# Assessment and Design of Industrial Environmental Management Systems

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# Abstract

Environmental management systems (EMS) are gaining acceptance as a tool for organizations to monitor activities with environmental impacts. Current EMS frameworks, such as the International Organization for Standardization EMS (ISO 14000), call for organizations to establish an environmental policy, set goals and targets for current environmental impacts, develop procedures and practices for tasks that have environmental impact, and conduct regular audits and reviews of the system. However, these EMS frameworks focus on the process of identifying and monitoring environmental impacts. The EMS do not provide information to management decision makers that can be used to evaluate options to cost-effectively reduce environmental impacts.

This research evaluates current EMS frameworks from an organizational perspective. A comparison of firms in the automotive assembly sector shows that facilities certified to ISO 14000 have a higher toxic waste per vehicle ratio and are just as likely to be out of compliance with air emission permits as facilities which have not been certified. Limitations of the ISO 14000 EMS are identified by applying the standard to several industrial scenarios which have environmental impacts. The exercise demonstrates the lack of comprehensive data collection and dissemination in the existing EMS structure. The ISO 14000 EMS also does not share effective characteristics of other environmental regulations and initiatives. An examination of safety management, however, reveals that non-financial factors can be improved when part of organizational strategy. Common outcome measures of safety are widely used by organizations, government agencies, and insurers to identify poor performance and target operational changes.

Environmental management systems must be redefined to be more effective for organizations. Effectiveness should be assessed with respect to regulatory compliance, changes in environmental impact, and cost. A model EMS is proposed that is based on providing information linked to each of these aspects. An essential component of EMS should be relevant, useful, and timely outcome measures. Outcome measures can focus the EMS as a tool to improve management decisions to reduce environmental impacts and to reduce costs. This EMS model can be implemented across a wide range of industries using the existing data collection and analysis systems of organizations.

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# Chapter 1 Introduction

Environmental management systems (EMS) have received much attention from consultants, academics, and policy makers in the 1990s as a means of helping organizations improve business practices and reduce their burden on the environment. Environmental management systems attempt to capture the environmental burdens of an entire facility or organization and encourage continual improvement of environmental performance. EMS typically consist of policies, procedures, and audit protocols for operations that create waste materials or emissions. For example, if a process produces a hazardous waste, then the environmental management system details how the waste is to be collected, handled, and disposed; who is responsible for each activity; and what to do if a spill or leak occurs. Common EMS frameworks provide structure and guidance only, and do not force specific activities or metrics. The frameworks provide flexibility in designing a system, allowing the framework to be adapted to a wide range of industries and locations.

Most of the literature in this area focuses on either the motives or implementation of such systems. The focus centers on the purported benefits of a thorough EMS or approaches to build an EMS from scratch. Much has been written by consultants and practitioners whose revenues are generated by organizations using their services. Generally, the EMS literature is prescriptive not descriptive. Little research regarding EMS reflects the components of environmental management systems or how well the resulting system actually benefits either the organization or the environment. Environmental policy makers have not embraced EMS, increasing skepticism of their value. This dissertation attempts to address these issues by assessing existing environmental management system frameworks and proposing a new model for their design and implementation.

I hypothesize that current EMS are not effectively reducing environmental impact and thus are not fully beneficial to organizations. Current environmental management system frameworks center on documenting procedures that have environmental impact and assigning responsibility for environmental impacts to specific personnel. However, environmental management systems do not produce output measures related to the performance of the organization with regard to environmental issues. Output measures are necessary for organizational leaders to make decisions on how to change operations and improve products to reduce environmental impact. To remedy this, my new EMS model is designed to produce timely and useful output measures for management. The model EMS would use existing organizational data and information to improve day-to-day and long-term decision making that will have an impact on the environmental burdens of an organization. The model EMS would integrate environmental aspects into traditional business strategy, bridging the gap between merely complying with environmental regulations and using environmental issues to excel.

## 1.1 The Evolution of Environmental Management in Organizations

A focus on environmental issues is a relatively new area for industry. Unlike business aspects such as negotiation, accounting, or inventory control which have been integral parts of commerce and industry from the start, environmental issues have been a major concern for only the past 30 years. The legislation on air and water quality in the early 1970s followed by the regulations on solid waste disposal and liability for prior actions in the 1980s turned organizations toward the environmental burdens of their operations (Andrews 1999, Barrow 1999). Manufacturing industries were the first targets of change as they were seen as the biggest polluters. As the economy shifts to a focus on service industries, their environmental burdens are coming to the forefront of concern.

Regardless of the industry sector, however, environmental issues have changed management and organizational structure (Hoffman 1994, Yosie and Herbst 1996). Three main stages describe the evolution of environmental management functions in organizations. First, environmental management entailed mediating between the organization and the regulators. Next, environmental management involved responsibility for assuring the organization met regulatory requirements. Finally, environmental management shifted to begin working to reduce environmental burdens.

### 1.1.1 From Technical Compliance to Pollution Prevention

From the onset of environmental regulation in the early 1970s through to the mid- to late-1980s, environmental management was a corporate level function (Hoffman 1994). Initially, legal departments were at the forefront and defending the organization against legal action was the top priority. Most organizations based any structured environmental activities on maintaining compliance. In terms of a business practice, the definition of goals and success was to meet the legal and regulatory requirements. This was typically accomplished either by "end-of-pipe" waste control and treatment systems or paying appropriate fines, whichever minimized cost (Graedel and Allenby 1995). End-of-pipe treatment was a technical fix. Environmental management necessitated the need for personnel with "traditional" civil engineering or chemical engineering backgrounds to mitigate wastewater effluents and air emissions.

In the 1980's, the main focus of environmental management remained compliance. The media-specific nature of environmental regulations generated discipline-specific departments within organizations (Hoffman 1994). Personnel were organized to handle one aspect of environmental impacts – typically air, water, or hazardous waste. With the passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), past activities of waste disposal became an organization's responsibility and a focus of environmental management. A major change for organizations was the recognition of this environmental liability on firm assets. The high cost of contaminated site remediation initiated the inclusion of environmental liability expenditures in financial filings of organizations. The Securities and Exchange Commission requires organizations to identify "significant environmental material expenses" in annual reports (FASB 1975). Often, these expenses are allocated to lost contingencies which includes costs for probable and reasonable estimable expenses. These expenses can include cost of initial assessment, remediation, closure, and post-closure monitoring of contaminated sites. Daily costs of environmental burdens are reported under traditional cost and expense categories, such as "cost of goods sold."

The recognition of environmental issues as a cost of doing business began to shift the organization of environmental management. Environmental positions were elevated to senior management or board-level standing (Hoffman 1994). End-of-pipe treatment options were only a temporary fix, as regulations continued to become more stringent and additional treatment became necessary. End-of-pipe treatment options became more costly and future liability loomed as a large expense. Production process change at the facility level began to be seen as a more efficient way to reduce environmental burden. Relatively simple and small adjustments in production processes, such as monitoring of control settings, reuse of scrap materials, or substitution of non-hazardous raw materials, were seen as a way to meet regulatory requirements at potentially lower cost. The passing of the Pollution Prevention Act of 1990 formalized the relationship between business operations and environmental impacts, promoting the concept that preventing environmental problems was easier than cleaning them up afterward.

Pollution prevention (P2) changed two major aspects of environmental management. First, as individual processes were targeted for waste reduction, environmental management became a plant-level concern (EPA 1997). Since end-of-pipe solutions were less acceptable, a knowledge of waste collection and treatment was less important. Instead, personnel had to have working knowledge of the operations and processes within the plant (OTA 1994). The process engineers and line workers, the employees with daily contact with the process, started to become a part of environmental management.

Second, environmental management became concerned with costs. Measuring pollution prevention is complex (EPA 1995a, Malkin et al. 1997, OTA 1994). It depends on production, materials accounting, personnel training, and new product introduction, in addition to the adjustments made in the process technology itself. Environmental management would have to gain authority within the organization to push for implementation of P2 projects. Individual pollution prevention projects often demonstrated that an attention to eliminating waste at the source, especially hazardous waste, could save an organization money (EPA 1997). So, environmental management became concerned with adjusting processes to reduce waste at the source, but tools to help justify the costs and risks of these process level changes were needed.

### 1.1.2 Designing Tools For Environmental Issues

Environmental management required tools to better analyze and assess environmental implications of products and processes. Traditional business tools have been adapted and new techniques developed for environmental management. A few are discussed here – environmental accounting approaches, life cycle assessment, design for environment, and corporate reporting. Each addresses a different aspect of organizational environmental management.

Environmental costs are found in many segments of financial data (Gray et al. 1993). Capital expenditures may include pollution control equipment; purchasing may include hazardous materials; risk assessment may involve long-term remediation costs; insurance premiums may cover accidental spills or releases. Future budgets also contain environmental costs, such as up-front costs for environmental impact assessments, site compliance, or energy purchases; and end-of-life costs for waste management and disposal or remediation. In many cases, these environmental costs are lumped into overhead accounts. As such, the direct cause of an expenditure is often unknown and the true cost of an activity may be underestimated.

Environmental cost accounting, total cost accounting, full cost accounting, activity based costing, or life cycle costing are all terms associated with estimating the "true" cost of an activity or product (Ditz et al. 1995, Schalteggar et al. 1996, Gray et al. 1993, EPA 1995a). Most often used for internal purposes, environmental cost accounting considers the total costs for implementing a new "environmentally conscious" process versus a current process. Environmental costs that are identified include materials and waste handling requirements, training requirements, compliance or permitting fees, and possible contingency costs. The results of an environmental accounting project can include standard financial parameters, such as return on investment or internal rate of return, or include a benefit cost analysis. Environmental cost accounting projects typically demonstrate that environmental costs, usually lumped into overhead accounts, increase the overall costs of current processes and make alternative processes more appealing.

Environmental cost accounting procedures have been recommended for environmental, health, and safety personnel to justify capital expenditures or changes in processes. The results are often only applicable to a single process change, however, and lack broad use for environmental management. Environmental expenditures are slowly being adopted into generally accepted accounting principles (CICA 1994). Organizations are encouraged to report on their environmental expenditures and liabilities, beyond that currently required. While incorporation of external costs born by others would be difficult under current accounting guidelines, accounting associations are encouraging professionals to be aware of environmental and sustainable development matters related to accounting and reporting.

Life cycle analysis (LCA) is a process of assessing the environmental impact of a product through the entire life cycle from raw materials extraction, component manufacturing, assembly, use, and disposal (SETAC 1991, Keoleian and Menerey 1993, Graedel and Allenby 1995, Curran 1996, ISO 1997). The three-step process consists of an inventory analysis stage to determine the inputs and outputs from all life cycle stages. Next, an impact assessment stage considers the environmental burdens caused by the inputs and outputs, such as resource depletion or global warming potential. Finally, an improvement analysis examines areas where impacts can be reduced. LCA is a data and time intensive process that provides only a static view of a product. Unless completed prior to actual manufacturing of a product, the information cannot be used by management to make decisions. LCAs have been completed for numerous products, but no indication is given as to how the results may have changed management consideration of environmental issues.

Design for environment (DFE) is the generic name given to a group of overall design objectives and approaches intended to reduce environmental impact of products over the life cycle. Design for environment can focus on materials selection, ease of assembly or disassembly, and recycling and reuse potential, among others (Simon et al. 1998, Fiksel 1996, OTA 1992). Like LCA, it has a product focus; however, implementation is generally less data and time intensive. Often, DFE tactics are essentially a checklist of "dos and don'ts" for designers to consider. For example, designers might minimize the different types of plastic material in a single product. A difficulty with initiating DFE is educating designers, and with the time and marketing constraints already required, environmental issues are not a high priority. Since DFE is implemented on a product-by-product basis at the engineering level, it has little impact on overall management of environmental issues of an organization.

Another effort in environmental management is publication of corporate environmental reports. Mimicking the format of annual financial reports, environmental reports describe the efforts and results of the past year's activities that relate to environmental issues. A survey of environmental reports was completed by Lober, et al (1997) who classified major trends in environmental reporting. Most reports included quantification of releases, goals and measures of achievement, and energy and materials balance information. The reports lack explanation of results, however, especially evaluations of total impact. Community and regional issues (noise, transportation, spills) are often not addressed. Reporting guidelines, such as the those of the Global Reporting Initiative, are attempting to standardize report format and content for easier comparison (GRI 2001). Overall, corporate environmental reports are geared toward communicating with external stakeholders and not for internal environmental management.

### 1.1.3 Green Management

The changes in environmental management are beginning to move organizations from a purely compliance-driven focus to one that includes pollution prevention. Recognizing the need to convince management to address environmental issues via production changes, environmental management has encompassed tools to identify environmental burdens of the organization. But overall, the recent efforts have been isolated. Single process changes, plant level authority, and product life cycle evaluation do not focus on the overall impacts of an organization. The next stage of environmental management attempts to cast a broader net in addressing organizational needs.

"Green management" has become a buzzword in organizational thinking. While the definition of green management is not uniformly accepted, the idea considers an organization in its entirety, in relation to its personnel, its community, its customers, its shareholders, and the environment when considering changes that would have an impact on these stakeholders (Fisher and Schot 1993, Richards and Frosch 1997, Taylor 1992). Numerous benefits have been attributed to "green management" working within organizations, including new products or marketing outlets, an improved or redefined competitive position, the ability to shape regulatory policy for the industry, and cost reductions in production, insurance, and lawsuits (Taylor 1992, Reinhardt 1999, Cairncross 1992, Marcus and Willig 1997).

Still, environmental management has not become fully incorporated into organizational thinking. In many cases, examples of "green management" resulting in success are not viewed as simply "good management" resulting in success. A final recommendation from a study of the evolution of environmental management systems was to "search for methods and strategies to more fully integrate EHS [environmental, health and safety] management with business goals and operations" (Yosie and Herbst 1996). As the transition of environmental management continues, the focus will be on efforts of integration, and of integration in new sectors of the organization. Fryxell and Vryza (1999) notes different perceptions of environmental issues across different departments. Not surprisingly, production and operations, and accounting and finance departments are not perceived as integrated with environmental issues. At the same time, production and operations departments are considered to be the departments with the greatest need for integration, but traditional integration tools such as guidelines, project teams, or ad-hoc committees though widely used are not necessarily improving integration.

Environmental management systems are thought to be a way to complete the transformation of environmental issues in organizations (Erickson and King 1999, Morelli 1999, Dyndgaard and Kryger 2000). Environmental management systems address environmental burdens of an entire facility or organization, and encourage continual improvement. Typical EMS frameworks call for organizations to document formal policies and procedures for environmental impacts. Responsibility for environmental issues is assigned to specific personnel. EMS encourage organizations to share environmental information with external stakeholders. Established frameworks, such as ISO 14000 or EMAS, provide guidelines for implementation and certification (ISO 1996, EC 1993). However, EMS remain in transition as organizations continue to cope with integration issues (Yosie and Herbst 1996).

## 1.2 Contribution of this Dissertation

Through each stage of evolution, efforts of environmental management have been discontinuous and isolated from other organizational operating practices. Environmental management systems are aimed at assembling these separate activities under a common umbrella. But measuring environmental success is difficult, so evaluating program effectiveness, as well as managerial effectiveness, is difficult. The role of environmental management systems in revenue generation is unclear. Finally, while traditional command-and-control regulations provide a clear level of performance, management systems have yet to develop a scope in the policy arena and thus in the needs of organizations. As expectations are developed, EMS will be under greater scrutiny to provide value to operations.

This research addresses these issues. The first step is to systematically evaluate environmental management systems as a business tool using statistical analysis. Are environmental management systems improving environmental performance? Managers must know whether the expense and time of implementing a system will allow them to achieve the goals of such a system. But if they are not improving environmental performance, what is missing from existing EMS models that prevent it from doing so? Applying the EMS structure to industrial case studies identifies the shortcomings of current systems. The current systems are too complicated and documentation oriented. They lack concise outcome measures to help managers make decisions and they lack incentives to encourage environmental issues to be a business priority. Based on the results of the above exercises, the second step is to design a new model for environmental management. The model EMS considers the needs of management for effective decision making.

### 1.3 Significance and Impact

The previous section discussing the evolution of environmental management alludes to the two main impacts of this proposal. First, just as environmental management has evolved, business management in general has and continues to evolve. Accounting and management hierarchy have adjusted to accommodate larger, vertically integrated firms (Johnson and Kaplan 1987, Kaplan 1990); marketing and sales are undergoing tremendous change in light of information technology advances and use of the internet. It is only natural for environmental management to be part of this evolution. "Organizations and management systems cannot be seen as disconnected sets of disciplines and techniques clustered around various function and activities with bolted-on environmental management" (McClosky and Maddock 1994). Instead, environmental issues must become an integral part of organizational strategy – decisions must be made, with the environment as part of the picture, because they will deliver positive returns or reduce risks of the organization (Reinhardt 1999). Environmental consideration is not in conflict with the principal goals of business and management; instead, it encompasses "one of the primary objectives [of management which is] to reduce the losses that are caused by waste and poor quality. (Harrington 1995)." Thus, this research supports this continuing progress of organizational management by developing a model EMS that can evolve with organizations.

Second, as research in the area of environmental management demonstrates, efforts have been scattered among different disciplines and motivations, and they have lacked a clear concentration in the management field (Yosie and Herbst 1996, Fisher and Schot 1993). For example, environmental performance metrics are being tracked, collected, and disseminated to the public; but whether or not these numbers are useful to decision makers has not been investigated. One review of the literature (Margerum and Born 1995) noted that work has been completed on the rationale for integrated approaches – the tools, case studies, and general practices for integrated environmental management. However, how these approaches are put into practice has not been discussed. Newman and Hanna (1996) have considered how manufacturing models may incorporate environmental issues, but the analysis remains to be finished. This research culminates in a model environmental management system that allows an organization to integrate environmental issues into traditional practices.

One viewpoint contradictory to these opinions is expressed in an analysis of environmental management system needs versus environmental risk (Vastag et al. 1996). The authors argue that the proper level of environmental management should be a function of risk, and many organizations already follow this general rule. Thus, integrated environmental management systems are only needed, and are most significant, for organizations with compelling and pressing environmental demands who must strategically plan to avoid endangering human health and the surrounding ecosystem. "It may not be necessary or profitable to move to a strategic view of environmental management systems (based on risk) even though considerable pressure exists to do so." While the argument is well-founded, the extent of integration can vary as needed for a particular organization. The model EMS is designed to allow for organizations to vary emphasis as needed on specific environmental impacts and risk; those that have an impact inside the organization or on society as a whole.

## 1.4 Outline of Dissertation

Chapter Two describes the current state of the art of environmental management systems. The origins of today's EMS from quality management efforts of the early 1980s are presented. The general components of the typical EMS are discussed, as well as the personnel involved in their operations. The information collected and disseminated is examined. This chapter includes a discussion of common frameworks for environmental management systems.

Chapter Three explores the effectiveness of ISO 14000 in improving organizational performance. Automotive assembly plants are the focus of the analysis. The analysis examines trends in toxic waste generation, air permit compliance status, and safety performance by comparing firms that have been certified to ISO 14000 to those that have not chosen to certify. The results indicate no significant improvement in performance of certified firms and lend support to the need for a new EMS model.

The results of the previous chapter indicate that ISO 14000 lacks the ability to improve environmental performance. Chapter Four examines the ISO 14000 EMS framework from a business perspective to find out why. Using actual organizational situations as a foundation, case studies examine industrial activities or procedures that are typically covered by environmental management systems. However, in each case, the

EMS lacks the ability to make systematic changes to lead to environmental performance improvements. Then, the EMS is compared with other environmental regulations and voluntary initiatives. Differences in scope, recognition, and data requirements are evaluated. General problems and shortcomings of the EMS in each area are discussed.

Chapter Five discusses safety and health management. Safety and health are often linked with environmental issues as they are seen as having common threads. But safety and health have seen an integration with overall management practices. This chapter investigates aspects of safety management that influence the concern of management. The lessons revealed by safety and health management can be applied to environmental management, or the systems can be combined to form an overall system that fully addresses the externalities of organizational operations.

Using the lessons of the previous two chapters, Chapter Six describes a revised model environmental management system. Using other useful management systems as a guide, the EMS is defined by outcome measures that can aid decision makers. Criteria for outcome measures are discussed, and examples of possible measures are presented. Implementation and scalability of the EMS framework is discussed.

The final chapter summarizes the research and the results. A discussion of implications for the model EMS from both organizational and policy perspectives is presented. Future extensions of the research are discussed.

# Chapter 2 Frameworks for Environmental Management Systems

Although each organization will have a unique environmental management system, most organizations have adopted the same general framework. Four universal elements of EMS are adopting policy, auditing activities, changing operations, and communicating information inside and outside the organization (Christie and Rolfe, 1995). Organizations can chose to develop a system of its own to best capture its environmental impacts. Or, an organization can chose to follow a well-established standard such as ISO 14000 or Responsible Care of the American Chemistry Council (formerly the Chemical Manufacturers Association). Regardless, the overall intent of an environmental management system is to be a framework for controlling environmental responsibilities, and controlling them systematically, effectively, and efficiently. This chapter details the characteristics of typical environmental management systems. The origins of EMS from quality management systems are discussed first, followed by the common components of EMS. Implementation of EMS is addressed only briefly as this has been the focus of past research. Three established frameworks, ISO 14000, Eco-Management and Auditing Scheme (EMAS), and the Compliance-Focused EMS (CFEMS) of the U.S. Environmental Protection Agency (EPA), are discussed in more detail. Finally, the place of EMS within the current regulatory framework is considered.

## 2.1 Origins of Environmental Management System from Quality Management Systems

Total Quality Management (TQM) was an important forerunner to environmental management (Aboulnaga 1998, Welford and Gouldson 1993, Welford 1992, Christie and Rolfe 1995). TQM aims for zero defects in products, thus minimizing the time and cost of appraisal, failures, returns, and scrap. In order to achieve this goal, companies instituted quality management systems (QMS) to assess and assure quality at every stage of the production process. QMS generally follow a plan-do-check-act cycle, described in more detail later. Specifically, QMS focus on proper operation of machinery, verification accuracy of measuring equipment (e.g., calibrating against standards regularly), and testing of final product for specifications.

The International Organization for Standardization created the series of ISO 9000 standards on Quality Management and Quality Assurance in 1987 in response to businesses' requests for a streamlined, common framework. Other quality standards include QS 9000 designed specifically for automotive parts suppliers based on requirements of the major U.S. automakers. Adoption of a quality management system is voluntary, but many companies find that certification is a requirement imposed by customers.

Many environmental management systems evolved from the quality management system framework. As some managers began to realize that improving quality would improve efficiency, they realized that improving environmental aspects of the production process could do the same. Reducing environmental impacts also had the potential to decrease labor and overhead costs associated with handling, treating, and disposing of wastes. Pollution prevention efforts grew out of this development. However, few organizations set goals to achieve zero waste as they had set goals to achieve zero defects; DuPont is one exception. Common EMS follow the same plan-do-check-act cycle of their QMS forerunners. Many existing standards for EMS follow the same format and structure of QMS, specifically ISO 14000 is built on ISO 9000. Articles and books often detail how an EMS can be integrated into or based on an existing QMS (Welford 1992, Block and Marash 1999, Culley 1998).

## 2.2 Environmental Management Systems Defined

An environmental management system (EMS) can encompass very different activities and environmental burdens depending on the organization utilizing it. The International Organization for Standardization defines an EMS as "that part of the overall management system which includes organizational structure, planning, activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing, and maintaining [the organization's] environmental policy." An EMS incorporates aspects of the organization relating to the environmental burden and provides a structure for activities related to compliance with environmental regulations.

Based on the QMS foundation, the general basis for environmental management systems is to write how a task with an environmental impact is to be done, do the task as it is written, and check periodically to verify that the task is being done as intended and, if not, correct the problem. This four-step process of plan, do, check, and act is often cited as the generic framework for initiating and maintaining an EMS. First, an organization should *plan* for environmental compliance requirements and environmental impacts that may occur. Second, the workers should *do* what is necessary to avoid non-compliance and environmental damage. Regularly, the plan should be *checked* to assure that it is operating properly and all environmental issues are covered. Finally, an organization should *act* to improve the system or change any problems that have developed. Following this methodology should allow an organization to evaluate their conformance with regulations and lead to improvements.

Environmental management systems are voluntary initiatives not required under current regulations. The frameworks do not set specific environmental performance levels for organizations, nor guarantee achievement of superior environmental performance. The organization itself must make the final decision on defining its environmental management system. However, in some cases, evidence of an environmental management system is a requirement of customers for doing business. Implementation of EMS also demonstrates environmental concern to external stakeholders such as community members or environmental groups. Both aspects encourage companies across industries to adopt EMS.

## 2.3 Components of an Environmental Management System

An environmental management system is defined by its components, and those components will vary from organization to organization. As stated previously, four broad elements are adopting policy, auditing activities, changing operations, and communicating information (Christie and Rolfe 1995). Welford (1992) specifies five components of an EMS, including an environmental policy, senior management commitment, an environmental committee overseeing the program, environmental action teams, and process improvement teams. In this framework, policy and general organization of the environmental management system flows from senior management at the top down to plant personnel, while information on problems and potential solutions flows from the process improvement teams at the bottom up to senior management. Two frameworks, ISO 14000 and the EPA Compliance-Focused EMS, do not designate personnel duties, but instead outline activities for the EMS. Most frameworks follow a general "plan, do, check, act" cycle, which is the focus of the discussion here (Little 1994, Wilson 1998, Marcus and Willig 1997, Woodside et al. 1998, Aboulnaga 1998). These four general stages encompass most components of an environmental management system.

