves toward sustainability, and toward their other self-selected priorities and targets.

Second, we can learn how the content of the EMS policy statement, priorities, and other commitments is shaped by the process by which it is created and sustained. Note that the decision even to adopt and implement an EMS is driven by factors other than the EMS itself (by definition, since the EMS at that point does not yet exist). The goals and content of the EMS may also be determined, therefore, more by these same exogenous factors—customer demand, market positioning, regulatory or liability exposure, a CEO champion, or others—than by the EMS process itself. On the other hand, preliminary impressions also suggest that the process does sometimes produce new and unexpected benefits—such as unanticipated cost savings, broader buy-in by managers outside the environmental health and safety hierarchy, and employee commitment and morale—that may reinforce organizational commitment both to EMS goals and to sustaining the EMS process. The motives that drive continuing commitment to an EMS once begun, that is, may be different from those that motivated its adoption in the first place.

Third, we can learn something about the influence of government encouragement on EMS adoption and design. Many of the facilities we are examining are participants in state pilot projects, which provide technical assistance and some other benefits to facilities willing to adopt EMSs and cooperate with government agencies in examining them. This cooperation may encourage more firms to adopt EMSs, especially perhaps small and medium-sized firms that lacked the financial and technical resources to do it entirely by themselves. But will it also bias the emphasis of their EMSs toward immediate government-related goals, such as regulatory compliance, rather than sustainability? Will it also result in EMS adoption based more on the availability of short-term external assistance than on long-term commitment for the enterprise's own business reasons?

Finally, and most important, we hope to identify some of the actual changes in environmental and economic performance and other outcomes that result from EMS adoption,

and whether these reflect significant movement toward more sustainable business practices or not.

In short, the widespread adoption of standardized environmental management systems offers hope of several positive adaptations toward more sustainable business practices. One is the simple commitment they represent to continuous improvement in environmental performance outcomes, however incremental such steps may be. A second benefit is the creation of an explicit and documented procedure for goal- and target-setting for environmental performance improvement, engaging cross-functional teams rather than merely separate vertical chains of command. A third is the diffusion throughout the organization of awareness and legitimacy for environmental goals as part of all business functions, and of explicit and documented accountability for their achievement, when such considerations have in the past been largely marginalized in the Environment, Health and Safety staff.

At the same time, EMSs by themselves are only limited procedural instruments for such purposes, and the goals themselves—sustainability or others—must and will be driven by more fundamental exogenous forces. All the substantive decisions that an EMS reflects are self-selected from within the enterprise, and often reflect only the perspectives and priorities even of particular facilities and business units. There is no reason to expect, therefore, that an EMS developed at the level of a specific facility will reflect more fundamental or far-reaching goals or innovations that might be identifiable at the corporate level. There is also no guarantee, and probably no logical expectation, that a facility-level or even an enterprise-level EMS will incorporate the broader perspectives on sustainability that would be seen from the point of view of a community, ecosystem, or aggregate national or global sustainable civilization rather than from that of a particular corporate enterprise itself.

The ultimate reality is that both the adoption and the content of EMSs, as voluntary and discretionary actions of businesses, will over time be only as good or as sustainable as are the underlying business reasons—the private benefits to the implementing organization—that justify them to their parent organizations and shareholders. Their content and continuity provide indicators of the existence of those forces, rather than causes of them. Such voluntary approaches to environmental performance improvement and sustainability are desirable in principle, but their advocates must also acknowledge the enduring realities of externalities, in which it remains more rational for a business or a government jurisdiction to dump costs on third parties than to incur them themselves. They must also acknowledge the reality of “tragedies of the commons,” circumstances in which the cumulative outcomes of individually rational choices have collectively perverse effects. Finally, they must acknowledge the important roles of unintended as well as explicit government incentives. For example, some of the important incentives for more environmentally sustainable business practices may lie in the very cost and time burdens imposed by regulations that businesses often decry, rather than in the regulatory standards themselves; and in some industries, they may be driven also by in relative costs driven by regulations such as EPA’s landfill standards which dramatically increased the profitability of commercial waste management and recycling. It is also true, of course, that government incentives can also work in powerfully perverse ways as well, such as continued subsidies for extractive industries such as mining and logging.

These realities suggest, therefore, that while EMSs may well prove to be a valuable tool for promoting continuous improvement toward more sustainable environmental performance, those results may not occur through EMS adoption alone, and probably not entirely even from any enterprise-defined approach alone, in the absence of some effective mechanism for meshing enterprise-based perspectives with those of the communities and ecosystems in which they operate and the aggregate ecological and equity effects of business activity. For the present, the incentives that many major transnational corporate enterprises experience to standardize their operations worldwide to U.S./European standards provide a promising starting point. For the future, further work will be necessary to assure that both these firms and other organizations have effective incentives to harmonize their activities with the fundamental substantive principles of sustainable development.

Environmental Management Systems: History, Theory, and Implementation Research[14]

April 2001

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I. INTRODUCTION

The widespread adoption of formal environmental management systems (EMSs) by businesses and other organizations has been promoted as an innovation that has the potential to alter profoundly both their environmental and economic performance, and their resulting relationships with longstanding environmental regulatory policies and agencies. Advocates argue that when implemented, EMSs have the potential not only to improve compliance with environmental regulations, but also to refocus the organization's attention beyond compliance toward a dynamic, continual process of improvement in both environmental and economic performance. In the process, it is likely that the organization will discover new opportunities to prevent rather than simply control pollution, and to reduce wasteful uses of resources, thus saving money while improving the environment. It may also discover opportunities to manage the organization as a whole more effectively.

Many businesses have developed their own environmental management procedures for years, but until recently there has been no trend toward formalizing or standardizing them more generally. Even within many corporations they 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. In late 1996, however, the International Organization for Standardization published the final version of an international voluntary EMS standard, ISO 14001. Other documents in the ISO 14000 series provide more detailed guidance on many EMS-related topics, such as life-cycle analysis, eco-labeling, and others.

An EMS is 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. The ISO 14001 standard provides an explicit and closely documented procedural template for such a system, which can be audited and certified by an approved third-party "registrar" as conforming to the ISO 14001 standard. At a minimum, organizations that

[14] Forthcoming 2001 in Regulating from the Inside: Can Environmental Management Systems Achieve Policy Goals?, edited by Cary Coglianese and Jennifer Nash. Washington, DC: Resources for the Future Press, chapter 2.
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adopt the ISO 14001 standard accept a responsibility to adopt a written environmental policy; to identify all environmental aspects and impacts of their operations; to set priorities, goals and targets for continuous improvement in their environmental performance; to assign clear responsibilities for implementation, training, monitoring, and corrective actions; and to evaluate and refine implementation over time so as to achieve continuous improvement both in implementation of environmental goals and targets and in the EMS itself. Similar procedural standards, varying somewhat in their details, have been adopted in Great Britain (BS 7750) and the European Union (EMAS, the Eco-Management and Auditing Scheme).

As of April 2000, an estimated 15,772 facilities worldwide had been certified as meeting the ISO 14001 standard, including approximately 750 in the United States. The latter number reflects an accelerating trend, approximately tripling within the previous two years. The increasing trend of U.S. adoption of ISO 14001 was bolstered by an onset of business-driven mandates and government programs. 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, by July 2003 (Ford) and by the end of 2002 (GM), and to encourage them to require such certification of second and third tier suppliers as well. Toyota announced a similar requirement, effective by the end of 2003. In April 2000 President Clinton 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 (EO 13148, April 22, 2000). Finally, the U.S. Environmental Protection Agency (EPA) and some state governments adopted policies that encouraged EMS adoption and certification, establishing "performance tracks" with incentives to benefit firms that implement EMSs, and incorporating EMS requirements into some "supplemental environmental projects" (SEPs) for firms found to be out of compliance with environmental regulations (http://www.epa.gov/opeihome/performancetrack/). For all these reasons and others, the implementation and certification of ISO-compliant EMSs will likely continue to increase, both in the United States and worldwide.

The advent of widely-used and formally documented environmental management systems therefore raises important questions, both for research and for public policy. As a research topic, it 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 environmental management decisions through the eyes of the businesses that make them, not just through those of government agencies that seek to influence them. At the same time, it should also shed new light on important environmental policy questions such as whether the environmental management initiatives of businesses themselves can produce more effective and economical environmental performance, better regulatory compliance, more efficient monitoring and reporting procedures, or other benefits both to the public and to the firms themselves.

The importance of these questions led to the creation of the Multi-State Working Group on Environmental Management Systems (MSWG) and to USEPA support for creation of a National Database on Environmental Management Systems (NDEMS), in cooperation with MSWG and with 50-100 participating facilities, to provide systematic empirical evidence on the

effects of EMS implementation. The NDEMS database is being developed jointly by the University of North Carolina at Chapel Hill and the Environmental Law Institute.[16]

In this chapter we provide historical and theoretical contexts for the initial research being carried out on this database, some preliminary results, and discussion of further research plans, needs, and opportunities.

II. HISTORICAL CONTEXT

For over three decades, both scholars and policy advocates have argued over what combination of voluntary measures, economic incentives, and government regulations represents the best way to control pollutant emissions and other environmental impacts (Andrews 1999). Before1970 the dominant approach was voluntary measures, plus regulations in a few states; by 1970 this approach was widely viewed as inadequate, and a series of major new federal regulatory statutes established technology-based permit requirements for air and water emissions and waste-treatment facilities as well as other requirements.

Critics have since denigrated these regulations as an unduly rigid and inefficient "command-and-control" approach (see e.g. U.S. EPA 1990), but in fact they were largely successful, though costly, in achieving significant reductions of air pollutant emissions and wastewater discharges as well as major improvements in both municipal and hazardous waste management (Andrews 1999). They did however dominate the agendas of both businesses and government, producing a preoccupation with regulatory compliance rather than with full and efficient integration of environmental considerations into the core goals and decisions of businesses. Environmental management was treated as a necessary evil 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 core function which should be the shared responsibility of managers throughout the organization. The question remained, therefore, whether more efficient and effective means to this purpose could be found.

Since at least the 1970s, it has also been documented that environmental impacts were themselves signals of economic inefficiency in production, which should be corrected in the interest of industrial as well as societal optimization. Kneese and Bower (1979) documented economically-efficient opportunities for pollution prevention in a series of industries during the 1970s, and by 1979 Michael Royston began popularizing the idea that "pollution prevention pays" (Royston 1979). A few leading corporations also began publicizing this idea at about the same time (3M, for instance), and other studies confirmed it (e.g. Sarokin et al. 1985).

As regulatory enforcement tightened in the1980s, many more businesses began instituting environmental auditing practices, initially for compliance assurance but also for due-diligence management of potential liability (especially by banks and insurance companies, in the wake of Superfund strict-liability legislation for hazardous-waste dumping in 1980). 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), which documented for the first time the actual quantities of pollutant releases

[16] All NDEMS documentation is publicly available on line, with the exception of information that would reveal the identity of specific facilities, at http://www.eli.org/isopilots.htm.

by many major businesses and thus generated new incentives for the firms themselves to identify and reduce them (Andrews 1999). 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. EPA Administrator William Reilly in 1991 began offering modest federal rewards for voluntary industrial initiatives to prevent and reduce emissions (the "33/50" and "Green 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 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 BCSD report posed this goal squarely as a challenge and opportunity for businesses; and 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).

By the 1990s, both in the United States and worldwide there was active advocacy, in some business and government circles, for increased "self-regulation" of businesses for environmental protection and pollution reduction. Specific proposals included sectoral pollution-reduction "covenants," market trading of emissions permits, third-party certification of environmental performance (e.g. under the European Union's Eco-Management and Auditing Scheme [EMAS] and the ISO 14001 Environmental Management System certification), ad hoc negotiation of regulatory flexibility in exchange for superior environmental performance, and others. Environmental sustainability had been publicly adopted, at least by some leading businesses and executives, as a fundamental business goal and opportunity, and environmental management as a core business function. The questions remained, however, how deep this commitment was; how widely it was shared among all firms and sectors; and how durable it would be in the face of conflicting economic pressures, such as the seemingly relentless demand for short-term profitability.

These questions in turn held central importance to the ongoing public policy debate over what reforms in environmental regulatory statutes should be considered. Should environmental regulations be implemented more "flexibly" in exchange for voluntary actions by industries, or would such "flexibility" in reality open the door to endless special pleadings and to erosion of the regulatory framework that had produced much of the environmental progress to date?

III. THEORIES OF CORPORATE BEHAVIOR AND THE NATURAL ENVIRONMENT

But on what grounds should one even expect businesses—or non-market organizations such as government operations, for that matter—to achieve environmental performance superior to what was required of them by regulation? And even if they did, why should one expect them to undertake the elaborate bureaucratic costs—paperwork, process, and external audits—

associated with an ISO-certified EMS, rather than simply implementing cost-effective changes ad hoc?

For at least half a century environmental problems have been characterized as externalities and commons problems, imposing social rather than business costs and thus rationally ignored by businesses until forced back on them by government action (Kapp 1950). "Traditional" environmental economics argued that while prescriptive regulations are inefficient, because they dictate inflexible and suboptimal means for achieving environmental goals, government should nevertheless provide market-based incentives such as emissions taxes or marketable credits in order to correct market signals that undervalue environmental assets (see e.g. Jaffe et al. 1995).

A parallel business literature assumed a zero-sum tradeoff relationship between business costs and social costs, such that any environmental improvement by a firm was assumed merely to transfer costs previously incurred by society back onto the firm, thus worsening the firm's manufacturing performance in terms of cost, quality, speed, and flexibility (Klassen and Whybark 1999, and further references therein). Standard engineering-economics textbooks postulated an exponentially rising curve for pollution-control costs with each increment of improved protection. Why then should businesses act voluntarily to internalize these costs if it was more efficient for them to push them off onto society in the first place?

A revisionist empirical literature began to appear in the 1980s, documenting a surprisingly pervasive range of cases in which pollution prevention investments in fact produced economic benefits both for society and for the business itself (see e.g. Royston 1979, Sarokin et al. 1985, Cairncross 1991, Schmidheiny 1992, Smart 1992, Fischer and Schot 1993, Hawken 1993, Allenby and Richards 1994, Porter 1991, Porter and Van der Linde 1995; and more recently Hart 1997 and Hawken et al. 1999). Experiences of a number of major corporations, especially after implementation of the Toxics Release Inventory reporting requirements, added support to this position. Far from operating at their peak efficiency as assumed by economic theory, many firms appeared to be operating mainly by habit, leaving significant opportunities for cost-effective environmental improvements "lying on the table." A growing chorus of voices thus argued for a "greening of industry" that would benefit both society and businesses themselves. This literature raised important challenges to the assumptions of traditional economic theory, but it remained largely atheoretical itself: why were businesses failing to recognize and correct such inefficiencies if it was in fact in their own economic self-interest to do so?

At the same time, a growing critical literature argued that existing approaches to environmental regulation, particularly in the United States, were at least inefficient and in some views ineffective as well. Beginning in the late 1970s, a literature developed attacking government "over-regulation" and demanding regulatory reforms (cf. Weidenbaum 1979). This reform agenda was sidelined for several years as the Reagan administration attempted instead to fundamentally dismantle federal environmental regulation, but then re-emerged in the form of an oversimplified cliché which pejoratively contrasted "command-and-control" regulations with the more attractive-sounding "market-based incentives" (see e.g. U.S. EPA 1990). These arguments included claims that conventional environmental regulation was inefficient, imposing higher costs than were necessary to achieve the desired environmental performance goals; that it was

ineffective, by requiring end-of-pipe control technologies that merely move pollutants around (among air, water, and land) rather than reducing its total quantities; that it was unworkable for "new generation" environmental problems, such as non-point sources and driving behavior, even if it was effective in reducing pollution from major point sources; and that it was increasingly unenforceable in any case, as formal governments increasingly lacked the resources, the political will, and in an open global economy, the effective authority to enforce conventional environmental regulations.

The combined effect of these arguments was a variety of proposals, both in Europe and the United States, to encourage increased environmental "self-regulation" by businesses. Some of these proposals would serve as alternative implementing mechanisms for public environmental goals, standards, and licensing requirements. Others propose fundamentally different approaches to environmental performance, which are claimed to be based on the enlightened self-interest and commitment of businesses themselves. Whether these proposals would in fact produce better results than existing regulatory regimes, and whether either existing regulatory regimes or self-regulation proposals will produce environmentally sustainable results, are important questions that have not yet been systematically answered. To address them requires both theoretical and empirical investigation of environmental decisionmaking in businesses, a subject that until now has not been widely studied.

The effectiveness of environmental self-regulation mechanisms must be evaluated not just in the context of hopeful "green" idealism, nor of the rhetoric and anecdotes of a few leading firms and their image-makers, but of the basic economic forces that drive and constrain business outcomes and that will relentlessly, if not immediately, sort long-term trends from fleeting experiments in business decision-making.[17]

Privately held companies can pursue whatever objectives their owners desire, within the limits of the laws, including accepting less than maximum short-term profits in order to be seen as a good community citizen or to maintain the long-term legacy and reputation of the firm. State-controlled firms can also pursue the objectives of the state that operates them, whether those be maximizing production at the expense of the environment or giving procurement preferences to "green" suppliers.

Publicly traded businesses, however, are subject to more rigid iron laws of the current global marketplace. In global capital markets in which capital is free to move instantaneously to the most immediately profitable investments anywhere in the world, this pressure is controlled not so much by consumers as by investors. Higher-cost firms lose both customers and investors, and "under-performing" firms are vulnerable to involuntary restructuring to better serve short-term investor interests. Fundamentally, such firms are forced increasingly to pay primary attention to short-term profitability. These market forces may threaten the substantial environmental, health and safety staff capabilities that some leading businesses have now developed at the corporate level. Even as some corporate EHS executives are hopeful of gaining

[17] Ehrenfeld and Howard (1996), for instance, observed that overwhelmingly the principal organized activity of U.S. industrial trade associations is lobbying to restrict or control environmental regulation, rather than to achieve greener environmental performance. They also noted that even many leading "green-image" firms such as AT&T said little or nothing about their environmental initiatives in their corporate annual reports, suggesting by implication that at least at that time, these matters were still considered inconsequential to the core of their economic and investment decisions.

increased influence at the headquarters level, others are finding themselves marginalized or even eliminated by the decentralization of decision-making to individual production units whose mandate is to produce short-term returns or be closed or sold.[18] These pressures may be less for privately-held or state-dominated firms, but they too must face cost-minimizing competitors unless they operate as monopolies or in protected markets.

Proposals for voluntary environmental self-regulation must therefore demonstrate (1) that there are private benefits of environmental self-regulation; (2) that these private benefits exceed the private costs of undertaking it, in the short term required by financial markets; and (3) that these private net benefits are sufficient to motivate private environmental performance that is equal or superior to public environmental standards (Andrews 1998).

Research on environmental management in business is still in its infancy. Schot and Fischer (1993: 372-73), in a research agenda on environmental strategies for industry, urged that more research be devoted to in-depth case studies to determine how learning processes occur within and among organizations that lead them from a defensive to an innovative environmental management approach, using theories developed within the framework of strategic management, organizational and innovation studies. They also called for research on how government policies can induce this transition, and on the influence of evolving new relationships between firms and environmentally-concerned publics, which they identified as one of the most important driving forces for changes in firm behavior.

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 argued that government regulations may serve in practice as a stimulus to both economic growth and cleaner production, if they are used as a business asset to gain market advantages over competitors. A subsequent review of the literature however concluded that neither positive nor negative effects of environmental regulation on competitiveness were easily detectable (Jaffe et al. 1995). Porter and van der Linde concluded more recently (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 1999).

This latter conclusion leads to an alternative line of theory, which has proposed that both economic and environmental performance of businesses are driven by similar and primarily internal forces, including management strategy and firm-level resources (Klassen and Whybark 1999). This "resource-based" view of the firm postulates 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

[18] One illustration is the pharmaceuticals firm CIBA-Geigy, which responded to several major environmental embarrassments by establishing a corporate commitment to superior environmental performance by all its production units, and built a widely-respected corporate environment, health and safety staff to implement this commitment throughout its operations. CIBA-Geigy was subsequently acquired by another firm, however, whose management policy was that each production unit should have decentralized responsibility for its own decisions. The CIBA-Geigy corporate EHS staff was severely down-sized, and most reportedly left the firm.

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 decisionmaking, and corporate sanctions of agents 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, continuous 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) argue 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 plants in several industries, they concluded that organizational resources, and particularly specialized environmental resources, provide the embedded capacity that allows sample plants 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 that both theoretically and with empirical confirmation, 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 effectively deploy pollution prevention technologies. These findings concur 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 remains to be studied in greater detail, Klassen and Whybark note, is whether allocating resources to management systems is a precursor to developing strategic organizational resources that favor the effective implementation of pollution prevention technologies (Hart, 1995; Russo & Fouts, 1997). To invest most effectively in pollution prevention, they argue, 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 suggest, but one not yet clearly proven.

Other researchers' findings also underscore the importance of determining how far and how fast the environmental management practices of leading firms are spreading to others. Arthur D. Little Inc. surveyed 185 North American environment, health and safety (EHS) executives in 1995, and found widespread barriers still blocking integration of EHS into the mainstream of their corporations' business, in particular their continuing difficulty in persuading management that EHS was a legitimate core business issue (Arthur D. Little Inc. 1995, Meima 1997). Florida (1996) surveyed 212 corporate leaders on their environmental strategies and manufacturing practices in 1995, and found that at least at that time the key drivers they perceived were still regulations and corporate citizenship, followed by the desires to improve technologies and productivity and serve key customers, and more distantly by such factors as competition, markets for "green" products, and pressure from environmental organizations.

Clinton Andrews (1998) also surveyed 116 Fortune-500 corporate leaders' perceptions of environmental business strategy, and found that while most advocated environmental protection as both a social goal and a core business objective, they still nonetheless perceived environmental considerations as more associated with risk and cost reduction than with value-adding competitiveness objectives such as productivity, prices and sales. He also found that in the firm's environmental decisions themselves, the respondents overall perceived environmental decisionmaking as still dominated by legal requirements, company values and public perceptions. However, larger firms focused more on their competitors' actions, company values, public perceptions, industry norms, and exhortation by public figures than did smaller ones, and multinational firms paid more attention to scientific evidence, suppliers' actions, company values, industry norms, and exhortation than did domestic ones.

These studies of the influence of individuals' attitudes on environmental management suggest the importance of an additional theoretical approach, which emphasizes not the business's strategic resources per se but individuals' perceptions of them. Meima (1997) proposed that the roles and interactions played by individuals throughout the organization are an essential consideration, and that these are themselves closely intertwined with the peculiar nature of environmental issues: environmental issues have an "ecological logic" which is at first alien to traditional managerial discourse, and must therefore be legitimized. Meima proposed using the "sense-making" tradition of organizational theory (Weick 1995) as an approach to this problem, investigating the ways in which individuals in the organization make plausible sense of environmental considerations and integrate them into their roles and interactions in ways that foster the development of the social-complexity assets advocated by Hart.

Research on EMS adoption itself, while still quite limited and largely atheoretical, offers some grounds for optimism. Stenzel (2000) 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.[19] Skeptics also criticized the ISO 14001 model for its origins in a relatively closed, self-appointed business organization; for the absence of any binding linkage to environmental performance standards, even regulatory compliance, other than those self-selected by the firm; for the absence of any requirement for public reporting and disclosure; and for its reliance on self-enforcement and on the standards and qualifications—as yet not clearly demonstrated—of third-party certifiers (Stenzel 2000). More recently, some of the best informed environmental NGO observers have concluded that EMSs can further principles of sustainability, help regulatory agencies achieve their policy objectives, and improve relationships among stakeholders, and that the ISO 14000 standards can play a positive role in the "greening" of global commerce; but that it cannot alone satisfy public policy objectives, and that in particular it needs to incorporate a meaningful public reporting requirement (Morrison et al. 2000).

Early discussions of ISO 14001 certification assumed that because of its cost and effort burdens, the standard would be of interest mainly if not exclusively to large transnational corporations, such as those that initially negotiated the standard. Ruth Hillary (1999), however, reported on a meta-analysis of 33 studies of EMS implementation by small and medium-sized enterprises (SMEs), primarily in Europe and the United Kingdom. Overall she found that SMEs which adopted EMSs found real and valuable benefits from doing so.[20] However, she also identified significant barriers to adoption. Internal barriers to EMS adoption were more important than external ones, particularly the scarcity of human resources (rather than financial ones), practical problems with determining environmental aspects and assigning significance, the interruptibility of the process in an SME setting, lack of knowledge about EMSs and their potential benefits, and attitudes that the environment simply was not a core SME business issue or one that offered economic benefits to them. She also found that customers were the key driver for the adoption of EMSs by SMEs, and had influence far beyond any of the other stakeholders cited; but that legislation and regulators were more important drivers for general environmental improvements in SMEs than were customers. Finally, she found that implementation often required more resources than expected, that identification of non-compliance could be either a benefit if the company could readily rectify the cause or a disbenefit if it could not or would not; and that benefits to SMEs often had not materialized as expected.

Rondinelli and Vastag (2000) report that even in a firm with environmentally efficient operations already in place, ISO 14001 certification could have important behavioral and managerial impacts that contributed to better environmental performance, and that these findings were reinforced by observations at other firms' ISO-certified facilities. Darnall et al. (2000) report similar results, showing that several firms that had mature EMSs in place prior to adopting ISO 14001 still reported experiencing substantial benefits due to improved organizational control, communications, and manufacturing efficiency, all of which improved their environmental performance.

[19] Note that ISO 14001 offered a worldwide alternative to two more stringent standards then being introduced in Europe, England's BS 7750 and the European Union's Ecomanagement and Auditing Scheme (EMAS).

[20] Examples included particularly the attraction of new businesses and customers, satisfaction of customer requirements, improved environmental performance, assured legal compliance, and material and energy efficiencies, as well as organizational improvements and efficiencies, financial savings, and broader attitudinal and communication benefits.

Finally, the emerging business literature on corporate environmental management promotes a presumption that industry itself now best understands what drivers are most appropriate and that government incentives should therefore focus on rewarding voluntary business efforts to deliver environmental performance superior to the requirements mandated by statutes and regulations, and eliminating perverse incentives caused by some environmentally damaging taxes and other policies (e.g. Schmidheiny 1992, Smart 1992, Lovins et al. 1999; note that "traditional" environmental economists would also endorse at least the latter prescription).

An important issue for research, however, is the sustainability of such EMS commitments themselves, both over time and across changes in personnel and in organizational ownership, structure and management. In the context of the resource-based theory of the firm, Russo and Fouts (1997) note that industry transitions may render previously critical resources of marginal value. If industrial society does evolve to the point where sustainable development is the norm, as Hart (1995) suggested, then technological, organizational, and human resources that serve a firm's environmental aims now should be even more valuable then. But Andrews (1998) also notes that real externalities and commons problems nonetheless continue to exist, and that others have been ameliorated only by the existence of costly regulations in the shadow of which businesses now calculate their strategic resources. The emerging theoretical arguments of a business case for EMSs, and for environmental performance improvements more generally, must therefore still be systematically and empirically proven against the impersonal forces of price and profitability in both product and investment markets. They must also be shown to be generalizable not only for self-selected leading firms, but for all businesses that most significantly impact the environment.

IV. THE NDEMS DATABASE AND RESEARCH PROGRAM

The most important question for EMS research, therefore, is arguably the most obvious: what effect does the implementation of an EMS have on the environmental and economic performance of an organization that adopts it? This question is centrally important not only to businesses but also to regulatory officials, to environmental interest groups, and to affected communities.

Other questions are also interesting and important. For example, what motivates organizations to implement and certify EMSs: what do they expect to gain from them, and what do they actually gain? Is an EMS valuable or even necessary to compete in international markets? Is it important to major customers or suppliers, and if so, why? Does it make a difference to investors, insurers, or other important stakeholders? Does it help the organization in other ways, such as improved coordination among managers and divisions or greater involvement of workers? Does it in fact reveal new opportunities for cost-effective pollution prevention, for reducing regulatory costs, or for more efficient business practices? Who actually is involved in adopting and implementing an EMS, and what difference does it make how and by whom it is carried out? And finally, 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?

One can ask equally important questions about the value of EMSs for achieving public policy goals. Does the implementation of an EMS improve businesses' environmental

performance, and reduce their environmental impacts? Does it improve regulatory compliance, or does it at least improve self-monitoring, so as to reduce the taxpayer costs of monitoring and enforcement? What changes in federal and state regulations should be considered, if any, to promote EMS innovations that benefit public environmental goals, and to assure against any undermining of those goals? Does the EMS process improve relationships between businesses and their neighbors and communities, and with environmental and other citizen organizations? Does it improve environmental performance by suppliers and customers as well as by the primary business itself? And what difference, if any, does third-party certification make?

The National Database on Environmental Management Systems (NDEMS) was initiated to provide a basis for answering such questions. A joint initiative of the University of North Carolina at Chapel Hill and the Environmental Law Institute, it is supported by the U.S. Environmental Protection Agency in cooperation with the Multi-State Working Group on Environmental Management Systems, ten state environmental agencies,[21] and so far approximately 60 businesses and other organizations that have agreed to share data with it.

NDEMS was designed initially to include data on EMS implementation from approximately 75 pilot facilities receiving assistance from state or federal agencies, plus approximately 20 non-pilot facilities, using identical data collection protocols for each. The goal was to determine the effects of ISO 14001 and similar EMSs on six kinds of outcomes: on environmental performance and environmental conditions; on economic performance; on regulatory compliance; on pollution prevention; and on engagement with stakeholders.

The design of the study is a longitudinal comparative-case analysis in real time. It is specifically designed to collect facility-level data, since 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. For each facility, the research team administers a baseline protocol capturing three years' retrospective data, in order to establish the environmental performance levels prior to EMS implementation; an EMS design protocol, which elicits data on the EMS implementation process as well as its substantive content (e.g. specific environmental aspects, impacts, goals and objectives, etc.); and a series of update protocols to be administered over the following two to three years, to capture changes in environmental, economic and other outcomes as well as refinements to the EMS itself. All data are subject to careful quality-control procedures, including rechecking with the facilities before final inclusion in the database, to assure against errors or misinterpretation.

As of June 2000, baseline data were complete for over 50 participating facilities, and initial EMS design data had been collected for over 30 facilities. EMS design data were to be completed by the end of 2000, and update data on changes in performance were to be collected during 2001 and 2002. The protocol data were also being augmented with on-site case studies for selected facilities.

[21] Arizona, California, Illinois, Indiana, New Hampshire, North Carolina, Oregon, Pennsylvania, Vermont, Wisconsin

V. PRELIMINARY RESULTS (1): WHAT KINDS OF FACILITIES ARE ADOPTING CERTIFIED EMSS?

Baseline data analysis reveals a variety of interesting characteristics of the sample facilities. In contrast to early assumptions that EMSs would be adopted and certified only by large transnational corporations, in fact EMSs are being implemented by facilities of all sizes and in many sectors. The database includes both private and public-sector facilities, both large and small businesses, and both simple and complex operations. Of the 50 facilities in the database so far, only 8 (16%) had more than 1000 employees; 30 had 100 to 999 employees, and 12 employed less than 100. Thirty-four were part of a larger parent organization, but 16 were not; more than three-quarters did business overseas, but 24% did not. Over a dozen sectors of the economy were represented, including chemicals, electronics, food processing, machinery, metals, pharmaceuticals, pulp and paper, printing, transportation, and utilities; 7 were Federal, state or local government facilities.

Second, sizable majorities of the facilities (88%) had some prior experience with environmental[22] and/or non-environmental[23] management systems, and nearly two-thirds reported participation in other voluntary environmental management incentive programs.[24] These findings tend to support Florida's contention (see ___, this volume) that innovative firms are likely to be innovative across multiple dimensions.

The facilities were not, however, idiosyncratically "clean." Most were regulated under air, water, and/or hazardous waste statutes, and over 60 percent generated TRI-reportable quantities of toxic pollutants. A dozen major violations had occurred at three of these facilities, and 78 minor violations at seventeen of them; most represented either violations of emission or discharge limits or of monitoring requirements. Forty-eight of these violations were self-discovered, and 36 by regulatory inspectors; 58 were discovered within one day, but sixteen only after more than two months. Similar issues were reported for "non-compliances" that were not cited as formal violations: 19 facilities experienced 27 actual non-compliances, and 25 facilities experienced 53 potential non-compliances, most frequently involving either emissions or discharges exceeding permit limits or unauthorized releases of other pollutants. Fifty-two of these non-compliances were self-discovered, and ten by formal facility audits; only three were discovered by regulatory inspectors. Fifty were discovered within one day, but 21 only after more than two months. All these results suggest potential benefits from more systematic environmental management procedures.

Forty-three of the facilities reported that they already involved some interested parties in their environmental management decisions during the three baseline years, most frequently non-management employees, owners and shareholders; about half involved local government agencies, but less than a dozen included environmental or other local citizen groups, community

[22] Examples included some form of pre-existing EMS, waste minimization planning, pollution prevention planning, compliance audits, internal and (less frequently) public environmental reporting, environmental best practices, and risk assessment or environmental accounting systems.

[23] Examples included ISO 9000 certification, Total Quality Management, materials accounting systems, Just-In-Time inventory systems, the OSHA voluntary protection program, and others.

[24] Most commonly, participation in state voluntary environmental management programs, or EPA's 33/50 or Green Lights Program; others mentioned (one or two each) included the Charter for Sustainable Development, CERES Principles, Business for Social Responsibility, and EPA's Green Star Program.

advisory groups, or neighbors. Twenty-five facilities, however, reported that they planned to institute or expand their procedures for involving interested parties in their decisions.

Finally, the baseline data suggest clear performance differences between facilities that did and did not have a formal pollution prevention plan in place. Table 1 shows that facilities that had such plans were far more likely to involve their suppliers and customers in pollution prevention initiatives, to consider pollution prevention in product design and business planning, to use materials accounting, to have pollution-prevention teams and training, and to reward their employees for pollution-prevention initiatives. These differences support Klassen and Whybark's speculations (1999) concerning the possible value of management systems for promoting pollution prevention. They also suggest the potential for similar differences between facilities that do and do not implement formal environmental management systems.

[Table 1 about here]

VI. Preliminary Results (2): What Motivates Facilities to Adopt a Certified EMS?

Analysis of preliminary data on EMS content and design processes also suggests interesting and useful findings. Based on data for 31 of the 50 facilities, we examined responses to the question of what factors had greatest importance in their decision to adopt a formal EMS. Possible answers included a parent company requirement for EMS adoption; pressure from regulators, customers, shareholders, or others; expectation of benefits, such as increased revenues, reduced costs, better insurance rates, regulatory benefits, competitive advantage, or value as a marketing or public relations tool; a desire to improve environmental performance, or to advance the facility's own environmental principles; a desire to improve employees' participation in environmental management; a desire to improve regulatory compliance; or the fact that government assistance made EMS adoption attractive. Each possible motivation was ranked high, medium, low, or not applicable by each responding facility; results are shown for the percent of facilities that ranked each factor as of "high" or "medium" importance..

Figure 1 highlights the results. Overall, improved environmental performance and compliance assurance were the two strongest motivating factors, with cost reduction and consistency with the organization's principles next; competitive advantage and regulatory benefits also were considered important by nearly three-quarters of the facilities, and enhancing employee participation by more than two-thirds; all other factors ranked considerably lower.

[Figure 1 about here]

A second question that can be asked of these data is whether business and government facilities have different motivations for EMS adoption. Figure 2 shows the results, which reveal some clear differences. For businesses, improving environmental performance was clearly the motivation most frequently asserted as important, followed closely by cost reduction and compliance improvement. For non-market organizations such as government facilities, in

contrast, compliance was the most important motivation, followed by consistency with principles; cost reduction was considered important by only 40 percent.

[Figure 2 about here]

Third, we examined whether customer and/or shareholder pressures were important factors in EMS adoption, and Figure 3 shows the results. For all facilities these were less important influences than those shown in Figure 1, but they varied significantly by size of facility and by whether the facility participated in foreign markets. Large facilities most frequently cited customer pressures as important, but interestingly, they were far more often concerned about pressures from domestic customers than from international customers or shareholders. Medium-sized facilities on the other hand were less concerned about such pressures generally, but were slightly more often concerned about international than domestic customers; and the small facilities among our respondents were almost equally often concerned about domestic customers but not at all about international ones. Interestingly, concern about both types of customers was centered in facilities that were active in foreign trade; for those that were not, neither type of customer pressure was perceived as important.

[Figure 3 about here]

Finally, we analyzed the importance of government assistance to different sizes and types of facilities, and the results are shown in Figure 4. Clearly government assistance was perceived as very important by small businesses and by government (non-market) organizations, and it was also perceived as distinctly more important by facilities that were not active in international trade and by those that were not part of a larger organization. This tends to confirm the importance of federal and state pilot assistance programs in helping these sorts of organizations, particularly small businesses and government facilities, to develop EMSs.

