

Diffusion of Environmental Practices through Supply Chain Mandates:
Evidence from Mexican Industry

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ABSTRACT

Andrew M. Hutson: Diffusion of Environmental Practices through Supply Chain Mandates:
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This study explores the emergence of *supply chain mandates*, initiatives by which businesses demand changes in the social or environmental behavior of suppliers and business partners over whom they exert economic influence. Under these mandates, firms within a corporation's production network are contractually obliged to adopt verifiable codes of conduct or certification institutions using the promise of future business, or threats of no future contracts, as incentives. It examines how major first-tier auto suppliers have themselves received and implemented mandates from the auto manufacturers to adopt formal environmental management systems (EMS), and how Mexican automotive suppliers in turn have responded to these mandates. Finally, it identifies other factors that influence the adoption of more systematic environmental management practices. Evidence for the study was collected through interviews with automotive manufacturers and large multinational suppliers and through a survey of Mexican automotive suppliers, and the resulting data were analyzed using several regression techniques including ordinal logistic regression and two-stage treatment effects models. The analyses find a large discrepancy between those facilities subject to supply chain mandates from major customers and those who actually adopt EMSs. However, several factors including the *perceived importance* of mandates, technical considerations related to more general industrial upgrading strategies, and ownership by US firms affect the adoption of EMSs by suppliers operating in Mexico. It also finds that while

supply chain mandates may have a negligible affect on the emphasis facilities place on specific environmental objectives, including regulatory compliance, pollution prevention, and eco-efficiency, having an EMS in place does influence prioritization of these objectives. Therefore, in cases where supply chain mandates effectively lead to EMS adoption, deeper commitments can be expected. The study also discusses the institutional failures related to monitoring and enforcement that hinder diffusion throughout the value chain and the potential for these quasi-regulatory private mechanisms to provide public benefits, particularly in industrializing nations.

Dedicated to the memory of Dr. Ronie Garcia-Johnson (1968-2003): teacher, mentor, friend.

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LIST OF ABBREVIATIONS

ACC – American Chemistry Council

CSR – Corporate Social Responsibility

EMS – Environmental Management System

EU – European Union

GM – General Motors

HP – Hewlett-Packard

INA – Industria Nacional de Autopartes

IBM – International Business Machines

MNC – Multinational Corporation

NAFTA – North American Free Trade Agreement

NGO – Non-Governmental Organization

OEM – Original Equipment Manufacturer

PROFEPA – Procuraduría Federal de Protección al Ambiente

US EPA – United States Environmental Protection Agency

CHAPTER 1: Introduction

Rising economic globalization over the past two decades has resulted in substantial shifts in manufacturing from locations in the first world to developing countries across the globe in response to increasingly liberalized trade and advantages in factor prices. While this shift has brought considerable foreign direct investment and in some cases sizable economic growth, it has also resulted in significant negative social and environmental externalities associated with the production process. The absence of clear rights for workers has been pronounced in many export-oriented industries from Asia to Latin America, and in many regions of the developing world, unsustainable natural resource use and industrial emissions to air and water threaten human health, damage the biosphere, and offset gains to social welfare provided by increases in economic activity.

Compounding these problems is the inability or unwillingness of the state to create and enforce laws to protect workers and the natural environment. Governments in many developing countries simply lack sufficient resources and the administrative capacity to enforce existing laws and draft necessary labor and environmental standards. Others purposely look the other way for fear of hampering investment and economic growth, assuming that such problems are a necessary byproduct, or stage, of the development process. Disappearing too is the influence of the vertically integrated multinational firm, with direct control over the entire production process – from the acquisition of raw materials, to the assembly of final products. In its place have emerged complex production networks,

where thousands of firms, large and small, collaborate with varying degrees of coordination in the manufacture of goods. This process of “vertical disintegration” has removed much oversight and responsibility over the manufacture of goods with large social and environmental risks from firms with active shareholders, customers, and sensitive brand images to less visible suppliers who often possess lower degrees of management experience, access to state-of-the-art production technologies, and are subject to little pressure from domestic civil society.

It is under these conditions that *governance gaps* have arisen – where host country governments are unwilling or unable to address the negative externalities of manufacturing, where production occurs outside the jurisdiction of applicable labor and environmental standards of industrialized nations, and where trade agreements fail to account for these considerations (see Gereffi and Mayer 2004). Such gaps are further exacerbated when the reach of multinational firms is hampered by the complexities of the global market, in which close scrutiny of the actions of suppliers and business partners is a complicated and expensive proposition. In response to these gaps, a variety of codes of conduct have emerged seeking to establish general standards of practice and safeguards for workers and the natural environment in a variety of sectors (World Bank 2003; Gereffi, Garcia-Johnson and Sasser 2001; Conroy 2001). Such codes, often created by coalitions of global advocacy groups, aim to exert market-based pressures upon firms to promote more stringent standards of social and environmental responsibility (Conroy 2001). However, while promoting high ethical standards and providing firm guidelines for behavior, the actual market leverage these codes of conduct have been able to produce on their own has been limited and the concrete changes

that have resulted have been variable, often due to weak institutions and incomplete enforcement mechanisms (Esbenshade 2004; O'Rourke 2003).

With an understanding that the presence of such guidelines without some form of validation may bring little external credibility, some trade associations and business groups, most notably in the chemical and forest products sectors, have created voluntary programs to self-police their social and environmental behaviors. These groups have done so in an effort to protect shared reputations, stave off citizen action and forestall potential future regulation (Kollman and Prakash 2002; Nash 2002). The result has been the creation of certification institutions that incorporate specific standards of behavior and process requirements that entail varying degrees of stringency and external verification (Garcia-Johnson 2001; Gereffi, Garcia-Johnson, and Sasser 2001). Participation in such programs is voluntary, and therefore requires a degree of enlightened self-interest on the part of firms who join them. That is, only firms who believe they will benefit from participation in the program, either through improved public relations, better relationships with regulators, or improved collective reputation in the industry, are likely to sign on (Kollman and Prakash 2002; Potoski and Prakash 2005). Firms that do not believe the benefits of participation are worth the costs are not obligated to join despite the potential threat their social and environmental behaviors may pose customers, business partners, or the sector as a whole.¹

Partially in response to these shortcomings, corporations in several industries have begun to develop and apply *supply chain mandates*, where businesses demand changes in the social or environmental behaviors of suppliers and business partners over whom they exert economic influence. Under these mandates, firms within a corporation's production network

¹ Membership in some trade associations does require participation in voluntary programs. The chemical industry's Responsible Care program is the most notable of these.

are contractually obliged to adopt verifiable codes of conduct or certification institutions using the promise of future business, or threats of no future contracts, as incentives.

These institutions, arising in response to social and environmental problems associated with increased globalization, may represent something larger than isolated initiatives to address crises affecting individual corporations or industries. Rather, supply chain mandates are quickly emerging as part of a new generation of quasi-regulatory policy tools, where private organizations use economic leverage in order to affect changes in pursuit of public goals. Among the most noteworthy of recent efforts to extend the reach of social responsibility from major corporations to their suppliers are the Electronics Industry Code of Conduct (EICC), promulgated by Dell, HP and IBM to require mandatory labor, environmental and human rights provisions for its networks of global suppliers; McDonald's restriction of antibiotics use by beef and poultry suppliers; Home Depot and Lowe's preference for suppliers of wood certified by the Forest Stewardship Council (FSC) who have eliminated purchases from old growth and endangered forests; and the mandates from Ford, General Motors and DaimlerChrysler that all direct suppliers be certified to the ISO 14001 environmental management systems (EMS) standard.

While the efficacy of certification institutions in general is still an open question, the emergence of supply chain mandates to force improvements along the value chain marks an important evolution in the development of strategies aimed at the improving the behavior of industrial actors. It is, in essence, a phenomenon in which corporations find themselves in the new role of regulators: responsible for the monitoring and enforcement of the policies they require. However, the degree to which suppliers adhere to these mandates, adopt the values of their customers, and the extent to which the programs are diffused throughout the

value chain is yet unclear. How thoroughly are suppliers adhering to the specific requirements of their customers? What mechanisms are in place to assure compliance? How widely are such practices diffused beyond direct supplier relationships?

To date, the majority of studies examining the role of corporate influence on the actions of supplier behavior and the institutions that have emerged to do so have focused on issues pertaining to labor and human rights (Gordon and Miyake 2000; OECD 2001; Elliot and Freeman 2001; Esbenshade 2004; Fung, O'Rourke and Sable 2001; Harvey, Collingsworth, and Athreya 2002; ILO 2002; O'Rourke 2003) and have largely ignored developments in the environmental realm. This study begins to address this lacuna in the literature by exploring the emergence of environmental supply chain mandates in the North American automotive industry. Specifically, it examines how widely mandates are diffused through production networks and how thoroughly the specific requirements are adopted by autoparts manufacturers in Mexico.

In the past seven years, major automotive manufacturers have moved to require their direct (tier-1) suppliers to adopt formal environmental management systems consistent with the ISO 14001 EMS standard, and have encouraged these firms to demand the same of their suppliers (see Hutson 2001). While not all automakers have expressly mandated the adoption of a formal EMS of their first tier suppliers (as Ford, General Motors and DaimlerChrysler have), virtually all the major global automakers have communicated it as an expectation and mark of quality in one form or another. In short, it is becoming a de facto requirement of participation in the industry as a whole.

Firms may adopt environmental management activities, and demand the same of suppliers, for reasons related to corporate strategy and performance. However,

environmental management may also be influenced by institutional pressures and factors related to industrial organization not necessarily predicated on environmental grounds. This study addresses three primary research questions surrounding these issues and the supply chain mandate policies of the automotive manufacturers. First, how are supply chain mandates to adopt ISO 14001 interpreted and implemented by suppliers in the automotive value chain? Second, are the mandates effective in their aims? That is, does the existence of the policies lead to adoption of complete EMSs in accordance with specific requirements of the standard? Further, are the systems that are adopted by plants in Mexico geared towards achieving a range of environmental goals, or are they simply “paper systems” that meet minimum requirements of the standard without addressing more intractable problems or moving “beyond compliance”? Third, have these policies been replicated and passed along the value chain to lower tiers of suppliers, or has penetration been limited to the first tier? What factors have contributed to, or hindered, diffusion of these policies?

Two parallel trends have contributed to the rise and evolution of supply chain mandates in global industry: the growing role and importance of corporate social responsibility to multinational firms, and twin forces of vertical disintegration and globalized production. Over the past two decades, major corporations across the globe have increased their participation in a variety of initiatives that can broadly be classified as corporate social responsibility (CSR) or sustainability efforts. Such initiatives intend to address the environmental, labor and human rights issues associated with business activity beyond that which is required by law, or promote activities with societal benefits that may not directly be associated with a firm’s profit-making imperative. The adoption of these initiatives can often be an expensive and complicated endeavor for firms, particularly when attempting to do so

for vast global production networks. Accordingly, many such efforts have been dismissed as “mere philanthropy” and disparaged by critics as distractions from the primary societal function of business (i.e. earning profits and increasing shareholder value). Despite such criticisms, more and more companies are defining sustainability principles as core values and central to a firm’s survival. Presumably such businesses do so not only because these endeavors are viewed as the “right thing to do,” but also because they serve as a source of value creation and brand protection.

Initiatives developed to address environmental and social aspects of a firm’s operation have been driven by both internal efficiency considerations and external threats that pose reputational risks. Particularly with respect to environmental behaviors, specific actions taken to decrease a firm’s social footprint can result in significant efficiency gains (Melnyk et al. 1999; del Brio et al. 2001; Hutson 2001; Morrow and Rondinelli 2002; Andrews et al 2003). Moreover, such efficiencies may ultimately lead to improvements in the bottom line and therefore serve as strong drivers to improve environmental performance (Porter and van der Linde 1995a,b; Hart and Ahuja 1996; Klassen and McLaughlin 1996; Sharma and Vredenburg 1998; Dowell, Hart and Yeung 2000; Christmann 2000). Some firms have found that enlightened self-interest is best served by optimizing a “triple bottom line,” incorporating social and environmental considerations alongside traditional economic ones (Elkington 1998, Hart and Milstein 1999, van Heel et al 2001).

Because large branded firms are often the most visible and easiest targets for NGOs, community groups and regulators, active participation in sustainability activities serves as an added layer of protection for such companies, both in terms of proactively addressing existing problems and for the public relations value associated. In short, engaging in

operations with a focus on sustainability objectives serves to extract efficiency gains through environmental improvements and standardization while protecting valuable brand images through the protection of both workers and the natural environment. If successful, the adoption of sustainability practices may place companies at a competitive advantage over those who choose not to behave as responsibly and result in improved financial performance and increased shareholder value (Hart 1997).

Parallel to the increasing focus on social responsibility within corporate hierarchies, two fundamental shifts have occurred in the global economy, particularly throughout the 1990s. First, firms in many industries have shifted the bulk of their production activities to locations in developing countries, often in search of the lowest production costs. Second, there has been a dramatic restructuring of the industrial organization of many industries associated with the globalization of firms' operations. Lead firms in several sectors (most notably automotive and electronics) have been "deverticalizing" their operations in order to focus on higher value activities, such as design and marketing, which they consider to be their core competencies (Kaplinsky 2000; Sturgeon and Florida 2000; Sturgeon 2002). Implicit in this process is a shift to high levels of outsourcing by these firms to independently operating "modular" suppliers who are increasingly responsible for activities such as product assembly and subassembly, global purchasing and sourcing, and specific elements of product design (Barnes and Kaplinsky 2000; Humphrey 2000; Sturgeon and Florida 2000; Humphrey 2003; Tewari 2003; Quadros 2003). Many of these outsourced processes have large environmental impacts and suppliers often have little experience with environmental management practices, or the labor standards that have evolved over the past century in the industrialized world.

Furthermore, because these industrial processes have moved to many countries where existing environmental regulations and labor standards are often weak, or not enforced, the potential for abuse is strong. It is often the case in such locations that governments lack adequate capacity for enforcement and companies with stated commitments to sustainable practices lack substantial oversight of production. Furthermore, a rise in global brands and a heightened level of concentration among lead firms over the past two decades has added a dimension of vulnerability and visibility to the business environment. For this reason, many firms have begun to develop mechanisms and policies to address potential hazards posed by the behavior of suppliers and business partners in the form of supply chain mandates.

In requiring their global suppliers to adopt management practices and standardized activities that may improve communication and transparency, firms seek to reap efficiency gains that suppliers may achieve. Perhaps more importantly, however, businesses seek to limit risk and protect their valuable brand image from bad behavior on the part of contractors (e.g. preventing “Nike” events). Companies that extend such programs to their supply base seek to mitigate damage to their reputations in two specific ways. First, by taking the proper steps, be it through better management of environmental processes or becoming better informed about the practices of business partners, firms hope to prevent incidents and accidents from occurring in the first place. Second, if an environmental accident or violation of labor codes should still occur, firms may be able to demonstrate to consumers, shareholders, and perhaps regulators, that they have at the very least demonstrated due diligence in an attempt to prevent such events from happening (Andrews, Hutson and Edwards 2005).

Environmental supply chain mandates find their conceptual genesis in voluntary environmental self-regulation programs. Conceptually, voluntary environmental regulations seek to offer greater flexibility to participating firms than traditional “command and control” approaches, which critics claim are far too costly in terms of monitoring, enforcement, and compliance costs (Jaffe et al. 1995; Coglianese and Nash 2001). Where traditional environmental regulations stipulate specific environmental performance outcomes or prescribe the adoption of particular pollution control technologies, voluntary programs take a more “management-based” approach to solving environmental problems. Since the internal characteristics of firms vary greatly both within and among industrial sectors, voluntary approaches replace uniform regulations and incentives with a formal planning process that accounts for the inherent heterogeneity that exists (Coglianese and Nash 2001; Coglianese and Lazar 2003). Because regulatory agencies face constraints that limit their ability to create and enforce environmental regulations appropriate to individual firms and manufacturing sites, procedural rules and standards are developed and implemented by firms themselves in order to achieve public goals (Andrews 1998; Orts 1995). Such goals generally include meeting existing regulatory requirements, but also establishing methods for finding additional improvements beyond what is required by law. If successfully adopted, voluntary programs may lead to “beyond compliance” improvements, where firms perform better than what is required of them by existing regulations, and find ways to improve behaviors in areas that are not regulated by the state. Voluntary management-based programs are, by nature, self-enforced initiatives with little oversight or interference from government agencies or external stakeholders— though some, like the ISO 14001 EMS standard, require verification by paid third-party auditors. Firms choosing to participate in

voluntary environmental programs generally find it in their best interest (or “enlightened self-interest”) to do so, to either proactively develop internal efficiencies, or to improve relationships with customers, regulators or the community. For their part, government agencies and the public may benefit from establishing voluntary approaches by promises of beyond compliance performance without the burden of additional monitoring and enforcement.

Despite this apparent “win-win” on the part of businesses and the public, there are fundamental questions posed by voluntary programs which draw skepticism on the part of both regulators and civil society. Primarily, can firms be trusted to implement changes that result in improved environmental behaviors without enforcement and oversight on the part of the government? Genuine problems with respect to transparency, accountability and credibility of voluntary programs exist in the eyes of the public precisely because they are voluntary and are subject to weak enforcement mechanisms (Haufler 2001; Krut and Gleckman 1998; Morrison et al 2000). In other words, the strength of such approaches can also be a potentially fatal weakness.

This weakness may be exacerbated when it comes to supply chain mandates that extend from management-based approaches. As stated above, the primary strength and motivating factor for participation in voluntary programs is that they are indeed voluntary and up to firms themselves to establish and control. However, when such programs are externally imposed, enthusiasm for the implementation and maintenance required may quickly evaporate, as firms subject to them may not view it in their self-interest to do so, or see the potential benefits. While the same flexibility exists with respect to a firm establishing its own environmental performance goals and means to achieve them, motivation to establish

and meet appropriate objectives may simply not exist. Supplier firms may simply see these programs as another of a long list of requirements from customers and regulators that must be fulfilled, without incorporating the spirit necessary for them to deliver improvements. If the voluntary nature is removed from voluntary programs, the likelihood of effectiveness in achieving public environmental goals becomes dubious – if firms are not motivated by enlightened self-interest to adopt and thoroughly implement voluntary initiatives and they are not subject to substantial oversight, there is little to suggest that such programs will have their intended effect.

In some ways, then, to be effective, self-regulation in the context of supply chain mandates must mimic the structure of traditional regulation – strong institutions for monitoring and enforcement on the part of companies issuing the mandates are therefore needed in order to ensure compliance with the policies. In practice, when deciding on whether or not to comply with regulation, rational actors weigh both the benefits and costs, and extent of both the probability and the consequence of compliance (see Becker 1968). Firms make choices regarding compliance with environmental requirements by weighing the severity of potential consequences and the probability of getting caught. A firm may opt not to comply with a given policy even when faced with substantial consequences if the likelihood of getting caught is sufficiently low. Likewise, if there is little risk of getting caught or the consequences are marginal, a rational firm will have little incentive to comply with external pressures to adopt a specific set of behaviors. If supply chain mandates are to have any benefit, organizations issuing the mandates must play the role traditionally occupied by regulators: creating institutions that effectively monitor behaviors, and consistently punishing non-compliance.

In investigating these issues, this study contributes to the broader topic of a “public role for the private sector” as explored by Virginia Haufler (2001) and others in discussions surrounding the rise of private authority. Following Haufler, the analyses in the following chapters investigate the role of self-regulatory regimes as a new form of global governance and how they may achieve public goals, particularly in developing countries. It also explores how effective such initiatives may be, given the weak mechanisms for enforcement and compliance in light of other more pressing corporate objectives, namely the profit-making imperative, and how these functions may be intertwined. The promotion of environmental policies by automotive manufacturers may in some ways be promoting an “upwards harmonization” of environmental standards to industrializing societies, where companies in effect export stricter standards and environmental best practices to locations where they do business (see Vogel 1995; Garcia-Johnson 2001). Corporate governance structures and production networks therefore may become a conduit for the promotion of behaviors that produce public benefits.

Such benefits may be particularly welcome in Mexico, where the administrative capacity to cope with environmental burdens associated with a burgeoning economy is relatively low. While liberalized trade in the post-NAFTA years has not led to the catastrophic environmental degradation from industrial activities that many critics of the trade agreement predicted, the country still faces substantial environmental challenges alongside diminished government capacity to address them. High levels of pollution are of considerable cost to the Mexican economy; from 1993 to 1999 environmental degradation and resource depletion equaled an average of 10.9 percent of GDP (Salazar and Carlsen 2001). At the same time plant-level environmental inspections in the *maquiladora* region decreased by over half in

2002, as compared with averages from 1994-2000 (Stromberg 2002), and in real terms overall environmental spending decreased by 45% in the period 1993-1999, making Mexico the lowest spending of the OECD nations on environmental policy (Gallagher 2004). Indeed, traditional regulatory tools have not been available or appropriate to address issues surrounding industrial development and the natural environment. Understanding private firm initiatives may provide an alternate means of dealing with the byproducts of economic growth.

The dissertation is organized into seven chapters. Chapter two explores the extant literature and primary bodies of theory that help to explain EMS adoption and diffusion. It specifically covers the literatures from corporate strategy and public policy that investigate why firms adopt environmental management strategies themselves and why they promote them through their production networks. It also looks at the adoption of environmental standards as a byproduct of increased value chain governance resulting from fundamental shifts in global industrial organization that have occurred over the past two decades. Finally, the chapter reviews the literature pertaining to the international diffusion of standards and rise in private authority that occurs among firms and across borders.

Chapter three discusses the methods for data collection used in the three primary analyses of the dissertation. It details structured interviews with representatives from the largest North American automotive suppliers and the automakers themselves used in chapter four. It also details the survey methods used to collect data from automotive supplier plants in Mexico, including the survey instrument design and pretest, population sampling, survey implementation, and error structure.

Chapter four explores the specifics of adoption and implementation of the automakers' policies for EMS adoption by their first-tier suppliers. It presents results from structured interviews with corporate environmental officers at large automotive supplier firms and large automakers to explore three main questions. First, how have the mandates been interpreted and adopted by the largest automotive suppliers, and what variance exists among the approaches each has taken? Second, how are the policies monitored and enforced by the automakers and to what degree have they been effective in their aims? Third, have the first-tier suppliers replicated these requirements for their own suppliers, and what hindrances exist to doing so? The chapter finds the threat of losing future business has been enough to convince companies to dedicate the necessary resources to environmental management efforts and comply with the requirements, though firms have used different strategies to adopt the policies on a company-wide basis. It also finds a lack of widespread replication of the EMS mandates by suppliers in the first tier, and no intention of monitoring or enforcing compliance by companies that have formally announced them.

Chapter five explores the effectiveness of supply chain mandates in leading to the adoption of EMSs by automotive suppliers in Mexico. It uses generalized ordered logistic regression to explore three questions. First, how effective are supply chain mandates in motivating the adoption of advanced environmental management practices in manufacturing facilities in an industrializing society? Second, what other considerations related to global industrial organization may facilitate such adoption? Third, what other demographic features, such as country of ownership and position in the value chain, may lead to higher levels of environmental management? Specifically, is there evidence that global manufacturers may indeed be "exporting environmentalism" through their vast

manufacturing networks? Overall, the analyses in this chapter find that there is a great discrepancy between those facilities subject to supply chain mandates and those who actually adopt EMSs. While the mere presence of supply chain mandates does not appear to be an effective means for assuring compliance with a customer's wishes, the perceived importance of customer requirements does lead to the adoption of formal environmental management systems. The findings also indicate that the degree of technological complexity of products, the overall capabilities of suppliers, and US ownership affect management outcomes.

Chapter six addresses two primary research questions aimed at understanding the role EMSs have on the level of commitment to specific environmental goals, including regulatory compliance, pollution prevention, eco-efficiency and product stewardship, and the specific impacts of supply chain mandates have on their prioritization. The chapter uses regression analyses (including ordinary least squares and two-stage treatment models) to address these questions. First, does the adoption of a formal EMS affect the priority a facility places on each one of these potential objectives? Second, do customer and corporate mandates affect a facility's commitment to these four objectives? Results indicate that the adoption of an EMS does appear to influence these businesses' prioritization in three of four environmental objectives categories. The findings also indicate that the strength of customer and corporate mandates to adopt formal EMS has very little influence on how facilities shape their environmental strategies, and in some cases the influence is negative. Taken together, these findings suggest that while mandates themselves may not lead to increased commitments, they may lead *indirectly* to improvements by influencing adoption, which then affects the commitment to environmental goals, including those that go beyond compliance. Finally, chapter seven reviews the findings from the analyses in preceding chapters and provides a

synthesis of issues raised. It places particular emphasis on how they address the theoretical issues and specific research questions posed by the dissertation as a whole.

The restructuring of global industry that has occurred alongside economic globalization has fundamentally changed cross-border business relationships. The trend of deverticalization in many sectors has allowed lead firms to reap the benefits of higher value activities by focusing on their core competencies. It has also released from their control a multitude of potentially high risk activities associated with the manufacturing process at a time when consumers are becoming increasingly concerned about social and environmental problems. Understanding how business relationships, different constellations of management capabilities, resources and institutional pressures may lead to improved environmental outcomes is an important step in addressing the negative environmental externalities associated with industrial development. It is my hope that this dissertation contributes not only to the discussion about the role of private mechanisms in improving environmental conditions, but also to the larger debate surrounding environmental protection and industrial development.

CHAPTER 2: Related Literature & Theory

In considering the primary research questions of this study and the overarching issues it addresses, several bodies of theory need to be considered to better understand how initiatives on the part of private industry may produce public environmental benefits. This section highlights three areas that inform the understanding of why environmental practices may be diffused by businesses through the value chain, and the mechanisms that facilitate this process. First is the question of why firms choose to adopt advanced environmental management activities in the context of voluntary management-based approaches, and why they extend these policies to include their major suppliers. The second concerns how firms coordinate the functions of their value chains through governance of the production network. The third area discusses how environmental standards diffuse across borders and between firms and the rise in private authority that makes this diffusion necessary and possible.

Why Firms Adopt and Mandate Environmental Practices

Research into the environmental actions of businesses has demonstrated that policies to standardize environmental behaviors have been driven by abstract environmental values, but also by broader strategic goals. Initiatives developed to address environmental aspects of a firm's operation have been driven by both internal efficiency considerations and external threats that pose reputational risks. Specific actions taken to decrease a firm's environmental footprint can result in significant efficiency gains and may ultimately lead to improvements

in the bottom line. The potential to achieve such gains may not be immediately apparent to plant managers and corporate leaders, however, who have traditionally viewed environmental management and regulation as externally imposed costs, rather than sources of savings and competitive advantage.

Broadly defined, voluntary environmental programs grew out of this view that environmental laws, however effective at reducing industrial emissions, were not designed with the best interests of businesses in mind. Many believed that pejoratively named “command and control” regulations, where specific environmental performance outcomes or particular pollution control technologies are prescribed, did not take into consideration the needs and capabilities of individual businesses and therefore imposed unnecessary costs and burdensome reporting requirements. After efforts by the Reagan administration to systematically dismantle environmental regulations failed in the 1980s, industry officials and thinkers from the new right began to devise and propose new “market-based” methods for controlling pollution that used different sets of incentives to provide greater flexibility to firms attempting to meet targets and achieve environmental improvements (Andrews 1998). One strain of this thinking evolved into the innovative “cap and trade” programs, such as the 1990 Clean Air Act Amendments, the other evolved into the voluntary self-regulatory programs with a management-based approach. So-called management-based approaches represent a new generation of policy tools that provide a more flexible and less costly way to achieve environmental protection that is more palatable to industry (Coglianese and Nash 2001; Andrews et al. 2001; OECD 2000; Andrews 1998).

Where traditional environmental regulations stipulate specific environmental performance outcomes or prescribe the adoption of particular pollution control technologies,

voluntary management-based programs seek to use a structured process to address the environmental impacts of individual firms using their own constellations of capabilities. Because the internal operations of firms vary greatly, voluntary approaches replace uniform regulations and performance requirements with a process standard that takes advantage of a firm's own resources to account for the heterogeneity that exists (Coglianese and Nash 2001; Coglianese and Lazar 2003). Because regulatory agencies also face constraints that limit their ability to create and enforce environmental regulations appropriate to individual firms and manufacturing sites, these procedural rules and standards are developed and implemented by firms themselves in order to more efficiently and suitably achieve public goals (Andrews 1998; Orts 1995; Gallagher 2002; Teubner 1983). These goals may include meeting existing regulatory requirements, but also frequently include finding additional improvements beyond what the law requires. If successfully adopted, voluntary programs may lead to "beyond compliance" improvements, where firms perform better than what is required of them by existing regulations, and find ways to improve behaviors in areas that are not regulated by the state. Voluntary management-based programs are, by nature, self-enforced initiatives with little oversight or interference from government agencies or external stakeholders— though some, like the ISO 14001 EMS standard, require verification by paid third-party auditors. Under these schemes, firms are forced to regularly examine their environmental operations, engage employees in environmental issues, monitor, document, and review their performance, which ultimately leads to more thorough knowledge about their internal operations (Darnall & Edwards 2006; Darnall 2006; Hart 1995). These actions may lead not only to improved environmental performance, but better overall management of a firm's operations.

Skeptics contend that voluntary approaches, while potentially valuable tools for firms to improve performance, are not adequate replacements for regulatory oversight and enforcement. At the core of such criticisms is the belief that firms cannot always be trusted to implement changes resulting in improved environmental behaviors on their own. Genuine problems with respect to transparency, accountability and credibility exist in the eyes of the public precisely because they are voluntary and are subject to weak enforcement mechanisms (Haufler 2001; Krut and Gleckman 1998; Morrison et al 2000).

Irrespective of these criticisms, nearly 107,000 firms around the globe have implemented voluntary management-based approaches consistent with either the ISO 14001 or European Eco-Management and Audit Scheme by June 2006.² Several studies have addressed the question of why firms choose to adopt formal environmental management and have reported a diverse range of reasons. Some motivations include the pursuit of improved environmental performance in manufacturing operations (Nash et al 2000; Florida and Davison 2001; Hutson 2001), enhanced management of environmental documentation (del Brio et al 2001; Hutson 2001; Morrow and Rondinelli 2002), improved public relations and company image (Nash et al 2000; Florida and Davison 2001; Hutson 2001; Morrow and Rondinelli 2002), the attainment of greater management efficiency through improved business processes (Hutson 2001; Morrow and Rondinelli 2002), the ability to integrate environmental management with existing quality management systems (Hutson 2001; Morrow and Rondinelli 2002), improved regulatory compliance (Nash and Ehrenfeld 2001; del Brio et al 2001; Morrow and Rondinelli 2002), and desire to achieve greater competitive advantage (Hutson 2001; Morrow and Rondinelli 2002). In a study of manufacturing facilities in the state of Pennsylvania, firms ranked motivations for EMS adoption in the following order of

² Please see <http://www.ecology.or.jp/isoworld/english/analy14k.htm> for current figures.

importance: the achievement of corporate goals, commitment to environmental improvement, state regulatory climate, business performance, and improved community relations (Florida and Davison 2001). More recently, Darnall (2006) has argued that firms mandate the adoption of formal EMS in their own facilities due to a combination of external pressures and the presence of complementary capabilities.

A host of empirical studies have reported that environmental management efforts do in fact lead to positive environmental benefits (Klassen and McLaughlin 1996; Melnyk et al 1999; Berry and Rondinelli 2000; Mohammed 2000; Rondinelli and Vastag 2000; Florida and Davison 2001, Anton Deltas and Khanna 2004; Andrews et al 2003; Potoski and Prakash 2005a, 2005b). However, simple environmental benefits may not be enough to motivate businesses to adopt formal EMSs; they must contribute to the bottom line as well.

Porter and van der Linde (1995a, 1995b) frame the “green and profitable” argument by suggesting that enhanced resource productivity, achieved through activities such as pollution prevention and production, recycling, and reduced energy and materials consumption, leads to improved financial performance and makes firms more competitive. Central to this belief is that pollution and waste are indicative of inefficiencies, and inefficiencies are expensive. When companies go green they reduce those inefficiencies, thus saving money for themselves and their customers, and ultimately become more competitive.