### 2.3.1 Plan – Environmental Policy, Environmental Impacts, and Environmental Goals

An environmental policy is the central component of an environmental management system. The policy in general outlines an organization's viewpoint on environmental issues and commitment of management to address environmental problems. The environmental policy typically details the organization's recognition of environmental impacts, resources devoted to reducing environmental burdens, and statement of commitment to continuous environmental improvement. The policy may designate responsibility of environmental issues to specific personnel, such as a vice president of environmental affairs. As a corporate level document, environmental policies provide guiding values and goals for all members of the organization. The comprehensiveness of policies vary widely from vague, sweeping generalizations, to more specific goals and mandates. Examples of corporate environmental policies are provided in Appendix A.

Although asserted by top management, the actual power in an environmental policy is limited. Most policies do not detail consequences of poor environmental performance or neglect of the policy. How the policy is interpreted by employees and how it is implemented via daily operations is subjective. It may serve only as an ideal state, rather than an ultimatum. While typically a public document, the availability of the policy by shareholders or community of an organization is variable, and the awareness of the policy may be low.

Another part of the "plan" step is to determine environmental impacts and compliance requirements. The environmental policy may help an organization determine where it is having an impact on the environment and identify areas to target for improvement. The range of impacts and regulatory requirements may include wastes and emissions, materials and energy use, or potential hazards from accidental releases. The operations may include assembly lines, delivery of products, or office work. An organization must define its priorities for how it wants to manage these environmental impacts. Once environmental impacts have been identified, most environmental management systems include a set of goals or objectives for reducing environmental impact. The goals and objectives can be general, such as work with suppliers to reduce packaging waste. The objectives may change from year to year, but usually indicate an overreaching goal of the organization in terms of reduced environmental impact.

Some management systems take the establishment of goals and objectives one step further and define specific targets for improvement. Targets give a set point at which to aim. For example, while reducing packaging waste may be an objective, reduction of packaging waste by 10% by weight over the next year is a target. Specific targets are not usually identified within the environmental policy, but in some other documentation of the environmental management system. Overall, the planning step in an environmental management system sets the groundwork for the later steps. The commitment to environmental issues, the effort for continuous improvement and the establishment of goals and targets provides the framework for environmental personnel to focus their attention.

### 2.3.2 Do – Environmental Documentation and Environmental Activities

A second major component of environmental management systems is documentation. Documentation includes a wide variety of elements, including the environmental policy, regulations to which the organization is subject, procedures and protocols for activities, and records of monitoring and measurement. These documents define the activities of an environmental management system and how personnel across the organization should act to fulfill responsibilities and hopefully meet targets of improvement. The documentation puts into writing the structure of operations.

For many organizations, the bulk of the environmental management system is the documentation. Individual procedures define the steps to be followed to fulfill the requirements of the EMS. For example, if an EMS requires an annual review, then a procedure would define the process for the review. The procedure would include how to schedule the meeting, items to include on the agenda, and what documentation should result from the meeting (e.g., official minutes, report to higher management, etc.).

Work practices are developed for activities that may have an environmental impact if not done correctly. The work practice describes various tasks for completing an operation, with emphasis on actions that must be followed for handling waste material, operating equipment within required ranges, or monitoring and measuring data for future analysis and reporting. For example, a procedure for receipt and delivery of chemicals at a loading dock would include steps for verifying the contents of the packaging and comparing to a purchase agreement, recording the type of chemical and its volume, notifying the person requesting the materials of its arrival, attaching a material safety data sheet (MSDS) to the containers while noting handling and storage requirements, and delivering the material using proper equipment. The intent of the documentation is to deliver the materials safely and without incident to its desired location. The documentation would provide clear instructions such that any person in the organization could complete the task properly.

Compliance information is a second part of the documentation of environmental management systems. Organizations must be aware of the federal, state, and local environmental regulations pertaining to its facilities. An environmental management system would include a procedure for maintaining regulatory documents such as federal register codes, permits or other documentation, and reporting forms and deadlines. Instructions of recordkeeping requirements, as well as the actual records from monitoring and measurement of environmental releases (e.g., hazardous waste volumes, air emission concentrations, etc.) should be included in the documentation. Other documentation would detail the procedures to follow if a non-compliance situation occurred.

Overall, frameworks for EMS are flexible to allow organizations to create documentation specific to their environmental impacts. If the facility does not generate hazardous waste, then no procedure for handling hazardous wastes is required. The documentation and activities that fall under the environmental management system detail how certain activities and responsibilities should be completed. This demonstrates the process-focused nature of current EMS. The procedures and work practices serve to delineate steps in a process.

### 2.3.3 Check – Environmental Auditing and EMS Performance Evaluation

A third part of environmental management systems is assessing the operation of the system. Auditing is the general term used to describe the evaluation of components of the EMS. Parts of an audit can include interviews with employees to determine their awareness of environmental issues and the EMS itself. Or, an interview can inquire as to how a worker is performing a job with respect to the EMS and the documentation provided for that job. Another common use of audits is examining problems that have occurred and created an environmental impact. For example, a spill of a chemical may have occurred while loading the material into a machine. An audit would assess the immediate actions taken to control and clean up the spilt material. The performance of personnel in response to the situation would reflect on their awareness of the EMS and their duties. An audit might also investigate why the spill occurred in the first place. The audit would attempt to find the cause of the incident and recommend changes in the EMS documentation as a preventative action from the situation to reoccur in the future.

Not only individual parts of an EMS, but the EMS as a whole can be audited. Audits typically involve a review of the environmental management system by upper management. Also, auditing may be completed by personnel external to the organization. This external review of the environmental management system provides an independent evaluation of the system.

### 2.3.4 Act – Environmental Training and Environmental Communication

A final component of an environmental management system is training and communication. Training and communication occur at many stages in order to improve awareness of the environmental impact of operations across all levels of the organization. Training includes more specific instruction on personnel roles and performance. Formal workshops or presentation sessions, such as those for learning machine operation and maintenance, or safety instruction required by regulations, would be included. Training assures that personnel are prepared for their specific job tasks and understand the impacts to the environment that could result from incorrect performance.

Communication entails informing all personnel of the environmental management system, the environmental policy, and their role in environmental matters. Communication should target all levels of the organization to improve awareness of individual responsibility in day-to-day activities and the commitment of the organization to environmental issues. Some communication can also go beyond the organization to suppliers, customers, communities, and shareholders. Suppliers and customers may be informed of the organization's efforts to improve its environmental burden. Communities may be educated of potential hazards and steps the organization has taken to minimize risk. Shareholders may be updated with environmental efforts and the impact it may have on the business.

These four components – plan: policy, do: documentation, check: auditing, and act: communication – form the backbone of most environmental management systems. The final form of any environmental management system will depend on the organization and its business and operations as well as its commitment to environmental improvement. The components are voluntary although they may have a connection to required regulations. For example, hazardous material handling training required by the Occupational Safety and Health Administration (OSHA) may be a segment of the EMS training component.

## 2.4 Boundaries of an Environmental Management System

Defining the boundary of an environmental management system can be difficult. Two ways to restrict the boundary are using organizational or operational constraints. The organizational boundary describes the personnel and facilities included in the system. Some organizations house the environmental management system at the national or corporate level with all facilities under one large EMS umbrella. The policy is established for all facilities and all personnel are subject to its intentions. Procedures must accommodate a wide range of operations, languages, and cultures over all locations. An advantage of this level of control is highly visible management commitment, comparison of locations against others, and consistency in expectations. IBM has certified its entire worldwide operations under a single ISO 14001 registration after several individual manufacturing plants had done so independently (Balta and Woodside 1999).

For other organizations, the plant or facility level is more practical for defining the bounds of the EMS. The range of documentation is smaller as few environmental impacts and environmental activities may be identified. An advantage of this boundary is the familiarity of the facility and its environmental aspects by the personnel in charge of the EMS. Unique situations can be managed individually. Still others may only consider one part of a business location (Leavitt and Garcia 2001). The boundary may encompass only those portions which are considered to have large environmental impact. Or, the choice may be to use only a portion of an organization as a trial to fully implementing an EMS over a larger boundary.

Operational boundaries can also be established for environmental management systems. Operational boundaries designate the activities included in the EMS. Marcus and Willig (1997) consider the activities of an environmental management system to include compliance assurance, health, safety, waste minimization, publication of an annual report, employee awareness, and community work. ISO 14001 considers the boundary to be any significant environmental aspects. Within manufacturing organizations, where most environmental management systems have been implemented, the EMS usually consider the impacts of the facilities where manufacturing occurs. Processes with end-of-pipe treatment equipment or permit applications, as well as processes that generate waste material in some form are included. Office areas or administrative work activities typically do not fall under the environmental management system, often because the impacts of these areas are viewed as less significant.

### 2.5 Environmental Management System Implementation

Beyond the description of the components of environmental management systems, the literature tends to focus on how to implement an EMS in an organization. Many practitioners feel a first step in implementing an EMS must obtain commitment from top management (McClosky and Maddock 1994, Christie and Rolfe 1995, Reijnders 1996, Marcus and Willig 1997, Woodside et al. 1998, Aboulnaga 1998). This commitment must then be communicated to all personnel as a priority of the organization. Then, the actual EMS can be implemented. Overall, while methodology varies somewhat, a few steps are seen as essential. The environmental policy and objectives of the program must be established first. Next, some assessment of the current environmental impacts should be completed. Based on the results, a plan of improvement is developed, a schedule for improvement defined, and responsibilities assigned to personnel. Implementation of the program is followed by recording achievements, auditing results, and reviewing the system. The process should be repeated to continually adjust activities to meet environmental performance objectives. Third-party assessment, if desired, is a final step in completing implementation.

Much of the literature on environmental management system components and implementation is based on practitioner information. Consultants in the field of auditing and certifying have contributed much of the work. The articles indicate the "drivers" for EMS and often provide a case study of past work with "pleased" clients. The lack of academic research on environmental management systems is one of the major drawbacks to this part of the literature. Unlike other management areas, such as human resource management, financial systems management, and strategy development, structured analysis of environmental management systems and their implementation has not been thorough (Yosie and Herbst 1996). The area of organizational research (and correspondingly, education in organizational research) has only begun to focus on environmental issues. Further, the literature does not present much evidence of effectiveness of EMS for environmental improvement. Case studies do indicate satisfaction with implementation of EMS as heightening awareness of environmental issues.

## 2.6 Common Frameworks for Environmental Management Systems

Common standards for environmental management systems establish a framework for structuring an organization specific program. The standards do not set specific environmental performance levels for organizations, nor does implementation guarantee compliance with regulations. Instead, the models allow an organization to set its own objectives, gives flexibility in meeting targets, and ensures a procedure is in place to deal with non-compliance situations when they might occur. Three such frameworks are described here – ISO 14000, a Compliance-Focused EMS (CFEMS), and the Eco-Management and Audit Scheme (EMAS).

### 2.6.1 ISO 14000

The most well-known and accepted environmental management system is the ISO 14000 series of standards on environmental management (ISO 1996). Established by the International Organization for Standardization, the ISO 14000 series includes documents related to environmental management systems themselves and environmental management tools to assist organizations (Welford and Gouldson 1993, Marcus and Willig 1997, Woodside et al. 1998). Organizations from manufacturing industries, financial institutions, municipalities and federal agencies can conform to the standards. Over 14,000 organizations worldwide have been certified as following the standard (ISO 2000).

ISO 14001 *Environmental Management Systems – Specification with guidance for use* and ISO 14004 *Environmental Management Systems – General guidelines on principles, systems, and supporting techniques* are the two documents related to whole systems.[1] ISO sees establishment of an EMS as essential to determining environmental policy, objectives, and targets. Other documents of the ISO 14000 series in final and draft form describe tools such as environmental auditing, labels and declarations, performance evaluation, and life cycle assessment. The tools are to assist organizations in achieving the policy, objectives and targets established by the EMS. ISO claims their

[1] Throughout the text references will be made to ISO 14000, or ISO 14000 certification. While technically correct to refer to ISO 14001 as the EMS standard or ISO 14001 certification, the term ISO 14000 is used for both simplicity and as a reminder that a series of documents exists to cover issues related to environmental management.

framework provides "for continuous improvements of environmental performance" (ISO 1998a). ISO states that organizations can achieve several benefits from implementation of the ISO EMS. These benefits include reduced cost of waste management, savings in consumption of energy and materials, lower distribution costs, and an improved corporate image among regulators, customers and the public.

An organization that implements an environmental management system according to the ISO 14001 standard can be certified as following the guidelines. Certification is completed by third-party organizations and recognizes the organization as adhering to the elements of the standard. Certification makes no assessment of the overall environmental performance of an organization, nor verifies that environmental performance is improving. Certification is typically valid for a three year period after which reassessment is necessary. Some organizations follow the standard in establishing their EMS but decide to self-certify and not seek third-party assessment. Publicizing the ISO 14000 certification is restricted to facility aspects only (it cannot be used as a product label) and should not imply that ISO itself is the certifying body (ISO 1998b).

Significant time and monetary resources are required for ISO implementation and certification. From the time the decision to go forward with implementation, facilities can take up to two years to reach certification (Alberti et al. 2000, Balta and Woodside 1999, Smith 1998). Labor cost is a significant portion of overall costs with a range of $15,000 to $150,000 reported by Graff (1997). This figure only includes implementation within the facility, certification by a third-party registrar and maintenance of the program are additional costs.

ISO 14001 – *Environmental Management Systems – Specification with guidance for use* describes the framework for an environmental management system (ISO 1996). The six main clauses of the standard detail the general requirements, policy, planning, implementation and operation, checking and corrective actions, and management review. Each of the clauses and major sub-clauses are provided in Appendix B. Examples of how the standard is put into practice are provided in Appendix C. Ford Motor Company has created a workbook on ISO 14000 and has allowed state environmental departments to publish it for local facility adaptation. The examples will be used as a basis for examining ISO in practice in Chapter Four.

Excerpts of one procedure are given in Figure 2-1. The procedure is for the regular management review of the EMS. The procedure conforms to the formatting procedures defined elsewhere in the system. Section 3.0 indicates that specific form, created within the EMS is required for attendance. The main subject is the steps required for the management review. The steps are common sense descriptions for gathering attendees, setting an agenda, and documenting the discourse. Specific environmental issues are not required to be discussed. The procedure does not present guidelines for the review team in evaluating the EMS, only indicating that they must consider the "continual suitability, adequacy, and effectiveness."

**Environmental Management System Management Review**

**1.0 Purpose/Scope**

This procedure defines the process for the periodic review and evaluation of the *Facility/Plant Name* environmental management system by the Facility/Plant Management Team, to ensure its continuing suitability, adequacy and effectiveness.

**2.0 Activities Affected**

All areas and departments

**3.0 Forms Used**

Attendee Sheet

**7.0 Procedure**

7.1 The Facility/Plant Manager and Facility/Plant Management Team shall conduct a review of the environmental management system at least once each year.

7.2 Management review meetings shall be scheduled in advance by the Environmental Management Representative and an agenda issued to ensure appropriate preparation and attendance.

7.3 The meeting shall review all applicable components of the *Facility/Plant Name* environmental management system. The Environmental Management Representative shall present information for review and concurrence, which may include but not be limited to:

a) Environmental Policy
b) Environmental Aspects
c) Objectives & Targets and Programs
d) Legal and Other Requirements
e) Training, Awareness and Competence
f) Operational Control
g) Emergency Preparedness and Response
h) Monitoring and Measurement
i) Nonconformance and Corrective and Preventative Action
j) Environmental System and Regulatory Compliance Audits

7.4 The Facility/Plant Manager and Facility/Plant Management Team shall review and confirm their approval and the continual suitability, adequacy and effectiveness of the environmental policy, environmental objectives and targets, environmental management programs and other elements of the system as well as regulatory compliance requirements are met..

7.5 The Environmental Management Representative or designee will publish and maintain meeting minutes identifying issues discussed and corrective and preventive actions to be taken. Required actions will be assigned to the responsibility of process, area and functional management.

7.6 Timely decisions will be made.

**Figure 2-1. Example of ISO 14001 EMS procedure documentation (PADEP 2000).**

### 2.6.2 U.S. EPA Compliance-Focused EMS

The U.S. EPA has argued that the lack of compliance assurance in the ISO 14000 framework is a significant drawback. Accordingly, the National Enforcement Investigations Center (NEIC) of the EPA has designed its own framework for environmental management systems. The NEIC is the branch of the EPA that investigates non-compliance events and enforces civil penalties and fines. Due to repeated findings in investigations that poor management was the cause of non-compliance, the NEIC developed a Compliance-Focused Environmental Management System (CFEMS) (Sisk 1997). Implementation of an EMS based on this format may be part of settlement agreements for past environmental incidents. A facility can choose to implement the EMS in lieu of having EPA levy sanctions.

The main components of CFEMS are described in Appendix B. The framework of this EMS is essentially the same as ISO 14000, but includes additional wording and requirements to ensure that compliance is met to the greatest extent. For example, the section on Accountability and Responsibility must describe consequences imposed as a result of non-compliance, including civil or administrative penalties. The EMS also addresses changes in environmental requirements (due to new regulations), application of environmental requirements to planning and design of new operations, provisions for pollution prevention initiatives, and community and public involvement in design of the EMS. The EMS must clearly designate authority in environmental matters and consequences for non-compliance. Preventative action is a top priority. The framework requires management review of the program annually. After sufficient time to implement the program (usually 2-3 years), the CFEMS must be audited by a third party with results shared with both the organization and the EPA.

### 2.6.3 Eco-Management and Audit Scheme

Within Europe, firms often adopt the environmental management system defined by the Eco-Management and Audit Scheme (EMAS) (EC 1993). EMAS is very similar in components and implementation to ISO 14000, and the current EMAS legislation is working to adopt the ISO framework as the basis for the EMS required within EMAS. The overall objective of EMAS is "to promote continuous environmental performance improvements of industrial activities by committing sites to evaluate and improve their environmental performance and provide relevant information to the public" (EC 2001).

The major articles of the legislation are provided in Appendix B. Two elements set EMAS apart from ISO 14000. First, EMAS requires an Environmental Statement to include a description of the site's activities relating to environmental performance, summary figures of environmental burdens, and an assessment of environmental issues. The statement must describe significant changes, positive or negative, from the previous statement. The statement is intended for public use, although the legislation does not mandate distribution. Second, EMAS is coordinated in each country by a Competent Body which oversees activities related to EMAS within the country, including maintaining a listing of facilities with the country certified to EMAS. The Competent Body registers sites based on recommendations of verifiers who actual audit facilities. Competent Bodies may revoke a site registration if a site fails to maintain compliance with relevant environmental legislation. Once certified and registered, facilities may publicize their achievement using the EMAS logo.

A survey of EMAS participants indicates that German firms account for about 76% of the 3,000 certified sites (FEAG 2000). The most important reason for implementing EMAS was continuous improvement of environmental performance, with energy resource use and motivation of employees also cited. The average time to register was 14 months (range 2-48 months). Implementation required on average about 12 full-time equivalent employees (range 1-20 FTE) and cost an average of $58,000 (range

$2,500 - $700,000). Twenty-five percent of respondents found EMAS to have provided a positive benefit-cost ratio, while 29% said they had negative benefit-cost ratio. Firms also indicate that EMAS places too much emphasis on the system and not enough emphasis on improving environmental performance.

## 2.7 Environmental Management Systems as a Regulatory Approach

A final consideration for existing environmental management systems is their place in the regulatory structure. EMS are generally voluntary undertakings. The Office of Policy, Economics, and Innovation at EPA proclaimed a commitment to:

> "encourage organizations to use EMSs that improve compliance, pollution prevention, and other measures of environmental performance...continue evaluation efforts to learn more about which EMS elements and applications are most effective, and...determine how these systems might be used to strengthen environmental programs and policies." (EPA 1999b)

The EPA recognizes both the potential in EMS and the uncertainty of their effectiveness and use. The EPA has not yet required organizations to establish any form of EMS, although it has begun using them as part of some settlement agreements. Since certification to the ISO 14000 standard does not guarantee compliance with existing regulations, the EPA has no incentive to abolish regulatory standards or procedures. The EPA views environmental management systems as frameworks for managing environmental responsibilities in a more systematic way, but since EMS do not set goals or limits for environmental impacts, traditional regulation must continue. Coglianese (1999) and Stenzel (2000) give thorough consideration to the place of EMS and ISO 14000 in environmental regulation. Coglianese states that an initial policy question is to ask whether these systems generate better results than existing regulations.

## 2.8 Conclusions

Although each facility will have a unique environmental management system, the general framework for EMS is similar across organizations. Common components are an environmental policy, an evaluation of environmental impacts, documents defining procedures to be followed to minimize environmental impacts, and regular auditing and review of the system. The boundaries of EMS can encompass a single process, an entire facility, or a whole corporation. Three common frameworks are the ISO 14000 EMS, the EPA Compliance-Focused EMS, and the Eco-Management and Audit Scheme. Without a requirement for environmental compliance, EMS currently have no direct role in regulations.

The current EMS frameworks are intended to formalize activities across an organization. But the EMS are based on processes, not outcomes. The standards require organizations to document how individual tasks will be completed and to assign and communicate responsibilities. The concern is on the specific activities within a facility and executing them properly and consistently, not on what is achieved by completing them this way. It is this focus on process, not outcomes, that limits the environmental management system frameworks.

# Chapter 3 An Empirical Evaluation of the Impact of ISO 14000 on Environmental Performance

In this chapter, the environmental management framework is tested and evaluated to determine the effectiveness for environmental performance improvement. The focus is the automobile and light truck assembly industry (SIC 3711). Facilities with and without ISO 14000 certification are compared on several performance measures to determine if significant differences in historic environmental performance are observable. The performance measures include toxic waste management, air permit compliance status, and safety violations. Other studies that have evaluated the impact of environmental management systems on various aspects of firm performance are also discussed. The overall results indicate no significant difference between the firms which are certified to the ISO 14000 EMS and those that are not.

## 3.1 Empirical Analysis of Firm Environmental Performance

ISO claims that its EMS can lead to such benefits as:

- "reduced cost of waste management,
- savings in consumption of energy and materials,
- lower distribution costs,
- improved corporate image among regulators, customers and the public, and
- a framework for continuous improvement of [a firm's] environmental performance (ISO 1998a)."

If these benefits are realized by firms that already follow the ISO 14000 guidelines (and exceed the cost of the system), then the current framework is worthwhile for organizations. Testing the first three points is difficult as facility level financial data is not publicly available for analysis. The latter two claims can be tested and form two hypotheses of one analytic approach to evaluating environmental management systems. First, if firms certified to ISO 14000 have an improved corporate image, then they must demonstrate superior environmental performance. Since some pollution effects at the firm and facility level are public, my measure of image is the amount of waste generated. Firms with the certification will generate less waste than firms without the certification.

- Hypothesis 1: Firms certified to ISO 14000 have lower waste generation than firms without certification.

Next, if firms with ISO 14000 certification should be continually improving on their environmental performance, then a change in the level of environmental performance should be seen after the system is implemented.

- Hypothesis 2: Firms certified to ISO 14000 improve their environmental performance faster than before implementing the system.

Another concern with ISO 14000 is that it does not guarantee compliance. Even though procedures to address non-compliance situations exist, facilities may not meet all requirements. This forms a third hypothesis to be tested:

- Hypothesis 3: Firms certified to ISO 14000 are more likely to be in compliance with environmental regulations than firms without certification.

As discussed later in Chapter 5, environmental issues are related to safety issues. Since ISO documentation produces standard operating procedures, safety incidents are likely to be reduced as workers follow required work practices. A fourth hypothesis is then:

- Hypothesis 4: Firms certified to ISO 14000 are more likely to be in compliance with environmental regulations than firms without certification.

To test the four hypotheses, various statistical analyses were performed on U.S. facilities within the automobile assembly industry. The automotive assembly industry consists of approximately 25 car and 35 truck assembly facilities across the U.S. Ford Motor Company, General Motors and Chrysler (now Daimler-Chrysler), the three major automotive manufacturers in the U.S., own and operate most of them, but foreign manufacturers and joint U.S.-foreign ventures have facilities as well. The facilities assemble vehicles in a range of sizes – from compact, 2-door model cars to heavy-duty trucks and multi-passenger vans. Operations include some manufacturing of parts, but focus on assembly of components into the final product. One of the most environmentally burdensome factors of the assembly process is painting operations. Painting operations often require solvents which can contain volatile organic compounds (VOCs). These compounds contribute to much of the toxic wastes emitted from automotive assembly facilities.

Automotive assembly facilities were selected for several reasons. Automotive assembly facilities have been a target of environmental regulators in the past. The motor vehicle assembly sector was an early participant in the EPA's Sector Notebook Project (EPA 1995b). The project focused on the commonalities across firm operations and identified pollution prevention and technology transfer opportunities for the various facilities. Also, automotive manufacturers have shown concern for environmental issues by issuing environmental reports and publicizing environmental efforts such as use of recycled materials. Both Ford Motor Company and General Motors have extended this concern by issuing directives for their suppliers to obtain ISO 14000 certification as a requirement for doing business (Sherefkin 1999). The sector also provides a sample of manufacturing firms that have received certification to ISO 14000 and those that have not. Finally, the sector produces annual data on production by facility using a common unit of vehicles produced. Facility level production data is often not available for industries.

