

Pollution among Manufacturers in Mexico

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## Pollution in Mexico

This is an interdisciplinary approach to industrial pollution prevention in Mexico. It examines the factors that affect the investments that businesses make in pollution prevention and examines which types of businesses are more or less susceptible to those forces for reasons having to do with their size or ownership type. It concludes that a subsidiary's pollution prevention program is affected by the management style of the parent company and that governments in Mexico should continue to provide technical and financial assistance for pollution prevention in small businesses.

## **I. Introduction**

Research on industrial pollution prevention usually looks at large or small businesses in isolation of one another (Makower, 1994, p. 138; EP<sup>3</sup>, 1994, 1995a, b, c; TNRCC, 1996, p. 1; CPML, 1997, p. 3). One study has examined the role of firm size, location in the supply chain, and industry as determinants of the firm's environmental position in one region of the United States (Scallon, 1997, pp. 145, 154). There are also analyses of particular industries in Mexico with respect to pollution (Alvarez, et al, 1995, pp. 41-51) and of investment in pollution prevention technologies across industries in Mexico (National Trade Bank, 1996, "Mexico - industrial water..."), which are very helpful but do not answer the question of what types of firms actually are polluting either the most or the most intensively.

This project sets out to see what differences in process-related pollution exist between businesses of different sizes and nationalities in order to advise government policy and consumers. This is an interdisciplinary approach, examining economic, organizational, legal, and other factors that may influence the investment decisions of businesses, discussing how these factors may differentially affect one type of business over another. The policy recommendation in this paper is that governments in Mexico should continue to offer technical and financial assistance for small- and medium-sized businesses.

## **II. Data**

The following descriptions are taken from field visits to manufacturing facilities, an environmental engineering consulting firm, the Canacindra (National Chamber for Manufacturing Industry), and the Department of Ecology of the State of Querétaro, and from news and journal articles and miscellaneous types of correspondence with informants.

**Chrysler de México** built the Lago Alberto Truck Plant in Mexico City in the early 1930s (personal communication, A. Díaz Garduño, 3 December, 1997). In 1992, when the government required of the food, chemical, textile, and automotive industries to close their antiquated, polluting facilities or upgrade them to cleaner standards, the corporation decided to close Lago Alberto and replace it with plants and existing capacity at Toluca and Saltillo. The plant never did not close, though. The Automotive Association of Mexico negotiated with the Mexican government standards for VOC emissions in December of 1996, and the Lago Alberto plant has until the year 2006 to bring its VOC emissions down to the levels that are acceptable in Canada, the United States, and Germany. As of January 1997, the facility had installed electrostatic paint applicators that have a very high application efficiency, water running underneath the metal grating floors of the paint lines to catch any paint vapors, and other efficiency-enhancing measures. The facility has not switched to using water-based paints because the facility lacks the space required for the large ovens that water-based painting needs. (personal communication, E. Arretche, 3 December, 1997)

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The new plant in Saltillo, built in 1994 for making the same product as Lago Alberto, has a zero-discharge policy, which means that no water comes out of the plant that is dirtier than the drinking water. The plant actually produces a surplus of clean drinking water that is put into the municipal drinking water system. The wastes that are recovered from the waste water by the on-site waste water treatment plant are confined in a hazardous waste landfill near Monterrey. Chrysler de México anticipates eventually converting Lago Alberto into a zero-discharge plant (personal communication, E. Arretche, 3 December, 1997). The Saltillo plant is recognized for producing the highest quality Chrysler trucks, out of two plants in Mexico and one or two others in the United States. (personal communication, E. Loiasa, 15 January, 1997)

The plant has not ceased to be upgraded since its construction. The facility implemented water-based painting in early January 1997, at the mandate of the government, and plans were underway to begin reclaiming metal scraps from another process in the plant. (personal communication, E. Loiasa, 15 January, 1997)

Chrysler de México is continually reducing their production of hazardous wastes (personal communication, E. Arretche, 3 January, 1997; personal communication, E. Loiasa, 15 January, 1997). The hazardous waste produced per unit in the new truck plant has been reduced almost in half of what Lago Alberto produces per unit. Both plants also filter and reuse materials within the plants, such as paint solids that are sent back to the paint tank, and outside the plants,