[Figure 4 about here]

VII. PRELIMINARY RESULTS (3): OTHER ASPECTS OF EMS DESIGN

We also have done more detailed analysis already on EMS design and implementation from eighteen facilities whose initial data were relatively complete, representing eight industrial sectors in nine states. These first impressions suggest potentially interesting findings if they hold up across larger numbers of facilities.

First, the responses appear to show that while not all facilities reported direct economic net benefits from EMS adoption, most believed that it had been a worthwhile process, and several explicitly stated that it had been sufficiently valuable that they would do it again even though it might not pay for itself on any strict economic basis.

Second, almost all of the facilities used the EMS design process as an opportunity to investigate thoroughly all activities and areas of their facilities, and to identify those that would have a potential impact on the environment. If there were any exceptions it was those facilities that relied too heavily on readily available, generic aspect and impact checklists rather than

designing a specific process for their facility, and thus bypassed part of the critical thought process of identifying their own distinctive aspects and impacts.

Third, most of the facilities also developed a formal system to evaluate the environmental aspects and impacts of their processes, and were quite creative in the use of those systems to determine significance. However, most used these rating-system outcomes only as a starting point for more judgmental decision processes, and a sizeable number of facilities explicitly gave greater weight to legal and compliance issues so that regulatory compliance remained a primary priority.

Fourth, most EMS design teams were headed by the facility environmental manager, and were composed primarily of other environmental and engineering staff. They occasionally included consultants and representatives of senior management as well, but rarely either hourly employees or external stakeholders. However, those facilities that did involve a wider variety of employees in EMS development reported a significant additional benefit from the process, namely a heightened and more widely shared awareness of environmental issues among employees, and a shared vision for addressing them.

Finally, over half of these initial 18 EMSs had just been developed during the past year as part of a state pilot project, and most of them set only a small number of short-term objectives and targets focused on compliance and/or pollution prevention.[25] In contrast, at least four of the facilities—those that had already prepared EMSs on their own, and had had them in operation for at least three years—exhibited objectives and targets that were far more varied and more integral to the facilities' long-term environmental plans.[26] For example, one facility with a pre-existing ISO-14001 certified EMS had explicitly incorporated principles of environmental sustainability into its EMS, and in so doing had shifted its emphasis from short-term compliance improvements to long-term product stewardship. It will be important to observe whether the newly initiated EMSs of pilot facilities evolve in this way over time as well, or whether state assistance proves to have been a structurally biasing incentive in favor of emphasizing short-term compliance improvement over other potential EMS priorities.

VIII. FURTHER RESEARCH PLANS

During the coming year, as the EMS design data are completed, UNC and ELI will begin to produce research analyses and findings on several issues that are of immediate interest and importance to public policy, business, and environmental stakeholder groups. These include five main questions.

First, what are the most interesting similarities and differences among the EMSs themselves? How do they differ in scope—facility-wide, or merely selected operations? How do they differ in priorities, such as improving compliance, improving regulated performance beyond

[25] Interestingly, one facility even included objectives and targets that had already been reached before the EMS was complete—perhaps to use early and easy successes to build momentum for further implementation, or perhaps simply to use the EMS document for good public relations.

[26] Two of the eighteen addressed product stewardship, two others included the development of employee environmental awareness programs as specific objectives and targets, and one incorporated an objective to design and implement an environmentally friendly cleaning program.

compliance, or improving non-regulated aspects of environmental performance? How do they differ in goals, objectives, and targets—how far and how fast do they choose to push themselves to improve? Are there patterns of difference by sectors, facility size, public versus private ownership, or other factors? And finally, is the EMS systematic and strategic in the goals and targets it recommends, or merely incremental and ad hoc?

Second, what difference does the EMS design and implementation process make? Who decides to do an EMS, and what the process and its goals will be, and with what expectations for it? Who participates: is it just the Environment, Health and Safety Office, or a small but broader core team, or does it also include other employees, consultants, outside stakeholders and community representatives, state technical assistance staff, third-party auditors, or others? What differences in the EMS content and outcomes result from differences in the process and participation by which it is created?

Third, what benefits and costs do the staff of participating facilities perceive from EMS implementation so far? How well are the costs and benefits tracked, and how comprehensively documented? Are there any unexpected benefits or costs? Do participants generally agree on these, or are there important differences in their perceptions? Do they consider the costs as worthwhile and justifiable in relation to the benefits gained? Why or why not?

Fourth, what differences do state or federal pilot programs make to these outcomes? Are state assistance or incentives an important factor in EMS content and outcome, and if so, how do they change the results? Are these programs producing benefits commensurate with the special allocation of staff effort and costs to them? What kinds of benefits: better environmental performance, or reduced state monitoring and enforcement costs, or improvement of regulatory processes, or improvement of regulatory relationships, or others? And so on.

Finally, what motivates facilities to adopt a formal EMS, given the considerable cost and effort necessary to do so? Who makes such decisions, what factors lead them to do so, and are these motivations similar or different across different sizes and characteristics of facilities: for instance market businesses versus government agencies, facilities that are or are not active in foreign trade, facilities that are or are not parts of larger organizations, and other characteristics?

Once the update data are collected on post-EMS adoption performance, we shall also be looking at additional questions. First and most important, what differences in actual results can be documented: what changes in environmental and economic performance, in regulatory compliance, in pollution prevention measures, and in relations with their workers, communities, and other stakeholder groups?[27] Second, what are the benefits and the costs, to the facility, to government, and to the public? Third, what differences do both state assistance and third-party certification make? And fourth, what evidence is there of continuing improvement over time, or alternatively of any slackening of commitment that might occur after the initial implementation process?

IX. LIMITATIONS

27 For instance, what additional benefits and costs result from involving interested outside stakeholders in the EMS process, and how does the involvement of both inside and outside parties change as a result of the adoption of an EMS?

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 so far of a heterogeneous set of approximately 60 facilities, enough to document many important similarities and differences but not enough to produce statistically conclusive generalizations about entire industrial sectors. All the facilities also are necessarily volunteers, which almost certainly implies an upward bias in the sample. 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.[28] Finally, on many questions the data report the perceptions and assertions of individuals in each facility, not all of which can be independently verified with documentary evidence: these are judgments of particular individuals, albeit individuals responsible for the EMS implementation process and carefully quality-checked with them.

Second, in this type of research the research process and protocols themselves may influence the EMS implementation process in directions other than those the facility would have pursued on its own. For instance, to what extent does state technical assistance to pilot facilities influence them to focus more on compliance and pollution prevention than on unregulated aspects such as energy or water conservation, product stewardship, or others? To what extent does even paying attention to our research protocols redirect their emphasis to the kinds of factors we are asking them about, at the expense of others? Some influence is probably unavoidable, but it is a particular challenge to our aspirations to draw conclusions from these data that might also be applicable to other facilities implementing EMSs on their own.

Third, some of the data could perhaps provide clues to confidential business information about competitive processes. Participating facilities have been extremely generous about sharing data with us, but in at least some cases they have found it necessary to withhold some data to protect confidential business information.

Fourth, facility-level data do not by themselves answer all important questions about the value and effectiveness of EMSs. The questions we are investigating in these facilities should certainly be replicated for additional comparison groups of facilities, and should also be augmented with more detailed on-site case studies. They should also be replicated for facilities in other countries, to compare national and cultural differences in the uses of these procedures. Some of these could well be different facilities of the same parent corporations; others should be facilities that do not share that common influence, and which might therefore reveal important differences in processes and outcomes rooted in different national jurisdictions, economic systems and cultures.

Additional questions should also be studied concerning corporate-level use of EMSs. For instance, are EMSs used by firms to make strategic decisions? If so, how? Are there strategic

[28] 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 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 the study so far: one hope for the future is to obtain data from a comparison group of compliance-mandated EMS adopters. Given these issues, we have conducted careful baseline data collection over several prior years to distinguish more carefully between facilities that were already high environmental achievers and those that were not.

motivations for introducing consistent types of EMSs throughout an entire corporate structure, or even to its suppliers and/or customers as well? What is the impact of EMS implementation on customers? On suppliers? Do such initiatives facilitate additional or different benefits from those available at the facility level alone? Examples might include changes in corporate-level cost accounting systems to allocate environmental costs more explicitly to specific activities that generate them ("activity-based costing"), which could not be altered at the facility level alone; or changes in the strategic configuration of an entire firm to achieve pollution-prevention efficiencies among wastes from some divisions and inputs to others.

Longer-term research is also needed concerning the stability or evolution of EMS goals and commitments over time, and particularly through changes in personnel and in organizational ownership and control. A stated commitment of EMS adoption is to continuous improvement in environmental performance. However, it is also possible that such commitments would not survive either the replacement of the individuals who made and implemented the original commitments, or changes in competitive pressures in either product or investment market conditions, let alone the changes in priorities and internal organization that often accompany a corporate takeover or buyout (or in the case of a public-sector facility, a change in elected political authorities). These issues need careful and ongoing study if EMSs are to be trusted as a "voluntary" approach to achieving public environmental goals.

Yet another set of questions concerns the process of third-party auditing and certification. What is the competence of the providers of these services? What standards and criteria do they use to support or withhold certification? How consistent are these criteria across certification providers? And what are the practical incentives to these firms to apply stringent or lenient standards for certification, and the resulting dynamics of the third-party certification services industry over time?[29]

Finally, important public policy questions also need to be evaluated in the context of EMS implementation. For instance, what sorts of regulatory flexibility might prove appropriate in the context of an effective EMS, and with what conditions? How should agencies judge whether an EMS qualifies a firm for regulatory flexibility? How do EMSs fit into the broader environmental policy debate over requirements for scientific and economic justification of regulatory policy? And do government, business and interest groups act and interact more or less productively in EMS implementation processes than they do in regulatory proceedings? What lessons does this offer for policy and procedural improvements?

All these questions offer promising and timely opportunities for research on EMS-related phenomena. The NDEMS database offers a valuable starting point for many of them, and we welcome interaction both with other researchers interested in using it and with those studying other related questions.

X. CONCLUSION

The widespread introduction of formal environmental management systems into the practices of businesses that affect the environment offers a unique opportunity to observe both

[29] The National Academy of Public Administration was concurrently conducting such a study in 2000-01, with support from the U.S. EPA.

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 motivations that contribute to the facility's decisions to voluntarily reduce its environmental impacts, both regulated and non-regulated, is critically important to future environmental initiatives at both the state and federal level, both voluntary and mandated. If the findings turn out to support it, 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 that EMSs may identify.

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Table 1. Association of Pollution Prevention Plans with Pollution Prevention Activities

Effects of Pollution Prevention Plan

• Total with/without	23 facilities	vs.	19 facilities
• Involve suppliers in P2	78%	vs.	42%
• Involve customers in P2	52%	vs.	42%
• P2 in product design	61%	vs.	42%
• P2 in business planning	57%	vs.	26%
• Materials accounting used	78%	vs.	47%
• P2 teams used	57%	vs.	32%
• P2 training provided	70%	vs.	26%
• Reward employees for P2	48%	vs.	26%

Figure 1. Seven Highest Motivations for EMS Adoption (N=31 Facilities)

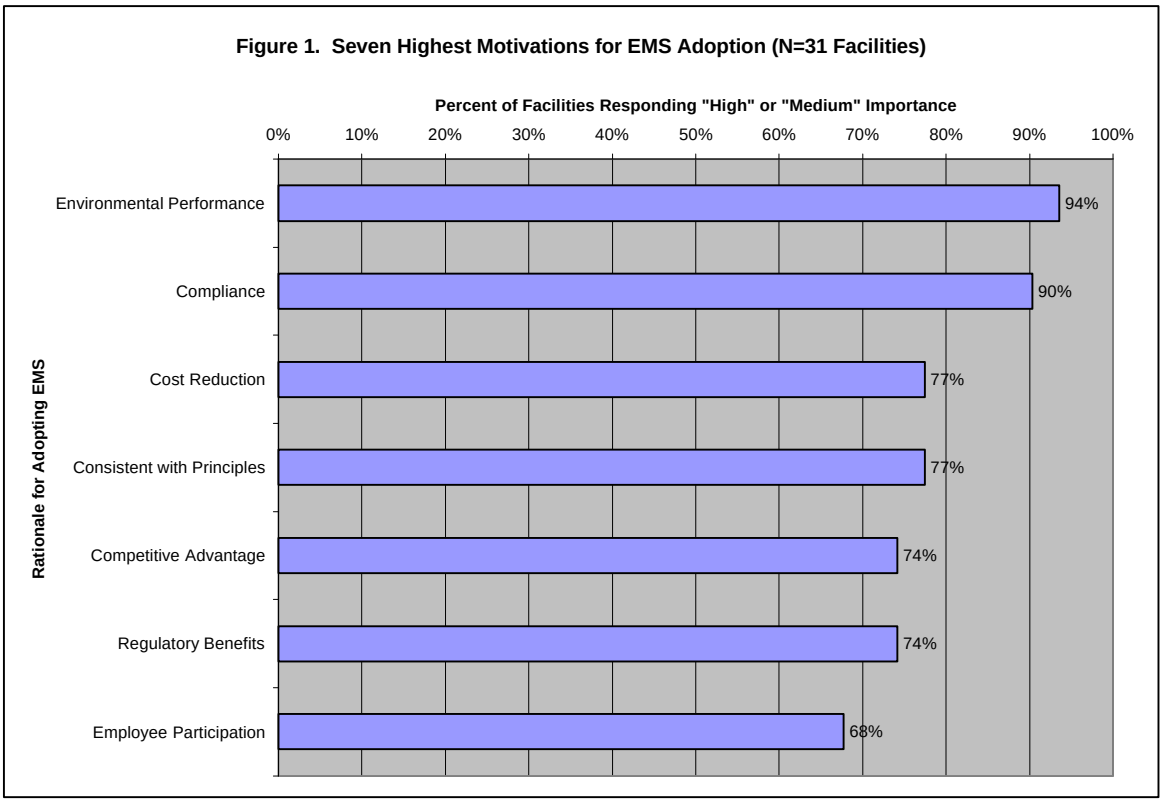


Figure 2. Differences in Motivation for EMS Adoption by Market vs. Non-Market Organizations

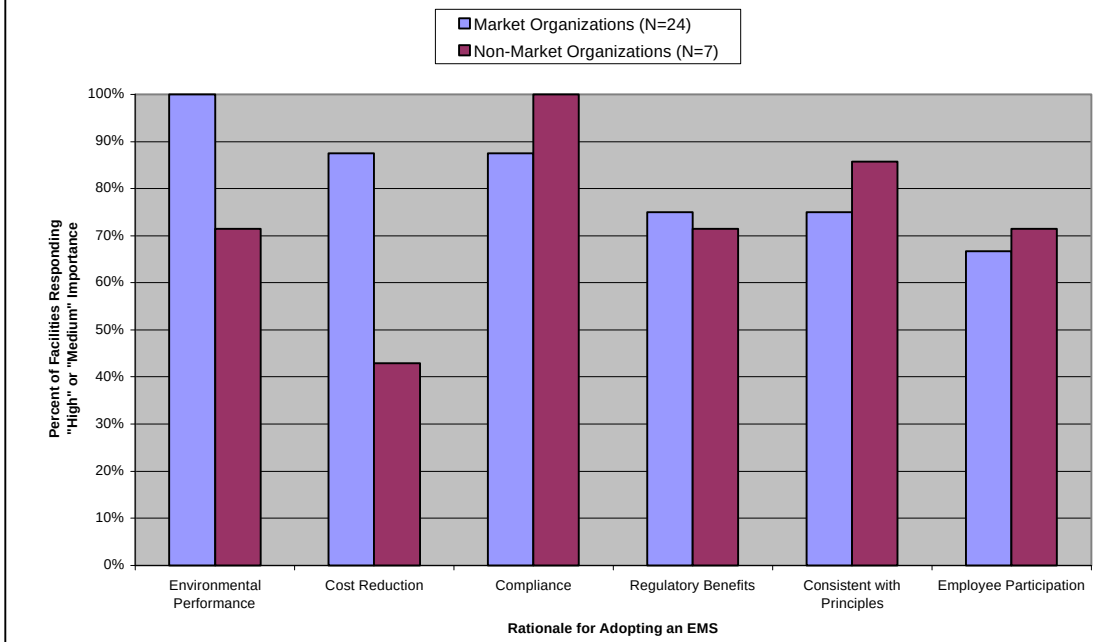


Figure 3. Importance of Customer and Shareholder Pressures in EM S Adoption

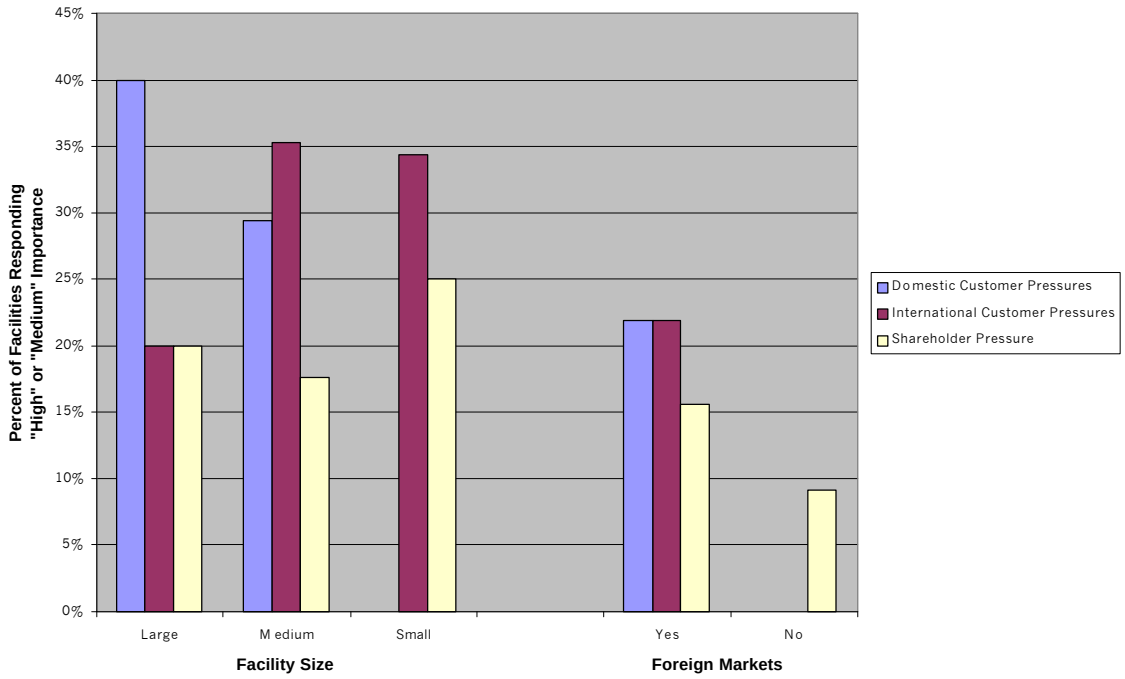
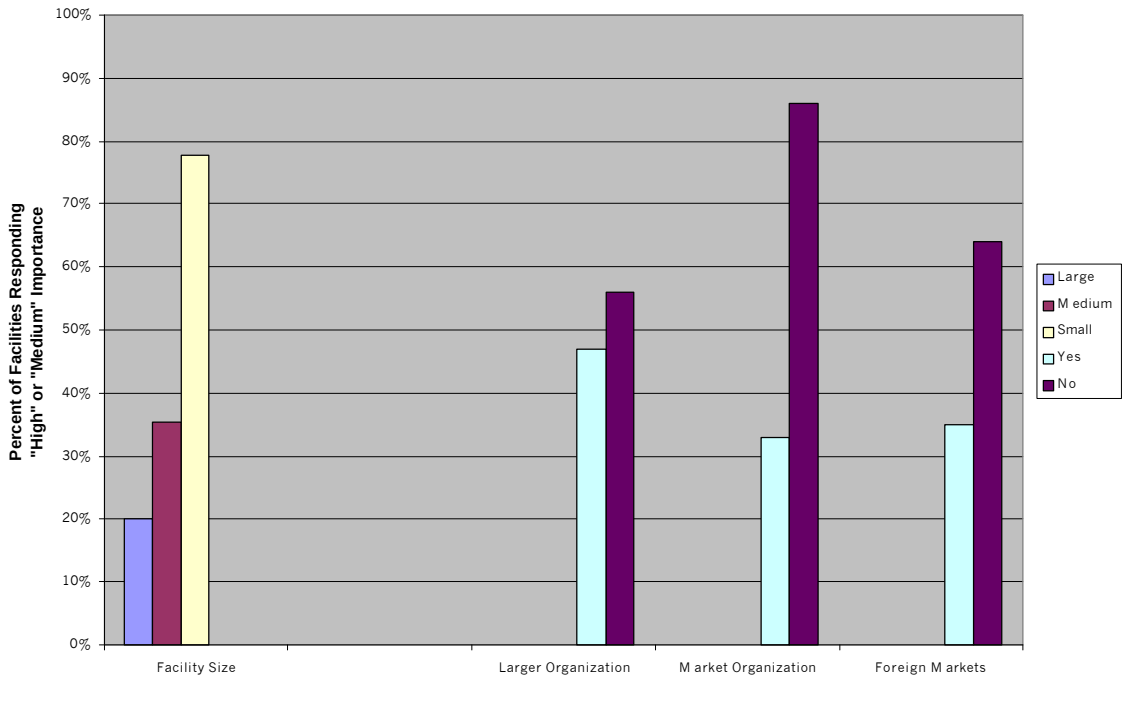


Figure 4. Importance of G overnment Assistance in EM S A doption, by Facility Size and Type



EMS IMPLEMENTATION IN PRACTICE

Environmental Management Systems: Opportunities for Improved Environmental and Business Strategy? [30]

May 2000

Nicole Darnall, Deborah Rigling Gallagher, Richard N. L. Andrews, and Deborah Amaral[31]

ABSTRACT

Less than four years after publication of ISO 14001, thousands of organizations worldwide have adopted the standard. In this article, researchers working with the National Database on Environmental Management Systems (NDEMS) review some preliminary data on organizations' experiences with EMS adoption and implementation. Their findings indicate that, although organizations may face hurdles in implementing EMSs, the majority believes the benefits outweigh the drawbacks. © 2000 John Wiley & Sons, Inc.

I. INTRODUCTION

The widespread adoption of formal environmental management systems (EMSs) by businesses and other organizations has the potential to alter profoundly both their environmental and economic performance, and their resulting relationships with suppliers, customers, employees, and environmental regulatory policies and agencies. Since the 1970s, many businesses have developed their own environmental management procedures, although environmental management largely remained the responsibility of a single manager who was responsible primarily for regulatory compliance and risk minimization, rather than an organization-wide mission for which all managers would be held accountable. In late 1996, however, the International Organization for Standardization published the final version of an international voluntary EMS standard, called ISO 14001. Since then, businesses are increasingly adopting ISO 14001 and other types of EMSs so that they may better integrate environmental considerations throughout their operations in order to more effectively and efficiently manage their environmental impacts.

An EMS is a formal set of procedures and policies that define how an organization will manage its potential impacts on the natural environment and on the health and welfare of the

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people who depend on it. It creates a system to assess, catalogue, and quantify facility environmental impacts, not simply activity by activity, but throughout the entire company. The goal of EMS adoption is to help organizations ensure that their operations comply with environmental laws and that major environmental risks, liabilities, and impacts are properly identified, minimized, and managed. An EMS supplies the framework to do so by creating a structure to adopt a written environmental policy; to identify environmental aspects and impacts of their operations; to set priorities, goals and targets for continuous improvement in their environmental performance; to assign clear responsibilities for implementation, training, monitoring, and corrective actions; and to evaluate and refine implementation over time so as to achieve continuous improvement both in implementation of environmental goals and targets and in the EMS itself.

Once a facility implements its EMS, in theory, it will not only be in conformance with all environmental regulations, but it may also surpass the regulatory standards for many environmentally regulated activities and identify opportunities for reducing non-regulated environmental impacts of its activities as well. Facilities that adopt EMSs and are able to reduce their environmental impacts beyond regulatory standards may also lessen their environmental reporting burdens and the costs associated with them. In doing so, businesses may redesign their operating structure, substitute unregulated inputs for regulated ones, and eliminate some regulated processes altogether so that they may no longer be subject to costly regulatory mandates. In the process, it is likely that facilities will discover new opportunities to prevent rather than merely control their pollution, and to reduce wasteful uses of resources, thus saving money while improving the environment. They may also discover opportunities to manage their organizations as a whole more effectively.

Since its development in 1996, over 10,000 facilities worldwide have had their EMSs ISO 14001 certified. In the U.S., certification has also expanded rapidly, from 169 facilities in 1996-98 to approximately 400 facilities by fall 1999; within the next year this number is expected to increase by approximately 50 percent more. But, while facilities are adopting ISO 14001 at a rapid pace, little is known about them or about why the voluntary environmental management standard is being adopted at all. This article identifies some of the reasons why facilities are implementing ISO 14001 EMSs based on preliminary information from nineteen facilities as the results from two more detailed case studies.

II. WHY ARE FACILITIES ADOPTING ISO 14001 EMSS?

Some businesses have experimented with EMSs for many years. Companies such as 3M and IBM, for example, each began implementing portions of their EMS over 25 years ago. Yet, prior to 1996, there was no major trend toward widespread adoption or standardization, perhaps due to a lack of international acceptance and understanding of the economic rationale. Publication of the ISO standard, however, changed this trend, as it generated great interest in the business community. While it is still speculative what factors motivate facilities to adopt ISO 14001, there is some preliminary evidence that suggests that international trade influences, supplier preferences, public relations pressures, customer preferences, shareholder interests, environmental performance factors, compliance pressure, and other motives may play a part.

Additional time is needed, however, to more fully research these topics as systematic inquiry remains in its infancy.

The preliminary evidence indicates that business interest in ISO 14001 EMSs is particularly notable in several international markets such as Europe and Asia, where certification may in the future be viewed as a prerequisite for trade. For this reason, many U.S. multinational corporations are interested in the potential ISO 14001 may have for their ability to operate in international markets. In some European markets, for example, trade preference is given to facilities that adopt the European version of a certified EMS, called EMAS, the Eco-Management and Audit Scheme.

U.S. firms that operate domestically also have shown interest in ISO 14001, and in its impact on their supplier relationships as well as the purchasers of their goods. Some business purchasers and government procurement officers already require that ISO certified organizations receive greater preference than non-ISO certified firms in their purchasing decisions, as these firms may signal their explicit commitment to systematic environmental management and continuous improvement in their environmental performance. General Motors, for example, has announced that it will require all its suppliers to adopt ISO 14001 EMSs by December 31, 2002. Similarly, Ford Motor Company has mandated that all its suppliers be ISO 14001 certified by July 1, 2003. Widespread company mandates such as these have the potential to profoundly impact supply chain relationships.

In addition to affecting facilities' operations management, the preliminary evidence shows that ISO 14001 EMSs have the potential to influence other aspects of company operations, including consumer and public relations. Over the last 10 years, consumers have increasingly demanded environmentally friendly products. Estimates of the sale of "green" products are over $120 billion per year and expected to reach $200 billion per year by the end of the decade (U.S. EPA 1990). Following this trend, more than 75 percent of U.S. consumers consider a company's environmental image in their shopping decisions (Kleiner 1991). Consistently, consumers attest that the environment, broadly defined, is near the top of the list of public concerns (Portney 1993). Facilities that are ISO 14001 certified may better satisfy these consumer demands for environmentally conscious products. Moreover, ISO 14001 facilities may be better positioned to market their products as environmentally friendly and bolster their environmental reputation. Each of these factors may grant ISO certified firms a competitive advantage and help them to reap greater financial rewards than their non-certified competitors.

Increased product sales, consumer satisfaction, and environmental efficiency may also translate into increased shareholder gains. As the ultimate owners of a corporation, shareholders stand to profit by a company's good environmental deeds. Because ISO certified facilities have in place a system that over time has the potential to reduce their environmental impacts (as well as their related health and safety liabilities) and bolster the facility's public image, although yet proven, they may experience enhanced financial performance at rates that exceed those of non-certified facilities.

There are additional potential financial impacts to facilities that adopt ISO certified EMSs. The ISO standard requires a procedure for identifying and complying with regulations.

So, in theory, a facility that adopts an ISO 14001 EMS will comply with all environmental regulations and reduce its emissions well below the regulatory standards thresholds, thus lessening its environmental reporting burdens and the costs associated with them.

Other preliminary evidence shows that businesses consider ISO 14001 certification as an opportunity to send a strong signal to regulators about their commitment to minimize their impact to the natural environment. If compliance is ensured, then facilities that adopt a certified EMS have minimal threat of punishment by regulators. For this reason, U.S. environmental regulators are trying to evaluate the businesses that adopt these systems to determine their potential for future public policy.

III. NATIONAL DATABASE ON ENVIRONMENTAL MANAGEMENT SYSTEMS (NDEMS)

Over the past three years, the U.S. Environmental Protection Agency (EPA) and ten Multi-State Working Group on Environmental Management Systems (MSWG) states have provided technical assistance, financial grants, enhanced publicity, and regulatory flexibility in various forms to 70 to 100 pilot facilities that adopt ISO 14001-based EMSs. In exchange, the pilot facilities have agreed to provide data on their EMS development process, as well as on their pre- and post-implementation performance, to the National Database on Environmental Management Systems (NDEMS).[32] The development of this database, which is a joint research effort between the University of North Carolina at Chapel Hill (UNC) and the Environmental Law Institute, is funded by the U.S. EPA. The pilot facilities and NDEMS offer a rare opportunity to study the EMS implementation processes and to identify the effects of EMS adoption on facility performance in real time.

NDEMS will include EMS implementation data from the pilot facilities plus approximately 20 non-pilot "control" facilities, all of which are using identical data collection protocols. The NDEMS data will help to determine the effects of ISO 14001 and other EMSs on five kinds of outcomes: on environmental performance; on regulatory compliance; on pollution prevention; on engagement with stakeholders; and on economic performance.

IV. EMS ADOPTION IN PRACTICE: PRELIMINARY RESULTS FROM TWO CASE STUDIES AND NINETEEN NDEMS FACILITIES

Already, preliminary NDEMS data on EMS design and implementation have been analyzed from two in-depth case studies, "Alpha Manufacturing" and "Beta Municipality".[33] They are supplemented by NDEMS data from nineteen facilities that represent eight industrial sectors in ten states.

The preliminary results show that in contrast to early presumptions that only by larger transnational corporations would adopt EMSs, in fact they are being implemented by facilities of

[32] All information about the database may be found on the Internet at http://www.eli.org/isopilots.htm, including the research protocols, periodic public reports, and other papers, guidance, and policy documents. In the future, the database itself will be available at this site once the data are quality checked and the sample size is of adequate size.

[33] A full summary of these case studies will be available in spring 2000 at the National Database on Environmental Management Systems' homepage at http://eli.org/isopilots.htm. Because of the anonymity agreement between UNC and each of the NDEMS facilities, all facility names have been changed to protect their identity.

all sizes and in many sectors. The first case study, Alpha Manufacturing, is an example of one of these smaller facilities.

Case Study 1: Alpha Manufacturing

Employing less than 100 full-time employees, Alpha is a privately held manufacturing facility located in the Midwest. It has been in operation since the early 1980s and is a Tier I supplier to the automotive industry. Prior to adopting its EMS, Alpha participated in both U.S. EPA's 33/50 Program (which helped it to voluntarily reduce its toxic chemical emissions) and EPA's Common Sense Initiative, and had in place both a pollution prevention plan and a waste minimization plan. Its management systems were recently certified to ISO 14001, ISO 9000, and QS 9000.

Several factors influenced Alpha's decision to adopt an ISO 14001 EMS. First, because of the facility's strong presence in its surrounding community, Alpha decided ten years ago that it should strategically reduce its emissions levels far below legal compliance thresholds. As part of its progression in better environmental management, adopting an ISO certified EMS represented the latest action in a series of activities to both "do the right thing" and help the facility to move beyond compliance. Alpha is not alone in its direction. Indeed, over half of the nineteen facilities that have submitted preliminary data to NDEMS report that one of the most important factors that contributed to their decision to adopt an EMS is to improve facility compliance with environmental regulations.

Alpha's suppliers also influenced its decision to adopt an ISO 14001 EMS. Because the automotive industry and other Alpha customers were increasingly asking it to audit its quality and environmental procedures, Alpha believed that obtaining both ISO 9000 and ISO 14001 certification would be beneficial. These systems were adopted concurrently, as the facility estimated that only a marginal level of additional effort would be required for Alpha to adopt ISO 14001 at the same time as it implemented ISO 9000 and QS 9000. It took Alpha approximately eighteen months to design and implement its ISO 14001 EMS and obtain certification.

Alpha's EMS adoption process was not easy and it encountered several hurdles, which are likely to be shared by other small manufacturing organizations. The first was related to the ISO 14001 framework itself. Alpha managers found it very difficult to navigate through the standard and to translate the ISO 14001 language into action. For this reason, it had to look outside its organization and hire a consultant to provide the expertise it needed. Alpha attests, however, that the investment in consultant expertise was a wise decision because the individual provided Alpha a bridge between the ISO 14001 standard and EMS design and implementation. Like most of the nineteen facilities that submitted their preliminary data to NDEMS, Alpha developed a formal process, which was tailored to its operations, and evaluated the environmental aspects and impacts of its processes. Its consultant created the structure for this process. The environmental evaluation was perhaps the most difficult part of Alpha's EMS adoption, requiring months of discussions, meetings, rankings, and assessment. While Alpha's managers describe its operations over the last ten years as environmentally progressive, never before had they evaluated all aspects of the facility's operations and their impacts on the natural environment, determined their significance, and set goals to address them. The task was arduous

and often resulted in Alpha managers engaging in heated debates, which their consultant moderated. Indeed, Alpha believes that if not for its consultant, its EMS design process would have been greatly extended.

The second hurdle that affected Alpha's ISO 14001 adoption was gaining mid-level managers' commitment to implementing an EMS. From the onset, mid-level managers were hesitant to allocate the staff time that was necessary to implement Alpha's EMS. They believed that Alpha's expected implementation costs exceeded its anticipated benefits. In fact, if it were not for the owner's insistence that Alpha adopt ISO 14001, the facility most likely would not have implemented a formal EMS. Alpha managers' skepticism remained until the facility began its EMS implementation. Managers who were otherwise critical became supportive when they were involved in identifying Alpha's environmental aspects and impacts, determining their significance, and setting its objectives and targets. Support for the system occurred in part because management gained ownership in the design process. Moreover, once mid-level managers progressed through the process of designing Alpha's EMS, they achieved a better understanding of how the facility's environmental management could be improved further.

While Alpha says that adopting an ISO 14001 EMS was a challenge, it also asserts the benefits of its implementation. By far the greatest benefit that Alpha professes is related to the EMS design process itself. It states that designing and implementing ISO 14001 vastly improved the shared employee understanding of the impacts of Alpha's manufacturing activities on the natural environment. Such an understanding has facilitated Alpha's ability to supplement its traditional environmental management practices so that it can continually improve its operations. By improving employees' shared understanding of its environmental goals, Alpha believes that it is better positioned to further minimize its impact on the natural environment.

Other Alpha benefits related to the EMS adoption process include developing a written environmental systems manual. Prior to designing its manual, which is a requirement of ISO 14001, Alpha's environmental policies and programs were not well documented (if at all) and had little formality. The documentation process also prompted Alpha to formally commit to a continual improvement of its environmental management. Such a result, Alpha argues, should not be discounted. While Alpha committed itself over a decade ago to go beyond the regulatory thresholds for environmental compliance, the continual improvement requirements of ISO 14001 has tested Alpha's current management practices and challenged its managers to improve upon them.

While Alpha does not currently report a direct economic net benefit from its EMS adoption, the facility did not anticipate such benefits when it decided to adopt ISO 14001. And Alpha is not alone. Of the nineteen facilities that have provided preliminary NDEMS data, approximately one-third indicate that economic considerations (i.e. reducing their costs and improving revenues) did not influence their decision to adopt their EMS. Rather, non-economic considerations such as improving facility public relations, environmental performance, compliance with environmental regulations, and others played a greater role. Such findings are particularly interesting as they contrast with early presumptions that facilities would adopt EMSs in order to improve their direct economic net benefits. For Alpha, however, a direct financial payoff will likely occur in the future as its customer demands have recently shifted. That is, two

of the big three automobile makers have mandated that all their suppliers (including Alpha) be ISO 14001 certified in the next two to three years in order do business with them.

Finally, Alpha managers state that after considering their adoption hurdles, they would implement one again even though it may not pay for itself in the short-term on any strict economic basis. This is true, too, for most of the nineteen facilities that submitted preliminary data to NDEMS.

Case Study 2: Beta Municipality

In contrast to Alpha Manufacturing, the second case study, Beta Municipality, profiles a large municipality with five departments, several subdivisions, and over 1,000 employees. It is located in the Southwest in an urban/suburban area that, in the last ten or more years, has experienced higher-than-average growth levels. Such growth is placing increasing demands on the municipality's operations and its ability to manage its environmental impacts.

Prior to adopting its EMS, Beta participated in both U.S. EPA'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 helped the municipality to develop a framework to evaluate its health and safety issues on an integrated, citywide basis. This framework facilitated an easier EMS implementation at Beta as the integrated EMS structure was familiar to employees and recognized to produce meaningful results.