### 3.1.1 Data Sources

Several sources provide data for this statistical analysis of firms with relation to ISO 14000 environmental management systems. All data were available from public sources. The first source of data was the Automotive News Market Data Book, a summary of the automotive market published annually by the trade magazine Automotive News (Automotive News 1995-1999). The summary provides the total number of vehicles produced in a calendar year at individual facilities located in North America. The city location and parent company of each facility is also identified, which allows production data of facilities to be matched with the corresponding environmental data.

The World Preferred Supplier Network provided a list of companies holding registrations to ISO 14001 (WorldPreferred.com Inc. 2001). World Preferred is a privately held, global company, that since 1993 has connected suppliers holding international standard registrations, such as quality standards, with potential customers who require registrations. Facilities enroll themselves in the Supplier Network for a fee, and potential customers searching the website can identify facilities with selected certifications prior to doing business. A list of companies holding registrations to ISO 14001 was gathered from the World Preferred Supplier Network in January, 2001. As of that date the Supplier Network listed over 1,100 U.S. facilities as registered to ISO

14001. The information gathered from the site included the company or facility name, complete facility address, SIC codes, date registered to ISO 14001, and the scope of registration. The scope of registration indicates if the ISO 14001 standard covered all operations at the facility, partial operations at the facility, or included other locations under the same registration. No facilities used in the final sample received certification to ISO 14001 prior to 1998. Facilities in the final sample that were not found on the WorldPreferred list are considered firms without ISO certification. Several of the facilities classified as not certified in the sample did eventually certify to ISO in late 2000. Given the scope of the analysis, this should not effect results.

The International Organization for Standardization does not compile a list of companies or facilities registered to any of its standards. It does produce a bi-annual survey of certification bodies that reports trends in ISO 9000 and 14000 certification worldwide (ISO 2000). In the 1999 survey, the information on certifications of U.S. firms was provided to ISO by World Preferred, indicating that the certification listing is reliable. According to the survey, the U.S. had 636 firms with certifications by the end of 1999, more than doubling the 291 certifications of 1998. The 1,100 certifications listed by the World Preferred Supplier Network is an increase of 72% from the previous year. Thus, a majority of companies within the U.S. with an ISO 14000 certification are likely found via the World Preferred website. While the listing across industry sectors may be biased towards larger organizations who can afford the $2,000 annual listing fee and would benefit from the public relations, the cost is minimal for the firms within the automotive assembly sector.

To assess the environmental burdens of facilities, the Toxics Release Inventory (TRI) database was used (EPA TRI Explorer 2000). The TRI database includes information on the releases, transfers, and treatment of over 600 toxic chemicals. Since the list of chemicals has changed since the inception of the reporting requirements, the final dataset includes only chemicals reported every year between 1994 and 1998. The category of total waste managed was selected for the analysis as the metric provides an estimate of overall toxic waste generated by a facility. In addition, TRI includes the facility name and complete address. The TRI data have limitations. The figures are reported by facility personnel and can be based on measurement or estimates. The data are limited to toxics identified by EPA as dangerous and do not include other hazardous waste or non-hazardous waste generated by the facility. Finally, the toxicity of the various chemicals is not factored into the results. However, the data are publicly accessible and are available for several years.

Air permit violations were selected to test the hypothesis of compliance because air emissions are a significant portion of waste and emissions generated by automotive assembly facilities. Information on current air permit compliance status was obtained via the Aerometric Information Retrieval System (EPA AIRS 2000). AIRS includes air releases information from various stationary sources of air pollution, such as individual facilities. Compliance status is defined at several levels – from in violation with no schedule for change, to in violation with regard to procedural compliance. Firms in the automotive assembly sector were classified as "in compliance" only if all compliance factors were acceptable, otherwise firms were classified as in violation. AIRS only supplies the most recent permit status of a firm, and the information is not directly related to a particular date. As such, the data provide one observation per firm and the status is compared only to ISO status, not other factors. The database also provides facility address information to identify individual facilities.

Similarly, OSHA provides information on safety violations at facilities (DOL Inspections within SIC 2001). Inspections at facilities are logged into the Integrated Management Information System (IMIS) by local and state agencies. In addition to facility identifying information, the inspection type (complaint, accident, planned), the number and type of violations (if any) and the amount of penalties currently assessed are provided. The analysis centered on the number of violations received over time, regardless of the number of inspections. The type of violation can be serious, willful, repeat, unknown or other. Information on violations from inspections made from 1994 through the end of 2000 were used for the analysis. The database also provides facility address information to identify individual facilities.

The final dataset used for the following analysis was compiled by matching entries in the above databases. The facility address was used to identify and verify individual facilities, as this information was found in all sources. In some cases several facilities with similar addresses had overlapping information within the various databases (e.g., the General Motors Lansing facility), and so were excluded in the analysis. Fifty-four plant locations were uniquely identified and compose the dataset, 21 of which were certified to ISO 14001. The final dataset and complete statistical analysis of the data is available in an accompanying technical report (Matthews 2001).

### 3.1.2 Preliminary Toxic Waste Analysis

The preliminary analysis includes basic statistical and graphical comparisons of the automotive assembly data in order to gain an understanding of the relationships between the data. *Toxic waste managed per vehicle* with units pounds per vehicle is the measure of environmental performance. This normalized variable avoids observing decreases in waste simply due to decreases in production. *Toxic waste managed* is given in units of million pounds and *vehicles* is given in thousands of units; *ISO* is a dummy variable (1 = with ISO certification, 0 = without ISO certification), as are the three company variables (*Ford, GM, Chrysler*) where a value of 1 indicates the facility is owned by the respective parent company. *Time* was scaled with 1994 as 0, 1995 as 1, etc. Descriptive statistics for the variables appear in Table 3-1.

**Table 3-1. Descriptive statistics of toxic waste, production, ISO status, and parent company data.**

| | Toxic Waste Managed per Vehicle | Toxic Waste Managed | Vehicles | ISO | Ford | GM | Chrysler |
|---|---|---|---|---|---|---|---|
| **Units** | pounds/vehicle | million pounds | thousands | | | | |
| **Mean** | 11 | 2.09 | 212 | 0.39 | 0.29 | 0.39 | 0.15 |
| **Median** | 9 | 1.78 | 211 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Standard Deviation** | 6 | 1.43 | 101 | 0.49 | 0.45 | 0.49 | 0.36 |
| **Minimum** | 0 | 0.01 | 5 | 0 | 0 | 0 | 0 |
| **Maximum** | 34 | 10.04 | 476 | 1 | 1 | 1 | 1 |

Table 3-2 shows the correlations between the variables. The highest correlation value is 0.794 between *ISO* and the *Ford* variables. All Ford plants in the sample had been certified to ISO, so the high correlation is expected. Also, the correlation between *ISO* and *GM* is –0.634; since no GM firms had ISO certification this negative and higher correlation is expected. The correlation coefficients greater than 0.12 are significantly different from zero at the 5% level, so most of the variables are highly correlated. *Time* is the least correlated with the other variables; only the correlation of *time* with *toxic waste managed per vehicle* and with *toxic waste managed* are significant at the 5% level.

**Table 3-2. Correlation of toxic waste, production, ISO status, and parent company data.**

| | Toxic Waste Managed per Vehicle | Toxic Waste Managed | Vehicles | ISO | Time | Ford | GM |
|---|---|---|---|---|---|---|---|
| Toxic Waste Managed per Vehicle | 1.000 | | | | | | |
| Toxic Waste Managed | 0.505 | 1.000 | | | | | |
| Vehicles | -0.261 | 0.571 | 1.000 | | | | |
| ISO | 0.195 | 0.387 | 0.256 | 1.000 | | | |
| Time | -0.156 | -0.184 | -0.037 | 0.017 | 1.000 | | |
| Ford | 0.232 | 0.306 | 0.146 | 0.794 | -0.009 | 1.000 | |
| GM | 0.008 | -0.202 | -0.300 | -0.634 | -0.022 | -0.503 | 1.000 |
| Chrysler | -0.318 | -0.282 | 0.038 | -0.332 | 0.010 | -0.264 | -0.332 |

Simple scatter plots of the data were completed to determine initial relationships between the variables and between companies with ISO certification and those without certification. Figure 3-1 shows the relationship between *toxic waste managed per vehicle* and *toxic waste managed.* Looking at all observations, no clear relationship is observed between the two variables. One does observe a "lower bound" on the scatter of the data, with no data points falling below a line with slope of 2 pounds of waste/vehicle per million pounds of waste. This could indicate that a minimal amount of waste/vehicle can be achieved at any given waste production level. In comparing the two sets of firms, a difference is seen. Only firms certified to ISO are found at the higher end of waste generation. The average pounds of toxic waste managed for ISO certified firms over all years was 2.78 million pounds. Firms without ISO certification averaged 1.65 million pounds over all years, for a difference over 1 million pounds or 50,000 pounds per facility certified to ISO over the 5 year period. This does not support the initial idea that firms adopting the standard have lower waste generation.

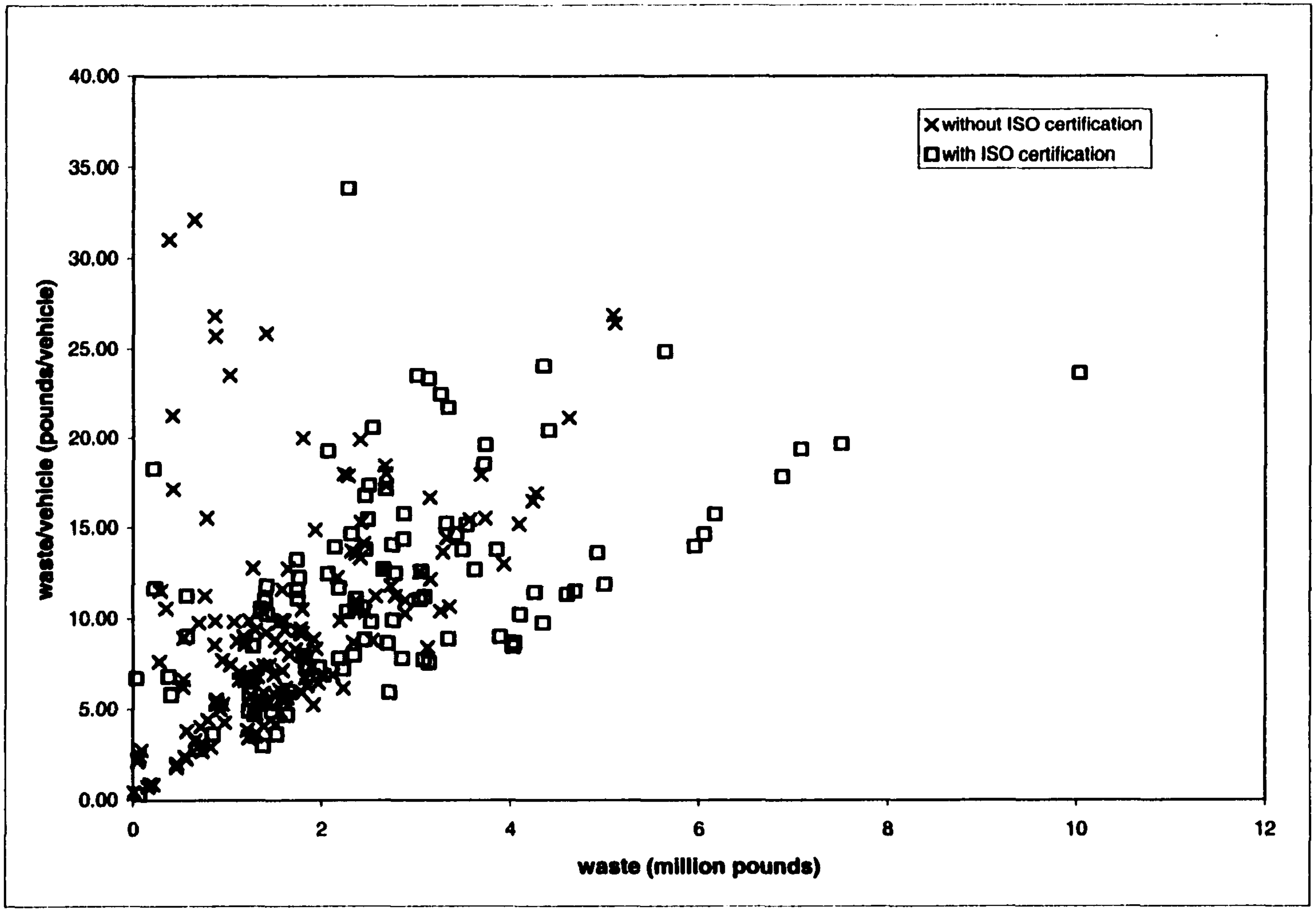


**Figure 3-1. Waste/vehicle vs. waste for all years, ISO certified firms and firms without ISO certification.**

Figure 3-2 shows the relationship between *toxic waste managed per vehicle* and *vehicles*. The scatter of data does not provide any good indication of how production and waste generation are related. A slight negative trend in the waste/vehicle ratio is seen as production increases, likely a function of economies of scale in production. Examining the two firm types, the data for ISO 14000 certified companies is located at the higher production levels. The mean production from 1994 through 1998 for firms with ISO certification was 245,000 vehicles, while for firms without ISO certification the mean production was 192,000 vehicles. For each year, firms with ISO certification produced about 50,000 additional vehicles, or about 2,500 additional vehicles per facility. It should be noted however that during the 1996 to 1998 period, facilities without ISO certification increased production by about 12,000 vehicles while the firms with ISO certification did not see a similar boost in production.

Finally, Figure 3-3 shows the relationship between *toxic waste managed per vehicle* versus *time* for both facilities with and without ISO certification. Again, no general trend is seen with the waste/vehicle ratio over time. The range of values for the waste/vehicle ratio is between 0 and 30 over all years. The variation between the two sets of firms is similar as well. Neither firm type shows a dramatic change in the waste/vehicle ratio over the time period. This does not support the initial idea that firms receiving certification will improve environmental performance faster after implementation.

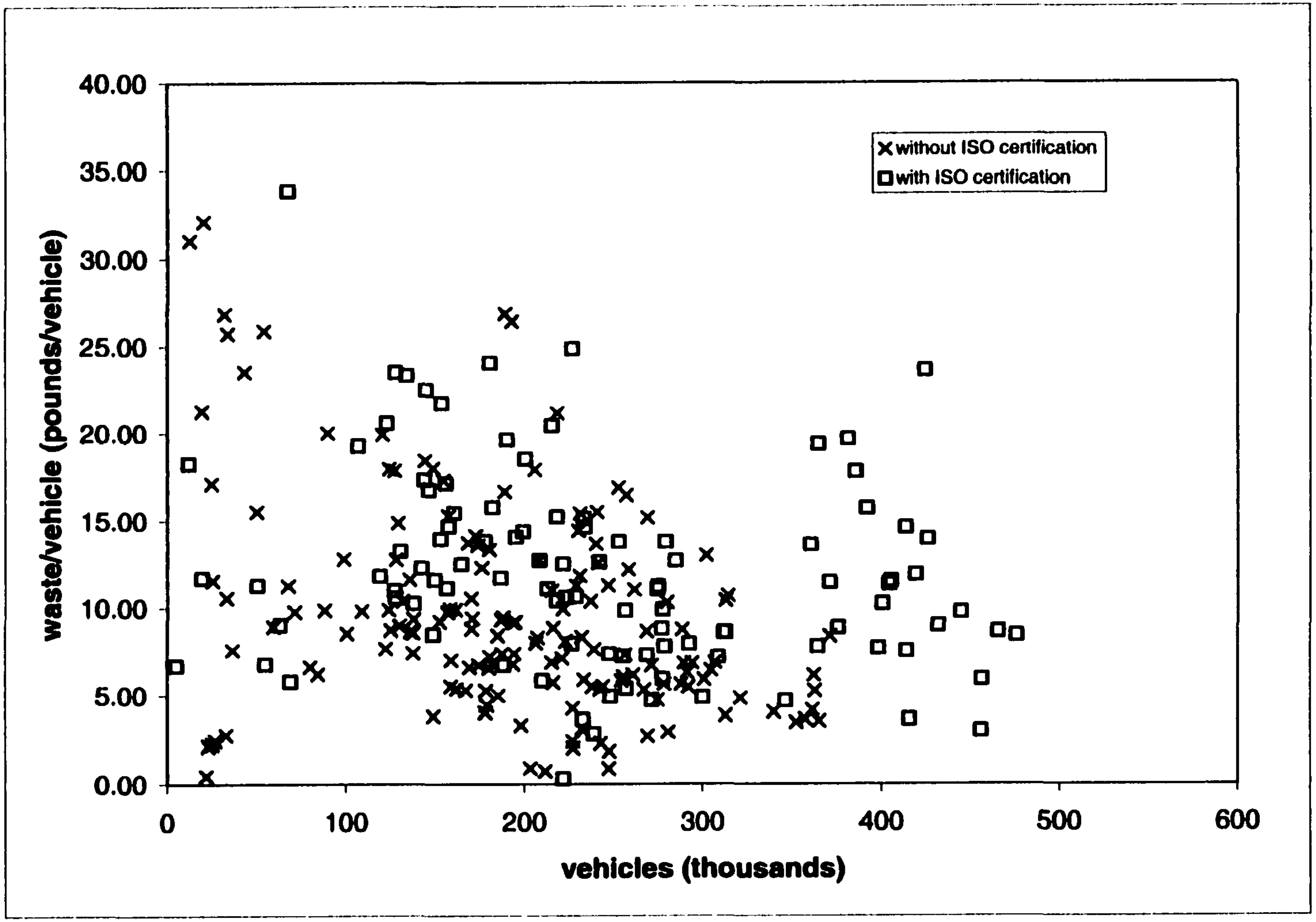


**Figure 3-2. Waste/vehicle vs. vehicles for all years, ISO certified firms and firms without ISO certification.**

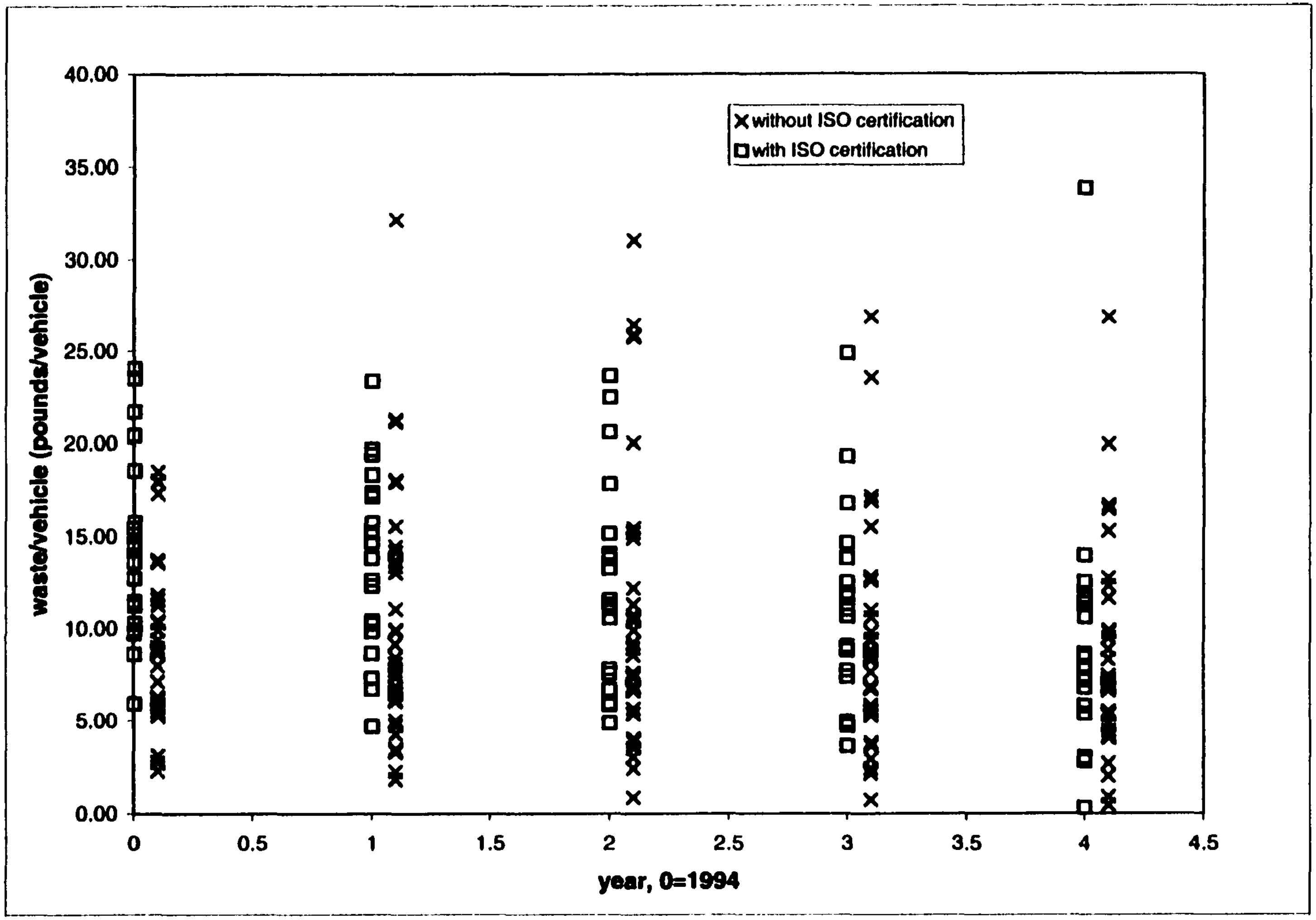


**Figure 3-3. Waste/vehicle vs. time for all years, ISO certified firms and firms without ISO certification.**

The preliminary analysis identified one outlier in the dataset. One facility had a *toxic waste* managed *per vehicle* ratio of 125 in 1994, almost 4 times higher than all other plants. The facility was identified as a newly operational plant for that year and its production was quite low – less than 500 units. The volume of toxics related to that year may be attributable to the construction and start-up of the facility and not to production alone. The *toxic waste managed per vehicle* factor for this same plant in subsequent years is in line with average values across remaining plants. The 1994 observation for this facility was removed from further analysis. For a second facility, the production data for 1994 and 1995 was recorded as significantly lower than in 1993 or 1996; however during the same time, toxic releases remained steady. Production data for 1993 was substituted into the analysis in place of the 1994 and 1995 data for this facility.

### 3.1.3 Toxic Waste Managed Per Vehicle Model

Using the preliminary analysis as a guideline, an initial model was established. *Toxic waste managed per vehicle* is the dependent variable, and is considered a function of the number of vehicles produced, time, and, of course, ISO status. Vehicles are used in the analysis to provide a measure of the economies of scale within a facility. As suggested by the correlation between *toxic waste managed per vehicles* and *vehicles*, higher production may lead to reduced waste generation so that the estimated regression coefficient will be negative. Likewise, time is expected to lead to improvements in efficiency and reduced waste generation, resulting in a negative estimated regression coefficient. Finally, if a firm is certified to ISO (*ISO* dummy changes from 0 to 1), the toxic waste managed per vehicle is expected to be lower, indicating better environmental performance. The estimated regression coefficient is expected to be negative. The *ISO* variable effects only the intercept of the regression equation.

The null hypothesis for the first test is that the coefficient for the *ISO* variable is negative, or that facilities with ISO certification have lower waste generation than firms without certification. Using standard regression analysis on all observations in the dataset, the model and coefficient estimates result as shown in Table 3-3. The reasonable fit of the overall model is reflected in the F-statistic for the regression, 17.89, which is significant. The coefficient of the *ISO* variable is positive and significant, so the null hypothesis is rejected. So, firms with ISO certification are found to have a higher toxic waste managed per vehicle ratio, and Hypothesis 1 stated previously is not supported. This does not mean that firms with ISO certification are not improving their environmental performance, but it does show that these firms are "dirtier" than firms without ISO certification. The 95% confidence interval for the ISO coefficient is from 2.1 to 5.0. It is interesting to note that production and ISO status have the same magnitude impact on the dependent variable, although in different directions. At the average of 212,000 vehicles per facility, the change in the dependent variable due to production level is -4.2 pounds/vehicle while the change in the dependent variable due to ISO certification is +3.5 pounds/vehicle.

**Table 3-3. Toxic Waste Managed per Vehicle model results.**

| | **degrees of freedom** | **SS** | **MS** | **F-Statistic** |
|---|---|---|---|---|
| **Regression** | 3 | 1649 | 549 | 17.89 |
| **Residual** | 259 | 7960 | 31 | **Significance F** |
| **Total** | 262 | 9610 | | <0.0001 |

| **Variable** | **Coefficient** | **Standard Error** | **t-Statistic** | **P-value** |
|---|---|---|---|---|
| **intercept** | 15 | 0.951 | 15.8 | <0.0001 |
| **vehicles** | -0.020 | 0.003 | -5.81 | <0.0001 |
| **time** | -0.75 | 0.726 | 4.88 | 0.002 |
| **ISO** | 3.5 | 0.243 | -3.07 | <0.0001 |

The second test examines only firms that have certified to ISO 14000 to determine if these firms improve their environmental performance faster than before the implementing the system. The results of a linear regression with all years of data from firms with ISO certification were compared to regressions on the data from 1994 through 1996 and from 1997 through 1998. The comparison determines if the structure of the model changes over time such that separate regressions are necessary to fully explain the relationship (i.e., do two lines reflect the nature of the data better than one). The null hypothesis is that the coefficients for the independent variables are the same in both regressions. An F-statistic comparing the error sum of squares of the three regressions is calculated. Table 3-4 shows the results of the three regressions. The calculated F-statistic is 0.17, which is not significant. The null hypothesis that the coefficients for the independent variables are the same in both time periods is not rejected. So, firms that have certified to ISO 14000 do not improve their environmental performance faster than before implementing the standard, which does not support Hypothesis 2.

