ISO 14001 AS AN ENVIRONMENTAL MANAGEMENT TOOL: HOW IS THE FLEXIBILITY OF THE ISO 14001 STANDARD APPLIED?

Deborah Rigling Gallagher and Richard N.L. Andrews

The University of North Carolina at Chapel Hill

ABSTRACT

Increasingly, many business managers are viewing ISO 14001 environmental management systems (EMSs) as a tool to achieve various management goals, such as improving regulatory compliance, environmental performance, waste and cost reduction, management coordination, and public image.

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. state environmental agency managers, began a research study of approximately 65 pilot facilities designing and implementing EMSs in ten states.

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 involved? The second variable measures the reach of facility-specific environmental goals; for example do most facilities' EMSs focus merely 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: do most facilities seek to complete the EMS design process and obtain ISO 14001 certification, or simply to achieve a level of EMS implementation that is "ISO 14001-ready?"

This typology is then illustrated by two case study analyses to illuminate and expand upon the empirical analysis. The results shed light on the role that internal and external stakeholders play in constructing EMSs and on whether particular patterns of influence are likely to produce different EMS types.

Key words: environmental management system, ISO 14001.

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 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, some business managers in the United States have been looking towards ISO 14001[1] environmental management systems (EMSs) as a tool to achieve compliance and improve environmental performance. 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 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 facilities' 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".

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."

[1] 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 that 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 itself 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; it also requires commitments by the firm to achieving compliance, to pollution prevention, and to continuous improvement.

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

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: we argue that facilities tend to 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.

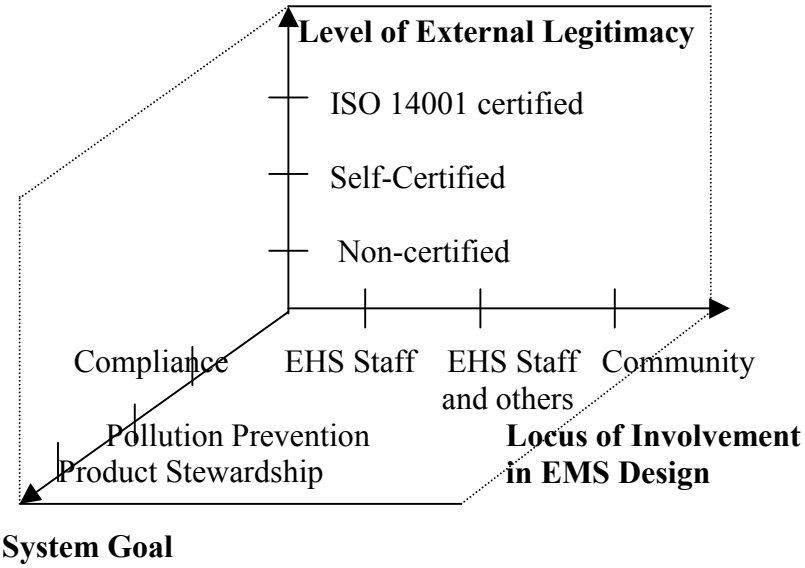

Figure 1: EMS Typology

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 environmental management processes are typically enacted; 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 also invites input and ideas from its external community—neighbors, government, NGOs, and others—is most likely to identify both the full range of available ideas and concerns and the most fully developed sense of candidate priorities for environmental improvement.

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 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 such as 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 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 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.

MATERIALS AND METHODS

In this study, 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, Connecticut, Indiana, Illinois, Maine, New Hampshire, North Carolina, Oregon and Vermont) 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, economic and environmental performance, and other attributes, and primarily qualitative information on EMS design characteristics. Post-EMS performance 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 administered 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 through 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 broader 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.

RESULTS AND DISCUSSION

EMS design data from twenty-six NDEMS facilities[2] 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".

[2] In this study only completely quality-controlled EMS design data were used, which at this juncture in the NDEMS project, reduced 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.

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 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.

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”[3] 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

[3] “Alpha Manufacturing” and “Lambda Equipment” are pseudonyms for facilities participating in the NDEMS project.

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.

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)

CONCLUSION

The results of this study indicate that facilities develop specific types of EMSs because of the influence 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 merely of production processes. It can also be used 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 have not used the flexibility of the EMS in this manner. In fact, our study shows that most facilities' EMSs focused on production processes through pollution prevention activities or efforts to assure regulatory 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 these facilities, EHS managers and staff were almost always the drivers of the EMS design process, and external stakeholders were rarely engaged. When internal stakeholders were included in EMS design, it was facility management personnel, such as production and operations managers, who were usually called upon to provide advice to EHS staff: laborers were rarely involved in system design.

Although considerable flexibility exists in ISO 14001, in short, this study indicates that so far, many facilities are not yet using it to its full potential. 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 the EHS staff? More research is needed to follow facilities as their EMSs become everyday components of their organization's overall management practices. With such research, we will be in a better position to know whether or not the flexibility inherent in ISO 14001 will indeed be put to use in improving environmental performance beyond compliance, or even beyond pollution prevention to emerge as a management tool to reach environmental sustainability.

ACKNOWLEDGEMENTS

We are grateful for the contributions of colleagues Nicole Darnall, David Edwards and Deborah Amaral at the University of North Carolina and Suellen Keiner, Matthew Mitchell, Dorigen Fried and Kapena Pflum of the Environmental Law Institute, as well as the continuing cooperation of participating facilities and state project managers.

REFERENCES

Andrews, K. 1971. The Concept of Corporate Strategy. Homewood, IL: Irwin.

Andrews, Richard N. L. 1999. Managing the Environment, Managing Ourselves: A History of American Environmental Policy. New Haven, CT: Yale University Press.

Andrews, Richard N. L.; Darnall, Nicole; Gallagher, Deborah Rigling; and John Villani. 1999. National Database on Environmental Management Systems: The Effects of ISO 14001 Environmental Management Systems on the Environmental and Economic Performance of Organizations. Project Summary I, March 27, 1999. Chapel Hill, NC: University of North Carolina.

Chandler, A. 1962. Strategy and Corporate Structure: Chapters in the History of the Industrial Enterprise. Cambridge: The M.I.T. Press.

Freeman, R.E. 1984. Strategic Management: A Stakeholder Approach. Boston, MA: Pitman.

Gallagher, Deborah; Darnall, Nicole; and Richard N. L. Andrews. 1999. International Standards for Environmental Management Systems: A Future Promise for Environmental Policy? Paper presented at the Twenty-First Annual Research Conference for the Association of Public Policy Analysis and Management, Washington, D.C.

Hirschhorn, Joel and Kirsten U. Oldenburg. 1991. Prosperity Without Pollution. New York: Van Nostrand Reinhold.

Oliver, Christine. 1991. Strategic Responses to Institutional Processes. Academy of Management Review 16(1), pages 145-179.

Puri, Subhash C. 1996. Stepping Up to ISO 14000: Integrating Environmental Quality with ISO 9000 and TQM. Portland, Oregon: Productivity Press.

U.S. Environmental Protection Agency. Science Advisory Board. 1990. Reducing Risk: Strategies for Environmental Protection. Washington, D.C.: U.S. EPA

U.S. President's Council on Sustainable Development. 1996. Sustainable America: a New Consensus for Prosperity, Opportunity and a Healthy Environment for the Future. Washington, D.C.: Government Printing Office.