Unlike Alpha, Beta Municipality adopted its EMS with government support. If not for the support from the U.S. EPA's EMS Municipality Project, Beta states that it probably would not have adopted an EMS. For municipalities, Beta argues, there are fewer reasons to implement an EMS because they 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 which is urging EMS adoption. Beta maintains that the U.S. EPA project served as its market driver by providing both the financial and technical support that made its EMS adoption feasible.

There were, however, other factors that 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. In regards to its historical environmental management, the municipality is still in the process of managing its previous environmental errors which occurred over twenty years ago. In the early 1980s, part of Beta's operations became a U.S. EPA Superfund site. This site and the slow remediation of it has strained Beta's relationships with both the state and federal government, as well as its public critics. In considering this issue, Beta's top management believed that the municipality would be better equipped to preclude future compliance problems, avoid repeated mistakes, and improve its stakeholder relationships and relationships with state and federal regulators if it adopted an EMS.

Another factor that contributed to Beta's decision to adopt an EMS was its desire to maintain a low "risk profile", which is an important performance indicator of the municipality's operations and management. As part of this issue, Beta was concerned about avoiding any

catastrophic environmental events and taking a proactive risk management approach rather than a reactive one. Beta's top management believed that adopting an EMS was consistent with this proactive approach.

Finally, Beta has had a long history of innovation. Its "corporate" culture involves trying new management approaches in order to improve upon its current operations. For Beta, EMS adoption was a logical next step in its environmental management strategy.

Like Alpha, Beta's EMS adoption process was not easy. It encountered several hurdles, which are likely to be shared by other large organizations. Bureaucracy associated with Beta's large operating structure and numerous departments and divisions created an atmosphere of inertia and resistance to change, and was perhaps the greatest barrier for it to overcome. With any entity this size, communication among the various departments was not consistent and managers often disagreed with one another. In order to transcend its inertia, Beta had to convince its mid-level management that allocating their employees' time to adopting an EMS could benefit both Beta and their department's long-term operating goals. In doing so, Beta used the EMS design process, like Alpha, as an opportunity to thoroughly investigate all organizational activities to identify those that would have a potential impact on the environment. By involving mid-level management in this process, Beta gained their support for the outcomes and for the EMS itself.

Similar to Alpha, Beta had difficulty decoding the ISO 14001 framework. Even though Beta is not ISO 14001-certified or seeking certification, it turned to the standard for assistance in developing its EMS because of the legitimacy ISO 14001 has among businesses and regulators. Beta found, however, that ISO 14001 was difficult to apply to Beta's operations. Beta believes that this difficulty stemmed from the standard's focus, which is at the facility-level and most applicable to manufacturing entities that produce a single type of "product." Beta Municipality, however, is a large organization that creates numerous, diverse goods for public consumption, with customers who are taxpayers rather than discriminating consumers. For this reason, Beta's managers argue that public sector operations will likely have more difficulty implementing ISO 14001 than will other types of businesses.

A final and very important hurdle for Beta to overcome became apparent when its divisions began to design and implement the EMS. The specialized language of the ISO 14001 standard (e.g. aspects, impacts, significance, objectives, and targets) and EMSs in general was difficult for its division employees to understand. The result was several unproductive training sessions where much time was absorbed in defining EMS-related terminology and allaying employee anxiety. To overcome this hurdle, Beta had to revise its initial training tools so that technical jargon was removed and replaced with more familiar language and practical examples.

While Beta says that its EMS adoption process was difficult at times, like Alpha, it asserts that the benefits of its implementation were worth the investment. One benefit is that Beta's EMS has enabled the municipality to better evaluate its internal operating processes. As part of its EMS design process, for example, Beta recognized inefficiencies associated with its wastewater discharge process. This evaluation has helped its management understand that the municipality's wastewater and other environmental impacts can be reduced further.

A second benefit of Beta's EMS is that the municipality better understands the high cost associated with its non-regulated impacts. By minimizing its non-regulated impacts, such as paper usage and emphasizing employee recycling, Beta expects that in the future it will more efficiently allocate taxpayers' revenue. For example, as part of its EMS, Beta recently evaluated its copier and printer leasing contracts and discovered areas where additional improvement can be made, especially in its supplier selection. The municipality decided that in the future it will exclusively use suppliers who can provide equipment that minimizes inputs and their related waste production.

A final benefit that Beta hopes to reap, in time, is shifting the municipality beyond a compliance-oriented mode of operation. Doing so will make its environmental strategy more consistent with its proactive risk management policy. Beta hopes that this management shift will also result in better relationships with its stakeholders and federal and state regulators, which as noted earlier have been strained at times in the past.

V. CONCLUSION

Time will tell whether Alpha Manufacturing's and Beta Municipality's EMSs are able to achieve all the goals they have articulated. Interestingly, several implementation hurdles and benefits were common to both organizations. Such results are contrary to conventional thought because the organizations are so very different from one another—Alpha is a small manufacturing company that produces goods for sale whereas Beta is a large municipality that produces goods for public consumption. Both organizations, however, had difficulty navigating the ISO 14001 standard and gaining mid-level managerial support for EMS adoption. The difficulty of translating the ISO 14001 standard into action is likely related to the newness for both facilities of integrating environmental considerations into their management structures. It is this newness that also likely affects managerial support (or lack of it) for adopting an EMS.

Even with all their hurdles, however, both organizations believe that adopting an EMS was a wise decision. While it is still too early to determine whether their environmental performance has improved, one unexpected outcome for these facilities—and for other companies in the pilot program—is the benefit of the EMS design process itself. This process, and especially the assessment of environmental aspects and impacts and determining their significance, while arduous has created a fuller and more widespread employee understanding of the facilities' impact on the natural environment. It has also bolstered employee involvement in the environmental issues that affect their work, and increased employee morale. These benefits, while difficult to quantify, can significantly affect facilities' operations.

Finally, all nineteen facilities (including both Alpha and Beta) report that non-environmental considerations such as meeting customer demands, maintaining a competitive advantage, reducing costs, and improving public relations influenced their decisions to adopt an EMS. While these results are preliminary, as additional data become available, we may find that businesses adopt EMSs for many other compelling reasons that are in addition to environmental improvement.

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ISO 14001: Greening Management Systems[34]

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ABSTRACT

This chapter brings to the fore many issues that have been widely speculated regarding facilities that adopt ISO 14001 EMSs, and validates as well as dispels some of the rhetoric associated with ISO 14001-certified facilities. It discusses three very different manufacturing facilities that have adopted ISO 14001 EMSs, what factors led to the decisions to certify their EMSs, and the internal and external outcomes they have experienced as a result of ISO 14001 certification. The cases illustrate that internal outcomes are surprisingly similar for all three facilities. All of the facilities have increased their employee involvement in environmental management, improved document control and manufacturing efficiency, and increased their focus on non-regulated impacts. Interestingly, the external outcomes due to ISO 14001 adoption have varied more widely across the case facilities, but include improved vendor contracts, increased customer satisfaction, increased ability to market products domestically, increased access to international markets, and some regulatory benefits.

I. INTRODUCTION

A challenge facing U.S. businesses is maintaining their role as technological and manufacturing leaders while protecting the natural environment in which they operate. Increased costs of maintaining environmental compliance, political pressure, and customer and supplier demand have caused hundreds of companies to reevaluate their traditional manufacturing processes and operations. In doing so, businesses are increasingly adopting the global environmental management system (EMS) standard, ISO 14001, to manage their environmental impacts more effectively and efficiently.

An EMS is a management structure that provides facilities and parent organizations with a framework to minimize their environmental impacts, ensure compliance with environmental laws and regulations, and reduce wasteful uses of natural resources. Facilities that adopt EMSs may be better able to redesign their operating structures, substitute their regulated inputs with unregulated (and perhaps less harmful) ones, eliminate some of their processes and waste

[34] This is a preprint of Darnall, N., Gallagher, D.R., & Andrews, R.N.L. (in press). "ISO 14001: Greening Management Systems." In J. Sarkis (Ed.) *Greener Manufacturing and Operations*. Sheffield, England: Greenleaf Publishing, Chapter 12.

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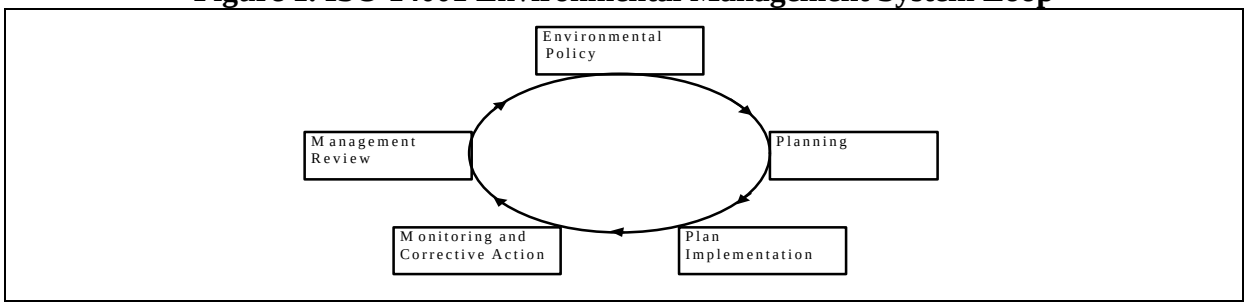
streams altogether, modify their supplier relationships, and implement other changes. As a result, these businesses may no longer be governed by a portion (or all) of the U.S. environmental regulatory system or burdened by its associated compliance costs. Moreover, facilities that adopt EMSs may better prevent the shifting of environmental impacts from one subsystem to another and can redirect their attention instead to their highest-priority overall effects on the natural environment.

Given the focus of this book, this chapter discusses the effects EMSs have on the operations of manufacturing facilities that adopt them. There are, however, many other results that EMSs may yield for facilities themselves as well as for public welfare, stakeholder involvement, public policy, business interactions with environmental regulators, and other equally important outcomes. In this chapter we describe the activities of three facilities that have adopted ISO 14001 EMSs. These facilities were selected because they bring to the fore many issues that have been widely speculated regarding facilities that adopt ISO 14001 EMSs, and validate as well as dispel some of the rhetoric associated with ISO 14001-certified facilities. The cases are illustrated with examples of how each of the three facilities has changed its operating structures, modified its input usage, and adjusted its supplier and customer relationships as a result of ISO 14001 EMS adoption.

II. ISO 14001 EMSs and the National Database for Environmental Management Systems

While many companies have employed EMSs for years, in 1996 the International Organization for Standardization (ISO) created a standardized model for them which was designated ISO 14001. Facilities that wish to adopt ISO 14001 EMSs must consider their environmental impacts and aspects systematically and include five broad components (Figure 1): an environmental policy, an environmental plan, an implementation strategy, monitoring and corrective-action procedures, and management review. ISO 14001-certified facilities are accredited by independent third-party registrars as adhering to the standard's provisions.

Figure 1. ISO 14001 Environmental Management System Loop



During the development of the ISO 14001 standard, many U.S. environmental regulatory agencies became interested in the standard's potential relevance to environmental protection. This interest prompted regulators in a number of states to form the Multi-State Working Group on Environmental Management Systems (MSWG), and in 1997 the U.S. Environmental Protection Agency (EPA) agreed to support a multi-state study in cooperation with the MSWG to

determine how ISO 14001-based EMSs affect the environmental and economic performance of facilities that adopt them. Today, ten states are providing technical assistance, financial grants, enhanced publicity, and regulatory flexibility in various forms to over 70 pilot facilities that are adopting ISO 14001-based EMSs. In exchange, the pilot facilities have agreed to provide data on their environmental and economic performance prior to and after adopting their EMS, as well as information on their EMS design processes, to the National Database on Environmental Management Systems (NDEMS) (see Note 1). NDEMS is a collaborative research effort of the University of North Carolina at Chapel Hill and the Environmental Law Institute in cooperation with the EPA, MSWG, and participating state agencies and facilities.

A subset of the pilot facilities has also agreed to provide in-depth case study information on their rationales for adopting their ISO 14001-based EMS, the EMS adoption process itself, and the benefits and costs of EMS adoption. Each case study is performed in-person and at the facility. Key participants are interviewed who were involved in the facility's EMS design process, as are site executives, to obtain detailed information that is otherwise difficult to elicit in surveys or telephone interviews.

The development of both the case studies and the database offers an unusual opportunity for researchers, the business community, and others to study the EMS implementation process and to identify the effects of EMS adoption on facility performance. Both the case studies and the database also provide information on how ISO 14001-based EMSs affect facilities' manufacturing and operations.

III. ADOPTING ISO 14001: THREE CASE STUDIES

Presented here are NDEMS case studies of three manufacturing facilities and the effects their ISO 14001 EMSs have had on their manufacturing and operations: "Delta Electronics," "Alpha Manufacturing," and "Epsilon Systems" (see Note 2). These cases shed light on the ISO 14001 EMS adoption experience, the types of facilities that adopt them, and the reasons for EMS certification.

Delta Electronics is the first case facility. What is distinctive about Delta is that it has had in place an EMS for nearly 25 years. Then in 1996, after weighing its options, Delta decided to certify its EMS to ISO 14001. Delta is what some may argue to be the stereotypical ISO 14001-adopting facility, because it is quite large and is part of a multinational corporation with many resources available to it. Also, Delta has sought for many years to manage its environmental impacts proactively.

Alpha Manufacturing is an interesting second case because it illustrates a non-typical ISO-adopting facility. Alpha is a small, single-facility manufacturing firm that is family-owned and operated. Because of its size, it has limited resources and yet still decided that the potential benefits of adopting ISO 14001 exceeded the costs.

The third case facility is Epsilon Systems. Epsilon's characteristics bridge the differences between Delta and Alpha in that it is a small manufacturing facility with a variety of resource constraints but also part of a larger division within a major international multi-product

corporation. Epsilon's primary decision to certify its EMS to ISO 14001 came about because the facility anticipated that in the near future its purchasers would require ISO 14001 certification.

Case Study 1: Delta Electronics

Delta is a large electronics facility with nearly four million square feet of operations, approximately 200 departments, and over 8,000 employees. The facility has been in operation for over 30 years and is part of a large multi-national corporation. What is particularly interesting about the Delta case is that prior to adopting ISO 14001, Delta had maintained an EMS for more than 25 years. Unlike its original EMS, which was mandated by its parent corporation, Delta's motivation to certify its EMS in 1996 to the ISO 14001 standard was an internal facility-level decision. Its primary reason for adopting ISO 14001, and for doing so prior to any corporate directive, was that Delta managers believed that certification would benefit the facility at the manufacturing and operational level by better integrating its EMS throughout its entire operating structure and creating more manufacturing and operational efficiencies. In achieving its goal, Delta integrated ISO 14001 into its existing ISO 9001 management system so that environmental responsibility became a component of its product quality. Within one year of adopting ISO 14001, Delta's parent company instituted a policy that required all its facilities to seek ISO 14001 certification.

Delta's decision to adopt ISO 14001 was also influenced by its investments in research and development and innovative technologies, although less directly. For years, Delta managers have considered environmentally conscious manufacturing principles in the facility's product design process. These early investments in "green" operations made it easier for Delta to move forward with ISO 14001 adoption, as many of its managers and employees were familiar with the objectives articulated in the ISO 14001 standard.

While pressures from the public, suppliers, state regulators, or customers are often cited in the literature as reasons why a facility might certify its EMS, Delta reports that it did not experience pressure from any of these sources. Delta did speculate, however, that in the future some of these factors might play a greater role in its ability to do business in the global economy, and EMS certification might serve as a means to better legitimate its proactive environmental leadership philosophy. Closer to home, Delta believed that certification might further enhance its image of being a responsible neighbor and community member, and one of the state's environmentally conscious business leaders.

Case Study 2: Alpha Manufacturing

Once the ISO 14001 standard was formalized in 1996, many of its critics suggested that EMS certification would most likely be limited to larger facilities, inasmuch as smaller facilities tend to have fewer resources to devote to such a procedure and less access to information networks. The case of Alpha Manufacturing challenges this argument. Alpha is a small, privately owned manufacturing facility with less than 100 employees. Compared to Delta and Epsilon's parent companies, Alpha is a relatively young firm that has been in operation for approximately 10 years.

Alpha is a Tier I supplier to the automotive industry as well as a supplier to the appliance and tooling industries. In 1996, the facility certified its newly developed EMS, six months after certifying its quality management system to both QS 9000 and ISO 9001. Like Delta, Alpha

integrated its 14001 EMS into its quality management system, thus making the facility's environmental goals a component of its quality-focused production.

Alpha adopted its ISO 14001 EMS for several reasons. First, in the early 1980s, the facility had a serious compliance problem that cost it approximately 20 percent of its annual gross revenues to remedy. This crisis, coupled with the facility's strong presence in the community, prompted Alpha to elevate its environmental performance to a level of priority that exceeded its environmental regulatory requirements, and to move Alpha toward a "beyond compliance" mode of operation.

Alpha's decision to adopt an ISO 14001 EMS was also influenced by a previously distasteful experience with its customers' supply-chain requirements. In the early to mid-1990s, Alpha's ability to market its products was constrained by its failure to adopt ISO 9000 and QS 9000. As a Tier I supplier to the automotive industry, when General Motors, Ford Motor Company, and Daimler Chrysler mandated that all their suppliers be ISO 9000 and QS 9000 certified, Alpha was pressed to certify its facility so as to maintain its customer base. When deciding whether to make the investment to certify its quality management system, Alpha managers thought it wise to certify its EMS as well, as a precautionary measure in the event that in the future its customers might also mandate ISO 14001 certification.

Finally, while Alpha does not invest in internal research and development, for a small company, it invests generously in staying informed of the state of the art both within its manufacturing area as well as in other manufacturing industries. The year prior to the finalization of the ISO 14001 international standard, Alpha managers made site visits to European firms that had certified their EMSs to the European Union's Eco-Management and Auditing Scheme (EMAS). They also consulted with an ISO 14001 expert to learn more about how the ISO 14001 standard was evolving, and to determine whether such a system would benefit Alpha. Based on what they heard, the facility's compliance history, and its experience with ISO 9001, Alpha adopted an EMS and certified it to ISO 14001.

Case Study 3: Epsilon Systems

Epsilon Systems is a facility whose characteristics bridge the differences between Alpha and Delta. Epsilon is a small manufacturing facility with just over 50 employees, and like Alpha, its smaller structure brings with it a variety of resource constraints that other smaller facilities share. It is also a Tier I supplier to the automotive industry. Unlike Alpha, however, Epsilon acted early to have its quality management system certified and as a result, benefited from its "preferred supplier" status.

Epsilon is also similar to Delta in that it is part of a larger products group within a major international multi-product corporation. As a result, Epsilon is supported by a larger organizational infrastructure, which was particularly beneficial when designing and implementing its EMS. Like Delta, Epsilon certified its EMS to the ISO 14001 standard prior to corporate mandate, although today its parent company requires that all its facilities achieve ISO 14001 certification.

Epsilon has had an EMS since 1993. In 1998, the facility certified its EMS because Epsilon expected increased customer demands to do business with ISO 14001-certified facilities.

After discussions in 1996 with General Motors, Ford Motor Company, and Daimler Chrysler, Epsilon managers speculated that future auto makers' mandates for ISO 14001 certified suppliers were highly likely. Epsilon's speculation was fortified both by the auto makers' early 1990 mandates that all their suppliers be ISO 9001 certified, as well as by the benefits Epsilon reaped after implementing its quality system implementation. Epsilon hoped that upon certifying its EMS, it would receive similar benefits and resource savings. As such, Epsilon moved to certify its EMS prior to any industry mandate. Then after achieving ISO 14001 certification, Epsilon used its certification in a campaign to encourage the "Big Three" U.S. auto makers to require that all Tier I suppliers be ISO 14001 certified, thus providing Epsilon an advantage over its non-certified competitors.

An additional reason why Epsilon decided to certify its EMS was related to its parent company's effort in 1993 to prepare an application for the Malcolm Baldridge Award. As part of this effort, Epsilon and its sister facilities put in place a corporate-designed EMS. Utilizing the formal EMS structure helped Epsilon managers realize that the ISO 14001 framework may further assist the facility in evaluating its environmental aspects and impacts at the site level, and that certification might give Epsilon legitimacy for its EMS. This legitimacy, Epsilon hoped, would translate into a valuable marketing tool and a means to distinguish itself and its corporation from their competitors.

Epsilon's decision to adopt ISO 14001 contrasts with Delta and Alpha in that the facility was not directly motivated by regulatory compliance issues or community concerns. Indirectly, however, Epsilon was affected by one of its sister facilities, which experienced compliance problems and caused all facilities within Epsilon's division to reconsider their environmental management practices.

IV. INTERNAL RESULTS OF ISO 14001 ADOPTION

Prior to adopting ISO 14001, all three case facilities participated in various voluntary pollution prevention programs. This historical context is important because some environmental groups and regulators have suggested that facilities which certify their EMSs to ISO 14001 are merely doing so to obtain third party legitimacy for environmental activities that they would have done anyway. This section provides evidence that contradicts this suggestion. Indeed, all three case facilities have used ISO 14001's structure to critically evaluate their environmental impacts, broaden their environmental focus, and minimize their overall impact on the natural environment.

Increased Employee Involvement

Internally, perhaps the most compelling result of ISO 14001 adoption for Delta, Alpha, and Epsilon is that no longer are environmental issues considered solely the responsibility of an isolated environmental, health, and safety staff. Today, environmental management activities—from aluminum can recycling, to office paper recycling, to operational efficiency—are now a responsibility of everyone, from secretaries to senior management. For Delta, such an outcome is particularly interesting, especially considering the maturity of both its preexisting EMS and environmental policy, which have been in place since the 1970s. Delta's previous history illustrates that having an environmental management program or policy does not necessarily

translate into improved employee understanding of environmental issues. Prior to adopting its ISO 14001, for example, approximately two Delta managers knew where to find the facility's environmental policy. Today, most of its 8,000 employees know where the policy is located, what it is, and how their actions contribute to the facility's ability to achieve its environmental goals.

For all three facilities, improved awareness helped them to integrate ownership of their facilities' environmental performance into their staffs' day-to-day business procedures. As a result, environmental goals have been personalized for many employees and have increased their morale and their shared support for the facility's overall business goals.

In involving their employees, Delta and Epsilon rely on EMS improvement suggestions from both their managerial and non-managerial staff. Alpha, however, has limited non-managerial employee involvement and only managers are involved in identifying ways to improve the facility's environmental operations. This difference may be due to the maturity of Delta and Epsilon's EMSs, as much of their "low-hanging fruit" has long since been picked. Similarly, as Alpha's EMS evolves, opportunities for obvious environmental improvements may diminish, and the need for greater employee involvement will become a more important factor in its ability to continually improve its EMS. The difference may also be related to Delta and Epsilon's corporate culture, which embraces employee involvement in their management systems. In contrast, Alpha's corporate culture is one with limited employee involvement, which may be an impediment to Alpha's ability to continually improve its EMS over time.

Improved Document Control

During various EMS-related conferences and NDEMS meetings, many facility managers have reported that ISO 14001's extensive documentation requirements are the most important reason why they do not certify their EMSs. Ironically, however, all three of the case facilities report that while documenting their EMS procedures to comply with the ISO 14001 standard was indeed arduous, they reaped significant benefits from it.

All three facilities attribute their increased understanding of how they impact the natural environment primarily to the documentation requirements of the standard itself. Although Epsilon had an EMS in place prior to adopting ISO 14001, it was the documentation requirements of ISO 14001 that caused the facility to systematically analyze some of its environmental impacts for the first time. One outcome of its analysis, for example, was that the facility began to consider its impacts related to using various product inputs.

At Alpha, managers found the aspect- and impact-identification process particularly valuable. In it, they considered for the first time how Alpha's auxiliary operations and supply chain affect the natural environment. As a result, Alpha has asked its suppliers to reduce their chemical use. Moreover, Alpha requires that all its suppliers provide the facility with a written certification of their compliance with all environmental regulations, and have begun to visit their suppliers and audit their operations and procedures.

Improved Manufacturing Efficiency

Environmental improvements are often credited with improving manufacturing efficiency. For each of the three cases this is also true. An important point worth noting, however, is that in each case efficiency improvements are largely attributed to the continual-improvement focus of ISO 14001, rather than to impact identification or any other specific component of the ISO 14001 procedure. For Delta, increased efficiency was gained by better calibrating its production tank levels and gauges, thereby minimizing its chemical and water usage. While Delta had always regulated its operational devices, incorporating the calibration process into the more structured framework of ISO 14001 improved Delta's control of them.

Alpha's manufacturing efficiency has also improved, largely due to its weekly managers meetings which focus on continual improvement to the facility's manufacturing efficiency. During its meetings, for instance, facility managers became aware of and targeted the large amount of water Alpha discharged and identified ways in which it could be minimized. Since then, a 5,000-gallon tank was installed and water that was otherwise discharged is now collected in the tank and reused in Alpha's manufacturing processes, thus reducing its water bill by 40 percent. In assessing the facility's manufacturing efficiency and product quality, Alpha managers also identified the impacts of some of its process chemicals on the environment on its workers' health. Today, Alpha has automated one of its process lines to produce a higher quality product while at the same time removing the need for human intervention, and reducing the potential risks and impacts of harmful spills.

At Epsilon, similar events have occurred. Tasked with fulfilling the facility's ISO 14001 objectives and targets, Epsilon's environmental improvement teams have instituted a number of manufacturing process improvements, the most significant being that it now reuses one of its process waste chemicals to pretreat the facility's wastewater. And, as part of Epsilon's continual-improvement focus, environmental impacts are routinely assessed during Epsilon's process reviews. Moreover, when new process lines are developed, Epsilon engineers include design for the environment (DfE) principles in their overall process design criteria. As a result, Epsilon is now able to manufacture its products more efficiently by reducing its use of chemicals, electricity, and water.

Increased Focus on Unregulated Impacts

It is often suggested that facilities which adopt EMSs have the potential to broaden their environmental focus and consider unregulated as well as regulated impacts. All three facilities' ISO 14001 EMSs have done this, although it appears that the maturity of a facility's EMS may play a part in the extent to which unregulated impacts are considered. Delta, in particular, rigorously assessed its unregulated impacts in part because it had focused for so long on its compliance with environmental laws, and thus naturally progressed towards more actively considering its unregulated ones as well. Specifically, Delta focused attention on its impacts on land use, transportation, and energy use. These issues may not all affect Delta's bottom line significantly, but the facility chose to evaluate them in part because its managers believe that they are an important component of Delta's environmental responsibility. The results include:

- Increased wildlife habitat and open space, by removing unused buildings and parking lots and revegetating unutilized land;

- Increased employee use of public transportation (by 36 percent), by offering a rideshare program, carpooling incentives, and free passes for county transit and light-rail;
- Reduced energy consumption (by over four percent each year), by retrofitting energy conservation technology and promoting efficient energy use. Delta also began co-generating its energy, and thus negotiates lower electricity rates from its local utilities.

Alpha and Epsilon have also begun to reduce their unregulated environmental impacts, although not to the degree that Delta has. In addition to reducing its water consumption, for example, Alpha has decreased its electric consumption by 20 percent by installing energy-efficient lighting and compressors. Similarly, Epsilon has begun to consider its electricity and water use as impacts for attention.

V. EXTERNAL RESULTS OF ISO 14001 ADOPTION

In addition to their internal benefits from adopting ISO 14001 EMSs, all three case facilities have also reaped varying amounts of external benefits, including improved vendor contracts, customer satisfaction, and marketing. For both Alpha and Epsilon, the hope of external benefits of certifying their EMSs played a strong role in their decisions to adopt ISO 14001 in the first place. Some Alpha managers have been disappointed by the slow pace at which they have realized such benefits, but these same managers note that the internal benefits by themselves have turned out to justify Alpha's certification. In contrast, Delta was largely driven to certify its EMS because of anticipated internal benefits, and external factors played little part. Since adopting ISO 14001, however, Delta's external operations have also benefited greatly.

Improved Vendor Contracts

Both Alpha and Delta recognized while documenting their internal operations that their ability to operate in an environmentally conscious manner relied in part on their vendors' procedures and processes. As a result, both facilities broadened their environmental focus to include their vendor's impacts as well as their own. Alpha, for example, evaluates its vendors' environmental impacts from a regulatory perspective and requires that they provide the facility with a written certification of their compliance with all environmental regulations.

Similarly, Delta evaluates its vendor operations prior to any contractual agreement with them. For example, Delta required its on-site cafeteria, which is contracted out for operation, to institute glass and plastic recycling. These activities, while may seem tangential to Delta's overall goal to manufacture electronic components, further impress upon its employees and the community how every aspect of the facility's operations affects the environment. Moreover, recycling programs such as this one have helped the facility to recycle over 72 percent of its solid waste each year.

To date, Epsilon has not considered its vendors' operations as a component of its ISO 14001 EMS. One might surmise that Epsilon is thus missing an opportunity to further minimize its environmental impacts, but this finding also illustrates that EMS implementation can legitimately vary both across facilities and in scope.

Improved Customer Satisfaction

When ISO 14001 was first finalized, there was much speculation about how the standard would affect customer relationships. For all three case facilities, certifying their EMSs to ISO 14001 has translated into improved customer satisfaction. As Tier I suppliers to the U.S. automotive manufacturers, both Alpha and Epsilon enjoy the advantages of being "first movers," certified before the auto makers actually required it (see Note 3). Both facilities have a very real opportunity to receive greater purchasing preference than do non-ISO certified firms, thus fortifying their market positions. This opportunity exists in part because of the time necessary to adopt an EMS: once a facility decides to adopt an ISO 14001 EMS, it can take as much as 18 months to 2 years to receive certification. In the short term, Alpha and Epsilon may thus benefit from their ISO 14001 EMSs while their competitors rush to get their EMSs in designed, implemented, and certified.

While Delta adopted ISO 14001 for other reasons, customer demand is now a factor that the facility considers as well. Especially in Western Europe, Delta's large corporate buyers are increasingly requesting that the facility provide them with documentation of its environmental policy and its aspects and impacts. These customers recognize that even ISO 14001-certified facilities may have EMSs that vary in quality and scope, and they are therefore scrutinizing the *content* of their suppliers' EMSs and not merely whether or not a facility is certified.

Improved Marketing

It is often suggested that firms that adopt ISO 14001 may reap benefits by increasing their ability to market their products. Both Delta and Epsilon would likely agree. Alpha, however, is more reserved. These differences may exist in part because of Alpha's small size, which unlike Epsilon is coupled with limited marketing resources. Indeed, almost all of Alpha's business is due to word of mouth rather than a formalized marketing strategy. Alpha also reports that many of its customers in the appliance and tooling industry do not yet understand the concept of an ISO 14001 EMS, and thus do not place much value on it. No doubt, increased understanding will occur over time as more information about the standard is available and as more facilities certify their EMSs. For now, however, Alpha is challenged with marketing its certification in such a way as to add value to its products.

In contrast, Delta has vigorously marketed its ISO 14001 certification and strong environmental leadership as selling points for its products, and as means to differentiate its products from its competitors'. As a component of this strategy, Delta has applied for and received five eco-label certifications for its products. These labels have better enabled Delta to increase its recognition for being an environmental leader, especially within the European Union, which requires eco-labels for all products sold within its boundaries. Outside of Europe, these labels also help Delta by differentiating its products from its competitors'.

Similarly, Epsilon believes that its ISO 14001 certification may increase its ability to market itself as an environmentally conscious producer. Epsilon hopes to benefit by reinforcing its customer relationships and its place as a preferred supplier. Already, these customer relationships are bearing fruit and increasing Epsilon's visibility as an environmental leader.

Regulatory Benefits

Both Delta and Epsilon are quick to point out that they did not certify their EMSs in the hope that it would bear any regulatory benefits. Alpha, however, held hope of receiving reduced state monitoring and surveillance requirements for ISO-certified facilities. While these benefits may occur in the future, Alpha has been disappointed that so far they have not transpired.

Despite Alpha's disappointment, all three facilities report that ISO 14001 certification has reduced the time burdens of their compliance-audit procedures by approximately one-third, due to the improvements in the facilities' documentation since adopting ISO 14001. Today, when state auditors perform their compliance audits, these facilities are able to quickly gather all the required information, promptly answer auditor questions, and expedite the audit process.

Ironically, Epsilon has received the benefits which Alpha had hoped to reap. The state environmental regulatory agency now "fast tracks" Epsilon's permit applications and modifications because the facility is recognized by the state as being an outstanding environmental performer. Whether this preference is due to Epsilon's ISO 14001 certification or its general image of being an environmental leader is uncertain as the two are too deeply intertwined.

V. SUMMARY OF RESULTS

Despite the differences among the three facilities, the outcomes of EMS adoption are remarkably similar, as noted in Table 1. There are of course different degrees to which each facility has benefited by the various categories of internal and external benefits, as discussed earlier. Nonetheless, all three facilities have increased their employee involvement in environmental management, improved document control and manufacturing efficiency, and increased their focus on non-regulated impacts. Interestingly, the external outcomes due to ISO 14001 adoption have varied more widely across the case facilities , but include improved vendor contracts, increased customer satisfaction, increased ability to market products domestically, increased access to international markets, and some regulatory benefits.

Table 1. Summarized Results of ISO 14001 Adoption

Results of ISO 14001 Adoption	Facility		
	Delta	**Alpha**	**Epsilon**
Internal Results			
• Employee involvement in environmental management	X	X	X
• Increased document control	X	X	X
• Improved manufacturing efficiency	X	X	X
• Increased focus on non-regulated impacts	X	X	X
External Results			
• Improved vendor contracts	X	X	--
• Increased customer satisfaction	X	X	X
• Increased ability to market products domestically	X	X	X
• Increased ability to access international markets	X	--	X
• Regulatory benefits	--	--	X

V. CONCLUSION

The increasing rate of adoption of ISO 14001 EMSs is an important phenomenon in itself, and for the businesses that choose to implement them. Among the many recent initiatives toward "voluntary approaches" to better environmental management, the adoption of ISO 14001 EMSs represents the most significant form to date of a systematic commitment to continuous improvement in environmental performance by a growing number of facilities and their parent organizations. The results of the three case facilities exemplify this notion, as each of them reports significant improvements in their operating and manufacturing procedures after adopting ISO 14001. This is true even for Delta and Epsilon, which had mature EMSs in place prior to certifying them to ISO 14001. The operating and manufacturing improvements include:

- Increased employee involvement
- Increased document control
- Improved operational control
- Improved calibration and retooling
- Increased process automation
- Increased reuse of chemicals and water in production cycles
- Increased focus on non-regulated impacts
- Increased focus on supply chain impacts
- Increased focus on vendor impacts

The benefits of certification have occurred in part because all three facilities used ISO 14001's procedure to critically evaluate their environmental impacts, broaden their environmental focus, and minimize their overall effect on the natural environment. All three facilities report that employee involvement has been a critical component of their success, particularly in cases where mature EMSs were already in place and fewer opportunities thus seemed to exist to improve the management system further. Smaller facilities like Alpha, with limited resources and information networks, may perhaps experience fewer external benefits of certifying to ISO 14001, but even Alpha is quick to note that the internal benefits alone justify its ISO 14001 certification.

There are no guarantees that the favorable results discussed in these three case facilities will occur across all facilities which certify their EMSs, much less that they will occur systematically across business sectors. Nor is there clear evidence as to the stability of ISO 14001 EMSs over time, especially as personnel committed to them change, and facilities themselves undergo changes in leadership, priorities, financial and market pressures, and even corporate structure and ownership.

However, these cases offer at least suggestive indications that real environmental benefits can occur for facilities that adopt ISO 14001 EMSs. They also illustrate how ISO 14001-certified facilities may benefit from related non-environmental achievements such as increased legitimacy, improved customer satisfaction and marketing, increased document and operational control, and improved operational efficiency.

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END NOTES

[1]All information about the database may be found on the Internet at the NDEMS homepage at http://www.eli.org/isopilots.htm. This site includes the NDEMS research protocols, periodic public reports, and other papers, as well guidance and policy documents. The baseline database itself is available at this site. EMS design data and data related to facilities' post-EMS adoption performance will also be available once the data are quality checked and the sample is of adequate size.

[2]All facility names have been changed to protect their identity.

[3]General Motors and Ford Motor Company announced in late 1999 and early 2000, respectively, that they will require all their suppliers to be ISO 14001-certified. General Motors requires that its suppliers receive ISO 14001 certification by December 2002 and Ford requires supplier certification by July 2003.

Signaling "Green": The Influence of Institutional and Organizational Pressures on Facilities' Environmental Strategies[36]

November 2000

Nicole Darnall[37]

ABSTRACT

This research explores theoretically and empirically the factors that contribute to a facility's decision to signal its environmental strategy. It develops an institutional and organizational framework of facilities' signaling decisions and then applies it to the environmental management system (EMS) context using data from the National Database on EMSs. Motivations for EMS adoption are evaluated for three types of organizations: publicly traded facilities, privately owned facilities, and government facilities. The results show that drivers for EMS adoption differ for all three types of organizations. A common theme among them, however, is the importance of regulatory pressures in facilities' decisions to adopt an EMS, which supports the idea that EMS adoption develops in the "shadow of regulation." It also provides evidence that government support in the form of technical assistance and regulatory benefits play a strong role in motivating facilities to adopt EMSs. These findings point to the potential importance that policy incentives may offer in encouraging widespread adoption of EMSs, especially for privately owned and government facilities.