Hart and Ahuja (1996) found that emissions reductions enhanced operating performance through lower raw material, compliance, disposal and liability costs and through more efficient use of assets. However, they also found that the operating and financial performance was enhanced more for firms with higher emissions levels than those with lower emissions levels. In cases where firms are already low-emitters, further pollution prevention

activities may make little financial sense. Studies have also found that proactive environmental responsiveness strategies taken by firms contribute to the emergence of competitive benefits (Sharma and Vredenburg 1998), and that “win-win” scenarios, though not inevitable, can be greatly enhanced by available resources and capabilities (Hart 1995; Christmann 2000, Darnall 2002). However, it is not enough simply to make a blanket statement that “environmental management and standards matter.” More specifically, the type of management activities may be what counts. As King and Lenox (2001) have found, the benefits of waste reduction and prevention alone may be responsible for the positive relationship between emissions reduction and improved financial performance. Generally cited as the exception to these findings, Walley and Whitehead (1994) have argued that gains from eco-efficiency and pollution prevention are vastly overstated. These gains are more often than not overshadowed by costs associated with implementing green strategies. Such strategies can be dangerous to the bottom line and potentially irresponsible to shareholders and employees if efficiency gains do not pay off as hoped. Instead, they propose a “trade-off zone” where prospective environmental benefits are weighed against potential value destruction.

In addition to environmental and financial performance improvements, several studies point to increased operational efficiencies associated with environmental management activities (Melnik et al 1999; Nash et al 2000; del brio et al 2001; Hutson 2001; Morrow and Rondinelli 2002; Andrews et al 2003). Such efficiencies include better record keeping, scheduling of environmental tests, and equipment calibration (Rondinelli and Vastag 2000). Additionally, preventative environmental approaches and sound internal waste management allowed companies to improve cost control and poorly executed management functions

(Corbett and Cutler 2000). In many ways a variety of firms have found that “enlightened self-interest” is best served by optimizing a “triple bottom line”, which includes social, environmental and economic considerations, rather than a single one (Elkington 1998, Hart and Milstein 1999, van Heel et al 2001).

While such arguments for firms to adopt environmental management in their own operations may be obvious to both corporate and facility level managers, the rationale behind requiring similar actions of suppliers may be less apparent. Why would firms bother interfering with the internal management practices of others? The answer to this question may be two-fold. First, many firms are eager to protect their reputations and brand images against risks brought about by actions of their business partners, particularly in sensitive areas such as labor and the natural environment. Second, standardizing environmental management throughout the value chain may result in additional management efficiencies (see also Andrews, Hutson and Edwards 2006). In short, the optimization of this triple bottom line includes extending such principles, and along with them any related efficiencies, to their networks of global suppliers.

The recent protests against Nike, and the broader movement against the use of “sweatshop labor” by apparel manufacturers, have demonstrated that major corporations, particularly those with publicly visible brands, are being held accountable for the actions of their less visible business partners and contractors (Klein 2000). Companies such as Nike, The Gap, and the Sean Jean clothing label, that have been found to outsource production to overseas contractors who engage in unfair or inhumane labor practices, have found themselves in the crosshairs of consumer groups and the targets of product boycotts. Consumer activism has forced such firms to make substantial changes in their business

practices, but has also tarnished their valuable brand images in the process. Firms in other industries have learned from the Nike experience and taken proactive steps to avoid becoming the next target for human rights and environmental activist groups as a result of the way they source their goods. For example, Starbucks has begun to purchase fair-trade (above market price for poor growers) and shade-grown varieties of coffee, DeBeers has begun sourcing diamonds from Canada in an effort to avoid the stigma of “blood diamonds” (where profits from the diamond trade in countries such as Sierra Leone are used to finance violent conflict), and fast food chains including McDonald’s and KFC have begun to make demands on suppliers regarding animal welfare and the use of antibiotics in livestock.

In response to criticism and allegations of negligence, Nike and other apparel companies have instituted programs and codes of conduct for contractors to better guide and monitor the behavior of firms to which they have outsourced production (O’Rourke 2003). Likewise, firms in various industries have begun to participate in certification institutions and codes of conduct, which to varying degrees establish minimum labor or environmental standards, codify processes, and assure that such standards and processes are met by firms and their global suppliers (Gereffi, Garcia-Johnson, and Sasser 2001).

Firms which adopt certification institutions and codes of conduct seek to mitigate damage to their reputations in two ways. First, by taking the proper steps, be it through better management of environmental processes or becoming better informed about the practices of business partners, firms seek to limit risk and protect their valuable brand image from bad behavior on the part of contractors (e.g. preventing “Nike” events), in essence, firms hope to prevent incidents and accidents from occurring in the first place. Second, if even after taking the proper steps a negative event, such as an environmental accident or violation of labor

codes should still occur, firms may be able to demonstrate to consumers, and perhaps regulators, that they have at the very least demonstrated due diligence in an attempt to prevent such events from happening (Andrews, Hutson and Edwards 2006).

Indeed, one of the first and most widespread environmental certification institutions was created in an attempt to protect industry reputation. The Chemical Manufacturer's Association (now the American Chemistry Council) created Responsible Care® in an effort to prevent future environmental disasters, such as occurred in Bhopal, India and Institute, West Virginia in the 1980s, which substantially harmed the reputation of member firms (Hoffman 1999).

Similarly, the evolution of environmental management systems and ISO 14001 in particular, can be explained in part by corporations searching for systems to effectively manage their environmental impacts, and signal to others that they take corporate responsibility seriously.³ By incorporating independent third-party verification, firms that certify to the ISO 14001 system standard are in effect communicating that they abide by industry best practices for environmental management. By requiring suppliers to certify to ISO 14001, lead firms gain a greater degree of confidence that those from whom they source are minimizing their environmental risks.

In addition to risk minimization and corporate responsibility, firms require suppliers to adopt environmental management in order to reap efficiency gains from better management and standardization (Rondinelli and Berry 1998; Geffen and Rothenberg 2000; Corbett 2002). Efficiency gains achieved through better environmental management may very well lead to positive financial benefits at the supplier level that can then be passed on to customers

³ However, ISO 14001 and other EMSs are process standards with no environmental performance requirements. Facilities that are registered are not necessarily cleaner or "green" facilities per se, but rather those which have simply adopted the procedural guidelines of the system.

in the form of lower prices. Such benefits may be even greater when suppliers in developing countries are included. As most benefits from environmental management may be gained early in the adoption process by taking care of the most costly problems first (harvesting “low-hanging fruit” so to speak), facilities in developing countries with little environmental management experience may achieve better relative gains. Dowell, Hart and Yeung (2000) have shown that multinational corporations which employ stringent global environmental standards have significantly higher market values than firms which default to host country standards, which are often less stringent or poorly enforced.

Standardized EMSs also allow for greater communication and coordination between firms by codifying business processes and creating a common language for specific management functions. Managers at both Ford and General Motors have claimed such features as major benefits, and even drivers, of their global ISO 14001 implementation process (Hutson 2001). Greater standardization of business processes in general, of which environment may only be one part, reduces transaction costs and makes the coordination of global manufacturing networks less problematic. This idea of management as part of a search for greater coordination of business functions will be more deeply explored in the following discussion of global value chain governance.

In short, by requiring global suppliers to adopt management practices and standardized activities that may improve communication and transparency, firms seek to reap efficiency gains that these suppliers may achieve. If successful, the adoption of such practices may also place companies at a competitive advantage over those who choose not to behave as responsibly and result in improved financial performance and increased shareholder value (Hart 1997).

Most studies to date have failed to examine the role of extending policies that encourage or require the adoption of management-based approaches to environmental protection, and instead have focused solely on the internal operations of firms themselves. Studies that have examined the role of corporate influence on the actions of supplier behavior and the institutions that have emerged to do so have focused on issues pertaining to labor and human rights, mostly in the apparel and footwear sectors (Wetterberg *forthcoming*; Gordon and Miyake 2000; OECD 2001; Elliot and Freeman 2001; Esbenshade 2004; Fung, O'Rourke and Sable 2001; Harvey, Collingsworth, and Athreya 2002; ILO 2002; O'Rourke 2003). And while these studies have shed substantial light on internal motivations and potential effectiveness of supply chain mandates, a considerable gap still exists in understanding environmental examples themselves. To understand these examples, however, it is also important to examine the industrial organization of global manufacturing and how value chain structures and relationships among firms and their suppliers impact social and environmental outcomes.

The Role of Global Value Chain Governance

Parallel to the increasing focus on social responsibility in businesses, two fundamental shifts have occurred in the global economy, particularly throughout the 1990s. First, firms in many industries have shifted the bulk of their production activities to locations in developing countries, often in search of the lowest production costs. Second, there has been a dramatic restructuring of the industrial organization of many industries associated with the globalization of firms' operations. Lead firms in several sectors (most notably automotive and electronics) have been "deverticalizing" their operations in order to focus on higher

value activities, such as design and marketing, which they consider to be their core competencies (Kaplinsky 2000; Sturgeon and Florida 2000; Sturgeon 2002). Implicit in this process is a shift to high levels of outsourcing by these firms to independently operating “modular” suppliers who are increasingly responsible for activities such as product assembly and subassembly, global purchasing and sourcing, and specific elements of product design (Barnes and Kaplinsky 2000; Humphrey 2000; Sturgeon and Florida 2000; Humphrey 2003; Tewari 2003; Quadros 2003). Many of these outsourced processes have large environmental impacts, and suppliers often have little experience with environmental management practices, or even with the labor standards that have evolved over the past century in the industrialized world.

Economic globalization has substantially increased both industrial and geographic fragmentation of manufacturing in a wide range of sectors. Decreased barriers to trade, lower transportation and communication costs, and increased access to expansive pools of labor have spurred major changes in the industrial organization of many industries. These factors have also allowed for broad geographic dispersion of design centers, manufacturing facilities, and the logistics networks that support them. Once-monolithic multinational corporations, well known for their internal hierarchical structures, have in many cases sold, spun-off, or completely folded segments of their businesses that deliver less value, and begun to outsource to diverse, and often intricate, networks of global suppliers.⁴ The challenges of coordinating the functions of these new arrangements in industrial organization and

⁴ Recent financial troubles within the industry have caused some re-structuring among automakers and their first-tier suppliers. In September of 2005, Ford announced that it would reacquire 23 plants and about 18,000 hourly and 5,000 salaried employees in an effort to avert bankruptcy at Visteon and steer both companies back to profitability (Kosdrosky 2005). More reacquisition efforts are expected throughout the industry in coming years, demonstrating just how tightly the fortunes of these companies are, regardless of how independently they may operate.

geography in order to bring a product to market are substantial – and the stakes are high. A firm’s ability to effectively govern and coordinate its network of suppliers is central to its survival. Firms that fail to do so will be driven from the market. As stated by Sturgeon and Florida (2000), “[c]ompetitive pressure (and advantage) has shifted from excellence at the point of production (now assumed) to excellence in governing spatially dispersed networks of plants, affiliates and suppliers.”

Global value chain analysis allows researchers to take industrial and geographic fragmentation into account and focus on the emerging issues of industrial re-organization, coordination, governance, and power in the chain in order to understand not only the fragmentation of global industry, but also its consequences (Humphrey and Schmitz 2003; Gereffi 2004). Specifically, global value chain analysis summarizes the economic value contained in each step of bringing a good to market (thorough design, manufacture, marketing, and logistics) and highlights the value added and economic rent which actors at each level of the chain are able to extract (Kaplinsky 2000; Gereffi and Kaplinsky 2001). In these arrangements, lead firms often retain much of the power in setting up and coordinating global production and sourcing networks (Gereffi and Korzeniewicz 1994). The central issue is, in part, to understand who controls the high value functions of the production process and how they coordinate supplier networks.

Early work on value chains focused on the dichotomy between buyer-driven and producer-driven chains (Gereffi 1994, 1996, 2001; Gereffi and Korzeniewicz 1994). Buyer-driven chains, typified by apparel and retail outlets, require the coordination of lead firms who design and market products and outsource virtually all production to contractors. Producer-driven chains on the other hand are often technology- and capital-intensive

processes which require tighter relationships between firms and coordination efforts throughout the chain. Chains in the automotive industry are typically producer-driven, where lead firms and direct suppliers have responsibility for coordinating the manufacturing process, including assembly and procurement functions. While such a distinction was useful, it failed to describe nuances between firms and industries and what may be causing different types of chains to arise. To augment these original descriptions, Gereffi, Humphrey and Sturgeon (2003) have presented an updated typology of value chains which highlights the particular arrangement by which firms govern their supplier networks. According to the authors, particular relationship structures arise based on three factors: the complexity of information and knowledge transfer needed with respect to product and process specification; the extent to which information and knowledge can be codified and transmitted without transaction specific investment between parties; and the capabilities of available suppliers to produce goods to required specifications.

The authors construct a typology of industry relationships that result due to varying permutations of these three factors. These categories of relationships range from *market* (or “arms length”) relationships, where transactions occur with little process specification and monitoring, to *hierarchies* in the form of traditional vertically integrated corporations who conduct most processes in-house.

In between these extremes, Gereffi, Humphrey, and Sturgeon propose three additional types of relationships that may influence the degree of governance necessary. *Captive* value chains arise when both the complexity of transactions and the ability to codify transactions are high, and the capabilities of the supply base are low. Accordingly, the costs of switching suppliers are high and dependence of small firms on larger buyers is substantial. In *modular*

and *relational* value chains, the complexity of transactions and supplier capabilities are both high, but the ability to codify transactions differs. Modular chains arise when product specifications are standardized, asset specificity is low, and firms have little need for direct monitoring or control over suppliers. These relationships generally result in a higher degree of supplier independence and lower need for interaction with lead firms. Relational chains arise when interactions between buyers and sellers are complex and mutual dependence and asset specificity are therefore high.

This typology of value chain categories is a useful heuristic for understanding what factors determine the kinds of relationships that arise, but should be considered as an inventory of ideal types rather than a census of concrete categories. As the authors concede, value chain governance patterns are not static or strictly associated with industries, but rather “depend on the details of how interactions between value chain actors are managed, and how technologies are applied.” What the model provides, however, is an insight into how different kinds of relationships arise and how coordination functions may differ based on products and firm capabilities.

In general, the need for chain governance decreases when products are standardized and buyers are “design takers” who have the ability to reliably source products from suppliers who take responsibility for production (Humphrey and Schmitz 2003). Such suppliers have complementary competencies with lead firms and cooperate with them within specific network relationships (Humphrey and Schmitz 2000). Though relationships vary greatly between the types of chains, what is common among the three types (excluding *markets* where virtually no coordination is needed, and *hierarchies* where coordination occurs in-house)

is that some level of coordination is needed in order to maximize efficiency and a firm's ability to be competitive.

The supplier networks for lead automotive firms center on large multinational direct suppliers who are given greater responsibility for many core functions of production previously held by the lead firms themselves. While not as interchangeable or modular as other sectors (such as electronics), first tier automotive suppliers are increasingly in charge of numerous functions of vehicle production, including some elements of design, component sourcing, and module sub-assembly (Barnes and Kaplinsky 2000; Humphrey 2000; Sturgeon and Florida 2000; Humphrey 2003; Tewari 2003; Quadros 2003). Lead firms are free to focus almost exclusively on their core competencies of product design and marketing, where the barriers to entry and value added are the greatest (Kaplinsky 2000). Therefore, the existing value chain structures have created a thickening of linkages between lead firms and their major suppliers over the past decade, and a thinning of linkages between lead firms and material and component suppliers – in effect creating an environment of more control with respect to behavior of those in the first tier, and a lower degree of control over component suppliers.

These conditions, however, are merely a useful lens for understanding value chain governance within industries. The actual structures that exist within sectors are far more complex than such explanations suggest. Multiple types of governance can occur simultaneously with a particular producer's production network, depending on how much communication and cooperation is needed. Highly complex products and specialized components may require very tight-knit relationships between lead firms and their first-tier suppliers that can be classified as *modular* or *relational*, while increased commoditization of

highly standardized components in recent years has led to largely *market-driven* relationships within value chains regardless of tier level. Such a shift has therefore decreased the degree of coordination necessary for some components and products, while other processes and components require a thickening of ties. This situation is certainly true within the automotive industry, where lead firms maintain very tight coordination of design and manufacture with a handful of large first tier suppliers, while also sourcing from thousands of individual component suppliers on a purely market-based level. It is also important to note that the tier structure of the industry is not cut and dry, where firms may have first-tier relationships with some automakers, and second-tier relationships with others. There are also situations where automakers *themselves* become, in essence, tier-2 suppliers by providing parts from their stamping plants to first-tier manufacturers.⁵ One must keep the complexities of these relationships in mind when considering overall coordination and governance within any sector.

Lead firms and first tier suppliers in these sectors adopt specific strategies in order to reduce the complexity of transactions between themselves and component suppliers in lower tiers. One central way firms reduce such complexity is through the development of technical and process standards. Such standards emerge in the form of public and private institutions that define grades and standards for products and processes and ensure compliance with them (Gereffi, Humphrey, and Sturgeon 2003). Standards may include just-in-time logistics, total quality management systems such as ISO 9000, or even SA 8000 and ISO 14001, dedicated to compliance with labor and environmental standards, respectively. With respect to developing countries, customers will often help contractors and others in their networks to

⁵ Indeed, when a manager from a large first-tier was asked whether she could draw a schematic of even the basic relationships within the automotive industry she replied, “I don’t think there is a piece of paper large enough.”

upgrade processes to meet requirements and specifications, particularly when standards and specifications are complex (Keesing and Lall 1992). Value chains, in essence, become conduits for diffusing practices and values – be they dedicated to improved quality, technological processes, or expectations regarding social and environmental behaviors.

For export-oriented industries such as the Mexican automotive sector, the role of value chain relationships for learning and standards acquisition are augmented by participation in local industrial clusters, where collective efforts by local firms encourage efficiency gains and improve capabilities and competitiveness (Humphrey and Schmitz 2000; Nadvi and Schmitz 1999; Rabellotti 1997). These advances include the ability to operate in accordance with the growing number of international standards expected by global manufacturers. A major reason inter-firm cooperation and industrial clustering aid in the successful adoption of international standards is that the sharing of resources allows local firms to take small steps towards upgrading with lower levels of individual risk, which eventually allows for the accumulation of capital, knowledge and skills (Nadvi and Schmitz 1999; Knorringa 1999; Tewari 1999; Nadvi 1999; Rabellotti 1999; Schmitz 1995, 1999). Local firms may share capital resources, jointly purchase inputs, and jointly engage in employee training, among other activities, in order to extract additional efficiencies and learn from one another. These firms may also work closely with customers or clients in their value chains in joint product development and marketing or capital purchases for similar reasons. In short, both internal factors specific to relationships within local economies (so-called *horizontal cooperation*) and relationships with external economies through value chains (*vertical cooperation*), affect firms' abilities to upgrade capabilities and allow for the successful adoption of international standards – including those pertaining to environmental outcomes.

Diffusion of Environmental Standards: Between Firms and Across Borders

To date, the literature pertaining to the diffusion of standards has mainly focused on national regulations addressing labor and the environment. The majority of these studies have concluded that increased trade between nations tends to lead to the strengthening of national regulatory standards (see Vogel & Kagan 2002 for summary). One of the strongest arguments along this vein is made by Vogel (1995) and his postulation of a “California” or “ratchet effect,” wherein firms forced to work in regulatory environments with strict standards find it in their economic interest to push for similar standards wherever they operate in order to gain a competitive advantage.

Institutional theory suggests that similar organizations and entities tend to adopt similar structures and practices over time (Meyer and Rowan 1977; DiMaggio and Powell 1983; Strang and Meyer 1993). Organizations often adopt these similar behaviors largely for ceremonial reasons and institutionalize them, even if they sharply conflict with efficiency criteria, in order to increase their legitimacy in the eyes of world business, political or civil society. Actors who adopt formal structures and practices (or rationalized elements) that are considered acceptable “maximize their legitimacy and increase their resources and survival capabilities” (Meyer and Rowan, 1977). In other words, in order to earn permission to play the game (whatever that game may be) actors must conform to socially defined expectations. From standard accounting procedures to quality management systems, standard practices are used as external assessment criteria to “demonstrate socially the fitness of an organization” (Meyer and Rowan, 1977). Additionally, the presence of standard practices and organizations are expected to be more pervasive within more “modern” societies (Strang and Meyer, 1993; Meyer and Rowan 1977). As such, standard international structures and

practices, including environmental behaviors, may signal the modernity of a firm and increase as a society develops institutionally.

This process of organizations becoming more similar over time is often referred to as *institutional isomorphism*. DiMaggio and Powell (1983) outlined three major types of pressures that facilitate these isomorphic changes: coercive, mimetic and normative.

Coercive pressures are associated with a direct consequence for action or inaction and may be crudely characterized as “do it or else” pressures. Mimetic pressures are associated with unknown consequences for action or inaction regarding a particular issue and may be described as “I don’t know what will happen, so I’d better” pressures. Normative pressures are those associated with the professionalization of a particular field, including the adoption of standards of practice and ethics.

In practice, Christmann (2004) has found increased standardization of companies’ environmental policies in response to a variety of pressures, including those from customers, governments, and industry generally. Along this vein, Garcia-Johnson (2000) posited that multinational chemical companies may be “exporting environmentalism” to the industrializing world by transplanting many of the environmental standards in place in their home country to their operations overseas. By using similar environmental standards in industrializing countries these firms were in fact introducing more stringent practices than had been previously present or required by local regulations. Industry leaders were raising the environmental bar, so to speak, and forcing others in the sector to either raise their standards as well or fall to a competitive disadvantage. Indeed, Wheeler (2000) has noted that large TNCs generally adhere to their home country standards when establishing their operations in areas where environmental regulations may be more lax. Going further, other

scholars have found cases where TNCs were actually more innovative in their approaches in developing countries than in comparable U.S. facilities (Rappaport and Flaherty 1992; Fowler 1995). In an empirical study of Chinese firms, Christmann and Taylor (2001) found that TNC ownership, having TNCs as customers and exporting products to developed countries increase self-regulation and environmental performance. On the macro-level, Prakash and Potoski (2006) found that high levels of ISO 14001 adoption in importing countries encourage firms in exporting countries to adopt the standard as well. This has proven to be a challenge for many firms in developing countries (Chang-Xing 1999), but can lead to improved performance and result in “win-win” scenarios when successful (UNCTAD 2000; Dasgupta, Hettige and Wheeler 2000).

While Garcia-Johnson suggests in her work that those forced to change their behaviors included domestic chemical firms and, perhaps by extension, those who supply them, little has been done to measure how those behavioral changes are influenced by business relationships, or how they are being adopted at the facility level. In a study of Mexican automotive suppliers, Hutson (2001) found that 65% of suppliers to Ford, General Motors, and others did not have a formal EMS in place prior to the automotive industry mandates for first-tier suppliers to adopt ISO 14001. These studies suggest that increased interactions with multinational firms based in the industrialized world are motivating facilities in Mexico to improve their environmental capabilities. However, such studies have been limited in what they can tell us about the specific details of facility adoption and about broader trends of industry-wide diffusion of environmental management. This study aims to address this lacuna in the literature.

These works must all be considered in light of the rise of private authority and the role it plays in an increasingly globalized world. Hall and Biersteker (2001) discuss the rise of private governance institutions in roles that challenge or replace the traditional roles of state and intergovernmental institutions. These authors suggest that the transference of authority from the state to private actors in areas such as the establishment of norms and standards stems from the state's conviction that doing so will lead to efficiency gains in the execution of state and market functions. Inherent in this shift is the notion that select private actors are trustworthy agents that have the moral authority to work in the public interest. In other words, the state *willingly* transfers power to private economic actors because they are able to perform state functions in a more efficient way while maintaining essential public trust.

Cutler, Haufler and Porter (1999), on the other hand, avoid wholesale acceptance that the transference of authority is a conscious rational choice on the part of the state. While the authors do concede that states often cede authority to private institutions as part of a shift to neo-liberal notions of private sector efficiency, private authority rises in response to gaps in existing state authority where governments are unwilling or unable to provide the governance structures necessary for market efficiency.

Going further, Haufler (2001) discusses how the private sector is engaging in the practice of private authority in areas that may provide public benefits – such as environmental protection and the promotion of human rights. They do not do so merely for reasons of philanthropy or even a larger sense of moral obligation. Rather, firms engage in self-regulation in order to protect themselves from political and economic risks, guard valuable firm reputations, and shield themselves from future state-based regulation that may arise in response to emerging problems. Private initiatives often rise due to transnational activist

pressures which seek to limit economic activities of firms engaged in controversial behaviors, or punish them for malfeasance. In some cases firms work in conjunction with activist groups to craft norms and standards that foster public goals and improve social and environmental conditions associated with economic activity – and perhaps raise barriers to entry in the process. Lipschutz and Fogel (2001) examine these initiatives and determine that while a number of non-governmental groups have been successful in using their moral authority to improve the behaviors of firms and craft more stringent environmental standards, private governance has not become an adequate substitute for the authority of the state, and supranational structures are needed to protect the public good in a globalized world (see also Andrews 1998).

Considered together, the literature and theory covered in this chapter inform the primary research questions of this study by providing an understanding of how private initiatives arise, function, and may produce public environmental benefits under the right conditions. The analyses in the coming chapters apply these ideas to the specific case of EMS adoption in Mexican manufacturing facilities and the particular institutional regime promoted by lead firms in the global automotive industry.

CHAPTER 3: Data Collection

As arguably one of the most wide-reaching and organizationally complex global sectors, the automotive industry has been at the forefront of developing methods to govern their spatially dispersed networks of suppliers through directives aimed at ensuring quality, delivery time, and cost savings (Sturgeon and Florida 2000). Environmental considerations stemming from the production processes along the value chain have been no exception to this development, as most automakers, in one form or another, have created expectations for the behaviors of their suppliers and the adoption of industry best practices.

Beginning in late 1990s, major automotive manufacturers, led by Ford and General Motors, began to require their direct suppliers to adopt formal environmental management systems consistent with the ISO 14001 EMS standard as an expansion of ISO adoption in their own facilities world-wide. These same firms have encouraged their suppliers to extend the requirement along the value chain to companies in lower tiers. The elaboration of these policies represents not only an extension of broader efforts to more effectively coordinate increasingly intricate and diverse supply networks in a hyper-competitive global market, but also a foray into promoting behaviors with outcomes that may provide public environmental benefits. If successful, this incursion could stand as an example of how private industrial actors may use economic leverage to influence the actions of business partners in pursuit of public goals where the reach of government has been ineffective.

This study explores the emergence of environmental supply chain mandates in the North American automotive industry, examines how widely mandates to adopt ISO 14001 are

diffused through production networks and how thoroughly the specific requirements are adopted by autoparts manufacturers in Mexico. Three principal research questions surrounding these issues and the supply chain mandate policies of the automotive manufacturers are addressed. First, how are supply chain mandates to adopt ISO 14001 interpreted and implemented by suppliers along the value chains of major automotive manufactures in Mexico, and how effective are they mandates in driving adoption? Second, are the systems that are adopted by plants in Mexico geared towards achieving a range of environmental goals and higher-order environmental objectives, or are they simply “paper systems” that meet minimum requirements of the standard? Finally, have these policies been replicated and passed along the value chain to lower tiers of suppliers, or has penetration been limited to the first tier?

In investigating these questions, several fundamental areas need to be examined. First, how supplier firms interpreted the environmental requirements of their customers and the internal processes they used to implement the practices must be explored, in order to gain a better understanding of the impact of the mandates. Second, the degree to which supplier firms pass along the requirements through their own networks need to be explored in order to understand the extent to diffusion within the industry. Third, the specific environmental practices in place at supplier facilities adopted in response to these mandates, as well as the particular performance objectives set by these firms need to be detailed. Additionally, as the ability to successfully adopt environmental practices may depend on several factors not expressly related the presence of mandates, or the environmental philosophies in place, existing management and technical capabilities in practices need to be considered, as well as relationships with other firms within local industrial clusters and external markets.

To this end, this study uses two primary methods for gathering data pertaining to these areas: structured interviews to gather qualitative data, and a survey instrument for quantitative data. This chapter details the methods used for the collection of both. It begins with an overview of the structure and content of interviews with representatives from six of the top ten largest automotive suppliers in North America, as identified by the Automotive News' *Top 150 North American Suppliers* annual ranking for 2004 and two major automakers. The chapter also details the process for collecting survey data from automotive supply manufacturing facilities in Mexico, including a detailed description of the survey type, the instrument design and pretest phase, population sampling, survey implementation, and the error structure.

Structured Interviews

A series of structured interviews were held with corporate environmental officers from six of the ten largest automotive suppliers in North America, as identified by the Automotive News' *Top 150 North American Suppliers* annual ranking for 2004. Interviews were also held with corporate managers from the automakers (also referred to as Original Equipment Manufacturers or OEMs) Ford Motor Company and General Motors. Interviews were held at corporate headquarters in the metro Detroit area, or by phone, from September 2005 to February 2006 and averaged 45 minutes in length. Interviews with suppliers focused on three main areas: the interpretation of the requirements from customers, the implementation process, and the replication of the mandates to their own suppliers (please see Appendix A). Interviews with OEMs focused on how expectations are communicated to suppliers, how the policy is monitored and enforced, and plans to extend the policy to lower tiers. Interview

responses were transcribed and coded. Follow-up conversations were also held with individual ISO 14001 registrars via e-mail to better understand the auditing process.

Because the automotive supply base is so large, even at the first-tier level, efforts were concentrated on obtaining interviews from the largest suppliers. In many ways, these firms can be considered ideal types of multinational automotive suppliers: those with the greatest knowledge and capital resources and scope of operations that are, in many cases, on par with their major customers. Though they all have a global presence and manufacture wide ranges of sub-assembly units and components, they are diverse in ownership and management structure, creating a degree of variation in the sample.⁶

Because the interviews were aimed at large first-tier suppliers, in order to better understand the response to the formal requirements and any efforts to replicate it, the external validity of the study is limited. That is, interview responses may not apply to smaller firms who are subject to the same requirements, but possess lower degrees of management expertise or financial resources and capital. Differences in how smaller companies may respond to these same pressures are discussed in the implications section, however, with special attention to how lack of such resources may affect outcomes.

Of the major global automotive manufacturers, only General Motors and Ford Motor Company agreed to be interviewed for this project. DaimlerChrysler, Toyota, Honda, and Nissan all either directly declined, or did not respond to multiple requests for meetings. As a result, I emphasize the policies from the Ford and GM interviews, while adding the same details of the others' policies from supplier interviews.

⁶ Because suppliers were promised anonymity, I have chosen not to report demographic features and manufacturing specializations. Doing so would make them easily identifiable due to the small sample size.

Survey Methods

Survey Type

The survey was administered via HostedWare's *HostedSurvey* web-based survey application. An internet-based instrument was chosen due to logistical considerations and budget constraints. A mail-based survey was not seriously considered due to potential problems with Mexican post and in-country resources to administer it. Face-to-face interviews, which would yield the best results and response rate, were also ruled out due to lack of resources to hire and train in-country interviewers and the geographic dispersion of manufacturing sites, spanning virtually all of Mexico. Help with English to Spanish translations came from content experts (academics and professionals) who are native Spanish speakers and experts in the field of environmental management in Mexican and North American industry.

Instrument Design and Pre-test

The main objective of the survey was to gain a better understanding of the environmental management practices in place in the manufacturing facilities of automotive suppliers, the specific motivations for adopting such practices, and the associated resources and capabilities that may contribute to environmental behaviors. The questionnaire was aimed at obtaining information from four main areas: (i) the environmental management activities currently in place at the manufacturing facility; (ii) the specific objectives of those activities; (iii) technical assistance and cooperation with other local firms, customers and suppliers; and (iv) demographic information about the firm and its business organization (please see Appendix B).

The survey was designed to take approximately 20 - 25 minutes to complete and each respondent was given an individual access code to return to the survey at their convenience. A previous version of this survey was pretested, evaluated by experts, and implemented at manufacturing facilities in four industries in the United States. This survey was subject to review and pretesting by industry experts in Mexico and Latin America before being sent to respondents.