The error in the model and omitted variables must be considered. The error term encompasses several characteristics of the facilities that could have an influence on the waste/vehicle dependent variable. These characteristics include age of the facility, technology age and type, and vehicle type. These factors are not included in the model because either the data is not available or is not easily classified. The concern is whether these factors are correlated with the ISO status variable and cause omitted variable bias in the ISO coefficient.

**Table 3-4. Toxic Waste Managed per Vehicle model results for ISO facilities only.**

| All Observations for ISO Certified Facilities | | | | |
|---|---|---|---|---|
| | degrees of freedom | SS | MS | F-Statistic |
| **Regression** | 2 | 633 | 317 | 11.67 |
| **Residual** | 99 | 2686 | 27 | **Significance F** |
| **Total** | 101 | 3319 | | <0.0001 |
| **Variable** | **Coefficient** | **Standard Error** | **t-Statistic** | **P-value** |
| **intercept** | 18 | 1.46 | 12.6 | <0.0001 |
| **vehicles** | -0.014 | 0.00452 | -3.10 | 0.002 |
| **time** | -1.4 | 0.368 | -3.85 | 0.0002 |

| 1994-1996 Observations for ISO Certified Facilities | | | | |
|---|---|---|---|---|
| | degrees of freedom | SS | MS | F-Statistic |
| **Regression** | 2 | 142 | 71 | 2.81 |
| **Residual** | 57 | 1435 | 25 | **Significance F** |
| **Total** | 59 | 1576 | | 0.069 |
| **Variable** | **Coefficient** | **Standard Error** | **t-Statistic** | **P-value** |
| **intercept** | 18 | 1.82 | 9.65 | <0.0001 |
| **vehicles** | -0.011 | 0.00576 | -1.98 | 0.05 |
| **time** | -1.2 | 0.796 | -1.46 | 0.15 |

| 1997-1998 Observations for ISO Certified Facilities | | | | |
|---|---|---|---|---|
| | degrees of freedom | SS | MS | F-Statistic |
| **Regression** | 2 | 198 | 99 | 3.12 |
| **Residual** | 39 | 1236 | 32 | **Significance F** |
| **Total** | 41 | 1435 | | 0.055 |
| **Variable** | **Coefficient** | **Standard Error** | **t-Statistic** | **P-value** |
| **intercept** | 20 | 6.38 | 3.07 | 0.004 |
| **vehicles** | -0.017 | 0.00748 | -2.33 | 0.025 |
| **time** | -1.5 | 1.74 | -0.885 | 0.38 |

The age of a facility, the technology types, and the age of the technology are all closely related. Older facilities may tend to have older technology that is less efficient and leads to higher waste generation. Older technology may require materials that are now deemed problems for the environment – for example, painting operations that require solvent-based paints. Different types of technology may also play a role here. Technologies for the same operation may have widely different efficiencies and waste generation characteristics – again, painting operations can include spray systems or dipping systems that have different environmental impacts. These three factors which have an impact on process efficiency may lead facilities to adopt ISO certification. Variables for these factors would be positively correlated with the ISO status variable. This positive correlation would result in the coefficient for ISO to be overestimated.

If these variables (or another variable to measure efficiency) were included in the model, the result may be that they dominate and that the sign of the ISO coefficient changes, but also that it is not significant. This would be consistent with the results of the hypothesis tests. The first test indicates that ISO firms are generating more waste, so perhaps their facilities or technology are older. The second hypothesis test indicated that facilities with ISO certification did not improve their waste/vehicle ratio after implementation. If technology change did not occur in a facility, the waste generation would likely be at the same level before and after implementation of the ISO system. So, while these measures of efficiency may change the sign of the ISO coefficient, the final model may better reflect variables that truly influence the waste/vehicle ratio.

Vehicle type (i.e., sedan, wagon, truck, van, etc.) is another factors that may influence the waste/vehicle variable. Each facility produced only one or two types of vehicles, and during the time period of the analysis the overall type did not change. For example, a facility producing mid-size cars continued producing mid-size cars, although the specific model characteristics may have changed (i.e., engine component upgrades, body shape modifications, etc.). So, within facilities over time, vehicle type is not expected to influence the decision to certify to the ISO standard. However, across facilities, many different vehicle types were produced, from compact 2-door cars to multi-passenger vans. This variation in vehicle type may have an impact on the dependent variable, and on the decision to implement ISO 14000, if certain vehicle types are associated with higher waste generation. Examining the waste/vehicle ratio of facilities with respect to vehicle type shows no relationship. Among Ford facilities, for example, similar low levels of waste/vehicle were seen at the facilities producing 8-passenger vans, mid-sized sedans, and sport utility vehicles. Luxury cars and heavy-duty truck assembly facilities had much higher waste/vehicle ratios. Smaller cars and other truck models were in the middle. Since no clear relationship is seen between the model type and waste generation level, model type is assumed to be independent of ISO status, so no omitted variable bias is introduced.

### 3.1.4 Toxic Waste Model Discussion

Several other factors limit the certainty of the model. First, the analysis only considers environmental performance through 1998, the year when the facilities with ISO certification had fully implemented their systems. The analysis assumes that improvements in environmental performance should be seen in the 2-year period before certification, the average time for a facility to implement and certify to the ISO framework. Since management has decided to focus on environmental issues, a new awareness of environmental responsibility should enter daily activities. During the implementation phase, facilities are auditing their operations and investigating their environmental impacts. As problems are found, the "low hanging fruit" that can be easily and cheaply remedied will likely be changed, leading to improvements during this time period. More recent data on toxics is not available at this time, although revisiting this work in the future is an intention.

Second, the analysis includes only total toxic waste managed for each year. This category from the TRI does not differentiate between the fate of the toxic waste. This category includes all releases of toxic chemicals on- and off-site, all chemicals transferred to other locations for disposal or treatment, and all wastes treated or recycled on-site. Examining these individual components may provide a different perspective of ISO certified firms. ISO certified firms may have fewer releases and increased recycling activities. The total waste managed variable was selected since it provides an overall view of the impact of toxic wastes from a facility. Trends in overall waste generation provide a picture of how facilities are operating with regard to environmental issues and changing overall impact.

Third, the analysis does not consider hazardous (but non-toxic) or non-hazardous waste generation. Packaging materials, scrap materials, or defective parts are a considerable portion of automotive assembly waste generation (Horney 1998). The toxic wastes considered here are only one component of a facility's environmental impacts. If toxics are not specifically an item targeted by the ISO system as a goal, then the analysis would be focusing on an issue that cannot be related to the existence of the ISO framework. In addition, reductions at an increased rate may not be seen for the companies with ISO certification. Within these facilities, however, toxics are an important factor – an average of 1.7 million pounds are generated annually by each facility. VOCs account for approximately 65% of air releases and 60% of total toxic releases in that sector (EPA TRI Explorer 2000). A significant portion of these wastes are air emissions from volatile organic compounds generated from processes such as cleaning equipment and metals, or coating vehicles with paints and finishes (EPA 1995b).

Since the EPA has targeted these chemicals for reduction it is likely goals for their reduction would be established. Also, if ISO is implemented as a public relations improvement tactic, then these toxic emissions, which are publicly available, are likely to be a target for reduction. Ford Motor Company indicates that one of its objectives for their ISO 14000 EMS was to reduce paint shop emissions to 60g/m2 by 2005 (Ford 2000).[2] So, for Ford facilities, the model should be capturing at least one important objective of the ISO framework.

Finally, the analysis considers only one industry; an industry that has been identified by regulators for environmental improvement, and that has initiated other environmental improvements voluntarily. Applying the results to other industries, or industries in general, is difficult. Additional analysis on suppliers to the automotive assembly industry would be an interesting exercise, especially considering the requirements of Ford and GM for suppliers to achieve ISO certification. Suppliers would be smaller firms generally, and have the incentive to certify to ISO 14000 as a requirement for business, not necessarily for regulatory-driven environmental improvement. Despite these limitations, the model provides an initial, quantitative assessment of the performance of ISO certified firms.

### 3.1.5 Compliance Analysis

The hypotheses of compliance status is tested using air permit status and safety violation record. The aim is to determine if the compliance status (or number of violations) is independent of the ISO certification status of the firm. Knowing that a

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[2] The initial baseline level of paint shop emissions was not given, providing no indication of the degree of commitment toward reductions. The 60g/$m^2$ figure is approximately 2.11 pounds/vehicle (assuming an average of 16 $m^2$ of painted area on a vehicle). The average pounds of toxic VOCs (typical emissions from paint shops) per vehicle for Ford facilities for 1998 was 2.04. Other objectives of the Ford ISO 14001 EMS are to phase out all PCB transformers by 2010 and reduce energy usage by 1 percent per year.

facility is in compliance with air permits, or knowing how many safety violations have occurred, can the firm be identified as being certified to ISO? To test the hypotheses of independence, contingency tables were created and a $\chi^2$-statistic was used.

For air permit compliance status, the null hypothesis is that the compliance status is independent of ISO certification. The complete contingency table is given in Table 3-5. A majority of firms overall are in compliance with air permit violations. The calculated $\chi^2$ test statistic has a value of 0.23, which is not significant. The hypothesis that the two sets of firms are independent is not rejected. Firms without ISO certification are just as likely to be out of compliance as firms with ISO certification, which does not support Hypothesis 3 stated previously.

**Table 3-5. Contingency table for firm type and air permit status.**

| | ISO certification | no ISO certification | Total |
|---|---|---|---|
| **In compliance** | 15 | 24 | 39 |
| **In violation** | 6 | 7 | 13 |
| **Total** | 21 | 31 | 52 |

Safety violations are the second variable used to test the compliance level of firms certified to ISO 14000. Information on safety violations are available for a longer time period – 1994 through 2000, but the data still had limitations. In most cases, the willful, repeat, and unknown violation types were grouped into a single variable so that the minimum expected frequency for the category was at least 5, a constraint for approximating independence with the $\chi^2$ distribution. In each case, the null hypothesis is that the two categories of firms are independent of the number of violations. The contingency tables and the calculated $\chi^2$ values are given in Table 3-6.

The first analysis with the safety data considered all violations between 1994 and 2000 (Test 1). ISO certified firms had 302 violations during this time while firms without ISO certification had 416. The test statistic is very high, so the null hypothesis of independence is rejected. Firms with ISO certification are different from firms without certification in relation to safety violations. However, the test does not indicate if the ISO certified firms have fewer violations which is the original hypothesis. Since ISO certification appears to have a relationship with safety violations, further subsets of the data were analyzed.

**Table 3-6. Contingency tables for firm type and safety violations.**

| Test 1 | All data from 1994 to 2000 | | |
|---|---|---|---|
| | ISO | no ISO | Total |
| Serious | 202 | 172 | 374 |
| WRU* | 23 | 16 | 39 |
| Other | 77 | 228 | 305 |
| Total | 302 | 416 | 718 |
| $\chi^2$ Value | 61.87 | reject H0 | |
| | | | |
| Test 2 | All data from 1994 to 1997 | | |
| | ISO | no ISO | Total |
| Serious | 38 | 135 | 173 |
| WRU | 3 | 12 | 15 |
| Other | 39 | 187 | 226 |
| Total | 80 | 334 | 414 |
| $\chi^2$ Value | 1.40 | do not reject H0 | |
| | | | |
| Test 3 | All data from 1998 to 2000 | | |
| | ISO | no ISO | Total |
| Serious | 164 | 37 | 201 |
| WRU | 20 | 4 | 24 |
| Other | 38 | 41 | 79 |
| Total | 222 | 82 | 304 |
| $\chi^2$ Value | 33.70 | reject H0 | |

*** WRU – Willful, Repeat, and Unknown classified violations were pooled.**

Firms were first compared using data from 1994 through 1997 only (Test 2). This represents data from the period before ISO would have been implemented. In this case, the $\chi^2$ test statistic has a value of 1.40. The null hypothesis of independence is not rejected. Prior to implementation of the ISO EMS, the two groups of firms had similar levels of safety violations. Next, firms were compared using only data from 1998 through 2000, the period after ISO would have been implemented. The resulting $\chi^2$ statistics is now very high, so the null hypothesis is rejected. Firms are different in the number of safety violations received.

Doing similar $\chi^2$ tests of independence for just the ISO certified firms and considering the time periods before and after ISO implementation also leads to the hypothesis of independence to be rejected. Further comparisons showed surprising results as to how the two sets of firms differ in relation to the number of safety violations. Table 3-7 compares the inspection and violation data. Over all years, ISO certified firms had a higher percentage of inspections result in violations than firms without ISO certification. But firms without ISO certification were inspected more often – 8 times versus 5. More interesting for firms with ISO certification is the comparison of inspections with violations before and after ISO implementation. With about the same average number of inspections per firm, the percentage of inspections with violations increased from 36% to 55%. The results are contrary to the idea that ISO would improve safety performance by defining clearer procedures for activities that involved environmental impacts. The results are contrary to Hypothesis 4 stated early.

The analysis of ISO certification in relation to air permit compliance status and safety violations support the concept that the ISO EMS is not improving environmental performance. With or without the formal system in place, a facility may be violating air permit limits. While safety is not specifically covered by ISO procedures, safety performance appears to worse in firms with the certification. A causal relationship between ISO certification and poor safety performance cannot be determined from this analysis, however. Together with the evaluation of toxic waste generation, the three analyses demonstrate that firm environmental performance is not being improved by gaining certification to ISO 14000.

**Table 3-7. Summary safety inspection and violation data for all facilities.**

| | Inspections | Inspections with violations | Firms inspected | Percentage of inspections with violations | Inspections per firm |
|---|---|---|---|---|---|
| **All dates** | 351 | 135 | 50 | 38% | 7.02 |
| **ISO** | 92 | 42 | 18 | 46% | 5.11 |
| **no ISO** | 259 | 93 | 32 | 36% | 8.09 |
| | | | | | |
| **Before 01/98** | 211 | 81 | 46 | 38% | 4.59 |
| **ISO** | 45 | 16 | 17 | 36% | 2.65 |
| **no ISO** | 166 | 65 | 29 | 39% | 5.72 |
| | | | | | |
| **After 01/98** | 140 | 54 | 42 | 39% | 3.33 |
| **ISO** | 47 | 26 | 17 | 55% | 2.76 |
| **no ISO** | 93 | 28 | 25 | 30% | 3.72 |

### 3.2 Related Analyses from Literature

Numerous studies have examined the link between environmental performance and financial measures (Klassen and McLauglin 1996, Konar and Cohen 1997, Cormier, Magnan, and Morard 1993, Stanwick and Stanwick 2000). Consistent positive results have not been found. Other studies have examined the relationship between environmental performance and other management systems, specifically within the chemical industry with respect to Responsible Care of the American Chemistry Council (ACA) (King and Lenox 2000, Howard et al. 2000). King and Lenox find that members of the ACA, who are required to follow the Responsible Care program, include "a disproportionate number of poor performers, and [that] its members do not improve faster than nonmembers" of the ACA. Given that a main objective of the program was to improve the reputation of the chemical industry with the public in general, the findings mirror the current analysis. Here, firms with ISO 14000 certification have been poor performers in the past, are not improving faster than firms not certified, and perhaps only implement the system to improve public relations.

In an effort to better compare the impact of environmental management systems on firms, the EPA in conjunction with state agencies has created the National Database on Environmental Management Systems (NDEMS) (Andrews et al. 1999). The project aims to track facilities across the nation, recording the process used for implementation of an EMS and the resulting environmental performance of the firms. One shortcoming of the database is the lack of environmental performance data prior to implementation of the EMS. Also, facilities are not restricted as to what goals or targets are set or what performance metrics are recorded. A consistent set of metrics will not be obtained to allow a comparison of overall environmental improvement across a large number of firms.

Many studies examine the impact of environmental management on cultural change or performance within firms (Montabon et al. 2000, Yosie and Herbst 1996, Roome 1999, Brockhoff et al. 1999, Wehrmeyer and Parker 1995). While the findings in these studies may be statistically significant or lead to desirable outcomes, most studies depend on survey data only. The survey data include questions asking respondents to rate impacts of environmental management on relative scales (e.g., strongly disagree, neutral, strongly agree). The answers are reflective of personal opinions and perspectives of environmental initiatives and do not consider actual performance. Typically, environmental personnel are targeted to complete the survey which may also bias results toward positive impacts of environmentally related issues. The results do not fully capture the impacts of environmental initiatives on actual outcomes.

One recent study does consider objective performance data across a large sample of firms (SPRU 2001). The Measuring Environmental Performance of Industry project assembled production, financial, management, and environmental data from 274 firms from six European countries. The data included as much publicly available information as possible, but depended on survey data as well. On average, only 2 years of data was available for each firm, limiting the scope of analysis. The data show that environmental performance of firms within the same sector varies widely. The variation is also seen across individual performance indicators. Furthermore, the research showed no statistically significant relationship between ISO certification or EMAS registration and environmental performance. One reason for the lack of performance improvement may be that performance changes lag the implementation of EMS; another is that perhaps firms seeking ISO certification are the worst performers who need the certification to assist them in catching up to better performers (SPRU 2001).

## 3.3 Reflecting Back on ISO 9000

ISO 9000 received similar criticism as ISO 14000 is now receiving with regard to the effort to implement the standard and the effectiveness in improving quality (Tommons 1994, Wett 1994, Zuckerman 1994). Widespread acceptance took several years and customer requirements are often a driving force for implementation (Ebrahimpour et al. 1997). Attitudes towards the results from implementing ISO 9000 are mixed, but are changing as the standard continues to be implemented. Some feel that the system has greatly aided in improving awareness of quality and other aspects of production; others feel the system is only a requirement for doing business and provides no real benefits. Simmons and White (1999) find that while firms certified to ISO 9000 had higher average profitability, the firms did not have higher operational performance.

Similar effects are likely with the ISO 14000 standard. ISO 14000 is still in its infancy and the long-term effectiveness on environmental impact is difficult to predict. The main limitation of the above analyses is the limited time period of the evaluation. The ISO 14000 EMS has only been available since 1996, and with the average 2-year implementation period, 1998 is the first year where change is expected to be observed. Even the analysis with ISO certification and safety violations is only able to examine data two years beyond implementation. It remains to be seen if ISO 14000 can bring about improvements in environmental aspects of firms as it is intended to do.

## 3.4 Conclusions

This quantitative analysis indicates that facilities with ISO 14000 are not performing significantly better than facilities without the system. No difference in toxic waste management is seen between firms certified to the standard and those without certification. Compliance to air permits is similar for both sets of firms. And, safety violations are actually worse in ISO certified firms, suggesting that environmental issues are possibly supplanting safety issues.

Organizations around the world have invested significant time and money into designing frameworks and standards for environmental management systems and implementing them within their own organizations. Given the weak results found between ISO 14000 certification and environmental performance, and the related mixed results on environmental management in general and environmental performance, one wonders what is limiting the current EMS frameworks. But as thorough and well-thought out these environmental management systems may be, many fall short in addressing environmental problems as a business issue. Regardless of the level of environmental performance of a facility or firm, environmental performance is a factor of other business functions, not simply the presence of an EMS based on the ISO 14000 standard. If improved environmental performance is the main goal, then the existing ISO 14000 EMS must be amended to include those other factors. The factors need to be identified and incorporated into environmental management systems, which is the task of the following chapters.

# Chapter 4 Qualitative Assessment of the ISO 14000 Environmental Management System

The previous chapter demonstrated two important factors about firms which have implemented an ISO 14000 Environmental Management System. First, the firms had higher waste per vehicle ratios compared to other firms in the same industry. Second, waste per vehicle ratios both before and after the decision to implement the system are similar. While ISO 14000 appears to be a system with broad coverage, it is limited in overall effectiveness. In this chapter, the weaknesses of the ISO system are investigated. The first consideration is the requirements for implementation and maintenance of the system. The second issue is the relationship between the requirements and actual environmental impacts found in industries. The third matter is considering how ISO 14000 compares to other options for reducing environmental impact.

## 4.1 The EMS Workbook of Ford Motor Company

Ford Motor Company uses the ISO 14000 Environmental Management System framework. Starting in 1996, all facilities were required to attain certification and had done so by 1998. Ford has developed an EMS workbook of sample EMS documentation templates for ISO 14000 implementation. The workbook has outlines for the various documents required of ISO, models for various procedures, and examples of work practices. Each major section of ISO 14000 has been considered. Ford has made this workbook publicly available (PADEP 2000). Selected portions of the workbook are discussed in detail to reflect several criticisms of implementing and maintaining an ISO 14000 EMS. The workbook sections, referenced here by number, are included in Appendix C.

One criticism of the ISO 14000 standard for environmental management systems is the extensive documentation that is required. Each of the major sub-clauses of the standard requires its own set of references, procedures, and forms. The documentation has strict version control rules to assure that current procedures are being used. Often, procedures and work practices reference other documents within the EMS making revision a tedious task. One requirement is a procedure that defines the format for procedures (EP-001). This procedure describes how to number and date documents, and indicate titles and page numbers. Yet, individual procedures can be "written in whatever form is considered to be appropriate to the operational circumstances." The number of work practices for a single facility, even for a single process within a facility, can be large. If changes are made to operations, each work practice related to the operation may need to be changed. Creating, updating, and controlling the documentation is a time consuming effort that has no direct impact on the environmental performance of the organization.

Another criticism is the static nature of the work practices. Work practices (EWP 023.01, EWP 024.01) are created for operations or activities associated with environmental aspects. The practices clearly identify specific steps to completing a task. Steps can include notifying appropriate individuals, verifying equipment integrity, completing required paperwork, or recording data. The intent of the work practices is to maintain the system in alignment with the policy, objectives and targets. However, completing a task following the work practice will maintain the current level of environmental impact for that task, not change it. For example, hazardous waste may be moved as directed, but the generation of hazardous waste does not change. From this perspective, environmental improvement will be impossible to achieve. In addition, the work practices do not reference the remainder of the EMS, and most importantly the environmental aspects for which they have been written. The work practices may decrease unexpected events, such as spills, that would cause environmental impact, however, this cannot be guaranteed.

The fact that ISO 14000 cannot guarantee compliance is another notable drawback of the system. ISO 14000 describes a framework for preparing an organization to face non-compliance situations. An organization can have an environmental policy and procedures in place, but release a contaminant level in its wastewater discharge higher than allowed by the facility permit due to a spill. The EMS would then allow the organization to act quickly and properly to remedy the situation and plan to avoid the exceeding the permit limits in the future. The procedure for Environmental Regulations and Other Requirements (EP-007) only requires that references to applicable regulations be available to personnel at the facility and that they be updated regularly.

Lack of accountability is another criticism of the framework. Without performance standards, an organization can implement ISO 14001 yet not achieve environmental improvement. Objectives may not focus on the most significant environmental issues of the organization nor consider long-term issues (Gallagher et al. 1999). Targets may be set to achieve minimal reductions in environmental impact. The Environmental Aspects, Objectives and Targets Determination form (EF-002.01) gives examples of these items. Note that the objectives are to "maintain compliance" to permits or regulations, not exceed them, or to investigate capital improvements. The targets qualify as meeting the requirements of section 4.3.3 of the standard, although none may lead to improving environmental performance.

Another example of the lack of accountability in the system is its ability to prevent changes that do not support the objectives. A procedure for Environmental Review of Projects (EP-008) is required to evaluate new projects. The Project Environmental Checklist (EF-008.01) must be completed to identify potential environmental impacts. The checklist does not identify specific pollutants and emphasizes requirements for end-of-pipe treatment control. The project review procedure allows the activity to be approved, even if it would result in negative environmental impacts. Similarly, the procedure does not give authority to prevent the funding of activities if approval is not granted.

Another issue with the implementation and maintenance of the ISO 14000 EMS is the extent of management review. The procedure for Management Review (EP-005) details the need for scheduling the meeting well in advance and providing an agenda. Step four indicates that the manager or team must confirm "the continual suitability, adequacy, and effectiveness" of the components of the EMS. However, the procedure does not evaluate the actual environmental performance of the organization. The review team can establish that the system is working if objectives and targets have been achieved, even though that may mean overall environmental improvement has been minimal. Effectiveness can be a measured cost savings for the organizations that does not result in a change in environmental impact (Coglianese 1999). Whether continued revision of objectives, targets, and documentation are made as a result of auditing is not known. From an organizational perspective, establishing and improving an environmental management system is very different from establishing and improving environmental performance.

A final criticism of the ISO system is scalability of the system across industries of different sectors and sizes (Culley 1998), and the issues described above enhance the difficulties. The extensive documentation requires resources that small firms may not be able to afford, and with fewer environmental impacts the extent of documentation may not be necessary for control. As supplier firms, small organizations may only be motivated to implement ISO 14000 at the requirement of customers, not to improve environmental performance. As such, the level of organizational commitment to improving environmental performance should be questioned. The EMS may only follow the "letter of the law," not the spirit of continuous improvement. Ford has required suppliers to certify to the standard; one facility must be certified by the end of 2001, and all manufacturing sites shipping products to Ford assembly plants must be certified by mid-2003. Since the automotive suppliers are required to implement and certify to the system in order to stay in business, their true interest in environmental performance improvement is not known. In fact, this requirement of supplier certification may only serve to enhance Ford's reputation. Ford may be perceived as being an organization concerned with environmental issues external to their own operations, even though in the long run little environmental improvement will actually occur.