I. INTRODUCTION

Over the past decade, U.S. policy makers have given increasing attention to market-based instruments for environmental protection, including various types of voluntary environmental programs. These programs represent a departure from government's traditional environmental regulatory role, which is largely characterized by its uniform pollution standards, requirements for specific forms of pollution control technologies for an entire industry, and punishment for enterprises that deviate from these mandates. Critics of this framework argue that facilities operating within it have little flexibility to comply with pollution regulations and are required to make costly capital investments, which often yield less efficient outcomes for environmental protection.

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Since the late 1980s, the U.S. Environmental Protection Agency (EPA) has broadened its single-conceptual approach to monitoring, permitting, and enforcement to include a second conceptual approach that rewards good behavior. This new approach incorporates into EPA's various media programs incentives for environmental stewardship and in large part relies on self-enforcement and incentives for good environmental behavior. Self-enforcement is increasingly being used within the regulatory sector and is particularly desirable from an efficiency perspective, because government in theory is able to spend fewer resources monitoring companies that are ahead of the regulatory curve and can instead focus its attention on facilities that fail to achieve their regulatory obligations.

A failure of the current self-monitoring model, however, is the lack of environmental signals and information that helps regulators and the interested public to determine which facilities are in compliance with environmental laws. These asymmetries in information exist in part because firms' environmental harm is not readily apparent to individuals outside the organization itself. The result is that facilities are generally viewed in the same light and their product prices reflect average prices rather than the actual cost of production, relative resource scarcity, and different levels of environmental impact. To determine the latter, consumers often validate environmental impact years after the fact. Examples of this phenomenon include the successful marketing of asbestos, dioxin, and uranium, which were once promoted as healthful products but years after their market introduction were found to be harmful to human health. Even when environmental information is more readily available, as is the case for data on facilities' toxic emissions, individuals external to the organization cannot access these data until nearly two years after their release into the environment. Thus, it is difficult for consumers to make rational purchasing decisions because product prices do not accurately reflect producers' current environmental impact. The result of this framework is that market participants make judgments about a facility's compliance and pollution emissions based on data that are largely outdated, and only a relatively few participants are willing to incur the transaction costs of becoming informed.

EPA is addressing some of these issues by designing programs that attempt to identify which facilities might be better environmental performers than others. These programs include EPA's Performance Track, Green Lights Program, Common Sense Initiative, Project XL, Energy Star, 33/50 Program, and Wa$te Wi$e. In each of these programs, *participation* may be the relevant signal to regulators that a facility is on the path to fulfilling or has already fulfilled its regulatory obligations. While compliance is not necessarily guaranteed, the likelihood that participating facilities have a heightened awareness of their regulatory obligations may be greater than for non-participating facilities.

To date, however, there is little empirical information that sheds light on the voluntary activities that facilities are undertaking to manage their environmental impacts and why signaling these activities to the market might be attractive. Instead, recent research has focused more simply on why facilities choose to participate in a particular environmental program, arguing that participation is a function of the economic costs and benefits of doing so. While this suggestion is not necessarily incorrect, it ignores the various institutional and organizational pressures that comprise this economic rationale. Perhaps most importantly, previous literature on facilities' voluntary environmental activities has ignored the organization's environmental compliance

history, which may likely play a significant role in some facilities' decision to send "green" signals so that they may change their tarnished image of the past.

The practical need for such information is great. Understanding the external and internal factors that motivate businesses to signal their environmental strategy is important to policy makers, since the effectiveness of their voluntary environmental programs depends in large part on how corporations respond to them. Moreover, as regulators increasingly expand their basket of market-based voluntary programs, it will be important for them to understand which facilities are more likely to participate in them.

This research explores theoretically the factors that contribute to a facility's decision to signal its environmental strategy. It evaluates the institutional framework of facilities' decisions to signal their greenness and relates this decision to their organizational capabilities. These influences are then evaluated using data from the National Database on Environmental Management Systems to analyze facilities' decisions to send a green signal by adopting an environmental management system (EMS).

II. THE INSTITUTIONAL FRAMEWORK OF ENVIRONMENTAL SIGNALING

Only recently has much attention been placed on understanding why a facility might signal their environmental strategy by participating in a voluntary environmental program. The lack of research on the topic may in part be attributed to conventional economic arguments that organizations should invest in environmental activities only to the point that they do not affect their financial performance. Interpreted more strictly, investment beyond that required by the current regulatory structure is detrimental to the organization's financial performance and a constraint on its financial opportunities (Christiansen and Haveman, 1981; Conrad and Morrison, 1989; Denison 1979; Jaffe and Palmer 1997; Lave 1973; Norsworthy, Harper and Kunze, 1979; Robinson 1975). These arguments suggest that there is little justification for a facility to signal its greenness.

Yet many facilities are sending green signals to the market, to regulators, and to the public. Have these facilities acted against conventional economic wisdom? Not necessarily. Indeed, recent research in management theory indicates that facilities may benefit substantially by better managing their environmental impacts (Hart and Ahuja, 1996; Henderson and Mitchell 1997; Klassen and McLaughlin 1996; Walley and Whitehead, 1994) and signaling their proactive environmental activities. In fact, proactive environmental management may develop in the "shadow of regulation," and the presence of the regulatory system may foster facilities' decisions to consider environmental stewardship goals as part of their profit maximizing criteria (Gallagher, Darnall, and Andrews 1999).

The multiple factors that prompt facilities to send green signals may be classified into two forms: external drivers and internal drivers. External drivers include pressures such as regulatory, market, resource, and social influences. Internal drivers include factors such as organization's management system capabilities, environmental management capabilities, resource capabilities, and organizational culture.

External Drivers—An Institutional Analysis

External drivers comprise all factors outside an organization that influence its routines and competencies (Aldrich 1999), and motivate facilities to send an environmental signal. Hoffman (1999) offers one of the most recent and comprehensive models. While his structure describes why facilities might change their environmental strategy, the framework may easily be applied to facilities' signaling decisions. There are four types of external forces exerted on facilities that prompt behavioral change: regulatory forces, resource drivers, market drivers, and social drivers.[38]

Regulatory Drivers. Within the environmental arena, regulatory pressures are the most frequently cited external drivers for an organization's environmental action (Angell and Rands 1998; Arora and Cason 1995; Garrod and Chadwick 1996; Hart 1995; Jaffe et al. 1995; Konar and Cohen 1997; Lawrence and Morrell 1995; Porter and van der Linde 1995). These pressures are exerted on facilities at the local, county, state, national, and international levels. They come in multiple forms and include facility mandates to apply for operating permits, to adopt specific control technology, to monitor and report on its media-specific environmental activities, to allow regulator audits of their environmental activities, and to address any emissions violations and their potential legal implications. All of these actions come at a significant cost. For these reasons, facilities may send a green signal in an attempt to move beyond a compliance mode of management and thus reduce their regulatory burdens.

Firms and facilities that signal their proactive environmental management may be able to negotiate with government officials an individualized reduction in their regulatory burden, especially in streamlining the environmental permitting process (Gallagher, Darnall, and Andrews 1999). But there might also be a strategic component to facilities' responses to these regulatory pressures in that signaling facilities may be able to influence government to impose stricter regulations and thus raise the costs of their rivals, thereby giving them competitive advantage (Darnall, Gallagher, Andrews, In Press; Salop and Scheffman 1983).[39]

Market Drivers. Market drivers are constituents who include consumers, trade associations, and competitors that are influencing companies to consider environmentalism in their market strategies and to send green signals. Formalized networks also play an important role. For example, facilities belonging to an industry association prominently lobbying Congress and EPA are more likely to be influenced by the association's activities (Hoffman 1999). Applied to a facility's decision to send a green signal, the prominence of, for example, the Chemical Manufacturer's Association (CMA)[40] may be one reason why its Responsible Care Program received such high rates of facility participation (King and Lenox 2000).

[38] Hoffman (1999) recognizes five drivers, the fifth being international drivers. These influences, however, may be considered as derivatives of regulatory, resource, market, or social drivers.

[39] The evidence is conflicting, however, as when the facilities act in anticipation of stricter regulation, particularly in the form of a uniform percentage reduction and increasing costs pollution reduction, there is an incentive for facilities to under-perform or delay their pollution abatement (Baumol and Oates 1988). Thus, facilities may not adopt voluntary environmental strategies in response to anticipation of regulation but for other regulatory-related reasons.

[40] CMA is now known as the American Chemical Council.

Other pressures relate to the consumer. As information has become more readily available about a facility's environmental activities, consumers have increasingly considered these factors when making their purchasing decisions (Arora and Gangopadhyay 1995; Marshall and Mayer 1991). In a 1990 public poll, 75 percent of U.S. consumers stated that they consider a company's environmental image in their shopping decisions (Kleiner 1991). Others state that they are willing to pay more for environmentally friendly products (Bhat 1993).

Resource Drivers. Resource drivers are a third type of external pressure exerted on facilities. They consist of the value chain of buyers and suppliers, insurance companies, shareholders, and investors, which affect the acquisition, processing, and distribution of resources. While a facility struggles with its own environmental issues, each of these organizations is doing the same. As a result, pressures are passed from one organization to the next, thereby normalizing environmental concerns up and down the value chain (Hoffman 1996). Related resource issues include the facility's ability to garner support from the value chain, which makes its capacity to manage its internal costs and to increase its revenues a factor particularly important to consider.

Social Drivers. Social drivers include the facility's external constituents that must be actively managed in order to develop effective and successful operating strategies (Hoffman 1999). Constituents in the social system, who include environmental groups, citizens groups and the media, can mobilize public sentiment, alter accepted norms, and change the way people think about the environment and the role of the facility in protecting it.

Social drivers have gained increasing attention since the 1980s due to the heightening influence of stakeholders on organizational strategy. Part of this changing focus may be due to increased public knowledge, albeit still limited, of organizations' environmental activities. In the past, a firm's or facility's environmental reputation received little attention, in part because of asymmetric information regarding the harmful effects of industry activity. This changed, however, with stories of environmental disasters like the nuclear accident at Three Mile Island, the Union Carbide toxic gas leak in Bhopal, and the Exxon oil spill, which have heightened public awareness and personalized the importance of facilities' environmental management. While no doubt these accidents represent an extreme, because each of these organizations was highly visible, they received additional public scrutiny for their actions (Getz 1995). These companies also have more liability exposure because of their "deeper pockets" that regulators and environmental groups may focus their attention (Arora and Cason 1996). More visible organizations are additionally likely to sell products directly to consumers and have brand identity. For these reasons, larger facilities may have a greater incentive to reduce their liability exposure by sending green signals.

In an effort to enhance their environmental reputation, facilities may signal their greenness by participating in government-sponsored pollution prevention programs such as Green Lights and 33/50. These programs offer publicity to facilities that participate in them in the form of government sponsored press releases and highly publicized awards ceremonies. Companies, moreover, may publicize their participation in their environmental reports, in press releases, on their product labels, and through other venues.

Internal Drivers—A Resource-Based Analysis

Internal drivers are the facility-level resources and internal capabilities that affect an organization's routines and competencies (Aldrich 1999), including management strategy and facility-level resources (Hart 1995; Klassen and Whybark 1999). This resource-based approach focuses on intra-organizational relations as the basic unit of analysis in sustained competitive advantage. The organization's main driver towards this sustainability is the 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 (Hart 1995). There are at least four types of internal drivers that factor into a facility's environmental signaling capability: management system capabilities, environmental management capabilities, resource capabilities, and organizational culture.

Management System Capability. In general, facilities develop their business strategies in an evolutionary way to cope with both external constraints and limited information and knowledge (Hart 1995; Florida 1996). For this reason, facilities that have a commitment to continual internal improvement might also send green signals because of their capability in managing and sustaining these systems. These facilities, moreover, are more likely to accumulate the necessary resources for proactive environmental management than are facilities without such prior capability (Hart 1995; Lawrence and Morell 1995; Welford 1992), and are more competent at transferring knowledge and generating momentum to send a green signal.

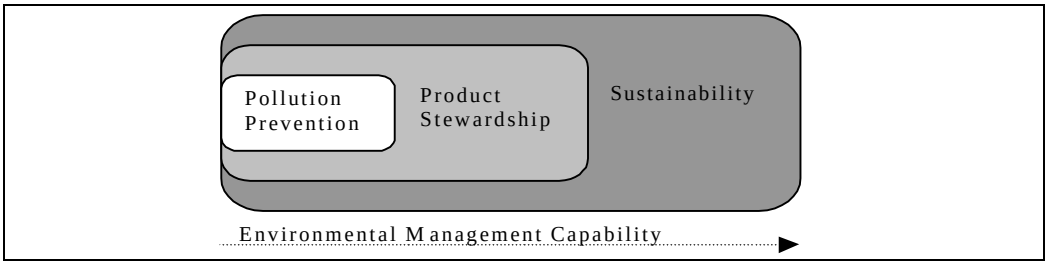
Environmental Management Capability. Facility resources leading towards sustained competitive advantage are path dependent and embedded relationships between facilities' strategic environmental capabilities (Hart 1995). In order for a facility to possess the capability of higher levels of environmental management such as environmental product stewardship, a rare and facility-specific resource, it must first acquire the capability of pollution prevention, a tacit or causally ambiguous resource. Similarly, in order for a facility to achieve the capability of sustainability (a higher level of environmental management), it must first be proficient in its pollution prevention activities and product stewardship, and acquire the socially complex or process-based resources to do so.

Embeddedness of an organization's environmental management capabilities inherently implies that the relationship is path dependent, as shown in Figure 1. Indeed one could argue that increasing progress towards organizational and environmental sustainability follows a sort of "Guttman scale," with each succeeding level both incorporating and transcending the previous levels. Thus, facilities that invest in sending environmental signals, at the very least, might have prior pollution prevention capabilities.

Resource Capability. A facility's decision to send a green signal may require multiple levels of employee involvement in addition to a competent staff. Facilities that are better positioned to deploy their human resources to address facility-wide management issues are also more likely to send an environmental signal in part because the costs of doing so will be less than that for facilities which require significant staff training. Sending green signals, especially via EMS adoption, will demand an organization to engage its human resources to a degree that has not been required in the past. This is due in part to the holistic view of environmental

management that an EMS encourages. Facilities, which are thus willing and able to take on the challenge, will be better equipped to change their environmental strategies and to continually improve them over time.

Figure 1. Path Dependence of Environmental Management Capabilities



Organizational Culture. Organizational culture, both within the parent organization and at the facility-level, is also likely to influence a facility's decision to send a green signal. While it is easy to dismiss such a notion as being idealistic and having marginal influence, sending an environmental signal often requires substantial investments in capital and human resources. Should these investments fundamentally conflict with the organization's philosophy of doing business, it will be less likely to undertake such an endeavor.

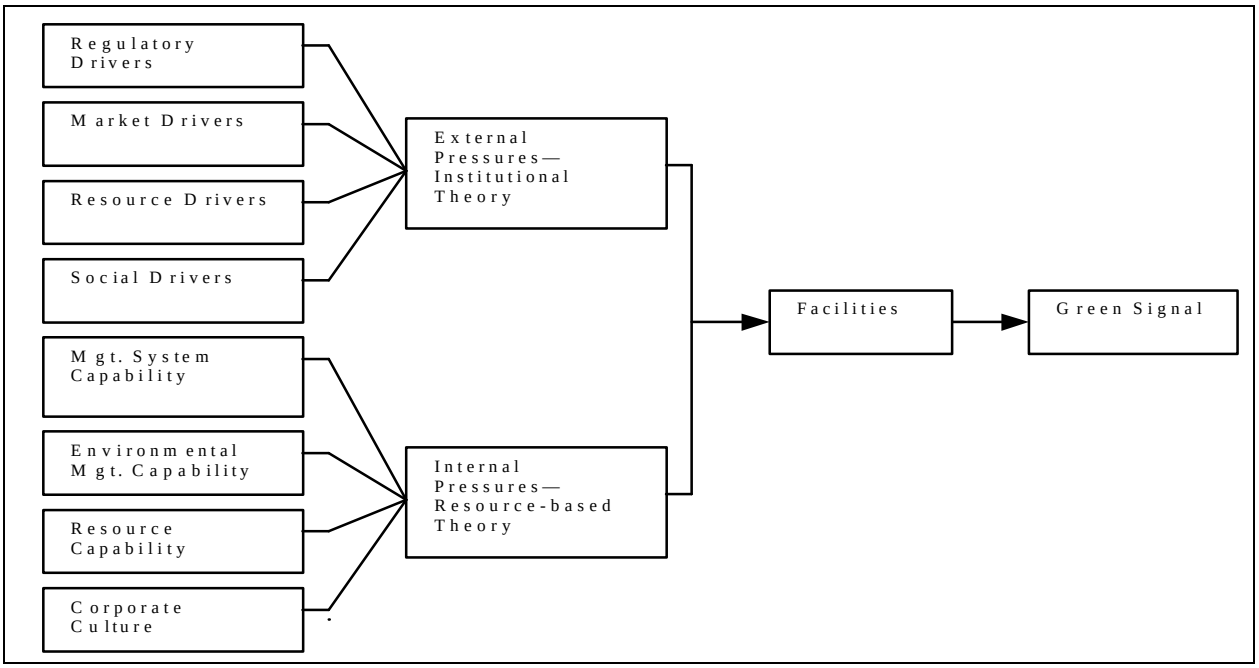
Each of the external and internal drivers collectively influences a facility's decision to signal their environmental strategy, and is illustrated in Figure 2. A key question to ask for public policy and management research is which of these influences are most relevant and how they might be leveraged to encourage more facilities to consider signaling devices, such as EMS adoption.

III. ENVIRONMENTAL SIGNALING AND EMS ADOPTION

There are many institutional vehicles that facilities may use to send environmental signals. In this study, green signaling is applied to the decision by facilities to adopt an EMS. EMS adoption is an important signaling vehicle to study for several reasons. First, EMSs have gained much attention since the internationally recognized ISO 14001 EMS standard was established in 1995. During its development many U.S. environmental regulatory agencies became interested its potential relevance to environmental protection. This interest prompted regulators in a number of states to form the Multi-state Working Group on Environmental Management Systems (MSWG). And in 1997 the U.S. Environmental Protection Agency (EPA) agreed to support a multi-state study in cooperation with the MSWG to determine how EMSs affect the environmental and economic performance of facilities that adopt them. Today, approximately 60 pilot facilities are adopting EMSs. These facilities have agreed to provide data on their environmental and economic performance prior to and after adopting their EMS, as well as information on their EMS design processes, to the National Database on Environmental Management Systems (NDEMS).[41]

[41] All information about the database may be found on the Internet at the NDEMS homepage at http://www.eli.org/isopilots.htm. This site includes the NDEMS research protocols, the baseline database itself, periodic public reports, and other papers, as well as guidance and policy documents. In the future, the EMS design database will be available at this site once the data are quality checked and the sample is of adequate size.

Figure 2. Theoretical Model of Green Signaling



Since the pilot program began, momentum has been gaining and EPA is increasingly endorsing EMS adoption. In July 1999, the agency released a report entitled *Aiming for Excellence: Actions to Encourage Stewardship and Accelerate Environmental Progress*, and one outgrowth of it is a new cross-agency workgroup, which is developing EPA's "Performance Track" Program. The program has three goals which the agency intends to achieve during the next three years: (1) Provide leadership in the practice of EMSs inside and outside the agency; (2) Create a fuller integration of EMSs into EPA programs and activities; (3) Promote wider adoption of EMSs across a range of organizations and settings.

Government endorsement of EMSs also extends beyond EPA and the states. In April 2000 President Clinton 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 (EO 13148, April 22, 2000, in Andrews et al., In Press).

The MSWG, EPA, and other regulators at the state and federal levels are moving forward with EMSs as a policy option because in principle they believe that organizations which adopt EMSs may in the long run be in compliance with environmental regulations at rates greater than non-EMS adopting facilities. Moreover, government officials suggest that for organizations that adopt EMS, the environmental regulatory system may perhaps become less relevant as they continually improve their EMS and upgrade their environmental goals and objectives. For these reasons, some government officials, in addition to firms and their facilities, see in EMSs an opportunity to make many regulations less applicable to signaling enterprises.

IV. METHODOLOGY

To better understand the reasons why facilities send an environmental signal via EMS adoption, data from the National Database on Management Systems (NDEMS)[42] were used to test the theoretical model described above. Approximately 60 facilities comprise NDEMS. These facilities were recruited (with the assistance and coordination of USEPA, members of the MSWG, EPA Region I, and environmental managers in ten states) to voluntarily participate in a multi-year research project on EMS adoption and the economic and environmental benefits of it.

NDEMS data are longitudinal and are being gathered in real time. They consist of *facility-level* data, since 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 (Andrews et al., In Press).

The sample of NDEMS data evaluated here consists of 39 EMS adopting facilities. While there are additional facilities in NDEMS, the 39 facilities represent organizations that have provided complete information for the thirteen protocol questions that are the source of this analysis (see Appendix 1). Each of these questions relates to the theoretical model, as illustrated in Figure 3.

Since different types of enterprises are likely to have varying rationales for adopting an EMS, the sample was divided into three groups of facilities: publicly traded facilities (n=18), privately owned facilities (n=14), and government facilities (n=7). While the sample sizes within each group are too small to allow for a rigorous empirical investigation, they still allow meaningful descriptive comparisons between them. Moreover, because so little information is available on facility motivations for EMS adoption, this analysis provides a real contribution to our understanding of the types of pressures that most affect facilities' decisions, as well as how different types of facilities perceive these pressures.

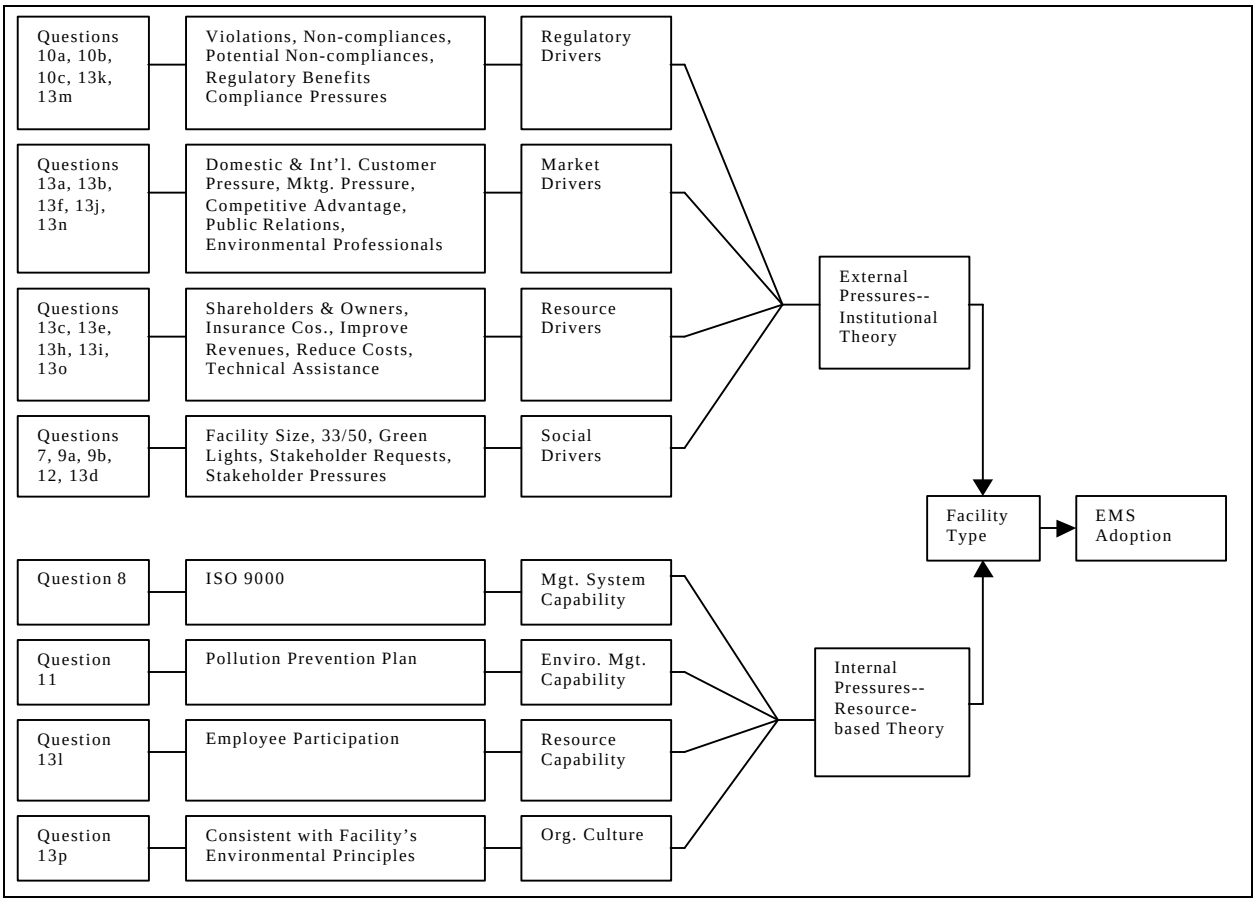
As part of grouping facility responses within each of the three facility types, it was necessary to quantify the responses using a common scale. While the NDEMS protocols were designed to address a variety of research questions related to EMS adoption, they employ multiple scales and measurements, which make comparability across some questions a challenge.[43]

The majority of the responses follow a four-point scale. Question 13, for example, asks facilities to evaluate their rationale for EMS adoption. Responses lay on a scale of high, medium, low, and not applicable. Because of the lack of strong distinction between low and not applicable pressures, these two responses were collapsed into a "low" category.

[42] NDEMS is a joint initiative of the University of North Carolina at Chapel Hill and the Environmental Law Institute. It is supported by the U.S. Environmental Protection Agency (EPA) in cooperation with the Multi-State Working Group on Environmental Management Systems (MSWG), ten state environmental agencies, and approximately 60 businesses and other organizations that have agreed to share data with it.

[43] There are various reasons why the questions have different scales that relate to the difficult task of anticipating how each question might be used in research, as well as the multi-level political process that shaped the NDEMS protocol development. As a result, for the fourteen questions relevant for this analysis, a common scale was developed.

Figure 3. Estimation Model of Facilities' Rationales for Sending Green Signals



Questions 10, 11, and 12 elicited discrete responses. In order to make these responses comparable to a three-point scale; the discrete choices were scaled equal to high if the discrete choice was made; low otherwise. Similarly, question 12 was rescaled. It elicited a response to one of five options. To make these data comparable to a three-point scale (H, M, L), the first two and last two choices were combined.

Once scaling was completed, responses for the three types of facilities were converted into proportions (percentages) for each type of external and internal pressure of interest, and then three types of analyses were performed. First, to better understand the nature of facilities that adopt an EMS and ISO 14001 certified EMSs a descriptive analysis was done. Then the model for facilities' rationales for EMS adoption was evaluated by creating indices for each of the external and internal pressures discussed above. These indices define the magnitude of each driver for EMS adoption and allow for comparisons across all three types of EMS adopters. Finally, both types of analyses were coupled with a nonparametric approach to test for the differences between the types of facilities, their various characteristics, and the external and internal pressures exerted on them.

A nonparametric approach was taken because the sample is small and the data do not meet the requirements for the usual tests of association via the Pearson chi-square or the

randomization chi-square.[44] Fisher's exact tests were performed for each type of external and internal driver, as well as for each of the external and internal driver indices. Because the theoretical model includes both dichotomous and ordinal data, exact tests were done separately for each data type.[45] Finally, because the sample sizes are necessarily small, differences are considered probably meaningful, although they do not meet conventional levels of significance (Kahn and Goldenberg 1991).

V. RESULTS

The descriptive statistics show that the publicly traded and privately owned enterprises largely consist of manufacturing facilities, as seen in Table 1. Two traded facilities have power distribution operations. Of the government facilities included in the study, four are local governments. The others consist of a national level government facility, a university, and a redevelopment agency.

Table 1. Industry Association

Facility Type	Industrial Type	
• Publicly Traded Facilities (18)	14 = manufacturing 2 = power distribution	1 = foods 1 = resource production
• Privately Owned Facilities (14)	13 = manufacturing	1 = lab equipment
• Government Facilities (7)	4 = local government 1 = national government	1 = university 1 = redevelopment agency

When comparing facility sizes, the publicly traded facility group differs from the privately owned and government groups in that it is comprised mainly of medium-large and larger-sized organizations (72 percent) and only a few small facilities (11 percent), see Table 2. The privately owned and government facility groups are more diverse, however, in that they are comprised of relatively equal sizes of small, medium, and large facilities, although there are fewer large facilities.

Table 2. Facility Sizes

Facility Type	Number of Employees[a]			
	< 100	100 to 299	300 to 999	> 1000
• Publicly Traded Facilities (18)	11% (2)	17% (3)	50% (9)	22% (4)
• Privately Owned Facilities (14)	29% (4)	29% (4)	36% (5)	7% (1)
• Government Facilities (7)	57% (4)	0% (0)	29% (2)	14% (1)

a Fisher's Exact Test shows that the association between facility size and facility type is statistically significant at $p < 0.11$.

[44] The Fisher's exact test determines the strength of the association between facility drivers and facility types. This nonparametric approach also has a distinct advantage over a parametric approach in that it does not require additional distributional assumptions that may be poor approximations in small samples and is not subject to model misspecification (Hess and Orphanides 1995; Stokes, Davis, and Koch 1995).

[45] For example, the regulatory driver index is comprised of three dichotomous variables and two ordinal variables. To evaluate this index, each of the five drivers that comprise it were tested individually, and then two joint tests were performed--one for the ordinal drivers and one for the dichotomous drivers. Similar tests were performed for the social, external, and internal driver indices. In contrast, because the variables that comprise the market and resource driver indices are ordinal, only one joint test was performed for each of them. While employing two types of exact tests for some of the indices creates difficulties in interpreting the results, the nature of the data required that the tests be separated.

All of the publicly traded companies are marketing their products internationally and 89 percent of them are producing their goods in international markets, as seen in Table 3. This contrasts with the privately owned companies, which are more subdued in the production and marketing of their products in international arenas. Seventy one percent of the privately owned companies are marketing their products internationally and 36 percent are involved in international production. As might be expected, the government facilities are much less involved in the international arenas. These differences are statistically significant at $p < 0.01$.

Table 3. International Production and Marketing

Facility Type	International Production	International Marketing of Products
• Publicly Traded Facilities (18)	89% (16)[a]	100% (18)[b]
• Privately Owned Facilities (14)	36% (5)[a]	71% (10)[b]
• Government Facilities (7)	0% (0)[a]	29% (2)[b]

a Fisher's Exact Test shows that at $p < 0.01$, the three types of facilities differ significantly in whether they produce their products internationally or not and (2) whether they market their products internationally or not.
b Fisher's Exact Test shows that at $p < 0.01$, the three types of facilities differ significantly in whether they market their products internationally or not.

Of the 39 facilities, four-fifths (80 percent) belong to a larger organization or parent organization, and of these facilities *all* of the publicly traded enterprises belong to larger organizations, as described in Table 4. In contrast, 64 percent of privately owned facilities and over half (57 percent) of the government facilities have parent organizations. The association between facility type and the presence of a larger organization is statistically significant at $p < 0.05$. These findings provide some insight on facilities' internal capabilities, as one might expect that organizations belonging to parent organizations might have greater access to resources that support the EMS adoption process.

Table 4. Relationship with Larger Organizations and ISO 14001

Facility Type	Single Facility Ownership & Certification Status		Facility with Parent Organization & Certification Status			Total ISO Certified[c] Facilities
	Single Facility[a]	*Single Facility w/ ISO 14001*	*Facility w/ Parent Org.*	*Facility w/ Parent Org. & ISO 14001*	*Parent Org. Requires or Encourages EMS Adoption*	
• Publicly Traded	0% (0)	N/A	100% (18)[a]	78% (13)[b]	89% (16)[b]	72% (13)
• Privately Owned	36% (5)	38% (3)	64% (9)[a]	44% (7)[b]	67% (6)[b]	71% (10)
• Government	43% (3)	33% (1)	57% (4)[a]	0% (0)[b]	0% (0)[b]	43% (3)
Facility Total	***21% (8)***	***10% (4)***	***80% (31)***	***51% (20)***	***56% (22)***	***67% (26)***

a Fisher's Exact Test results show that at $p < 0.01$, the three types of facilities differ significantly in whether they are part of a larger organization or not.
b Fisher's Exact Test results show that at $p < 0.01$, the three types of facilities differ significantly in whether they whether their parent organization mandates, encourages, or is neutral regarding ISO 14001 certification.
c Denotes those facilities that are presently certified to ISO 14001 or are seeking third party certification to ISO 14001. Facilities that forego third party certification are not included in these counts.

For publicly traded and privately owned facilities with parent organizations, ISO 14001 certification rates are similar, as 72 and 78 percent, respectively, have adopted or intend to adopt ISO 14001. This differs from government facilities, for which 50 percent either have already adopted or intend to adopt ISO 14001.

For publicly traded facilities, 89 percent were either required or encouraged by their parent organization to adopt an EMS. Privately owned companies, however, have less parent organization involvement in their EMS adoption, as about two thirds (67 percent) of them are required or encouraged by their parent organization to adopt an EMS. Interestingly, none of the parent organizations of government facilities have mandated or even encouraged EMS adoption.[46] Instead, these larger organizations have remained neutral in the facility-level decisions related to this matter. Thus, EMS adoption largely occurs under the leadership of the facility managers themselves.

Finally, facilities that can be described as "single facility" with no parent organization have ISO 14001 certification rates less than those organizations with parent organizations. ISO 14001 certification for single-facility private companies is 38 percent, as compared to 78 percent of privately owned companies with parent organizations. This information points to the importance of parent organizations' influences on facility-level ISO 14001 certification decisions.

The estimation results of the theoretical model of facilities' rationales for EMS adoption are illustrated in Table 5. The table describes the estimated indices for each of the external and internal drivers as well as the various pressures that comprise the indices themselves.

External Drivers

Regulatory Drivers. Of all the *external* drivers, regulatory pressures had the greatest influence on facilities' decisions to adopt an EMS, as noted by the *regulatory driver indices* in Table 5. Between 62 percent and 84 percent of each of the facilities considered regulatory pressures to be a medium or high influence, and the percent of those facilities that report that regulatory pressures exerted "high" influences was greater than for any other external driver category. Sixty percent of public facilities report that regulatory pressures were "high" influences on their decision to adopt an EMS. While publicly traded and private facilities also report their importance, they are less influential (40 and 34 percent, respectively). Despite these differences, results from the Fisher's exact test show no significant statistical difference between them $p <= 0.32$–dichotomous, $p <= 0.25$–ordinal, respectively), as seen in Table 6 below. Collectively, these findings speak to the importance of the environmental regulatory system on facilities' decisions to adopt an EMS, and are congruent with previous research on the voluntary environmental activities of enterprise.

[46] The results of the Fisher's exact test show that the differences between the three types of facilities related to whether their parent company mandates, encourages or is neutral about ISO 14001 are statistically significant at $p < 0.05$.