Sampling and Survey Implementation

The sampling frame for this study was provided by the *Industria Nacional de Autopartes'* 2005 directory of members. The members of INA represent various subsectors involved in the manufacture of automobiles – ranging from the production of tires and batteries, to metal fabrication, windshields and components. From this directory I was able to obtain email addresses and contact information for over 858 facilities.

The survey was conducted from October 4 – November 15, 2005 and was done in accordance with Dillman's Tailored Design Method (TDM) for mail and internet surveys. The target respondents for the survey were plant managers, environmental managers, or managers designated by plant managers with knowledge of a facility's environmental management practices. Members of the association were sent advance notice from INA during the last week of September, alerting them that they would receive an invitation to join the study in the coming week. This notice was followed one week later by an email from me explaining the study (in cover letter form) with an individualized link to the HostedSurvey website. As incentive to participate in the survey, respondents were offered an entry into a lottery to win an Apple iPod Nano. A reminder email with the individualized link was sent

one week later, a reminder email and invitation two weeks later and a final invitation with a link was sent four weeks after the initial invitation. In line with TDM, recipients were sent a total of five contacts over the course of data collection. Potential respondents were notified that their cooperation was voluntary, informed of their rights as research participants and that the study had been approved by the Academic Affairs Institutional Review Board (AA-IRB) at the University of North Carolina at Chapel Hill. After accounting for incorrect email address, ineligible and incomplete responses, the survey yielded an overall response rate of 26.14%. This response is slightly above average for surveys of business establishments in the United States (Dillman 2000).

Error Structure

This section details the factors that could introduce biases or errors to the representativeness and quality of the data.

First, despite the advantages for this particular study, there are several problems inherent in using a web-based method. First, the technology and methodology are relatively new, leading researchers to face greater unknowns than is the case with more tried and true methods of mail, telephone and face-to-face interviews. Potential coverage errors that may exist based on this mode of implementation. For example, many smaller and lower-tier manufacturing facilities may not have the same quality of internet connections as larger operations (e.g. dial-up vs. DSL), which may lead to higher instances of abandoning the survey in process, or not attempting it in the first place.

Additionally, the use of this mode may lead to a high number of bad and inappropriate contacts, as e-mail addresses and personnel change frequently, or messages may be filtered

due to e-mail security features. Indeed, a very large number of invitations (nearly 25% of the sampling frame) were never delivered to intended respondents and were returned. Many of these “bounced” emails may have been due to spam filters not allowing emails containing web links or coming from unrecognized sources, or the addresses were simply outdated or incorrect. Additionally, many of the contacts listed in the directory were for sales representatives and not plant managers (many more may also have been for sales representatives, but not as clearly marked). As a result, many plant managers may never have received the invitation to participate in the survey, despite a request to forward the invitation if it was sent to an inappropriate contact. It is unclear to what extent these directions were followed.

Fourth, some locations in the sampling frame were not manufacturing sites and were therefore not eligible to participate in the survey. Some contacts were for corporate offices and not listed as such. Others no longer have manufacturing operations in Mexico themselves but still engage in purchasing functions within the value chain. Several respondents sent reply emails indicating that their operations had either moved to Asia, or that they served as intermediaries between Asian firms and multinational corporations for component sourcing. While those who responded were taken into account, invitations to similar firms may have been ignored. In order to test for any resulting bias that may have been introduced due to these potential problems, several tests for simple effects bias were run using interaction terms with demographic variables and variables of interest in the regression analyses. None of the tests indicated the presence of significant bias in the survey responses.

CHAPTER 4: Policy Adoption and Diffusion by Major Suppliers

This chapter explores three major questions associated with the OEM policies for EMS adoption by their first-tier suppliers. First, how have the mandates been interpreted and adopted by the largest automotive suppliers and what variance exists in the approaches each has taken? Second, how are the policies monitored and enforced by the OEMs and to what degree have they been effective in their aims? Third, have the first-tier suppliers replicated these requirements for their own suppliers and what hindrances exist to doing so?

In the following sections, I outline the EMS policies of the OEMs and their methods for monitoring and enforcement, examine the extent to which the policies have been replicated, and discuss the implications of these results. The findings suggest that while all firms in the sample interpreted the EMS policies as strict mandates without room for interpretation, there has been some variation in the approaches taken to implement and register their EMSs. However, it also finds inconsistencies in how the policies are monitored and important exceptions that exist. Despite these apparent inconsistencies, suppliers still interpret the requirements as firm and many would not have implemented EMSs in conformance with ISO 14001, nor gone through the process of external verification, in its absence. It should be stated at the outset, however, that the actions to comply with the policies of the OEMs refers only to the process of acquiring registration to ISO 14001 and does not guarantee that the systems are complete or that the content of the EMS will lead to environmental performance improvements. Accordingly, this chapter presents a more proactive approach by automakers

to ensure more effective adoption of EMSs – both in terms of structure and content – and adherence to their policies. Finally, this chapter explains how requirements to adopt formal EMSs are not being replicated by tier one suppliers in any systematic way – and why they are not enforced in the few cases where companies have instituted such policies.

During the 1990s, most major automakers undertook major global initiatives to certify their manufacturing facilities to the ISO 14001 environmental management standard. By the end of the decade most had successfully completed this process and had recognized the operational, managerial and environmental benefits associated with standardizing their environmental efforts. As a result, some moved to require that direct (tier-one) suppliers to their manufacturing facilities also certify to the ISO 14001 standard as well.

The importance of supplier networks to the automotive value chain helps provide context to this decision. Many of these same firms had been experiencing considerable changes to their organizational structures over the same period. The most significant of these changes involved the automakers (also called *Original Equipment Manufacturers* or OEMs) divesting themselves of key manufacturing and design functions and outsourcing them to production networks operating across the globe. In a few cases automakers spun-off entire business units to form independently operating supplier firms with whom they maintained strong cultural and economic ties. Delphi and Visteon, among the largest multinational automotive suppliers, were created as General Motors and Ford moved to streamline their operations and focus on core design and assembly competencies.

Because of the increased fragmentation of their production networks, and increased global span of operations more generally, automakers began to employ a host of initiatives to increase standardization and efficiency on a worldwide basis to facilitate these changes.

Such strategies included global integration of operations and previously independent geographic business units, upgrading of information technologies and communication channels, and centralizing decision-making to serve a global market. Ed Hagenlocker, President of Ford Automotive Operations in the mid-1990s, stated, “by centralizing decision making, we can take the broadest possible view of market opportunities, and we can develop products that serve multiple markets, vastly increasing the return on every product development dollar” (Financial Times 1995). Other executives referred to such strategies to integrate global operations as “a wrecking ball” to knock down all the bureaucratic and geographic barriers that complicate international operations (Financial Times 1995).

A desire to improve standardization and efficiency partly drove the decision to include suppliers into their environmental management strategies for global operations, as did a need for protection against reputational risks and more abstract goals to foster corporate social responsibility (Hutson 2001; Hutson, Andrews, and Edwards 2006). Additionally, the OEMs issuing the mandates had hoped that first-tier suppliers would also recognize the benefits of EMS adoption and replicate the requirement for their own suppliers in lower tiers, creating a “cascade effect” throughout the entire value chain (Hutson 2001).

The OEM Policies⁷

While policies of the automakers requiring ISO 14001 adoption are essentially the same, there are slight differences among them that deserve attention. This section briefly details the policies themselves, the differences among them – namely General Motors’ option for a

⁷ An earlier version of this section can be found in Hutson 2001. Updates have been made to this section since its initial writing.

“self-declaration” option that some suppliers may choose – and the methods for monitoring and enforcement by the companies.

In April of 1995, the General Motors Vauxhall assembly plant in the United Kingdom gained certification to the British environmental management standard BS 7750 and soon after was certified to the ISO 14001 standard (McCulley 1999). In February of 1996, GM held an Environmental Strategy Focus Forum to think about ways to better incorporate environmental issues facing their firm into the business planning process (GM 1996). Out of this meeting came the decision to adopt a uniform environmental management systems standard for their entire global manufacturing operations. Subsequent internal discussions and meetings with their “SEA Team” (Supplier Environmental Advisory) led to the 1999 announcement that all of its own manufacturing facilities would be ISO 14001 certified by December 2001 and that it would require all of its direct suppliers to have an EMS in place for “all manufacturing facilities supplying product to GM by the end of 2002” (GM Purchasing memo to suppliers 2000).

In March 1996, the Ford Halewood Assembly and Transmission Plant in Liverpool, England received ISO 14001 certification and was followed closely by plants in Germany and Taiwan. Soon after, Ford set the ambitious goal to have all of its manufacturing sites obtain ISO certification by the end of 1998 (Ford 1998). By December of 1997 all of Ford’s Australian facilities were certified to ISO 14001. Ford was able to meet its 1998 goal and become the first automaker to have all its existing plants certified to ISO 14001. In 1999, Ford also issued a mandate to its suppliers: all manufacturing sites shipping products to Ford must be ISO 14001 certified by July 1, 2003 (Ford 1999). In 2000, DaimlerChrysler too

announced that it would require all supplier manufacturing sites be registered to the ISO 14001 standard by January 1, 2003 (IES Update 2000).

While they are minor, slight differences do exist in the policies regarding ISO 14001 certification for suppliers. Ford requires all direct materials suppliers be registered to ISO 14001, as well as all non-manufacturing service providers with “significant environmental risks” (e.g. facility painting, machine servicing and cleaning) (Monique Oxender, Ford Motor Company, personal interview, September 2005). According to the Ford policy, there is no room for negotiation and no exemptions are offered with respect to the requirement. Monitoring of the standard is enforced by the engineering division within purchasing, which is responsible for monitoring overall quality and assigning a supplier’s quality rating. EMS certification is attached to Ford’s top quality rating, or “Q1” status, which enables suppliers to bid on and receive preference for contracts, is reviewed upon bidding for new contracts and is frequently re-evaluated based on specific product specifications and components. If a firm loses Q1 status, it is virtually guaranteed that they will not be awarded any future sourcing contracts unless they are able to regain it by meeting all required certifications and passing all relevant inspections. As of September 2005, 99.5% of Q1 suppliers were certified to ISO 14001. According to Ford, the remaining half percent are not exceptions to the policy, but rather new business relationships or facilities that have contractually agreed to obtain certification within a defined period of time (Monique Oxender, Ford Motor Company, personal interview, September 2005).

General Motors has defined their policy in slightly different terms for suppliers. It has required all direct suppliers of parts for GM products to have an environmental management system in place since the end of 2002, but has some flexibility in how that EMS is verified.

Instead of a sole reliance on certification to ISO 14001, direct suppliers must have a system in place that is *in conformance with* ISO 14001. Worldwide Purchasing, the division of GM leading the charge for supplier implementation of EMSs, has stated that it will also accept registration to the European Union Eco-Audit and Management Scheme (EMAS) as a demonstration of EMS implementation or the more controversial alternative option of *self*-certification. GM has stated that while “(t)hird party confirmation is strongly preferred, it also will accept written declaration by a responsible executive that a site is operating under an EMS that is in conformance with ISO 14001” (GM, press release 1999). The responsible executive is defined by the policy as the head manager of a supplier facility.

Suppliers taking advantage of the self-certification option do have additional requirements under the official policy. First, they must re-submit EMS documentation to General Motors every three years (those who opt for third-party have no such requirement unless their registration is revoked). Second, while GM considers this option equivalent to third-party verification, “suppliers utilizing the self-declaration process should be prepared upon request, and/or audit, to demonstrate conformance” (GM 2000). Self-declarers must also perform yearly internal audits, take appropriate steps to correct deficiencies found in those audits, have top management review the results of such audits on a yearly basis and be prepared to provide Worldwide Purchasing with documentation supporting their environmental objectives, targets, and environmental programs upon request. This policy was established in order to facilitate the process for suppliers who may already participate in programs such as the American Chemistry Council’s (ACC) *Responsible Care* program or other codes of practice or EMSs. Such long established programs are seen as useful frameworks for achieving environmental goals and are therefore acceptable to General

Motors – as long as participants self-declare (Lee Hachigian, General Motors Corporation, personal interview, December 2000; e-mail correspondence 2006). However, very few suppliers use this option: most appear to prefer the more conventional route of external verification and ISO registration.

Similar to the Ford process, GM's global purchasing division is responsible for tracking and managing ISO 14001 registrations when the bidding process for new contracts begin and when quality ratings are reviewed. There are no yearly or scheduled check-ups, and plants verify status by sending an electronic copy of their registration to the purchasing division. Similar temporal exemptions also exist, where suppliers without ISO 14001 at the time of contract bidding may agree to do so within a defined period of time specified in the contract (Lee Hachigian and Pat Beattie, General Motors Corporation, personal interview, September 2005). While representatives from DaimlerChrysler refused participation in this project, suppliers to DaimlerChrysler indicated that the monitoring and enforcement policy is comparable, with electronic submission of certificates of registration required at the time of contract bidding. Suppliers also reported that while other companies, such as Toyota and Honda, fell short of directly mandating ISO 14001 adoption, several of them "strongly encourage" it but do not threaten a supplier's quality rating or other measures if they fail to achieve certification. One supplier suspected a free-riding component, where some firms use resources to create a public good and enforce the standard, while other companies invest little and reap potential benefits from a shared supply base. That is, most suppliers do not work on an exclusive basis with any single automaker. If one automaker requires ISO 14001 and expends resources, however limited, to communicate and enforce the policy while another

does not, they both share equally in whatever reputational or managerial benefits the standard produces.

Unlike in the area of quality, where OEMs will occasionally audit a supplier's plant themselves if they have experienced problems with quality or suspect a potential problem, the automakers do not audit environmental systems themselves, though GM does reserve this right in cases where suppliers choose to self-certify. Instead, OEMs depend on independent third-party ISO 14001 registrars, hired by suppliers themselves, who award certificates based on the results of the audit process. Despite the potential pitfalls in accuracy of relying on external monitors paid by supplier firms, OEMs prefer this method over conducting such audits themselves for two main reasons. First, the corporate infrastructure and resources necessary to engage in such audits would be extraordinary, as the production networks of the OEMs exceed 3000 plants located around the globe. The direct benefits derived from such audits – namely, more accurate assessments of supplier behaviors – would be dwarfed by the massive costs of deploying teams of auditors to all supplier plants worldwide. Second, and perhaps as importantly, engaging in such audits would expose the automakers to increased liability and risk. By actively engaging in the environmental management efforts of their suppliers, they would be taking a degree of ownership over the processes in place, and exposing themselves to greater reputational and financial risks in the event of an accident or adverse environmental incident.

Unlike quality issues, where a faulty component directly affects an automaker's end products and OEMs therefore frequently conduct internal audits when a problem is suspected, environmental issues remain outside the scope of what are considered primary business functions. Maintaining a policy of requiring an externally monitored EMS, rather

than direct involvement, demonstrates due diligence if such an event should occur while divorcing them from any direct responsibility. As a result, there are no plans for any of the automakers to actively monitor the environmental activities within supplier plants.

How Mandates have been Adopted and Implemented

While all firms interviewed for this study interpreted the requirements from the automakers as strict mandates without room for interpretation, there has been some variation in the approaches taken to implement it in terms of centralization of the process and choice of registrars (Table 4-1). And while all firms state that they would have adopted some form of environmental management in the absence of a formal requirement, the choice of some automakers to make the adoption of ISO 14001 mandatory, rather than communicating it as a softer “expectation,” was an important driver for most firms to implement a more stringent standard. The OEM policies motivated upper management in supplier firms to devote the necessary resources to formal adoption and third party monitoring, when many would have otherwise been satisfied with less stringent internal efforts.

All suppliers interviewed stated that there was absolutely no confusion regarding what was expected from them with respect to the OEM mandates, as vice presidents in each company’s purchasing department sent letters to suppliers detailing precisely what needed to be done and giving deadlines for implementation. Absent these deadlines and explicit instructions, most supplier firms stated that they would not have responded with third party auditing of their EMSs, or the adoption of ISO 14001 equivalent systems. Of the firms interviewed, two had already undertaken the ISO 14001 adoption process on a firm-wide basis prior to it becoming a contractual requirement with OEMs, three others were in the

process of adopting EMSs using the ISO 14001 template as a guide, and one would not have adopted a formal EMS at all and instead would have continued to focus on a “compliance-based” approach to environmental management at all of its sites. Of these firms, however, only the two with ISO 14001 in place prior to the OEM mandates would have had their EMSs externally verified and undergone the certification process without the explicit requirement from the OEMs. The rationales for the other three firms pursuing EMSs to not seek third-party certification, and the fourth to not implement an EMS in conformance with the ISO standard in the absence of the mandates, hinged on the same factor: upper management at these companies would not have invested the resources necessary absent explicit external pressure from the OEMs.

Table 4-1

	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Supplier F
How mandate was interpreted	Strict	Strict	Strict	Strict	Strict	Strict
Adopted EMS based on ISO 14001 w/o mandate?	Yes	Yes	No	Yes	Yes	Yes
3 rd party audits w/o mandate?	Yes	No	No	Yes	No	No
Centralized v. decentralized corporate structure for environmental management	Decentralized	Centralized	Centralized	Centralized	Centralized	Decentralized
Single or multiple firms used to audit and register global sites?	Single*	Single	Single	Single	Single	Multiple
Faced punitive action for non-compliance?	No	No	No	No	No	Yes
Replicate mandates to own suppliers?	No	Yes	Yes	No	Limited	No
Plans to enforce supplier mandates?	---	No	No	---	Limited	---

*90% of global plants use the same company to audit and register their systems

Even though corporate environmental officers within supplier firms had been actively pushing for company-wide adoption of ISO 14001, their requests for the resources to do so often fell on deaf ears. Not seeing the potential financial and management values first-hand, as environmental managers often do, the leadership of companies viewed environmental activities as an expense, rather than a potential source of savings and competitive advantage

(Hart 1997). In some cases, company leaders were unwilling to budget for registrations when some plants had already undergone the bulk of the work required to gain certification. As one corporate environmental officer stated, “We even had sites that were ready to certify due to our internal efforts, but the company brass found it to be an unnecessary expense, so we didn’t” (Supplier F, personal interview, September 2005). According to another environmental manager, “we would never have gotten the support of upper management [to adopt ISO 14001 company-wide] without the OE’s [*sic*] insistence – certainly not the third-party aspect of it – going with third-party would have required extra costs that management would not have been keen to take on” (Supplier C, personal interview, September 2005).

The dedication of resources became an issue of market imperative to business leaders – it had to become very clear to keepers of corporate purse-strings that adopting and certifying to ISO 14001 was a rigid business requirement. “It was clearly seen as a condition of doing business, that is what made leadership take it on - absent the consequences we would have instead done a ‘compliance’ process if the customers would have come out softer on it” (Supplier B, personal interview, September 2005). Even stronger, “the threat of losing business and the threat that they would not get to bid on new business was the biggest driver for adoption – had the mandate not been in place [company leadership] would not have gone for certification” (Supplier F, personal interview, September 2005).

The question of upper management buy-in and dedication of necessary resources also raises questions regarding the quality of the EMSs that would have resulted under this counterfactual, without external pressure from customers for certification. EMS adoption, even the process of self-certification, often requires the dedication of large amounts of financial and human resources in order to implement effectively (Andrews et al 2001). They

can be expensive and time-consuming endeavors, particularly if the company itself does not possess internal competencies and experience with environmental management. Without the commitment of resources and rigor which auditors sometimes offer⁸, self-certified systems may have been of lesser quality and thoroughness. In the words of one corporate manager, “the external requirement from customers made it faster to adopt and probably higher quality – third-party auditors drive the discipline we need sometimes” (Supplier B, personal interview, November 2005). Additionally, internal corporate mandates for environmental action may not be taken as seriously by all plant managers as external threats from customers with genuine consequences for current and future business. “Since the expectation was put out by OEM management – you *will* certify and you *will* have it done by X date – that’s why they [individual plant managers] complied. Had that pressure not been there, I don’t think management at all facilities would have done so” (Supplier B, personal interview, November 2005). In short, the OEM mandates not only drove adoption, but forced the issue of environmental management to become a larger priority for suppliers and forced companies to allow for expenditures where they otherwise would not have dedicated the resources.

The OEMs gave no specific instructions regarding how direct suppliers must adopt ISO 14001 in their plants – only that they must do so by a specific date. Accordingly, each company has had the flexibility to implement the standards in ways that align with their corporate structure and individual management styles. Companies that allow their plants and business units to operate with greater autonomy more generally are also more inclined to assign more independence to plants with regard to EMS adoption. The firms in this study used methods for implementation and maintenance of their systems that fall into two broad

⁸ The quality of auditors can often vary in terms of expertise and thoroughness, as reported by three of the suppliers interviewed. See also NAPA 2001 for a detailed assessment of the ISO auditing process. This point will be discussed further below.

categories – decentralized or centralized coordination of their EMS processes. Decentralized approaches assume a low degree of coordination and oversight from corporate headquarters and generally rely upon plant managers, or managers from geographic clusters of plants, to design EMSs and conduct internal audits prior to third-party verification. Centralized approaches imply a greater degree of coordination and oversight by corporate environmental officers and departments, who often provide “off the shelf” EMS templates for plants to follow, provide technical assistance with implementation, and conduct internal audits prior to visits from registrars. Two of the six firms interviewed used decentralized methods for EMS implementation and maintenance, while four took a more centralized approach.

Supplier A and Supplier F both relied on plants themselves, and clusters of plants with geographic proximity, for their internal corporate efforts to implement and maintain their systems. Supplier A’s process involved using managers from clusters of plants to internally audit one another’s EMSs, and provide technical assistance and feedback when necessary, before each plant submitted to external auditing by registrars. “Stand alone” plants, not located within a reasonable proximity of others, generally relied on outside consultants for technical assistance and help with internal audits prior to the external registration process.⁹ Supplier F’s process functioned in a similar way, with plants within certain regions providing technical assistance where necessary, but were not as far-reaching with respect to joint internal auditing of one another’s facilities. While plants did report to corporate headquarters and environmental officers in charge with respect to these measures, they were given a great deal of autonomy in the process, provided they maintained their certification status.

⁹ Outside consultants providing technical assistance are not the same companies that conduct the registration audits, which is prohibited under the ISO 14001 standard.

The other four companies were more centralized in their approaches, often providing “off the shelf” templates for ISO 14001 adoption (Suppliers B and E) , conducting internal audits on a company-wide basis (Suppliers C, D, E) and in some cases registering several plants on one “multi-site” certification (suppliers B and C). Each of these companies maintained an environmental officer and department at corporate headquarters to oversee global operations and review audits and non-conformances (problems) that might be uncovered in the process. Several functional differences did exist, however. Supplier B maintained a very small environmental staff with one person responsible at headquarters for coordinating and reviewing all environmental work, which was often outsourced to consultants with particular areas of expertise in specific regions, while Supplier D conducted all plant audits with internal corporate experts on a yearly basis in order to incorporate company-specific knowledge for each of its business units that they did not believe was possible from outside consultants. Similarly, Supplier E used one standardized process to prepare for ISO 14001 and TS 16949, an automotive industry specific quality standard, for all global locations.

Virtually irrespective of how centralized or decentralized the process of EMS adoption and maintenance has been for each supplier firm, nearly all firms used a single global registrar to certify the EMSs in place at their plants – with five of the six suppliers interviewed using this method.¹⁰ Supplier firms used one global registrar primarily to remove discretion from individual plant managers and receive more objective and reliable audits, which they believed were valuable tools for ensuring validity of their initiatives. Removing discretion from plant managers is an important step to prevent “shopping” for

¹⁰ I use the term “virtually irrespective” because it difficult to conclusively determine the relationship between these factors with such a small sample of firms. It is true that one of the more decentralized firms does not use a single registrar for all its plants and the other uses one for 90%, revealing the possibility that degree of centralization of corporate management may indeed have some impact on this choice.

auditors. That is, if plant managers are given the power to hire specific auditors to register their EMSs to ISO 14001, they may simply choose an auditor who will conduct uncritical audits and award certification without revealing shortcomings a manufacturing facility may have. With the threat of losing business on the line, plant managers will often choose the easiest path to obtaining certification given the option, particularly if environmental management does not rank high on their lists of personal priorities.

Corporate offices, on the other hand, will often want a genuine return on their investment from resources dedicated to environmental management rather than a simple “rubber stamp” from auditors. As one corporate environmental officer commented,

If you spend the time and money to put together an EMS, you need to be sure it is done properly. It would be stupid to put a system in place that doesn't mean anything, even though some companies do...Our company risk rates each plant according to non-conformances they receive. If there are a lot of non-conformances, we know there is something else wrong at the plant (Supplier C, personal interview, September 2005).

In other words, environmental audits are not only good tools to assess the environmental behaviors of a plant, but also as an indicator of overall management quality. If audits are rubber-stamped by lax auditors hired by uninterested managers, such objective assessments are not possible and the full value of the system is not realized. Expending resources without reaping the potential benefits makes little sense to corporate managers. Without objective assessments, supplier firms may expend valuable resources on obtaining certification without assurance that the system will provide management benefits that theoretically arise if implemented properly. From the perspective of these large supplier firms, obtaining certifications in order to continue relationships with their customers are of primary importance, but running clean and efficient operations are also essential in sectors as highly competitive as the automotive industry.

Firms also benefit from additional efficiencies that may be extracted from using one global auditor for all their facilities, as it makes both financial and managerial sense to streamline the process and centralize the registration information for each plant. Supplier E used a much less centralized process before the OEM mandates, employing eighteen different auditing firms in Europe and eight in Asia. As its North American operations began to standardize the process in response to the mandates, other regions were folded into the process, which presently uses one auditing firm in conjunction with an internally standardized process. Other firms (Suppliers B and D) have taken advantage of single auditors to incorporate their multi-site registrations. Prior to creating a common process, Supplier B had 72 separate EMSs. Incorporating an umbrella certification for their sites based on their different business units has created much greater efficiencies and streamlining of processes.

A potential criticism of using a single registrar globally is that it may encourage “rubber-stamping” or “shopping” for certifications on a larger scale, where multinational auditing firms provide lax audits in exchange for exclusive contracts. However, managers here suggest two reasons why such a scenario is unlikely. First, as stated above, supplier firms seek objective assessments of their plants – environmental audits done by qualified external auditors provide such assessments. Second, large auditing firms risk sully their own valuable reputations if they are caught or accused of lax performance. Many of the largest companies that provide these registrations, such as Det Norsk Veritas, SGS, Bureau Veritas, and BSI, have their own set of internal qualification requirements, incentives and disciplinary measures to limit embarrassing outcomes during registration audits. These actions are in addition to disciplinary measures that may be imposed by national accreditation boards for

poor performance.¹¹ As one registrar stated in response to this issue, “[t]hese are big multinational firms that do all kinds of certifications/registrations (not just quality and environmental management systems). Their worst fear is to certify a company to ISO 14001 only to have the company experience an environmental disaster shortly thereafter in which criminal culpability is involved” (Foster Knight, The Lexington Group, e-mail correspondence, February 2006). As the practices of these large firms stretch far beyond a single client’s desires, at least on the surface most registrars for these companies seek to conform to the highest professional standards in order to protect their own reputations.¹²

The one company that does not use a single global registrar for all of its facilities, Supplier F, still removes discretion from individual plant managers and obtains more objective assessments of its plants EMS, by hiring one registrar for geographic clusters of facilities. For example, one company is used for all plants in the United States, another for all of Mexico and another for Brazil and South America. This registrar is selected by a corporate environmental officer not located on-site at any individual plant. The rationale given for this decision is slightly at odds with environmental officers from other companies. “Could I save money for my region if I had a single supplier for 14000? Yes, I could and could look like a hero, but sole sourcing on a regional or global scale is just too risky. If one plant, say, a tiny little one in Uruguay fails an audit it could place my certification at risk and thus my business relationship with Ford” (Supplier F, e-mail correspondence, March 2006).

¹¹ It is unclear to what extent a registrar has ever been punished by the accreditation bodies for poor performance, if ever. In any case, it is an extraordinarily infrequent occurrence.

¹² This is not to suggest all registrars operate under these incentives, as many smaller firms have larger incentives to rubber-stamp to attract business. The intention here is to point out how larger MNCs that operate as single registrars for these suppliers may adhere to stricter standards. However, short of criminal actions or environmental disasters, even the large firms face very little incentive to be tough on their clients, particularly with respect to marginal violations or non-conformances.

Since the announcement of the mandates seven years ago, all suppliers interviewed believe they have extracted value from their systems and improved their performance over time. Over the course of the discussions, and not in response to any pointed questions regarding the benefits that have emerged, company managers referred to several areas where they have seen improvement. The most frequent comment was with respect to improved streamlining of global operations that emerged over time (Suppliers B, D, E, and F). This improved streamlining has led to improved communication and better documentation of processes and saving money. Two firms (Suppliers A and C) mentioned the importance of continual improvement that has causes “peaks and plateaus” in their environmental performance over time – first harvesting the “low hanging fruit” and then finding new areas to pursue. One supplier mentioned the effect that implementing EMS has had on other firm competencies, including related environmental initiatives in the industry, such as the End of Life Vehicle (ELV) directive from the European Union¹³, and in quality management. Finally, Supplier F strongly suggested the greatest benefit has been to increase the profile of environmental activities in overall operations in the eyes of management. “We [environmental management personnel] still don’t get to drive as nice of company cars [*sic*], but we’re getting more of the resources we need” (Supplier F, personal interview, September 2005).

¹³ The End of Life Vehicle (ELV) directive from the European Union entails a series of requirements for the disposal of motor vehicles sold in member countries, including the restriction of heavy metals and the recovery of 85% of the vehicle before disposal. In response, the automotive industry has introduced the Integrated Management Database System (IMDS) to track the components of vehicle parts throughout the supply chain, and eliminate restricted substances on a global scale.

Monitoring and Enforcement

Though the OEMs' policies are clearly communicated to suppliers and the methods for verifying ISO 14001 certification status are straightforward, there exist some exceptions and inconsistencies in monitoring and enforcement. All suppliers stated that there is indeed a consistent and systematic process for *reporting* their ISO 14001 certification status to the OEMs, in accordance with the OEM policies described above, but there has not been consistent *enforcement and monitoring* of the status of individual plants executed by the OEMs. Inconsistencies stem from two major areas – dependence upon verification at the time of contract bidding¹⁴, rather than continuous and random monitoring, and exceptions made for new plants, new relationships and important contracts. Despite such inconsistencies, large supplier firms appear to have gotten the message that obtaining certification is an important factor in their relationships with the OEMs that require it. Nevertheless, some problems with relying on third-party registrars do exist, and could be mitigated by OEM efforts to extend selective quality monitoring to environmental areas as well, particularly in cases where they suspect problems.

As stated above, inconsistencies in monitoring and enforcement stem from two primary factors. First, because monitoring is generally done by purchasing departments at the time of contract bidding and registrations are not monitored in a consistent way throughout the life of a contract for all companies, registrations may lapse and dedication to the tenets of the system may wane without customer knowledge or resulting penalty. One supplier stated, “No company [OEM] takes annual stock of who is up to date with certifications – the process is pretty hit or miss regarding monitoring” (Supplier E, personal interview, September 2005).

¹⁴ Ford's Q1 process may be an exception. Though there is no fixed schedule for quality monitoring, it is a “continual process with certain cycles for some commodities” (Ford, personal interview).

According to another supplier, “it really depends on the OEM, some check, some don’t” (Supplier B, personal interview, November 2005).

Second, automakers may make temporary exemptions for newly constructed facilities, new contracts and important components. When locations and contracts are new, OEMs do not want to preclude relationships based on the absence of a certification. In these cases, companies generally negotiate an agreement under which suppliers are granted a contract with a clause agreeing to implement the ISO 14001 standard within a specified period of time. According to GM, “these are just technical areas where suppliers fall between the gaps of the policy for one reason or another, but don’t stray from the spirit of it” (Lee Hachigian and Pat Beattie, General Motors Corporation, personal interview, September 2005).