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such as spent solvents that get sold to a chemical company and plastic wrap that gets sent to a recycler (personal communication, A. Díaz Garduño, 3 January, 1997; personal communication, E. Loiasa, 15 January, 1997). No one at Chrysler de México mentioned having their hazardous wastes recycled, which is a viable option in the United States, but there are not as many viable alternatives for hazardous wastes in Mexico as there are in the United States, (personal communication, E. Arretche, 3 January, 1997), and Chrysler de México's ways of dealing with their wastes of different types are in line with the best recommended available alternatives for those particular wastes (Comisión Ambiental Metropolitana; Sociedad Alemana de Cooperación Técnica; TÜV ARGE-MEX, 1996, pp. 49-55).

**General Motors de México** closed its plant in Mexico City as a result of the same legislation that spurred Chrysler to modernize Lago Alberto. The plant was built in 1936 in an undeveloped area in Mexico City about a kilometer from the Lago Alberto truck plant. The plant closed in 1992, and GM has since built a new plant in Guanajuato. Newspapers report as reasons for the closure the government's concerns about smog and new, stricter environmental regulations for industries in the Mexico Valley and an ozone action alert in Mexico City (Darling, 1992). A GM executive said that the new regulations presented a good opportunity to build a modern plant that can compete with modern facilities near the border. But an informant at Chrysler de México says that the government closed that plant (personal communication, E. Arretche, 3 December, 1997).

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Environmentalists had targeted 220 businesses for poor emissions control.

(Darling, 1992)

There are cases in which unsafe practices that do not occur in the home-country facilities are done in the Mexican facilities (personal communication, R. Alvarez, 30 December, 1996). The environmental engineer at a U.S. automaker's subsidiary in Mexico said that they discharge chromium into the wastewater, which is prohibited in the United States, because it is not prohibited in Mexico (personal communication, E. Arretche, 3 December, 1997). Though GM and Chrysler would say that their environmental conduct in developing countries is beyond reproach, their World Wide Web sites give environmental data for their facilities in the United States and Canada but only a very limited amount of data for Mexican facilities ([www.gm.com](http://www.gm.com) and [www.chrysler.com](http://www.chrysler.com)).

**Tremec** (Transmisiones y Equipos Mecanicos) employs 1300 people and makes manual transmissions for ninety percent of the trucks built in Mexico and also exports to the world (—, 1995, "Mexican Mandate ...," p. 83). Its main facility in Quéretaro opened in 1964. Tremec was a Mexican-owned company until the Dana Corporation's Mexican affiliate, Spicer S.A. de C.V., bought it in 1994 (—, 1995, "Dana Corp. ..."). Spicer consists of 30 companies (personal communication, F. Fernandez M., 13 January, 1997).

Tremec's environmental program was lead by an ecology committee, which was replaced by a new program called Environmental, Safety, and Health Control System (SI-CASH), which replaced the ecology committee, which had

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existed since 1990, when Tremec was bought by Spicer (personal communication, R. Uribe Mendez, 3 July, 1997). Tremec built a waste water treatment plant in 1976, before it was required by the government. Today the facility implements many pollution-preventing steps in its metal finishing and other operations, including returning used chemical containers to the supplier, counter-current rinsing of cleaned parts, replacement of old, inefficient ovens (probably used in the foundry), and use of alkaline cleaners. They also contain hazardous wastes in the landfill near Monterrey. (personal communication, F. Fernandez M., 13 January, 1997).

**FAISA** (Fabricaciones Automotrices e Industriales, S.A. de C.V) is a small business which makes air brakes and associated components for domestic sale and export. It closed its forging operation on its own initiative because it polluted too much. The assessor there said that the business was soon going to move to Irapuato, largely because he did not like life in Mexico City. FAISA stopped its metal forging operation a few years ago because it was a major source of pollution. Tremec still continues its metal forging operation, apparently with little pollution problem (personal communication, F. Fernandez M., 13 January, 1997). According to one expert, small businesses are limited in resources for technical staffing and new technology, but they are learning that clean production is not too expensive for them and often is profitable (personal communication, M. Guerrero, 14 January, 1997; personal communication, M. Rovalo, 17 January, 1997). The assessor at FAISA said that the non-pollution laws in Mexico have, in



the past few years, driven down the costs of products which used to cost a lot to manufacture without polluting. (personal communication, O. Mirón Yezpez, 8 January, 1997)

### **III. Data analysis**

This section looks into the factors for which there is theoretical or empirical evidence for their being influential in the investment decisions of businesses and discusses which factors may tend to affect one size or class of business more than another. Some factors from the literature do not appear to be important from the data are left out of this article for brevity but will appear in a thesis at the University of Wisconsin-Madison in December of this year.