One potential benefit to ISO 14000 during the implementation phase is the potential to thoroughly assess environmental impacts across a facility or organization. Some organizations may use generic templates to identify environmental aspects and impacts and forego deep investigation of their own operations; but many organizations do take the opportunity to carefully scrutinize operations in regard to environmental impact (Gallagher et al. 1999). As the organization assesses activities, it may discover problems that are easily remedied. Some activities may be eliminated as unnecessary, workers may be trained (or retrained) so that activities are done correctly, or simple capital improvements or maintenance may be completed. These initial changes are likely to result in some reductions in environmental impacts prior to the full implementation. But once implemented, the effectiveness of an EMS may not continue.

## 4.2 Evaluating EMS from a Business Perspective

The previous section demonstrated how, on paper, the ISO 14000 framework limits environmental performance improvement. This section examines the ISO EMS framework from the perspective of operations and activities once implemented . Several real industrial experiences are described and the requirements of an ISO 14000 EMS are applied. In each case, the ISO framework lacks the ability to fully capture the environmental problems of the situation and initiate change.

The examples are based on actual activities and situations at a large manufacturing company. Company X is a multi-national manufacturing company with headquarters in the U.S. The company has an environmental policy to operate in a safe and responsible manner with respect to the environment and health of employees, customers, and communities where it operates worldwide. It currently does not have certification for ISO 14000 at the corporate or facility level, although it is considering this option. Company X is vertically integrated – one business unit manufactures a product that is sold internally to another business unit for additional manufacturing, and so on. At the same time, each business unit also sells some of its finished product externally. Each business unit operates its processes so that the business unit is profitable while meeting internal and external customer demands. Each business unit also has its own research and development focus, independent of other business units. The business units have independent facilities and shared facilities within the entire organization. At the specific manufacturing facility under study, Company X has four business units with operations. The facility has a number of buildings dedicated to the operations of each business unit separated among three main areas of the facility. Services for manufacturing operations, such as environmental engineering or maintenance, are shared among the business units.

### 4.2.1 Processing Sludge – Materials Usage

A main processing stage of Company X results in large volumes (millions of gallons per day) of a watery sludge. A waste product of the process, the sludge is not classified as a hazardous substance, nor considered a toxic material, and thus is not subject to reporting and recordkeeping waste regulations. The sludge is pumped into holding lagoons on site. The solids settle in the lagoons, and the surface water is occasionally pumped off and sent through a wastewater treatment plant before discharge. Since the material is not hazardous and is not subject to any environmental regulation, the low cost of the holding lagoons is a rational choice for the organization. The area around the lagoons is monitored and the groundwater is tested frequently to determine if contamination has occurred. The company owns enough land around the facility to maintain the current lagoons and add additional ones as necessary for the foreseeable future. Although current technology is used in the plant, it is not terribly efficient. The sludge contains material that would be desirable to recover as saleable product, as well as residual processing materials that could be reused.

When identifying environmental impacts, the organization may only see the potential for wastewater or groundwater contamination as an impact of sludge generation, not the sludge itself since it is not subject to regulations. As such, objectives, targets, and work practices would be designed either to monitor the effluent of the treatment plant or to minimize material exiting through the groundwater. Since using the lagoons has been standard procedure and plenty of land is available, any work practices would define upkeep of the lagoons to prevent contamination and further validate the practice as acceptable. ISO would not capture issues related to the sludge material itself – the amount generated, its content of saleable product or processing materials, or the costs related to each of these items. In the long term, the land use issues and impacts on the surrounding ecosystem would not be included.

### 4.2.2 Hazardous Waste Handling – Waste Generation

The Company X facility has several plant buildings each of which generate hazardous waste. No options are available at the current time to eliminate the waste generation, so a procedure is detailed for proper handling of the waste. When a waste drum is full, a person in the building notifies the hazardous waste department. A member of the hazardous waste department is sent to remove the full drum and replace it with an empty drum. The contents of the drum are tested to verify its characteristics and a manifest is completed. The hazardous waste department, when completing the manifest, assigns the waste to an area of the plant based on the building where it was generated. The manifest and the area assignment are sent to the environmental department. An environmental engineer approves the manifest, and determines which accounts (based on the area assignments) will be charged for the disposal. Once a manifest is complete, the drum is transported to a hazardous waste disposal company. The disposal company eventually bills the total cost of disposal to the corporate environmental management department at the company headquarters and forwards the final manifest to them.

An ISO 14000 EMS would capture the activities related to the above tasks. A hazardous material, the waste would likely be identified as an environmental impact. The actual steps for transporting and testing the waste would be included in work practices. A training procedure would assure that the worker had received proper training for handling the hazardous substances and takes the necessary precautions when moving and testing the materials. Any problems encountered in this procedure, especially a spill of the material, would be covered under corrective action policies, and prevention instituted to avoid accidents in the future. The path of the manifest would also be considered in the ISO EMS as the paperwork is a compliance issue.

However, as detailed and comprehensive as the work practices may be, they do not encourage the waste generation to be reduced. The process that generates the waste is not identified by the environmental engineer, only the area of the facility where it was generated. The final manifest is sent to corporate headquarters, so information on the amount and type of waste generated is recorded there, not at the facility. The department that actually generated the waste is not involved once the hazardous waste department is notified that a drum is full and an empty one is needed, unaware of the amount or costs of hazardous waste generation. Unless the management of the process is accountable for the volume of waste generated and the cost of disposal, no incentive to reduce the generation or hazard level of the waste exists.

### 4.2.3 Chemicals Usage – Materials Usage

Company X manufactures a series of similar components within the same product family. To manufacture the components, the same processes are used, although the series of processes will vary depending on the design of the component. A more complex component will require additional passes through some processes; a simple component will require only one pass or will skip some processes. Machines in the facility are retired on a regular basis, about every 2 years, as the product families are re-engineered and improved. Each process step is highly automated, requiring very little human intervention aside from placing the components in a machine and removing them when a process is complete. Liquid and gaseous chemicals are used in nearly every process step and many of the same chemicals are used at different steps. The process machine controls the addition of chemicals through an automated system based on the type of component, number of components in a batch, and the stage of processing. The chemicals are housed in bulk in a central area and fed to the machines via pipelines, and used chemicals leave machines and are fed back to a waste processing area. Reuse of chemicals is not currently feasible; any impurities mixed with the chemicals during a process make the chemicals unsuitable for reuse. Based on compatibility, some waste chemicals are mixed for disposal. Records are kept of shipments of chemicals to the chemical storage area, and shipment of waste drums from the waste processing area. Meters are not available on individual machines to monitor chemical use. The cost of each component is developed based on a formula for labor-hours and machine-hours while being manufactured plus portions of total facility operating costs.

ISO 14000 would again track the control of the processing chemicals while in the facility. The EMS assures only that chemical delivery is free of spills. Leaks or distribution problems are addressed immediately under the corrective action procedure. However, the procedures and work practices do not address the chemical usage by each process or by each product. The cost of chemicals for each component type is unknown and the EMS cannot provide that information. Prices of the components manufactured are arbitrarily set by management to cover estimated design and engineering costs, and also manufacturing labor and materials. Introduction of new process technology only substitutes machinery for existing machinery, and the same chemicals and chemical feed systems are used. Since the chemicals would be incorporated into the existing storage, distribution, collection, and treatment system, project reviews would not identify additional environmental impacts. Project review and completion of the environmental impacts checklist with its focus on wastes, would not identify the need for metering to measure chemical usage.

### 4.2.4 Machine Lubricant – Maintenance

The machinery used by Company X to form materials into different shapes involves machinery with numerous rollers and wheels. Oily lubricants are required on bearings to keep the machinery moving with low friction. Maintenance personnel, rather than personnel operating the system, are in charge of maintaining the lubricant reservoirs. A drum of lubricant is requested when needed from the supply storage department and kept in the area to service several reservoirs in the proximity. Smaller amounts of the lubricant are taken from the central drum and used to fill individual reservoirs. Detailed records are kept as to when a reservoir was filled and how much lubricant is added. Used lubricant is collected occasionally from the reservoirs. Other lubricant leaks or drips at various locations along the machinery due to the configuration of some rollers and bearings. The leaks, drips, or any spills of lubricant are cleaned by maintenance personnel as needed. Waste lubricant or dirty rags from spill clean up are not hazardous waste.

The ISO impact assessment may not identify the lubricant as an environmental impact since the material and the resulting waste are not hazardous. If it is identified, then work practices would detail the activities for proper lubricant handling. Corrective action would be employed once spills or leaks were detected. However, the lubricant use and disposal is overseen by the maintenance department, not the process operating department. The ISO 14000 would not identify the department or process responsible for lubricant requirements.

Some lubricant also remains on the finished product as it moves through the machine. This lubricant is removed from the product prior to the next step of manufacturing in a cleaning step, which occurs at a different facility operated by a different department in a different business unit. The cleaning step results in an oily water waste that must be treated prior to discharge. In the next process, the cleaning step is an integral part of the process line. However, the department and business unit operating the line incurs the cost of operating the equipment, of purchasing cleaning solution, and of treating wastewater generated from the cleaning step.

Again, the ISO work practices would describe the tasks for treating the wastewater generated from the cleaning step at this facility. But since the ISO systems would be implemented at each individual facility, no link would be made between the operations as the first facility and the second. Objectives to minimize the waste from the cleaning process may only consider methods that can be implemented within the cleaning process, not changes in the product itself since the true source of the lubricant is not identified. Changes to either process depend on communication between personnel at the two facilities. With different ISO 14000 procedures for project review, this may be difficult.

### 4.2.5 Wastewater Treatment – Long Term Planning

Company X generates wastewater of various types at several locations at the large facility and treats the effluent in a central processing facility prior to discharge. Various departments and processes generate the wastewater eventually sent to the central treatment facility. Two departments are involved with the wastewater treatment process directly. The laboratory department monitors and tests the outfall, and the maintenance department is responsible for upkeep of equipment. One of the contaminants of the wastewater is below the permit level as it is now written, but the State agency for environmental protection has informed the company that it intends to lower the maximum contaminant level an order of magnitude in two years.

An existing ISO system would include procedures for operating the wastewater treatment facility, monitoring the contaminant level of the outfall, and making sure measurement equipment is accurate. If the only option is to improve the wastewater treatment technology, the ISO system would provide for reviewing the project for new environmental impacts of the eventual finished process. Once the contaminant level changes, documentation in the ISO system would need to undergo several changes – work practices for the treatment facility updated, regulatory documentation updated, measuring equipment reassessed or recalibrated, etc.

However, implementing improved wastewater treatment technology may not be the only possibility; but the ISO system does not provide for the organization to clearly assess alternatives for reducing contaminants below the new lower level. The ISO EMS does not provide a means to evaluate the current effluent characteristics and determine the required change to meet the new regulated levels. The mixed wastewater streams do not identify the specific process or processes that are generating the contaminants so that reduction or elimination at the source could be investigated. The ISO procedures would not necessarily consider communication among the departments contributing to the effluent to find the optimal solution. Finally, if major changes to the wastewater treatment facility are needed to accommodate the new technology changes, the ISO review process does not capture the potential impacts from these initial activities, for example, the impacts of construction.

#### 4.2.6 Life Cycle Analysis – Organizational Decision Making

At Company X, each business unit operates its processes so that the business unit is profitable while meeting internal and external customer demands. A finished product customer has set specifications for the characteristics of the materials and description of the product desired. To meet these specifications, additional processing of the material must be completed before forming the final product. The additional processing will remove impurities in the material to improve its overall properties. The additional processing can be done at any of the four manufacturing stages prior to final forming, and it is somewhat more efficient technically if completed at an earlier stage. Each of the four manufacturing stages is operated by a different, independent business unit. The additional processing will result in a additional costs – processing costs, as well as treatment and disposal of the impurities. The additional costs would be passed on to the customer (or business unit). All downstream customers do not require these strict material specifications, but if extra material were processed to meet the specifications, the increased quality of the product may interest other customers and reap additional revenues.

In a traditional EMS structure, especially one that is implemented independently at different facilities, organization-wide issues are difficult to assess. In this case, if each facility has an ISO 14000 EMS, each business unit has an interest in passing the impurities onto the next business unit. The next customer would then have to address the removal of the materials and how to dispose of them, and the associated project reviews and changes to the documentation of the existing ISO system. Since the business unit at the end of the chain in the organization is the one ultimately required to provide the finished product to customer specifications, that business unit will independently make a decision to process their raw material accordingly, or request higher specification product from its supplying business unit. This decision-making process will continue through each business unit. However, the organization may benefit from assessing the issue as a whole and determine which business unit is best capable of completing the processing and dealing with the wastes. This requires information about the operations and environmental implications of each business unit to be communicated to a higher management level for additional consideration.

### 4.2.7 Regional Planning

Company X is headquartered in a large metropolitan area, but its facilities are scattered across the U.S. and the world. One facility, from which most of these examples are taken, is located in the Northeastern United States, in a urban community and draws workers from the surrounding small towns up to an hour away. The facility in area is quite large, almost equal to the remainder of its municipality. It borders the river from which the facility draws water and which serves as a drinking water source for the local communities. Rail lines run through the facility for transportation of raw materials and finished goods, and nearby state-maintained highways carry heavy-truck traffic to the facility throughout the day. The urban area has no other major manufacturing company, but support services such as schools and hospitals are other major employers. The facility falls with city and county boundaries which control the transportation systems, emergency response personnel, and municipal services such as drinking water, sewage, and garbage disposal. The state oversees environmental requirements of the facility, including wastewater treatment at public treatment works and air emission permitting.

A regional planning commission has been established to address economic, social, and environmental issues of the area. Three states are involved to some degree, with 20 counties participating in discussions and sending representatives to the commission. Issues of greatest concern include economic development and quality of life, enticing more companies with high-paying permanent jobs to the area, and establishment of green space boundaries to maintain the forested areas and waterways.

First, the ISO EMS may not recognize environmental impacts that occur indirectly, and external to the facility, such as emissions from truck and rail transportation. Second, ISO 14000 has a requirement about communicating with external parties, but only requires that communication regarding the EMS contain consistent messages. It does not specify what information, if any, should be shared with the community, although requirements of regulations would be a top priority. So, for example, information on hazardous substances would be shared with emergency planning teams. Finally, on a wider scale, the issues of the regional planning commission are environmental impacts outside the scope of the usual facility EMS. The extent to which an ISO 14000 would identify or support the regional planning commission is unknown.

### 4.2.8 Discussion of Case Studies

These examples indicate the lack of business-oriented concern in the ISO EMS framework. The source of environmental impact is not always associated with a specific process or product. The EMS does not consider costs of activities with environmental aspects, or communicating the costs to decision makers. The documents cannot specify how departments or business units with individual business goals will work together to find solutions with "global" optima. The system does not anticipate future regulations that will require major technological innovation. Monitoring only requires that end-of-pipe systems work properly, not that incoming waste is minimized. Communication of environmental performance outside the facility is not required. An approach to environmental management without a concern for the business objectives of the organization will fail in these capacities. The model EMS considers the business needs along with the environmental performance needs.

## 4.3 Evaluating EMS from a Policy Perspective

This final section considers the ISO 14000 framework in relation to other environmental regulations and voluntary initiatives. Since ISO 14000 is voluntary, organizations must consider if it is the right choice to address environmental impacts, or if other initiatives are better, or if simply adhering to requirements of existing laws is sufficient. This section considers aspects of the TRI reporting regulation, and two voluntary environmental approaches - the 33/50 Program and WasteWise. A brief overview of each program is provided considering four business aspects – motivation, operating requirements, performance measures, and impacts on environmental performance.

### 4.3.1 Toxics Release Inventory Reporting

TRI reporting has been a regulatory requirement for manufacturing sectors for more than ten years, and the program is expanding to include other industry sectors such as electricity generation and mining. Reports cover operations at the facility level – all operations that use or generate the toxic materials at a single operating location. Each calendar year, a facility must report on the amounts of toxic chemicals released, transferred, or treated as waste from the facility. Reporting consists of completing a 5-page form for each chemical which has been identified as toxic and which meets the reporting use thresholds. The form includes information on releases of the material, transfers to treatment or recycling (and details on the type of treatment or recycling), and forecasts for future years.

The information is compiled by the EPA and the total toxics released and managed for each facility is available for public review. The lag between reporting year and publication is 2 years. At the start of the regulatory program, publication of the facility data drew intense media coverage, as local communities knew for the first time what toxics were present in their neighborhoods. Public interest waned in later years, although when the new information is released media coverage is seen[3]. In initial years of the regulation, reductions in chemical releases were high, down 10% after the first year of reporting, and down 13% in the third year. In more recent years, the decrease in releases has been lower, in the 3% to 5% range. From 1996 to 1997, the total chemical releases actually increased by 2% (EPA TRI Explorer 2000).

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[3] A search of major newspapers for TRI data release announcements and local evaluations reveals articles only during the two months following the initial data release for a given year.

### 4.3.2 33/50 Program

The 33/50 Program was a five-year initiative from 1990 to 1995 to reduce releases of 17 toxic chemicals, all of which were on the TRI list of chemicals (EPA 1999a). The goal was to reduce releases in the first 2 years by 33% over the baseline year, and in the last three years by 50%. The program targeted big polluters to join, but participation was voluntary. For industries, the activities for the 33/50 Program were a subset of the activities for TRI. The program targeted a small subset of chemicals across a facility. Companies were able to follow their own timeframes and technology choices to reduce releases. Companies were asked to pledge commitment to the program and set individual goals for reduction, but additional data requirements did not exist. The program used annual TRI reporting to assess the results. Widespread recognition of the program outside the EPA was limited, although progress reports profiled firms and their initiatives to reduce releases. Firms were able to indicate that they were participating in the program. The program was successful, and reached its final 50% reduction goal one year early. Table 4-1 compares the reductions in chemicals on the TRI list that were and were not targeted by the 33/50 Program. During the existence of the 33/50 Program, chemicals targeted by the program were reduced at twice the rate of chemicals not in the program. Also, after the end of the program, reductions in the 33/50 chemicals continued while reductions in all other chemicals hardly decreased.

**Table 4-1. Percent reduction in releases & transfers of TRI chemicals in the 33/50 Program**

| Time Period | All TRI Chemicals | TRI Chemicals not included in 33/50 | TRI Chemicals included in 33/50 |
|---|---|---|---|
| 1988-1990 | -14.7% | -14.3% | -15.4% |
| 1990-1995* | -33.2% | -25.3% | -46.9% |
| 1995-1996 | -3.2% | -0.04% | -10.7% |

***Period of 33/50 Program. Source: EPA 1999a.**

### 4.3.3 WasteWise

The WasteWise program targets non-hazardous waste generation including packaging waste, office paper and cardboard, and yard trimmings (EPA WasteWise 2001). The program is applicable to small firms, municipalities, and large corporations with multiple locations. Participants commit to the program for three years, establishing waste reduction goals and goals for purchasing or manufacturing products with increased recycled content. A participant is requested to focus on only three major waste areas during the program, limiting the scope of the efforts. The data requirements are minimal and include three items – a registration form with facility identifying information, goals identification form to be completed within 6 months of joining, and an annual report describing the progress made toward the goals. Companies are permitted to use the WasteWise logo for internal and external company use to advertise their participation. Firms are also eligible for EPA awards recognizing efforts in reducing waste. Since the program began in 1994, 35 million tons of waste have been removed from the waste stream or recycled, with current levels at 9 million tons annually (EPA 2000), or approximately 4% of the average annual municipal waste stream of 220 million tons (U.S. Census Bureau 2000).

### 4.3.4 ISO 14000 Environmental Management System

The ISO 14000 environmental management system framework aims to capture all environmental impacts of a facility. While only a few issues may be targeted for reduction, most frameworks require that all environmental issues be recognized. ISO documentation is extensive, with strict requirements for maintaining revisions of procedures. Data requirements are not strictly established, and regular data collection may not occur. Objectives and targets are unique to each facility and can address any type of environmental aspect. Companies may approach environmental issues (whether for reduction or correction) within their own schedule and technology capabilities. Initial time and effort to produce these documents is extensive. Annual management reviews are required, but no set format is required. ISO itself does not certify or register facilities to the ISO 14000 standard and does not recognize companies that have been certified or registered by a third party. Facilities are able to advertise certification to the standard, although official logos may only designate the third-party registrar and may not be used on products. Within the business sector, ISO 14000 is recognizable as the international EMS framework. The impact of ISO 14000 on environmental performance is not fully understood at the current time.

### 4.3.5 Discussion of Policy Issues

Table 4-2 summarizes the four programs across the four aspects of motivation, operating requirements, performance measures, and impact on environmental performance. The ISO 14000 framework differs from the other three programs on all counts. Motives to implement are often customer, not regulatory, driven, and publication of certification is limited. The scope encompasses the entire facility and all environmental aspects. Performance measures are not consistent across firms hampering comparisons among facilities. Finally, the impact on environmental performance has not been verified.

**Table 4-2. Summary of characteristics of various environmental initiatives.**

| Program | Motivation | Operating Requirements | Performance Measures | Impact on Environmental Performance |
|---|---|---|---|---|
| **TRI** | federal regulatory requirement, information available to public, media exposure identifies poor performers | facility scope, 600 chemicals, annual 5-page form | total toxic chemical releases, transfers, treatment | reductions in total weight over years but efforts decreasing |
| **33/50** | information available to public, participation can be advertised by organization | facility scope, 17 chemicals already regulated and reported under existing regulations | subset of total toxic chemical releases | larger reductions in total weight than for non-targeted chemicals even after end of program |
| **Waste Wise** | participation can be advertised by organization using program logos, awards given to superior participants, applicable to wide range of facilities and industries | three self-selected waste types, 5-page annual report | amount of solid waste diverted | significant reductions in solid waste generation |
| **ISO 14000** | registrar logos, participation can be advertised by organization using third-party logos, customer requirement for business | facility scope, all environmental impacts, extensive documentation | unique to facilities | unknown |

Other studies of organizational reaction to voluntary environmental initiatives have similar results. Labatt and Maclaren (1998) found that threat of regulations, public image, financial considerations, and peer pressure motivated the decision to participate in a voluntary initiative. Videras and Alberini (2000) gauge the participation in voluntary environmental programs. Firms are more likely to participate in initiatives sponsored by regulatory agencies if the firm publishes an environmental report. This may signal a need to participate simply to have material for the report and not to find environmental performance improvements. A second report found the following common factors of success for voluntary, non-regulatory initiatives (Yachnin et al. 2000):

- performance measures tied to environmental objectives,
- clear accountability mechanisms,
- specific performance objectives and provisions for monitoring and reporting,
- clear communication to all stakeholders,
- clear roles and responsibilities for all stakeholders,
- realistic expectations,
- incentives tied directly to motives,
- transparent decision making processes.

The ISO 14000 EMS lacks the nearly all these factors. Overall, careful consideration should be given to whether implementation of an ISO 14000 environmental management systems is a worthwhile undertaking.

## 4.4 Conclusions

Many limitations prevent ISO 14000 from being an effective EMS. First, establishing such a system is an immense undertaking and maintaining the requirements demands considerable resources, especially for smaller organizations. The tasks do not directly have an impact on environmental performance, but only establish procedures for activities that could have an impact on environmental performance. Applying the requirements to real industrial situations demonstrates that the framework encourages consistent operations, not change, and encompasses no measures for decision making that could cause change. Finally, considering the other options for focusing on environmental performance improvement that have been proven to be effective, the ISO system shares none of the important characteristics that can make it an effective program.

ISO 14000 is expected to be a management system. But a management system is used to make decisions for the direction of an organization, and this is where the ISO framework fails. The critical factors found lacking in ISO 14000 within each discussion above are simplicity and outcome measures. The current ISO framework is too complicated and process-oriented to create an effective system. ISO does not establish consistent, long-term, ambitious goals that can impel organizations to truly improve environmental performance. Safety, which has received the attention of management, has focused on the two characteristics of simplicity and outcome measures. The example of safety as a basis for the new model EMS is discussed next. The new model EMS developed by this research attempts to capture these characteristics as well. The new model EMS must bear in mind the resources for implementation and maintenance and must consider the generation of outcome measures that can be used for decision making

# Chapter 5 The Example of Safety

This chapter examines the role of safety in organizations and management, and how safety can provide an example for environmental management. First, environmental issues and safety are often at the same group in an organizational structure. Safety issues and environmental issues share the same sources, so this joint approach makes sense. However, safety is more closely linked with cost and operational impacts than environmental issues are. And, data collection and reporting of safety information is quite different from that of environmental information. These aspects of safety management can be used as basic characteristics for the new environmental management system.

## 5.1 Organizational Structure of Environmental, Health, and Safety in Firms

Most firms place the responsibilities for environmental, health, and safety issues within the same line of authority. At lower levels, within facilities, individuals in Environmental, Health, and Safety (EHS) Departments are charged with tasks related to industrial hygiene, personal protection equipment, training, spills, recordkeeping and reporting for emissions, permits, or accidents and related compliance issues. Some personnel may also provide assistance with process and product environmental issues during various stages. Environmental management system implementation and operation often falls to individuals in EHS departments. These individual departments are usually supported by (and report to) a corporate level directorate that oversees environmental and safety issues at all locations. Many firms have a position with environmental and safety charge at the vice-presidential level or on the board of directors (Karliner 1997).