Similarly, Ford has stated that new plants and contracts are not exceptions, but rather those that are still under review for Q1 status (Monique Oxender, Ford Motor Company, personal interview, September 2005). Though Ford and General Motors both stated that such facilities are not exempt from the requirement, several suppliers claimed to be aware of locations that were operating without ISO certification. To quote one, “I know of competitors that don’t have it in some plants – mostly big companies working in newer locations that have been up and running for two or three years now that still haven’t gotten it – and they still get business. That’s not fair to other companies, but it is just a fact of life” (Supplier X, personal interview, 2005).¹⁵

Despite these apparent inconsistencies and gaps, large supplier firms have largely received the message that adopting EMSs is an important facet of their operations and an imperative when doing business with the Big Three. Only one supplier (Supplier F) reported any action stemming from non-compliance, in which one plant lost its top quality ranking.

¹⁵ Supplier identity further hidden by designating as ‘X’ due to the sensitive nature of this comment.

Under these conditions, the plant quickly implemented and registered its EMS to regain its status. Throughout the industry, OEMs did report some initial resistance to their policies and Ford reports to having revoked Q1 status from “a number” (Ford would not specify how many) of suppliers who failed to gain certification of their EMSs. Many of these suppliers quickly acted to rectify the situation. “The message came through loud and clear – this was something we were serious about and would follow through with. It was not just an empty threat” (Monique Oxender, Ford Motor Company, personal interview, September 2005). General Motors has not discontinued any relationships for ISO 14001 related issues.

Even if full compliance with the policies is achieved, the full spirit of the policy – which aims for continual improvement in environmental performance and efficiency – may not exist with complete reliance upon external auditors for enforcement. Two shortcomings in particular are present. First, as explained in the next chapter, third party audits may be incomplete with respect to the requirements of the system. That is, auditors may be lax, or incomplete, in their assessments and grant ISO 14001 to facilities that may be undeserving.¹⁶ In such cases, OEMs may be accepting the word of unreliable sources that suppliers have met their obligations under the ISO 14001 policy. Second, even if a supplier plant is meeting the structural requirements of an EMS, there is no guarantee that the contents of the system, which are flexible and intended to meet the needs of individual plants, will lead to environmental performance improvements (Krut and Gleckman 1998; Andrews et al 2001; NAPA 2001). EMSs conforming to the ISO 14001 standard ensure that a specific process is in place, but do not require any specific improvements for certification. Accordingly, plants

¹⁶ This factor, of course, needs to be considered in light of the specific safeguards individual auditing firms have in place to discourage or prevent lax performance of individual auditors. The problem may be more prevalent among the lower tiers of accredited auditors than with the more respected global firms.

may have systems that are virtually meaningless in terms of performance outcomes, yet meet their contractual obligations (Krut and Gleckman 1998).

With respect to other certifications that suppliers must obtain, particularly in the realm of product quality, the OEMs themselves may perform audits if they suspect a potential problem with supplier conformance. Supplier E, for example, has had quality ratings lowered at a few facilities, even though they were fully up to date with applicable certifications, after an OEM conducted their own audits due to suspected inconsistencies. OEMs do not, however, conduct similar checks with respect to the content or quality of suppliers' EMSs, even during the process of quality audits. Because certification schemes do not guarantee good performance, or even full compliance with their requirements, conducting audits of this kind could both ensure the integrity of the certification and improve the contents of the system, which may lead to better performance outcomes.

OEMs have decided not to engage in such action, as neither of the firms interviewed for this study intend to conduct environmental audits of supplier plants. The high financial costs that would be related with any such effort and associated liability of becoming closely involved with a business partner's environmental operations are the primary factors barring this kind of involvement. As the number of direct suppliers for each firm numbers in the thousands, a coordinated effort to review or audit the environmental systems of each would be prohibitive. Considering the relatively low budgetary status environmental departments already rank within the hierarchy of global automotive firms, the additional expenditures necessary to staff and conduct such audits are unlikely to be viewed as necessary by corporate leaders, particularly while the industry as a whole struggles to maintain competitiveness. The benefits would be difficult to quantify with respect to costs of

implementation. Additionally, few firms are willing to engage in behaviors that directly tie them to the environmental behaviors of others. While reputational risks may always exist through such relationships, as discussed in the theory section of this dissertation, direct legal liability is easier to avoid by refraining from becoming directly involved with a suppliers' EMS processes. "[OEMs] don't come into the plant to check up on you like they would with quality – they don't want to – if you go into a plant and get involved with compliance at a facility, you get dragged into the process and associated liability. Instead, they take the word of the registrar and hope the checks and balances work out" (Supplier C, personal interview, September 2005). As explained below, suppliers themselves face similar obstacles for not engaging in the monitoring of their own suppliers' plants.

Replication of the Mandates

The question of whether suppliers subject to the ISO 14001 mandates replicate these requirements is central to understanding the degree to which such policies are diffused throughout the industry. If suppliers recognize the values of EMSs and require their suppliers to also adopt, these private mechanisms may be effective tools for promulgating advanced management practices to the small and medium sized enterprises that would most benefit from them (Wells and Galbraith 1999; Dasgupta, Hettige and Wheeler 2000; Dasgupta, Lucas and Wheeler 1998). However, if suppliers do not replicate this requirement and instead are permitted to continue with their own strategies for addressing environmental aspects of their operations, the diffusion of these standards may be stalled at the upper tiers of production networks with firms that already are among the best managed in the industry.

The promise of such an environmental “cascade effect” throughout their production networks was mentioned by both Ford and General Motors as a key benefit they hoped would occur upon issuing their mandates in 1999 (Hutson 2001). This section investigates the policies of the major first-tier automotive suppliers with respect to this question. Overall, it finds that requirements to adopt formal EMSs are not being replicated by tier-one firms in any systematic way. Though some firms are formally requiring an EMS of their suppliers, there are no plans to monitor and enforce the policies, or to punish non-compliance. Suppliers identified three primary hindrances to implementing such a policy: a fear of imposing high EMS adoption costs on smaller suppliers who may not have the managerial maturity to fully benefit from them; decentralized corporate structures and procurement methods; and the lack of clear direction from OEMs regarding “greening the supply-chain” issues.

Of the six firms interviewed, two are requiring ISO 14001 registration of their suppliers¹⁷ (Supplier B and Supplier C), one has limited the policy to two geographic regions (Supplier E), and three do not require ISO 14001 of their suppliers. All companies stated that they formally “encourage” adoption by suppliers in their lower tiers, and one has offered technical assistance (Supplier F) should its direct suppliers wish to implement it. Neither of the two suppliers that contractually mandate adoption of ISO 14001, however, have any concrete plans to strictly monitor or punish non-compliance with the policy. Supplier B has taken a step-wise approach with their suppliers, alerting them that the policy would be coming soon, giving them a deadline, and expecting them to comply – though not creating any mechanism to ensure this compliance. In 2002, the company made it part of their contractual terms and conditions that ISO 14001 certification would be required for all direct suppliers to not only

¹⁷ Supplier B has had the policy since 2002; Supplier C’s policy takes effect December 31, 2006.

adopt EMSs in their own facilities, but also pass along the requirement to all suppliers in lower tiers as well. They have not, however, enforced this policy but instead continue to emphasize its importance for business relations and efficiency. In 2005, Supplier B began to assess compliance with a survey asking suppliers to send in a copy of their ISO 14001 certificates, with little success. They have found that suppliers in lower tiers are not responding to the survey or have not yet achieved certification. Though not actively enforcing their policy, the company maintains the position that ISO 14001 certification is technically required and any company that fails to meet this mandate is in breach of contract and subject to loss of current and future business. Environmental managers hope that compliance with the policy will improve over time, much as they believe it has in the first-tier.

Similarly, Supplier C currently requires that all suppliers must have “an effective environmental management program” in place (Supplier C, Global Supplier Requirement Manuel 2005) and should be ISO 14001 certified by the end of 2006. The company has no plans to enforce this policy, however. Instead, Supplier C has attached the adopting of an ISO EMS to its quality rating system, though the absence of one hardly affects a supplier’s overall quality score. Of all the factors considered, environment only receives five percent of the total points, meaning that even without a certified EMS, suppliers may still achieve the highest possible quality rating. Supplier C’s corporate environmental officer stated however, “[g]enerally, all good suppliers will have [a certified EMS], those who don’t will probably have quality or management problems that become apparent” (Supplier C, personal interview, September 2005). In other words, the company sees it as an indicator of overall

management health – it may not matter if they don't have an EMS, if they don't take care of their environmental aspects, they may lose business on other grounds.

First-tier suppliers have given several reasons for not requiring EMS of their own suppliers or for not enforcing the policies they have put into place. Chief among these reasons are the resources and effort it would require to ensure compliance, with five of the six firms interviewed citing such difficulties. Suppliers maintain very complex and varied supply chains, often working with 4000 – 5000 different companies, many of whom manufacture the same commoditized part which they purchase in primarily buyer-driven relationships with little need to govern the specific practices in place. Tier-one firms generally view attempting to keep up with the certifications of their thousands of suppliers as difficult at best, quixotic at worst. Suppliers are particularly hesitant to conduct audits themselves for reasons similar to the OEMs reluctance to audit tier-one supplier operations: resources and potential liability.

We just don't have the resources to follow up with them to ensure compliance. We're working really hard just to get these guys up to speed on quality; adding environmental would be very difficult... If they are smart, they will go through the process themselves to find out where their cost savings and efficiencies could come from. We don't have the time to make them smart in a hyper-competitive environment. We've just got the time to focus on quality (Supplier E, personal interview).

With respect to potential legal liability, both Supplier A and Supplier C mentioned this as a factor for not entering supplier sites for environmental inspections – “we dare not” – stated Supplier C.

Suppliers are also concerned that such efforts to force companies to adopt EMSs would put additional strain on their supply base and not yield significant environmental improvements or increases in efficiency. Supplier A, Supplier E and Supplier F all cited reasons of inadequate resources and capabilities in the supply base as hindrances to effective

policy diffusion. Indeed, effective use of EMSs may greatly depend on the resources and capabilities of a firm (Hart 1995; Christmann 2000, Darnall 2002). Suppliers located in the second and third tiers are often small and medium enterprises, or “mom and pop operations” (in the words of Supplier F) without the necessary resources or capabilities to effectively employ and take advantage of formal EMSs.

We know what our company went through in terms of expense and transition of adopting these standards, so we’re very sensitive to how additional requirements would affect our own supply base...it might force them out of business or hurt them in other ways that affect [our company]. These suppliers may not have the money to spend on outside expertise or auditors and it may not pay off for them in terms of increased efficiencies. In other words, the economic benefits may not justify the costs to them – which in turn may drive up our costs (Supplier A, personal interview, September 2005).

Similarly, Supplier E believes that the value in formal EMSs may not pay off for smaller operations with fewer resources and lower levels of experience.

There isn’t much value in that a lot of the suppliers don’t have the maturity to really understand what the ISO process is supposed to do – they don’t have the capabilities to implement the systems and gain anything from them. It would be very superficial and not worthwhile. How much can we really afford to push on this as opposed to other competing priorities? That is, the market prices are only going down, and supplier givebacks are only going up. So how can we add on something that gives them something to throw back at us? (Supplier E, personal interview, September 2005).

The rationale for not establishing an all-inclusive policy in which suppliers adopt ISO 14001 may also stem from issues relating to corporate structure, rather than on grounds of resources and capabilities. The complex and decentralized organizational structure of Supplier A, also responsible for a dispersed internal strategy for company-wide EMS adoption, is the primary reason it has not replicated the ISO 14001 requirement. There is no central environmental, health and safety (EH&S) department or purchasing division within the company. Rather, each plant makes its own purchasing decisions and negotiates its own contracts, making it much more difficult to make centralized management decisions. Doing so would require

buy-in from every plant within a region (e.g. North America or Asia-Pacific), or across the globe. Such limitations make the policy difficult and unlikely.

Indeed, Supplier E's limited policy to require ISO 14001 of suppliers in specific geographic regions stems from corporate structure and the preference of a single purchasing manager. Similar to Supplier A, Supplier E's *purchasing* process is not centralized.¹⁸ Instead, each purchasing manager has the authority to make sourcing decisions and set policies for each line that he or she controls. One purchasing manager employed an ISO 14001 policy for a specific product line in Europe, then was reassigned to the Asia-Pacific region, where he replicated the mandate based on what he viewed as previous successes with the program. His successor in Europe continued to maintain the policy, keeping it in place in two regions for the company. There are no plans to make the program company-wide and it remains the discretion of individual managers to decide.

Finally, two of the suppliers (Suppliers A and C) point to the lack of direction from the OEMs to "green the supply chain" as hindrances to action. These companies believe that even though the OEMs have expressed vague interest in cascading the policies, they have not been explicit enough in their directives, as they have been with regards to quality management and associated certifications. As for the OEMs themselves, neither Ford nor GM has pursued a formal policy of requiring EMSs throughout the entire supply chain. Ford has included language in contracts with first-tier suppliers to "encourage" ISO 14001 adoption in the sub-tiers, but has not formally pursued more explicit requirements. "How would we enforce [such a policy]? You have to keep your scope manageable and it is barely manageable with our tier-ones...the networks are so varied, so complex and there are just too

¹⁸ The purchasing processes and EMS implementation processes are organizationally separate. So while the EMS process may be centralized, it does not mean that the purchasing process is.

many suppliers” (Monique Oxender, Ford Motor Company, personal interview, September 2005). Instead, OEMs are focusing on initiatives such as the Suppliers Partnership for the Environment and the Ford Sustainability Forum to share best practices with the entire supplier network, rather than becoming directly involved in the process of requiring and verifying EMS certification throughout the lower tiers of suppliers.

Though some first-tier suppliers do have policies in place, it is unclear whether they will make any difference in environmental outcomes, or will even be effectively adopted by suppliers in lower tiers, due to lack of enforcement. As was stated by the first-tier companies themselves, compliance is largely dependent upon threat of action and possibility of being caught not complying (see Becker 1968). If no such threats of enforcement exist and the probabilities of being caught are low, then there is no reason to expect compliance with the policies. Whether or not tier-one suppliers decide to become stricter is yet to be seen, but for the time being there is no reason to expect widespread adoption in the lower tiers as a result of these policies.

Chapter Conclusions

Several key insights regarding the automotive industry’s ISO 14001 policies can be drawn from the interviews with first-tier suppliers and the automakers themselves, particularly with respect to how the policies have been interpreted and implemented by direct suppliers, how they are monitored and enforced, and to what degree they have been replicated and diffused to lower tiers of the value chain. Overall, the OEM policies appear to be effective in their aims to motivate the adoption of EMSs, at least among large first-tier suppliers who have undertaken large efforts to implement them on a company-wide basis. Two key factors have

contributed to this success. First, the mandatory nature of the mandates themselves, with explicit deadlines for adoption and threats of losing current or future contracts, clearly communicated the seriousness of the OEMs intentions and prompted the upper management of supplier firms to dedicate resources necessary for successful compliance. Second, the existing wealth of resources and capabilities of these firms facilitated the adoption throughout their global operations with few obstacles. However, additional steps could be taken to ensure more effective and thorough diffusion of the standard throughout the value chain.

The interviews also revealed some inconsistencies in how the policies are monitored by the OEMs. These inconsistencies, however, do not appear to contribute to any widespread shirking of the policies, at least not among the major first-tier companies. Even those who were initially reluctant to adopt the policy eventually did so to avoid of losing current business or the ability to procure future contracts. It appears that the threat of action has been enough to convince these companies to dedicate the necessary resources to environmental management efforts and to comply with the requirements. It should be stated, however, that “compliance” simply refers to acquiring registration to ISO 14001. It does not guarantee that said systems are complete, or that the content of the EMS will lead to environmental performance improvements.

The lack of widespread replication of the policies by suppliers in the first-tier, and no observed intention of monitoring or enforcing them where they do technically exist, may hinder the diffusion of environmental management through the value chain. Firms interviewed for this chapter are among the largest, best managed and most resource-rich in the industry (both in terms of knowledge and financial capital, as well as management

capabilities). Many in this echelon were reluctant to adopt and certify EMSs until the policies of the OEMs became strictly mandated and clearly communicated. Without this impetus, the effort to adopt an EMS, and the resources devoted to it, would not have been as extensive.

The high costs associated with monitoring and enforcing such a policy on the part of the first-tier suppliers, however, remains among the largest obstacles to diffusion of the standard. Like their primary customers, tier-one suppliers already require a host of quality and other types of certifications of their own suppliers. With additional effort, environmental management requirements could be added to the list. Compliance may not be full and implementation may not be as complete or effective, but the communication of the expectation as essential, with enforceable consequences for non-conformance, would be an important first step. It is likely that firms in lower tiers of the value chain will not adopt EMSs with equal vigor in the absence genuine external motivation to do so. As demonstrated by even the largest firms in the first-tier, mimetic pressures are insufficient motivators for EMS adoption within the automotive industry. Something must be explicitly required, preferably with unequivocal deadlines, to be taken seriously.

For their part, OEMs could be more forceful about demanding the cascading of environmental standards, as they have for quality and other requirements. Though such initiatives may be a difficult sell to direct suppliers already experiencing financial problems due to persistent cost reductions, and who increasingly wield greater power and influence in the value chain, little action will be taken across the industry in a uniform manner without their explicit guidance and instruction. However, even if such steps are taken it is unknown how smaller firms with lower levels of capabilities and management experience will respond.

SMEs often do not possess the management capabilities or the financial resources necessary to fully implement EMSs on their own, even though they may benefit more from them than larger firms that are generally better managed operations (Wells and Galbraith 1999; Dasgupta, Hettige and Wheeler 2000; Dasgupta, Lucas and Wheeler 1998). Indeed, several managers at supplier firms pointed to this issue when explaining why they hadn't mandated EMSs of their own suppliers – they believed that their suppliers had neither the management maturity nor the necessary resources to adequately adopt an EMS in accordance with the ISO 14001 template.

This chapter has described the OEM environmental supply chain mandates and explained how they been interpreted and adopted by the largest automotive suppliers, the variance that exists in the approaches taken by them, and how the policies are monitored and enforced by the automakers themselves. It has also explained the extent to which first-tier suppliers have replicated these requirements, and pointed out potential shortcomings of the policy and existing hindrances to achieving more thorough diffusion throughout the value chain. The following chapters investigate how effectively EMSs have been adopted, as a result of these policies, in Mexican manufacturing operations. Additionally, Chapter 6 explores the specific environmental goals set by these facilities and the impact EMSs, and mandates to adopt them, have on the dedication that individual plants have for these goals.

CHAPTER 5: Evaluating Supply Chain Mandates

This chapter examines the adoption of formal environmental management practices by automotive parts suppliers in Mexico, in response to supply chain mandates from major automotive manufacturers. It aims to better understand how well these suppliers have responded to industry mandates to standardize and improve their environmental behaviors, and to identify other factors that may influence the decision to adopt more thorough levels of environmental management practices. The chapter addresses three primary research questions. First, how effective are supply chain mandates in leading to the adoption of advanced environmental management practices in manufacturing facilities in an industrializing society? Second, what technical considerations related to global industrial organization may facilitate such adoption? Third, what other demographic features, such as country of ownership and position in the value chain, may lead to higher levels of environmental management? Specifically, is there evidence that global manufacturers may indeed be “exporting environmentalism” through their vast manufacturing networks?

In pursuit of these questions, the chapter examines the apparent discrepancy that exists between manufacturing facilities that are required to adopt formal environmental management systems (EMSs) by customers and corporate parents, and those that actually do so. It uses a generalized ordinal logistic model to investigate how other factors, including product complexity, influence of regulators, and technological complexity, may also be strong predictors of the thoroughness of environmental management practices in place. It

finds a large discrepancy between those facilities subject to supply chain mandates and those who actually adopt EMSs. However, several drivers, including the *perceived importance* of mandates, degree of technological complexity, and US ownership may affect management outcomes.

Methods

Variable Descriptions

This chapter uses three primary groups of independent variables – drivers for EMS adoption, technical considerations, and demographic characteristics of firms – and assesses their impact on the degree of environmental management system adoption. This section details each of these independent variables and discusses how the dependent variable for each EMS category is constructed.

Dependent Variable

The primary dependent variable in this study is the extent to which a manufacturing facility has adopted an environmental management system. While self-assessment and reliance upon databases of ISO 14001 certification may be the prominent methods for measuring a plant's EMS status, such measures may not be a true reflection of the environmental behavior of its facilities.¹⁹ Instead of relying upon such self-assessments by managers or international databases of certified facilities, respondents to the study were assigned to one of three categories of EMS adoption based on specific environmental practices that they reported

¹⁹ As will be discussed in the Results section, a substantial gap may exist between firms who believe they have an EMS in place and those who actually meet the requirements based on actual practices. Further, third-party registrars may grant undeserving plants ISO 14001 certification, making databases of such facilities an imprecise measure.

having in place. These activities are based on the requirements of the ISO 14001 EMS standard. Accordingly, facilities that engage in all practices were assigned “ISO Equivalent EMS” status. Plants that fell short of this benchmark, but whose practices met the minimum criteria established in previous work by the National Database on Environmental Management Systems (NDEMS) to be considered a formal EMS, were assigned “Formal EMS” status (see Hutson, Andrews & Edwards 2005). All other respondents were classified as “no EMS.” These requirements for each category are presented in Table 5-1.

Table 5-1: Formalization of Environmental Management		EMS Category	
<i>Environmental Activity Facility...</i>	<i>Formal EMS</i>	<i>ISO Equivalent EMS</i>	
Has adopted a written statement of environmental policy goals.	X	X	
has set specific environmental performance objectives.	X	X	
has planned specific, measurable steps to meet environmental performance objectives.	X	X	
has a single manager who has primary responsibility for environmental management activities.		X	
trains employees in specific activities related to environmental aspects of their jobs.	X	X	
has a procedure in place for identifying legal requirements.	X	X	
regularly tracks and manages environmental compliance indicators.	X	X	
regularly tracks and manages environmental indicators other than compliance.		X	
makes some environmental performance data available to the public.		X	
makes results of environmental performance available to employees.	X	X	
has a formal procedure for documenting environmental management practices.	X	X	
has procedures in place for responding to environmental spills or accidents.	X	X	
periodically conducts top management reviews of environmental performance.	X	X	
has procedures in place for taking corrective action based on outcomes of audits.	X	X	
conducts regular internal audits of environmental procedures	X	X	
conducts regular external audits of environmental procedures		X	
Cronbach's alpha	0.934	0.939	

These categories, while functionally similar, differ in a few fundamental ways. Chief amongst these differences is the requirement of external third-party auditing of the system for the ISO equivalent category. External verification of a system's structure, goals and principles – including the assessment of continual improvement – is viewed as elemental for system efficacy and particularly for public policy implications. Systems that are not externally verified lack transparency (even the restricted transparency offered by private

registrars) and offer limited evidence of plant commitment to environmental improvement (Gereffi, Garcia-Johnson and Sasser 2001). Further, externally audited systems may be more thorough, even if results are not publicly disclosed, as pressures to meet societal norms of good behavior may positively influence system processes and outcomes (Prakash 2000). However, external auditors who are paid by the firms being audited may not be effective verifiers of system effectiveness, as conflicts of interest may prevent accurate and objective assessments of internal processes (O'Rourke 2000).

Independent Variables

In the first category, independent variables are classified as *drivers* for EMS adoption: specific pressures or motivations that lead a plant to seek and implement formal environmental management systems. I have used eight such drivers in this study: customer requirements to adopt an EMS, corporate requirements to adopt an EMS, shareholder pressure to adopt an EMS, the adoption of an EMS as a means to avoid a potential problem with legal compliance, EMS adoption as part of a negotiated settlement with local, state or federal regulators, the adoption of EMS for insurance purposes, the involvement of external stakeholders and the consideration of future generations. Each of these variables is scaled from 0-4, corresponding to the manager's perception of how strongly each driver influenced the decision to adopt a formal EMS (regardless of whether the plant actually possesses an EMS). A response of zero indicates that the factor was not present or did not apply, while responses from 1-4 represent a scale ranging from low to high priority.

Of these eight drivers, customer and corporate mandates serve as important indicators for the effectiveness of so-called supply chain mandates. As explained earlier, several corporate

initiatives to green the supply chain through ISO 14001 requirements exist within the global automotive industry. Virtually all the global automotive manufacturers, including Ford, GM, DaimlerChrysler, Nissan, Toyota and Honda, have communicated it as an expectation to first tier suppliers, while Ford, GM and DaimlerChrysler have made it a requirement, part of their quality ranking systems, and a condition of continued business. Some tier-1 suppliers have also begun to communicate an ISO 14001 expectation from their own suppliers, though few plans exist for making it a strict requirement. In addition to these customer mandates, several companies have embarked on internal corporate initiatives to implement EMSs at all their facilities in North America, and in some cases, worldwide. Many of these initiatives include ISO registration with third-party audits, while others have opted for self-certification and a process of internal audits.

The second category of independent variables includes those classified as *technical considerations*. Such variables are factors related to a firm's production operations that may not be related to environmental activities per se (with the obvious exception of the PROFEPA "Clean Industry" program), but may influence a plant's environmental management outcomes.

Cooperation with other firms, both local and global, is often an important factor for industrial upgrading. For the purposes of this report, "upgrading" may be defined as the ability for a firm to increase the value-added of its production activities and extract greater rent from the value chain (Humphrey and Schmitz 2003, Porter 1990) and may come in the form of process upgrading (more efficient transformation of inputs into outputs), product upgrading (the manufacture of more sophisticated product lines), or functional upgrading (moving to more profitable segments of the value chain) (Lall 2000; Gereffi 1999). From

increased cooperation with other local firms, business partners, suppliers, and customers, firms may extract greater resource and management efficiencies and, in many cases, improve competitiveness through knowledge and information sharing (Keesing and Lall 2000; Humphrey and Schmitz 2000; Nadvi and Schmitz 1999; Rabellotti 1997). Such improvements may not only increase the competitiveness of individual businesses, but the overall competitiveness of local manufacturing clusters and regional economies (Nadvi and Schmitz 1999; Knorringa 1999; Tewari 1999; Nadvi 1999; Rabellotti 1999; Schmitz 1995, 1999). From such cooperation firms may face an increase in institutional pressures leading to changes in internal processes and routines (DiMaggio and Powell 1983; Meyer and Rowen 1977; Aldrich 1999) and may affect internal capabilities related to the environment (Hart 1995; Russo and Fouts 1997; Rugman and Verbeke 1998; Sharma and Vrendenburg 1998; Christmann 2000).

This analysis includes two measures of inter-firm cooperation: cooperation with other local firms (so-called “horizontal” cooperation within clusters) and with customers (“forward” cooperation). These measures of cooperation are based on the concept of collective efficiency, first proposed by Schmitz (1995) and further defined by Nadvi and Schmitz (1999) as competitive advantage derived from external economies and joint action. In other words, collective efficiency can be thought of as business activities jointly pursued by firms within value chains and clusters to maximize the productivity of such actions. The specific activities to operationalize this concept of cooperation for each type of cooperation were adapted from Giuliani, Pietrobelli, and Rabellotti (2005) and are listed in Table 5-2. The variables are coded into categories from 1 to 4.

Table 5-2: Cooperation with Local Firms and Customers

Horizontal Cooperation (with other local firms)	Forward Cooperation (with customers)
Exchange of information and experiences Sharing orders Joint product development Lending machinery Joint marketing of products Joint employee training Joint purchasing of inputs	Exchange of information and experiences Negotiation of payment and delivery conditions Joint product development Improving quality Improving delivery time Employee training Setting of product specifications Technological upgrading

Consistent with the discussion of the typology of value chain relationships, the complexity of product specifications and the degree to which such specifications can be codified may influence the degree of EMS adoption. While the automotive industry can be classified as a “medium tech” industry overall (Lall 2000), there is a great deal of variance in the technological complexity required in the systems and subsystems that comprise a finished automobile. For example, the electronics integrated into most modern autos require a much greater degree of technical competence than do traditional metal-bending operations that are still an integral part of automotive manufacturing. Products with complex technical specifications require exceptionally high degrees of technical competence and strict management to produce high-quality products with low numbers of defects. The processes required to manufacture products in this manner may produce “spillover” effects to environmental management, where several varieties of quality management systems, and the rigorousness with which they are employed, may lead to improved environmental management as well.

The type of value chain relationship in which a plant is engaged with its customers may depend highly upon the ability to codify product specifications (Gereffi, Humphrey and Sturgeon 2003). That is, the ease with which the information detailing precise product specifications is transmitted between customers and the firms they have contracted to produce, it may influence the relationship that exists between firms. In situations where product specifications can be codified, complex information can be exchanged with little coordination and oversight on the part of customers. Where product specifications are difficult to codify, more direct oversight by clients is needed and the degree of dependence between the two parties is high. In such circumstances, frequent contact is required for accurate and timely manufacturing output.²⁰ Increased interactions among firms may increase the institutional pressures that lead to the adoption of environmental practices in manufacturing facilities.

For technological complexity at a plant, the degree of technical skill required of employees was used as a proxy – the assumption being that highly skilled workers are needed to produce highly technical components.²¹ The variable was coded on a scale from one to five assessing the level of technical skill, on average, required of plant employees. The degree to which product information can be codified was measured by the amount of consultation needed with customers in order to manufacture goods to precise product specifications. A low degree of consultation needed indicates a high level of codification, a high degree of consultation indicates lower ability to codify this information. The variable

²⁰ Please see Gereffi, Humphrey and Sturgeon (2003) for a full discussion on how different permutations of supplier capabilities, codified information and technical complexity may influence the varieties of value chain relationships.

²¹ Obvious exceptions exist to this assumption depending on specific processes, as low skilled workers may work on the assembly of highly skilled products and some highly skilled workers are needed in medium to low tech goods, but the question asked about skill level, on average.

was coded on a scale from 0-4, with zero indicating no consultation and four indicating “constant” consultation.

The third technical consideration was previous or current participation in PROFEPA’s “Clean Industry” program. Mexico’s federal environmental enforcement body, *Procuraduría Federal de Protección al Ambiente* (PROFEPA), administers a voluntary environmental audit program administered by third-party (PROFEPA accredited) auditors. If a plant passes the audit, it receives designation as a “Clean Industry” site and is able to utilize the Clean Industry logo as a message to consumers and the community that it fulfills its legal responsibilities. If a site does not pass, it is subject to a PROFEPA proscribed “Action Plan” to correct problem areas. While not the same as ISO 14001, the Clean Industry program, and the Action Plan in particular, often relies on similar components to achieve its environmental goals. Accordingly, plants with previous experience with this program would be expected to have better environmental management in place than those that have not participated.

The final category of dependent variables includes *demographic considerations* that may influence EMS adoption. In particular, the location of plant ownership holds great importance for the primary research questions of this chapter. Foreign companies operating in industrializing countries may perform better than local firms because they are more technologically dynamic due to competitive global pressures, often import state-of-the-art pollution technologies, are subject to higher regulatory standards in their home markets, and seek to minimize transaction costs and liability risks (Gallagher 2005). Some empirical evidence exists to support this claim (Eskeland 1997, Ruud 2002, Gallagher 2004, Rappaport and Flaherty 1992; Fowler 1995) while other studies, including one specifically addressing environmental management in Mexico, found no difference among local and foreign firms

(Dasgupta, Hettige and Wheeler 2000; Hettige et al 1996). To further test this question, dummy variables for Mexican, US, Japanese and European ownership were included.

Related to the notion of access to complementary resources and capabilities, publicly traded firms may also find it easier to adopt advanced environmental strategies than those who are not publicly traded (Bowen 2002; Russo and Fouts 1997) and may be able to do so at a lower cost than other types of organizations (Darnall and Edwards 2006). Accordingly, a dummy variable is used to test whether publicly owned plants have higher degrees of environmental management practices in place than other forms of ownership.

Because plants at different levels of the value chain may respond differently to mandates (due to differing monitoring requirements and reporting regimes²²) a dummy variable is used to indicate whether a plant is located in the first tier or in a lower tier. A variable to control for plant size based on the number of full-time employees was also included. Categories based on responses were coded on a seven-point scale consistent with the classifications of the U.S. Economic Census (1=less than 20, 2=20-99, 3=100-249, 4=250-499, 5=500-999, 6=1000-2499, 7=more than 2500).