**1. Governments.** Governments affect the environmental performance of businesses by creating and enforcing rules regarding pollution, offering financial and technical incentives for certain business practices that impact environmental performance, and informing the public about environmental issues.

#### **Mexican pollution-related governance**

Mexican environmental regulation in the 1970s was ineffective due to its nightmarish administrative complexities but has grown more streamlined since then (personal communication, R. Alvarez, 30 December, 1996). Legislation in 1988 and 1992 caused permitting and other administrative activities to be less of a burden to environmental protection (personal communication, R. Alvarez, 30 December, 1996). The Mexican government has taken on a more incentive-based,

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cooperative approach to pollution prevention than its earlier, command-and-control approach (CEC, 1996, p. 13; personal communication, R. Alvarez, 30 December, 1996), soliciting cooperation from businesses by means of voluntary agreements, which is a growing trend throughout the world (Ledgerwood, 1997, pp. 36, 37). In 1994, General Motors de México and the Secretariat of Social Development signed an agreement for GM's 50 Mexican facilities to undergo environmental self-audits and receive recommendations for improvement whose implementation would be overseen by the Attorney General of the Environment (PROFEPA) (—, 1994b). The Zedillo administration and PROFEPA endorse voluntary environmental audits (Espriú, c1995, p. 7), self-auditing, and the use of ISO 14000 (Lichaa, 1997, pp. 4, 5).

The Mexican government has targeted certain industries with respect to pollution issues, starting with the maquiladoras after the implementation of the General Ecology Law in 1988 (personal communication, R. Alvarez, 30 December, 1996). Pollution in the maquiladora sector has been drastically reduced (personal communication, R. Alvarez, 30 December, 1996). Today, the government has targeted exporters and high-risk industries as candidates for voluntary environmental audits (Espriú, c1995, p. 7) and small businesses as recipients of technical and financial assistance for environmental compliance (CEC, 1996, pp. 51, 52). The Mexican government has offered tax breaks for environmental investment on at least two occasions, but the current provision reportedly applies only to businesses that are already in compliance with

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environmental regulations, which will probably nullify its effect (personal communication, I. Gotelli, ? August 1997).

Transnational corporations (TNCs) naturally deal with more governments on more issues than firms that are owned in the country in which they are operating. Maquiladoras, for instance, are required, under the La Paz Agreement between the United States and Mexico, to repatriate their waste products (TNRCC, 1996, p. 2). TNCs prefer to invest in countries that have clearly established regulatory regimes, stable governments which are friendly to foreign investment, and surety that their investments will continue to be profitable in the future (Goodman, 1987). TNCs get backing from their home governments, and host governments often get pressure from foreign governments in order to extend the privileges of TNCs operating within their borders (Goodman, 1987).

TNCs represent a multiplicity of interests, as seen in the representation on the board of directors (Goodman, 1987, p. 35; Kline, J.M., 1991, p. 28) or the fact that a former host country government official now sits in a position of authority in a TNC subsidiary (Stopford, 1991, p.137, 154). TNCs strive to diversify their holdings and activities, whereas host countries see it as being in their best interest to develop strong ties with foreign corporations (Stopford, 1991, p. 154). These two goals tend to work counter to each other, and TNCs find it difficult to adapt to local needs when they are planning on a global scale (Stopford, 1991, p. 138; Lerner, 1991, p. 59).

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Multinational corporations control over half the world's trade in manufactured goods (Stopford, 1991, p. 14) and provide about half of Mexico's manufacturing jobs (Alvarez, et al, 1995), but the number of large manufacturing businesses is only a small part of the number of manufacturing businesses in Mexico (Alvarez, et al, 1995).