The reason for this organizational structure is the interrelationship among environmental, health, and safety issues and concerns. In many cases, a problem in one area will have an impact in the others. Materials use is one example. Generation of hazardous materials by a process is an environmental issue – records of generation, transfer, and disposal must be kept and reported. At the same time, the materials can cause health problems for workers if they are not cautious when handling the materials or not wearing proper protective clothing. Another example is dangerous conditions in a facility, such as leaking equipment. The mechanical problem can result in injuries or illnesses from falls, or the problem may result uncontrolled spills of material that become an environmental issue. Major accidents at a facility, such as pipe bursts or fires, or catastrophic events inevitably result in combinations of environmental, health, and safety problems. Most OSHA and EPA regulations are based on health issues, either of workers within a facility or of society in general. The processes regarding compliance and treatment of environmental, health, and safety issues then naturally fall under the same branch in organizational structure.

Given this link between environmental and safety issues, one would expect that the management focus on the two topics would be similar. Decisions to correct a safety problem would likely have some effect on an environmental problem. However, organizations have shown increased emphasis on safety issues and safety awareness in the past. Four aspects of safety management are discussed in detail here – the impact on operations, impact on personnel, reporting and recordkeeping, and outcome measures. Each aspect encourages safety to be a priority of management focus. In comparison, environmental issues are not often characterized or handled in a similar manner, which may explain why the concentration in environmental areas may be a lower priority.

### 5.2 Impact on Operations

Costs and profit are crucial business factors, and safety is an outside issue that can have quite an impact on both. Directly, the level of safety performance within a company determines the cost of worker's compensation insurance. As a firm's safety record improves, premiums to cover workers in cases of injury or illness go down. Other direct costs include treatment of workers for injury or illness on site, as well as paperwork requirements for insurance claims. These costs can be attributed to the overall safety record of a firm; reductions in safety incidents lead directly to lower operating costs.

Beyond these direct costs, safety incidents can result in increased costs in other areas internal to the firm. Safety incidents have an impact on productivity levels and costs of operation. If an injury or illness is serious, a worker may be absent from work or may require temporary reassignment. Costs of replacement workers must be considered, and the lost productivity from an absent worker or an untrained replacement are real as well. Safety incidents can lead to a shut down in operations, temporarily or longer-term. If a safety incident is the result of mechanical problems or hazardous conditions, problems must be corrected. Unscheduled maintenance of machinery or non-process related repairs (e.g., adding railings to walkways to prevent falls, or replacing furniture to provide a more ergonomic workstation) are indirect costs of safety problems. Major incidents that garner headlines in the news can also damage a firm's reputation. Further expenses must be allocated to marketing for damage control.

Safety performance can also influence liability costs. Whether it is firm liability or personal liability, both of which can lead to criminal or civil penalties, safety problems can result in high costs that motivate management to avoid and prevent dangerous situations. Overall, the total costs of safety incidents is overwhelming. Since the costs are obvious in many cases, action is taken to reduce safety problems and thus reduce the costs of the consequences.

As discussed in the introductory chapter, costs are not as clearly linked with environmental issues. Many costs are hidden in overhead accounts or considered merely a cost of doing business. Liability insurance for potential future remediation may deter only poor waste management practices, not generation of waste. Clearly identifying the costs of hazardous materials handling, waste disposal, or end-of-pipe treatment technology will reflect the growing importance of environmental issues in business strategy and decisions. Linking environmental issues to costs should be a top priority of environmental management systems. Specifying targets and compensation within an EMS provides concrete values to be achieved.

## 5.3 Impact on Personnel

The impact of poor safety and health management is directly reflected on employees across an organization. Workers who have been injured or who have become ill due to workplace incidents experience costs. Lost work or reassignment may reduce wages. Pain and suffering are difficult to assign costs, but real costs are experienced there as well. Workers in all industries in all positions have an reason to act safely and responsibly – to avoid being injured themselves. A level of risk is accepted with every job, and some compensation for accepting risk is apparent in the wages paid. Since the costs are obvious in many cases, employees are self-motivated to act responsibly and safely. Personal protection is likely the strongest incentive for good safety performance. Management compensation is often linked to safety performance as well. With fewer incidents, upper level management is rewarded – essentially sharing in the money "saved" from dealing with problems.[4] So, even upper-level employees have an incentive to minimize problems across the organization.

Authority to promote and protect safety is available at various levels throughout a firm at a personal level. Workers have authority to stop working when an incident occurs, whether they themselves are harmed or it is another worker that needs assistance. Many workers are trained to assist in cases of emergency – assisting in evacuation, providing medical treatment, or fighting fires. They have authority vested in them by management to perform duties outside their normal responsibilities and alleviate or reduce the severity of safety problems. In addition, industrial and trade unions have spearheaded efforts to identify workplace hazards and institute reforms (Conway and Svenson 1998). The backing of union support increases the authority of individual workers on suggesting change and improvements.

Other aspects of regular job tasks relate the importance of safety to personnel. Training is provided from the start of a new job regarding the safety and risks associated with a workplace. When performing tasks, safety equipment is worn to prevent injuries from occurring. Working conditions are modified to reduce hazardous situations. Posters, signs, and announcements are constant reminders of the risks involved and each

[4] Conway and Svenson (1998) note that management bonuses tied to safety rates may unintentionally promote underreporting of injury and illness.

worker's responsibility. The personal nature of safety incidents is an influence on the attention received by management.

Environmental management must also be supported with incentives and authority. While the same level of personal incentive may not be achieved with environmental issues, enhancing awareness of environmental burdens can help improve performance. Management compensation should be tied to environmental performance as safety performance is. Environmental management systems should include methods to promote understanding and consequences of activities that harm the environment and the local community. For example, an EMS could require posters or training sessions that relate potential chemical spills to water contamination and lower quality waterways for recreation, directly relating the impacts of environmental burdens to impacts on worker's lives outside the facility. This personal responsibility toward environmental impacts can help lead toward improvements.

## 5.4 Reporting and Recordkeeping

Safety records are collected and filed on a facility basis. Currently, two forms are required – OSHA Number 101 Supplementary Record Occupational Injuries and Illnesses and OSHA Number 200 Log and Summary of Occupational Injuries and Illnesses.[5] The accompanying instructions outlines which incidents are considered reportable, provides classifications and definitions of injuries and illnesses, and gives instructions and examples for completing the forms.

[5] OSHA has revised recordkeeping requirements starting in the 2002 reporting year. The changes are not substantive in content, but are adjustments in form (paper size, readability, clearer definitions and examples). The new form numbers are 300 for the Log, 300A for the Summary, and 301 for the Incident Report.

OSHA Form 101 records specific information about an incident that resulted in an injury or illness. The form includes employer and employee identifying information and the location of the incident. More importantly, the form asks three specific questions about the incident:

- What was the employee doing when injured?
- How did the accident occur?
- Name the object or substance which directly injured the employee.

The form thus records the activities taking place, events that occurred or objects that were involved to lead to an incident, or tools or equipment or materials that caused an injury or illness. The injury or illness is directly related to a specific part of the organization's operations.

OSHA Form 200 records general information for each incident resulting in an injured or ill employee over the course of a calendar year. Set in a tabulated form, each line classifies a case as a fatality, or an injury or illness and the associated work restrictions. The form can be reviewed easily and areas with recurring problems clearly identifying the process, material, or activity that is causing the incidents. Totals for each sheet, and for each year, can easily be summed. Totals for a calendar year must be posted publicly at a facility for one month. This summary information, along with estimates of the total full-time employee numbers for a facility, are used in providing injury and illness rate data to regulators.

Considering the forms and information required, the collection of health and safety data is relatively simple. Two forms are required, and the content of the form has not changed for at least 10 years. In addition, other forms, reports, or documentation are acceptable as records for OSHA if they contain all the relevant information. For example, if an insurance claim form is also used by the company when an incident occurs, it may be substituted for OSHA forms, further simplifying paperwork. Companies may even list the information on a plain sheet of paper.

Gathering the information will typically take only a short time. For either form, completing a response is estimated to take approximately 15 to 20 minutes. The information is available by speaking with the person involved in the incident, or perhaps to a co-worker in addition. No specialized knowledge is required to define health conditions (burns, strain, cough, etc.). Follow-up is necessary to assure that the final "extent or outcome" of the injury or illness is recorded. For example, if an injury first only requires medical treatment, but subsequently the worker lost days away from work, the record must be updated to indicate the change in condition.

Records must be made within 6 days of an incident, allowing flexibility in gathering data. The task can be completed once per work week rather than as incidents occur. For some industries, the completion of the form is a regular process given the occurrence of incidents. Consider SIC 3711 Motor Vehicles and Passenger Car Bodies and data from the 1998 reporting year. For the entire sector, the rate of injuries and illness per 100 full-time equivalents was 23.9, while employment was 345,000. That results in approximately 80,000 individual incidents per year for the industry. Assuming 1,500 individual facilities in the sector results in approximately 55 cases per year at a given facility, or about one every five days. The completion of the information is routine and regular; a weekly activity throughout the year.

Recordkeeping and reporting for environmental regulations is much more complex and time consuming. Requirements exist for different media and different materials, resulting in numerous forms to be completed. Specific knowledge of the processes may be necessary in some cases. For example, the TRI form requires estimates of the efficiency of treatment processes. The data may be scattered over various locations. Completing the forms takes much longer. The estimated time to complete the TRI form for a single chemical is 52 hours. The auto assembly industry averages 18 chemicals per year, so the total time to complete the forms is about 6 months of a full-time worker. The various data are also collected at various intervals. Some emissions are constantly monitored but reported only monthly; others are reported annually or biannually.

Data requirements are another area where environmental management can adopt practices of safety management. While specific information requests of government agencies cannot be controlled by firms, an EMS can be designed to ease the recordkeeping and reporting burdens. An EMS can request continual logging of process and product data to make environmental issues a regular concern. An EMS can make use of existing data collection activities to supplement datasets.

## 5.5 Outcome Measures

More important than the ease of completing reports is the type of data that is collected. The safety incident record form includes information on the activities of workers, the tools or materials involved, and reasons for the accident. The availability of causal information is invaluable to both the firm and regulatory agencies. The detail allows an employer to quickly pinpoint areas in a facility where dangerous situations occur, job tasks that put employees at high risk, and objects or substances that are resulting in injuries and illnesses. As they are fulfilling regulations by completing the forms, employers can see what they might work on to prevent the same problem happening in the future. Likewise, regulatory agencies can target similar hazards across industries and focus research and correction in these areas to benefit a greater number of workers.

Overall safety performance is based on the total recordable cases of occupational injury and illness as reported by OSHA. Firms submit a summary of incidents based on the rate of injury and illness experienced per 100 full-time workers. Published in the annual *Occupational Injuries and Illnesses: Counts, Rates, and Characteristics*, OSHA provides incidence rates for occupational injuries and illness in several categories across industry. The categories include total cases and lost workday cases, and data is given for 2-digit and 4-digit SIC groups. These are the main metrics used to compare industries and individual facilities with respect to safety performance. OSHA uses the metrics to target industries for inspection and compliance assistance. Firms use the metrics to benchmark their facilities against the average firm in their sector. Groups use incidence rates of injuries to judge their overall safety performance.

These injury and illness rates are a relative estimate of safety and are somewhat comparable across industries and facilities of different scope and size. For example, an industry sector such as SIC 29 Petroleum and Coal Products had a injury and illness rate of 3.9 incidents per 100 full-time workers in 1998 while SIC 37 Transportation Equipment had a rate of 14.6 incidents per 100 full-time workers in the same year. This indicates that workers in auto assembly plants are at higher risk for an injury than workers at a oil refining facility. But these data are not perfect metrics of safety within a facility or organization.

First, the rates do not distinguish between job types within an industry (e.g., within the mining industry a machine operator and a clerical worker have very different safety risks). Second, the rates do not indicate the level of severity of an incident (e.g., a fall could result in an injury as mild as a minor bruise or as serious as quadriplegia). Third, the rates do not quantify the impact on work (e.g., an ankle sprain may cause a worker to miss a day of work, while carpal tunnel syndrome may result in a worker being reassigned to different duties). Fourth, the data are self-reported, which can lead to underreporting at the facility level to improve the facility's overall safety rate. Finally, illnesses due to occupational exposures are much more difficult to identify. The cause of an illness may not initially be connected to workplace conditions, or may have a delayed onset and is not recognized as caused by the workplace.

Improvements in environmental management could result in following the data collection of safety management. First, the source of waste or emissions is not often included on environmental forms. The processes or materials generating the waste cannot be clearly identified. Second, a set of related outcome measures that can be applied to all industry sectors is not available. Instead, the environmental data are specific to media and materials. Neither government agencies nor organizations themselves have the information to make comparisons and identify problems. The safety measures demonstrate that while the measures do not fully capture the impacts and consequences of safety incidents, they can be beneficial in guiding decision makers to make improvements. An environmental management system should tackle these issues by including causality in records and establishing a comparable outcome measure.

### 5.6 Safety In Practice

This section reflects on safety management within Company X, the model for the case studies in the previous chapter. Company X is a company that prides itself on its past safety performance. Their rate of injuries, illnesses, and fatalities worldwide is far below the U.S. national average, even in comparison to industry sectors considered to be quite safe. In 1989, six core values of the firm were established, and safety and health was one of them.[6] The other core values were integrity, quality and excellence, people, profitability, and accountability. Safety and health of workers and the communities in which Company X worked is a top priority of doing business. The core values were distributed to employees, then the corporate management provided films, training sessions, and departmental meetings to further educate the workforce. Soon after, Company X included application of these core values in evaluating employees and daily operations. The safety record of the firm is highlighted in the financial Annual Report as an essential business element.

Company X has set a goal of an injury-free workplace, and follows general safety procedures throughout its facilities to achieve this goal. Within manufacturing facilities, safety equipment is mandatory at all times for workers and visitors. Safety statistics and posters are highly visible throughout. Even in non-manufacturing spaces, the company places a priority on safety. At the start of meetings with non-company personnel, announcements are made as to what signals may be heard in case of an emergency and

[6] The core value of safety and health was later amended to environment, safety and health.

what to do when they are heard. Company X has established exposure levels for certain contaminants below regulated levels based on current information on the contaminants' potential health effects. When OSHA began to include repetitive stress injuries as reportable injuries, facility management did not implement corrective action until executive management indicated that the injuries would count against their performance and compensation.

The company has created a real-time safety data system to convey safety information across the firm. The system communicates facts about safety incidents and provides instruction on corrective actions that should be taken both at the site where the incident occurred, and other sites where the same hazard may exist. This safety data system prevents similar accidents from happening across different locations. A second computer management system monitors the occupational health of employees worldwide. The system gathers information on employees worldwide to provide data to focus a long-term health strategy, to assess exposure limits, and to check hearing and heat stress levels.

Company X extends this desire for good safety performance beyond its doors. When building a new office complex, the senior management of Company X required the subcontractors on the construction site to follow additional safety regulations. For example, steel workers were required to wear harnessing equipment at all times while on floors without completed floor surfaces. Additional barriers were requested during phases of the project when floors of the building were incomplete and could lead to a fall to a lower level by any of the workers. The cost of the steel structure for the building was increased by 5% due to the added safety measures required of the constructions crews.

No fatalities and few injuries were recorded over the life of the project. The requirements that Company X established are now being considered as standards for all construction sites.

Although Company X is not ignoring environmental issues, they have not seen the same emphasis as safety issues. The safety issues are clearly linked to both cost of operations and compensation. All work areas are considered equal in having an impact on safety, and communication of hazards and prevention is immediate. The emphasis even extends to external issues. The safety management system is based on one overreaching goal – zero workplace injuries. This measure is evaluated regularly and guides decisions at all levels of the organization.

### 5.7 Conclusions

Worker safety and health issues have been associated within common groups in organizational structures with environmental issues. Environmental, health, and safety departments are charged with overseeing concerns in these areas which are connected by cause and effect. But safety management receives different emphasis. Safety performance is linked to business aspects such as costs and incentives that promote better performance. With a personal consequences at stake, employees take responsibility for promoting a safe and healthy workplace. Management is intent on reducing safety incidents, which leads to a focus on safety awareness at all levels. Safety reporting and records also identify safety problems to ease correction. An important factor in safety management is the availability of a consistent, comparable outcome measure. These characteristics of safety management should be applied to environmental management systems. Safety management is a mandatory task for firms – making a profit at the expense of worker well-being is unacceptable in most firms, thus safety is a high priority. The same is not true of environmental management issues. A model EMS must work to bring greater awareness and responsibility of environmental issues to all workers so that they become a top priority as well.

# Chapter 6 A New Model for Environmental Management

The previous chapters have built a case for changing existing environmental management systems. As shown in Chapter 1, organizations currently have environmental management systems segregated from core business strategy and decisions. Chapter 2 described common EMS frameworks that are procedural based – defining work activities so as to prevent deviations from proper tasks – and that have little weight in organizational decision making. A statistical analysis in Chapter 3 provides evidence that firms with ISO 14000 certification do not change their level of environmental burden. Chapter 4 provided examples of real-life scenarios to demonstrate that the ISO framework is static in nature and does not provide the necessary information to facilitate change that can improve environmental performance. Finally, in Chapter 5, the ties of environmental management with safety, although strong in organizational structure, are shown to be weak with regard to organizational culture, but safety provides a starting point for change. In this chapter, a model environmental management system is created, one that can provide management with information to help with decisions related to environmental issues.

Generally, organizations (or individual facilities) do not have formalized safety management "systems." However, based on regulations and common sense, processes are followed or materials are purchased, training is provided, and records are kept, made public, and filed with government agencies on a regular basis. The activities are accomplished regardless of the type of operations within the organization. The impetus behind this is the common outcome measures of safety, injuries per 100 full-time equivalents, for example. The common measures facilitate data collection at various levels of the organization, identify problem areas for management, allow employee performance to be evaluated, and fulfill government regulations for recordkeeping and reporting. The measures are not without their limitations. The extent of the injury is not equal nor is the overall risk to various employees alike. But the measures are relevant and useful to decision makers in an organization, guiding decisions towards improvements in safety.

An argument for relevant management systems is provided by Johnson and Kaplan (1987). Financial accounting and the requirements of regulators have lead organizations to build financial systems only to meet reporting obligations. The information from these system is also provided to management for guiding day-to-day operations. However, the data are too late, incorrectly aggregated, and imprecise for management to make proper decisions about how to operate the organization. Johnson and Kaplan stress that relevant and useful financial measures should be collected even if they are solely used for management to run the organization and not required by regulators. In later work, Kaplan and Norton (1996) expand this strategy to include non-financial measures to adequately describe the performance of a firm and help guide decisions. These arguments are the foundation for the model environmental management system.

Environmental issues affect the bottom-line of organizations. As such, organizations must manage their environmental impacts and managing means making decisions to reduce those impacts and their associated costs. Making decisions about environmental impacts requires information on the impacts themselves, as well as related costs, operations, materials, labor, and customers. Pertinent and useful information related to environmental impacts must be gathered, analyzed, and disseminated to organizational decision makers. An environmental management system, then, should make this possible.

## 6.1 Environmental Performance Outcome Measures

A first step in developing an environmental management system is to decide on specific outcome measures for environmental impacts. The outcome measures provide the basis for management to evaluate performance and implement change to make improvements. The outcome measures should be chosen based on the goals of the organization with regard to environmental issues. For some organizations, the measures may focus on compliance only; for others, the measures may move the organization beyond compliance, toward minimizing environmental impacts cost-effectively. Each organization will need to consider individually what outcome measures provide the relevant information that is necessary to best meet its priorities and fairly represent its operations. However, regardless of the final aspects to be measured, some common criteria should be considered when developing outcome measures.

First, the outcome measure should reflect environmental burdens that can be changed by management decisions. Establishing a measure that is beyond the control of decision makers restricts the capability for improvement. Consider energy consumption as an example. Total energy consumption may be difficult to reduce without significant technological changes that cannot be immediately justified due to their cost. However, the type of energy utilized by the firm likely can be changed to include more renewable sources. A switch to renewable energy sources reduces the overall environmental burden of an organization, even though reductions in pollutants may not occur at the facility itself. At the same time, the change would not have major impacts on costs. Focusing the outcome measures on aspects that management can control, allows specific parts of the operations to be targeted for change.

Next, measures should be linked to the source of environmental burden, either a process or product. Safety records identify the cause of an injury (fall, chemical exposure, etc.), and likewise environmental measures should identify the source of pollution (painting operations, raw material packaging, etc.). The link to a cause will assist decision makers in targeting actions for change so that impacts are reduced, not shifted to other media or transferred to other processes. Consider the objective for paint shop emissions set by Ford Motor Company discussed in Chapter 3. The aim is to reduce paint shop emissions to $60 g/m^2$. The metric provides no insight as to the specific source of the emissions (paints, solvents, cleaners, etc.) or the specific operation (preparation, painting, curing, etc). The metric also does not indicate the product at the core of the operations, although presumably the denominator refers to square meters of painted surface area. Converting this figure to "grams of a specific pollutant per vehicle painted" provides a quantitative outcome measure that is clearly linked to the source of the burden.

Next, the measures must be normalized to reflect the existing operating conditions. In a facility of 30 part-time workers, 10 injuries pose much larger risk than 10 injuries in a facility of 3,000 over-time workers. Similarly, a facility that produces 10,000 vehicles and one million pounds of toxic waste is having a much greater impact than a facility that produces the same amount of waste for 100,000 vehicles. For the environmental outcome measures, the normalizing factor must take into account some level of production that is directly related to the environmental burden. The total number of units produced, or the amount of raw material as inputs, have an impact on the resulting waste or emissions. Financial measures should be avoided for normalizing factors as they do not adequately reflect the level of production but instead prices related to labor and capital.

The measures must address needs at various organizational levels. Process or product level data allow managers to pinpoint specific attributes of these items for changes. Facility level data allow comparison between similar facilities, to identify lagging facilities and initiate technology transfer from locations with superior performance. Facility level data that assesses environmental and health risks can be shared with employees and community members. Aggregating data from across the organization, the total environmental impact of the organization can be estimated and communicated to shareholders, government agencies or environmental groups. As such, privacy issues must be considered when developing outcome measures.

Finally, the measures should be monitored and reported regularly and frequently. Repeated calculation places emphasis on the environmental impacts and encourages attention to them. The constant reminder of environmental performance can help change the organizational culture to one that is continuously striving for improvement. Using the outcome measures as a way of evaluating employee work performance further emphasizes the concern for environmental issues and can help motivate employees to act responsibly and initiate improvements.

The range of possible environmental outcome measures is wide, but these criteria provide a guide to developing specific measures for organizations. Some possible measures are:

- weight of materials received / weight of product shipped,
- weight of waste generated (gaseous, liquid, & solid) / weight of product shipped,
- amount of energy consumed / weight of product shipped,
- cost of materials handling (including labor) / units of product shipped,
- cost of waste disposal (including labor & materials) / units of product shipped,
- capital dollars on end-of-pipe treatment systems,
- expenditures on remediation of contaminated sites,
- number of chemicals reported to TRI,
- number of air and water permit applications submitted,
- social costs of environmental burdens.

Any specific outcome measure will have limitations. All factors of environmental impact, such as human health and ecological impacts, cannot be incorporated into a single measure. The risk of various wastes or emissions may be difficult to aggregate, for example toxic versus hazardous versus non-hazardous solid wastes have different risks. Adding units of production from facilities producing different products is difficult as well. The span of the impact may be local, such as water contamination, or global, such as climate change. The safety measures used by organizations and regulators have similar limitations, but as consistent, comparable outcome measures, they are effective in identifying problems. The point is to identify a small set and begin to use them, realizing the imperfections and uncertainty. The measures can be a basis for further investigation and analysis of how the organization functions. Within an organization, the measures will guide decisions, and outside an organization the measures will communicate the level of performance. Several independent groups have recommended environmental performance indicators for organizations (Schulze 1999, GRI 2001) although a single measure has not gained consensus. These environmental performance indicators are geared for external evaluation of a firm and not necessarily for firms themselves to make decisions as to how to operate. An EMS based on outcome measures can help to identify indicators that can be useful to both organizations and external stakeholders.

### 6.2 Implementation and Operation of the Model EMS

Two criticisms of previous EMS frameworks were the extensive documentation and difficulty in scaling the system. My recommended model EMS overcomes both of those drawbacks. Implementation of an EMS of this sort can be done using existing data collection and analysis systems within organizations. In many cases, data that can be used to calculate environmental performance measures may not be items typically associated with environmental burden, but are readily available. For example, weights of raw materials and product shipments are typically available on invoices. Likewise, costs of materials, wastes, and products are already included in accounting systems. These materials handling and accounting systems simply need to be linked to the environmental management system information.

An advantage for larger firms is the prevalence of enterprise resource planning (ERP) systems. ERP systems are used to collect, manage, and report data at various levels of the organization. The systems often include data related to environmental impacts (Scheer 1998), however data must be identified and assembled into useful analyses and reports. Extending ERP systems to functionality for environmental management systems is logical. One such framework for adapting ERP systems for life cycle assessment and product stewardship efforts has been identified (Januschkowetz 2001), and this framework can be further developed to encompass EMS as shown in Figure 6.1.

The left side of the figure depicts the existing architecture for ERP systems, with three levels of administration. The operational system assembles data from various organizational functions into the system. The tactical system links the data across functions for facility and lower management decisions. The strategic system further aggregates the data for organizational decisions. The environmental systems can be imbedded in this existing system, as shown by the shaded boxes. The right column details the data requirements, functions, and reporting that can then be completed at the three levels. Again, the existing ERP system is not reorganized, environmental information is simply included and linked to existing information.