Model Description

The primary analysis of this chapter uses a generalized ordinal logit/partial proportional odds model to estimate the influence of the independent variables on the ordered categories of the dependent variable. In ordinal logistic models generally, ordered categories are compared through multiple logistic regressions ($M - 1$, where M = the number of categories of categories of the dependent variable). For example, if there are three categories of dependent

²² While suppliers in the first tier are often required to submit an electronic copy of their ISO 14001 certification when competing for new contracts or undergoing periodic quality assessments, few second tier suppliers face similar conditions.

variable (e.g. 1, 2 & 3), two separate binary logistic regressions are run: one comparing category 1 v. categories 2 and 3 and another comparing category 3 v. categories 1 and 2. The comparison categories used in this study are presented in Figure 5-1. In such models, results are presented in one table with the assumption that coefficients for each independent variable are equal across models. However, it is rare that this condition of equal coefficients (the “parallel lines” or “proportional odds” assumption) holds across all models, and often cause coefficient estimates to be biased and unreliable (Long and Freese 2006).

Ordinal logit model with parallel lines restriction:

$$P(Y_i > j) = \frac{\exp(\mathbf{a}_j + X_i \mathbf{b})}{1 + [\exp(\mathbf{a}_j + X_i \mathbf{b})]}, j = 1, 2, \dots, M - 1 \text{ (1)}$$

To correct for this problem, statisticians have proposed the generalized ordered logit (or “proportional odds”) model (McCullagh 1980; Fu 1998), which relaxes the assumption of equal coefficients across models²³.

Generalized ordered logit model (`gologit` in Stata), with proportional odds (Fu 1998):

$$P(Y_i > j) = \frac{\exp(\mathbf{a}_j + X_i \mathbf{b}_j)}{1 + [\exp(\mathbf{a}_j + X_i \mathbf{b}_j)]}, j = 1, 2, \dots, M - 1 \text{ (2)}$$

²³ As noted by Williams (2006), equations (1) and (2) are essentially the same, with the exception that the betas (though not alphas) are the same for all values of j in the proportional odds model (1). A more detailed description of equations presented here can be found in Williams (2006): <http://www.nd.edu/~rwilliam/gologit2/gologit2.pdf>.

While the standard generalized ordered logit model does correct for violations of the proportional odds assumption, it can often present too many parameters and complicate model interpretation (as the proportional odds assumption is relaxed for each variable and not only in cases where violations occur). Therefore, Williams (2006) has presented a partial proportional odds model to facilitate interpretation and generate more powerful estimates and comparisons among categories. In this model, the proportional odds assumption is assessed for each variable and relaxed only in cases where it is violated.

Partial proportional odds model (`gologit2` in Stata) (Williams 2006):

$$P(Y_i > j) = \frac{\exp(\mathbf{a}_j + X1_i \mathbf{b1} + X2_i \mathbf{b2} + X3_i \mathbf{b3}_j)}{1 + [\exp(\mathbf{a}_j + X1_i \mathbf{b1} + X2_i \mathbf{b2} + X3_i \mathbf{b3}_j)]}, j = 1, 2, \dots, M - 1 \quad (3)$$

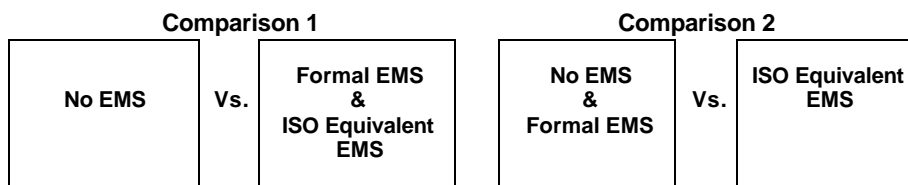
Diagnostic tests (the Brant test in Stata) indicated that the original ordinal logistic regression model used in this chapter violated the proportional odds assumption. Therefore, I have chosen to use William's `gologit2` model for partial proportional odds.

Because the dependent variable in this analysis has three categories (No EMS, Formal EMS, and ISO 14001 Equivalent EMS), the model estimated two binary logistic regressions for comparison. The first compares the No EMS category with the Formal EMS and ISO Equivalent EMS categories and the second compares the ISO Equivalent category with the Formal EMS and No EMS categories. In other words, the first model looks at differences between those with at least a formal EMS in place with those without, while the second compares those with an ISO 14001 equivalent EMS with those who fall short of the ISO requirements. The proportional odds assumption held for all estimates except for "customer mandate" coefficients. Therefore, coefficient estimates presented in the Results section of

the chapter are consistent across category comparisons, with the exception of the customer mandate variable, which differs between models.

Finally, to increase the stability of the model, missing values for each covariate were replaced with the mean of the observed values. To ensure that this process did not bias final estimates, I constructed a dummy variable equal to 1 for each missing observation and ran diagnostic regressions. In the three cases where the dummy was significant at the .10 level, the variables were replaced with the originals that include missing values.

Figure 5-1: Comparisons within Ordinal Regression Model



Results

Before delving into the regression findings it is important first to examine basic statistics regarding EMS adoption by respondent facilities. Such statistics help paint an overall picture of the state of environmental management within the automotive sector in Mexico and help put the regression results into perspective. Based on their responses to the requirements listed in Table 5-1, respondents were classified into three EMS categories: no EMS, formal EMS, and ISO Equivalent EMS. More than half of the plants in the sample fell short of the formal EMS category, 26% percent met the minimum requirements for an EMS, while only 16% met the requirements for ISO 14001 equivalency. As seen in Table 5-3, there was a great discrepancy between those plants reporting to have a formal EMS and those that had the environmental practices in place to merit this distinction. In this table, plants did not

need to be ISO equivalent to classify as having an EMS, but only the criteria for “Formal EMS.” Of the 114 respondents reporting a formal EMS, only 65 (57%) met the criteria for a formal EMS – meaning the other 49 facilities incorrectly assumed EMSs where none exist. Though not displayed in the table, nearly 30% of plants claiming ISO registration did not meet the minimum requirements for a formal EMS in the most basic sense and overall, only 16% of plants meet the requirements for ISO 14001 equivalency. There is no indication that respondents purposely misrepresented their experience or attempted to be misleading. A more probable explanation for some plants is that many managers misunderstood the basic elements and requirements for an EMS and therefore interpreted any environmental management activities as a formal system. This does not explain, however, those plants reporting an ISO registered system where the minimum requirements were not met. In such cases, poor or improper assessment by third-party auditors is a more likely explanation.

Table 5-3

Self-Reported v. Calculated EMS				
		Formal EMS Calculated by Activities		
		No EMS	EMS	Total
	No EMS	31	1	32
	EMS	49	65	114
Total		80	66	n =146
Pearson $\chi^2 = 29.198$; $p = 0.000$				
Presence of Customer Requirement v. Actual Adoption				
		Formal EMS in Place		
		No EMS	EMS	Total
	No Requirement	31	6	37
	Requirement	40	56	96
Total		71	63	n =133
Pearson $\chi^2 = 19.037$; $p = 0.000$				
Presence of Corporate Requirement v. Actual Adoption				
		Formal EMS in Place		
		No EMS	EMS	Total
	No Requirement	36	11	47
	Requirement	34	51	85
Total		70	62	n =132
Pearson $\chi^2 = 16.273$; $p = 0.000$				

Table 5-3 displays the discrepancies that existed between those plants subject to supply chain mandates and those that had systems in place based on calculation of their management activities. According to the table, 96 facilities (or 72% of those responding) were subject to a requirement from a customer, and 85 (64% of respondents) were subject to a corporate requirement. Despite the presence of these requirements, however, a great many plants failed to adopt a formal EMS. Of the plants that reported the presence of a mandate to adopt an EMS from a major customer, 40 (nearly 42%) did not have one in place. Similarly, of the plants reportedly subject to a requirement from their corporate headquarters to implement a formal EMS, 34 (40%) failed to do so. Potential explanations for these shortcomings include

poor monitoring and lack of consequence for non-compliance, more detailed discussion of these findings will be presented in the final chapter of this study.

Table 5-4 summarizes the regression model results. As explained in the Model Description section, all independent variables with the exception of one met the proportional odds requirement, and had equal coefficients across categories. The differences between categories (customer mandate and the intercept) are presented at the bottom of the table.

Table 5-4: Model Results for Levels of EMS Adoption

Independent Variable	B	S.E.	Z	95% Confidence Interval		Odds Ratio
Drivers						
Customer Mandate	.544	.199	2.73***	.154	.934	1.723
Corporate Mandate	.072	.210	0.34	-.340	.484	1.075
Stakeholder Involvement	.390	.202	1.93*	-.007	.787	1.477
Consideration of Future Generations	.347	.211	1.65*	-.066	.760	1.415
Shareholder Pressure	.382	.197	1.94*	-.004	.769	1.465
Potential Compliance Problem	.293	.186	1.58	-.071	.657	1.340
Lower Insurance Rates	.175	.277	0.63	-.368	.719	1.91
Part of Regulatory Agreement	-.826	.229	-3.60***	-1.276	-.376	.438
Technical Considerations						
Cooperation w/Customers	.539	.191	2.82***	.164	.914	1.714
Cooperation w/ Local Producers	-.522	.228	-2.29**	-.969	-.075	.593
Codification of Product Specifications	.389	.170	2.29**	.055	.722	1.476
Technological Complexity	.523	.232	2.26**	.069	.978	1.687
Participated in PROFEPA "Clean Industry" Program	1.518	.513	2.96***	.513	2.524	4.563
Demographic Considerations						
1 st Tier Supplier	-.079	.573	-0.14	-1.201	1.044	.924
US Ownership	2.175	.706	3.08***	.791	3.560	8.802
European or Japanese Ownership	1.004	.775	1.30	-.515	2.523	2.729
Public Ownership	-.235	.626	-0.38	-1.462	.991	0.791
Plant Size	-.043	.154	-0.28	-.345	.259	0.958
Constant	-6.098	1.377	-4.43***	-8.798	-3.399	0.002
Differences in ISO Equivalent Category						
Customer Mandate	.019	.215	0.09	-.403	.440	1.019
Constant	-7.571	1.564	-4.84	-10.637	-4.505	.001

***p = 0.01; **p = 0.05; *p = 0.10

LR χ^2 = 98.49***

N = 119; Pseudo R² = .4023

Table 5-5: Correlations and Descriptive Statistics

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Customer Mandate (1)	1.000																	
Corporate Mandate (2)	0.466	1.000																
Stakeholder Involvt. (3)	0.260	0.239	1.000															
Consid. of Fut Gens (4)	0.258	0.340	0.485	1.000														
Shareholder Pressure (5)	0.302	0.547	0.325	0.356	1.000													
Compliance Problem (6)	0.361	0.377	0.243	0.352	0.401	1.000												
Lower Insurance (7)	0.185	0.278	0.254	0.234	0.356	0.259	1.000											
Regulatory Agreement (8)	0.119	0.313	0.180	0.277	0.421	0.451	0.394	1.000										
Customer Cooperation (9)	0.215	0.338	0.309	0.325	0.078	0.238	0.087	0.059	1.000									
Local Cooperation (10)	0.144	0.060	0.388	0.217	0.135	0.232	0.155	-0.028	0.330	1.000								
Supplier Capabilities (11)	-0.159	-0.122	-0.178	-0.281	-0.111	-0.095	-0.156	-0.146	-0.229	-0.122	1.000							
Tech Complexity (12)	-0.013	0.104	0.204	0.304	0.187	0.134	0.151	0.175	0.219	0.1845	-0.268	1.000						
PROFEPA Program (13)	0.343	0.308	0.220	0.339	0.066	0.216	0.036	0.064	0.159	0.0484	0.1804	-0.146	1.000					
1st Tier Supplier (14)	0.067	0.374	0.074	0.161	0.113	0.015	-0.013	0.123	0.047	-0.021	0.108	0.202	-0.115	1.000				
US Ownership (15)	0.188	0.313	0.041	0.198	0.182	0.176	0.181	0.235	0.205	0.128	-0.141	0.054	0.125	-0.292	1.000			
EU or Japanese Own (16)	0.240	0.238	0.156	0.247	0.082	0.280	0.068	0.185	0.143	0.064	-0.263	0.080	0.240	0.131	-0.029	1.000		
Public Own (17)	0.120	0.409	0.293	0.204	0.183	-0.056	0.212	0.042	0.139	0.025	-0.162	0.066	0.122	0.349	-0.063	0.287	1.000	
Plant Size (18)	0.331	0.348	0.235	0.298	0.251	0.181	0.051	0.143	0.142	-0.057	-0.209	0.155	0.286	0.255	0.025	0.276	0.306	1.000
Mean	1.992	2.045	1.911	2.373	1.641	1.863	.600	1.406	2.675	3.133	1.785	2.911	.600	.288	.162	.304	.285	4.120
Standard Deviation	1.439	1.596	1.487	1.339	1.579	1.558	.864	1.409	1.357	1.118	1.308	1.006	.487	.381	.310	.461	.388	1.586

Drivers for EMS Adoption

Five of the eight drivers measured in this analysis had a significant influence on levels of EMSs adopted by manufacturing facilities. With respect to supply chain mandates, the degree of importance of customer requirements reported by plants is an influential factor for formal EMS adoption, but not ISO 14001 equivalency. Managers that viewed customer mandates as important were more likely than others to adopt a formal EMS at their plants, but there was no difference among groups when compared at the ISO 14001 equivalent level. This finding suggests, at least on the surface, that using value chain pressures as leverage may lead to better management in some cases. However, because no difference was found when comparing those facilities who had achieved all necessary elements for the successful adoption of ISO 14001 with the other two groups, even the strength of customer mandates does not automatically lead to compliance with the OEMs' policies. The level of importance placed on corporate mandates, however, did not appear to affect EMS outcomes, signaling some important differences in the types, and the extent, of pressures that may lead to higher outcomes.

Both the degree to which a plant incorporates the views of external stakeholders when making decisions regarding environmental behaviors, and the degree to which it considers the environmental impact of manufacturing operations on future generations, influence the likelihood of EMS adoption. Facilities that ranked both factors as important were more likely to adopt both formal EMSs and ISO equivalent EMSs.

Shareholder pressure to adopt EMS also led to more thorough management outcomes, with those facilities that placed higher degrees of importance on shareholder demands meeting higher levels of EMS implementation.

The two drivers related to regulatory influence examined in this chapter revealed differing, though not necessarily contradictory, outcomes. Plants adopting EMSs to avoid potential compliance problems were more likely to achieve higher levels of adoption, while those reporting agreements with regulators as important drivers were actually *less* likely to adopt formal and ISO equivalent systems than other plants in the sample. Such findings may indicate a difference between systems proactively adopted to avoid potential problems, and those adopted in response to government pressure. In cases where plants were self-motivated to improve management performance, an EMS may be used as a tool to achieve desired outcomes and may therefore be adopted in a more rigorous fashion. In situations where an EMS was externally prescribed, limited care may have been taken in applying the minimum components of the system needed to satisfy regulators, resulting in incomplete implementation.

Technical Considerations

Several technical aspects associated with manufacturing operations significantly influenced the level of EMS adoption at manufacturing sites. Perhaps not surprisingly, the degree of cooperation with customers in activities such as product development, employee training and quality assurance are associated with increased formalization of environmental management activities. The degree of cooperation with other local producers in similar activities, however, did not appear to influence these levels of adoption. The differences between these groups may be due to the types of institutional pressures they present and the degree of experience with environmental management present in each group. That is, the pressure to conform to environmental behaviors may be stronger with respect to customers who exert

economic influence, even if such pressures are not explicitly coercive, than with peer facilities. Additionally, customers' experience with environmental management may be more advanced, particularly if they are multinational entities, making the degree of learning possible more pronounced than with other local manufacturers. One confounding result, however, was that facilities with higher degrees of cooperation with other local producers made them less likely to adopt formal EMSs. Such a finding may indicate more insular behavior among producers with stronger local ties, as these businesses may rely more on each other rather than links with multinationals and the external international market with stronger expectations for the adoption of international standards.

The complexity of product specifications and the degree to which such specifications can be codified also influenced higher levels of EMS adoption. Facilities that manufacture technologically complex products were more likely to adopt formal and ISO equivalent EMSs than those manufacturing less sophisticated goods, supporting the notion that the strict management processes required to produce these types of products may produce spillovers that lead to improvements in environmental management. The ability to codify product specifications is also important, but perhaps counterintuitive. As discussed with respect to cooperation with customers, one may expect that more frequent interaction with customers may influence EMS adoption. While this may be true with respect to several facets of interaction, a lower degree of interaction with respect to the precise specifications necessary for the manufacture of components may instead be indicative of the degree of supplier capabilities. Highly capable suppliers generally require a lower degree of guidance from their customers than do their less-proficient peers. Independence in operations, and resulting market success, may stem from better overall management and the existence of related

expertise that leads to greater organizational efficiency (Wernerfelt 1984; Barney 1991; Grant 1991; Roome 1992; Collis and Montgomery 1995; Oliver 1997). Such management expertise may exist in the form of complementary management capabilities that lead to better environmental management (Hart 1995; Christmann 2000).

Finally, plants that either participated in the PROFEPA's *Clean Industry* program at the time of the survey, or had done so in the past, were more likely to achieve higher levels of environmental management than those that had not. Not only do these results suggest that the Action Plans designed by PROFEPA accredited auditors lead to effective adoption of formal EMSs (even if the plans themselves are not targeted towards achieving ISO 14001 registration), but also that cooperative government initiatives, if properly designed, can lead to improved management outcomes.

Demographic Considerations

Of the demographic considerations included in the model, the plant ownership variables yielded the most noteworthy results for the purposes of this chapter. As compared with Mexican-owned manufacturing sites, plants with US-based ownership were more likely to adopt formal and ISO equivalent EMSs. Plants with European or Japanese ownership, however, did not tend to have significantly different levels of environmental management in place. This finding for European and Japanese firms was unexpected, as these regions are among the most proactive in terms of formal EMS adoption (including ISO 14001 and the Eco-management and Audit Scheme, or EMAS)²⁴.

A plant's position in the value chain may not be as important as the nature of the relationships within them, as there were no statistically significant differences between tier-1

²⁴ Current statistics on global EMS adoption can be found at: <http://www.ecology.or.jp/isoworld/english/analy14k.htm>

plants and those located in lower tiers with respect to EMS adoption. Part of the explanation for this finding may be that relationships among tiers may be so complex as to render the demographic classifications somewhat meaningless. Suppliers in the automotive sector can simultaneously occupy several tiers, or shift position based on order runs and needs of particular customers. Indeed, there are even instances where auto manufacturers such as Ford are considered second tier suppliers when their stamping plants provide inputs to large supplier firms such as Lear or Delphi. Public ownership and plant size did not appear to influence the level of EMS adoption.

Chapter Conclusions

These findings hold important implications for the three primary research questions posed by this chapter regarding the efficacy of supply chain mandates, how technical considerations related to industrial organization may influence EMS adoption, and to what degree firms may be “exporting environmentalism.”

Overall, there was a great discrepancy between those facilities subject to supply chain mandates and those who actually adopted EMSs. Indeed there was also a large gap between those who believed they have an EMS in place (and those claiming ISO 14001 registration) and those who met the requirements for one. Such shortcomings indicate severe flaws in relying on methods of this kind to upgrade environmental standards along the value chain. While the mere presence of mandates did not appear to be an effective means for assuring compliance with a customer’s (or parent company’s) wishes, if properly designed, they may play a role in promoting the diffusion of standards along the supply chain. The perceived *strength* of customer requirements was associated with the adoption of environmental

management practices. Facilities that viewed the mandates as more important were more likely to adopt formal EMSs than those believing them to be less important. This finding suggests that if supply chain mandates are to be effective, they must be perceived as having “teeth” and effective systems for monitoring and enforcement. That is, there must be real consequences for noncompliance (such as the threat of losing current or future contracts) and plant managers have to believe that there is a strong probability that they will be caught if they don’t comply.

While the strength of customer mandates did influence formal EMS adoption, it did not appear to affect the successful adoption of an ISO equivalent EMS indicating that even in cases where the threat of punitive action exists, many firms simply fail to meet the expectations of their customers.

Further, a great deal of plants claiming to have an ISO EMS in place failed to meet the requirements for such a system. This failure may stem from managers’ misunderstanding of what an EMS consistent with ISO 14001 entails, or simply be an indicator that many firms have been granted ISO 14001 registration without meeting its requirements. In either case, this finding signals an essential problem in the communication and implementation of the policy throughout the industry in Mexico.

The model also provides practical insight into how the global restructuring of industry may present opportunities for improvement. The upgrading of environmental standards may be partially achieved by industrial upgrading more generally, as more highly capable suppliers and those involved with more highly complex processes are more likely to achieve higher levels of system adoption. Efforts by industry associations, government agencies and perhaps major customers aimed at improving supplier capabilities, and not solely focusing on

environmental issues per se, may provide important spillovers to the area of environmental management.

The results of the analysis additionally suggest a positive role for government in assisting the adoption of environmental management systems. The PROFEPA program serves as a strong example of the potential success that can be achieved through cooperative technical assistance on the part of government. While not identical to the ISO 14001 system, the requirements of the Clean Industry program prepared participating plants well for the demands of the private market. While much of this success may be attributed to the nature of the auditors themselves, who are accredited by PROFEPA and not beholden to plant management, the experience creates a base of expertise that persists beyond program participation.

Finally, U.S. ownership did increase the likelihood that a plant will adopt higher levels of environmental management. Such a finding lends some support to Garcia-Johnson's (2000) argument that firms may be exporting environmentalism as they move their plants to industrializing societies. However, this finding should be taken with some caution, as the results for European and Japanese firms indicate that this phenomenon is not universal, as there was no statistical difference among firms with Mexican, European and Japanese ownership. The results do suggest that manufacturing facilities in Mexico, even while controlling for ownership, were motivated to adopt formal EMSs as a result of supply chain mandates from customers regardless of national origin of ownership.

This chapter investigated the effectiveness of supply chain mandates on implementation of formal environmental management systems. As simple adoption of an EMS may not lead to environmental changes, the following chapter takes the analyses a step further and

investigates the influence that EMS adoption, and the mandates to adopt them, have upon the prioritization of specific environmental goals.

CHAPTER 6: Determinants of Environmental Objectives

The analyses in the preceding chapter found that although there exists a great discrepancy between plants that are subject to supply chain mandates and those that actually adopt them, the perceived importance of mandates does influence whether or not facilities adopt formal EMSs. A remaining issue, then, is whether plants that are motivated to adopt by strong external pressures use the opportunity to implement robust systems aimed at achieving genuine environmental improvements, and construct their EMSs accordingly, or whether they simply opt to go through the motions, and adopt the structure of an EMS, in order to meet minimum requirements for certification. This is an important issue, as EMSs based on the ISO 14001 standard merely require the selection of “objectives and targets” appropriate to the individual needs and desires of each manufacturing facility. However, the nature and stringency of these objectives is left entirely to the discretion of the adopter, without any specific prescriptions. Facilities may therefore choose both which objectives they deem important and the degree of focus they place on them. Consequently, some plants may take a very broad scope in terms of the objectives they select, opting for more comprehensive systems, while others may focus very narrowly on areas such as regulatory compliance. In other words, EMS adoption may entail little more than superficial alterations to current strategies, or it could be fundamental and substantive changes that may produce genuine environmental and management improvements.

This chapter explores two primary research questions aimed at understanding first the associations of EMSs with the level of commitment to specific environmental objectives – regulatory compliance, pollution prevention, eco-efficiency and product stewardship – and second, the specific impacts of supply chain mandates on these objectives. Stated more clearly: first, does the adoption of a formal EMS affect the level of priority a facility places on each one of these potential objectives? Additionally, do customer and corporate mandates affect a facility's commitment to these four categories of objectives?

These questions are addressed using two regression techniques (least squares and logistic regression) to investigate the impact of several explanatory factors on the level of commitment to each objective, and also to determine what factors lead to above-average commitment to each. The analysis finds that the presence of an EMS does indeed influence the level of objectives prioritization, and that facilities with an EMS in place are more likely to have above-average commitment to most categories of objectives. It also finds, however, that supply chain mandates have little effect on how plants structure their environmental strategies and in some cases have a negative influence and produce EMSs with only average or below-average commitment to environmental objectives. Conversely, strong environmental attitudes at facilities tend to lead to stronger commitments. Plant managers who are “true believers” in the value of their environmental activities therefore improve the content of EMSs and create opportunities to extract value from a plant's environmental operations.

The chapter proceeds as follows. An explanation of each of the categories of objectives is presented, along with related theory about why such categories may be important factors for plants to consider as part of their overall environmental strategy. These issues are then

considered in the Mexican context. Next, the variables and models used in the analyses are explained and the results presented. Finally, conclusions stemming from the findings are proposed.

Background and Theory

Formalized environmental management systems, typically based on the ISO 14001 template, require several fundamental procedures upon implementation: identifying environmental aspects and impacts, setting goals and objectives, assigning responsibilities, training, corrective and preventive actions, and periodic review of the system. To conform with ISO 14001, these systems should work towards three overarching objectives for that process: compliance with applicable environmental laws and regulations, the prevention of pollution, and continual improvement of the system. Though these goals are fixed, the adopter is free to choose the specific objectives, priorities, and pace of improvements in order to achieve these principles.

Businesses are thus free to choose among different environmental objectives, such as improving regulatory compliance, pollution prevention, eco-efficiency, product stewardship, or the adoption of cleaner production technology (Hart 1995, 1997), and to pursue them with differing priorities and aggressiveness. Deborah Gallagher (2002) argues further that a manufacturing facility's environmental objectives move along a continuum from regulatory compliance toward environmental sustainability: facilities with less aggressive commitment may emphasize merely achieving more consistent regulatory compliance, while more enterprising facilities may emphasize objectives that are progressively centered on pollution prevention, conservation of raw materials (eco-efficiency), product design (product

stewardship), and ultimately consideration of the facility's impact on environmental quality for future generations (ecological modernization and sustainability).

The resource-based view of the firm (RBV) contends that organizations may achieve and sustain competitive advantage based on the attributes of their available resources and capabilities (Rumelt 1984; Dierickx and Cool 1989; Barney 1991; Peteraf 1993). Resources may include physical capital resources, including specific technologies, geographic location, manufacturing plants and equipment, and access to raw materials; human capital resources, such as the experience, training, knowledge and expertise of managers and employees, and; organizational resources, such as management systems, formal reporting structures and procedures, and planning, coordinating and control systems (Barney 1991). This perspective suggests that organizational decisions are based on rational criteria, consistent with transaction cost economics, in which managers make active choices to address institutional pressures (Oliver 1991). Resource allocation, therefore, is determined by rational, or "boundedly" rational, choices of firm decision-makers based on the perceived costs and benefits of particular capabilities. Working from the resourced-based view, Hart (1995) contends firms may also use *natural* resources – or environmental considerations – as unique resources and capabilities to develop sustained competitive advantage. By integrating strategies such as pollution prevention and product stewardship into strategic management more generally, firms may realize both internal efficiencies that lead to competitive advantage, and external capabilities that increase social legitimacy, enhance reputation and improve market performance. Hart also predicts that organizations that have previous experience with management systems will be able to accumulate the necessary resources for pollution prevention, and for other strategic uses of environmental management capabilities,

more quickly than firms without such experience. Gallagher's continuum can serve then as a guidepost for the types of objectives facilities may set as part of their EMS process. Of the five categories along the continuum, I have selected four to explore in this analysis: regulatory compliance, pollution prevention, eco-efficiency and product stewardship.²⁵ While adherence to these specific objectives may not guarantee specific environmental performance improvements in manufacturing operations, a deeper prioritization to each of them may signal a plant's commitment to corresponding behaviors and lead to eventual improvements. The following paragraphs outline the four categories of objectives and explore the rationale that firms and managers have for placing priority on each.

Regulatory Compliance

Firms comply with environmental regulations, and seek strategies to achieve legal compliance, both for economic reasons and for social legitimacy (Cohen 1998). And while a traditional line of thought has been that stringent environmental regulations hinder the competitiveness of firms, little evidence exists to support this claim (Jaffe et al. 1995). The economic rationale for striving to achieve and maintain regulatory compliance includes both the avoidance of penalties and potential financial losses due to reputational damage stemming from non-compliance, while legal and regulatory penalties are also extremely important factors in deterring environmental violations (Karpoff, Lott and Wehrly 2004). Even when the likelihood of being caught and the level of sanctions are both low, firms still seek to achieve legal compliance in order to avoid being placed in targeted enforcement groups based on prior violations (Harrington 1998). Further, firms often overestimate the

²⁵ Because the concept of sustainability can be elusive and difficult to operationalize in terms of tangible actions, I focus on the first four of these concepts and use adherence to the philosophy of sustainability as an explanatory factor instead of an outcome variable.

expected penalty for violating environmental regulations and therefore behave as though penalties were stricter than they actually are (Cohen 1998; see also Becker 1968; Keeler 1995). Managers also consider effects on the business's reputation with regulators, shareholders, and consumers, as poor compliance may affect relationships with these stakeholders (Downing and Kimball 1982; Cahill and Kane 1994). Finally, many firms seek to achieve and maintain legal compliance to avoid confrontational relationships with local governments and citizen groups, thus maintaining their "license to operate" (O'Rourke and Macey 2003; World Bank 2000; Brooks and Sethi 1997; Hettige, Pargal and Wheeler 1997; Arora and Cason 1996; Pargal and Wheeler 1996). In short, the rationale firms use to justify compliance with environmental regulations, whether based on social or economic considerations, are mostly related to attempts to reduce and avoid penalties, protect firm reputation, avoid community conflict, and maintain both a legal and social license to operate. Simply attempting to stay in compliance with federal, state and local laws has little to do with adding value to plant activities and businesses that focus their environmental strategies solely on compliance fail to adopt additional approaches to environmental management, where internal efficiencies may be found.

Finally, to technically be in compliance with the ISO standard, firms must also adhere to "other requirements to which the organization subscribes, that are applicable to the environmental aspects of its activities, products or services" (§ 4.3.2, ISO 14001 Standard). Conformance with ISO therefore requires compliance with supply chain mandates from customers, industry associations and business partners, among others. While the logic may be circular in the particular case of the automakers' EMS mandates (i.e. one must comply with the mandates to be certified to ISO 14001 in order to be certified to ISO 14001), other

mandates, such as the phasing out of heavy metals and other toxic substances included in the End of Life Vehicle directive, must be followed in order to be registered to the standard.

Pollution Prevention

Efforts to move beyond compliance often begin with activities that center around the concept of pollution prevention (Hart 1997). Activities to achieve pollution prevention are designed to reduce pollution at its origins in production processes, rather than just at the “end of the pipe” as often required for regulatory compliance. Examples include modifications to equipment or technology, changes in the production process or operating procedures, and improvements in housekeeping, maintenance, training, or inventory control. As a first step in moving past traditional “end of pipe” thinking, pollution prevention plans have become common practice inside many manufacturing plants over the past two decades. Such initiatives can produce competitive advantage by reducing waste and compliance costs and thereby increasing a firm’s profitability (Hart 1995, King and Lenox 2000). Manufacturing facilities that have emphasized pollution prevention have done so largely through improving existing production technologies, replacing inefficient or obsolete technology, and redesigning their production processes to eliminate or reduce environmental impacts. Indeed, firms that used pollution prevention strategies to reduce emissions have found these activities often lead to positive financial and environmental outcomes (Hart and Ahuja 1996; Klassen and Whybark 1999).

Eco-efficiency

Broader and more systematic than pollution prevention activities that are focused mainly on technology upgrades and process re-design, eco-efficiency practices seek to reduce the environmental impacts of production by increasing the overall efficiency of materials and energy use throughout a firm's operations. Plants targeting eco-efficiency emphasize cost-effective means of using inputs associated with the process of manufacturing, such as water, electricity, toxic chemicals, and the substitution or redesign of other inputs and materials in order to both maximize product value and reduce its environmental footprint. Incorporating eco-efficiency principles into business operations may include reducing inputs per unit of output, recycling materials and reducing waste at each stage of production. The term "eco-efficiency" was coined by the World Business Council for Sustainable Development (WBCSD) as part of the larger agenda for the Rio de Janeiro "Earth Summit" in 1992.