Large corporations have resisted and still do lobby against environmental regulations. Large corporations exercise their power in bargaining for ownership in joint ventures (Fagre, 1982, p. 19; Weintraub, S., 1991, p. 76), profit sharing (Goodman, 1987, p. 130), and many other items (Stopford, 1991, p. 154). Large corporations have also led the way in developing the ISO 14000 guidelines (Roberts, 1997), but some say that big industry has designed ISO 14000 in ways that protect it from being liable for its actions (Benchmark Environmental Consulting, 1996, pp. 12, 13).

### **Mexican development and impact on pollution**

The Mexican government began in the late 1960s to subsidize modernization in industries businesses (Suárez Aguilar, 1994, p. 46). The opening-up to the global economy put enormous pressure on small, manually-operated businesses which now had to compete with the low-cost alternatives becoming available from abroad (Suárez Aguilar, 1994, p. 60, 61). The government encouraged exporting, which was being done by large, modernized businesses (Suárez Aguilar, 1994, p. 13, 46). Modernization has ushered in new technologies and led to domination of industries by large businesses (Suárez

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Aguilar, 1994, p. 19) and now threatens non-exporters with extinction (personal communication, R. Alvarez, 30 December, 1996; personal communication, O. Mirón Yepez, 8 January, 1997).

The type of manufacturing that accompanied the late 1960s through the 1980s was mainly mechanization of processes which were previously done manually (Suárez Aguilar, 1994). Except in the case of the automotive industry, in which robots were introduced, these steps toward modernization affected only the *stream* of production, not the acts of production themselves (Suárez Aguilar, 1994, p. 63, 64). This type of modernization increases pollution by virtue of its heavy energy demands. During the present decade and the last, many businesses have begun implementing high-precision technologies, which reduce waste, into their processes (National Trade Bank, 1996, "METALWORKING ...).

### **Various levels of government**

The majority of the actions on the part of the state regarding pollution prevention have been to underscore acts of the Federal Government or to define their regulations more specifically. For example, whereas the General Ecology Law sets guidelines for the emission of wastewater from industrial plants, Querétaro's State Ecology and Environmental Protection Law sets criteria for wastewater dischargers to meet in order to locate in Querétaro (Espriú, c1995, p. 6, 7). Querétaro is an ambitious state and may be leading the federal government in some areas, too. Whereas SEMARNAP has just begun to encourage voluntary audits and even self-auditing privileges, the State of Querétaro has already been

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specifically endorsing ISO-14000, ISO-9000, and QS-9000, which are codes that are geared toward quality assurance and effective environmental auditing and implementation of environmental management strategies (Espriú, c1995, p. 8).

Different industries are placed under the jurisdiction of federal, state, or local governments depending upon their risk level (personal communication, R. Alvarez, 30 December, 1996), and the automotive industry is under state charge, being a medium-risk industry (personal communication, A. Espriú, 14 January, 1997). There are very strict regulations for industries in and around the Federal District (DF) (personal communication, E. Arretche, 3 January, 1997, Darling, 1992).

The Federal Government is more inclined to carry out severe enforcement action than state governments, which are more apt to offer technical assistance or an incentive for industries to come into compliance (personal communication, R. Alvarez, 30 December, 1996; personal communication, G. Goya, 10 January, 1997). The federal government lacks the staff to inspect all of the manufacturing facilities, and inspections occur sporadically, covering one block and missing the factory on the next block (personal communication, M. Rovalo, 17 January, 1997).

### **Informing the public**

A freedom-of-information ethic may be developing in Mexican government. There are provisions in the North American Free Trade Agreement side agreements for public participation and dissemination of information, and in

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December 1996, the Mexican Congress approved right-to-know legislation (Mexican Congress, 1996). The Mexican government has also solicited input from citizens on environmental issues (McAllen, 1996). Timelines, schedules, and descriptions pertaining to SEMARNAP's activities and other environmental information are readily available. Mexico has run a one-year pilot of a pollutant release and transfer register (National Institute of Ecology, 1996).

Monterrey, Mexico's second largest and second most industrialized city, requires industries to permit local residents to visit their facilities, which has brought about considerable changes in performance (personal communication, R. Alvarez, 30 December, 1996).