Table 5. Statistical Analysis Results

Drivers	Facility Type								
	Publicly Traded (n»18)			*Private (n»14)*			*Government (n»7)*		
	H	M[a]	L	H	M[a]	L	H	M[a]	L
EXTERNAL DRIVERS:									
Regulatory Drivers									
1. # Violations–10a	38%	–	63%	38%	–	62%	29%	–	71%
2. # Non-Compliances–10b	47%	–	53%	29%	–	71%	57%	–	43%
3. # Potential Non-Compliances–10c	40%	–	60%	31%	–	69%	71%	–	29%
4. Regulatory Benefits–13k	33%	28%	39%	21%	43%	36%	71%	0%	29%
5. Improve Compliance–13m	44%	28%	28%	50%	29%	21%	71%	29%	0%
Regulatory Driver Index Dichot.	***41%***	–	***59%***	***33%***	–	***68%***	***52%***	–	***48%***
Regulatory Driver Index Ordinal	***39%***	***28%***	***33%***	***36%***	***36%***	***29%***	***71%***	***14%***	***14%***
Market Drivers									
1. US Customer Pressures–13a	17%	22%	61%	7%	14%	79%	0%	0%	100%
2. Int'l Customer Pressures–13b	17%	22%	61%	14%	0%	86%	0%	0%	100%
3. Marketing Tool–13f	29%	29%	41%	21%	21%	57%	0%	0%	100%
4. Public Relations Tool–13g	17%	28%	59%	29%	43%	29%	43%	14%	43%
5. Competitive Advantage–13j	22%	61%	17%	29%	50%	21%	0%	29%	71%
6. Enviro. Profs. Support EMSs–13n	6%	25%	69%	7%	21%	71%	0%	29%	71%
Market Driver Index	***18%***	***32%***	***51%***	***18%***	***25%***	***57%***	***7%***	***12%***	***81%***
Resource Drivers									
1. Insurance Pressures-13e	0%	0%	100%	0%	21%	79%	0%	0%	100%
2. Shareholders/Owners–13c	18%	12%	71%	14%	7%	79%	0%	0%	100%
3. Technical Assistance–13o	0%	11%	89%	36%	14%	50%	29%	43%	29%
4. Reduce Costs–13h	44%	28%	28%	36%	57%	7%	43%	14%	43%
5. Increase Revenues–13I	14%	43%	43%	8%	31%	62%	0%	0%	100%
Resource Driver Index	***16%***	***18%***	***66%***	***19%***	***26%***	***55%***	***14%***	***14%***	***71%***
Social Drivers									
1. Facility Size–7	72%	17%	11%	43%	29%	29%	43%	0%	57%
2. 33/50 Participation–9a	39%	–	61%	29%	–	71%	0%	–	100%
3. Green Lights Participation–9b	28%	–	72%	7%	–	93%	0%	–	100%
4. # Stakeholder Requests–12	17%	17%	67%	7%	14%	79%	14%	43%	43%
5. Stakeholder Pressures–13d	0%	0%	100%	0%	0%	100%	0%	0%	100%
Social Driver Index Dichot.	***33%***	***–***	***67%***	***18%***	***–***	***82%***	***0%***	***–***	***100%***
Social Driver Index Ordinal	***31%***	**12%**	***57%***	***17%***	***14%***	***69%***	***19%***	***14%***	***67%***
EXTERNAL DRIVER INDEX 1	***39%***	–	***62%***	***26%***	–	***74%***	***31%***	–	***69%***
EXTERNAL DRIVER INDEX 2	***23%***	***23%***	***54%***	***20%***	***25%***	***55%***	***20%***	***13%***	***67%***
INTERNAL DRIVERS:									
Management Sys. Capability									
1. ISO 9000–8	72%	–	28%	79%	–	71%	0%	–	100%
Environment Mgt. Capability									
1. Pollution Prevention Plan–11	61%	–	39%	43%	–	57%	14%	–	86%
Resource Capability									
1. Employee Participation–13h	57%	29%	14%	50%	29%	21%	43%	43%	14%
Organizational Culture									
1. Environ. Principles–13p	67%	33%	0%	71%	21%	7%	57%	43%	0%
INTERNAL DRIVER INDEX 1	***67%***	–	***33%***	***61%***	–	***39%***	***7%***	–	***93%***
INTERNAL DRIVER INDEX 2	***55%***	***30%***	***15%***	***54%***	***39%***	***7%***	***50%***	***36%***	***14%***

a "–" represents a dichotomous variable. Weighted averages that comprise the indices for "medium" values include ordinal data only.

Table 6. Statistical Differences of Driver Indices

Driver Category	*p* value <=
External Driver Indices	
• Regulatory Drivers--dichotomous	0.32
• Regulatory Drivers--ordinal	0.25
• Market Drivers	0.02[a]
• Resource Drivers	0.50
• Social Drivers--dichotomous	0.03[a]
• Social Drivers--ordinal	0.56
• *Aggregated External Drivers--dichotomous*	0.32
• *Aggregated External Drivers--ordinal*	0.10[a]
Internal Driver Indices	
• Management Systems Capabilities	0.01[a]
• Pollution Prevention Capabilities	0.13[a]
• Resource Capabilities	0.39
• Corporate Culture	0.77
• *Aggregated Internal Drivers--dichotomous*	0.01[a]
• *Aggregated Internal Drivers--ordinal*	0.86

a Drivers are statistically significant at $p <= 0.13$. *p* values correspond to Fisher's exact two-tailed test for all facilities being equal. A weaker association is found in some instances between facility types and drivers influencing EMS adoption, as is the case for the ordinal Aggregated External Driver Index. There are, nevertheless, fewer than ten chances in one hundred that the association results are due to chance alone. For those indices which are statistically insignificant at $p <= 0.13$ (i.e., regulatory drivers, resource drivers, ordinal social drivers, and ordinal internal drivers, the results are still interesting and point to how the facilities respond similarly to specific individual drivers, despite their organizational differences.

The specific influence of *regulatory benefits* on facilities' EMS adoption decisions is also worth addressing. While these benefits have yet to be realized, pilot facilities anticipate them to come in the form of expedited and consolidated permitting. Some states are considering the possibility of waiving state regulations, and seeking waivers of federal regulations, for facilities that achieve environmental results that are superior to those otherwise required by law. All three types of pilot facilities have responded to these potential regulatory benefits which appear to influence their decision to adopt an EMS (62 percent of publicly traded facilities report either medium or high influence; similarly, 64 percent of privately owned and 71 percent of government facilities report medium or high influence). These findings may be particularly meaningful for public policy and the role of government in encouraging future EMS adoption.

Market Drivers. As might be expected, market drivers are more relevant to publicly traded facilities and privately owned facilities as, respectively, 50 percent and 43 percent of them report them that they were a high or medium influence. Government facilities, however, report that market pressures had only a marginal impact on their EMS adoption decisions as only 19 percent report that they had a high or medium influence, as indicated in the *Market Driver Index*. These findings are consistent with the international production and marketing figures described in Table 3, which indicate low activities by government facilities in these arenas.[47]

There are, however, differences among the types of facilities and the market driver influences on their EMS adoption decisions. Only public relations opportunities yielded high influences for government facilities' EMS adoption decisions (40 percent reported them as

[47] The differences between facility type and market drivers are statistically significant at $p < 0.02$, as seen in Table 6.

"high"), and to a lesser degree, privately owned facilities' decisions (29 percent reported them as "high"). These findings are particularly important as EPA and the participating states had hoped that when designing the pilot program facilities might be influenced to adopt an EMS if government offered them enhanced publicity (e.g. press releases and announcements, media events, pollution prevention awards, and annual conferences). Despite these efforts, it appears that increased public relations opportunities did not influence publicly traded companies in their EMS adoption decisions (17 percent reported them as a "high" influence). Instead, public relations opportunities had a more moderate influence on EMS adoption. Forty five percent of publicly traded facilities, 72 percent of private facilities, and 57 percent of government facilities report that these opportunities had either a "high" or "medium" influence on their decision to adopt an EMS.

Of the various market drivers, *customer pressures* from both domestic and international buyers were more relevant to publicly traded facilities' EMS adoption decisions than they were to privately owned facilities' decisions. In addition, publicly traded and privately owned facilities believed that EMS adoption might provide them a competitive advantage, and thus was a high or moderate influence on their decision to adopt an EMS (83 percent and 79 percent, respectively). These differences among the facility types are statistically significant at $p < 0.11$, as seen in Table 7.

Resource Drivers. Perhaps the most important finding related to the various resource driver influences is the role that government assistance programs played for privately owned companies and government programs. These programs influenced over 50 percent of private organizations and 72 percent of government facilities by offering aid during their EMS development and implementation. In contrast, publicly traded facilities were largely unaffected by offers of government technical assistance as only 11 percent viewed these programs as at most a "moderate" influence and none of them reported it to be a high influence. These differences are statistically significant at $p < 0.01$, as seen in Table 7, and suggest that government facilities operate very differently from publicly traded and privately owned facilities that also adopt an EMS.

Table 7. Statistically Significant Differences of Adoption Drivers[a,b]

Driver Category	*p* value <
External Drivers	
• Competitive Advantage	0.11
• Increase Revenues	0.15
• Insurance Pressures	0.13
• Technical Assistance	0.01
• Facility Size	0.11
Internal Drivers	
• Management System Capability (ISO 9000)	0.01
• Environmental Management Capability (Pollution Prevention Plan)	0.13

a The table reflects all variables with statistical significance of $p <= 0.15$. *p* values correspond to Fisher's exact two-tailed test for all facilities being equal. A weaker association is found in some instances between facility types and drivers influencing EMS adoption. There are, nevertheless, fewer than fifteen chances in one hundred that the association results are due to chance alone. For all other individual drivers, the facilities respond similarly to them, despite their organizational differences.

b Although this table lists only the specific drivers which are statistically significant, those drivers which are omitted and statistically insignificant are still interesting to consider. These results point to how the facilities, despite their organizational differences, respond similarly to specific individual drivers.

All three facilities reported that resource drivers to reduce costs were relevant to their EMS adoption decisions (traded facilities = 72 percent; private facilities = 93 percent; government facilities = 57 percent). Publicly traded and privately owned facilities also see in EMSs the possibility of increasing their revenues (57 percent and 39 percent respectively), although this finding is not as strong as was the potential to reduce their costs. These differences are statistically significant at $p < 0.15$, as seen in Table 7. Interestingly, shareholders and owners have only limited influence (71 percent and 79 percent, respectively, reported it as "low"). Taken together, these results may indicate that facility managers are considering an EMS as a tool to increase production efficiency, although managers of privately owned enterprises do so to a lesser degree. In contrast, government facilities only considered half of the efficiency argument. That is, they report that revenue potential had little impact on their decisions to adopt an EMS, as all reported that it had "low" influence, despite the fact that cost reductions did play a part (43 percent report it to be a "high" influence). These findings point to the important differences between government and for-profit organizations in how they operate and their internal incentive structures.

Social Drivers. Social drivers are the least influential external drivers for privately owned and government facilities. Approximately one-quarter of privately owned facilities report that social drivers had either a moderate or high influence on their EMS adoption decisions. Similarly, nine percent of government facilities report that they had at most a moderate influence. It is important to note, however, that for the publicly traded facilities social drivers influenced their EMS adoption decisions more than did resource drivers. This difference may be due the fact that traded facilities often have greater public exposure due to their size ($p < 0.11$), name recognition, and community prominence, and thus have additional social pressures placed on them. Finally, while government facilities report a moderate number of stakeholder requests, they also suggest that social pressures are only a marginal component of their EMS adoption decisions. This finding may be due in part to the form of the stakeholder requests themselves, as they are probably non-threatening inquiries, otherwise they would likely have had a greater influence on facilities' EMS adoption decisions.

Internal Drivers

For publicly traded and privately owned facilities, *internal* drivers had a greater impact on facility's EMS adoption decisions than did *external* drivers, as seen when comparing the moderate and high influences in the *internal driver indices* to the *external driver indices*. These differences suggest the importance of facilities' internal capabilities in their EMS adoption decisions. For government facilities, however, while the overall influence of internal drivers is an important factor in their EMS adoption decisions (72 percent report a medium or high influence), regulatory drivers are more important (74 percent report a high influence). This difference is magnified when comparing "high" influences only as 60 percent of government facilities report regulatory influences to affect their decisions as compared to internal drivers (29 percent).

Management System Capability. In evaluating facilities' management system capabilities prior to EMS adoption both publicly traded and privately owned facilities largely made their EMS adoption decisions with ISO 9000 management system capabilities in place. Because of this preexisting capability, EMS adoption and maintenance likely demand fewer

internal resources and are more easily integrated into the facility's management practices themselves. This is a stark contrast to government facilities, of which none had in place an ISO 9000 management system prior to EMS adoption. These differences are statistically significant at $p < 0.01$, as seen in Table 7, and further supports the notion that government facilities operate very differently from publicly traded and privately owned facilities that also adopt an EMS. It also points to the potential role of public policies that assist government facilities by enriching their management capabilities with technical assistance and other programs that may encourage EMS adoption.

Environmental Management Capability. With respect to facilities' prior environmental management (EM), most publicly traded facilities had relatively high EM capabilities (61 percent) as measured by whether they had a pollution prevention plan or not during the three years prior to EMS adoption. Forty-three percent of privately owned facilities had in place relatively high EM capabilities. Only fourteen percent of government facilities, however, had prior EM capabilities. Despite the lack of strong capabilities prior to EMS adoption, government facilities still pursued EMS adoption, which is surprising. These differences are statistically significant at $p < 0.13$. One explanation for these results is that shortcomings in government facilities' management system and EM capabilities might have been offset by the technical assistance benefits that they received, as interestingly these benefits played a significant role in their EMS adoption decisions. For privately owned facilities, technical assistance played a moderate role. In contrast, publicly traded facilities, which largely had strong internal capabilities prior to EMS adoption, were influenced only marginally by the technical assistance programs that were offered to them. In fact of the external drivers, technical assistance programs had one of the lowest rated influences on publicly traded facilities' EMS adoption decisions.

Resource Capability. Despite the management capability differences among the three types of facilities, they all largely hoped that EMS adoption might improve their employees' participation in their environmental management activities.

Organizational Culture. All three facility groups report that their organizational cultures affected their decision to adopt an EMS. Indeed, for privately owned and government facilities, it is the most powerful internal driver. While it is easy to dismiss these findings as being overstated as some environmental managers may likely romanticize the organizational culture in which they work, adopting an EMS generally requires substantial investments in capital and human resources. Should these investments fundamentally conflict with the organization's philosophy of doing business, the facility will be less likely to undertake such an endeavor. For all three facility groups, organizational culture played an influential role in their EMS adoption decisions.

VI. CONCLUDING REMARKS

The increasing rate of EMS adoption is an important environmental signaling phenomenon in itself, and for the businesses that choose to implement them. Among the many recent initiatives toward "voluntary approaches" to improve environmental management, the adoption of EMSs represents the most significant form to date of a systematic commitment to continuous environmental improvement by facilities and their parent organizations, which also gives it greater legitimacy as a green signal. This research begins to understand the phenomenon

of environmental signaling by presenting a theoretical model and performing an exploratory analysis to explain EMS adoption decisions.

The results of this exploratory analysis, while somewhat limited due to sample size constraints, emphasize the importance of the U.S. environmental regulatory system as a motivator for EMS adoption for all three types of facilities. These findings give further evidence to the suggestion that the presence of the regulatory system itself may foster facilities' decisions to consider environmental management goals as part of their profit maximizing criteria. More specifically, it appears that facilities are adopting EMSs to ease the regulations imposed on them. In doing so, they are "signaling" their likelihood for exemplary environmental compliance, and thus reducing their regulatory burdens via negotiated regulatory benefits. This finding is particularly relevant to regulators in that EMS adoption at the facility level might be encouraged in *all* types of organizations by extending regulatory benefits to them.

Second, publicly traded facilities appear to have strong internal capabilities that fortify their EMS adoption decisions. For privately owned and government facilities, these capabilities are less impressive, which may create a moderate barrier in their decision to adopt an EMS. Internal capabilities, however, inherently interact with external resources. Where a capability might be lacking, an external resource might be leveraged to strengthen it. With respect to a facility's decision to adopt an EMS, the availability of technical assistance (e.g. EMS design and implementation training, small grants, and periodic meetings with other facilities to learn about each other's EMS implementation successes and failures) may be particularly relevant to strengthening these capabilities so that EMS adoption is possible for privately owned and government facilities that would otherwise not consider it. Technical assistance, moreover, may be particularly important for federal facilities that are subject to Executive Order 13148, as their internal capabilities might not be able to support and maintain a viable EMS.

Technical assistance, at least in the form stated above, may be less effective at encouraging EMS adoption for publicly traded facilities, as it was one of the *least* influential pressures on their EMS adoption decision. One reason for this is that publicly traded facilities have prior internal resources and capabilities that are more likely to support EMS adoption, and thus technical assistance is not needed. All of these facilities, moreover, belong to parent organizations, which increases their access to additional resources.

Government facilities, and to a lesser degree private facilities, were moderately influenced by the possibilities of leveraging EMS adoption as a public relations tool. For this reason, policy tools that increase the publicity they receive for adopting an EMS may influence government facilities in particular. In the pilot program, policy incentives came in the form of press releases and announcements, media events, pollution prevention awards, and annual conferences. For publicly traded facilities these incentives had less effect on their EMS adoption decisions.

Publicly traded facilities do appear, however, to respond to incentives related to potential regulatory benefits. While these benefits have yet to be realized, pilot facilities anticipate them to come in the form of expedited and consolidated permitting. Some states are considering the possibility of waiving state regulations, and seeking waivers of federal regulations, for facilities

that achieve environmental results that are superior to those otherwise required by law. All three types of pilot facilities have responded to these potential regulatory benefits, which appear to influence their decision to adopt an EMS.

Two topics merit exploration in future research. First, while EMS adoption occurs at the facility level, many facilities' decisions about their environmental management strategy are made at the corporate level. Evidence of this corporate-level influence is seen in the descriptive statistics above—78 percent of the publicly traded facilities have adopted their EMSs because of corporate mandate. Thus, a key question for future research to address 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, these results are for facilities that participated in a pilot program. What is important to know is how these facilities and their parent organizations differ from facilities that do not adopt an EMS and facilities that adopt an EMS but do not participate in a government-sponsored program. It is likely that the pilot facilities, because states imposed compliance criteria on their participation, have compliance records that are better than average. In order to achieve these better-than-average compliance records, resource-based theory suggests that these facilities and their parent organizations have *greater* internal capacities than other enterprises. If this suggestion is correct, then technical assistance may be even *more* relevant to encourage EMS adoption among the broader population of U.S. facilities.

There is still much that can be learned about facilities' EMS adoption decisions, and the voluntary environmental management activities that lead to green signals. The information presented here provides a theoretical framework for exploring these decisions and offers some preliminary evidence about those types of factors that may play a greater role than others.

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APPENDIX 1:
Relevant Subset of NDEMS Questions[48]

1. What is your facility's primary business or function? _____ (see attached organization type code list)
   If your facility's primary business function is I1 (other), please specify what that function is: _____

2. Is your facility or parent organization (please check one):
   ___ publicly traded
   ___ privately owned
   ___ government (municipality or federal facility)

3. Is your facility part of a larger business or government organization? *Note: a larger organization is the corporate or parent enterprise, if such an enterprise exists, with which a facility is affiliated.*
   ___ no
   ___ yes (How did that organization affect your facility's decision to adopt an EMS? Choose one:
      ___ The larger organization *requires* (or will require) all its facilities to adopt an EMS.
      ___ The larger organization *encourages* all its facilities to adopt an EMS.
      ___ The larger organization is *neutral* (neither encourages nor discourages) its facilities to adopt an EMS.
      ___ The larger organization *discourages* its facilities to adopt an EMS.

4. Does your organization produce any products in countries other than the United States?
   ___ yes (please list the countries: _____)
   ___ no

5. Does your organization market its products in countries other than the United States?
   ___ yes (please list the countries: _____)
   ___ no

6. ISO 14001 Certification—Check **all** the categories that describe your facility's certification status:
   ___My facility is ISO 14001-certified
   ___My facility is ISO 14001-**self-certified**
   ___My facility intends to become ISO 14001-certified
   ___My facility intends to become ISO 14001-**self-certified**
   ___My facility **does not** intend to become either ISO 14001-certified, or self-certified

7. How many full-time employees work at your facility?
   ___ < 20 ___ 100 - 299
   ___ 20 - 49 ___ 300 - 999
   ___ 50 - 99 ___ > 1,000

8. Did your facility have ISO 9000 certification prior to adopting its EMS?
   ___ yes
   ___ no

9. Which of the following voluntary environmental management did your facility participate in prior to adopting its EMS? (Check all that apply)
   __ a. EPA's 33/50 Program
   __ b. Green Lights

[48] The complete NDEMS protocols are available at www.eli.org/isopilots.htm.

10. Violations, Non-compliances, and Potential Non-compliances—Please use the following definitions when answering (10.a) and (10.b), below:
Violation: non-compliance discovered by environmental agency personnel or reported to agency personnel which results in a formal enforcement action against the facility.
Non-compliance: non-conformity in fulfilling legal requirements.

a. Over the past three years, has your facility had any violations?
___ yes
___ no

b. Over the past three years, has your facility had any reported non-compliances?
___ yes
___ no

11. During the three years prior to EMS adoption, did your facility engage in pollution prevention activities?
__ yes
__ no

12. Over the past three years, how often has your facility, on average, responded to inquiries from outside parties regarding the environmental characteristics of your products or services or the environmental performance of your facility?
___ 0 or 1 time per year
___ 2 to 10 times per year
___ 11 to 50 times per year
___ 50 to 100 times per year
___ 100 or more times per year

13. Rationale for Adopting an EMS—Facilities adopt EMSs for a variety of reasons. From the list of options below, please circle the appropriate letter (H= high importance; M= medium importance; L= low importance; N/A= not applicable) *to rank each* of the following items in terms of how important they were to your facility's decision to adopt an EMS.

a.	H	M	L	N/A	Domestic customers' pressure for ISO 14001 certification
b.	H	M	L	N/A	International customers' pressure ISO 14001 for certification
c.	H	M	L	N/A	Shareholders' or owners' pressure for ISO 14001 certification
d.	H	M	L	N/A	Outside interested parties' pressure to adopt an EMS
e.	H	M	L	N/A	Insurers may reward ISO 14001 certification
f.	H	M	L	N/A	EMS adoption may be a valuable marketing tool
g.	H	M	L	N/A	EMS adoption may be a valuable public relations tool
h.	H	M	L	N/A	Adoption of an EMS may reduce our costs
i.	H	M	L	N/A	Adoption of an EMS may increase our revenues
j.	H	M	L	N/A	Adoption of an EMS may provide a competitive advantage
k.	H	M	L	N/A	Adoption of an EMS may lead to regulatory benefits
l.	H	M	L	N/A	Adoption of an EMS may improve our employees' participation in the facility's environmental performance
m	H	M	L	N/A	Adoption of an EMS may improve facility compliance with environmental regulations
n.	H	M	L	N/A	Environmental management professionals are increasingly supporting EMSs
o.	H	M	L	N/A	Availability of government assistance programs to aid in EMS development makes EMS adoption attractive
p.	H	M	L	N/A	Adoption of an EMS is consistent with the facility's overall environmental principles
q.	H	M	L	N/A	Other (please specify: _____)
r.	H	M	L	N/A	Other (please specify: _____)

Many Shades of Green: Discovering the Types of Environmental Management Systems that Facilities Develop[49]

November 2000

Deborah Rigling Gallagher[50]

ABSTRACT

Business managers are increasingly looking towards environmental management systems (EMSs) like ISO 14001 as a tool for achieving regulatory compliance and improving environmental performance. This paper examines this trend to determine what types of EMSs facilities build and how they might be used as a public policy tool to promote increased environmental performance. A typology of EMSs is proposed and tested using facility level data from the National Database on Environmental Management Systems, a joint research project of the University of North Carolina at Chapel Hill and the Environmental Law Institute. Case study information from two NDEMS facilities is also examined to highlight the influences of internal and external stakeholders on the development of specific EMS types. The possibility of a new business-government relationship, less focused on direct government surveillance of business behavior and more on leveraging business management systems, is considered.

I. INTRODUCTION

Since the early 1970s, businesses in the United States have been obligated to comply with an increasingly complex set of overlapping environmental laws and regulations addressing air and water emissions, solid and hazardous waste generation and disposal and disclosure of toxic byproducts. These myriad laws and regulations, which generally focus on single environmental problems, are continually modified and updated. This has contributed to an atmosphere of uncertainty, making it difficult for firms to develop an efficient and effective path toward compliance, let alone optimal environmental performance (USEPA, 1990).

Business managers are increasingly looking towards environmental management systems (EMSs) to make sense of this uncertainty. EMSs help facilities chart a course toward achieving compliance with environmental laws and regulations and to improve environmental performance beyond compliance. This paper builds on the growing body of literature concerning why facilities adopt EMSs (Darnall, 2000; Delmas, 2000; Florida, 1999) to discern the specific types of EMSs that facilities build and to consider how EMSs might be used as a public policy tool to promote increased environmental performance.

II. THE ENVIRONMENTAL MANAGEMENT SYSTEM AS A STRATEGIC RESPONSE

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[50] Curriculum in Public Policy Analysis; 919-962-9827; Deborah_Gallagher@unc.edu. I am grateful for the contributions of colleagues Nicole Darnall, David Edwards, Richard Andrews, Yihua Zhang and Deborah Amaral of the University of North Carolina and Suellen Keiner, Matthew Mitchell, Kapena Pflum and Dorigen Fried of the Environmental Law Institute, as well as the continuing cooperation of participating facilities and state project managers.

Alfred Chandler (1962) defined a business strategy as, "the determination of basic long-term goals of an enterprise, and the adoption of the courses of action and allocation of resources necessary for carrying out these goals". Further, Andrews (1971) asserted, "the most important function of strategy is to serve as the focus of organizational effort, as the object of commitment, and as the source of constructive self-control in the organization itself." Each of these authors was speaking directly to the form and content of a firm's business strategy, how the firm addresses external problems such as choosing which products to make and how to operate within specific markets in order to achieve an appropriate return on investment.

A facility's EMS can be evaluated as its strategic response to the challenges of environmental laws and regulations and of pressures from neighbors, customers and parent corporations for the facility to behave as an environmental citizen. Facilities respond to these pressures by designing and implementing EMSs that reflect their strategic business interactions with internal and external stakeholders (Oliver, 1991) as they operate in the natural environment. Not only do these pressures influence facilities to decide to adopt EMSs (Darnall, 2000), they also influence the type or characteristics of EMSs they build, which may lead to differences in outcomes and resulting performance.

EMSs assist facilities in reaching compliance and help them identify, minimize and manage environmental risks. They are designed to ensure continuous improvement of environmental performance. And finally, EMSs reflect the form and content of the facility's relationships with internal stakeholders such as employees and parent companies, as well as external stakeholders such as consultants, regulators, customers, and neighbors. An EMS generally consists of five components: an environmental policy, an environmental plan, an implementation strategy, a monitoring and corrective action system, and management review. But, although all EMSs are designed to fulfill the objectives of these five components, facility EMSs vary significantly. EMSs vary in goals and objectives, timeframes, communication procedures and the parties involved in their design and implementation.[51] And, EMSs are designed and developed in specific ways to address particular problems and to express the individual characteristics and cultures of individual facilities.

III. THEORETICAL FRAMEWORK AND MODEL

Little research has been conducted to examine what EMSs look like at the facility level, or to understand the processes by which they are developed. Few researchers (Rondinelli, 2000) have attempted to go inside facilities as they design and develop EMSs. Most research on environmental management systems has been based on one type of EMS, the ISO 14001 EMS [52], (Chin and Pun, 1999; Tenner, 1999; Nash et.al, 1999). Researchers have considered pollution

[51] For example, in a preliminary examination of EMS design (Gallagher, Darnall and Andrews, 1999), the facilities studied had developed a variety of programs to communicate information about their environmental policy and EMS components to employees. These included formal training sessions and meetings, web site postings and personal copies of the facility's environmental policy.

[52] Many firms are seeking certification of their environmental management systems under ISO 14001, the international environmental management standard. Under ISO 14001, firms construct EMSs according to criteria provided by the International Organization for Standardization. ISO 14001 certification is granted if an independent auditor determines the firm's EMS is in conformance with all criteria. Firm environmental performance is not certified; its environmental management system is certified. But, to be certified a firm must have in place an adequate system for measuring and monitoring performance. Departures from compliance are evidence of a substandard system.

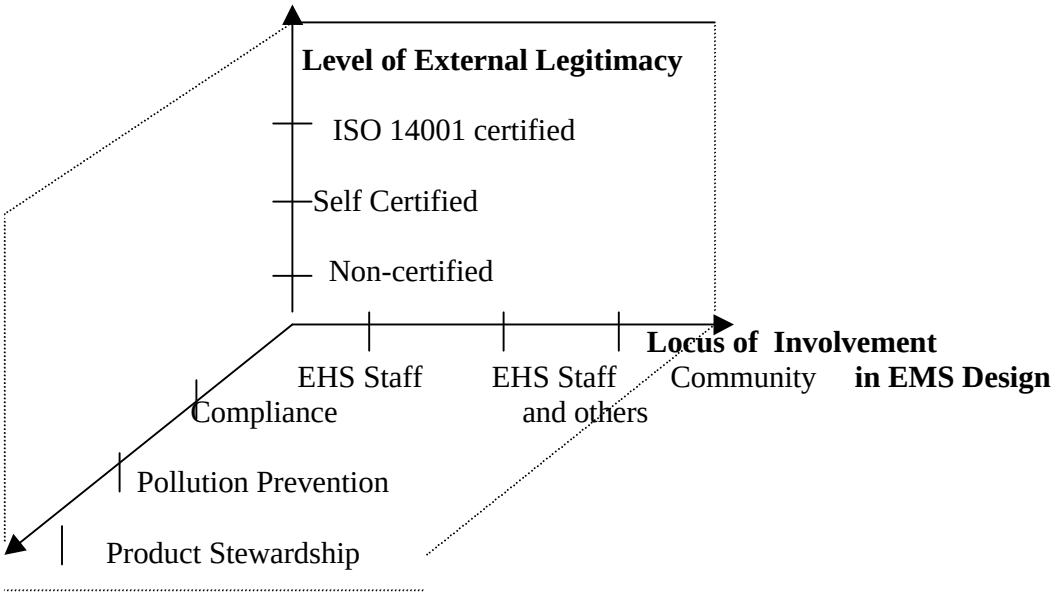
prevention in EMSs (Florida, 1999), policy options for increasing the use of EMSs (Coglianese, 1999), and the relationship between EMSs adoption and environmental excellence (Nash and Ehrenfeld, 1999). But critical issues such as how facilities develop EMSs, what factors are influential in their development and what the specific outcomes of their efforts look like are yet to be addressed. This study goes further by examining EMS design and development in detail to make the facility-specific EMS more transparent and to uncover the conditions that influence the development of specific EMS types.

An Environmental Management System Typology

A typology can systematically describe, in terms relevant to business and policy practitioners and scholars alike, the kinds of EMSs that facilities construct. When facility-level data are analyzed using an EMS typology, a clearer view of the EMS landscape may emerge. When this analysis is combined with case studies of facilities developing EMSs, we can begin to understand how and why facilities develop specific types of EMSs and discern the roles that internal and external stakeholders play in shaping facility–specific EMS design and hence track differences in outcomes as well.

Figure 1, below, shows the dimensions of a typology suitable for describing facility EMSs. Each dimension is a relevant reference point to business and policy scholars, community leaders, regulators and facility managers. Each axis measures where a facility's EMS is located in a specific dimension and is constructed as a progression of environmental policy goals. Each axis is also path dependent; facilities first develop the strategic capability closest to the origin of the axis before they develop the strategic capability associated with the second and so on.

Figure 1. EMS Typology



Locus of Involvement in Design. This axis represents a progression of actors that a facility may seek to involve in the design, development and implementation of its EMS. As a facility becomes more sophisticated with respect to seeking the advice and counsel of actors outside its core environmental health and safety (EHS) group, a broader sphere of external influence will be incorporated into its environmental management system (Freeman, 1984).

A facility with an environmental management system designed with information and feedback to the EHS team from regulators (EPA, state or local) is placed just to he right of the origin of the axis. This is the format in which environmental management processes are typically enacted: the EHS staff interacts with regulators, then implements their requirements or suggestions.

A facility which seeks advice and counsel from non-EHS employees in designing and implementing its EMS is placed next on the locus of involvement axis. The core EHS team reaches out to the employees within the facility who are not environmental experts but know a great deal about day to day facility operations. The addition of this type of expertise to EMS design efforts is beneficial in a number of ways. First, the EMS is more appropriately designed to fit the particular circumstances of the facility, such as those linked to process design, production and product distribution, for example. Second, it is likely to identify a range of opportunities for continuous improvement and efficient coordination and integration of aspects and impacts with other management considerations. And, third, when the EMS is implemented it is more likely to be familiar to a larger group of employees and better integrated into the facility's daily work.

A facility that looks toward its neighbors in the community to design and implement its EMS is placed in the third position on the axis. Advice from external stakeholders who are concerned with the facility's effect on the natural environment are incorporated into the EMS design. This type of facility-neighbor interaction may be formalized in a community advisory panel or it may be ad hoc as the EMS design efforts unfold. EPA and state regulators, in policy statements and in public participation requirements, have clearly indicated the importance of incorporating the advice of non-EHS management employees and of seeking input from those in the surrounding community as an EMS is designed and implemented.

Level of External Legitimacy. Facilities that obtain ISO 14001 certification are pursuing external legitimacy. A certified EMS signals to regulators, customers, parent corporations and neighbors alike that the EMS meets a certain externally defined threshold. Companies that achieve ISO 14001 certification frequently advertise this achievement; often decorating their facilities with banners attesting to their success.

The progression of this axis reflects facilities' pursuit of external validation and legitimacy. First, a facility designs an uncertified EMS, then may or may not seek to self-certify that EMS by first undergoing an internal audit of the system. An external audit may follow. An externally audited and self-certified facility, at that point "ISO-ready", may then seek to have that EMS ISO 14001-certified and registered (Puri, 1996).

System Goal: A facility typically progresses in a linear fashion in defining the environmental goals that its EMS will address. Most standards like ISO 14001 require that as a

minimum an EMS must be designed to reach full compliance with environmental laws and regulations. A facility's first goal in developing an EMS is typically to achieve compliance with environmental laws and regulations. Once the system has been fully specified and implemented to achieve compliance, pollution prevention goals are typically added.

Pollution prevention, in which waste streams are reduced and eliminated at the source through efforts such as improved operation and maintenance, input substitution or process redesign, generally builds on a facility's expert understanding of its legal and technical requirements. The inclusion of pollution prevention goals in a facility's EMS may be motivated by the facility's desire to escape some of these requirements. The technical skills and organizational resources necessary to achieve compliance are thus a building block for a pollution prevention-focused system. Pollution prevention efforts are also sometimes motivated by management decisions to weed out manufacturing process inefficiencies such as over-use of cleaning chemicals and to uncover cost savings.

Once pollution prevention goals are operational and waste streams are reduced or eliminated, a facility is in a position to develop a product stewardship-focused EMS. Facilities focused on product stewardship re-evaluate production processes to examine how products are designed. Product stewardship emphasizes evaluating long-term or life-cycle environmental impacts of materials incorporated into products throughout the design and production process. High impact materials are then reduced or eliminated. Design for the environment (DfE), materials accounting and life cycle design (Hirschhorn and Oldenburg, 1991; Hart, 1995) are tools of product stewardship.

The system goal axis's progression follows historical developments in public policy and business strategy and ultimately to strategic management for long-term sustainability. In the 1970s, U.S. environmental rules and regulations focused on compliance. In the late 1980's and 1990's, a pollution prevention focus (in addition to compliance) developed (Andrews, 1999). Finally, the United Nation's 1987 Brundtland Commission and the Earth Summit of 1992 in Rio have focused attention on the evolving policy goal of environmental sustainability. The concept of product stewardship, or design for the environment (DfE), where manufacturers take full account of environmental costs throughout a product's life cycle (President's Council on Sustainable Development, 1996) plays a critical role in evolving policies of environmental sustainability.

Application of the Typology

The EMS typology proposed above depicts twenty-seven possible types of EMSs. For example, a facility may design a self-certified/ EHS staff involved/pollution prevention focused EMS. Alternatively, a facility may design an ISO 14001 certified/community involved/compliance-focused EMS.

It is unlikely, however, that empirical analysis will show the existence of 27 EMS types in practice. Rather, an evaluation of facility EMS designs will most likely indicate the presence of a smaller number of EMS types. To test this theory, the EMS typology described in Figure 1 above was empirically estimated using a sample of facility-level EMS design data. A cluster

analysis of these data serves to locate the EMS types that exist in the study population described below.

III. STUDY CONTEXT AND DATA SOURCES

The National Database on Environmental Management Systems (NDEMS)

Since 1997, ten states (Arizona, California, Indiana, Illinois, New Hampshire, North Carolina, Oregon, Pennsylvania, Vermont and Wisconsin) and EPA Region I (through its StarTrack initiative) have adopted pilot programs that provide a variety of benefits, including technical assistance, financial grants, enhanced publicity, and regulatory flexibility to facilities that adopt ISO 14001-based EMSs. In exchange, these pilot facilities have provided data on their EMS development processes to the National Database on Environmental Management Systems (NDEMS), a joint research effort of the University of North Carolina and the Environmental Law Institute.

Currently, NDEMS contains data from just over 50 facilities. The data include both quantitative and qualitative information on pre-EMS compliance and economic and environmental performance and other attributes and primarily qualitative information on EMS design characteristics. Post-EMS design data are also being collected. The database has been constructed using information provided by volunteer pilot facilities recruited by the ten participating states.

The data supplied to NDEMS are gathered through a series of three research protocols, which are available on the project web site (http://www.eli.org/isopilots.htm). First, in the Baseline Protocol facilities describe pre-EMS design and implementation activities in five key areas: management systems, environmental performance, regulatory compliance, pollution prevention, stakeholder involvement and economic performance (costs and benefits of EMS).

Next, in the EMS Design Protocol, facilities describe how they designed and implemented their EMS. Detailed information on activities and associated environmental aspects and impacts and on EMS objectives and targets are provided during this phase. A third and final protocol, the Update, will soon be provided to participating facilities. It has been designed to obtain data on facility's post-EMS performance, and will be closely linked to the baseline and design protocols.

In addition to the survey data obtained from facilities though completion of the three research protocols described above, case study data have been obtained from nine facilities that have developed EMSs. Seven of these facilities are participants in the NDEMS project. These detailed case study data describe procedures used in designing the EMS and highlight the influences of employees, consultants, parent companies, regulators, customers, and neighbors on EMS design. Case study data were obtained during on-site interviews with facility employees involved in the EMS design process.