Product Stewardship

Unlike pollution prevention and eco-efficiency, which focus on the production process, product stewardship also addresses the potential environmental impacts of the product itself. While EMSs generally focus on management processes in specific facilities or business units, businesses that prioritize product-stewardship objectives may take a broader approach, evaluating the environmental impacts of their products not only during the manufacturing facility's production process, but throughout its life cycle from raw materials extraction to production, distribution, use, recycling, and end-of-life disposal, and using "design for environment" (DfE) principles to minimize these (Hirschhorn and Oldenburg 1991; Gallagher 2002; Hart 1997). Both internal and external business benefits may result: costs

may be reduced by efficiencies found in reconfiguring products, reducing liability associated with the products by reduction in the use of hazardous materials, reducing transportation and distribution costs, and reducing expenses associated with disposal of wastes and hazardous materials. Additionally, firms may benefit from a greener image in the eyes of shareholders, customers and regulators, as well as improved operations (Hart 1995).

Environmental Objectives in the Mexican Context

The Mexican regulatory environment is still heavily dependent upon efforts aimed at emission control rather than pollution prevention at the source of production (Vega-López and Pacheco-Vega 2000). Unlike regulatory agencies in the United States (including the U.S. EPA, state and local agencies), which have actively engaged industry to focus on pollution prevention (Pollution Prevention Act, U.S. Code Title 42 1990)²⁶, Mexico focuses mostly on approaches to environmental protection that are heavily reliant on facility inspections and the imposition of fines as established in their landmark Federal Law on Environmental Protection in 1982 and subsequent passing of the *Ley General del Equilibrio Ecológico y la Protección al Ambiente* (LGEEPA) or the General Law of Ecological Equilibrium and Environmental Protection, created in 1988.

In 1996, modifications to the LGEEPA created several additional provisions for specific manufacturing processes in the form of the 73 *Normas Oficiales Mexicanas* (NOMs), to which facilities in the automotive sector are subject. These modifications also created provisions for revised environmental planning, environmental impact assessments, introduction of economic policy instruments, new standards for the production of hazardous

²⁶ This is not to suggest that regulatory agencies in the United States have abandoned technology-based approach to environmental protection, as the U.S. system is still overwhelmingly focused on such standards.

substances, and strengthened enforcement and prosecution of existing environmental laws (Pacheco-Vega et al 2001; NACEC 2004; Azuela et al. 2005). Another approach was the introduction of a Pollutant Release and Transfer Registry (PRTR) in 2000, based on similar “right to know” approaches used in the United States’ Toxics Releases Inventory (TRI) and Canada’s National Pollutant Release Inventory (NPRI) (Pacheco-Vega 2002). The program began as a voluntary initiative, but reporting of toxic emissions to the Mexican government as part of the *Registro de Emisiones y Transferencia de Contaminantes* (RETC) program became mandatory in 2004.

Additionally, Article 4 of the Mexican constitution in 1998 inserted language which guarantees that “all persons have the right to an environment appropriate for their development and well-being” (Gutiérrez Nájera 1999). While these changes to Mexican law set the foundations for government action on pollution prevention activities by broadening the scope of acceptable approaches for environmental protection, they did not define pollution prevention as the prevention of emissions at the source of generation, or create specific provisions for the enactment of sustainable development principles (Pacheco et al. 2001; NACEC 2004).

Instead, efforts of both government and industry at “beyond compliance” goals have been largely voluntary in nature. One federal government-led effort is PROFEPA’s “Clean Industry” program, described in the preceding chapter, where manufacturing sites submit to voluntary audits and prescribed action plans to improve environmental performance. Smaller pilot programs have also been initiated at the state and municipal level in locations such as Mexico City, Monterrey, the US-Mexico border states, and others. Some programs supported by industry such as the GEMI initiative and the chemical industry’s Responsible

Care program, and others supported by the United Nations, the World Bank and US AID have all aimed to incorporate pollution prevention principles, but have not been widely adopted.

While there exist some efforts to formally introduce pollution prevention initiatives into formal environmental law, there are no concrete plans to do so presently. In short, the regulatory environment in Mexico has not yet entered the first stage beyond traditional compliance activities, much less higher order objectives such as eco-efficiency and product stewardship. Voluntary efforts have generally been confined to small regional experiments or to specific industries and have not been widespread. As such, plants operating throughout Mexico tend to use compliance as their primary environmental benchmark.

Methods

Variable Descriptions

The models used in this chapter use dependent variables derived from the degree of prioritization a facility places on each of the four categories of objectives described in the previous section. The independent variables include EMS status and mandates, as well as attitudinal, technical and demographic considerations. The individual measures are more thoroughly described in this section.

Dependent Variables

In order to operationalize the measures for the four categories of objectives, facilities were asked to rate the priority they place on a list of potential activities associated with each goal,

as listed in Figure 6-1 and evaluated on a scale from 0-4. The measures for each category were calculated based on the scores reported for each grouping and were used to investigate the influence of each of the explanatory factors on a facility's degree of prioritization. Each dependent variable category was measured on a scale from 0-12, with higher values corresponding to deeper commitments to each objective. Means and standard deviations for each are listed in Table 6-2 and histograms for distributions are presented in Appendix C.

Table 6-1: Cronbach's Alpha for Categories of Objectives

Objectives Category	Cronbach's a
Compliance	0.8520
Pollution Prevention	0.8985
Eco-Efficiency	0.8543
Product Stewardship	0.8568

Table 6-2: Descriptive Statistics – Dependent Variables

Objective	Mean	Standard Deviation	Range
Compliance	8.411	3.847	0-12
Pollution Prevention	6.536	3.881	0-12
Eco-Efficiency	7.712	3.880	0-12
Product Stewardship	4.167	3.931	0-12

Figure 6-1: Formalization of Environmental Objectives

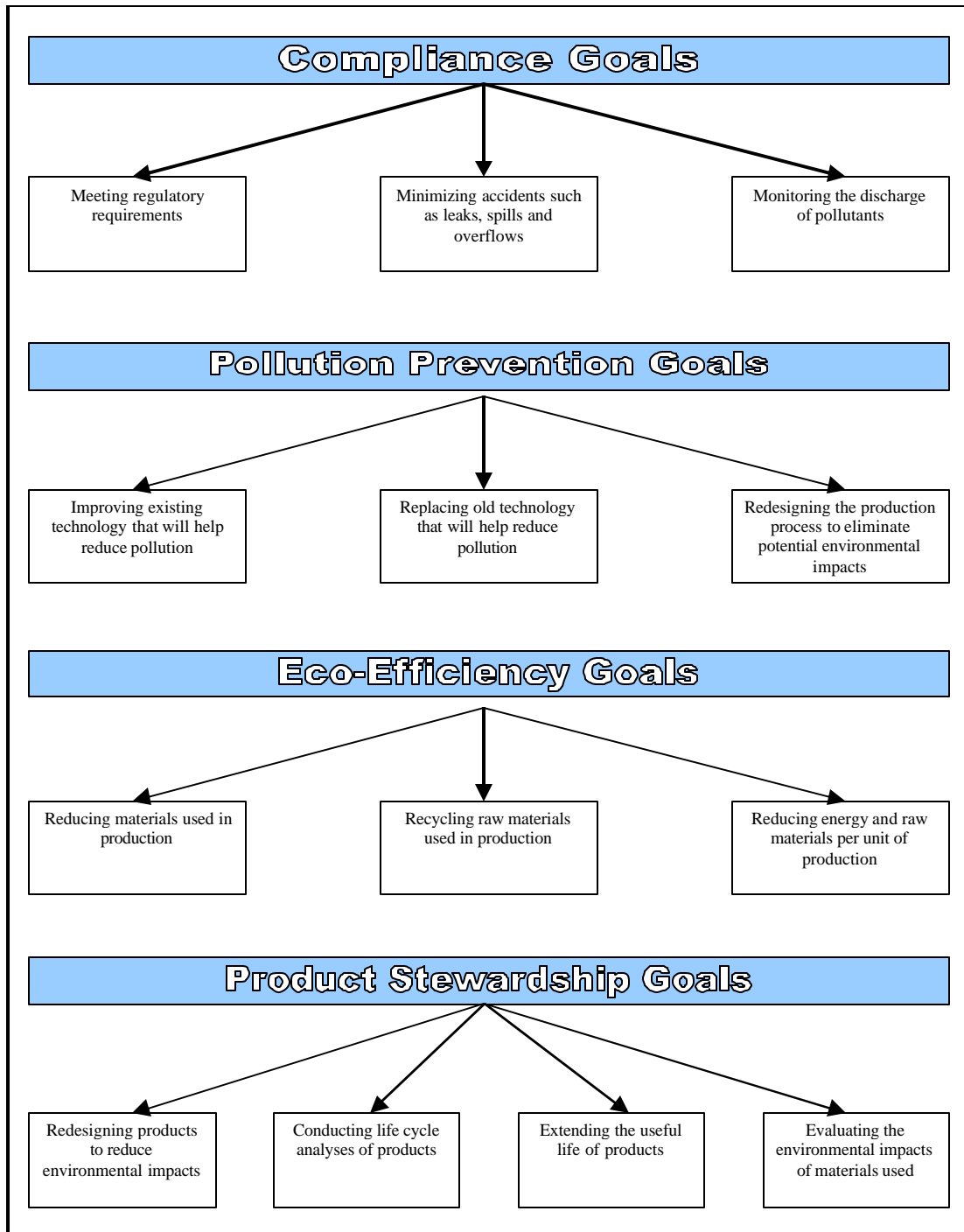


Figure design by Daniel Edwards Jr.

Independent Variables

The ISO 14001 EMS standard, and formal EMSs based on its structure, provide a standard template for the process elements of an EMS. These elements include identifying environmental aspects and impacts at a given manufacturing site, setting environmental goals and objectives for the plant to achieve, assigning responsibilities, employee training, corrective and preventive actions, and periodic management review. Among the most important for resulting outcomes from an EMS is the adoption of explicit objectives for performance improvement (Hutson, Edwards, and Andrews 2004). As previously mentioned, EMSs merely provide a template for a system without determining specific requirements – the nature and stringency of these objectives is left entirely to the discretion of the adopter. Accordingly, facilities may choose both which objectives they deem important and the degree of focus they place on them. The procedure to adopt an EMS, however, may take plants through a useful exercise, wherein managers and employees use the process to broaden the scope of their objectives and deepen their commitment to them. As a result, the presence of a formal EMS may influence both the choice of objectives and the amount of importance a facility places upon them. As in the preceding chapter, whether or not a facility had a formal EMS in place was evaluated based on the specific activities in place, and not by using registration to the ISO standard. Treatment models are used for most categories of objectives and the technique for measuring the impact of EMS on objectives prioritization is detailed in the model description section below.

There is little to suggest that supply chain mandates in the automotive industry come with specific guidelines as to how plants must implement the systems, and managers are therefore free to use their own discretion in choosing what objectives they believe are important.

While some corporations do use global benchmarks and guiding philosophies in adopting standards and have found that using universally stringent standards may lead to improved market value (Dowell, Hart and Yeung, 2000), it is unclear if such guiding philosophies and benchmarks lead to different emphases among each of the four categories explored in this chapter. It is even less clear whether similar benchmarks and guiding philosophies of major customers lead to greater prioritization on environmental objectives inside supplier plants. It is quite possible that many plants simply use external mandates as drivers to adopt formal EMSs with minimal effort, foregoing opportunities to create more robust and comprehensive systems. Variables measuring the presence of customer and corporate mandates are scaled from 0-4, corresponding to the manager's perception of how strongly each driver influenced the decision to adopt a formal EMS (regardless of whether the plant actually possesses an EMS). A response of zero indicates that the factor was not present or did not apply, while responses from 1-4 represent a scale ranging from low to high priority for each.

Plants may receive technical assistance with the adoption of their environmental activities in a variety of forms and from a variety of sources. In the sample of manufacturing facilities in this study, technical assistance activities came in several different forms, including workshops (10%), educational materials (6%) and financial aid (a mere 2%), but overwhelmingly in the form of consulting services (75%). Most consulting services came from customers and business partners (28%) or from hired private consultants (31%), with an additional 12% coming from federal or local governments. Plants that received technical assistance from outside experts may have more thoroughly developed sets of environmental objectives in all categories than if they attempted to shape their environmental program on their own. Outside experts presumably bring knowledge and insight regarding environmental

management and propose opportunities for improvements that managers may otherwise overlook. Depending on the quality of this insight, facilities that receive technical assistance may therefore place a higher priority across the spectrum of environmental objectives. The models use a dummy variable to account for this factor.

More so than mandates to adopt EMS, collaboration with customers on specific facets of production may influence the prioritization of specific environmental objectives. That is, collaboration with customers who may have knowledge regarding product inputs and production processes, or that may influence the adoption of state-of-the-art technology, may produce spillovers to the prioritization of specific environmental objectives. For example, because pollution prevention measures rely on technological and process changes, suppliers who work closely with customers on technology upgrading may be more likely to focus on these activities with greater intensity. Similarly, as eco-efficiency objectives involve altering the raw materials used in production (both in content and degree) and product stewardship objectives focus on the overall impacts of products and inputs used, the degree to which a supplier collaborates on product design may influence its focus on these objectives. The two measures used in this paper measure the degree of collaboration with customers on product design and with the upgrading of production technology. The variables are measured on a scale from 0-6, with six indicating a large degree of cooperation and zero indicating no collaboration.

Two “attitudinal variables” have been included to explore how environmental ideals may influence the adoption of more thorough sets of environmental objectives at manufacturing plants. The first of these variables is the inclusion of external stakeholder perspectives in the development of a plant’s environmental management strategy. Including external

stakeholders in the design and implementation of a firm's environmental strategy can lend social legitimacy to the firm's operations and result in a variety of operational improvements (Fiorino 1990; Berman et al. 1999; Beierle 1999; Carmin, Darnall and Mil-Homens 2003; Rondinelli and London 2003). In addition to such improvements, the degree to which a manager engages with external stakeholders may signal a strong level of commitment to social and environmental issues that may then be reflected in the priority he or she places on the environmental objectives of the facility. The greater the involvement of external stakeholders in a facility's environmental management activities, the greater the competitive advantage a firm is likely to report (Delmas 2001). As such, a higher degree of stakeholder engagement may lead to stronger commitments to all four sets of objectives. Further, the adoption of a formal EMS may lead to stronger relationships between some businesses, particularly small and medium-sized ones, and local communities (Hillary 1999).

The second attitudinal variable that may impact the strength of commitment to objectives is a facility's consideration of future generations into the strategic planning of its operations. In the view of some authors, internalizing the idea that a business's enlightened self-interest is best served by optimizing a "triple bottom line", including environmental and social value, may lead to improved overall firm performance (Hart 1997; Elkington 1998, Hart and Milstein 1999). While difficult to operationalize concretely, the concept of sustainability is widely communicated as considering the needs of future generations when making business decisions. Accordingly, those facilities whose managers more strongly believe that it is important to consider the impacts of business operations on future generations may show stronger environmental concern more generally, and be more thorough about their environmental behaviors, including choice and thoroughness of objectives. Both variables

are measured on a scale from 0-4, with 4 indicating the factors as a “very high priority” for the facility.

Finally, several demographic considerations were included in the analysis, including whether the plant is part of a larger business organization, location in Mexico where the plant is located, and the size of the facility, based on the number of full-time employees.

Manufacturing facilities that are parts of larger business organizations may be more thorough in their goal selection and have greater opportunities to shape environmental strategies around higher-order objectives. This may be the case as such plants may have greater access to resources and capabilities, both in terms of financial and knowledge capital as well as experience with corporate greening policies. A binary variable is used to account for plants that are part of a larger business organization.

There are several reasons to suspect that plants located in the State of Jalisco, where Mexico’s self-styled “Silicon Valley” is located, and along the US-Mexico border may prioritize environmental objectives differently than those located in other locations around Mexico. Both areas are particularly sensitive to environmental problems. Guadalajara is infamous for its smog due to its topographic features and has been criticized for its relatively weak environmental standards (Wells and Galbraith 1999; Gallagher 2005). Similarly, the US-Mexico border states have been the focus of much environmental scrutiny due to its delicate topographic features combined with massive industrial, transportation and population growth over the past two decades due to the importance of the *maquiladora* sector (Johnston 1995). According to the EPA, the concentration of industry and people at the border has increased pollution and health problems and led to water shortages in the region (EPA 2000).

Both locations have been the recipients of a great deal of foreign direct investment (FDI), particularly in high-tech sectors and assembly operations that actually tend to be *less* pollution-intensive overall than traditional “smokestack” industries. Indeed, in Mexico the *maquiladora* sector performs better (in aggregate terms) than the non-*maquila* industry with respect to environmental externalities (Stromberg 2003). Many of the well-publicized environmental problems in these regions may stem from the actions of small firms in the informal sector (Blackman et al 2000), from motor vehicles with inadequate pollution control or simply due to cumulative emissions in a sensitive landscape, rather than from highly polluting individual plants. However, due to the pressing environmental problems in these locations, plants operating there may face increased pressure, from regulators, civil society groups and business partners to achieve better performance. As a result, the plants in Jalisco and along the U.S.-Mexico border may have more fully realized sets of environmental objectives in place from all categories of objectives. Dummies were included for the performance of each of these regions compared to the rest of Mexico.

Regarding plant size, generally speaking, larger firms in Mexico tend to have better compliance with environmental regulations than do smaller firms (Hettige et al 1997; Dasgupta, Hettige and Wheeler 2000) and many of these plants have been influenced by pressures to clean up from the international market (Dominguez-Villalobos 2000). In addition, larger, more complex facilities may encounter economies of scale from formalization of environmental practices (Darnall 2003). As a result, larger plants may be more likely to have more thoroughly prioritized sets of environmental objectives in place.

Model Description

For each of the four categories of objectives, least squares regression models are used to investigate the influence of the explanatory variables on the priority scores for each facility. The base outcome model for the analyses is displayed in equation (1), where Y_i equals the degree of commitment to each environmental objective at the i^{th} facility, X_i is a vector of facility specific exogenous variables, and E_i is a facility's formal EMS status, equal to 1 if it meets the minimum requirements to have a formal EMS and 0 if it does not. \mathbf{b}_i and \mathbf{a} are vectors of parameters and \mathbf{e}_i is a normally distributed error term.

$$Y_i = X_{li} \mathbf{b}_i + \mathbf{a} E_i + \mathbf{e}_{li}, i = 1, \dots, I \quad (1)$$

This model is used in the form presented in equation (1) only for the analyses for compliance objectives. I used treatment effects models for the other three categories of objectives. In general, treatment effects techniques are used to discern the differences between those that have a higher propensity to self-select into treatment categories and the effects of the treatment itself (in this case the choice to adopt a formal EMS). One classic example is the effect of higher education on income – the effect of college education itself on income must be parsed from the fact that individuals made the choice to receive the treatment (that is, attend university). In the case of environmental categories of objectives, it makes sense to consider compliance objectives as fundamentally different than higher-order environmental objectives. Irrespective of the choice to adopt an environmental management system, all manufacturing facilities must consider the relative legal requirements – federal,

state or local – to which they are subject. There may be significant differences in *how thoroughly* plants address these requirements, but plants do not have the ability to choose which environmental laws apply to them. The choice of more advanced environmental objectives, on the other hand, may be very strongly influenced by the presence of a formal EMS, which requires the selection of specific objectives and targets for the system. Accordingly, pollution prevention and eco-efficiency objectives, which require some fundamental design and process changes, and product stewardship objectives, which require substantial design changes, may be very strongly influenced by the EMS adoption process and may produce strong treatment effects when attempting to estimate the models. Therefore treatment effects models are used to estimate these three categories, but not for estimating the models for objectives associated with regulatory compliance.

Similar treatment effects models are commonly used to estimate the influence of participation in voluntary environmental programs on environmental performance (Khanna and Damon 1999; King and Lenox 2000; Anton, Deltas and Khanna 2004; Potoski and Prakash 2005; see also Hartman 1988 and Barrow et al 1981).

$$\hat{E}_i = X_{2i} \mathbf{b}_2 + \mathbf{e}_{2i} \quad (2)$$

Following Khanna and Damon (1999) and Potoski and Prakash (2005), I use the net benefit at each facility of formal EMS adoption for the selection equation (2). Where, \hat{E}_i is the net benefit from formal EMS adoption, X_{2i} is vector of exogenous variables for the i^{th} firm, some of which are included in X_1 , and \mathbf{b}_2 is vector of parameters.

$$E_i^* = F(X_{2i}b_2) + e_{2i} \quad (3)$$

Since the net benefits stemming from EMS adoption are unobserved, I estimate the probability of EMS adoption by a facility (Equation 3) using a probit model, where F is the cumulative normal distribution. Probabilities E_i^* are then substituted in the re-specified treatment effects model for E_i , as shown in equation (4). To run these models, I choose a single nested approach using Stata's `treatreg` command, rather than two individual equations, separately estimating the probit model.²⁷

$$Y_i = d_i + X_{1i}b_1 + aE_i^* + e_{1i}, i = 1 \dots I \quad (4)$$

Selection models, such as the treatment effects equations explained here, are necessary because some unobserved characteristics, including the propensity to choose behaviors that favor improved environmental outcomes, are likely to be correlated, resulting in the correlation of the error terms e_{1i} and e_{2i} . A significant correlation of the error terms at the 5% level, as indicated by a significant rho statistic, is confirmation that the use of a treatment model is appropriate for a given analysis. Indeed, none of the compliance models produced a significant rho statistic when diagnostics were run and two of the three models for the other

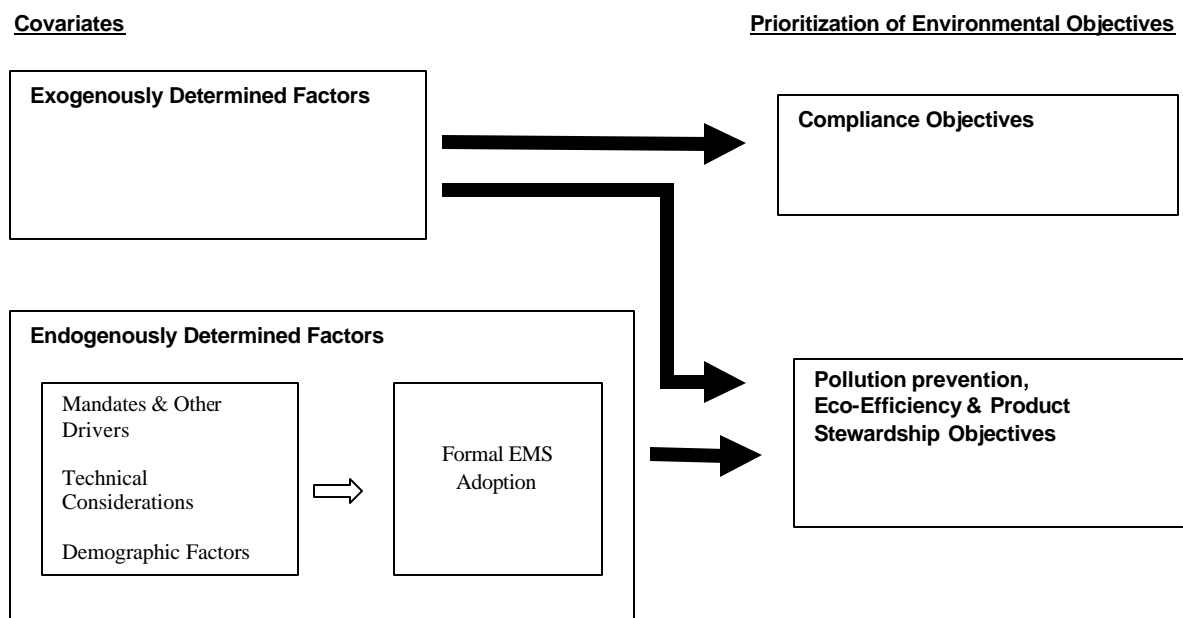
²⁷ As explained by Potoski and Prakash (2005), single nested models produce more statistically efficient results than independently estimated first and second stage equations – though they do produce more similar outcomes as N approaches infinity (see footnote 18 in Potoski and Prakash for a further explanation). For comparison, I ran independent models, which produced virtually identical results.

categories produced a significant rho statistic at the .05 level. These test results support the choice of models selected for estimating the four categories of objectives.²⁸

The models use thirteen variables that serve as sources of statistical identification. These variables influence the adoption of formal EMSs, but do not influence the prioritization of environmental objectives explicitly. That is not to say that they have no impact upon prioritization, but that the impact that they do have is demonstrated through their role in influencing the adoption of formal environmental management systems. These variables include shareholder pressure and incentives of lower insurance rates to adopt environmental practices, potential compliance problems in place, adoption of environmental practices as part of a regulatory agreement, cooperation with customers and local producers, degree of technological complexity of products, ability to codify product specifications, country of ownership (US, Mexican, European or Japanese), participation in PROFEPA's Clean Industry program, whether or not the facility is publicly owned, and whether or not the facility is a first-tier supplier.

²⁸ These four categories are not assumed to be mutually exclusive or unrelated. Indeed, strong relationships among these categories should be assumed, as facilities placing a high priority on one category are more likely to score highly in others as well. However, because seemingly unrelated (SU) regression techniques used to parse apart these differences are incompatible with treatment effects models, these four objectives categories are modeled as if they are independent from one another and violations of OLS may exist.

Figure 6-2 Determinants Environmental Objectives Prioritization



Results

This section details the results of regression models for the four categories of objectives, which are summarized in Table 6-4. Because the first-stage equation for the treatment effects models was the focus of the preceding chapter on EMS adoption, the specific findings are not discussed here. The regression estimates for the first stage, however, are listed in Table 6-3.

In three of the four categories of objectives, the adoption of formal EMSs led to higher prioritization by facilities. The presence of a formal EMS was associated with stronger than average commitment to compliance, pollution prevention, eco-efficiency, suggesting that the implementation process for formal EMSs does indeed lead to stronger commitments across these categories. Only in the product stewardship category did EMS adoption not lead to a

statistically significant result, perhaps reflecting the fact that features of product stewardship are generally related to product design and may be out of the control of individual plants.

Table 6-3: First-Stage Regression Results for Nested Models

Parameter	Coefficient	S.E.	Z	95% Confidence Interval	
1 st Tier Supplier	-.329	.455	-0.72	-1.220	.562
Customer Mandate	.324	.147	2.21**	.036	.612
Corporate Mandate	.028	.167	0.17	-.299	.355
Stakeholder Involvement	.328	.152	2.16**	.030	.625
Consideration of Future Generations	.202	.164	1.24	-.1183	.523
Shareholder Pressure	.007	.152	0.04	-.291	.304
Potential Compliance Problem	.213	.155	1.37	-.091	.516
Lower Insurance Rates	-.032	.205	-0.15	-.434	.371
Part of Regulatory Agreement	-.371	.166	-2.24**	-.697	-.046
Cooperation w/Customers	.297	.142	2.09**	.018	.576
Cooperation w/ Local Producers	-.357	.189	-1.89*	-.726	.013
Technological Complexity	.234	.160	1.47	-.079	.547
Codification of Product Specifications	.148	.124	1.19	-.095	.391
US Ownership	1.200	.559	2.14**	.103	2.296
European or Japanese Ownership	.736	.576	1.28	-.394	1.865
Participation in "Clean Industry"	1.076	.390	2.76***	.313	1.840
Program					
Plant Size	.0176	.113	0.876	-.203	.238
Public Ownership	-.357	.467	-0.76	-1.273	.558
Constant	-3.071	.838	-3.66***	-4.714	-1.428

***p = 0.01; **p = 0.05; p = .10

Table 6-4: Second-Stage Regression Results for Objectives Scores

Parameter	Compliance Objectives		Pollution Prevention Objectives		Eco-Efficiency Objectives		Product Stewardship Objectives	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
	No Treatment Effects		Treatment Effects Model		Treatment Effects Model		Treatment Effects Model	
Formal EMS	1.597**	.741	2.522*	1.482	2.615*	1.490	1.951	1.454
Customer EMS Mandate	.226	.223	-.561**	.229	.104	.242	.282	.237
Corporate EMS Mandate	-.470**	.210	.269	.226	.154	.232	.324	.227
Technical Assistance	3.324***	.807	.589	.795	.754	.834	.053	.809
Collaboration on Technology Upgrading	.614**	.272	.564**	.277	-.149	.279	.023	.271
Joint Product Design	-.243	.272	.126	.272	.760***	.281	.457*	.272
Stakeholder Involvement	.540**	.236	.637*	.248	.940***	.257	1.239***	.251
Consideration of Future Generations	.543**	.242	.679***	.255	.172	.267	.539**	.261
Part of Larger Business Organization	1.449	.900	.373	.889	.554	.919	-.679	.891
US/Mexico Border	-.222	.762	-.556	.770	1.306	.799	.119	.774
State of Jalisco	-.215	.772	-.932	.785	.176	.800	.545	.774
Plant Size	.255	.212	.045	.212	-.312	.221	-.309	.215
Constant	-.038	1.225	-.123	1.246	.941	1.307	-2.112*	1.273
p = 0.01; **p = 0.05; * p = .10	N = 99 F = 10.62 $\bar{R}^2 = 0.5409$		N = 102 Wald $\chi^2 = 111.23$ *** $\chi^2 = -0.063$		N = 105 Wald $\chi^2 = 103.75$ *** $\chi^2 = -0.206$ **		N = 105 Wald $\chi^2 = 129.31$ *** $\chi^2 = -0.326$ ***	

Table 6-5: Correlations and Descriptive Statistics

Independent Variable	EMS (1)	IV (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Formal EMS /EMS IV (1)	1.000	1.00											
Customer Mandate (2)	0.424	0.587	1.000										
Corporate Mandate (3)	0.433	0.606	0.459	1.000									
Technical Assistance (4)	0.194	0.312	0.299	0.397	1.000								
Collab. On Tech Upgd. (5)	0.338	0.395	0.224	0.256	0.275	1.000							
Joint Product Design (6)	0.255	0.275	0.156	0.168	0.172	0.512	1.000						
Stakeholder Involvt. (7)	0.379	0.482	0.275	0.224	0.238	0.295	0.232	1.000					
Consid. of Fut Gens (8)	0.422	0.595	0.257	0.313	0.305	0.240	0.150	0.478	1.000				
Part of Larger Bus Org (9)	0.440	0.527	0.421	0.494	0.240	0.269	0.124	0.244	0.364	1.000			
US/Mexico Border (10)	0.107	0.169	0.165	0.101	0.044	-0.020	0.084	-0.004	0.090	0.306	1.000		
State of Jalisco (11)	-0.034	-0.053	0.033	0.001	0.005	0.078	0.029	0.031	0.007	0.031	-0.387	1.000	
Plant Size (12)	0.382	0.512	0.386	0.384	0.231	0.241	0.118	0.255	0.310	0.552	0.295	-0.036	1.000
Mean	.420	.498	1.992	2.045	.770	3.863	4.214	1.911	2.373	.690	.333	.245	4.120
Standard Deviation	.494	.366	1.439	1.596	.371	1.189	1.087	1.316	1.339	.392	.456	.416	1.586

The impact of mandates for EMS adoption on the prioritization of objectives, however, is not as consistent. No discernable pattern of the influence of mandates to adopt formal EMSs on the prioritization of environmental objectives emerged from these models. Only in two instances – corporate mandates on compliance objectives, and customer mandates on pollution prevention objectives – were the outcomes statistically significant. In both cases, however, the influence of these mandates had a negative effect on prioritization of objectives. In fact, the stronger the corporate mandate, the lower the commitment to compliance objectives. Similarly, the stronger the customer mandate, the lower the commitment to pollution prevention objectives. These findings indicate that external motivation for EMS adoption may have little influence over the actual content of the systems themselves and where there did appear to be some influence, commitment to these objectives was not prioritized as strongly.

Explanatory factors addressing technical considerations may provide more detailed insight into how plants may improve commitment to specific objectives in ways that business mandates do not. Technical assistance with the adoption of environmental management did appear to influence the priority that plants place on compliance objectives, though it did not significantly influence the focus on other types of objectives. Plants that received assistance with their environmental practices increased their level of commitment to compliance objectives. However, technical assistance is the more influential factor for commitment to regulatory compliance when compared with EMS adoption.²⁹ It is very likely that plants

²⁹ When the levels of significance and coefficients are examined in the absence of one another, technical assistance remains virtually unchanged if EMS is removed. Conversely, EMS loses significance if the technical assistance variable is taken away.

benefit in the area of regulatory compliance because that is where the general focus of external assistance is placed.