Still, obtaining environmental information about industries can be next to impossible. Two informants, both nationally respected experts, attested to the difficulty of accessing pollution data (personal communication, R. Alvarez, 30 December, 1996; personal communication, A. Espriú, 14 January, 1997), and results of voluntary environmental audits done by PROFEPA and done for the RETC have been kept confidential.

## **2. Customers**

Consumers have influenced change large industries by voicing disapproval of environmentally harmful practices, and in some cases, less than one percent of the customer base actually was involved. The announcements that accompanied the changes that were made in these industries indicate that their motivation is

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their customers' demands, not the health of the environment. (Makower, 1994, p. 97)

Customers in the world have made heard their demand for environmentally sound production, packaging, use, and disposal of what they buy, driving the push for eco-labeling and environmental management strategies, which are the focus of ISO 14000 (Roberts, 1997). Tremec is certified under QS-9000 by request or requirement of its customers, Ford, GM, and Chrysler, and Tremec also requests its own suppliers to be certified under the same (personal communication, R. Uribe Mendez, 3 July, 1997).

In Mexico, according to several informants, big firms are leading in pollution prevention, while micro- and small- and medium-sized businesses are dying out, partially because they are not exporting (personal communication, R. Alvarez, 30 December, 1996; personal communication, M. Rovalo, 17 January, 1997). FAISA and Tremec export, and their clients come from the United States to inspect their operations (personal communication, O. Mirón Yopez, 8 January, 1997; personal communication, A. Chacón Gonzalez, 18 January, 1997). Exporting is what makes them have to pay closer attention to quality, subdivide their processes in order to locate problems (personal communication, M. Rovalo, 17 January, 1997), and comply with ISO 14000 standards (personal communication, M. Guerrero, 14 January, 1997).



### **3. Activists**

There are about one thousand environmental groups in Mexico (McAllen, 1996). Environmentalists in Mexico have blocked construction of hazardous waste confinement facilities. According to one expert, the rights provided under the North American Agreement for Environmental Cooperation (NAAEP) represent a big step in the right direction (McAllen, 1996). Transnational corporations have been noted to change their investment decisions on the basis of their concern for their global image (Goodman, 1987, *Small Nations...*, p. 80), and environmental issues are often part of such concerns (Makower, 1994; —, 1996, “The New ...”; Roberts, 1997).

Activists can focus most easily on the firms which are the most visible. However, a corporation whose subsidiaries operate under different names in other countries may be invisible to activists who do not know which companies belong to which umbrella corporation (Broadman, 1991, p. 63). We did not know at first to associate Tremec with its American owner, Dana Corporation.

Foreign and domestic polluters are both susceptible to the disapproval of residents who are affected by pollution (personal communication, R. Alvarez, 30 December, 1996; de Mello Lemos, 1997, p. 14), but large, clearly visible businesses probably receive more blame for environmental problems than do small ones, as was the case when a giant explosion in the sewer system of Guadalajara was initially blamed on a vegetable oil manufacturer (personal communication, R. Alvarez, 30 December, 1996). What the literature does not

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reveal about one automaker's assembly plant closing in Mexico City is that the neighbors pressured the government to force the plant to close (personal communication, E. Arretche, 3 December, 1997). The residents in the area of that plant, called Polanco (—, 1995c), are upper-class people, and the residents of the other, outdated, polluting plant are lower-class people (personal communication, E. Arretche, 3 December, 1997).

### **4. Financial institutions**

Several of Mexico's dirtiest industries are dirty reportedly because they are dominated by small businesses which lack the money to modernize (Alvarez, et al). The Commission for Environmental Cooperation reports that small- and medium-sized enterprises (SMEs) lack the resources and expertise to implement pollution prevention and think of pollution prevention as costly (CEC, 1996, p. 15).

In 1996, financial institutions of all sorts began environmental risk rating in order to bring financing in line with environmental practice (Ledgerwood, 1997, p. 23). In Mexico in April of this year, the Secretariat of the Environment, Natural Resources, and Fisheries (SEMARNAP), Managers/Owners Coordinating Council, and the directors of several major Mexican banks publicly signed an agreement to promote environmental investment (Lichaa, 1997, pp. 4, 5). The world insurance industry, except for the businesses in the United States, have signed an agreement to adopt best environmental management practices and to encourage their clients to do the same (Ledgerwood, 1997, p. 35).