NDEMS Data Used in This Study

In the current study, EMS design data from a group of NDEMS facilities have been applied to a cluster analysis of the proposed EMS typology. Data on facility EMS objectives and targets have been used to determine the characteristics of the facilities' environmental management system goal. Data on facilities' certification plans have been used to determine the characteristics of facilities' level of external legitimacy. And finally, data on the internal and external actors involved throughout the EMS design process have been employed to determine the characteristics of facilities' locus of involvement in EMS design.

In this study case study data from two NDEMS facilities are also explored to illuminate the findings of the cluster analysis. These data from on-site interviews of facility employees involved in EMS design add to an understanding of how internal and external stakeholders such as employees, consultants, parent companies, regulators, customers, and neighbors may influence the process and outcomes of EMS design.

EMS design data from twenty-six facilities were input to a cluster analysis [53]. Based on review of the data, each facility was given a score for level of legitimacy, locus of involvement in design and systems goal. For legitimacy, a facility received a score of 1 for a non-certified EMS, a score of 1.5 for an intention to self-certify, a score of 2 for a self-certified EMS, a score of 2.5 for an intention to certify and a score of 3 for an ISO 14001-certified EMS. In determining the facility's system goal score a weighted average of all its EMS objectives was calculated. Objectives related to compliance were given a score of 1, those related to pollution prevention were given a score of 2 and those related to design for the environment were given a score of 3.

Finally, in determining the facility's locus of involvement score, the involvement of EHS staff only, of EHS staff plus a more broad group of employees, or of EHS staff, other employees and parties external to the facility development phases was considered. These phases were environmental policy development, aspect and impact identification, significance determination and objective and target setting. In each phase a score of 1 for EHS staff only, 2 for EHS staff and other employees, or 3 for EHS staff, other employees and external party involvement was assigned to each facility. A weighted average was then developed.

IV. RESULTS

Data Summary Analysis

Summary statistics for the facilities' alignment along the three axes are presented in Table 1, below. It is evident that for the sample EMSs examined, there exists more variability along the involvement and legitimacy dimensions than along the systems goal dimension.

[53] In this study only completely quality-controlled EMS design data were used, which at this juncture in the NDEMS project, reduces the sample size from 50 to 26 facilities. These facilities, however, are representative of the database overall; a cross-section of facility sizes and industrial sectors are present. For a more detailed description of demographics, see Andrews, et.al. (1999). Future work will be based on the full NDEMS sample complemented by data from a matched sample of non-NDEMS participant facilities.

Table 1. Facility EMS Characteristics along EMS Typology Dimensions

Axis	Minimum Score	Maximum Score	Mean Score	Standard Deviation
Involvement	1.00	2.75	1.91	0.52
Legitimacy	1.00	3.00	2.40	0.75
System Goal	1.00	2.14	1.87	0.28

To examine the variance in greater detail a difference of means test was completed. The results are as follows:

Cluster Analysis

A hierarchical cluster analysis procedure using Ward's method was used to determine the number of data clusters in the sample population. In this method a coefficient equal to the value of the distance between the two most dissimilar points within data clusters being combined is created during each iteration. Successive coefficients are compared to determine the appropriate number of clusters existing in the sample. When the increase in the coefficient value becomes large, clusters have reached maximum possible spread and cluster creation must end. Statistical power, available in cluster creation is a function of both the number of variables being considered (in this case, 4) and the sample size (in this case, 26). Because of these limitations, the Ward's method solution could only discern two distinct clusters, even though it appears evident in Figure 2 below that three EMS clusters may exist.

This procedure was followed up with a "k-means" cluster analysis in which the number of clusters is specified at the outset. The two-cluster solution suggested by Ward's method was specified. A k-means type of cluster analysis is used to elicit specific details on cluster location and membership for each descriptive variable. In each case the SPSS program (Norusis, 1997) was used. Summary data for the two-cluster solution are presented in Table 2, below.

Table 2. Cluster Analysis Summary

Cluster Type	Members (n = 26)	Locus of Involvement	Level of Legitimacy	Systems Goal
ISO-14001 Certified, Facility-wide Team Created	19	1.46	1.29	1.90
Non-certified, EHS Staff Driven	7	2.08	2.82	1.72

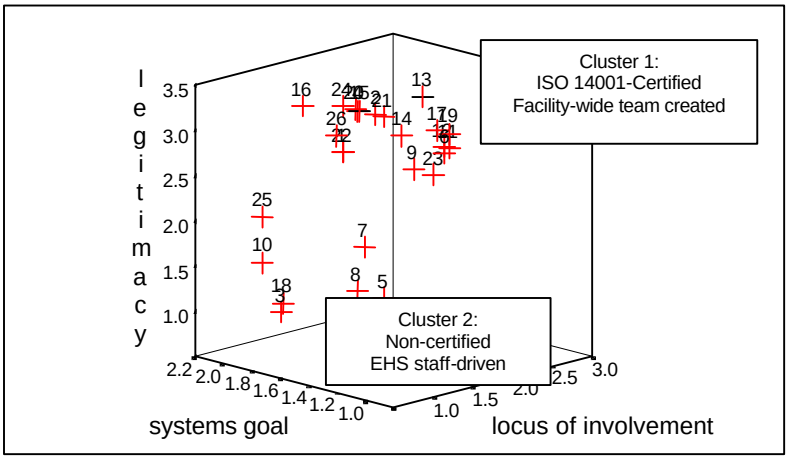
These results show two distinct clusters. The nineteen facilities of the first cluster involved employees and managers beyond the core EHS staff in EMS development activities. EMSs in this cluster of facilities were certified to ISO 14001, or they intended to become fully certified. EMSs of facilities in cluster 1 jointly focused on the goals of pollution prevention and compliance.

In contrast, the seven facilities belonging to the second cluster generally involved only EHS core staff in the development of their EMS. Their EMSs were not certified to the ISO

14001 standard, and the facilities had no intention to do so. The primary focus of the EMSs of facilities in this cluster was on pollution prevention.

Figure 2, below shows a three dimensional scatterplot representation of how facility EMS data locate within the typology.

Figure 2. Facility EMS Location within Typology Dimensions



Several issues are relevant in examining the ways in the two clusters or EMS types appear in Figure 2, above. First, cluster 1 is larger (has a greater membership) and appears to be tighter or less dispersed. Cluster 2, in contrast, is smaller, with only seven members, and appears to be much more dispersed. However, as can be seen in table 3, below, cluster 2 EMSs vary significantly less along the locus of involvement dimension (5.65%) than do the cluster 1 EMSs (17.82%). Variability, however, is much greater for cluster 2 EMSs than for cluster 1 EMSs in terms of the goals pursued and the level of legitimacy sought.

Table 3. Coefficients of Variation[54] for Cluster Dimensions

Cluster Type	Members (n = 26)	Involvement Coefficient of Variation, %	Legitimacy Coefficient of Variation, %	Systems Goal Coefficient of Variation, %
Cluster 1: ISO-14001 Certified, Facility-wide Team Created	19	17.82	8.80	19.67
Cluster 2: Non-certified, EHS Staff Driven	7	5.65	30.6	34.75

It is difficult to ascertain the reasons why cluster 1 EMSs are more tightly organized along the legitimacy and systems goal dimensions than cluster 2 EMSs. Alternatively, it is difficult to understand why cluster 2 EMSs are less variable in terms of the kinds of people involved in their design. Possible explanations include that those facilities obtaining ISO 14001

[54] The coefficient of variation is equal to the standard deviation of the cluster membership along a specified dimension divided by its mean, thus providing a way in which to compare the variability of the typology dimensions within each cluster.

certification tend to orient their EMSs around a more common set of environmental goals than do other facilities. Or, facilities with non-certified EMSs tend to look toward similar groups of employees in developing their EMS, whereas facilities with ISO 14001 certified EMSs do not. The sample size limitations of the current EMS typology study in answering these questions directly points to the need for an investigation of specific experiences of facilities as they design their EMSs.

Case Study Results

While the above cluster analysis of facility survey data highlighted the types of EMSs that facilities develop in practice, case study information can be used to learn more about how facility EMSs are specifically developed. Case study information from two NDEMS facilities, each representing one of the two types uncovered by the cluster analysis, was examined to learn how internal and external stakeholders might influence the design and development of specific EMSs.

Interviews were conducted at two facilities, "Alpha Manufacturing" and "Lambda Equipment".[55] A cross section of employees who had been involved in the EMS design process was questioned at each facility. Survey data from both of these facilities were employed in the cluster analysis.

Alpha Manufacturing

Alpha Manufacturing, a small, family-owned metal finishing facility, is situated in a mid-sized town near a large metropolitan area. Alpha was one of the first firms in the US to be certified to ISO 14001. The design of Alpha's EMS was lead by Alpha's environmental managers with significant input from a broad group of management employees. A consultant was involved in Alpha's design and development processes. While the consultant acted primarily as a facilitator, his influence extended from the development and implementation of a process to identify environmental aspects and impacts to the specific way in which protocols and procedures were documented. Alpha's CEO was a significant influence on EMS design. His leadership affected the design of the facility's EMS by encouraging those involved to focus on creative ways to achieve a high level of environmental performance.

As a supplier to the U.S. auto industry, Alpha felt it was in its best interest to obtain ISO 14001 certification, although at the time Alpha became ISO 14001-certified automakers had not made certification an explicit requirement, as they have today. Although Alpha employees indicated that regulators did not directly influence the EMS design, most were concerned about avoiding a recurrence of a significant past enforcement experience. This experience understandably influenced Alpha's EMS designers to jointly focus on compliance issues along with pollution prevention. Because of Alpha's location in an industrial park and its reputation as a good environmental citizen, Alpha employees felt no pressure from neighbors as they designed their EMS.

[55] "Alpha Manufacturing" and "Lambda Equipment" are pseudonyms for facilities participating in the NDEMS research project.

Alpha's ISO 14001-certified EMS, focuses primarily on pollution prevention activities, but also on regulatory compliance. A cross-section of environment, quality, production and operation managers from Alpha was involved in EMS development. Alpha's EMS thus can be found in cluster 1, ISO 14001-certified, facility-wide team created.

Lambda Equipment

Lambda Equipment, a small energy equipment division of a larger European owned conglomerate, is located on the outskirts of a small town in a rural area. Lambda is considered by all to be a good neighbor with an exemplary environmental compliance record. Because of this, Lambda employees felt no pressure from regulators or neighbors to design their EMS in any particular way. Lambda has made the decision to forego ISO 14001 certification of its EMS.

Lambda's EMS was designed by core group of three employees who used a template provided by a state environmental agency-funded consultant to develop the EMS. This consultant was actively involved in helping Lambda design its EMS and thus had a significant influence in the way the facility identified and rated environmental aspects and impacts and developed EMS objectives and targets. Lambda's EMS designers were actively involved in their state's EMS working group. They benefited from advice and counsel from their peers in this group as they identified environmental aspects and impacts and created systems to monitor and measure performance. Neither Lambda's parent company or its customers exerted any pressure for the EMS to be ISO 14001 certified.

Lambda, whose EMS focuses pollution prevention goals, relied primarily on a core team of EHS employees to develop its EMS, but occasionally sought input from other employees. Lambda's EMS, is located in cluster 2, non-certified/EHS staff-driven.

These results suggest that facilities developing specific types of EMSs, such as, for example, the pollution prevention focused, EHS staff driven, non-certified EMS, are influenced by the actions of different stakeholders during design and implementation. In the case of Lambda Equipment, the influence of professional peers and their consultant were especially significant. In contrast, at Alpha the impact of customers, facility leadership, their consultant and past enforcement on the type of EMS they designed was evident. Employees, consultants, customers, senior managers and regulators may all play a role in shaping the EMSs that facilities develop. Relationships with regulators are but a single component of the network that a typical facility interacts during its journey to produce products while achieving environmental management goals. Table 4, below, summarizes the case study findings.

Table 4. Internal and External Stakeholder Influences on EMS Design

Facility	EMS Type	Internal Stakeholder Influences	External Stakeholder Influences
Alpha Manufacturing	ISO 14001 certified, Facility wide team created, Joint pollution prevention and compliance focus	Company CEO	Customers (automakers) Regulators (past enforcement) Consultant (facilitator)
Lambda Equipment	Non certified, EHS staff driven, Pollution prevention focus	None	Consultant (active involvement) EMS working group (meetings)

Relevance to Public Policy

Business managers like those at Alpha and Lambda are promoting EMSs because they provide a flexible approach to reach environmental management goals. They attest to EMSs' flexibility. This flexibility, they argue, can be used to examine environmental impacts of products, rather than singularly on production processes or to engage the advice of multiple stakeholders in designing environmental programs, rather than relying solely on the expertise of facility environmental staff or government regulators.

Government policy makers are interested in understanding how EMSs might be used as a tool to assist facilities in engaging external stakeholders and moving beyond compliance. They also are interested in using facility EMSs to monitor and measure environmental performance. Indicators of government confidence in EMSs' potential as a policy tool include Wisconsin's Green Tier "Regulatory Choice" system [56], Oregon's Green Permits/EMSIP program [57], and the USEPA's National Performance Track program [58]. These programs are based on facilities' use of EMSs to achieve superior environmental performance and government's leveraging of EMS information to monitor performance.

Industry's support for the use of flexible systems-based approaches to managing environmental impacts is increasing. So too is the interest of regulators in their applicability as a policy tool. Could this indicate that a new type of business/government relationship is in order? How would such a relationship be configured?

Traditionally, relationships between businesses and government have been structured around strict government regulation of business activities. Under this structure, congressional policy makers enact laws to achieve certain social or economic objectives, and the executive branch goes to work developing the rules, regulations and administrative structures necessary to put those objectives into action. A consequence of this process is the existence of myriad regulations to protect the environment, protect worker health and safety and to ensure product quality and consumer safety. This puts stress on both government and business alike. [59]

In the areas of environmental protection and worker health and safety, businesses must comply with detailed permits addressing specific aspects of their operations, submit to regular inspections by government regulators, and provide extensive reports to regulators on their activities. However, as regulations have multiplied, the ability of business to dually focus on production and compliance and the ability of government to permit, inspect and monitor all regulated facilities has diminished significantly. As a result, businesses have developed

[56] Wisconsin's Green Tier Regulatory System provides ", a two tier regulatory system that would promote and reward exemplary environmental performance". Information on this program can be found at the Wisconsin Department of Natural Resources' web site: http://www.dnr.state.wi.us/org/caer/cea/reinvention/green_tier/.
[57] Oregon's Green Permits program, which ", is designed to encourage and reward innovative approaches that achieve environmental performance that is significantly better than otherwise required by law", is described on Oregon Department of Environmental Quality's web site at http://www.deq.state.or.us/od/p2/p2.htm.
[58] EPA's performance track program is ", designed to motivate and reward top environmental performance by companies and facilities of all types, public and private", is described at EPA's web site: http://www.epa.gov/performancetrack/.
[59] Leone (1986), goes so far as to call the outcome of such a system, the "Iron Law of Public Policy", whereby individual winners and losers are created in the marketplace and individual businesses must develop strategies for working with public policies in order to come out on the winning side.

continuous improvement-based, total quality management systems, which have become core components of an overall business strategy to assist them, systems such as the EMSs used in the environmental protection arena. Similar systems have long been used by businesses to address product quality [60] and are increasingly being created to manage worker health and safety [61].

As businesses continue to develop management systems to address product quality, environmental performance and worker health and safety, a new kind of business/government relationship, one dependent on these systems to assure the public that businesses are operating in a responsible manner, may be in order. This new relationship would leverage the promise of business management systems to achieve results against government's diminished capacity to permit, inspect and/or monitor the growing number of facilities governed by environmental, product quality and safety rules and regulations.

The results of this study indicate that although it may be appropriate to consider a business/government relationship less focused on direct government surveillance of business behavior and more focused on leveraging business management systems, there is much that must be understood. It is not yet clear whether government and other external and internal stakeholders influence the kinds of management systems that businesses build and especially on the results that these systems produce. Even less certain is whether the specific types of management systems described here are effective in producing product quality, environmental, health and safety results. The results of this analysis provide a starting point from which these issues may begin to be addressed.

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[60] For example, ISO 9000, a precursor of ISO 14001 has been used by many facilities to manage product quality issues and serve as a signal to customers and consumers that certain standards have been met. In addition, many industries, such as the food industry, for example, have developed their own widely used quality management systems.

[61] ISO 18001, currently being developed by the International Organization for Standardization, will address worker health and safety issues. Furthermore, a number of corporations have proceeded on their own to develop EHSMSs, environmental health and safety management systems, which address environmental protection and worker heath and safety issues together in one continuous improvement-based management system.

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ISO 14001 as an Emerging Environmental Management Tool: How is the Flexibility of the ISO 14001 Standard Applied?[62]

January 2001

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ABSTRACT

Increasingly, business managers are looking towards ISO 14001 environmental management systems (EMSs) as a tool to achieve compliance and improve environmental performance. The ISO 14001 standard by design provides businesses with considerable flexibility to use in constructing EMSs to meet facility-specific goals. To understand how facilities use this flexibility in designing EMSs, in 1997 the U.S. EPA in conjunction with the Multistate Working Group on Environmental Management Systems, a consortium of U.S. environmental agency managers from 10 states began a research study of approximately 65 pilot facilities designing and implementing EMSs. This paper examines data from a subset of 26 of these pilot facilities to evaluate the specific kinds of EMSs that were designed. It proposes a typology of EMSs, which can be used to compare EMS designs according to three variables of interest. The first yardstick of the typology measures the locus of involvement of individuals internal and external to the facility in EMS design, and asks, are EMSs being designed and developed by facilities' core environmental team, or are others within the company and even external to it, such as neighbors involved? The second variable measures the reach of facility-specific environmental goals; for example do most facility's EMSs focus on achieving strict environmental compliance or on designing environmentally sustainable practices? The final variable measures the level of external legitimacy facilities desire for their EMSs, whether most facilities seek to complete the EMS design process and obtain ISO 14001 certification, or are simply "ISO 14001-ready". This typology is then coupled with case study analyses to illuminate and expand upon the empirical analysis. The results will shed light on the role that internal and external stakeholders play in constructing EMSs and whether certain influences are likely to produce specific EMS types.

I. INTRODUCTION

Businesses operating in the United States must comply with a complex set of overlapping environmental laws and regulations addressing air and water emissions, solid and hazardous waste generation and disposal and disclosure of toxic byproducts. These myriad laws and regulations, which generally focus on single environmental problems are continually modified

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and updated. An atmosphere of uncertainty thus exists in the U.S., making it difficult for firms to develop an efficient and effective path toward compliance (USEPA, 1990), let alone optimal environmental performance

Increasingly, many business managers in the United States have been looking towards ISO 14001[64] environmental management systems (EMSs) as a tool to achieve compliance and improve environmental performance: as of July 2000 over 840 facilities had achieved certification. The ISO 14001 standard provides considerable flexibility to use in constructing EMSs to meet facility-specific goals. To understand how facilities use this flexibility in designing EMSs, in 1997 the U.S. EPA in conjunction with the Multistate Working Group on Environmental Management Systems, a consortium of U.S. state environmental agency managers began a research study of approximately 65 pilot facilities designing and implementing EMSs in ten U.S. states.

This paper examines EMS design data from these pilot facilities to evaluate the specific kinds of EMSs that were designed. It proposes a typology of EMSs, which can be used to compare EMS designs according to three variables of interest to business and public policy researchers and practitioners. The first yardstick of the typology measures the locus of involvement of individuals internal and external to the facility in EMS design, and asks, are EMSs being designed and developed by facilities' core environmental team, or are others within the company and even external to it, such as neighbors involved? The second variable measures the reach of facility-specific environmental goals; for example do most facility's EMSs focus on achieving strict environmental compliance or on designing environmentally sustainable practices? The final variable measures the level of external legitimacy facilities desire for their EMSs, whether most facilities seek to complete the EMS design process and obtain ISO 14001 certification, or are simply self-certified and "ISO 14001-ready".

II. THE ENVIRONMENTAL MANAGEMENT SYSTEM AS A STRATEGIC RESPONSE

Chandler (1962) defined a business strategy as, "the determination of basic long-term goals of an enterprise, and the adoption of the courses of action and allocation of resources necessary for carrying out these goals". Further, Andrews (1971) asserted that, "… the most important function of strategy is to serve as the focus of organizational effort, as the object of commitment, and as the source of constructive self-control in the organization itself." When the strategic components contemplated by Chandler and Andrews are examined in an environmental context, the objects of environmental protection commitments, to paraphrase Andrews, and the facility's strategic response to environmental protection challenges are likely contained within the facility's EMS. A facility's EMS can be viewed is its strategic response to the challenges that stem from environmental laws and regulations and from pressures from neighbors, customers and parent corporations for the facility to behave as an environmental citizen. In this sense, facilities design and implement EMSs to reflect strategic business

[64] Many companies are seeking certification of their environmental management systems under ISO 14001, the international environmental management standard. ISO 14001 certification is granted to a firm if an independent auditor (certified under ISO) determines the firm's EMS is in conformance with all criteria. Periodic audits of certified firms are conducted to ensure that conformance with the standard is maintained. Firms are also expected to conduct periodic self-audits according to the standard. The firm's environmental performance is not certified, rather its environmental management system is certified. Of course, one of the ISO 14001 EMS criteria is that a firm has an adequate system for measuring and monitoring performance.

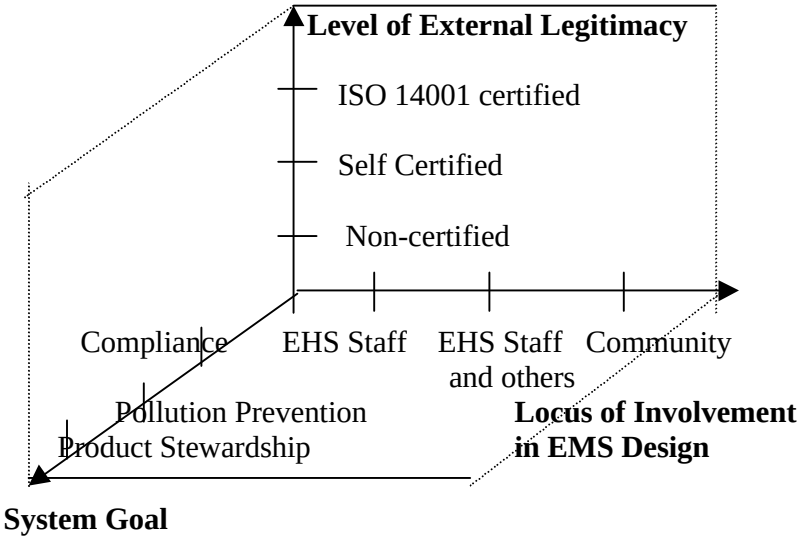
responses to interactions with these institutional actors (Oliver, 1991) as they operate in the natural environment.

III. AN ENVIRONMENTAL MANAGEMENT SYSTEM TYPOLOGY

An EMS typology can succinctly describe the kinds of EMSs that facilities construct. The application of an EMS typology will assist in increasing an understanding of how and why facilities develop specific types of EMSs. It will also show how facilities have used EMSs' inherent flexibility to reflect site-specific characteristics and cultures. And, when a typology-based analysis is combined with detailed case studies of facilities developing EMSs, the roles that internal and external stakeholders play in shaping facility–specific EMS design will be better understood.

Figure 1, below, shows the dimensions of a typology suitable for describing facility EMSs. Each dimension is a relevant reference point to business and policy scholars, community leaders, regulators and facility managers. Each axis measures where a facility's EMS is located in a specific dimension and is constructed as a progression of environmental policy goals. Each axis is also path dependent; facilities first develop the strategic capability closest to the origin of the axis before they develop the strategic capability associated with the second and so on.

Figure 1. EMS Typology



X-Axis: Locus of Involvement in Design. This axis represents a progression of actors that a facility may seek to involve in the design, development and implementation of its EMS. As a facility becomes more sophisticated with respect to seeking the advice and counsel of actors outside its core environmental health and safety (EHS) group, a broader sphere of external influence will be incorporated into its environmental management system (Freeman, 1984).

A facility with an environmental management system designed using information and feedback to the EHS team derived only from regulators (EPA, state or local) is placed just to the right of the origin of the axis. This is the format in which many conventional environmental

management processes are typically developed: EHS staff interacts with regulators and implements their requirements or suggestions.

A facility which seeks advice and counsel from non-EHS employees in designing and implementing its EMS is placed next on the locus of involvement axis. The core EHS team reaches out to the employees within the facility who are not environmental experts but know a great deal about day to day facility operations. The addition of this type of expertise to EMS design efforts is beneficial in a number of ways. First, the EMS is more appropriately designed to fit the particular circumstances of the facility, such as those linked to process design, production and product distribution, for example. Second, it is likely to identify a range of opportunities for continuous improvement and efficient coordination and integration of aspects and impacts with other management considerations. And, third, when the EMS is implemented it is more likely to be familiar to a larger group of employees and better integrated into the facility's daily work.

Finally, a facility that reaches out still further to invite the suggestions and concerns of outside stakeholders—neighbors, community organizations, NGOs, government officials, and others—has perhaps the best chance of capturing all the relevant concerns and the best ideas for potential improvements.

Y- Axis: Level of External Legitimacy. Facilities that obtain ISO 14001 certification are pursuing external legitimacy. A certified EMS signals to regulators, customers, parent corporations and neighbors alike that the EMS meets a certain externally defined and deigned threshold. Companies that achieve ISO 14001 certification frequently advertise this achievement, often decorating their facilities with banners attesting to their success.

The progression of this axis reflects facilities' pursuit of external validation and legitimacy. First, a facility designs an uncertified EMS, then may or may not seek to self-certify that EMS by undergoing an external audit of the system. An externally audited and self-certified facility, at that point "ISO-ready", may then seek to have that EMS ISO 14001-certified and registered (Puri, 1996).

An ISO 14001-certified EMS, placed at the third point on the axis, is an improvement over self-certified because the facility's EMS becomes transparently comparable to the international standard. Certification is a signal to customers, neighbors, regulators and others that the facility's EMS encompasses the specific administrative requirements of the standard to which it is certified.

Z Axis: System Goal: A facility typically progresses in a linear fashion in defining the environmental goals that its EMS will address. Most standards like ISO 14001 require that as a minimum an EMS must be designed to reach full compliance with environmental laws and regulations. A facility's first goal in developing an EMS therefore is likely to be achieving compliance with environmental laws and regulations. Once the system has been fully specified and implemented to achieve compliance, pollution prevention goals are typically added.

Pollution prevention, in which waste streams are reduced and eliminated at the source through efforts such as improved operation and maintenance, input substitution or process

redesign, generally builds on a facility's expert understanding of its legal and technical requirements. The inclusion of pollution prevention goals in a facility's EMS may be motivated by the facility's desire to escape some of these requirements. The technical skills and organizational resources necessary to achieve compliance are thus a building block for a pollution prevention-focused system. Pollution prevention efforts are sometimes motivated by management decisions to weed out manufacturing process inefficiencies, such as over-use of cleaning chemicals, and to uncover cost savings.

Once pollution prevention goals are operational and waste streams are reduced or eliminated, a facility is in a position to develop a product stewardship-focused EMS. Facilities focused on product stewardship re-evaluate production processes to examine how products are designed. Product stewardship emphasizes evaluating long-term or life-cycle environmental impacts of materials incorporated into products throughout the design and production process. High impact materials are then reduced or eliminated. Design for the environment (DfE), materials accounting and life cycle design (Hirschhorn and Oldenburg, 1991; Hart, 1995) are tools of product stewardship.

The system goal axis's progression follows historical developments. In the 1970s U.S. environmental rules and regulations focused on compliance. In the late 1980s and 1990s a pollution prevention focus (in addition to compliance) developed (Andrews, 1999). Finally, the United Nation's 1987 Brundtland Commission and the Earth Summit of 1992 in Rio have focused attention on the evolving policy of environmental sustainability. The concept of product stewardship, or design for the environment (DfE), where manufacturers take full account of environmental costs throughout a product's life cycle (President's Council on Sustainable Development, 1996) plays a critical role in evolving policies of environmental sustainability.

IV. MATERIALS AND METHODS

In this study, a group of twenty-six facility EMSs were examined to determine where they would fall within the dimensions of the typology proposed above. Data from the National Database on Environmental Management Systems, described below, were used in these analyses.

The National Database on Environmental Management Systems (NDEMS)

Since 1997, ten states (Arizona, California, Indiana, Illinois, New Hampshire, North Carolina, Oregon, Pennsylvania, Vermont and Wisconsin) and EPA Region I (through its StarTrack initiative) have adopted pilot programs that provide a variety of benefits, including technical assistance, financial grants, enhanced publicity, and regulatory flexibility to facilities that adopt ISO 14001-based EMSs. In exchange, these pilot facilities have provided data on their EMS development processes to the National Database on Environmental Management Systems (NDEMS), a joint research effort of the University of North Carolina and the Environmental Law Institute.

Currently, NDEMS contains data from just over 50 facilities. The data include both quantitative and qualitative information on pre-EMS compliance and economic and environmental performance and other attributes and primarily qualitative information on EMS design characteristics. Post-EMS design data are also being collected. The database has been

constructed using information provided by volunteer pilot facilities recruited by the ten participating states.

The data supplied to NDEMS are gathered through a series of three research protocols, which are available on the project web site (http://www.eli.org/isopilots.htm). First, in the Baseline Protocol facilities describe pre-EMS design and implementation activities in five key areas: management systems, environmental performance, regulatory compliance, pollution prevention, stakeholder involvement and economic performance (costs and benefits of EMS). Next, in the EMS Design Protocol, facilities describe how they designed and implemented their EMS. Detailed information on activities and associated environmental aspects and impacts and on EMS objectives and targets are provided during this phase. A third and final protocol, the Update, will soon be provided to participating facilities. It has been designed to obtain data on facility's post-EMS performance, and will be closely linked to the baseline and design protocols.

In addition to the survey data obtained from facilities though completion of the three research protocols described above, case study data have been obtained from nine facilities that have developed EMSs. Seven of these facilities are participants in the NDEMS project. These detailed case study data describe procedures used in designing the EMS and highlight the influences of internal and external stakeholders on EMS design. Case study data were obtained during on-site interviews with facility employees involved in the EMS design process.

Data Used in This Study

Data on facility EMS targets were used to identify facilities' overall environmental management system goals. Data on facilities' certification plans were used to identify levels of external legitimacy. And finally, data on internal and external actors' involvement throughout the EMS design process were used to establish the locus of involvement in EMS design.

Each facility was given a score for level of legitimacy, locus of involvement in design and systems goal. For legitimacy, a facility received a score of 1 for a non-certified EMS, a score of 1.5 for an intention to self-certify, a score of 2 for a self-certified EMS, a score of 2.5 for an intention to certify and a score of 3 for an ISO 14001-certified EMS. In determining the facility's system goal score a weighted average of all EMS targets was calculated. Targets related to compliance were given a score of 1, those related to pollution prevention were given a score of 2 and those related to design for the environment were given a score of 3.

Finally, in determining the facility's locus of involvement score, the involvement of EHS staff only, of EHS staff plus a more broad group of employees, or of EHS staff, other employees and parties external to the facility in key EMS development phases was considered. In each phase a score of 1 for EHS staff only, 2 for EHS staff and other employees, or 3 for EHS staff, other employees and external party involvement was assigned to each facility. A weighted average was then developed.

IV. RESULTS AND DISCUSSION

EMS design data from twenty-six NDEMS facilities [65] were examined to determine the range of facility EMS configurations along the axes of the proposed typology. Summary statistics for these facilities along the three axes are presented in Table 1, below.

Table 1. Facility EMS Characteristics along EMS Typology Dimensions

Axis	Minimum Score	Maximum Score	Mean Score	Standard Deviation
Involvement	1.00	2.75	1.91	0.52
Legitimacy	1.00	3.00	2.40	0.75
System Goal	1.00	2.14	1.87	0.28

Locus of Involvement in EMS Design

A majority (16) of the twenty-six facilities we studied designed their EMSs with input both from EHS staff and others throughout the facility. Most often facilities included the EHS manager and staff, production, operations and engineering managers, quality manager, plant manager and corporate environmental staff representative on their EMS design team. Eight facilities in this group, however, looked toward cross-functional teams that included not only managers, but also hourly workers and union representatives to design their EMSs. As one facility described it, their EMS was developed by a "working group (environmental and safety officer, production and engineering managers, chemical engineer, facilities supervisor and the facility's lead auditor). The process engineers were responsible for identifying and evaluating all the aspects associated with their process and products".

Five facilities designed their EMS using the singular efforts of the EHS staff. At one small facility the president of the company designed the entire EMS himself.

Only four of the twenty-six facilities looked toward external stakeholders in the community for advice, and these facilities were required to do so to participate in their state EMS pilot program. At these facilities a formal stakeholder group, comprised of citizens, environmental group representatives and state and local environmental agency representatives, was convened. At these facilities internal cross-functional teams developed the EMS and met with the stakeholder group regularly to obtain feedback. One facility described their stakeholder group as comprised of "the county pollution control, the city engineer, two teachers from the local high school and the state environmental agency".

These results indicate that most facilities are not using the full flexibility of the EMS process to involve multiple stakeholders. The EMS appears to be the domain of the facility EHS department, which, when it engages the advice of other facility employees, relies primarily on

[65] In this study only completely quality controlled EMS design data were used, which at this juncture in the NDEMS project, reduces the sample size from 50 facilities to 26 facilities. These facilities, however, are representative of the database overall; a cross-section of facility sizes and industrial sectors are present. For a more detailed description of demographics, see Andrews, et.al. (1999). Future work will be based on the full NDEMS sample complemented by data from a matched sample of non-NDEMS participant facilities.

production or operation management. Stakeholders from the community are rarely involved and hourly workers are rarely consulted.

Level of External Legitimacy

Just less than half (12) of the twenty-six facilities we studied had obtained ISO 14001 certification of their EMS. However, an additional seven facilities indicated their intention to obtain certification in the near future. One facility was self-certified and another two expressed their intention to do so. Four facilities indicated that they had no intention of ever obtaining ISO 14001 certification of their EMS.

These results indicate that most of these facilities' EMSs are not simply "ISO-14001 ready"; most of them do obtain ISO 14001 certification, or intend to do so. Only a small fraction (15%) of the facilities in our study had no intention of becoming certified.

System Goal

A large subset (15) of the twenty-six facilities we studied focused their EMSs primarily on meeting pollution prevention goals. Examples of specific targets for this group included, "reduce oil mist and emissions", "reduce solvent waste generation", "95% reduction in nitric acid use", and, "implement office paper recycling program".

A smaller group of facilities (7) focused equally on compliance assurance and pollution prevention. Approximately half of these facilities' EMS targets, such as, "comply with sanitary flow requirements", were related to achieving compliance. The remainder, such as, "reduce the use of coolant", were related to pollution prevention.

Three facilities' EMSs focused primarily on compliance assurance, with at least 75% of their targets related to achieving compliance with environmental regulations. These facilities cited targets such as "comply with stormwater discharge permit", "100% regulatory compliance", and "100% of hazardous waste disposed in conformance with applicable laws".

Only one of the twenty-six facilities we studied had product stewardship as its primary EMS goal. This facility identified targets such as, "study alternatives to lead-containing raw materials", and, "study the environmental impacts of products during life cycle".

Interestingly, twelve of the twenty-six facilities included program management, training, communication and/or employee health and safety objectives and targets within their EMS in addition to pollution prevention and compliance assurance. Examples of the targets identified by these facilities include, "maintain costs within the environmental department budget ", "identify training needs", "promote employee awareness of the EMS program" and, "reduce team member exposure to chemical hazards".

In summary, most of the facilities we studied focused their EMSs on pollution prevention or jointly on pollution prevention and compliance. Only one out of twenty-six facilities used the flexibility of the EMS to look beyond production and operations and examine ways to address

issues of product stewardship. However, some facilities are using EMS flexibility to build a management program to address important issues like training, communication and employee health and safety.

V. CASE STUDY RESULTS

The preceding analysis of facility survey data highlights the types of EMSs that facilities develop in practice. Next, given the locations of specific facility EMSs within the typology, case study data from two NDEMS facilities were analyzed to explore the journey that facilities might have taken to arrive at their EMS destination. A cross section of employees who had been involved in the EMS design process at two facilities, "Alpha Manufacturing" and "Lambda Equipment" [66] were interviewed to build the case studies. These data illuminate the findings of the typology dimension analyses to increase an understanding of how internal and external stakeholders such as employees, regulators, consultants and customers may influence the process and outcomes of EMS design.

Alpha Manufacturing

Alpha Manufacturing, situated in a mid-sized town near a large metropolitan area in the United States, is a small, family-owned metal finishing facility. Alpha was one of the first firms in the U.S. to be certified to ISO 14001. The design of Alpha's EMS was guided by Alpha's environmental manager with significant input from a broad group of management employees. A consultant was involved in Alpha's design and development processes. While the consultant acted primarily as a facilitator, his influence extended from the development and implementation of a process to identify environmental aspects and impacts to the specific way in which protocols and procedures were documented. Alpha's CEO was a significant influence on EMS design. His leadership affected the design of the facility's EMS by encouraging those involved to focus on creative ways to achieve a high level of environmental performance.