As anticipated, collaboration with customers on technology upgrading and product design both appear to influence the prioritization of pollution prevention, eco-efficiency and product stewardship objectives. Collaboration on technology upgrading resulted in deeper commitments to pollution-prevention goals, while joint product design influenced plants' commitments to product stewardship objectives. These results imply that collaboration on some areas that are not necessarily directly related to environmental objectives may have spillovers that affect environmental behaviors. Improved technology and product design may lead to deeper commitments to pollution prevention, eco-efficiency and product stewardship objectives by simply improving access to improved technology and developing capacity for higher value production activities. These spillovers may span environmental behaviors and include not only the adoption of cleaner technology, but actions that promote wise resource use and advanced design principles such as life-cycle analyses and the incorporation of design-for-environment principles.

Of all the explanatory factors explored in this analysis, the two attitudinal variables appear to be the most consistent predictors of influence on levels of commitment to each objective category. For all four categories of objectives, stakeholder involvement influenced the degree of commitment. In a similar fashion, a plant manager's perception of the importance of future generations influenced higher levels of commitment to all objective categories except eco-efficiency. These findings suggest that guiding philosophies and community engagement can indeed translate into increased commitment across the broad

spectrum of objectives, from regulatory compliance to higher-order targets that affect both production processes and product design in a facility's operations.³⁰

As is the case with technical assistance, plants that are units of larger business organizations tended to place higher priority on compliance objectives and were far more likely to have above-average commitment to these objectives than stand-alone facilities. This finding may reflect greater access to knowledge and capital resources of these plants, but may also be the outcome of more rigorous global environmental management strategies of multinational corporations (MNCs) that often use a single global or regional standard for all plants and use a single registrar to avoid plant-level discretion and shirking of responsibilities related to environmental management (see Chapter 4). It should be noted, however, that even plants that were units of larger organizations failed to have significantly stronger commitment beyond objectives related to achieving regulatory compliance, as this status did not influence commitment to any of the higher-order objectives. With respect to plant location, no strong trends emerged indicating any consistent pattern of behavior.

Chapter Conclusions

The results from this analysis indicate that adopting an EMS does appear to have an influence on the prioritization on most categories of objectives, suggesting that the process of objectives selection inherent in the implementation of a formal EMS does indeed affect how facilities shape their environmental strategies. The results also indicate that the strength of customer and corporate mandates to adopt a formal EMS has very little influence on how facilities shape their environmental strategies, and in some cases the influence is negative.

³⁰ An interaction term for these two concepts was also examined in earlier iterations of the model, with no significant findings.

On their own, both appear to have a negative influence on the degree of prioritization for compliance and pollution prevention objectives – in the cases of corporate and customer mandates respectively. Otherwise, the influence of such requirements alone does not appear to be associated with stronger commitments across sets of environmental objectives. One may conclude from these results that in cases where plants are externally motivated to adopt environmental management the outcome may be negligible, or even negative, casting doubt on the efficacy for such initiatives to produce improved environmental behaviors.

However, we should be careful here not to overstate this point, as there may actually be some positive impact in these results if considered in light of the findings from the previous chapter (and first stage regression in these analyses). Even though mandates have little direct influence on the prioritization of environmental goals, the perceived strength of customer requirements does have a significant impact on the adoption of a formal EMS, as determined in the preceding chapter. Such adoption, as reported here, leads to increased commitment to all four categories of objectives. So, while *mandates* may not lead to increased commitments, *EMSs* do. On balance, customer mandates may therefore lead indirectly to improvements in some areas, even if the level of commitment among their peers with formal EMSs is at or below-average.

Conversely, facilities that have a strong philosophy that guides their environmental strategy tend to have stronger prioritization across all four categories of objectives than their peers. Managers who involve external stakeholders in their management approach, and perhaps learn from them, and those that tend to internalize the concept of sustainability, not only continue to focus on meeting regulatory expectations but also are successful in addressing higher-order objectives. These actions may create opportunities for value creation

beyond meeting business and legal commitments and may provide companies a means to improve market position in an extraordinarily competitive global environment. It is important to note that the impact of these attitudinal variables can be considered independently of EMS adoption, as the influence of EMS adoption was statistically significant in three of the four objectives categories even when controlling for these attitudinal factors. This result is important because it suggests that EMSs were found to be an important factor in motivating deeper commitments even in facilities that did not demonstrate strong environmental attitudes demonstrated through other behaviors and beliefs.

Despite this differentiation, internal motivation still appears to be a very strong driver in ensuring that efforts to improve environmental management actually produce systems that comprehensively address the spectrum of potential impacts of a plant's operations. Convincing managers that environmental efforts are worthwhile and should focus beyond compliance activities, is therefore a challenge that should be undertaken by those interested in reaping the benefits of improved management – including customers interested in reaping efficiency gains (which may be translated into lower prices) and protecting reputations, and regulators interesting in protecting the public good. Motivation for adoption does matter. If the motivation to adopt is not driven by a strong internal environmental philosophy, then the management systems that are adopted may be of less value to the business that mandates them or to the public at large.

Plants receiving technical assistance, and those that are units of larger business organizations, are much more likely to have stronger commitments to goals associated with compliance activities. One may suspect that such plants have stronger commitments to these

goals, and tend not to extend this dedication to higher-order objectives, because achieving compliance is the central focus of the given advice and often the heart of company-wide environmental strategies. The vast majority of resources dedicated to environmental activities, EMSs included, are aimed at ensuring compliance and not necessarily incorporating more advanced objectives. While part of this outcome most certainly stems from “off the shelf” templates used by corporations and consultants to implement EMSs in a standardized and efficient manner for vastly dissimilar manufacturing operations, a very real need exists to move past such templates to meet the precise needs of individual plants. After all, flexibility is seen as one of the main advantages of these systems. Wholesale adoption of templates created by corporate parents or consultants without careful consideration of areas for improvement within individual plants may result in sub-optimal outcomes. Broad opportunities may be found by incorporating pollution prevention, eco-efficiency, and in some cases, product stewardship principles tailored to the specific products and processes of each plant. These same resources and efforts that are dedicated to observing minimum legal commitments may be extended to other categories of objectives, where additional environmental and financial improvements may be found. When plants fail to use the opportunity to make a serious commitment to their environmental strategies they may be missing valuable opportunities to establish and maintain competitive advantage stemming from improved internal efficiency and reduced environmental risk and liability.

While supply chain mandates may influence the adoption of formal environmental management systems, there is little to suggest that such requirements have much impact on the content of a facility’s EMS. There is some evidence that suggests that firms who are externally motivated to adopt an EMS by either a corporate parent or customer may have a

negative influence on compliance and pollution prevention objectives, respectively. The good news is that, overall, the process of implementing an EMS positively influences the level of commitment to all categories of objectives evaluated in this chapter. The next chapter considers these findings in light of conclusions from previous analyses and discusses the broader implications of supply chain mandates for businesses and their use as a policy tool to achieve public goals.

CHAPTER 7: Conclusions

From the analyses presented in the preceding chapters, this dissertation has sought to shed new light on several broad and pressing environmental governance issues associated with the globalization of manufacturing. Chiefly, how private corporate mechanisms for addressing the environmental behaviors within their manufacturing operations, and the operations of their business partners, may be promoting environmental protection in regions where traditional regulatory mechanisms for doing so may be weak or ineffective. That is, how might corporate policies for the adoption of environmental activities throughout their production networks mitigate the problem of “governance gaps” – where home country regulations do not extend to overseas operations and the capacity or will of governments in industrializing societies to address negative environmental externalities associated with manufacturing is either low or does not exist – that emerge through increased economic activity? Such gaps have arisen due to a combination of developments in global industrial organization. Most pronounced of these developments are the joint processes of vertical disintegration of corporate structures and geographic shifts that have occurred over the past few decades of production networks to regions and countries with distinct labor and cost advantages, many of which are located in the economically, politically, and institutionally developing world. Many corporate environmental initiatives have not been undertaken expressly to address such governance gaps, but have instead been part of larger strategies to standardize global production, better govern spatially dispersed networks of suppliers, and

reap potential efficiency gains. Nonetheless, it is important to assess the effectiveness of these private policies and how they may or may not lead to public environmental benefits. With these broader issues in mind, this dissertation has addressed several research questions associated with the policies of manufacturers in the automotive industry to require the adoption of the ISO 14001 environmental management system standard by their direct suppliers, with a particular focus on operations in Mexico. It has primarily explored three major questions. First, how are supply chain mandates to adopt ISO 14001 interpreted and implemented by suppliers in the automotive value chain? Second, are the mandates effective in their aims? In other words, does the existence of the policies lead to adoption of EMSs in accordance with all specific requirements of the standard? Further, are the systems that are adopted by plants in Mexico designed to achieve a variety of environmental performance objectives, or are they simply “paper systems” that meet minimum requirements of the standard? Third, have these policies been replicated and passed along the value chain to lower tiers of suppliers, or has penetration been limited to the first tier? What factors have contributed to, or hindered, diffusion of these policies?

In addressing these primary research questions, this dissertation has also explored several of the broader theatrical issues associated with environmental governance and private business behavior in an increasingly globalized world. Among these issues are the degree to which multinational corporations are indeed “exporting environmentalism” to manufacturing locations in industrializing countries, what kinds of institutional isomorphic pressures influence the adoption of environmental management practices through value chain relationships, how sets of firm characteristics may influence the degree of value chain governance, and the extent to which the greening of the supply chain may be an extension of

corporate greening initiatives more generally. This chapter reviews the findings from the preceding analyses, with particular emphasis on how they address these specific research questions and theoretical issues posed by the dissertation as a whole. It also examines the broader implications of supply chain mandates for achieving public goals.

Primary Research Questions

As stated in the first chapter, this research project set out to examine the role of private institutional mechanisms in achieving public goals, in this case the application of supply chain mandates for environmental management. The first question regarding the process of ISO 14001 adoption by global suppliers was primarily addressed in Chapter 4, which used structured interviews with environmental officers at the largest North American automotive supplier firms, and the automakers (OEMs) themselves. These interviews revealed that there was little confusion among the large first-tier suppliers regarding the expectations of the OEMs with respect to the supply chain mandates. All firms interviewed stated that the policies were interpreted as strict requirements, without room for interpretation. The explicit deadlines for adoption and threats of losing current or future contracts clearly communicated the seriousness of the OEMs intentions and prompted upper management of supplier firms to dedicate the resources necessary for successful compliance. As a result, all suppliers interviewed undertook company-wide efforts to achieve ISO 14001 registration in their facilities in accordance with their customers' wishes. And though suppliers used different internal strategies to do so, the existing wealth of resources and capabilities of these firms facilitated the adoption throughout their global operations with few obstacles. In all cases, these corporations removed plant manager discretion in choosing ISO registrars in

order to obtain more accurate audits, and in doing so, removed one of the major shortcomings of external validation of certification systems of employing paid auditors.

Overall, it appears that the tough stance taken by the OEMs has been enough to convince the larger companies to dedicate the necessary resources and comply with their EMS mandates. It does not guarantee, however, that the EMSs adopted in supplier facilities are complete or that the content will lead to environmental improvements – it only signifies that they have sincerely moved to achieve ISO 14001 registration on a company-wide basis. The external validity of these findings is also limited to the multinational firms with sizeable knowledge and financial resources to effectively undertake these efforts. They may not be generalizable to small and medium-sized enterprises, particularly those operating in developing countries that may have greater difficulty in achieving similar levels of compliance.

The degree to which facilities in Mexico are truly able to comply with the requirements and the extent to which they are designed to promote actual environmental improvements was addressed in Chapters 5 and 6, which addressed the second research question. Survey data and regression results reported in these explained how well facilities comply with requirements, and the prospects for genuine environmental improvements stemming from the resulting systems. Most significant among these findings is the discrepancy that exists between those facilities subject to supply chain mandates to adopt EMSs and those that actually implement them, as a large number of plants required to do so fell short of the minimum requirements for a formal system. However, the perceived *strength* of customer requirements did lead to the adoption of environmental management practices and may be an effective means for assuring compliance with customers' environmental policies. If suppliers

believe that their customers are serious about the requirements and there may be consequences for non-compliance, they are motivated to more thoroughly implement contractual requirements.

Facilities that were successful in adopting formal EMSs tended to place a greater degree of emphasis on a host of environmental goals, including higher-order objectives that move beyond regulatory compliance. While it is true that mandates (from either customers or corporate parents) may have a negative influence upon select categories of environmental goals, firms that adopt EMSs tended to have deeper commitments to environmental protection through setting performance objectives associated with regulatory compliance, pollution prevention and eco-efficiency. These findings suggest that even though supply chain mandates may not automatically lead to the adoption of environmental management systems on their own, in cases where they do, facilities deepen their commitment to a broad range of environmental goals not limited to regulatory compliance. And since the perceived importance of the mandates influences whether or not facilities adopt EMSs in the first place, changing environmental behavior supply chain mandate initiatives must be properly designed to give all suppliers the impression that they are indeed important and must be taken seriously.

Finally, interviews with supplier firms outlined in Chapter 4 addressed the third question pertaining to the replication of environmental supply chain mandates to lower tiers of suppliers. As reported in Chapter 4, automotive supply firms are not replicating the mandates to adopt formal environmental management systems to their own networks of suppliers in any systematic way. Even more, in cases where supply firms have formally announced such requirements, no plans are in place to monitor or enforce them, making

widespread implementation of EMSs by firms in lower tiers highly unlikely. As representatives from first-tier firms noted, adoption of EMSs consistent with their own customers' wishes was facilitated, and primarily motivated, by the communication of strict deadlines and explicit instructions regarding what precisely was expected for compliance. Even under these conditions, compliance with the policies has been inconsistent at best among manufacturing facilities facing uneven monitoring of their EMSs, as reported in Chapter 5. It is therefore doubtful that weak replication from some businesses in the first-tier will produce significant adoption across the supply base.

Overall, the most significant finding comes from considering these findings together: while supply chain mandates themselves may not lead to increased commitments to environmental performance objectives among automotive suppliers in Mexico, having an EMS in place leads firms to develop greater priority not only among compliance objectives, but in pollution prevention and eco-efficiency as well. That is, it is not the mandates, *per se*, that are leading to more advanced practices at manufacturing facilities, but rather the adoption of an EMS. So, in cases where the mandates are successful in motivating the adoption of formal EMSs, one can expect to find an upgrading of practices among suppliers. The trick, then, is to ensure compliance with supply chain mandates by communicating strong expectations that suppliers take seriously, as the perceived strength of customer requirements did have a significant impact on the adoption of a formal EMS. This question of motivating compliance among supplier firms is discussed below in greater detail.

Related Theoretical Issues

This study also explored several theoretical issues associated with supply chain mandates and the role of private authority in influencing environmental behaviors. One of the most hotly debated topics related to globalization and the natural environment over the past two decades has been the “pollution-haven hypothesis.” Critics contend that decreased barriers to trade have led to increased movement of capital production to nations with lax environmental regulations expressly to skirt strict regulations of advanced industrialized states (Korten 1995; Salazar and Carlsen 2001; Cavanaugh and Anderson 2002). Proponents of trade liberalization argue that increased trade will lead to greater affluence, and with it, increased societal demand and improved capacity for environmental improvements within industrializing nations (Stigson 1992; Bhagwati 2004). And though empirical support for pollution havens is weak (Eskeland 1997, Ruud 2002, Gallagher 2004, Rappaport and Flaherty 1992; Fowler 1995; Dasgupta, Hettige and Wheeler 2000; Hettige et al. 1996), the influence of business and industry in developing countries is still an open question. Garcia-Johnson (2000) suggests that capacity within developing countries may be strengthened by multinational firms who “export environmentalism” through the incorporation of advanced environmental standards in manufacturing facilities.

The analyses in the preceding chapters suggest that the automotive industry is indeed exporting environmentalism to some extent. While limitations in the cross-sectional data do not allow for the examination of the specific effect of the ISO 14001 requirement on adoption by Mexican firms, manufacturing plants with U.S. ownership were more likely to have formal systems in place than Mexican-owned facilities. Such findings suggest that not only are U.S. firms not locating south of the border to engage in poor environmental

behavior, but that they are holding themselves to more stringent operating procedures than their local counterparts. These results are not only consistent with the vast majority of the extent literature disputing the pollution haven hypothesis (please see Gallagher 2005 for summary), but also lend support to Garcia-Johnson's primary argument: improved environmental standards may be promoted through industry initiatives. Interestingly, despite the proactive stance of the European Union with regards to promoting environmental standards and ISO 14001 adoption, and pronounced ISO14001 adoption by firms operating in Japan, similar results were not present for European or Japanese firms operating in Mexico.³¹ Prakash and Potoski (2006) found similar results, or lack of an "EU effect" or "Japan effect" when looking at international adoption of ISO 14001. Data do suggest that manufacturing facilities in Mexico, even while controlling for ownership, were motivated to adopt formal EMSs as a result of supply chain mandates from customers regardless of national origin.

These findings therefore add to our understanding of how isomorphic pressures influence institutional change among firms in the automotive industry. Specifically, it appears that coercive isomorphic pressures are the primary conduit for diffusion of environmental standards through the value chain to businesses operating in industrializing nations. At the same time, there is little to suggest that mimetic isomorphic pressures hold the same weight in managers' decisions to implement formal EMSs at manufacturing sites. As several corporate environmental officers from supplier firms stated in the interviews presented in Chapter 4, the primary motivation for corporate implementation of ISO 14001, and the factor that made resources available for them to do so, was the *explicit* nature of the mandates from

³¹ The European Union has been so active in recent years with the promotion of environmental standards that David Vogel, who coined the term "California Effect" recently commented that the phenomenon should be renamed the "EU effect" (public lecture 2004).

the automakers, with precise requirements and specific deadlines. Softer mimetic expectations from companies such as Honda and Toyota have not had a similar effect in the industry and have served merely as guidelines, rather than motivating factors, to spur EMS implementation. Likewise, regression results from Chapter 5 indicate that the perceived strength of the mandates (or the degree of coercion, in the parlance of isomorphism) is what motivated action among Mexican manufacturers, rather than plain existence of them. Such a finding is important to keep in mind when considering that extensions of this, and similar policies using business pressures to induce behaviors with a public goods component, need to contain an explicitly coercive element if they are to be taken seriously by supplier firms.

Regression results in Chapter 5 also inform the growing literature on value chain governance and industrial upgrading. Manufacturing sites with more advanced capabilities and the ability to produce highly technologically complex components are also more likely to employ more thorough sets of environmental practices. The relationships among these factors suggest that higher degrees of standardization may contribute to increased modularity and independence of suppliers within production networks. Facilities that manufacture technologically complex products are more likely to adopt formal and ISO equivalent EMSs than those manufacturing less sophisticated goods. Additionally, highly capable suppliers generally require a lower degree of guidance from their customers than do their less-proficient peers. Such factors decrease the need for tight governance on the part of lead firms, which may then focus on their areas of core competency and value creation rather than maintenance and supervision of their production networks. The degree of cooperation between supplier firms and their customers also contributes to the development of these capabilities, as cooperation in areas such as technology upgrading, employee training, and

just-in-time product delivery influenced the successful adoption of formal EMSs. The interplay among these factors also informs the potential for how industrial upgrading more generally may influence the capabilities for improved environmental management and lead to environmental spillovers. Indeed, industrial advancement may serve to strengthen environmental capabilities in developing countries, rather than weaken efforts to protect the natural environment.

Implications and Conclusions

The analyses in this study point to several conclusions regarding the role of private institutional mechanisms for achieving public goals, and the value of environmental management systems specifically, in improving environmental capabilities at manufacturing operations in industrializing nations. First, private mechanisms may indeed provide public benefits, but suffer the same shortcomings of traditional regulation for achieving these ends: a real threat of action for non-compliance must exist as well as a reasonable probability of being caught. These factors lead to a situation where industry self-regulation begins to resemble traditional government regulation, where firms make choices regarding compliance with environmental requirements by weighing the severity of potential consequences and the probability of getting caught (see Becker 1968). In other words, if there is little risk of getting caught or the consequences are marginal, a rational firm will have little incentive to comply with external pressures to adopt a specific set of behaviors. In the strictest sense of Becker's model for crime and punishment, a high probability for getting caught, hefty consequences, or both, are necessary for rational actors to comply with a law. In practice, rational actors weigh both the benefits and costs, and extent of both the probability and the

consequence, when coming to a decision regarding compliance. A firm may opt not to comply with a given policy even when faced with substantial consequences if the likelihood of getting caught is sufficiently low. For a policy to be effective, therefore, both conditions should be met.

In the case of supply chain mandates in the automotive sector, the large first-tier suppliers interviewed work under both conditions, while smaller and independently operating companies do not. As discussed in Chapter 4, several large supplier firms have implemented the policies by removing discretion of the choice of registrars from individual plant managers, with the intent of receiving more objective and accurate plant audits. The actual registration status that is then reported to OEMs through each company's reporting procedure (however flawed it may be) may therefore be a more trustworthy assessment of facility behavior than where plant managers may choose to hire and fire specific auditors: plants who are not meeting their obligations under the ISO 14001 regime are not very likely to be granted certification under these conditions. Conversely, independently operating plants may have a lower probability of being reported for non-compliance with the mandates if they are able to effectively "shop" for registrars who will grant certification, even if all elements of the standard are not met, leading to "fox in the henhouse" tensions, where blatant conflicts of interest may arise (Garcia-Johnson 2001). Regimes where individual plant managers are responsible for the selection of auditors are fundamentally ineffective at achieving desired outcomes because under such arrangement it is plant management that pays to verify its processes to a customer, rather than the customer paying to ensure compliance with its policies. Under this scenario it is in the auditors' interest to provide a favorable outcome, or potentially lose future business. Even if such strategies are not explicitly pursued, the nature

of the monitoring regime provides tacit incentive to seek and give positive results by whatever means available. In short, the transparency of a program and the independence of monitors can greatly affect the outcomes of audits (O'Rourke 2003).

Even given the threat of loss of future business for failure to adopt formal EMSs, a very large percentage of businesses subject to the mandates may have superficially adopted the systems, and some have even acquired certification, but did not meet all the necessary requirements. The lack of any real oversight from OEMs has surely contributed to this outcome. For there to be wider compliance, the mandates must be therefore be perceived as having “teeth” on the part of OEMs and improved institutions for assuring accuracy of the inspection process. That is, there must be real consequences for noncompliance (such as the threat of losing current or future contracts) and plant managers have to believe that there is a strong probability that they will be caught if they don't comply. While some companies in the automotive sector do present such threats by tying ISO 14001 certification to a supplier's quality rating and requiring a copy of the ISO certificate as part of the purchasing process, most customers do not and none of them press for deeper knowledge of suppliers' systems.

The problem of full compliance may be compounded if there exists a tacit understanding among parties that the intention of the policy is not directly aimed at achieving public goals, but instead for internal reasons of improved efficiency and standardization – or even the demonstration of due diligence in the event of an accident. In other words, OEMs issuing requirements to their networks of suppliers may be more interested in coordinating the functions of their production networks by improving communication and creating standard operating procedures that improve the overall operating efficiency of business partners rather than attempts to reduce environmental impacts. Additionally, these firms may wish to reduce

their own liability – either in strict legal sense or in the court of public opinion – that they are conscientious about their suppliers’ environmental impacts without becoming directly involved by requiring the adoption of EMSs. Overall, OEMs may be less concerned about full compliance with environmental mandates than they are with other supplier requirements, most notably quality management and timely delivery of products. If suppliers are able to implement most of the elements of an EMS, and marginally improve in areas often considered to be ancillary to profit creation, OEMs may be satisfied.³² In areas where strict adherence to standards is needed, as in the case of quality, automakers have demonstrated that they are willing to more forcefully engage with suppliers and even conduct their own audits and levy strict penalties. They have shown little interest in doing the same in the environmental arena. As a result, full compliance and genuine environmental improvements may be nice byproducts of the initiatives, should they occur, but are not the central goals and therefore may not garner the attention and resources necessary to achieve public benefits.

Second, even if the intention to comply with private mechanisms exists, it must be accompanied by an adequate knowledge base in order to be effective. In the case of Mexican suppliers, a very large number of facilities that believed they had a formal EMS in place actually fell short of the necessary elements. These shortcomings may be due more to inexperience than to a lack of technical understanding of what an EMS entails. Many consultants operating in Mexico, even those among large auditing firms, have backgrounds in the field of quality management systems, which are structurally similar to EMSs, but do not have specific experience in environmental protection. Without proper technical assistance or education, there is little chance managers at such plants would be able to fully comply

³² A key exception may be where successful EMS adoption is viewed by OEMs and first tier suppliers as an indicator of overall supplier competence.

with requirements on their own. And given that acquiring the knowledge to properly implement a working EMS is an expensive prospect for firms, particularly small and medium-sized enterprises, it is no surprise that many fail to adopt adequate systems. Even if all structural elements of an EMS are met with the help of outside consultants, such efforts may not lead to environmental improvements. While corporate environmental managers in the US indicate this situation is improving with time in Mexico, the immediate environmental outcomes may be limited.

Large rates of non-compliance with mandates that did occur among surveyed facilities may also lie with an inadequate auditing process rather than malfeasance and shirking on the part of suppliers. If suppliers without substantial environmental experience, and exposure to management systems more generally, are registered by auditors without adequate technical competence or strict codes of ethics, they may fail to employ the basic requirements of the system – let alone achieve continual improvement or beyond compliance behaviors – while still achieving ISO certification.

If OEMs are interested in improving compliance, they should not only monitor certification, but also conduct selective audits at supplier facilities. By doing so, OEMs could both avoid potential pitfalls of relying on third-party monitors and ensure more effective EMSs are in place. As the automotive industry continues to follow a model where OEMs assume less of a direct manufacturing role, they may find it valuable to better coordinate their supply chain activities, including the incorporating improved oversight of CSR activities. Such steps are unlikely anytime soon, however, as additional costs and potential liability associated are considered too great and the benefits too small. Nevertheless, by selectively reviewing the content of supplier EMSs where they suspect a

problem or non-compliance with the mandates, OEMs could more confidently and accurately assess supplier behavior at a fraction of the cost of a comprehensive program. While these firms may want to avoid any intrusion into supplier facilities, they may be motivated to do so if the reputational threats posed by business partners become large enough to warrant it – much like they have done in the quality realm to correct emerging problems and ensure that components are built to proper specifications. However, the industry will continue to depend on third-party registrars to issue certification for the foreseeable future. Though reliance upon external monitors is problematic in some areas, it remains the most cost effective means to ensure compliance from the point of view of the OEMs, who assume virtually none of the costs of compliance.

Assurance of compliance may only extend to the larger suppliers who have removed discretion from plants themselves by having a single global registrar or registrars responsible for multiple plants within a specific region. This reliance upon external audits, however, does not address the problem of ensuring adherence to the policies by SMEs or stand alone firms, the quality of whose systems may be suspect for reasons described above. SMEs, and even larger firms who have little interest in actively pursuing thorough environmental management initiatives, may meet only the minimum requirements necessary for certification.

This situation may not be easily remedied, however, as an effective system of monitoring and verifying compliance that does not rely on paid auditors would be an extraordinarily expensive and resource-intensive endeavor for OEMs already facing difficult financial situations. Even in the electronics industry, where companies like Hewlett-Packard have had some success in implementing their own systems for monitoring supplier compliance with

social and environmental requirements, companies have found difficulties achieving effective penetration beyond direct suppliers due to vast and complex supplier networks. OEMs could press tier-1 suppliers to make EMS mandatory throughout the value chain if greening the entire production network is a goal to be achieved, as they have learned from the experience with their direct suppliers, firms in lower tiers will not act until it becomes a business imperative to do so. However, firms should also bear in mind that such mandates alone will not guarantee the desired outcomes, as suppliers without adequate experience or resources may have a more difficult time adopting EMSs than larger firms with greater capabilities and access to financial and managerial resources. Accordingly, targeted technical assistance may aid in this process. While supplier forums, such as Supplier Partnership for the Environment the Ford Sustainability Forum may assist such smaller firms, participation has to this date been dominated by large suppliers and a handful of smaller firms, and certainly has not permeated much beyond the first-tier and certainly not in industrializing countries.

Collaboration between firms in value chain relationships may provide additional evidence that industrial upgrading, both through capital expenditures and through knowledge-based activities, create positive environmental externalities from development and modernization of the industrial base. Efforts by industry associations, government agencies and major customers aimed addressing the general competitiveness of the sector and improving supplier capabilities may provide important spillovers to the area of environmental management. Individuals and institutions interested in economic development should be mindful that strategic investments in industrial advancements can coincide with environmental benefits and are not fundamentally at odds. Such improvements may however prove difficult for the industry, as the prevailing trend is for customers to “squeeze” suppliers for cost savings,

rather than help them boost capabilities. The relatively low degree of standardization and codification that exists throughout the industry may also slow the pace of meeting of a host of new global environmental standards (including recent initiatives banning hazardous substances coming out of the European Union) despite costly internal efforts by automotive firms to comply³³. However, increasing consolidation throughout the supplier sector may result in a culling of less competent suppliers, and an increase in overall capabilities.

Even so, the move towards widespread adoption of EMSs, even if not complete, has positive implications for environmental improvements in Mexico. Previous studies have demonstrated that the adoption of ISO 14001 improves environmental performance along a variety of measures in the U.S., Europe and Mexico (Potoski and Prakash 2005; Dahlstrom, Howes, Leinster and Skea 2003; Dasgupta, Hettige and Wheeler 2000; Russo 2001). Even more, the specific environmental goals chosen by manufacturing sites determines the particular areas in which it will improve its performance (Hutson, Edwards, and Andrews 2006). This study has determined that the adoption of formal EMSs leads to stronger prioritization across an array of environmental goals. If similar conditions apply, analogous environmental improvements may be seen in Mexican manufacturing where plants have successfully complied with the mandates.

The two seemingly disparate findings from the analyses in Chapter 6 – that mandates did not affect the prioritization of environmental objectives, but EMS positively affecting it – may be reconciled by a shift in guiding environmental ideology, as those plants that have a strong positive attitude towards environmental behaviors tend to place a stronger priority on

³³ While the degree of codification varies by product and supplier, the industry maintains low ability to codify product specifications. Please see p. 32 of “Environmental Management in the Mexican Automotive Supply Sector” <[http://www.unc.edu/~hutson/supplier_report\(16jan06\).pdf](http://www.unc.edu/~hutson/supplier_report(16jan06).pdf)> for a deeper discussion of product codification in the industry.

all four categories of objectives. It is largely up to customers, corporate parents, and hired consultants with greater levels of experience to facilitate this shift and convince suppliers of the value of adopting other approaches to environmental management. For this solution to be widely adopted, however, corporations and customers must be convinced of the value of moving beyond compliance themselves, but it is yet unclear if companies are willing to do more than pay lip service to this notion.

The degree to which firms in general have moved beyond a focus on compliance activities and basic greening as the primary components of their environmental strategies is also unclear. Most firms have not yet internalized the potential value in adopting higher-order objectives, particularly in a traditional industry such as automotive, where patterns of behavior are more entrenched and modifications are difficult to implement without radical disruptive change. Many consultants and registrars, with industry specific knowledge, may also lack the innovative perspective to guide their clients towards more achieving advanced objectives. However, companies that fail to improve the capabilities of their suppliers and increase the efficiency in their global operations are missing valuable opportunities. Consultants who fail to help their clients take advantage of these opportunities are doing their customers a disservice and registrars to ISO 14001 who fail to evaluate facilities based on significant continual improvements, are not meeting their obligations under the standard. This is not to say that all actions aimed at achieving more advanced environmental objectives will result in greater efficiencies or even guarantee environmental performance improvements. However, increased attention on the environmental aspects of a plant's operations, and improved management of them, greatly enhance the opportunities to find areas for improved environmental and financial performance.