Smaller firms are less likely to have such robust ERP systems in place, but the EMS can be easily scaled to their needs. The criteria for establishing the measures consider the applicability of environmental outcome measures to firms of various sizes. Smaller firms can select fewer measures to reduce the burden of data collection and analysis, yet still identifying problem areas that need to be addressed. Smaller firms may have an advantage in that the outcome measures can be more focused and specific to their operations since the level of aggregation is minimal. Similarly, the EMS can be implemented in organizations across different industry sectors, including service industries. The outcome measures can be developed to reflect the environmental impacts and production (or service) level of their specific operations.

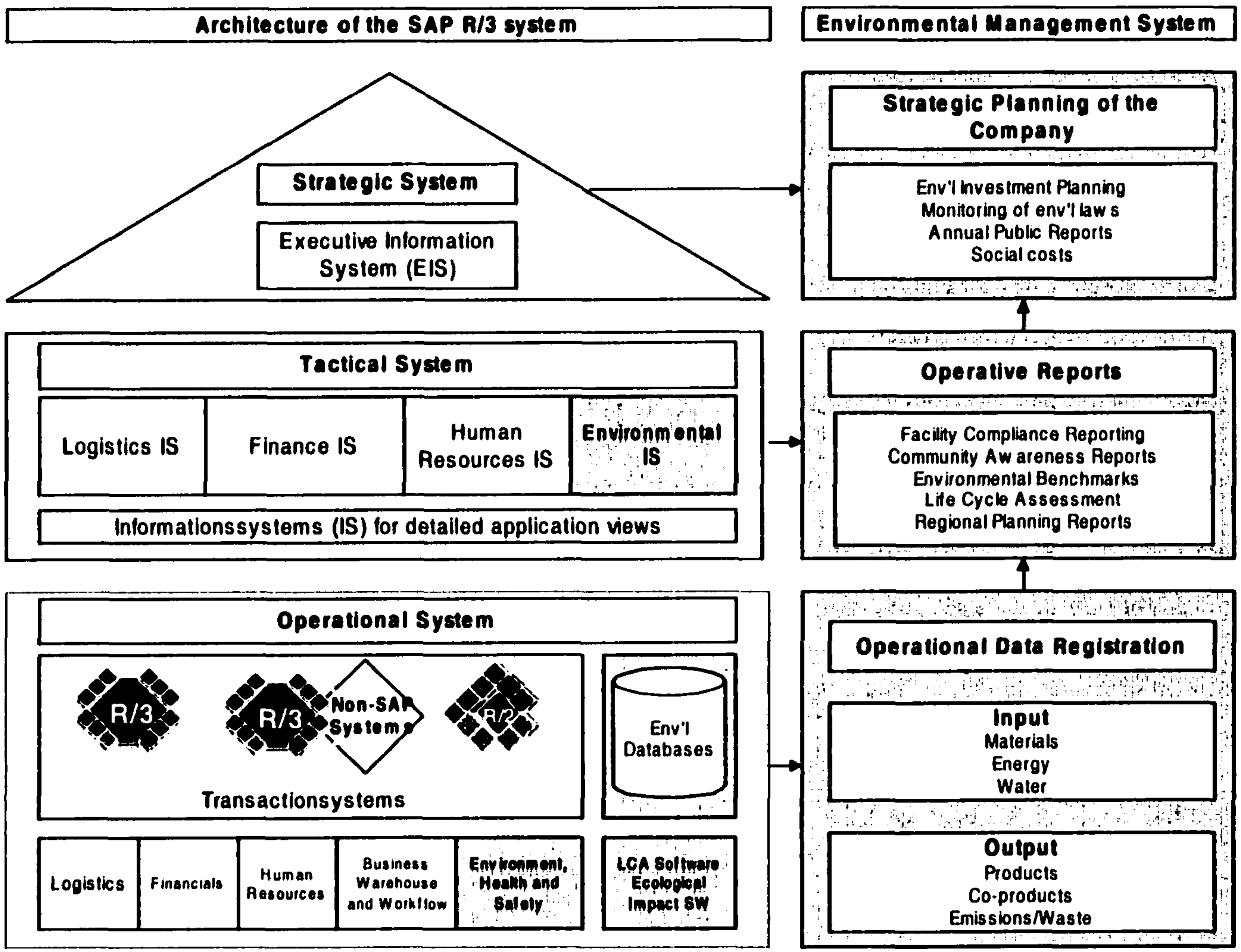


**Figure 6-1. Model environmental management system within an enterprise resource system (Januschkowetz 2001)**

For facilities that have an environmental management system in place, the model EMS can easily by incorporated into the organization. Facilities certified to ISO 14000 do not need to give up on the system, simply augment the framework with additional data collection and analysis. ISO 14000 certified firms have already identified a range of environmental impacts that can be used as the basis for developing outcome measures. The review of the system can be modified to assess performance against the outcome measures.

## 6.3 Conclusions

This research emphasizes a need to redefine environmental management systems to be more effective for organizations. The model EMS is intended to serve as a system for distributing information to organizational decision makers so that changes in environmental impact can be made. The outcome measures at the core of the model EMS focus attention on the source of environmental impacts at various levels. The measures can capture impacts that effect operations and activities within the plant, or impacts to the community and environment outside the facility.

An EMS of this type can also benefit organizations if environmental regulators adopt the model for policy. As with safety data, regulators could define a small set of outcome measures for facilities to report. The results could be aggregated at the industry level and made public. Organizations could easily compare their own facilities to industry averages to determine if they are leading or lagging. Industry sectors with high impacts would be identified for attention from regulators. The general public could estimate the burden from local industries. All of this would be accomplished without additional burden on the organization to collect additional environmental information.

While the model EMS is developed with organizational performance in mind, any change on environmental burdens will only be the result of organizations supporting the system. Organizations must recognize that improving environmental performance and reducing environmental burdens is a priority and put some authority behind the system. Linking the measures to employee or business unit performance evaluations and compensation brings additional attention to environmental issues as a business factor. The model EMS does not constitute a stopping point for environmental management in organizations. Instead, it should act as a starting point to guide organizations, regulators, and the public, in discovering environmental impacts and their sources and making decisions to reduce them.

# Chapter 7 Conclusions

This research assesses environmental management systems in relation to facility-level performance and provides a framework for improving them. Chapter 1 puts the work into the context of current organizational design showing that environmental issues are external to core business strategies. Environmental management systems, as described in Chapter 2, are seen as a means to address environmental impacts, but the effect of EMS on environmental performance has not been completely assessed.

Chapter 3 provided an initial assessment, with results that demonstrate firms with ISO 14000 certification tend to manage more toxic waste, are just as likely to be out of compliance with air permits, and generally have more safety violations than firms without the system in place. The evaluation is broadened in Chapter 4 to consider the business perspective of ISO 14000. The assessment indicates that business outcome measures are not incorporated into the standard, which limits decision making that could change environmental impact. Safety management provides an example to follow, as discussed in Chapter 5. The clear, frequent measurement of safety information, and its relationship to business factors such as cost, have put safety in the eye of management.

The final result, presented in Chapter 6, is a new model for environmental management systems that attempts to resolve the shortcomings in existing structures. The model EMS is a system focused on outcome measures. With carefully chosen outcome measures, organizations can effectively address environmental impacts. The model is built on accessible data and reporting mechanisms, minimizing the burden of the implementation and allowing adoption by a wide range of organizations.

This research focused only on firms in manufacturing industries, and only on U.S. firms. But the results can be extended outsides these boundaries. Other manufacturing industries are likely to be experiencing similar problems with ISO 14000 or other process-based environmental management systems. The model EMS, with outcome measures focuses on the specific operations of an industry, can help improve those systems, and guide organizations in various sectors toward better environmental management.

Likewise, the common EMS have been adopted by industries and organizations in numerous countries, and the effectiveness of the system is likely the same. The model EMS can easily be adopted by organizations in other countries. Likewise, the growing globalization of organizations means that environmental management will need to span international boundaries. The model EMS can incorporate measures that can be aggregated various organizational levels, including national levels.

The new EMS model strives to consider overall business management in line with environmental concerns in order to have an impact. Unlike other discussions of EMS in the literature, this research is not concerned with the issues of what drives organizations to adopt management systems. Instead, the research focuses on how the systems are working once they are in place, and what value a system can provide to an organization.

Future work as an extension of this research includes several items. First is enhancing the analytical model to incorporate additional environmental data and industries. Next is further development of the outcome measures. Implementation is another aspect, specifically the use of enterprise resource planning systems as a vehicle for the EMS, scalability to organizations of different size, and overall data availability issues. Finally, a goal is to see the model system implemented and operated in an organization to identify how environmental management data can support decision making.

# Appendix A

## Examples of Corporate Environmental Policy

**Health and Environmental Policy of Ford Motor Company**
Sustainable economic development is important to the future welfare of Ford Motor Company, as well as to society in general. To be sustainable, economic development must provide for protection of human health and the world's environmental resource base. It is Ford's policy that its operations, products and services accomplish their functions in a manner that provides responsibly for protection of health and the environment.

Ford is committed to meeting regulatory requirements that apply to its businesses. With respect to health and environmental concerns, regulatory compliance represents a minimum. When necessary and appropriate, we establish and comply with standards of our own, which may go beyond legal mandates. In seeking appropriate ways to protect health or the environment, the issue of cost alone does not preclude consideration of possible alternatives, and priorities are based on achieving the greatest anticipated practical benefit while striving for continuous improvement.

Ford's policy of responsibly protecting health and the environment is based on the following principles:

Protection of health and the environment is an important consideration in business decisions. Consideration of potential health and environmental effects - as well as present and future regulatory requirements - is an early, integral part of the planning process. Company products, services, processes and facilities are planned and operated to incorporate objectives and targets that are periodically reviewed so as to minimize, to the extent practical, the creation of waste, pollution, and any adverse impact on health and the environment.

Protection of health and the environment is a company-wide responsibility. Management of each activity is expected to accept this responsibility as an important priority and to commit the necessary resources. Employees at all levels are expected to carry out this responsibility within the context of their particular assignments and to cooperate in company efforts.

The adoption and enforcement of responsible, effective, and sound laws, regulations, policies and practices protecting health and the environment are in the company's interest. Accordingly, we participate constructively with government officials, interested private organizations, and concerned members of the general public toward these ends. Likewise, it is in our interest to provide timely and accurate information to our various publics on environmental matters involving the company.

(http://www.ford.com/)

**Alcoa Environmental, Health and Safety Policy**

EHS VALUE
We will work safely in a manner that promotes the health and well-being of the individual and the environment.

EHS POLICY
It is Alcoa's policy to operate worldwide in a safe, responsible manner which respects the environment and the health of our employees, our customers and the communities where we operate. We will not compromise environmental, health or safety values for profit or production. All Alcoans are expected to understand, promote and assist in the implementation of this policy and the accompanying principles.

EHS PRINCIPLES
In support of Alcoa's Environmental, Health and Safety Policy, the following principles have been developed to provide additional direction on accountability and on specific issues.

**We are all accountable for conforming with the EHS Policy.** Each employee, including contractor employees, is responsible for working in a manner that respects the health and safety of the individual and the environment. Such behavior is a requirement of the workplace. Line management, beginning with the CEO, is specifically accountable for assuring compliance with the EHS Policy.

**We will work diligently to prevent all incidents.** Alcoa believes that all incidents, including illnesses, injuries, spills and excursions, whether immediate, latent or cumulative, can be prevented. Line management is responsible for providing a workplace that is designed to be free of incidents, and all employees must contribute to this goal. Alcoa will sponsor environmental, health and safety training to equip employees with the skills necessary to prevent incidents.

**We will practice sound environmental, health and safety management.** Alcoa will integrate environmental, health and safety management fully with business and operating management to ensure that long-term and short-term environmental, health and safety issues are considered, together with market and economic aspects, when decisions are made regarding new and existing facilities, processes, products, services, acquisitions and divestitures. We are committed to continual improvement in all aspects of our environmental, health and safety performance.

**We will comply with all applicable laws, regulations and permits, and will develop and employ more restrictive internal standards where necessary to conform with Alcoa's EHS Policy.** We will anticipate environmental, health and safety issues, work with government officials and others to develop fact-based and reasonable laws, regulations, standards and protocols, and take appropriate actions which may precede laws or regulations. Alcoa will challenge inappropriate laws, regulations and standards when information and data are available to support Alcoa's position.

**We will audit our operations and report findings.** Alcoa will audit each of its operations on a regular basis to identify strengths and weaknesses of the location's environmental, health and safety management processes and plans and to identify actions that need to be taken to prevent environmental, health and safety problems or correct deficiencies. Appropriate management, which may include the Alcoa Board of Directors, will be informed of the audit findings.

**We will sponsor activities to improve the science of environmental, health and safety protection.** Alcoa will sponsor and conduct research and development, including the application of emerging technologies, to improve our ability to predict, assess, measure, reduce and manage the environmental, health and safety impacts of our operations and our products.

**We will report on our activities.** Alcoa will communicate promptly and openly with individuals and communities regarding the environmental, health and safety aspects and impacts of our operations, as well as with concerned parties who request such information. Alcoa will also provide an annual Environmental, Health and Safety report that describes our programs, plans and performance. The report will be made available to shareholders and the public.

**We will support sustainable development, the responsible use of natural resources and energy conservation.** Alcoa will incorporate sustainable development into our operations by integrating environmental, health and safety considerations into all relevant business decisions. We will achieve cleaner production through programs of waste minimization and pollution prevention, including product recycling with specific and measurable reduction targets. We will utilize the best available information to plan and execute all projects that involve extraction of raw materials, or which may restrict the use of natural resources or impact ecosystems. Alcoa will strive to maximize efficient energy use, conserving non-renewable resources.

**We will supply safe and reliable products and services.** Alcoa will take all reasonable precautions to assure that the products and services that Alcoa supplies to its customers are consistent with the EHS Policy. Customers will be provided complete and accurate product information.

(http://www.alcoa.com/common/assets/pdf/EHSpolicy.pdf)

**United States Postal Service Environment Management Policy**

Our Environmental Mission

The United States Postal Service is committed to provide employees and customers with a safe and healthy environment. Environmental protection is the responsible thing to do and makes for sound business practices.

In 1993, the United States Postal Service (USPS) launched an effort to integrate environmental decision making into daily operations. The Seven Guiding Principles were published, and an Environmental Strategic Plan was drafted to carry out the initiatives set forth by the Seven Guiding Principles.

Seven Guiding Principles

We will meet or exceed all applicable environmental laws and regulations in a cost-effective manner.

We will incorporate environmental considerations into our business planning processes.

We will foster the sustainable use of natural resources by promoting pollution prevention, reducing waste, recycling, and reusing materials.

We will expect every employee to take ownership and responsibility for our environmental objectives.

We will work with customers to address mutual environmental concerns.

We will measure our progress in protecting the environment.

We will encourage suppliers, vendors, and contractors to comply with similar environmental protection policies.

(http://new.usps.com/cgi-bin/uspsbv/scripts/content.jsp?B=-10455&R=10767)

# Appendix B

# Examples of EMS Frameworks

## ISO 14000 Environmental Management System

**4.1 General Requirements** – Describes the requirements for an organization to establish and maintain an EMS that follows the standard

**4.2 Environmental Policy** – Requires development of an environmental policy appropriate for the organization, and demonstrating commitment to improvement and compliance. The policy must be documented, reviewed by management, communicated to the public, and available to the general public.

**4.3 Planning**

**4.3.1 Environmental Aspects** – Establishes mechanisms to identify elements of an organization's activities, products, or services that can interact with the environment, and attach a level of significance of the environmental impact to those aspects in a structured and logical way.

**4.3.2 Legal and Other Requirements** – Determines knowledge of applicable environmental laws, codes, practices in industry sector.

**4.3.3 Objectives and Targets** – Sets an objective and target for control and minimization of environmental aspects.

**4.3.4 Environmental Management Programs** – Allocates responsibilities and resources and sets time scales for activities that have been planned and for new activities to be subject to the EMS.

**4.4 Implementation and Operation**

**4.4.1 Structure and Responsibility** – Assigns duties and responsibilities of specific personnel, and designates representatives who are responsible for the EMS operation.

**4.4.2 Training, Awareness, and Competence** – Defines mechanisms for increasing awareness of environmental aspects and impacts. Identifies training needs and measures success of training. Provides awareness of consequences if personnel fail to follow procedures.

**4.4.3 Communications** – Calls for internal and external communication, including receiving, documenting, and responding to external communication.

**4.4.4 Environmental Management System Documentation** – Demonstrates the existence of the program through the core elements and their interactions.

**4.4.5 Document Control** – Maintains organization of documents to identify location, review cycle, current versions, and authorizes control of documentation.

**4.4.6 Operational Control** – Documents activities considered significant that require control and communicate the relevant procedures to employees, contractors, and suppliers.

**4.4.7 Emergency Preparedness and Response** – Identifies potential risks, potential for harm, and plans to mitigate harm in response.

**4.5 Checking and Corrective Action**

**4.5.1 Monitoring and Measurement** – Provides detail for regular monitoring and measuring key characteristics of operations and activities, including maintenance and operation of reliable measuring equipment.

**4.5.2 Nonconformance and Corrective and Preventive Action** – Define responsibility and authority for evaluation of nonconformance, actions taken for immediate treatment, and actions for prevention.

**4.5.3 Records** – Describes system for maintaining records of measuring, monitoring, auditing, etc., as separate from documents (4.4.5) that define procedures.

**4.5.4 Environmental Management System Audit** – Establishes the procedure and frequency of planned assessments of conformance of the system to the standard.

**4.6 Management Review** – Requires top management to review periodically to determine suitability, adequacy, and effectiveness.

International Organization for Standardization (ISO). 1996. *ISO 14000 Series in Environmental Management Systems.* Geneva: International Organization for Standards.

Woodside, G. and P. Aurrichio. 2000. *ISO 14001 Auditing Manual.* New York: McGraw-Hill.

**U.S. Environmental Protection Agency Compliance-Focused Environmental Management System**

**1. Environmental Policy**

a. This policy, upon which the EMS is based, must clearly communicate management commitment to achieving compliance with applicable federal, state, and local environmental statutes, regulations, enforceable agreements, and permits (hereafter, "environmental requirements") and continuous improvement in environmental performance. The policy should also state management's intent to provide adequate personnel and other resources for the EMS.

**2. Organization, Personnel, and Oversight of EMS**

a. Describes, organizationally, how the EMS is implemented and maintained.

b. Includes organization charts that identify units, line management, and other individuals having environmental performance and regulatory compliance responsibilities.

c. Identifies and defines duties, roles, responsibilities, and authorities of key environmental program personnel in implementing and sustaining the EMS (e.g., could include position descriptions and performance standards for all environmental department personnel, and excerpts from others having specific environmental program and regulatory compliance responsibilities).

d. Includes ongoing means of communicating environmental issues and information to all organization personnel, on-site service providers, and contractors, and for receiving and addressing their concerns.

**3. Accountability and Responsibility**

a. Specifies accountability and responsibilities of organization's management, on-site service providers, and contractors for environmental protection practices, assuring compliance, required reporting to regulatory agencies, and corrective actions implemented in their area(s) of responsibility.

b. Describes incentive programs for managers and employees to perform in accordance with compliance policies, standards and procedures.

c. Describes potential consequences for departure from specified operating procedures, including liability for civil/administrative penalties imposed as a result of noncompliance.

**4. Environmental Requirements**

a. Describes process for identifying, interpreting, and effectively communicating environmental requirements to affected organization personnel, on-site service providers, and contractors, and ensuring that facility activities conform to those requirements. Specifies procedures for prospectively identifying and obtaining information about changes and proposed changes in environmental requirements, and incorporating those changes into the EMS.

b. Establishes and describes processes to ensure communication with regulatory agencies regarding environmental requirements and regulatory compliance.

**5. Assessment, Prevention, and Control**

a. Identifies an ongoing process for assessing operations, for the purposes of preventing and controlling releases, ensuring environmental protection, and maintaining compliance with statutory and regulatory requirements. This section shall describe monitoring and measurements, as appropriate, to ensure sustained compliance. It shall also include identifying operations and waste streams where equipment malfunctions and deterioration, operator errors, and discharges or emissions may be causing, or may lead to: (1) releases of hazardous waste or other pollutants to the environment, (2) a threat to human health or the environment, or (3) violations of environmental requirements.

b. Describes process for identifying operations and activities where documented standard operating practices (SOPs) are needed to prevent potential violations or pollutant releases, and defines a uniform process for developing, approving and implementing the SOPs.
c. Describes a system for conducting and documenting routine, objective, self-inspections by department supervisors and trained staff, especially at locations identified by the process described in a. above.
d. Describes process for ensuring input of environmental requirements (or concerns) in planning, design, and operation of ongoing, new, and/or changing buildings, processes, maintenance activities, and products.

**6. Environmental Incident and Noncompliance Investigations**

a. Describes standard procedures and requirements for internal and external reporting of potential violations and release incidents.
b. Establishes procedures for investigation, and prompt and appropriate correction of potential violations. The investigation process includes root-cause analysis of identified problems to aid in developing the corrective actions.
c. Describes a system for development, tracking, and effectiveness verification of corrective and preventative actions.
d. Each of these procedures shall specify self-testing of such procedures, where practicable.

**7. Environmental Training, Awareness, and Competence**

a. Identifies specific education and training required for organization personnel, as well as process for documenting training provided.
b. Describes program to ensure that organization employees are aware of its environmental policies and procedures, environmental requirements, and their roles and responsibilities within the environmental management system.
c. Describes program for ensuring that personnel responsible for meeting and maintaining compliance with environmental requirements are competent on the basis of appropriate education, training, and/or experience.

**8. Environmental Planning and Organizational Decision-Making**

a. Describes how environmental planning will be integrated into organizational decision-making, including plans and decisions on capital improvements, product and process design, training programs, and maintenance activities.
b. Requires establishing written targets, objectives, and action plans by at least each operating organizational subunit with environmental responsibilities, as appropriate, including those for contractor operations conducted at the facility, and how specified actions will be tracked and progress reported. Targets and objectives must include achieving and maintaining compliance with all environmental requirements.

**9. Maintenance of Records and Documentation**

a. Identifies the types of records developed in support of the EMS (including audits and reviews), who maintains them and where, and protocols for responding to inquiries and requests for release of information.

b. Specifies the data management systems for any internal waste tracking, environmental data, and hazardous waste determinations.

**10. Pollution Prevention Program**

a. Describes an internal program for preventing, reducing, recycling, reusing, and minimizing waste and emissions, including procedures to encourage material substitutions. Also includes mechanisms for identifying candidate materials to be addressed by program and tracking progress.

**11. Continuing Program Evaluation and Improvement**

a. Describes program for periodic (at least annually) evaluation of the EMS, including incorporating the results of the assessment into program improvements, revisions to the manual, and communicating findings and action plans to affected employees, on-site service providers, and contractors.

b. Describes a program for ongoing evaluation of facility compliance with environmental requirements, and should specify periodic compliance audits by an independent auditor(s). Audit results are reported to upper management and potential violations are addressed through the process described in element 6 above.

**12. Public Involvement/Community Outreach**

a. Describes a program for ongoing community education and involvement in the environmental aspects of the organization's operations and general environmental awareness.

Sisk, S. W. 1997. *Compliance-Focused Environmental Management System – Enforcement Agreement Guidance*. EPA 330-9-97-002R. Washington, DC: U.S. Environmental Protection Agency.

**Eco-Management and Audit Scheme**

**Council Regulation 1836/93**
**Annex 1. Environmental management systems**

The environmental management system shall be designed, implemented and maintained in such a way as to ensure the fulfillment of the requirements defined below.

**1. Environmental policy, objectives and programmes**
The establishment and periodic review, and revision as appropriate, of the company's environmental policy, objectives and programmes for the site, at the highest appropriate management level.

**2. Organisation and personnel**
Responsibility and authority - Definition and documentation of responsibility, authority and interrelations of key personnel who manage, perform and monitor work affecting the environment.

Management representative - Appointment of a management representative having authority and responsibility for ensuring that the management system is implemented and maintained.

Personnel, communications and training - Ensuring among personnel, at all levels, awareness of:

(a) the importance of compliance with the environmental policy and objectives, and with the requirements applicable under the management system established;
(b) the potential environmental effects of their work activities and the environmental benefits of improved performance;
(c) their roles and responsibilities in achieving compliance with the environmental policy and objectives, and with the requirements of the management system;
(d) the potential consequences of departure from the agreed operating procedures.

Identifying training needs, and providing appropriate training for all personnel whose work may have a significant effect upon the environment.

The company shall establish and maintain procedures for receiving documenting and responding to communications (internal and external) from relevant interested parties concerning its environmental effects and management.

**3. Environmental effects**
Environmental effects evaluation and registration - Examining and assessing the environmental effects of the company's activities at the site, and compiling a register of those identified as significant. This shall include, where appropriate, consideration of:

(a) controlled and uncontrolled emissions to atmosphere;
(b) controlled and uncontrolled discharges to water or sewers;
(c) Solid and other wastes, particularly hazardous wastes;
(d) contamination of land;
(e) use of land, water, fuels and energy and other natural resources;

(f) discharge of thermal energy, noise, odour, dust, vibration and visual impact;
(g) effects on specific parts of the environment and ecosystems.

This shall include effects arising or likely to arise, as consequences of:

1. Normal operating conditions;
2. abnormal operating conditions;
3. incidents, accidents and potential emergency situations;
4. past activities, current activities and planned activities.