As a supplier to the U.S. auto industry, Alpha felt it was in its best interest to obtain ISO 14001 certification, although at the time Alpha became ISO 14001-certified automakers had not made certification an explicit requirement, as they have today. Although Alpha employees indicated that regulators did not directly influence the EMS design, most were concerned about avoiding a recurrence of a significant past enforcement experience. This experience understandably influenced Alpha's EMS designers to jointly focus on compliance issues along with pollution prevention. Because of Alpha's location in an industrial park and its reputation as a good environmental citizen, Alpha employees felt no pressure from neighbors as they designed their EMS.

In summary, Alpha's ISO 14001-certified EMS, focuses primarily on pollution prevention activities, but also on regulatory compliance. A cross-section of environment, quality, production and operation managers from Alpha was involved in EMS development. Alpha's EMS is thus characterized as a facility-wide team created, ISO 14001-certified, pollution prevention and compliance oriented EMS.

[66] "Alpha Manufacturing" and "Lambda Equipment" are pseudonyms for facilities participating in the NDEMS project.

Lambda Equipment

Lambda Equipment, a small energy equipment division of a larger European owned conglomerate, is located on the outskirts of a small town in a rural area in the northeastern United States. Lambda is considered to be a good neighbor with an exemplary environmental compliance record. Because of this, Lambda employees felt no pressure from regulators or neighbors to design their EMS in any particular way. Lambda has made the decision to forego ISO 14001 certification of its EMS.

Lambda's EMS was designed by core group of three employees who used a template provided by a state environmental agency-funded consultant to develop the EMS. This consultant was actively involved in helping Lambda design its EMS and thus had a significant influence in the way the facility identified and rated environmental aspects and impacts and developed EMS objectives and targets. Lambda's EMS designers were actively involved in their state's EMS working group. They benefited from advice and counsel from their peers in this group as they identified environmental aspects and impacts and created systems to monitor and measure performance. Neither Lambda's parent company or its customers exerted any pressure for the EMS to be ISO 14001 certified.

In summary, Lambda, whose EMS focuses on pollution prevention goals, relied primarily on a core team of EHS employees to develop its EMS, but occasionally sought input from other employees. Lambda's EMS, is thus characterized as an EHS staff driven, non-certified, pollution prevention oriented EMS.

These results suggest that facilities developing specific types of EMSs, such as, for example, the pollution prevention focused, EHS staff driven, non-certified EMS, are influenced by the actions of different stakeholders during design and implementation. In the case of Lambda Equipment, the influence of professional peers and their consultant were especially significant. In contrast, at Alpha the impact of customers, facility leadership, their consultant and past enforcement on the type of EMS they designed was evident. Employees, consultants, customers, senior managers and regulators may all play a role in shaping the EMSs that facilities develop. Relationships with regulators are but a single component of the network that a typical facility interacts during its journey to produce products while achieving environmental management goals. Table 2, below, summarizes the case study findings.

Table 2. Internal and External Stakeholder Influences on EMS Design

Facility	EMS Type	Internal Stakeholder Influences	External Stakeholder Influences
Alpha Manufacturing	ISO 14001 certified, Facility wide team created, Joint pollution prevention and compliance focus	Company CEO	Customers (automakers) Regulators (past enforcement) Consultant (facilitator)
Lambda Equipment	Non certified, EHS staff driven, Pollution prevention focus	None	Consultant (active involvement) EMS working group (meetings)

VI. CONCLUSION

The results of this study indicate that facilities develop specific types of EMSs because of the influences of different institutional actors on them during design and implementation. In the case of Lambda Equipment, the influence of professional peers and their consultant were especially significant. In contrast, at Alpha the impact of customers, facility leadership, their consultant and past enforcement on the type of EMS they designed was evident. Employees, consultants, customers, senior managers and regulators may all play a role in shaping the EMS that facilities develop. Relationships with regulators are but a single component of the network that a typical facility interacts during its journey to produce products while achieving environmental management goals.

Business managers such as those at Alpha and Lambda are promoting EMSs because they provide a flexible approach to reach environmental management goals. They indicate that the flexibility of the EMS can be used to examine environmental impacts of products, rather than singularly on production processes or to engage the advice of multiple stakeholders in designing environmental programs, rather than relying solely on the expertise of facility environmental staff or government regulators.

However, in this study we have seen that most facilities do not use the flexibility of the EMS in this manner. In fact, our study shows that most facilities' EMSs focus on production processes through pollution prevention activities or in efforts to assure compliance. To date we have not seen EMSs widely used by facilities to assist them in reaching product stewardship or environmental sustainability goals. And facilities have not used EMSs' flexible approach to engage the advice of multiple stakeholders in their quest to improve environmental performance. In our study we have seen that EHS managers and staff are almost always the drivers of the EMS design process. External stakeholders are rarely engaged. When internal stakeholders are included in EMS design, facility management personnel, such as production and operations managers are called upon to provide advice to EHS staff. Laborers are rarely involved in system design.

Although considerable flexibility exists in ISO 14001, this study indicates that facilities are squandering it. Whether this will change is an important issue. As facilities' EMSs mature, does the focus shift from pollution prevention and compliance assurance to product stewardship and sustainability? Do facilities modifying and improving upon existing EMSs reach out to a broad group of external and internal stakeholders, or does the EMS remain the singular domain of EHS? More research is needed to follow facilities as their EMSs become everyday components of their organization's overall management system. With such research, we will be in a better position to know if indeed the flexibility inherent in ISO 14001 can and will be put to use in improving environmental performance beyond compliance, even beyond pollution prevention to emerge as a management tool to reach environmental sustainability.

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Similarities and Differences Among Environmental Management Systems[67]

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Richard N. Andrews[68]

ABSTRACT

The purpose of this paper is to examine similarities and differences in the actual choices made in a range of EMSs to date. It is based on a detailed comparative content analysis of EMS environmental planning data from 40 facilities included in the National Database on Environmental Management Systems (NDEMS) that have implemented ISO 14001-based EMSs. Data were drawn from protocols completed by facilities in 10 U.S. states, and in many cases from detailed examination of the facilities' actual EMS planning documents as well. These facilities represent approximately 12 economic sectors, including both private-sector businesses and public-sector organizations such as military bases and wastewater treatment plants. They range from major manufacturers, electric utilities, and branch plants of large multinational corporations to small independent businesses such as electroplaters and auto parts suppliers. For most of these facilities the data include detailed documentation of both their activity-aspect-impact-significance assessments, and their objectives, targets and dates, as of November 2000. We are grateful for their generosity in sharing these data with us, and for the assistance of state project managers in helping collect them.

Since we have not yet completed quality assurance reviews with all these facilities, especially on the completeness of the data received, and we are also anticipating data from 10-20 additional facilities, these findings should be interpreted as tentative and preliminary at this time.

I. INTRODUCTION

Since the mid-1990s a growing number of businesses, government enterprises, and other organizations have chosen to adopt formally structured environmental management systems (EMSs) as a procedure for more systematically managing the environmental impacts of their activities. Many of these have been motivated by the publication, in 1996, of the ISO 14001 international voluntary registration standard for environmental management systems. As of July 2000 over 840 U.S. organizations had chosen to register their EMSs as conforming to the ISO 14001 standard, including auditing and registration by certified third-party registrars. Many more organizations, however, chose to use the template of ISO 14001 as a basis for designing and implementing an EMS, but without necessarily seeking the external legitimation (or incurring the costs) of third-party auditing or formal registration to the standard. Still other organizations have had EMSs of their own design for substantially longer, and have simply performed "gap

[67] Unpublished draft prepared for USEPA and state pilot project managers' review.

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analyses" to identify any areas for upgrading their own systems to conform to the ISO 14001 standard.

This study provides a comparative analysis of the EMS environmental planning documentation of a range of facilities that have generously consented to share detailed data with the National Database on Environmental Management Systems (NDEMS). The present preliminary assessment includes data that are presently available for 40 facilities, which are mostly complete but not all yet finalized and signed off by the facilities; in the final version we anticipate data for over 50 facilities.

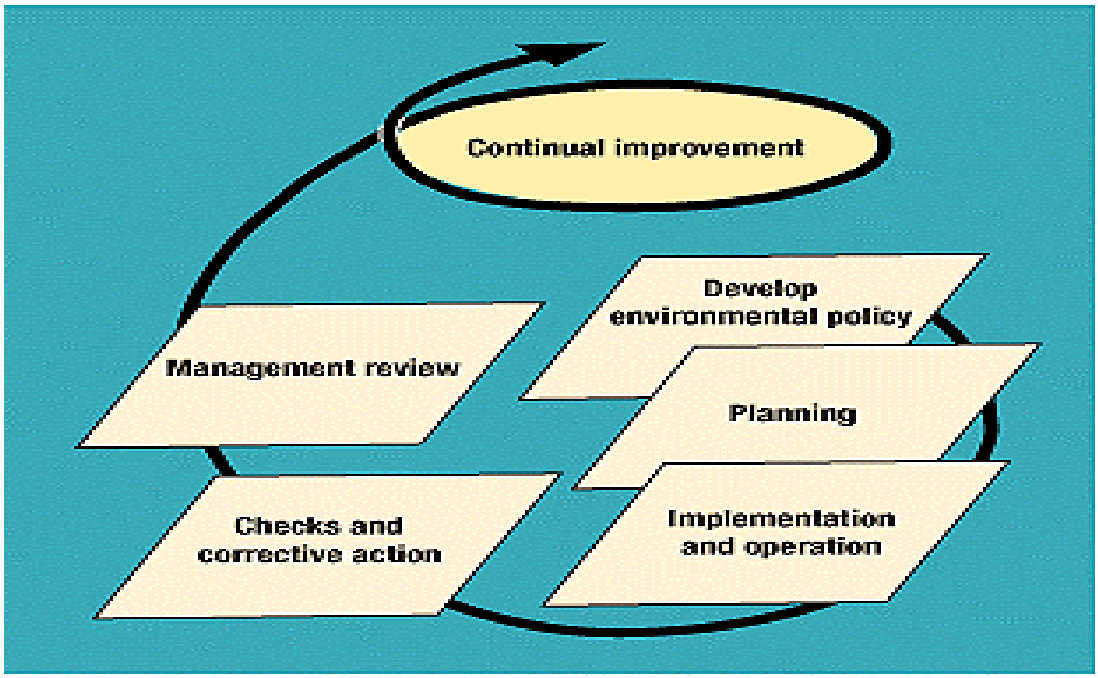
Since much current attention has focused on ISO 14001 as a model, both for voluntary EMS adoption and for public policy uses of EMSs as a basis for public recognition or regulatory flexibility, in the analysis that follows we have used the template and language of ISO 14001 as a benchmark for comparison of the various EMSs. This does not mean that all facilities studied have adopted ISO 14001 per se, nor that they all intend to seek ISO 14001 registration (approximately two-thirds of them have stated such an intent), nor that they are deficient if they choose not to do so. It simply provides one widely available benchmark for comparison of similarities and differences in current practice as to what an EMS contains and means. The purpose of this study is to provide a sense of that state of current practice.

II. THE ISO 14001 FRAMEWORK

ISO 14001, the international voluntary standard for environmental management systems, provides a "plan-do-check-act" procedural framework for the design of environmental management systems that can be used for consistent and goal-oriented environmental management within an organization, and can also be audited and verified by independent third-party registrars. Its purpose is to provide a systematic, documented, consistent procedure that provides clear evidence of the relationship between an organization's publicly stated environmental policy and the implementation of this policy in practice.

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

Figure 1. The ISO 14001 Environmental Management Process



This process then repeats regularly as a procedure both for assuring achievement of the firm's specified environmental policy goals, objectives and targets, and for adjusting the goals, objectives and targets themselves to achieve continuous improvement.

The origin of ISO 14001 was a 1991 effort of the World Business Council for Sustainable Development (WBCSD) to orchestrate a business-led initiative to the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, Brazil (UNCED, the "Earth Summit").[69] In a book entitled Changing Course, WBCSD spokesman Stephen Schmidheiny argued forcefully that business leadership was necessary to achieve a sustainable society, and that such leadership in turn was good for business itself: poor environmental management was evidence of poor management more generally (Schmidheiny 1992).

The goal of these original proponents was to produce a voluntary, business-led initiative that would increase sustainability, integrate sustainability and other environmental goals into mainstream business decision-making, and improve business management more generally; and at the same time, allow businesses to set and achieve their own objectives for improving environmental management as an alternative to a more rigid, global-scale environmental regulatory system. This voluntary model would include compliance with legal requirements and other commitments among its requisite objectives, and would also require businesses to commit to pollution prevention and to continuous improvement in their environmental management practices. By so doing, its advocates hoped, ISO 14001 would also create global norms among businesses themselves that would "harmonize upward" their environmental management practices, even in countries where regulation itself was inadequate or poorly enforced (Stenzel 2000).

From the issuance of the ISO 14001 standard in 1996 to July 2000, over 18,000 organizations were certified as conforming to it worldwide, including over 840 in the United States, and the numbers have grown increasingly in recent years. Most of the major auto manufacturers and some other firms have mandated ISO 14001 implementation by their first-tier suppliers as well as their own facilities; and a presidential Executive Order mandates implementation of EMSs by all federal agencies at all "appropriate" facilities.

With this increasingly widespread interest in EMS adoption, there has been a growth of interest on the part of some firms, government agencies, and other stakeholders in using EMS implementation and ISO 14001 certification for additional purposes as well. In particular, does ISO 14001 certification represent sufficient evidence of superior environmental management practices to warrant favorable government recognition, regulatory flexibility, or even regulatory relief? Such shifts might represent either flexibility in the application or trading-off of substantive environmental regulatory standards, or at least streamlining of reporting, inspection and monitoring to respond to better documentation, and more reliable self-monitoring and

[69] Both WBCSD and the UNCED conference in turn were strongly influenced by the 1987 report of the Brundtland Commission (United Nations' World Commission on Environment and Development), Our Common Future, which articulated the goal of sustainable development as a goal for human society: meeting today's human needs in ways that do not foreclose people from meeting their needs in the future, and specifically seeking what has come to be called a "triple bottom line" combining economic development, environmental sustainability, and social equity (World Commission on Environment and Development 1987).

continuous improvement, demonstrated by ISO 14001-conformant firms. Such presumptions are implicit in recent "green track" regulatory options by the U.S. Environmental Protection Agency (the National Performance Track program, www.epa.gov/performancetrack) and by a number of states such as Oregon, Indiana, Wisconsin, and others.

Advocates argue that such initiatives provide opportunities for voluntary improvements benefiting both firms and the public, and for redeployment of scarce public regulatory resources from superior to inferior performing firms and sectors. Skeptics however express concern over a number of unresolved issues:

- a lack of substantive environmental performance standards in the ISO 14001 procedure;
- a lack of transparency and verifiability beyond the firm and the 3rd-party auditors and registrars which it hires;
- a risk of "greenwashing" by low-performing firms, hiding behind the label of ISO 14001 registration while merely setting their own minimal objectives (Darnall 2000);
- a risk of eroding the uniform legal precedents of environmental regulations in favor of excessive administrative discretion to waive regulatory requirements for "good" firms (and thus create opportunities for worse ones with political influence);
- a risk of creating shields against information disclosure and legal liability behind "audit privilege" statutes; and
- a risk that too many scarce public resources may not be redirected to more intensive enforcement against low-performing facilities, but may be devoted instead to servicing of those seeking high-performance recognition.

To resolve these issues, it is essential to document empirical evidence on the actual content, variability, and results of EMSs across organizations that adopt and implement them. There are now rapidly growing literatures on ISO 14001 requirements and implementation handbooks (e.g.Tibor 1996, Jackson 1987, Ritchie and Hayes 1997, Woodside and Aurrichio 2000) ; on arguments about its hoped-for benefits and costs, both to firms and society (e.g. Morrison et al. 1999, Parry 2000, Stenzel 2000); on motivations for its adoption, both aspirational and empirical (e.g. Delmas 1999, Darnall 2000); and case studies of best practices (e.g. Rondinelli and Vastag 2000, Hillary 2000, Darnall et al. forthcoming).

As yet, however, there is little systematic comparative evidence on EMS adopters' actual use of the discretion that is allowed in the ISO 14001 procedure, and that is also present for firms not seeking ISO 14001 registration, to identify the environmental aspects and impacts of their own activities, to decide which to focus on as significant, and to set objectives and targets for improvement. The closest related work was a comparative study, performed in 1999, of 75 corporate environmental policy statements representing 101 ISO 14001 registered organizations (Barton 1999). This study found that over 97 percent of the statements -did in fact include the required commitments to continual improvement, prevention of pollution, and compliance, and that over 70 percent explicitly mentioned a framework of objectives and targets. Many also went well beyond the minimum requirements: over 60 percent stated policy commitments to internal audits or reviews, 60 percent to the conservation of natural resources, and approximately 50

percent to a safe working environment and to producing environmentally responsible products and services. However, it also noted that only 25 percent of the statements mentioned commitments to compliance with requirements other than government regulations (for instance, sectoral codes of conduct), though not all firms in fact have such requirements. In addition, 34 ISO 14001 registered organizations did not even respond to the request for their environmental policy statement, even though ISO 14001 conformance requires that such statements be made available to the public.

Barton's study thus showed strong common elements among policy statements of organizations registered as conformant with ISO 14001, but also some variance in actual practice, compared both with each other and with the elements of such statements that are required by ISO 14001 language and criteria. One might expect at least similar variance, and perhaps far more, in the practice of selecting environmental aspects and impacts of an organization's activities for consideration, and in determinations of significance and selections of objectives and targets among them.

III. THE ISO 14001 ASSESSMENT AND PLANNING PROCEDURE

The research reported here focuses on the second element of the EMS process as described by ISO 14001, 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 process, which should provide evidence both of the consistency or variance in implementation across organizations, and of the extent of commitment which implementing facilities are actually making to improvements in environmental management. What environmental aspects and impacts of their activities do they actually consider in the EMS? Which do they define as significant, and by what processes and criteria? And what objectives and targets do they choose to set for improving them? Answers to all these questions must be carefully documented by the organization if it seeks to achieve ISO 14001 conformance, and are important to understanding of an organization's EMS in any case. To the extent that the organizations are willing to share this information with researchers and the public, they provide a valuable source of information both on the meaning of the EMS and on the organization's substantive environmental management perspective and priorities.

ISO 14001 sets out a specific sequence of steps for this procedure, and its companion ISO 14004 guidance document offers additional non-binding direction as to how to carry it out (Figure 2). The implementing organization must begin by deciding the scope of the EMS (will it include the entire firm, all operations at a particular site, or just specific divisions or functions?). Then it should identify the various activities, processes, 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.

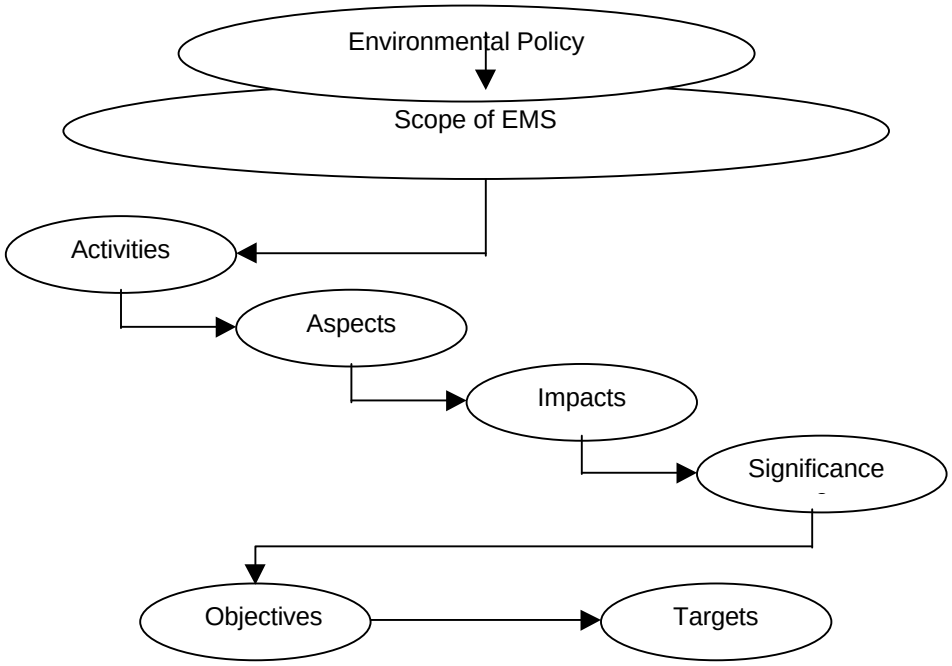
Second, the organization should then identify all the environmental aspects of each of these activities, products and services. An environmental aspect refers to an element of an organization's activity, product or service which can have a beneficial or adverse effect on the environment, such as a discharge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

Third, the organization should identify as many as possible of 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 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.

Fifth, in light of its significant impacts, the organization should then set performance objectives for implementing its environmental policy goals, and specific and measurable targets and dates for achieving progress toward this end. The organization "shall ensure that … aspects … which have or can have significant environmental impacts … are considered in setting its environmental objectives." These objectives and targets should be periodically reviewed and revised, and should take into consideration the views of interested parties.

Figure 2. EMS Design (Planning) Process



This procedure is thus quite specific as to the steps to be carried out, but it allows great flexibility and discretion to each organization to determine the actual content, priorities, and implementation pace of its environmental management system. Organizations have considerable discretion in how they design their EMSs to reflect their own environmental goals, objectives, and management culture.

An important issue for observers outside the organization, therefore—customers and investors, state and federal environmental agencies, neighbors and communities and

environmental citizen groups, for instance, and other potential users of the information that a particular organization is "ISO 14001 certified"—is understanding what the implementation of an ISO 14001 EMS really means. This in turn requires understanding how a particular organization itself has used the flexibility inherent in the EMS, what variation exists among organizations in the priorities their EMSs emphasize, and the extent to which they use the EMS to achieve better environmental performance, regulatory compliance, and other goals.

In order to be registered as compliant with the ISO 14001 EMS certification standard, an organization must document both this procedure and the implementation plan and assignments of responsibilities by which it is carried out. The existence of this documentation, to the extent that an organization is willing to share it, offers an opportunity to learn in detail about how an organization understands the environmental impacts of its activities, products and services, and how it sets priorities to improve them. The ISO 14001 standard itself does not require public sharing of this information but many organizations are in fact willing to do so.[70]

The EMS planning documentation thus offers a window not only to observe EMS design and anticipated implementation (and ISO 14001 certification, in cases where that is sought), but to understand the environmental perspective and management priorities of the organizations more generally. With important qualifications, one can also compare these perspectives and priorities across organizations of different types, sizes and levels of complexity.

One should expect considerable variance in the practice of selecting aspects and impacts for consideration, and in determinations of significance and selections of objectives and targets among them. Some reasons for such variance are obvious and appropriate. Examples include differences in kinds of operations in different firms and sectors; differences in size, scale, and physical extent of each facility's production processes and operations; and differences in the environmental conditions in which they operate, which would lead to differences in environmental significance in different places. Other likely reasons for variation include differences in perceptions and priorities on the part of those developing the EMS: environment, health, and safety (EHS) managers, cross-functional teams, non-management employees, consultants, community and NGO stakeholders if they are involved, etc.

An organization's EMS documentation should also be expected to vary with complexity of the scope of activities and processes included within it , such as an individual production process versus a facility-wide or even multi-facility, corporate-wide EMS. As an analogy, in the early days of the environmental impact statements (EISs) required by the National Environmental Policy Act there were important differences between EISs for highway segments versus highway corridors, and for site-specific range management versus generic EISs for range management practices overall.

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

[70] It does direct that the views of interested stakeholders be taken into account in setting objectives and targets, which could reasonably include external as well as internal parties.

- 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?
- How do organizations designing EMSs balance their attention to activities-aspects-impacts assessment on the one hand, and to setting objectives and targets on the other?
- What kinds of objectives and targets do the organizations choose to set, and what does this suggest about the organization's primary purposes in undertaking an EMS? Does it appear to seek mere documentation of existing practices to achieve the external legitimacy benefits of certification, or compliance assurance and improvement, or cost savings and efficiency increases in the uses of environmental resources, or broader goals such as environmental improvement, occupational safety and health improvement, product stewardship, and other longer-term sustainability goals?

The answers to these questions are important to anyone who needs to understand what is meant by the existence or certification of an EMS.

The purpose of this paper is to examine similarities and differences in the actual choices made in a range of EMSs to date. It is based on a detailed comparative content analysis of EMS environmental planning data from 40 facilities included in the National Database on Environmental Management Systems (NDEMS) that have implemented ISO 14001-based EMSs. Data were drawn from protocols completed by facilities in 10 U.S. states, and in many cases from detailed examination of the facilities' actual EMS planning documents as well. These facilities represent approximately 12 economic sectors, including both private-sector businesses and public-sector organizations such as military bases and wastewater treatment plants. They range from major manufacturers, electric utilities, and branch plants of large multinational corporations to small independent businesses such as electroplaters and auto parts suppliers. For most of these facilities the data include detailed documentation of both their activity-aspect-impact-significance assessments, and their objectives, targets and dates, as of November 2000. We are grateful for their generosity in sharing these data with us, and for the assistance of state project managers in helping collect them.

The analysis that follows is not intended to praise or criticize any particular organization. Nor is it 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 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 certified EMS.

As the analysis will show, the content of an 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 more important to examine than the mere fact or absence of EMS certification. It is therefore likely 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—may find it necessary to share more specific information about the content 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..

Several important cautionary notes are in order about the interpretation of these data. First, all data were drawn from facilities that volunteered to participate in the study and to share detailed data with us, and with state environmental agencies with which they are participating in pilot projects. They are thus not necessarily representative of facilities that have not shared such data, and may over-represent facilities that are especially proud of their accomplishments.

Second, we have not yet completed quality assurance reviews with all these facilities, especially on the completeness of the data received, and we are also anticipating data from 10-20 additional facilities. These findings should all be interpreted, therefore, as tentative and preliminary at this time.

Finally, these data are based on only a portion of the materials now becoming available to us from the facilities, (chiefly Tables 2 and 5 of the EMS Design Protocol: see www.eli.org/isopilots.htm), and we anticipate doing more extensive and detailed analyses in the coming months on other elements and combinations of these data. For example, we have not yet attempted to analyze in detail all the similarities and differences in specific scoring systems used for significance determination, nor to correlate differences in EMS designs with facilities' demographic characteristics from their baseline data, nor to analyze a number of other kinds of information collected in the protocols. We look forward to conducting additional studies of these data in the year ahead.

IV. FINDINGS

Scope of the EMS: The size and complexity of facility or operation for which an EMS is implemented varies greatly, and may or may not include all the most environmentally significant activities.

This may seem obvious, but it is important to recognize explicitly in examining any EMS. EMSs included in the sample, for instance, ranged from small businesses conducted in a single building to large but relatively well-defined manufacturing processes on single sites, to

organizations operating similar processes at more than one site, and military bases that included many very different functions and operations on large and complex sites. Understanding an EMS must begin by identifying what domain of activities, products and services it actually covers.

The choice of EMS scope can lead to considerable differences in what activities, products and services are actually included within the EMS. For instance, one facility in the sample, which is in fact a large and diversified organization for which a wide range of environmental impacts could be envisioned, chose to carry out an EMS only for its laboratory activities. This is one perfectly acceptable internal use of an EMS, to improve management of an environmentally important function for which a particular department (EHS) was responsible rather than to seek external certification of the facility as a whole. The EMS in this sense was in effect a project design and implementation template for improving a particular pre-selected activity domain. The only important cautions with this approach are first, that it not then be publicly interpreted as ISO 14001 certification for the entire organization (which is not presently contemplated in this case); and second, that opportunities to identify additional opportunities for improvement in environmental management elsewhere in the organization may be being overlooked.

In another example, a major airline (not one of the pilot facilities) certified merely its airline's headquarters building—not its aircraft and 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. In another case, the cover photograph of the annual report of a large and highly diversified corporation prominently features the words "ISO 9002" and "ISO 14001," even though only a fraction of its constituent companies and facilities are in fact ISO 14001 certified so far.

This issue is similar to one that was heavily debated in the early years of the environmental impact statement (EIS) procedure mandated by the National Environmental Policy Act of 1969 (NEPA) for all "major federal actions that might significantly affect the quality of the human environment" (42 U.S.C. 4321). In one case, the Bureau of Land Management proposed to prepare a single EIS for range management practices (such as chaining of brush) that were generically practiced on many public lands throughout the American West. A lawsuit by an environmental group ultimately required that it also prepare site-specific EISs as supplements, in order not to overlook impacts such as damage to the habitats of endangered species that would only be recognized as significant at a site-specific level. Similarly, the Federal Highway Administration ultimately had to develop EISs both for the overall impacts of highway corridor selection and subsequently for the more site-specific impacts of the construction of individual highway segments within the corridor. For some EMSs as well as for EISs, ultimately some similar sort of "tiering" may be necessary, in order to identify and appropriately prioritize both large-scale and more site-specific and operational impacts.

To the interested observer, therefore, it is essential to ask first of any ISO 14001 certification, what range of the organization's facilities and sites, activities, products, and services is actually included in the scope of the EMS; and are there any activities that may have significant environmental impacts that have been excluded?

Activities: There is great variation in the way environmental "activities" are characterized, and in their level of detail.

ISO 14001 guidance directs that an organization should identify the various activities, processes, products or 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."

Facility staff with whom we spoke frequently described the activities-aspects-impacts identification process as the most difficult and frustrating part of the EMS process, and the diversity of the resulting documents illustrates this challenge (see e.g. Darnall et al. 2000, Darnall et al. 2001).

The majority of facilities (22) interpreted "environmental activities" as meaning production processes and other broad on-site operations and business functions. Many, for instance, defined their environmental activities in functional or operational terms such as manufacturing, maintenance, construction, housekeeping, groundskeeping, transportation, waste management, and other similar terms.

A significant but smaller number (15) broke their activities down into more specific processes and equipment operations (for instance boilerhouse operations, rinsing, stripping, molding, extrusion, polishing, cleaning, forklift operation, aircraft refueling, airport pavement deicing, grit removal, etc.).

A few (six) listed as environmental activities specific chemicals used, such as aluminum sulfate, sodium hydroxide, sulfuric acid, nitric acid, chlorine, cyanide, heavy metals, alcohol, propane, mercury, and others. A few (six) also defined their environmental activities as specific resource uses and waste streams, which to others were more appropriately described as environmental aspects or impacts. Some for instance listed as environmental 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, soiled rags, and others.

A few broke their activities down into levels of such minute detail that most others evidently considered unnecessary or even excessive: for instance drinking fountains, urinals, toilets, showers, janitorial sinks, shoveling snow. Ten did not provide (or have not yet provided) data on activities considered.

Significantly, only a very few of the organizations in the sample included products or services along with their activities, although ISO 14001 and 14004 guidance documents state that the EMS should identify the environmental aspects and impacts of all their "activities, products and services." The few that did so stand out as exceptions so far. This suggests that as yet, many U.S. organizations implementing EMSs may be focusing only on site-specific production and support activities, and are not yet viewing the procedure through the broader lens of life-cycle analysis, product stewardship, and other longer-term sustainability goals.

<u>Aspects</u>: There is considerable variation in the characterization of environmental aspects of these activities as well, and in the level of specificity and detail at which they are identified.

ISO 14001 guidance directs that the organization should identify all the environmental aspects of each of its 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. Aspects, in ISO 14001 terms, are activities that interact with the environment; impacts are the changes in the environment resulting from that interaction (Tibor 1996). Environmental aspects to be considered include all those that the organization "can control and over which it can be expected to have an influence."

More than half of the 40 facilities interpreted environmental aspects as including more detailed actions associated with each activity, which could directly cause environmental impacts. Another 25percent of them (11 facilities), however, simply duplicated their activity lists as their environmental aspects, or began their analyses with lists of environmental aspects without providing corresponding activity lists. Three listed as environmental aspects merely more detailed business functions or operations without evident environmental content.

These patterns suggest the possibility that notwithstanding the rationalized sequence of the ISO 14001 process from EMS scope to activities, aspects, and impacts, in practice some facilities may be finding it more logical to start their analysis with specific aspects that may cause environmental impacts, or even with the most evident impacts themselves, and then to think backwards from these to their causative aspects and thence to the activities of which they are part. This alternative thought process may even have advantages for focusing attention first and foremost on improving performance related to the most significant impacts, whereas the prescribed sequence may have benefits related to developing more detailed and facility-wide awareness of all aspects of the organization's activities that may have environmental consequences.

Among the majority that did identify more detailed environment-related aspects, there were great differences in the degree of detail represented in these data. Some, for instance, broke these aspects down into very specific sub-activities that might lead to different—and differently controllable or improvable—pollution prevention or improvement actions. Example 1, for instance, shows eight distinct aspects that were identified for one industrial activity, each of which generates different environmental impacts for consideration.

Note that this facility also used the EMS procedure to discriminate among its impacts, some which it considered significant in comparison with others which it did not.[71]

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

Example 1. Activities-Aspects-Impacts-Significance Identification

Activity	Aspects	Impacts	Significance
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

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. Example 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.

Example 2. Activity-Aspects-Impacts-Significance Identification

Activity	Aspects	Impacts	Significance
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 to an outside observer more as a formality for certification purposes than a working management tool.

Finally, the overall level of detail and complexity of the activity-aspect-impact-significance analyses varied 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 Q-tips 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 snow-blowers or Q-tips, let alone 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 may also reflect important variations in the process and goals of EMS implementation in different facilities, each of which may have value but for different purposes. Such differences may be due, for instance, to the way the organization assigned responsibilities for developing the EMS. For instance, an EMS whose activities and aspects are laid out in a very systematic and concise hierarchy may be a more efficient management tool for setting objectives and targets to remedy the most obviously significant impacts, or merely for achieving ISO 14001 registration; but an EMS that contains extensive "laundry lists" of every conceivable aspect may also 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 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.

Finally, these difference suggests the importance of identifying who within a facility is involved in EMS development and at what steps. They also suggests the importance of the EMS being integrated with an overall environmental management philosophy. When facilities are driven primarily by a goal of certification for its own sake, for instance, rather than to develop a useful management tool for internal business reasons, the result may be more disjointed or perfunctory.

Impacts: Impacts are most often described generically, in 15 to 20 standard categories.

ISO 14001 guidance directs that the organization should identify as many as possible of 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.

The impacts identification procedure is perhaps the most important step in the EMS thought process. What is it, after all, that could be environmentally important about all those activities and aspects? Yet to an outside reader, it is by itself one of the least informative elements of the EMS.

The overwhelming majority of facilities (32) identified impacts in 15-20 generic types, without specification of their details or quantification of their magnitudes: for instance 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.

Four facilities identified impacts as more detailed lists of separate waste streams that could potentially be prevented, reduced, or recycled—waste streams that other facilities identified instead among their environmental aspects. Four also (though not the same four)

identified other general concerns such as compliance, liability, risk severity and frequency, and money among their impacts.

Six facilities specifically included occupational health and safety concerns among their impacts, which go beyond the ISO 14001 model; and seven (but only seven) included positive as well as negative environmental effects among their impacts, which are supposed to be included in the ISO 14001 assessment.

Three further points are worth noting about the facilities' characterizations of their impacts. First, not all facilities interpreted impacts in the same way, though a majority apparently did. For most of the facilities, environmental impacts amounted to about 15-20 generic types, which often were not specifically quantified. For a few, impacts were interpreted as more specific waste streams or other impacts that could be identified, quantified, and reduced or prevented, sometimes including a wider range of impacts than purely environmental (for instance, occupational health and safety); and for a very few they focused on business concerns (compliance, liability, money) and did not mention specific environmental impacts at all.

Second, a few facilities specifically quantified their impacts, but many others did not, settling for mere categorical identification of major impact types. This represents an important difference in the actual levels of information the EMS is producing or using to improve environmental management in the organization.

Third, the overwhelming majority of facilities addressed only adverse impacts of their activities on the environment: only seven also identified positive environmental impacts of their activities. This is an important issue for consideration by other facilities considering adopting an EMS, and particularly for those considering ISO 14001 certification. In most cases, adverse impacts may well be the most important issues for consideration, so that it is appropriate and cost-effective simply to focus on them without expending effort on identifying beneficial impacts. 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 continuous improvement. As an example, there is one company whose product was listed as a positive impact because they make regulators for boilers and if the product works correctly boilers operate more efficiently. Other obvious examples include organizations (both private and public) that manage natural lands, waters, forests, and wildlife habitat; undoubtedly there are others as well, such as those whose products, services, and organized voluntary efforts make particularly strong contributions to environmental sustainability.

Significance Determination: There is great variation in facilities' judgments about the significance of their environmental impacts, as well as in the procedures used to determine significance.

ISO 14001 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.