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Large Mexican businesses have protected themselves from high debts by taking out loans from the government (Suárez Aguilar, 1994, pp. 62, 63 ), taking out dollar-denominated loans, and obtaining funds from the home office (—, 1995a). Sometimes, though, managers of subsidiaries in developing countries often have to go to great lengths in order to convince the managers at the home office that their investment proposals are worth the requested funds (Goodman, 1987, pp. 57, 108; Stopford, 1991, p. 137). The environmental manager at Chrysler said that the home office will provide funding for any necessary projects but turns skeptical when the subsidiary starts proposing projects beyond what it necessary (personal communication, E. Arretche, 3 December, 1997).

Lending institutions in Mexico may give preference to domestic firms, as did the World Bank and the State of São Paulo, Brazil, when that state embarked on an aggressive pollution prevention program (de Mello Lemos, 1997, p. 13).

Mexico has grants and other forms of financial assistance made available by non-governmental organizations, the Mexican government, and the World Bank for small businesses (CEC, 1996, p. 37). There are also organizations that provide pollution prevention training and advice for small businesses, some of which are offered free of charge, which are a cost alleviation to those who use them. Small businesses, though, think that pollution prevention is a very expensive undertaking and therefore tend to think no further than mere compliance (personal communication, G. Goya, 3 January, 1997).

## **5. Other businesses and their associations**

Industries experience “bandwagon” effects (Roberts, 1997) and sign formal agreements with third party organizations, each other, and governments. Whether ISO 14000 can assure that businesses will act in an environmentally responsible way is a subject of hot debate. The document, ISO 14001, is criticized for several reasons regarding its treatment of sharing of information from audits, applicability to foreign subsidiaries, and commitment to applying the best available environmental solutions (Benchmark Environmental Consulting, 1996, p. 1). Small firms that are on tight budgets may see formal association with a community to be an administrative burden that is not in their best interests, whereas large firms often have officers set aside specially to implement the goals of the community (Roberts, 1997). There are numerous other formal pacts that many companies have formed for the purpose of announcing their intent to be responsible caretakers of the natural environment in their business practices, such as the Responsible Care program in the chemical industry, the CERES principles, Future 500, and Global Environmental Management Initiative (GEMI).

The CERES principles are ten principles for good environmental performance and accountability to the public (Makower, 1994, p. 80). The CERES principles were first embraced by smaller companies, but now are subscribed to by many large corporations, including General Motors (Makower, 1994, p. 165). GM and several other corporations which present themselves as guardians of the environment are also members of an organization called the

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Global Climate Coalition (GCC), whose mission, according to their critics, is to eliminate pressure to develop public policy that discourages fossil fuel use (Ledgerwood, 1997, pp. 34, 35). The Canacintra conducts pollution prevention research for its members, and it has seen a large influx of membership since 1988, indicating that there is definitely a surge of interest in pollution prevention among industries since the enactment of the General Ecology Law in 1988, when the General Ecology Law went into effect (personal communication, G. Goya, 3 January, 1997).

### **6. Ethics**

“There are good companies that are concerned about the environment and some companies are listening to us. There are others, unfortunately, that don’t seem to care.”

— Oscar Moctezuma, Naturalia (McAllen, 1996)

When asked why his business is conscientious not to pollute, the assessor at FAISA gestured to the pictures of his children on the shelf behind himself.

Some managers or corporate owners make right decisions simply because it is the right thing to do. These managers may or may not be convinced that their decision will be the best one for business. But the problem remains, according to one source, that the weight of the world economy is against good environmental stewardship (Greer, 1996, pp. 37, 38).