Register of legislative, regulatory and other policy requirements - The company shall establish and maintain procedures to record all legislative, regulatory and other policy requirements pertaining to the environmental aspects of its activities, products and services.

**4. Operational control**

Establishment of operating procedures - Identification of functions activities and processes which affect, or have the potential to affect, the environment, and are relevant to the company's policy and objectives.

Planning and control of such functions, activities and processes, and with particular attention to:

(a) documented work instructions defining the manner of conducting the activity, whether by the company's own employees or by others acting on its behalf. Such instructions shall be prepared for situations in which the absence of such instructions could result in infringement of the environmental policy;
(b) procedures dealing with procurement and contracted activities, to ensure that suppliers and those acting on the company's behalf comply with the company's policy as it relates to them;
(c) monitoring and control of relevant process characteristics (e.g. effluent streams and waste disposal)
(d) approval of planned processes and equipment;
(e) criteria for performance which shall be stipulated in written standards.

Monitoring - Monitoring by the company of meeting the requirements established by the company's environmental policy, programme and management system for the site; and for establishing and maintaining records of the results. For each relevant activity or area, this implies:

(a) identifying and documenting the monitoring information to be obtained;
(b) specifying and documenting the monitoring procedures to be used;
(c) establishing and documenting acceptance criteria and the action to be taken when results are unsatisfactory;
(d) assessing and documenting the validity of previous monitoring information when monitoring systems are found to be malfunctioning.

Non-compliance and corrective action - Investigation and corrective action, in case of non-compliance with the company's environmental policy objectives or standards, in order to:

(a) determine the cause;
(b) draw up a plan of action;
(c) initiate preventative actions, to a level corresponding to the risks encountered;
(d) apply controls to ensure that any preventative actions taken are effective;
(e) record any changes in procedures resulting from corrective action.

**5. Environmental management documentation records**
Establishing documentation with a view to:

(a) present in a comprehensive way the environmental policy, objectives and programme;
(b) document the key roles and responsibilities;
(c) describe the interactions of system elements.

Establishing records in order to demonstrate compliance with the requirements of the environmental management system, and to record the extent to which planned environmental objectives have been met.

**6. Environmental audits**
Management, implementation and review of a systematic and periodical programme concerning:

(a) whether or not environmental management activities conform to the environmental programme and are implemented effectively;
(b) the effectiveness of the environmental management system in fulfilling the company's environmental policy.

European Commission. 1993. *Eco-Management and Audit Scheme Council Regulation (EEC) No 1836/93.* Brussels.

# Appendix C

## Ford Motor Company's ISO 14001 Environmental Management System Workbook

The Ford Motor Company's ISO 14000 EMS Workbook has been made available on-line to assist suppliers in implementing the standard. The manual includes guidance and sample forms Ford used in implementing its own EMS. Listed below are the main sections available in the workbook. The elements followed by an asterisk are included in this appendix.

Section 1 - ISO 14000 Overview Presentation (general description of ISO 14000, elements of the standard, and getting started in implementing the standard)

Section 2 - Launch Document and Implementation Tools (guides for introducing the implementation process, gaining management support, flowcharts and schedule for proceeding)

Section 3 – EMS Manual Template (defines the scope of the Environmental Management System (EMS) and provides a linkage of system documents to the various elements of the ISO 14001:1996 standard)

- Appendix A - Policy
- Appendix B - Aspects, Objectives & Targets
- Appendix C - Legal & Other Requirements *
- Appendix D - Management Programs
- Appendix E - Structure & Responsibilities
- Appendix F - Training Matrix
- Appendix G - Master Document List
- Appendix H - Master Records List
- Appendix I - Procedures
  - Ep-001 Formatting Procedures *
  - Ep-002 Aspects
  - EF-002.01 Aspects Form *
  - EF-002.02 EMP Form
  - Ep-003 Audits
  - EF-003.01 Internal Audit Checklist form
  - EF-003.02 CAR form
  - EF-003.03 CAR LOG form
  - EF-003.04 Audit Schedule form
  - Ep-004 Corrective Actions
  - Ep-005 Management Review *
  - EF-005.01 Sign In Sheet form
  - Ep-006 Emergency Response
  - Ep-007 Regulations & Other *

Ep-008 Review of Projects *
EF-008.01 Project Environmental Checklist *
Ep-009 Agency Approvals
Ep-010 Communications *
EF-010.01 External Communications Log
Ep-011 Contractor Control
EF-011.01 Briefing Packet & Method Statement
Ep-012 Document Control
EF-012.01 Master Document List Form
Ep-013 Records
EF-013.01 Index of Environmental Records form
Ep-014 Training
EF-014.01 Training Needs Matrix - Courses form
EF-014.02 Training Needs Matrix – Procedures form
Ep-015 Monitoring & Measurement
Appendix J - Work Practices
EWP020.01 Refrigeration Equipment
EWP023.01 Waste Drums *
EWP024.01 Bulk Loading *

Pennsylvania Department of Environmental Protection (PADEP). Ford Motor Company ISO 14001 Environmental Management System Workbook. Posted October 2000. Accessed March, 2001. <http://www.dep.state.pa.us/dep/deputate/pollprev/iso14001/ford_manual/fordmanual.htm>

## Environmental Legal Requirements (portions)

| ASPECT | REQUIREMENT | CITATION/SOURCE |
|---|---|---|
| Material Usage | Hazardous Substances and Reportable Quantities (CERCLA) | 40 CFR Part 302 |
| | Hazardous Chemical Reporting: Community Right To Know (SARA Title III) | 40 CFR Part 370 |
| | Toxic Chemical Release Reporting: Community Right To Know (SARA Title III) | 40 CFR Part 372 |
| Air Emissions | Air Quality (CAA) | 40 CFR Parts 50-61 |
| | CFC Containing Equipment | 40 CFR Part 82 |
| | State Air Permit #8580 | State Act 336 Part 2 |
| Stormwater Discharges | Discharge of Oil | 40 CFR Part 110 |
| | Spill, Pollution Control and Countermeasures | 40 CFR Part 112 |
| | Water Discharge Permits | 40 CFR Part 122 |
| | Test Procedures for Analysis of Pollutants | 40 CFR Part 136 |
| | State Stormwater Permit #8585 | State Act 246 Part 2 |
| | City Water & Sewerage Permit #123 | City Ordinance 65 |
| Wastewater Discharges | State NPDES Wastewater Permit #8587 | State Act 225 Part 6 |
| Other | Environmental Management Systems | ISO 14001:1996 |
| | Ford Restricted Substance Management Standard WSS-M99999-A1 | Addresses chemicals and material involved in products or services delivered to Ford and identifies those considered either restricted or prohibited |
| | Ford Worldwide Design Standard 00.00D28 Complete Vehicle Recycling | Outlines the requirements for developing and implementing recycling strategies and technologies |
| | Production, Non-Production and Post-Production Material Procedure, Ford Automotive Procedure 03-132 | Outlines the material approval process prior to bringing materials into Ford facilities |

# EP-001 Formatting Environmental Procedures, Work Practices & Forms

**1.0 Purpose/Scope**

This procedure defines the format to be used in creating *Facility/Plant Name* environmental procedures (EPs), environmental work practices (EWPs) and forms (EFs).

The control of these documents is addressed in environmental procedure EP-016 (Environmental Document Control).

**2.0 Activities Affected**

All

**3.0 Forms Used**

None

**4.0 References**

ISO 14001:1996, Element 4.4.5

**5.0 Definitions**

None

**6.0 Exclusions**

None

**7.0 Procedure**

7.1 Environmental Procedures shall:

a) have a unique reference number in the bottom corner of the page in the format "EP-###" where:
EP = *Facility/Plant Name* Environmental Procedure identifier
EP-### = Environmental Procedure Number and each # is a digit.

b) be paginated in the format "Page # of #" in the bottom center of the page.

c) be dated as per date of issue/revision in the bottom corner of the page.

d) have a title at the top of the page

e) have the following sections:
1.0 Purpose/Scope
2.0 Activities Affected
3.0 Forms Used
4.0 References
5.0 Definitions
6.0 Exclusions
7.0 Procedure
8.0 General Rules

9.0 Records
Record of Revisions

7.2 Environmental Work Practices shall:

a) have a unique reference number in the bottom corner of the page in the format
"EWP-###" where:
EWP = *Facility/Plant Name* Environmental Work Practice identifier.
EWP-### = Environmental Work Practice Number, each # is a digit.

b) have a title at the top of the page.

c) be paginated in the format "Page # of #" in the bottom center of the page.

d) be dated as per date of issue/revision in the bottom corner of the page.

e) be written in whatever form is considered to be appropriate to the operational circumstances.

7.3 Environmental Forms shall:

a) have a unique reference number in the bottom corner of the page in the format
"EF-###.##" where:
EF = *Facility/Plant Name* Environmental Form identifier.
EF-###.## = Environmental Form Number, each # is a digit.

b) have a title at the top of the page

c) be paginated in the format "Page # of #" in the bottom center of the page.

d) be dated as per date of issue/revision in the bottom corner of the page.

e) be written in whatever form is considered to be appropriate to the operational circumstances.

## 8.0 General Rules

None

## 9.0 Records

None

## Record of Revisions

| Revision Date | Description | Sections Affected |
|---|---|---|
| | | |

# EF-002.01 Aspects Form

**Example No. 2**
**Environmental Aspects, Objectives & Targets Determination**

Environmental Audit Report:
Privileged Document

Form Completed by: **Jane Doe**
**Department/Area:** Engine Assembly

Date Completed: **9/24/99**
**Process/Activity:** All

| **Aspect Identification** | | **Significance** | | **Objectives & Targets** | |
|---|---|---|---|---|---|
| **Category*/ Aspect** | **Quantity / Volume** | **Rationale for Significance / Nonsignificance**** | **S/NS***** | **Objective** | **Target** |
| **AIR EMISSIONS** | | | | | |
| Maintenance paint spray booth exhaust | | R | S | Maintain compliance to regulations.<br>Upgrade maint. Paint booth exhaust system | On-going<br>6/98 |
| Air discharge from air scrubber at waste treatment | | NS | NS | | |
| **WASTEWATER DISCHARGE** | | | | | |
| Sanitary sewage discharge to city | | R | S | Maintain compliance to permits for life of permits.<br>Investigate low flow shower heads | On-going<br>1/99 |
| **LIQUID &SOLID WASTES** | | | | | |
| Waste gasoline gen. By hot test, dyno, ind. Garage, & tank farms | | R | S | Maintain compliance to hazardous waste regulations | On-going |
| Cartridge filters | | NS | NS | | |
| **MATERIAL USE** | | | | | |
| Hydraulic, lube oil usage | | NS | NS | | |

*Aspect Categories: Air Emissions, Wastewater Discharges, Liquid & Solid Wastes, Energy Use, Storm Water Discharges, Water Use, Storage Tanks, Material Usage, Noise, Odor, Natural Environment, Land Condition

**Rationale for Significance/Non-Significance: R = Regulated/Other Req., A = Accidental Release, E = Energy, L = Environmental Load, NS = Does not meet significance criteria

***Abbreviations: S = Significant & NS = Not Significant

# EP-005 Environmental Management System Management Review

## 1.0 Purpose/Scope

This procedure defines the process for the periodic review and evaluation of the *Facility/Plant Name* environmental management system by the Facility/Plant Management Team, to ensure its continuing suitability, adequacy and effectiveness.

## 2.0 Activities Affected

All areas and departments

## 3.0 Forms Used

Attendee Sheet

## 4.0 References

4.1 EP-002 Environmental Aspects, Objectives and Targets, and Management Programs

4.2 EP-003 Environmental Management System and Regulatory Compliance Audits

4.3 EP-004 Nonconformance and Corrective and Preventive Action

4.4 EP-007 Environmental Regulations and Other Requirements

4.3 EP-015 Monitoring and Measurement

4.5 ISO 14001:1996, Element 4.6

## 5.0 Definitions

None

## 6.0 Exclusions

None

## 7.0 Procedure

7.1 The Facility/Plant Manager and Facility/Plant Management Team shall conduct a review of the environmental management system at least once each year.

7.2 Management review meetings shall be scheduled in advance by the Environmental Management Representative and an agenda issued to ensure appropriate preparation and attendance.

7.3 The meeting shall review all applicable components of the *Facility/Plant Name* environmental management system. The Environmental Management Representative shall present information for review and concurrence, which may include but not be limited to:

a) Environmental Policy
b) Environmental Aspects
c) Objectives & Targets and Programs
d) Legal and Other Requirements
e) Training, Awareness and Competence

f) Operational Control
g) Emergency Preparedness and Response
h) Monitoring and Measurement
i) Nonconformance and Corrective and Preventative Action
j) Environmental System and Regulatory Compliance Audits

7.4 The Facility/Plant Manager and Facility/Plant Management Team shall review and confirm their approval and the continual suitability, adequacy and effectiveness of the environmental policy, environmental objectives and targets, environmental management programs and other elements of the system as well as regulatory compliance requirements are met..

7.7 The Environmental Management Representative or designee will publish and maintain meeting minutes identifying issues discussed and corrective and preventive actions to be taken. Required actions will be assigned to the responsibility of process, area and functional management.

7.8 Timely decisions will be made.

## 8.0 General Rules

None

## 9.0 Records

Records shall be retained consistent with EP-013.

**Record of Revisions**

| Revision Date | Description | Sections Affected |
|---|---|---|
| | | |

# EP-007 Environmental Regulations and Other Requirements

1.0 **Purpose/Scope**

This procedure defines the mechanism for identifying and maintaining current legal and other requirements and regulations applicable to the *Facility/Plant Name*, and for maintaining access to up-to-date editions of those requirements.

2.0 **Activities Affected**

Environmental Coordinator

3.0 **Forms Used**

None

4.0 **References**

4.1 EP-010 Environmental Communication

4.2 Governmental/commercially available publications

4.3 Other requirements to which *Facility/Plant Name* subscribes (e.g., Ford requirements)

4.4 ISO 14001:1996, Element 4.3.2.

5.0 **Definitions**

None

6.0 **Exclusions**

None

7.0 **Procedure**

7.1 The Environmental Coordinator shall maintain up-to-date listings of applicable environmental legal and other requirements through the maintenance, access and review of the relevant references listed in Section 4.0 above at least annually.

7.2 The Environmental Coordinator may undertake additional activities as appropriate to ensure that all applicable legal and other requirements are available.

7.3 Access to, or copies of, all applicable legal and other requirements shall be readily available.

7.4 The Environmental Coordinator shall communicate legal and other requirements to all applicable areas and departments, consistent with EP-010.

8.0 **General Rules**

None

9.0 **Records**

Records shall be retained consistent with EP-013.

**Record of Revisions**

| Revision Date | Description | Sections Affected |
|---|---|---|
| | | |

# EP-008 Environmental Review of Projects

**1.0 Purpose/Scope**

This procedure defines the method for identifying and evaluating the environmental issues of new projects at the *Facility/Plant Name* to:

a) ensure that appropriate consideration is given to environmental issues prior to project approval and funding;

b) ensure that new environmental aspects generated by projects are identified and their significance evaluated; and,

c) provide a mechanism for the amendment of environmental management system elements and programs, where relevant, to ensure that the environmental management system applies to such projects.

**2.0 Activities Affected**

All areas and departments

**3.0 Forms Used**

Project Environmental Checklist

**4.0 References**

EP-002 Environmental Aspects, Objectives and Targets, and Management Programs

**5.0 Definitions**

None

**6.0 Exclusions**

None

**7.0 Procedure**

7.1 Areas/departments initiate Project Appropriation Requests when the need for project funding becomes apparent.

7.2 The initiating activity or designee shall identify and evaluate environmental issues associated with the project. A summary of this evaluation shall be documented on a Project Environmental Checklist form and the form added to the Appropriation Request. This process may be undertaken in liaison with the Environmental Coordinator (or other competent individual) at the discretion of the initiating activity, and shall include an identification of environmental aspects, and requirements for obtaining approvals from environmental regulatory agencies.

7.3 The initiating activity shall submit the Appropriation Request and completed Project Environmental Checklist for review to the Environmental Management Representative.

7.4 The Environmental Management Representative, or designee, shall review the proposed project to ensure that all relevant environmental issues have been identified, and if incomplete shall return the Appropriation Request and Project Environmental Checklist to the initiating activity for alteration.

7.5 The Environmental Management Representative, or designee, shall review the environmental aspects of the project, considering their significance in line with EP-002.

7.6 Following appropriate review, the Environmental Management Representative or designee may approve the project by returning the Appropriation Request to the initiating activity for further processing. If a project is not acceptable, the initiating activity will coordinate any necessary actions to satisfy concerns identified. The initiating activity in conjunction with the Environmental Management Representative or designee will coordinate any necessary prevention, mitigation or control activities associated with the project.

**8.0 General Rules**

8.1 Environmental aspects associated with projects shall be evaluated for significance by the Cross Functional Team per EP-002.

8.2 Changes to the Environmental Management System resulting from an environmental review of a project will be approved by the Facility/Plant Management Team.

**9.0 Records**

Records shall be retained consistent with EP-013.

**Record of Revisions**

| Revision Date | Description | Sections Affected |
|---|---|---|
| | | |

# EF-008.01 Project Environmental Checklist

**Project Description:**

**Project Number:**

| AIR EMISSIONS | Yes | No |
|---|---|---|
| Will this project/process change produce air emissions? | | |
| Will this project/process change require an air permit or permit modification? | | |
| Does the change require air pollution controls? | | |
| Does the project/process change require the use or purchase of ozone depleting substances? | | |

| WATER DISCHARGES | Yes | No |
|---|---|---|
| Does the project/process change result in a wastewater, sanitary or storm water discharges? | | |
| Will the project/process change result in changes to water discharge flow rates? | | |
| Will the discharge require a permit modification? | | |
| Will new or additional pretreatment be required? | | |
| Are facility discharges to a common sewer altered? | | |

| STORAGE TANKS | Yes | No |
|---|---|---|
| Will underground storage tanks be installed? | | |
| Will tanks be installed to store hazardous waste or materials, petroleum products or propane? | | |

| WASTE GENERATION | Yes | No |
|---|---|---|
| Will the project/process change produce a waste or recyclable material? | | |
| Will the waste be classified as special or hazardous? | | |
| Will off-site disposal be required? | | |
| Are special handling, abatement or disposal measures required? | | |

| ENERGY USAGE | Yes | No |
|---|---|---|
| Will the project/process change effect facility energy usage? | | |

| OTHER CONSIDERATIONS | Yes | No |
|---|---|---|
| Do recycling options and costs need to be considered? | | |
| Does the project/process change require use of toxic, hazardous or carcinogenic materials? | | |
| Do project/process materials require special handling or storage? | | |
| Does the project cause land disturbances? | | |
| Do pollution prevention issues need to be addressed? | | |
| Does the project/process change impact the surrounding community (i.e., odor, noise etc.)? | | |
| Are there any wildlife or land use issues? | | |
| Does the project/process change alter or add to current facility aspects? | | |
| Does the project/process change require a change to Emergency Response methods? | | |

__________________________________ ____

Initiating Activity Manager — Date

__________________________________ ____

Environmental Management Representative — Date

## EP-010 Environmental Communication

**1.0 Purpose/Scope**

This procedure defines the process for:

a) Internal environmental communication/awareness within the *Facility/Plant Name*.

b) External environmental communication between the *Facility/Plant Name* and external interested parties, such as regulatory authorities and the public/local community groups.

**2.0 Activities Affected**

All areas and departments

**3.0 Forms Used**

External Communication Log

**4.0 References**

4.1 Environmental Policy
4.2 EP-002 Environmental Aspects, Objectives and Targets and Programs
4.3 EP-005 Environmental Management System Management Review
4.4 EP-006 Emergency Preparedness and Response
4.5 EP-007 Environmental Regulations and Other Requirements
4.6 EP-008 Environmental Review of Projects
4.7 EP-009 Agency Approvals
4.8 EP-011 Contractor Control
4.9 EP-012 Environmental Document Control
4.10 EP-014 Environmental Training and Awareness
4.11 ISO 14001:1996, Element 4.4.3.

**5.0 Definitions**

External Communications: written or electronic correspondence, telephone conversations and oral discussions or meetings with anyone external to the company.

**6.0 Exclusions**

None

**7.0 Procedure**

7.1 Internal Communications/Awareness

7.1.1 Internal environmental communications shall be implemented to ensure those personnel at each relevant level and function are aware of the following:

7.1.1.1 the environmental management system;

7.1.1.2 the importance of conformance with the environmental policy, procedures and system;

7.1.1.3 the potential consequences of system non-conformances;

7.1.1.4 individual roles and responsibilities in achieving conformance with procedures, including emergency preparedness and response; and

7.1.1.5 the significant environmental aspects associated with work activities and the environmental benefits of improved personal performance.

7.1.2 Internal environmental communications may be accomplished by the use of:

7.1.2.1 Notice boards

7.1.2.2 Awareness training of facility personnel, as appropriate in line with job function

7.1.2.3 Environmental training of relevant job functions, as appropriate (see environmental procedure EP-014: Environmental Training and Awareness)

7.1.2.4 Newsletters

7.1.2.5 Electronic notes

7.1.2.6 Team meetings and meeting minutes

7.1.2.7 Management reviews and meeting minutes

7.1.2.8 Corrective Action Requests

7.1.3 Communication of environmental issues from employees to the Facility/Plant Management Team shall be handled by the Cross Functional Team member representing the affected area, in coordination with the Environmental Management Representative. These communications shall be documented.

7.1.4 Communication of changes to legal & other requirements to employees shall be handled by the Area or Department Manager or designee. These communications shall be documented.

7.2 External Communications

7.2.1 External communications concerning the environmental aspects of the facility should be directed to the Security Manager, Human Resources Manager or the Environmental Management Representative.

7.2.2 The Environmental Management Representative or Environmental Coordinator is responsible for responding to inquiries from interested parties and regulatory agencies.

7.2.3 The Human Resources Manager or designee is responsible for sending current copies of the environmental policy to interested parties. These requests will be documented on the External Communications Log.

7.2.4 The Human Resources Manager in consultation with the Environmental Management Representative is responsible for responding to media communications.

7.2.5 Where community concerns relate to an environmental emergency, EP-004 shall be implemented.

7.2.6 The Environmental Management Representative or designee is responsible for determining the need for and preparation of any notification to regulatory agencies on an as needed basis.

**8.0 General Rules**

8.1 CFT members and Area or Department Managers shall maintain their own internal communication records.

8.2 The Environmental Management Representative shall maintain records of external environmental communication with interested parties and the media.

8.3 The Environmental Coordinator shall maintain records of external environmental communications with regulatory agencies.

**9.0 Records**

Records shall be retained consistent with EP-013.

**Record of Revisions**

| Revision Date | Description | Sections Affected |
|---|---|---|
| | | |

*Facility/Plant Name*

**ENVIRONMENTAL WORK PRACTICE**

**EWP-023.01**

OPERATION: **WASTE DRUM SHIPMENTS**

1 The designated waste handler contacts the proper disposal facility and transporter to schedule the waste drum shipments.

2 The designated waste handler will direct the transporter to the pickup location.

3 The transporter will verify proper labeling and cleanliness of drums before they are loaded, and prepare the proper waste manifests.

4 The designated waste handler or designee stages and loads the drums onto the transportation vehicle.

5 In the event of a non-incidental spill, the Emergency Response Coordinator will be notified.

6 After the transportation vehicle has been loaded, the transporter will provide the completed waste manifests to the waste handler.

7 If required, the driver will placard the transportation vehicle. The waste handler will determine when and what placarding is required.

8 The Environmental Management Representative or designee shall review the waste manifests and sign them when appropriate.

9 The Environmental Management Representative shall retain copies of the waste manifests.

*Facility/Plant Name*

**ENVIRONMENTAL WORK PRACTICE**

**EWP- 024.01**

OPERATION: **BULK MATERIAL LOADING AND UNLOADING**

1 When the Bulk Material Transporter arrives at the facility, an area or department representative will direct the transporter to the appropriate tank.

2 The transporter and area or department representative will follow this transfer procedure:

2.1 The transporter is responsible for ensuring that the truck has appropriate DOT placarding prior to entering the facility.

2.2 The transporter is instructed by the area or department representative regarding the facility's bulk material transfer protocol.

2.3 The area or department representative indicates proper tanker spotting.

2.4 The area or department representative verifies that the volume available in the bulk storage tank is greater that the volume of product to be transferred from the delivery tank. The transporter is responsible for ensuring the capacity of the tank truck is not exceeded.

2.5 The area or department representative will remove pipeline caps or blanker flanges and assure connection to the correct delivery transfer lines.

2.6 The area or department representative inspects facility transfer connections for damage or material leaks.

2.7 The transporter will make all connections necessary for material transfer.

2.8 The area or department representative will stay alert and have a clear unobstructed view of the operation at all times during the transfer.

2.9 The area or department representative will verify the transporter is in attendance monitoring the transfer operations.

2.10 The area or department representative is authorized to order the transporter to terminate the transfer and have the driver move the tanker during an emergency.

2.11 The transporter will remove transfer lines such that excess material will flow back toward the receiving tank or catchment basin.

2.12 The area or department representative will monitor the termination process.

3 Copies of shipping manifests are retained by the appropriate area or department. Waste manifests are retained by the Environmental Management Representative or designee.

4 The bulk material storage area is inspected weekly by the appropriate area or department and an inspection log completed.

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