The prospect of improvements, with or without such corrections, however, should not preclude the role of the public sector in continuing to enforce environmental regulations, punish violators, and where possible, cooperate with plants to promote best practices. However strained such agencies may be in developing countries, the continued threat of action and presence of inspection regimes serve as substantial motivation for plants to comply with their legal obligations. Further, in cases where the Mexican government has cooperated with plants on environmental protection measures, as in the case of the PROFEPA audit program, plants have improved their capabilities and facilitated the adoption of complete EMSs. Again, one should bear in mind, though, that even given these factors the adoption of an EMS does not guarantee improvements, even if it increases the likelihood that they may occur. For even as such initiatives have the potential to serve as effective measures to address governance gaps that emerge as globalization deepens, they should not be considered replacements for the traditional duties of the public sector.

As stated in the introductory chapter, environmental supply chain mandates find their conceptual genesis in voluntary environmental self-regulation programs that seek to offer greater flexibility to participating firms than traditional regulatory approaches by applying “management-based” approaches to environmental problems. However, they also face similar limitations. Such approaches lack adequate transparency, accountability and credibility in the eyes of critics precisely because they are voluntary and are subject to weak enforcement mechanisms (Haufler 2001; Krut and Gleckman 1998; Morrison et al 2000). Such weaknesses do not have to be fatal, however, and private sector mandates may be used for public benefit if these problems are correctly addressed. The mandatory (or *involuntary*) nature of supply chain mandates need not cancel out the positive aspects of management-

based approaches (i.e. greater flexibility in addressing specific problems and the quest for continual improvement). With proper oversight, encouragement, and guidance from customers and regulators, suppliers may take advantage of the overriding strengths of these approaches and appropriately use business requirements as motivating factors that may lead to positive public benefits. This potential for supply chain mandates to serve as an effective policy tool, however, hinges upon the ability of companies to ensure compliance and spur genuine changes in supplier behavior and management. Until institutional corrections are made which address these shortcomings, they will remain a marginal tool for achieving environmental improvements and lessening the impact of industrialization on the natural environment.

APPENDIX A: INTERVIEW PROTOCOL

Requirements from Customers

1. How do you interpret the environmental requirements from customers? (e.g. as strict mandates, softer expectations, simple guidelines, etc.).
2. Would you have adopted EMS without the mandates?
3. Are there any threats of punitive action from your customers for non-compliance? How does this differ among clients (point system for quality?)
4. What kind of monitoring are you subject to wrt ISO certification from OEMs – how does this differ among companies (ask about each company individually)?
5. Have you received any help in adoption/technical assistance with regards to the codes of conduct/requirements?
6. How are environmental expectations communicated to you?
7. What differences exist among your customers with respect to specific requirements and how you report your status? (get specifics here for each company)

Ford

GM

Honda

Toyota

DCX

Nissan

Requirements for suppliers

1. What are the specific environmental requirements you demand? How do you communicate your expectations regarding environmental practices to your suppliers?
2. Do you expect that your suppliers replicate your expectations? If so, how do you communicate this expectation?
3. Are there consequences for non-compliance with these expectations for supplier firms? If so, what are they? Has your firm taken any punitive action against any suppliers for non-compliance? If so, can you tell me about it? Is there a similar point system for quality rating? Have you had to discontinue relationships with any suppliers due to poor performance?
4. How do you monitor compliance with requirements? What methods do you use?
5. What sort of help do you provide to suppliers/facilities to get them up to speed to meet your requirements/codes of conduct/expectations?

Supplementary Questions (time permitting):

How are you implementing the ELV/IMDS requirements?

- What are the specific challenges you are facing with respect to these requirements?
- Are you, or your customer, responsible for this process?
- What kind of assistance is received?

APPENDIX B: SURVEY INSTRUMENT (ENGLISH)

Thank you for taking the time to complete this questionnaire. Most of these questions can be answered by checking a box next to the answer you choose or by writing in the blank space provided. If there is a question you do not wish to answer, please bypass it and proceed to the next question. All information you provide is strictly confidential.

We appreciate your help with this project!

I. Environmental Management Activities in Your Facility

Most manufacturing facilities must manage the environmental impacts of their operations in one way or another. This section is designed to help us better understand how plants in different industries incorporate specific management practices to address those impacts. Please answer the following questions as accurately as you can.

Is there a formal environmental management system in place in your facility?

- ☐ no
- ☐ yes, my facility is ISO 14001 registered (date of registration _____)
- ☐ yes, my facility has a formal EMS in place **equivalent** to ISO 14001
- ☐ yes, my facility has a formal EMS in place, but it is **not equivalent** to ISO 14001
- ☐ other (please specify _____)
- ☐ not sure

Is your facility in the process of implementing a formal EMS?

- ☐ yes
- ☐ no
- ☐ I don't know

How would you classify your relationship in the automotive industry?

- ☐ tier-1 supplier
- ☐ tier-2 supplier
- ☐ other (please specify _____)

Please check the “Yes” box if the following statements accurately characterize activities in your facility, otherwise, check “No”.

<i>My facility:</i>		<u>Yes</u>	<u>No</u>
a.	has adopted a written statement of environmental policy goals.	<input type="checkbox"/>	<input type="checkbox"/>
b.	has set specific environmental performance objectives.	<input type="checkbox"/>	<input type="checkbox"/>
c.	has planned specific, measurable steps to meet environmental performance objectives.	<input type="checkbox"/>	<input type="checkbox"/>
d.	has a single manager who has primary responsibility for environmental management activities.	<input type="checkbox"/>	<input type="checkbox"/>
e.	Trains employees in specific activities related to environmental aspects of their jobs.	<input type="checkbox"/>	<input type="checkbox"/>
f.	has a procedure in place for identifying legal requirements.	<input type="checkbox"/>	<input type="checkbox"/>
g.	regularly tracks and manages environmental compliance indicators.	<input type="checkbox"/>	<input type="checkbox"/>
h.	regularly tracks and manages environmental indicators other than compliance .	<input type="checkbox"/>	<input type="checkbox"/>
i.	posts environmental indicators for all employees to see.	<input type="checkbox"/>	<input type="checkbox"/>
j.	makes some environmental performance data available to the public.		
k.	makes results of environmental performance available to employees.	<input type="checkbox"/>	<input type="checkbox"/>
l.	actively seeks out suggestions from non-management employees for improvements in environmental practices.	<input type="checkbox"/>	<input type="checkbox"/>
m.	has a formal procedure for documenting environmental management practices.	<input type="checkbox"/>	<input type="checkbox"/>
n.	has a formal pollution prevention plan.	<input type="checkbox"/>	<input type="checkbox"/>
o.	has a formal waste minimization plan.	<input type="checkbox"/>	<input type="checkbox"/>
p.	has procedures in place for responding to environmental spills or accidents.	<input type="checkbox"/>	<input type="checkbox"/>
q.	periodically conducts top management reviews of environmental performance.	<input type="checkbox"/>	<input type="checkbox"/>
r.	conducts regular internal audits of environmental procedures.	<input type="checkbox"/>	<input type="checkbox"/>
s.	conducts regular external (3 rd party) audits of environmental procedures.	<input type="checkbox"/>	<input type="checkbox"/>
t.	has a procedure in place for taking corrective action in response to potential environmental problems.	<input type="checkbox"/>	<input type="checkbox"/>

Many manufacturing facilities have recently had to make the decision of whether or not to adopt a formal environmental management system (EMS). For each of the following statements, please use the scale below to indicate whether the following pressures or inducements were present in your facility and how important they were to your decision of whether or not to adopt an EMS. *Please answer this question even if your facility did not ultimately decide to adopt a formal EMS.*

	N/A	Low Importance	Moderate Importance	High Importance
a. Major customer required us to implement an EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Major customer encouraged us to implement an EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Corporate required us to implement an EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Corporate encouraged us to implement an EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Insurer required us to implement EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Insurer offered lower rates with EMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Facility agreed to introduce EMS as part of a regulatory or legal settlement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Government offered recognition or publicity for EMS adoption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. EMS necessary to compete in some markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Shareholders requested EMS adoption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Facility adopted EMS to avoid a potential compliance problem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Similarly, many businesses that are subject to mandates have decided to mandate or encourage the adoption of formal EMS or other environmental management activities on their own suppliers. Please tell us if any of following apply to your facility (please check all that apply):

- ☐ My facility **requires** the adoption of formal EMSs of our suppliers
- ☐ My facility **encourages** the adoption of formal EMSs of our suppliers
- ☐ My facility **requires** the adoption of environmental management practices of our suppliers, *but not* formal EMS
- ☐ My facility **encourages** the adoption of environmental management practices of our suppliers, *but not* formal EMS
- ☐ My facility *neither encourages nor requires* the adoption of environmental management practices by our suppliers
- ☐ Don't know

Is there a formal Total Quality Management (TQM) system in place in your facility?

___ Yes

___ No

___ Not sure

II. Objectives of Environmental Activities

When managing the environmental impacts of their operations, many manufacturing facilities find it useful to set formal objectives for the environmental activities in place. Below are listed several statements regarding potential objectives associated with such activities. For each statement, check No if the statement does not represent a written objective of your facility's environmental management activities. Otherwise, check what approximate level of priority your facility assigns to each of these written environmental objectives.

The written environmental objectives of my facility include...	Yes, Priority Level				
	No	Low 1	→ 2	3	High 4
a. Meeting regulatory requirements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Monitoring the discharge of various pollutants.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Reducing materials used in production.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Recycling raw materials used in production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Reducing water, energy, raw materials used per unit output	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Minimizing accidents such as leaks, spills and overflows.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Improving existing technology that will help minimize the discharge of pollutants.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Replacing old technology with newer equipment that will help minimize the discharge of pollutants.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Redesigning the production process to eliminate potential environmental impacts.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Redesigning products to reduce environmental impact.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Conducting life cycle analyses of products.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Evaluating the environmental impact of materials used.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Extending the useful life of products.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Incorporating the views of external stakeholders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o. Considering the effects on future generations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How costly have environmental management activities in your facility been relative to benefits? (Please check only one):

- ☐ Costs considerably greater than benefits
☐ Costs somewhat greater than benefits
☐ Costs approximately the same as benefits
☐ Benefits somewhat greater than costs
☐ Benefits considerably greater than costs

Please indicate if your plant tracks the following environmental indicators by checking only one box per row. Check "N/A" if the item does not apply to your facility.

Does your plant track...?		<u>Yes</u>	<u>No</u>	<u>N/A</u>
a.	Water use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	Energy use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	Recycled inputs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	Recycling of waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	Chemical inputs per unit of production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f.	Total material inputs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g.	Hazardous waste generation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h.	Non-hazardous solid waste generation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i.	Pollutant levels in wastewater effluent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j.	Air pollution emissions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k.	Greenhouse gas emissions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l.	Noise generation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m.	Smell generation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n.	Disruption of the natural landscape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o.	Soil contamination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p.	Severe leaks or spills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q.	Legal violations or potential violations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

III. Technical Assistance and Product Specifications

Has your facility received technical assistance in adopting environmental management practices?

- ☐ yes
☐ no
☐ don't know

If yes, in what form was this technical assistance?

- ☐ Workshops
☐ Educational materials (e.g. books, software programs, web pages)
☐ Technical consultants
☐ Financial awards/incentives
☐ Other (please specify _____)

If yes, from whom did you receive this assistance?

- ☐ Industry association
☐ Customer
☐ Business partner
☐ Local government
☐ Federal government
☐ Other (please specify _____)

Do you cooperate with **other local manufacturers**? Please specify in the following areas:

Area	Never \leftrightarrow Very Often
a. Exchange of information and experiences	1 \leftrightarrow 5
b. Sharing orders	
c. Joint product development	
d. Lending machinery	
e. Joint marketing of products	
f. Joint employee training	
g. Joint purchasing of inputs	

Do you cooperate with your suppliers of inputs/subcontractors? Please specify in the following areas:

Area	Never \leftrightarrow Very Often
a. Exchange of information and experiences	1 \leftrightarrow 5
b. Negotiation of payment and delivery conditions	
c. Joint product development	
d. Improving quality	
e. Improving delivery time	
f. Employee training	
g. Setting of product specifications	
h. Technological upgrading	

Do you cooperate with the customers/buyers of your products? Please specify in the following areas:

Area	Never \leftrightarrow Very Often
a. Exchange of information and experiences	1 \leftrightarrow 5
b. Negotiation of payment and delivery conditions	
c. Joint product development	
d. Improving quality	
e. Improving delivery time	
f. Employee training	
g. Setting of product specifications	
h. Technological upgrading	

Please rank the most important way (with '1' being the most important) your facility receives information about product specifications:

- ___ from our own design
 ___ a prototype from customers
 ___ CAD files from customers
 ___ Paper drawings from customers
 ___ video conferences, email messages, or telephone conversations with customers
 ___ in-person meetings with our customers' engineers
 ___ other

Please indicate the amount of consultation needed after your facility receives information about product specifications:

- ___ None
 ___ Very Little
 ___ Some
 ___ A Great Deal
 ___ Constant

For each statement below, please circle the number that most closely agrees with the experience at your facility

- a. On average how complex are the product specifications you receive from your major customers? Does not apply ☐
- Not very Complex 0 1 2 3 4 5 6 Very Complex
- b. How skilled must your employees be in order to manufacture the products in your facility? Does not apply ☐
- Not Very Skilled 0 1 2 3 4 5 6 Highly Skilled

V. Facility Information

Is your facility part of a larger business organization?

- ☐ yes
- ☐ no
- ☐ don't know

Is your facility or parent organization (please check as many as apply):

- ☐ publicly traded
- ☐ privately held (not publicly traded on a stock exchange)
- ☐ foreign-owned subsidiary/transplant
- ☐ joint venture
- ☐ other (please specify_____)

How many full-time employees work at your facility? _____

What is the primary product that you manufacture at your plant?_____

Ownership of your facility is based in what country or region?

- ☐ Mexico
- ☐ United States
- ☐ Canada
- ☐ Europe (EU)
- ☐ Japan
- ☐ Latin America
- ☐ Asia
- ☐ Other (please specify_____)

In what country or region are your major customers located (please check all that apply)?

- ☐ Mexico
- ☐ United States
- ☐ Canada
- ☐ Europe (EU)
- ☐ Japan
- ☐ Latin America
- ☐ Asia
- ☐ Other (please specify_____)

In what country or region are your major suppliers located (please check all that apply)?

☐ Mexico

☐ United States

☐ China

☐ Korea

☐ Canada

☐ Japan

☐ Europe (EU)

☐ Other (please specify _____)

Does your plant currently participate in PROFEPA's "Clean Industry" program?

☐ Yes

☐ No

☐ Don't know

Has your plant participated in PROFEPA's "Clean Industry" program in the past?

☐ Yes

☐ No

☐ Don't know

APPENDIX B: SURVEY INSTRUMENT (SPANISH)

Gracias por tomarse el tiempo para llenar el presente cuestionario. La mayor parte de estas preguntas pueden responderse marcando una casilla al lado de la respuesta de su elección, o bien escribiendo en el espacio en blanco correspondiente. Si hay una respuesta que usted no desea contestar, por favor ignórela y proceda a la siguiente. Toda la información que proporcione es estrictamente confidencial.

Una vez que haya terminado la encuesta, por favor colóquela en el sobre timbrado adjunto y envíenosla de regreso. Apreciamos mucho su ayuda en este proyecto.

I. Actividades de Gestión Ambiental en su Planta

La mayoría de las plantas de fabricación deben manejar los impactos ambientales de sus operaciones de un modo u otro. Esta sección ha sido diseñada para ayudarnos a entender cómo incorporan las plantas de diversas industrias prácticas específicas de gestión para afrontar esos impactos. Por favor conteste las siguientes preguntas tan precisamente como le sea posible.

Existe un sistema formal de gestión ambiental implantado en su instalación?

- ☐ no
- ☐ sí, mi planta está certificada al ISO 14001 (fecha de certificación:_____)
- ☐ sí, mi planta cuenta con un SGA formal implantado **equivalente** al ISO 14001
- ☐ sí, mi planta cuenta con un SGA formal implantado, pero **no es equivalente** al ISO 14001
- ☐ otro (favor de especificar_____)
- ☐ no estoy seguro

¿Está su planta en el proceso de implantar un SGA formal?

- ☐ Sí
- ☐ No
- ☐ No lo sé

¿Cómo clasificaría su relación comercial en la industria automotriz?

- ☐ proveedor de primer nivel (tier-1)
- ☐ proveedor de segundo nivel (tier-2)
- ☐ proveedor de tercer nivel (tier-3)
- ☐ Otro

Por favor marque la casilla “Sí” si las siguientes declaraciones caracterizan adecuadamente las actividades en su planta; de otro modo, marque “No”.

<i>Mi planta:</i>		<u>Sí</u>	<u>No</u>
a.	Ha adoptado una declaración escrita de intenciones de política ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
b.	Ha establecido objetivos específicos de desempeño ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
c.	Ha planeado pasos específicos y medibles para lograr los objetivos de desempeño ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
d.	Cuenta con un solo gerente que tiene la responsabilidad primordial de las actividades de gestión ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
e.	Imparte capacitación a los empleados en actividades específicas relacionadas con los aspectos ambientales de su trabajo.	<input type="checkbox"/>	<input type="checkbox"/>
f.	Cuenta con un procedimiento implantado para identificar requisitos legales.	<input type="checkbox"/>	<input type="checkbox"/>
g.	Regularmente monitorea y gestiona indicadores de cumplimiento ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
h.	Regularmente monitorea y gestiona indicadores ambientales diferentes de los de cumplimiento.	<input type="checkbox"/>	<input type="checkbox"/>
i.	Publica internamente indicadores de desempeño ambiental y de cumplimiento para que todos los empleados los vean.	<input type="checkbox"/>	<input type="checkbox"/>
j.	Pone a disposición del público algunos datos de desempeño ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
k.	Pone a disposición de los empleados los resultados del desempeño ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
l.	Activamente busca sugerencias entre los empleados no gerenciales para mejorar las prácticas ambientales.	<input type="checkbox"/>	<input type="checkbox"/>
m.	Cuenta con un procedimiento formal para documentar las prácticas de gestión ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
n.	Cuenta con un plan formal para la prevención de la contaminación.	<input type="checkbox"/>	<input type="checkbox"/>
o.	Cuenta con un plan formal de minimización de residuos.	<input type="checkbox"/>	<input type="checkbox"/>
p.	Cuenta con procedimientos implantados para dar respuesta a derrames o accidentes ambientales.	<input type="checkbox"/>	<input type="checkbox"/>
q.	Conduce revisiones periódicas de la alta gerencia sobre el desempeño ambiental.	<input type="checkbox"/>	<input type="checkbox"/>
r.	Conduce auditorías internas regulares sobre los procedimientos ambientales.	<input type="checkbox"/>	<input type="checkbox"/>
s.	Conduce auditorías externas regulares (de 3ª parte) sobre los procedimientos ambientales.	<input type="checkbox"/>	<input type="checkbox"/>
t.	Mi planta tiene un procedimiento aprobado y en ejecución para implementar acciones correctivas en respuesta a problemas ambientales que se pudieran suscitar.	<input type="checkbox"/>	<input type="checkbox"/>

Muchas plantas productivas han tenido recientemente que tomar la decisión de si adoptar o no un sistema formal de gestión ambiental (SGA). Para cada una de las siguientes declaraciones, por favor utilice la escala de abajo para indicar si las siguientes presiones o inducciones estuvieron presentes en su planta y qué tan importantes fueron para su decisión sobre si adoptar o no un SGA. *Por favor conteste esta pregunta aún si su planta decidió por último no adoptar un SGA formal.*

	No <u>Aplica</u>	Importanc ia <u>Baja</u>	Importanc ia <u>Moderada</u>	Importancia <u>Alta</u>	Se <u>Desconoce</u>
a. Uno de nuestros clientes principales nos requirió implantar un SGA.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Uno de nuestros clientes principales nos animó a implantar un SGA.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. El corporativo nos requirió implantar un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. El corporativo nos animó a implantar un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. La empresa aseguradora nos requirió implantar un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. La empresa aseguradora ofreció tarifas menores con un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. La planta acordó introducir un SGA como parte de un convenio regulatorio o legal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. El gobierno ofreció reconocimiento o publicidad por adoptar un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Se necesita el SGA para competir en ciertos mercados	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Los accionistas requirieron la adopción de un SGA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. La planta adoptó el SGA para evitar un problema potencial de cumplimiento	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

De manera similar, muchos negocios que están sujetos a directivas específicas han decidido requerir o sugerir a sus propios proveedores la adopción de Sistemas de Administración Ambiental (SAAs) formales o realizar algunas otras actividades de gestión ambiental. Por favor díganos si alguna de las siguientes opciones aplica a su planta (por favor marque todas las que apliquen):

- _____ Mi planta **requiere** la adopción de SAAs por parte de nuestros proveedores
- _____ Mi planta **sugiere y motiva** la adopción de SAAs formales por parte de nuestros proveedores
- _____ Mi planta **requiere** la adopción de prácticas de administración ambiental por parte de nuestros proveedores, *pero no* que tengan un SAA formal.
- _____ Mi planta **sugiere y motiva** la adopción de prácticas de administración ambiental por parte de nuestros proveedores, *pero no* que tengan un SAA formal.
- _____ Mi planta **no requiere** ni **motiva** ni **sugiere** la adopción de prácticas de administración ambiental por parte de nuestros proveedores.
- _____ No lo sé.
- _____ No aplica

¿Hay un sistema formal de Gestión Total de la Calidad (GTC) implantado en su planta?

- ☐ Sí
☐ No
☐ No lo sé

II. Objetivos de las Actividades Ambientales

Tal gestionar los impactos ambientales de sus operaciones, muchas plantas manufactureras encuentran útil establecer objetivos formales para las actividades ambientales implantadas. Enseguida se enlistan varias declaraciones referentes a objetivos potenciales asociados a tales actividades. Para cada declaración, marque No si la declaración no representa un objetivo escrito de las actividades de gestión ambiental de su planta. De otra manera, marque el nivel aproximado de prioridad que su planta asigna a cada uno de estos objetivos ambientales documentados.

<i>Los objetivos ambientales documentados de mi planta incluyen...</i>	No	Sí, Nivel de Prioridad			
		Bajo	®	Alto	
		1	2	3	4
a. Satisfacer requisitos legales.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Monitorear la descarga de diversos contaminantes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Reducir los materiales utilizados en la producción.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Reciclar materias primas utilizadas en la producción	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Reducir agua, energía, materias primas utilizadas por unidad de producción	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Minimizar accidentes tales como fugas, derrames y desbordamientos.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Mejorar la tecnología existente para ayudar a minimizar la descarga de contaminantes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Sustituir tecnologías antiguas por equipo más nuevo que ayude a minimizar la descarga de contaminantes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Rediseñar el proceso de producción para eliminar impactos ambientales potenciales.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Rediseñar productos para reducir su impacto ambiental.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Llevar a cabo análisis del ciclo de vida de los productos.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Evaluar el impacto ambiental de los materiales utilizados.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Extender la vida útil de los productos.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Incorporar los puntos de vista de partes interesadas externas.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o. Considerar los efectos que nuestras actividades puedan tener en las generaciones futuras.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

¿Qué tan costosas han sido las actividades de gestión ambiental en su planta en relación con los beneficios? (Por favor marque sólo una):

- ☐ Los costos han sido considerablemente mayores que los beneficios
☐ Los costos han sido ligeramente mayores que los beneficios
☐ Los costos han sido aproximadamente equivalentes a los beneficios
☐ Los beneficios han sido ligeramente mayores que los costos
☐ Los beneficios han sido considerablemente mayores que los costos

Por favor indique si su planta monitorea los siguientes indicadores ambientales. Marque la casilla apropiada o “N/A” si el concepto no se aplica en su planta.

¿Monitorea su planta...?		<u>Sí</u>	<u>No</u>	<u>N/A</u>
a.	Consumo de agua	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	Consumo de energía	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	Entradas recicladas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	Reciclaje de residuos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	Entradas de químicos por unidad de producción	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f.	Entradas totales de materiales	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g.	Generación de residuos peligrosos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h.	Generación de residuos sólidos no pelig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i.	Efluentes de aguas residuales	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j.	Emisiones contaminantes al aire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k.	Emisiones de gases de invernadero	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l.	Generación de ruido	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m.	Generación de olores	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n.	Alteración del paisaje natural	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o.	Contaminación del sueb	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p.	Fugas o derrames severos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q.	Infracciones legales o potenciales	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

III. Asistencia Técnica y Las Especificaciones de Producto

¿Ha recibido su planta algún tipo de asistencia técnica en la adopción de prácticas de administración y gestión ambiental?

- ☐ sí
☐ no
☐ no lo sé

Si la respuesta es sí, ¿en qué forma se dió ésta asistencia técnica?

- ☐ Talleres
☐ Materiales educativos (p.ej. libros, programas de software, páginas web)
☐ Consultores técnicos
☐ Reembolsos / incentivos financieros
☐ Otro (por favor especifique _____)

Si la respuesta es sí, ¿de quién recibieron usted esta asistencia?

- ☐ Asociación o cámara industrial
☐ Cliente
☐ Asociado de negocio
☐ Gobierno local
☐ Gobierno federal
☐ Otro (por favor especifique _____)

Coopera usted con **otros productores/manufactureros locales**? Por favor responda de manera específica en las siguientes áreas

	Nunca \leftrightarrow Frecuentemente
Intercambio de información y experiencias	1 \leftrightarrow 5
Ordenes conjuntas	
Desarrollo conjunto de productos	
Préstamo de maquinaria	
Mercadotecnia conjunta de productos	
Entrenamiento conjunto de empleados	
Compra conjunta de suministros y materias primas	

Coopera usted con **sus proveedores de materias primas o contratistas**? Por favor responda de manera específica en las siguientes áreas

	Nunca \leftrightarrow Frecuentemente
Intercambio de información y experiencias	1 \leftrightarrow 5
Negociación de pagos y condiciones de entrega	
Desarrollo conjunto de productos	
Mejora de la calidad	
Mejora del tiempo de entrega	
Entrenamiento y capacitación de empleados	
Establecimiento de especificaciones del producto	
Mejoras tecnológicas	

¿Coopera usted con **sus clientes**? Por favor responda de manera específica en las siguientes áreas

	Nunca \leftrightarrow Frecuentemente
Intercambio de información y experiencias Negociación de pagos y condiciones de entrega Desarrollo conjunto de productos Mejora de la calidad Mejora del tiempo de entrega Entrenamiento y capacitación de empleados Establecimiento de especificaciones del producto Mejoras tecnológicas	1 \leftrightarrow 5

Por favor priorice la forma más importante a través de la cual su planta recibe información acerca de especificaciones de producto (donde '1' es la más importante):

- ☐ de nuestro propio diseño
☐ un prototipo de los clientes
☐ Archivos de CAD (diseño asistido por computadora) de los clientes
☐ Dibujos en papel de los clientes
☐ Videoconferencias, mensajes de correo electrónico, o conversaciones telefónicas con clientes
☐ Reuniones en persona con los ingenieros de nuestros clientes
☐ Otras

Por favor indique qué tanto requieren ustedes hacer consultas con los clientes después de que su planta recibe información sobre las especificaciones de los productos:

- ☐ Nada
☐ Muy poca
☐ Algo
☐ Mucho
☐ Constantemente
☐ No aplica

- a. Por favor indique en la siguiente escala, en promedio, ¿qué tan complejas son las especificaciones de producto que ustedes reciben de sus clientes principales?
- No muy Complejas 1 2 3 4 5 Muy Complejas ☐
- b. Por favor indique en la siguiente escala, qué tan capacitados deben estar sus empleados para ser capaces de manufacturar los productos de su planta?
- No Muy Capacitados 1 2 3 4 5 Altamente Capacitados ☐

IV. Información sobre la planta

¿Su planta es parte de una organización más grande?

- ☐ sí
- ☐ no
- ☐ no estoy seguro

¿Su planta o su organización corporativa (por favor marque todas las que apliquen):

- ☐ cotiza en la bolsa de valores?
- ☐ tiene propietarios privados (no cotiza en la bolsa de valores)
- ☐ es subsidiaria de una empresa transnacional?
- ☐ es una empresa por asociación?
- ☐ es de otro tipo? (favor de

especificar _____)

¿Cuántos empleados de tiempo completo tiene su planta? _____

¿Qué su producto principal? _____

¿Los dueños de su planta se encuentran en qué país o región?

- ☐ México
- ☐ Estados Unidos
- ☐ Canadá
- ☐ Europa (Unión Europea)
- ☐ Japón
- ☐ América Latina
- ☐ Asia
- ☐ Otros (por favor especifique _____)

En qué país o región se encuentran sus clientes principales? (por favor marque todas las celdas que apliquen)

- ☐ México
- ☐ Estados Unidos
- ☐ Canadá
- ☐ Europa (Unión Europea)
- ☐ Japón
- ☐ América Latina
- ☐ Asia
- ☐ Otros (por favor especifique _____)

En qué país o región se encuentran sus proveedores principales? (por favor marque todas las celdas que apliquen)

- ☐ México
- ☐ Estados Unidos
- ☐ China
- ☐ Corea
- ☐ Canadá
- ☐ Japón
- ☐ Europa (Unión Europea)
- ☐ Otros (por favor especifique _____)

¿Participa su empresa actualmente en el programa "Industria Limpia" de PROFEPA?

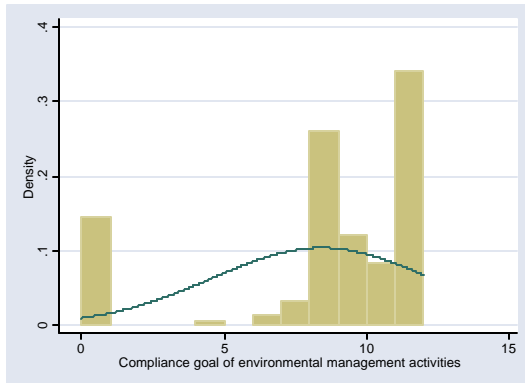
- ☐ Sí
- ☐ No
- ☐ No lo sé

¿Ha participado su empresa en el programa "Industria Limpia" de PROFEPA anteriormente?

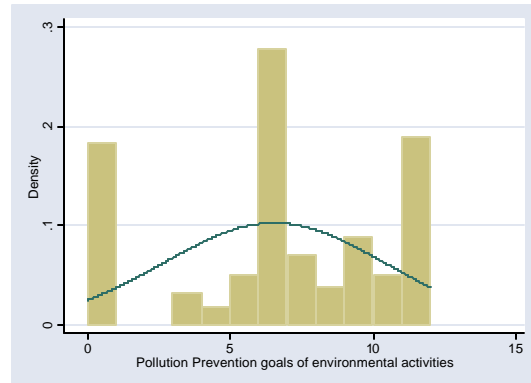
- ☐ Sí
- ☐ No
- ☐ No lo sé

APPENDIX C: DISTRIBUTIONS FOR ENVIRONMENTAL OBJECTIVES PRIORITIZATION

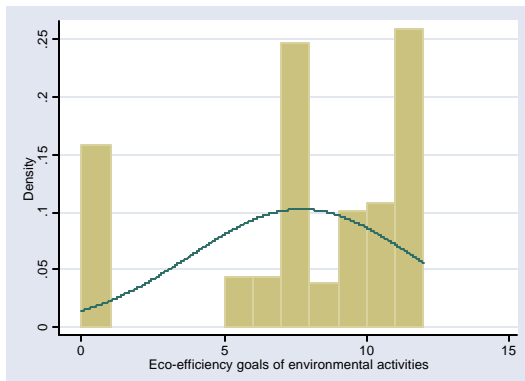
Compliance Objectives



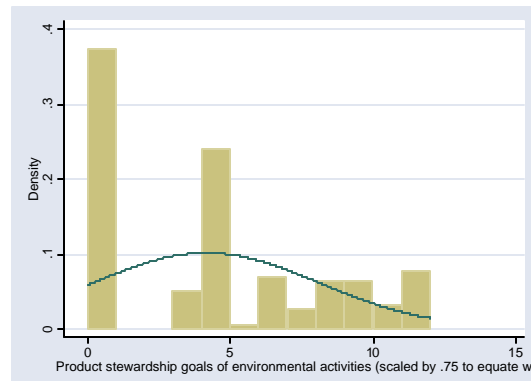
Pollution Prevention Objectives



Eco-Efficiency Objectives



Product Stewardship Objectives



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