### **7. Organizational structure**

The key concept to differentiate between the types of firms we are

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considering is efficiency. The concept of efficiency can be viewed in three categories: operating efficiency, innovation efficiency, and social efficiency. Innovation efficiency is central to pollution prevention in different types of businesses because it has to do with finding better ways of reducing waste. Social efficiency, with respect to pollution, refers to the social costs of pollution, and operating efficiency as it affects pollution prevention pertains to the question whether the firm is wasting as little as possible of waste materials that leave the plant and must be disposed of. With respect to pollution prevention in manufacturing, innovative efficiency brings about operating efficiency. (Adams, 1986, p. 29)

Operating efficiency usually dictates a large *plant* size (Adams, 1986, p. 30). Modern technology is also associated with operating efficiency. It is usually presumed that labor-intensive processes are less pollution-intensive than capital-intensive processes. But, at the same time, modern technology, which is very capital-intensive, is credited with low pollution in modernized industries (Alvarez, et al, 1995, pp. 41-45, 50, 51).

The existence of inexpensive measures that can drastically reduce waste and pay for themselves quickly (Kindschy, 1991, p. 4; TNRCC, 1996, pp. 5-11; CMPL, 1997, pp. 8, 12, 17, 21, 24) raises the question, can small or large firms implement these measures more readily than the other? TNCs have kept their foreign operations running in times of negative profits simply because the sunk costs that would be lost if they closed those operations justified staying in

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business (Stopford, 1991, p. 75), which Adams and Brock would point out as an example of inflexibility. GM de México shifted its production to exports in 1995, when the Mexican automobile consumption fell by forty percent, saying they would send vehicles to “wherever we can find customers” (—, 1995c). If there was actually unmet demand in the countries to which those vehicles were sent, then the action was using flexibility to fill a void, but otherwise, those cars were probably used to over-fill inventories. General Motors announced that it would take three years longer than the government allowed it to complete the closure of its Mexico City plant (Darling, 1992) — hardly a display of flexibility.

TNC home offices intervene in decision-making more often in matters of finance and marketing and less often in matters of equipment (Goodman, 1987, p. 107). For this reason, TNCs can be expected to have freedom to act as they please as long as they can obtain the needed funding, which is the more difficult part. Home office managers place a high priority on minimizing the expenditure of their time in affairs of subsidiaries that they see as marginal to their core mission or their revenues (Goodman, 1987, pp. 113, 114). There is a wide range of degrees of freedom that subsidiaries enjoy (Stopford, 1991, p. 139). The Dana Corporation, for example, has been recognized for keeping very loose reins on its subsidiaries (—, 1995, “Dana Corp. ...”), which may be a reason for Tremec’s continued success in pollution prevention implementation

It has been documented that foreign manufacturing firms depend more heavily on outside sources of technology than do domestic firms (Fairchild and

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Sosin, 1986) and that multinationals in Mexico are less technically efficient than the domestic firms (Sterner, 1990), seeming to indicate that the outside sources of technology, presumably the home offices, are not providing the more excellent technology. This may be happening because TNCs are supplying their foreign subsidiaries with old, used equipment, which has been documented (National Trade Bank, 1996, "METALWORKING ...").

### **IV. Conclusions**

This research does not conclusively answer the question of what types of businesses pollute more intensively than others in Mexico. That will require more research and more freely available information in Mexico. The following conclusions are drawn regarding the environmental performance of manufacturing businesses in Mexico:

1. The Mexican government should continue to offer and publicize technical and financial assistance to micro-, small-, and medium-sized businesses. It is clear from the case studies conducted by EP3, the TNRCC, and the CPML that pollution prevention is in the best financial interest of many small businesses, and, considering the small business mindset that pollution prevention is too expensive, and the lack of personnel dedicated to environmental issues, the government needs to spread this message by offering the initial incentive that will convince small businesses to make such investments.
2. A subsidiary's ability to implement clean production is largely a function of



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the subsidiary management style of its parent corporation. While the environmental performance of a subsidiary cannot be determined by just one factor, it is clear that a subsidiary that is free to innovate as it sees fit will be a better environmental performer than one whose parent company prevents it from trying new ideas.

This research reveals the need for the follow topics to be studied in greater depth in order more fully to understand the forces at work in determining the environmental performance of a business:

1. the effectiveness of funds and technical assistance for pollution prevention in micro-, medium-, and small-sized businesses;
2. the power wielded by industrial associations in influencing policy; and
3. the effectiveness of ISO 14000 and other formal environmental agreements in encouraging pollution prevention.

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