In practice, there is 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 necessarily 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. ISO 14001 itself was designed to serve as a generic template for use by all organizations that believe they can improve their environmental management practices by adopting it, without respect to the actual magnitudes of their environmental impacts. Some of these respondents may be facilities whose environmental impacts are 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 be facilities whose environmental impacts are significant mainly to themselves, to their activities and products and services, and to the values of their managers and the morale of their employees. To the extent that an ISO 14001 EMS serves simply to improve internal management for an organization's own benefit, therefore, 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 significance should at least be internally consistent and address impacts that external observers would also consider significant. To the extent that external observers are also to rely on them as evidence of superior environmental performance—for instance, using third-party certification as an alternative basis for government recognition programs or regulatory flexibility—they should also include explicit attention to impacts that are important to external stakeholders such as the community, government regulatory agencies, and others. The ISO 14001 standard itself, however, appears 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 because of differences in management structures or organizational cultures.

Table 1 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 had a score that exceeded 174; but an impact scoring only 39 was also ranked 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.

Table 1. 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
	Water use	Municipal	Natural resource depletion	No	Low cost, not regulated from environmental perspective

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 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 all the impacts it identified as significant. Only one facility (B) mentioned the environmental impacts of a product among its environmental impacts (this is 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 result is that 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 Q-tips 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 Q-tips, let alone designate them as significant.

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, but simply to document the significant differences that in fact exist among them. What is significant in the judgment of one facility may not seem so to another.

For an interested external observer, however, 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 do provide it), but it does direct that the concerns of interested stakeholders be considered in setting objectives and targets.

It is worth noting that only a distinct minority of facilities as yet appear to have involved external participants in their deliberations about significant impacts. Of 16 facilities for which data on this question is available, for instance, eight involved government officials, five used consultants, and four involved representatives of their governing boards or shareholders; only five involved their own non-management employees, and only three involved environmental or community groups.

Objectives and Targets: At least four distinct approaches to setting objectives and targets could be identified.

Finally, ISO 14001 guidance directs that in light of its significant impacts, the organization should set performance objectives for implementing its environmental policy goals, and specific and measurable targets and dates for achieving progress toward this end. These objectives and targets should be periodically reviewed and revised, and should take into consideration the views of interested parties.

Comparison of the objectives and targets reveals at least four distinct types of objectives and targets, which can be characterized as performance-oriented, project-oriented, management activity-oriented, and compliance-oriented.[72] There are also a variety of other objectives and targets that do not fit any common category.

[72] Based on data for 33 facilities, the number for which these data are now available.

From the perspective of an observer interested in the effects of an EMS on environmental performance improvement, the objectives and targets one would most like to see are those that set quantified and monitorable objectives, targets, and dates for improvement of specific types of environmentally significant impacts. Table 2 provides examples of some of the most specific and quantifiable performance-oriented objectives and targets that were identified, drawn from a number of EMSs. Examples A and B specify 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 2. 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

A second type of target was specified by a number of facilities not in terms of quantifiable performance improvement per se, but in terms of completion dates for specific projects that could be expected to produce environmental performance improvement (though the actual extent of improvement often was not specified). Table 3 shows examples of these project-oriented 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 are equally specific and verifiable as the performance-oriented targets, and lack only the latter's specific quantification of the actual environmental performance improvements resulting from them.

Table 3. 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

A third category of objectives and targets includes management activities that are plausibly steps toward the achievement of environmental performance improvement, either generally or specifically, but are not directly linked to measurable performance improvement targets. These include for instance employee training, vendor awareness-raising, and communication programs, studies of options for possible process changes to reduce impacts, and even ISO 14001 certification itself (stated by several facilities as a target). Table 4 shows examples of these sorts of targets. These sorts of actions can be appropriate and important steps toward environmental performance improvement, but they are both more generally specified and less directly linked to verifiable environmental performance targets than were the previous two categories.

Table 4. Management, Training, and Awareness-raising as 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 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

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 of course one important use of an EMS, but for some facilities it appeared to be the dominant or even sole category of objectives and targets, with little recognizable attention to continuous improvement or to pollution prevention beyond regulatory requirements. Table 5 shows examples of such compliance-oriented objectives and targets. Example A is the most specific, and includes a target 50 percent lower than permitted levels by a specified date. The other examples, however, include merely a listing 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 5. Compliance-assurance 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

Note that neither these examples, nor most other NDEMS facilities, included identifiable objectives and targets related to life-cycle analysis or other product stewardship goals. Only three could be clearly identified: one studying alternatives to lead-containing raw materials, a second optimizing its product's life-cycle design, and a third mentioning customer packaging initiatives. Also, only three facilities specifically mentioned risk reduction among their objectives and targets, and in all three cases it was oriented to maintaining regulatory compliance. One mentioned broader watershed-protection planning targets rather than merely facility-specific objectives and targets.

In a separate forthcoming paper, Gallagher and Andrews (2001) report findings from a detailed comparison of the objectives and targets of 26 NDEMS facilities that have provided quality-assured data so far. Nearly 60 percent (15 of the 26 facilities) focused their EMSs primarily on meeting pollution prevention goals. Examples of specific targets for this group included "reduce oil mist and emissions," "reduce solvent waste generation," "95 percent reduction in nitric acid use," and "implement office paper recycling program."

A smaller group of facilities (seven) focused more or less equally on compliance assurance and pollution prevention. Approximately half of these facilities' EMS targets, such as "comply with sanitary flow requirements," were related to achieving compliance. The remainder, such as "reduce the use of coolant," were related to pollution prevention.

Three facilities' EMSs focused primarily on compliance assurance, with at least 75 percent of their targets related to achieving compliance with environmental regulations. These facilities cited targets such as "comply with stormwater discharge permit," "100 percent regulatory compliance," and "100 percent of hazardous waste disposed in conformance with applicable laws."

Only one of the 26 facilities had product stewardship as its primary EMS goal. This facility identified targets such as “study alternatives to lead-containing raw materials,” and “study the environmental impacts of products during life cycle”.

Interestingly, 12 of the 26 facilities included program management, training, communication and/or employee health and safety objectives and targets within their EMS, in addition to pollution prevention and compliance assurance. Examples of the targets identified by these facilities include “maintain costs within the environmental department budget, “identify training needs,” “promote employee awareness of the EMS program,” and “reduce team member exposure to chemical hazards.”

In summary, most of the facilities focused their EMSs on pollution prevention or jointly on pollution prevention and compliance. Only one of the 26 facilities used the flexibility of the EMS to look beyond production and operations and examine ways to address issues of product stewardship. However, some facilities did use the EMS to develop management initiatives for training, communication, and employee health and safety as well as pollution prevention and compliance per se.

It is worth noting that 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 targets and objectives 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, “to meet all applicable regulatory requirements at the facility,” with target dates identified simply as “ongoing.” This sort of EMS appears to serve primarily to legitimize and 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.

Finally, note that the target dates for all facilities in NDEMS fell without exception into three categories: already accomplished (a few cases), the coming year (2000-01), or “continuous" or “ongoing" (as for instance in maintaining compliance). None mentioned any objectives or targets for two to five years or further into the future. This finding suggests, at least for the facilities included in this sample, a very dominant preoccupation with immediate priorities, with limited if any linkage to longer-term strategic commitments to continuous improvement.

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, this response would merely confirm rather than rebut the observation that the EMS process by itself cannot necessarily be counted on to drive continuous improvement to a strategic level of organizational change, from compliance and pollution-prevention efficiencies to fundamentally more sustainable products, services, and production. In interested organizations it may be successfully used for this purpose, but so far these appear to be distinct exceptions.

In future research, using update information from the facilities one and two years after these initial data, it will be important to try to learn whether or not their 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 "continuous improvement" in environmental performance are important.

V. CONCLUSION

Facilities have considerable discretion in how they design their EMSs to reflect their environmental goals and objectives and their management priorities and culture. These preliminary findings suggest that in practice they exercise this discretion to produce EMSs that differ quite significantly, both in their interpretations, approaches, and levels of detail, and in their apparent purposes and uses. . Thus, an important issue for state and federal environmental agencies is understanding how the flexibility inherent in the EMS is put to use; and what variation exists between facilities, in the priorities their EMSs emphasize and in the extent to which they challenge themselves to achieve continuous improvement in environmental compliance and performance.

These findings strongly suggest that for most interested external observers of EMSs, the content 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 certification 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 purposes, however, there is also every 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 to develop explicit and consistent training procedures for new employees operating processes that can have significant environmental or health and safety risks.

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

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Case Study 1
"Alpha Manufacturing"

Winter 2000

Deborah Rigling Gallagher and Nicole Darnall

I. WHO IS "ALPHA"?

"Alpha Manufacturing" is a small, privately held manufacturing facility located in the Midwest with less than 100 employees. It is located in an industrial park zoned for heavy industrial use within a small suburban town. The facility is surrounded by industry and separated from a residential area by a railroad track. Alpha has been in operation at or near its present location since the early 1980s and considers itself a model corporate citizen. The local government has placed stringent environmental requirements, beyond those required by the state or federal governments, on all its industrial operations.

Prior to being asked by the state to volunteer to be an EMS pilot facility, Alpha participated in USEPA's 33/50 program. Alpha's experience with the 33/50 program was helpful in that it taught them about participating in voluntary government programs. This experience lead to Alpha's continuing involvement in EPA's Common Sense Initiative through the Strategic Goals program. Alpha was recently certified to ISO 14001, ISO 9000 and QS 9000. Environmental best management practices and pollution prevention and waste minimization planning have been used at Alpha since the early 1980's. In addition, Alpha has been conducting compliance audits since the early 1990s.

II. WHY ALPHA ADOPTED AN EMS

Several factors were instrumental in influencing Alpha to decide to develop 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. They thought that Alpha already had in place most of the elements of an ISO 14001 EMS and all that was needed was documentation. Also, analogous to QS 9000 and ISO 9000 certification, ISO 14001 they believed that 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.

III. WHO DESIGNED ALPHA'S EMS?

Alpha's senior management team, including the President, Vice President of Operations, Vice President of Technology, the Quality Manager, and other key managers were involved in designing the EMS. A consultant also assisted in the process and played a leadership role in educating the team about the requirements of ISO, in keeping them on track and in refereeing heated arguments. Meetings with team members and 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 their roles and responsibilities as well as the company's environmental 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 have been trained as internal auditors.

IV. ALPHA'S EMS ADOPTION PROCESS

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 was 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 that was facilitated by their consultant, each of Alpha's senior managers were charged with developing their own list of activities at Alpha that had an impact 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 actions were incorporated into the design of the 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 all 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.

It took Alpha approximately 18 months to design and implement its ISO 14001 EMS and obtain certification. This work was accomplished concurrently with designing and implementing its quality system and becoming QS 9000 and ISO 9000 certified.

V. ALPHA'S ISO 14001 EMS ADOPTION PROCESS

While Alpha's managers would like to obtain future economic benefits in terms of an increased market share due to ISO 14001 certification, they do 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 are also hoping that regulators will reduce their monitoring and surveillance requirements for ISO 14001-certified facilities, but again that remains to be seen. However, the relationship between Alpha and regulators, while always cordial, has improved throughout the process of EMS implementation and ISO 14001 certification. State regulators consider Alpha's EMS design and implementation efforts to be a model for other companies to follow and have rewarded and publicized Alpha's efforts.

Besides an improved relationship with regulators, Alpha has benefited from adopting ISO 14001 in other ways. In particular, the written environmental policy produced significant benefits to Alpha. 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 have the opportunity to know what their specific environmental stewardship roles and responsibilities are.

A commitment to continuous improvement, even for a facility, which decided ten years ago to go beyond compliance, has also been helpful. The plan-do-check-act cycle of the ISO 14001 EMS provides 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 have both proved to be valuable. The changes made to Alpha's processes and programs since the ISO 14001 EMS was implemented both improved environmental performance and reduced costs.

VI. ALPHA'S BENEFITS OF EMS ADOPTION

But, by far, the primary benefit of the ISO 14001 experience at Alpha has been 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 speak a common language with respect to the environment. No longer do managers and EHS-related staff have to convince employees that environmental activities are worthwhile. Employees now increasingly view environmental stewardship activities as integral to their daily work and take the initiative to suggest ways to improve environmental performance.

Case Study 2
"Beta Municipality"

Winter 2000

Nicole Darnall and Deborah Rigling Gallagher

I. WHO IS "BETA"?

"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. In last 10 or more years, this area has experienced higher-than-average growth levels and tourism. Such growth is placing increasing demands on the municipality's operations and ability to manage its environmental impacts.

Prior to being asked by USEPA to volunteer to be an EMS Municipality Project, Beta employed Total Quality Management principles, pollution prevention planning, waste minimization planning, and life cycle since the mid-1990s. It also 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 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.

II. WHY BETA ADOPTED AN EMS

If not for the USEPA's EMS Municipality Project, Beta would likely 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. So, why did Beta adopt its EMS? Beta maintains that the USEPA project served as its market driver and cost mitigator. The federal agency provided both the financial and technical support that made EMS adoption feasible. Later, Beta received additional support from its state and county government, which facilitated its EMS implementation.

There were, however, other factors that contributed to Beta's decision to adopt an EMS. Specifically, these factors were (1) Beta's historical environmental performance, (2) its desire to maintain a low-risk profile, and (3) its desire to be an innovative operator. In regards to its historical environmental management, the municipality is still in the process of managing its previous environmental errors, which occurred over twenty years ago. In the early 1980s, part of Beta's operations became listed on the National Priorities List, otherwise known as Superfund. This site and the slow remediation of it has strained Beta's relationships with both the federal

government and its public critics. In considering this issue, top management thought that the municipality would be better equipped to preclude future compliance problems, avoid repeated mistakes, and improve its stakeholder relationships if it adopted an EMS. They believed that the EMS structure, which focuses environmental management in the long-term, would be the vehicle to move Beta forward in all of these areas.

The second factor that contributed to Beta's decision to adopt an EMS was maintaining a low "risk profile", which is an important performance indicator of the municipality's operations and management. As part of this issue, Beta was concerned about avoiding any catastrophic environmental events and taking a proactive risk management approach rather than a reactive one. Beta's top management believed that adopting an EMS was consistent with this proactive approach.

Finally, Beta has had a long history of innovation. Its "corporate" culture involves trying new management approaches in order to improve upon its current operations. Dedication to this cultural style is seen in its voluntary participation in GLP and VPP. It is also seen in Beta's management direction. Top-level managers recognize the increasing demands on both the municipality's transportation ways and the environment. To address these problems, they have traveled to numerous 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.

III. WHO DESIGNED BETA'S EMS?

Beta's EMS design team, known as the EMS Steering Committee, consisted of 3 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, were also involved in Beta's EMS design process. Similar to management's participation in Beta's EMS design, 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 is accessible to both Beta employees and the public.

Several external stakeholders also influenced the entire design process, too. The city's Environmental Quality Advisory Board, which is comprised of citizens who are interested in and advise Beta's environmental affairs, reviewed the municipality's EMS and provided recommendations for improvement. As well, a publicly owned manufacturing facility, which had already adopted an EMS, provided Beta with technical information and EMS development

software. Beta was able to borrow these tools and modify them so that they were more relevant for their use.

Finally, Beta involved employees in each of its 5 departments and various sub-divisions during its 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.

IV. BETA'S EMS ADOPTION PROCESS

In adopting its EMS, Beta formed a steering committee, which had a knowledge of the city's 5 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 various aspects and impacts that were relevant to each department. Then, committee members took both the template and the list to each of its 5 departments to 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. Department employees largely 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. Then, the department personnel were asked to list a minimum of 3 department objectives. 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.

V. BETA'S UNIQUE EMS ADOPTION HURDLES

While the process described above appears to be relatively uncomplicated, Beta encountered several hurdles when implementing its EMS, which are likely to be unique to other municipalities or other very large business organizations like Beta. Bureaucracy and its resulting inertia to change was perhaps the greatest barrier for it to overcome. Beta has a very large operating structure with numerous departments and divisions. With any entity this size, communication among the various departments was not consistent and managers were not always in agreement with one another. In order 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) though new, innovative approaches, such as seeking grants, soliciting state-level or county-level assistance, etc. so that it could still operate within its existing budget, and thus allay middle management's resource concerns.

An additional hurdle for Beta to overcome was the ISO 14001 framework, itself. Even though Beta is not ISO 14001-certified or seeking certification, the standard has evolved into the benchmark in which all EMSs are compared. For this reason, the municipality turned to the standard for assistance in developing its EMS, but found that ISO 14001 was difficult to apply to Beta's operations. Beta believes that this difficulty stemmed from the standard's focus, which is at the facility-level and most applicable to manufacturing entities. Beta Municipality, however, is a large organization, with an EMS that covers more than one "facility". Other difficulty that Beta encountered was related to the standard's applied emphasis on facilities that manufacture a single type of "product" that is ultimately produced for sale. However, Beta creates numerous, diverse goods for public consumption. Many of Beta's performance indicators, too, are 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 are foreign to the average manufacturing facility's EMS and the ISO standard. Finally, Beta's customers are taxpayers, rather than discriminating consumers, which the municipality is convinced creates a management structure that is very different from the structure that ISO 14001 was designed to address. Beta believes that each of these factors made ISO 14001 less applicable to a public sector operation, and thus, very difficult to implement.

A final and very important 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 (e.g. aspects, impacts, significance, objectives, and targets) and EMSs in general was difficult for the 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 redeveloped and retooled. All technical jargon was removed and replaced with more familiar terminology and examples, and slick choreographed presentations on the U.S. environmental regulatory system were made less formal and substantially abbreviated.

VI. BETA'S BENEFITS OF EMS ADOPTION

While Beta says that its EMS adoption process was difficult at times, it recognizes the benefits of its implementation, too. Adopting an EMS has enabled Beta to better evaluate its wastewater discharge process. Doing so has helped its management understand that they were able to minimize the municipality's environmental impact further. Since then, Beta has made several capital purchases and installed additional mitigation equipment.

A second benefit of Beta's EMS is that the municipality better understands the high cost associated with its non-regulated impacts. By minimizing its non-regulated impacts, such as paper usage and emphasizing employee recycling, in the future, Beta expects to save a great deal of public money. For example, as part of its EMS, Beta recently evaluated its copier and printer leasing contracts. Beta discovered areas where additional improvement can be made, especially

in its supplier selection. The municipality decided that, in the future, it will exclusively use suppliers who can provide copiers with default settings for double-sided printing.

A final benefit that Beta hopes to reap, in time, as a result of adopting an EMS is moving the municipality beyond a compliance-oriented mode of operation. That is, Beta hopes that its EMS will help its employees to lower the municipality's emissions to such a degree that its operations are well below the regulatory thresholds. Doing so will make its environmental strategy more consistent with its proactive risk management policy. A secondary benefit that Beta hopes to realize as part of this management shift is a better relationship with federal and state regulators, which has been strained at times in the past.

In closing, time will tell whether Beta Municipality's EMS is able to achieve all the goals it has articulated. Even with the hurdles it has had to overcome, Beta's management believes that adopting its EMS was the correct decision, which was fortified by USEPA's financial and technical assistance. The cost of maintaining its EMS is expensive, though, and will, no doubt, continue to be an issue that is key to its long-term efficacy.

Case Study 3
“Delta Electronics”

Fall 2000

Nicole Darnall and Deborah Rigling Gallagher

I. WHO IS "DELTA"?

"Delta" is a large electronics facility with nearly four million square feet of operations, approximately 200 departments, and approximately 7,000 employees. 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 believes that incorporating environmental concerns into its management system creates a more efficient operation within all of its facilities and contributes to its overall business objectives. Also, its EMS has 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 have adapted their operations and EMSs to meet the requirements of the corporate provisions. The corporate EMS establishes the environmental policy, instructions, and practices for facility operations. It also defines managerial responsibilities, assures environmental considerations are integrated throughout its business operations, and requires facilities to provide environmental performance data and information to allow the corporation to effectively monitor its worldwide environmental performance.

In 1997, Delta registered its EMS to the ISO 14001 standard. Prior to this registration, the facility 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 participated in OSHA's Voluntary Protection Program and EPA's Energy Star program. These environmental initiatives had little influence on Delta's decision to certify its EMS to the ISO 14001 standard. Instead, participating in these and other programs influenced Delta's decision to participate in the EMS pilot program as a result of the positive experiences it had working with regulators to better manage the facility's environmental impacts.

II. WHY DELTA ADOPTED AN EMS

Unlike Delta's reasons for adopting its original EMS, which was done primarily in the 1960's and was corporate-driven, its motivation to register its EMS 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 to make 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 evaluate how best to proceed with a corporate program to register all of its development and manufacturing facilities to the ISO 14001 standard. Based on its evaluation in early 1997, Delta's corporate parent company instituted a program that required all of its development and manufacturing facilities to obtain ISO 14001 certification. Today, overall ISO 14001 registration occurs at the corporate level, thus matching the overall corporate EMS.

Delta acknowledges that its investments in research and development as well as in innovative technologies also played a less direct role in its decision to register its EMS. Delta has invested heavily in technology development, which assisted in allowing it to operate more "greenly". During product development, Delta personnel routinely consider 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, although they were not familiar with the standard itself.

External factors such as the public, Delta's suppliers, regulators, Delta's compliance history or Delta's customers played a much smaller part 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 of being one of the state's business leaders.

III. WHO DESIGNED DELTA'S EMS?

Delta's ISO 14001 EMS design team, known and as its "EMS Core Team", consisted of both Delta managers and employees. Additionally, guidance was solicited from Delta's parent corporation environmental staff and Delta's 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.

IV. 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 aspects identified were four aspects that were also 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 locations, 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 motivate Delta employees and management and to receive 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.

Today, each of Delta's more than 200 departments is required to have its own ISO 14001 EMS plan, which are 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 is that Delta has more effectively involved its nearly 7,000 employees in its EMS deployment.

To better monitor and improve its ISO 14001 EMS, Delta convenes 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 are incorporated into the management review process for Delta products and are a criterion for managerial performance.

Delta's overall environmental performance is reviewed by its senior facility executives and specific direction for establishing future objectives and targets for activities, products, and services is discussed with the Core Team during this review. One change that occurred as a result of these assessments is that Delta's health and safety audits are now more closely integrated into its annual ISO 9001/14001 internal audit program to achieve greater operational efficiency.

V. DELTA'S UNIQUE ADOPTION HURDLES

While Delta managers believe 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. The 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 specific department objectives and targets rather than facility-wide aspects, such as water conservation and energy use, and their respective objectives and targets which affect all facility areas. Should Delta have followed through with this 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 may 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 their 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 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 and which, if minimized, 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 respective employees.

The Core Team addressed managers concerns for ISO 14001's documentation burdens by creating templates for departments 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 appropriate location within their existing manuals, thus reducing the time required for implementation at the department-level.

Considering all of its implementation hurdles, one Delta manager suggests that if he had to do it all 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 other issues to overcome--related to its continual improvement process--in order to maintain its EMS. A unique feature of Delta's EMS is that it is fairly mature. Having had in place an EMS for 25+ years, the facility has for some time factored environmental concerns into its operating procedures. ISO 14001, however, required that Delta more formally focus on continually improving its EMS. Because of the maturity of Delta's EMS, this has been a challenge as much of its "low-hanging fruit" has long-since been picked. Moreover, because many of Delta's managerial staff have been with the facility for many years it experienced difficulty with its staff becoming too accustomed to typical operating procedures, thus diminishing employees' ability to think creatively to improve the ISO EMS over time.

To overcome these hurdles, Delta executives and employees have focused on how its EMS is what on Delta manager describes as a "living plan". During the facility's annual review, emphasis is placed on how changes might be made to the system and to various programs. But change within any organization is difficult to achieve. One factor that facilitates Delta's focus on change and continual improvement is that facility management encourage a work environment where employees have the ability to periodically change their job positions. Doing so helps prevent what one Delta employee describes as "personnel tunnel vision". For example, one employee recently changed her job position and assumed responsibility for the alternative commute program. Because of her perspective differs from her predecessor, she has been able to incorporate fresh ideas into the program. This strategy helps Delta maintain its continual improvement focus. So, too, has its employee incentive program, which offers employees monetary incentives should their recommended improvement options be implemented.

VI. DELTA'S BENEFITS FROM EMS ADOPTION

Since the 1970's, Delta has made great strides in improving its environmental performance and philosophy. During the early stages of development, the facility managed its environmental affairs in more of a responsive manner. In general, when an environmental incident would occur, albeit infrequently, Delta would respond and try to manage any impacts as best it could. Since adopting its initial EMS, a succession of executives and environmental managers have brought with them fresher perspectives and increased environmental awareness and leadership. Now, more focus has been placed on reducing the facility's "environmental footprint", avoiding the occurrence of any incidents, and on the 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 in place a strong EMS.

Since certifying its EMS Delta has reaped numerous internal and external benefits:

Internal Benefits

Integration of Environmental Management. Internally, perhaps the most impressive benefit is that ISO 14001 adoption has more formally made environmental management--from soda can recycling to duplex printing, to aluminum foil recycling, to turning off desktop computers at night, to turning off lights when not in use, and much more--the responsibility of every employee, from secretaries to senior management. In 1996, very few people knew where to find Delta's environmental policy. Today, about 7,000 employees know where to find it, know what it is, and know how their individual actions contribute to the facility's ability to achieve its environmental goals. This awareness helped to more effectively integrate ownership of Delta's environmental performance into the day-to-day business processes of all site employees. Today, there is also an organizational understanding of how the facility impacts the environment, why these impacts should be minimized, and how it is every employee's responsibility to minimize their effect to the environment. As a result, environmental issues have been personalized for many Delta employees, thus heightening employee morale and increasing employee support for the facility's business goals.

Document Control. Other internal benefits relate to increased document control, improvement to the calibration process, 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 has continued to replace inefficient manufacturing equipment with new tooling. For Delta's product components that require chemical processing, such processing has been modified so many of these components are now sprayed rather than dipped into a chemical bath. These improvements continue to occur as Delta's employees identify manufacturing processes where process changes will result in chemicals being more effectively and efficiently utilized. 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 has also helped the facility 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, etc.). 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 personnel are informed of procedural changes.

Landuse. Other internal benefits of Delta's ISO 14001 adoption relate to how it manages its land use. For example, rather than focusing only on how Delta may negatively impact the environment, the facility now considers its *positive* impacts, too. For years, Delta has maintained on-site orchards. As a result of ISO 14001 adoption, however, the facility has broadened its environmental management focus to specifically consider its 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 has enabled Delta to consider elements of its activities, such as employee transportation, that were not previously considered key environmental aspects. 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 employee 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 the past year alone, Delta has been able to increase its employee use of alternate commute options by more than 50 percent.

Energy Use. Delta also continues to benefit from minimizing its energy use. This also results in immediate monetary benefits, as well. Since adopting ISO 14001, Delta has continued to achieve more than 4 percent energy conservation each year. In 1998 alone, the facility's energy savings were equal to the annual energy consumed by approximately 1,800 homes. To achieve this energy savings, Delta retrofitted energy conservation technology in some of its operations and promoted efficient energy use in its operations. The facility also encourages its employees to turn off unused lights and to turn their computers off when not in use and to use their computers energy saving settings. Delta has initiated a program, moreover, to install light sensors throughout its buildings, where appropriate, to automatically turn lights off.

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 has been contracted out, has 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, serve to further impress on employees how every element of the facility's operations can potentially affect the environment. Finally, Delta's solid waste recycling programs have helped the facility recycle over 70 percent of its annual solid waste each year.

External Benefits

In addition to the internal benefits described above, Delta has also reaped several external benefits related to customer satisfaction and marketing:

Customer Satisfaction. While Delta adopted ISO 14001 for reasons primarily other than customer demand, customer preferences are now a factor that the facility considers. Indeed, these preferences are playing a part in Delta's ability to operate internationally. Especially in Western Europe, customers, both large and small, are increasingly requesting information related to Delta's environmental policy and its aspects and impacts. Some potential customers, for example, are beginning 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 helped make a difference in its ability to receive contracts with certain 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, at least in part, on the content of its EMS (e.g. its aspects and impacts) rather than simply whether or not it is registered. 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 more formally integrate its environmental activities 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 has successfully achieved most of its ISO 14001-related goals, in part, because of the strength of its preexisting EMS. The maturity of its system has benefited Delta by creating an organizational culture of environmental concern. But, as noted earlier, the maturity of its EMS is also a challenge for Delta because of the difficulty related to continually improving its EMS. Fortunately, Delta executives and managers recognize this, and are promoting an organizational culture in which employee change--within and between employee positions and departments--is encouraged. This culture will, no doubt, help to assure Delta's future ability to both continually improve its ISO 14001-based EMS and assure its long-term success.

Case Study 4
"Epsilon Systems"

Fall 2000

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I. WHO IS EPSILON?

"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 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's campus is in an industrial park in a suburban locale just north of a major metropolitan area. A number of other similar light manufacturing and corporate headquarters type operations are located in this industrial park, which is just off a major interstate highway. Residential areas are located nearby but separated from the industrial park by the interstate and the green landscaped lawns of the various corporate headquarters.

Epsilon has had an EMS in place for a number of years. In 1998 it was the first US facility within the corporation to become ISO 14001 certified, following after a European facility, which had been certified in late 1996, also a member of SPG. Epsilon now serves as a model for other company sites going through the process of ISO 14001 certification.

Epsilon is considered by its suppliers to be a leader in quality and in environmentally responsible manufacturing practices. Epsilon was recently named supplier of the year by one of its large customers. Epsilon has frequently participated in and led seminars organized by U.S. automakers on environmentally responsible manufacturing.

II. WHY EPSILON ADOPTED AN ISO 14001 EMS

Although Epsilon Environmental Health and Safety (EHS) managers first got the idea to go with ISO 14001 as a result of interactions with the Big Three U.S. automakers in 1996, at that time there was no direct supply chain pressure or requirement to become certified. Group EHS managers had the vision 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 and SMG's experience with ISO 9000 fortified this perception; significant supplier pressure had been applied. And, benefits had resulted from implementation of the quality system implementation. Managers at Epsilon recognized the possibility of resource savings from a similar ISO-based environmental system.

All facilities in the corporation are now ISO 9000 certified and the automotive groups like SMG are QS9000 certified as well. EHS managers' perception that the automakers would require certification at some point in the future was 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 the perception of future pressures from suppliers to certify, Epsilon was also motivated by 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. Epsilon, having been the first SMG facility to become QS 9000 certified was accustomed to piloting programs. 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 good word about EMSs and ISO 14001. These managers felt that the ISO 14001 certified EMS would not only be a valuable marketing tool with customers, and a way to distinguish themselves from other suppliers, but would also increase the productivity of environmental programs and serve as a framework from which to reduce environmental impacts.

Now that Epsilon and its sister SPG facilities are all ISO 14001 certified, the corporation has required all facilities within its organization to develop ISO compliant EMSs. Epsilon and SPG EHS staff feel that the success of their EMS development and ISO 14001 certification efforts have been influential in the corporation's decision to take this step. The corporation has recently published a corporate EMS that includes safety components (an EHSMS), and corporate EHS staff audits all facilities to this standard biennially.

An additional and important reason behind Epsilon's decision to become certified was its participation in a corporate-wide effort to apply for the Malcolm Baldridge Award in 1993. While the corporation ultimately decided not to apply for this award, environmental management systems were put in place at that time to look at 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 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. Having been part 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 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 environmentally centered relationships with the community quite low-keyed. 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 some compliance problems.

This did effect the entire group's practices and may have prompted SPG managers to look more positively on the ISO 14001 EMS because of its potential as a system that could improve facility compliance.

III. WHO DESIGNED EPSILON'S EMS?

At Epsilon, a steering committee of engineering staff and managers was assembled to implement 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 Baldridge application process also participated. As the objectives and targets were developed, process engineers and process technicians became more involved. EHS staff from SMG 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 the SMG EHS representative explained, "it's best when the facility designs its own EMS, rather than the consultant's".

IV. EPSILON'S ISO 14001 EMS ADOPTION PROCESS

The EMS steering committee brainstormed together and also with specific process related groups to develop aspects and impacts. For example, committee members met with staff from Epsilon's facilities group to determine which of their activities would create environmental aspects and impacts. The committee looked through each process line to determine where the big chemical users or producers were located. The group 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. The steering committee listed activities on this grid and from it they identified ten aspects and twelve impacts.

Next, direct and indirect effects were estimated using a complex scoring system. A tool, developed by SMG EHS staff was used to evaluate aspects and impacts. It had first been used in SMG's ISO 14001 certified European facility. The scoring system looked at regulatory requirements, emissions and waste as well as impacts to human health. All aspects and impacts were scored. The steering committee supervised the scoring process. 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 included as significant certain areas like communication, packaging and inventory control that had been identified during the corporate driven Baldridge application process as needing improvement.

Once the significant items were pinpointed, objectives and targets were set. Objectives and targets were set for high scorers for whom programs were not already in place through the Baldridge application efforts of corporate PPI teams. 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 there were no programs in existence, then 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 has been given an EMS handbook stating Epsilon's environmental policy, employee responsibilities, summarizing the EMS structure and providing information on the environmental work teams. A more structured training is provided to employees with specific EMS responsibilities. Employee responsibilities are emphasized by signs, which have been placed in the production areas.

V. EPSILON'S UNIQUE EMS ADOPTION HURDLES

Because Epsilon's corporate parent had instituted a corporate level EMS-like process, it was somewhat difficult to obtain manager and employee buy-in of a new system, especially when an environmental system replete with corporate audits was already in place and no regulatory issues existed. And when this was coupled with a lack of clear understanding at first about the details of ISO 14001, it made the EMS a harder sell. 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 of dedicating resources to the effort.

In addition to problems related to obtaining buy-in on a new environmental management system, when a "perfectly good one" already existed, the EMS steering committee and environmental work teams faced obstacles in developing new objectives and targets. In a number of cases the EMS driven objectives and targets were modifications of existing PPI driven projects. It was difficult to set meaningful targets, when there had been little effort to develop baseline data. It was difficult to determine how much had been accomplished and where the new bar should be set. At first the teams set goals like, "reduce use of chemical by 50%", and went about developing the missing baseline data. Currently, because the EMS has been in place for over a year, the targets are more concrete. And, the teams have begun normalizing performance according to production fluctuations.

A final hurdle related to the lack of a broad-based employee involvement in actual EMS implementation. While all employees are commonly aware of and supportive of the system, most of their day to day work is peripheral. The EMS environmental work teams charged with shepherding successful completion of objectives and targets are generally comprised of the same employees as were the existing PPI teams. To address this issue, steering committee will likely convene new teams in the future.

VI. EPSILON'S BENEFITS FROM EMS ADOPTION

But even given these challenges, Epsilon has reaped a number of benefits from the design and implementation of its ISO 14001 EMS. First, for a Tier I supplier to the US automotive manufacturers, Epsilon enjoys the advantages of being a first mover – being certified before the automakers actually required certification of all their suppliers. Epsilon's early EMS

implementation and ISO 14001 certification was seen as a way to position itself favorably with its customers and, as a result, increase market share. Epsilon believes that as an ISO 14001-certified firm, they will have a clear advantage over their non-certified competitors. Epsilon believes they can obtain benefits from marketing itself as a green, environmentally conscious facility, with the legitimacy that derives from external certification while their competitors are involved in the hard work of designing and implementing their ISO 14001 EMSs. Epsilon' competitors are playing catch up. And, further, Epsilon can benefit earlier than their competitors from the improved environmental performance and resource savings provided by the implementation of their EMS.

For example, Epsilon managers cited the benefit of 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. 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 stated that environmental impacts had not been routinely assessed within the company's process reviews, but now are. Because of the EMS, all process reviews now include a consideration of environmental impacts, materials usage and pollution. An analysis of electricity use had never before been included in process reviews. Electricity use is now examined in all reviews, and electricity costs have declined. One of Epsilon's EMS driven environmental work teams is also systematically examining facility water use, with the hopes of encountering similar results. Another team discovered a way of using waste potassium hydroxide to treat wastewater, rather than disposing 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.

Other indirect benefits of Epsilon's ISO 14001 EMS implementation are evident. While SMG's EHS manager and others indicated that ISO certification was not driven by the goal of improved relations with regulators, since implementing its EMS, the group manager stated, "permit modifications and the like" were now fast tracked. Also, Epsilon's environmental and production managers all indicated that a significant benefit of the ISO certification process was the increase in environmental awareness by company employees and management. No longer are environmental issues purely considered the responsibility of EHS staff. As one SMG EHS manager put it, no longer is 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 are now "in the top 3" considerations. Another manager cited the personal satisfaction of doing the right thing, and the increased focus on the environment as a benefit.

Epsilon's ISO 14001 certification and integration of environmental awareness in its business practices are consistent with the overall "greening" goal of the automotive industry to which it supplies its products. A number of automakers, which are Epsilon's customers, have stated that environmental stewardship is a priority and 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. And as a result, for the past 3 to 4 years, Epsilon has been invited to participate in a major automotive manufacturer's annual environmental event. At this event, Epsilon is afforded the opportunity to showcase its green culture and teach suppliers' employees and customers how to incorporate environmental principles into product design and manufacturing processes.