

Development-Environment Interactions in the Export of Hazardous Technologies

A Comparative Study of Three Multinational Affiliates in Developing Countries

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ABSTRACT

We reconstruct case histories of siting hazardous manufacturing facilities in India and Thailand by three multinational corporations: Du Pont, Occidental Chemical, and Xerox. The analysis focuses on the interactions of the host country development agenda, corporate culture, and the nature of business arrangements between parent and joint venture partner to explain decisions and tradeoffs during the siting process. The cases provide the foundation for a four-stage model of key determinants of management and regulatory actions in four phases of the facility life cycle. Six themes emerge: parent company preservation of environmental and occupational health management responsibilities; forces leading to responsible corporate behavior; downstream consequences of upstream decisions; key determinants of corporate performance; "functional equivalency" in practice; and hidden tradeoffs over the life cycle of the facility. Our findings are interpreted in the context of emerging concepts of corporate environmentalism and sustainable development.

Introduction

US-based multinational corporations (MNCs) are prominent agents of technology transfer to developing countries. Such transfers assume many forms: patents, licenses, technical information, education programs, distribution of products, as well as direct investments in manufacturing facilities [1-3]. Among these various forms, manufacturing facilities have been among the most dominant [4]. Estimated at \$16 billion per year from

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1980 to 1989, foreign direct investment activities of US-MNCs averaged 21% of total worldwide figures. Moreover, the \$345 billion in total assets under their control account for 35% of the worldwide foreign direct investment stock [5].

Location of affiliates in developing countries provides numerous payoffs to MNCs that are essential to remaining competitive in an increasingly global economy: access to local business knowledge and entrepreneurs; reduced production costs through utilization of lower-cost labor and raw materials; and establishment of a corporate presence in key current and future markets. Operating in developing countries, however, also has its drawbacks: high investment risks; inadequate infrastructure; erratic, unpredictable business and regulatory climates; and—for those committed to doing so—impediments to achieving environmental and occupational standards equal to their home country facilities.

From the host country perspective, the picture is equally mixed, and MNCs signify both opportunities and sacrifice. On the opportunity side is the infusion of equity capital; increased domestic production capacity; technology learning through the exposure to advanced hardware and management systems; infrastructure development; and employment creation. These opportunities come at a price: potential domination of local markets by foreign firms; implantation without real learning or adaptation of advanced technologies; outside interference with political and economic policies; and potential adverse effects on human health and the environment. Thus, the challenge to both MNC and developing host country is to implement policies and procedures that enhance the positive and attenuate the negative effects of MNC operations as a project moves from negotiations and construction into start-up and sustained operations.

In this paper, we report on three case studies of the facility siting process by socially responsible MNCs, focusing on the interactions among the key participants in the process. These are stories of success, departing from the more familiar domain of industrial management failures and accidents. Instead, the cases we examine are firms that claim to be socially responsible and ventures that are profitable and, to date, environmentally sound. Our central premise is that both the host country and the MNC share two sets of values: those related to protection of environment, human health, and safety (EH&S),¹ and those related to host country development or company business development. In the process of establishing overseas facilities, these two sets of values are manifested in host country and corporate goals, policies, and practices. For example, the pursuit of equitable regional development by the host country may lead to development of explicit locational policies, while the pursuit of technological advancement may lead to limitations on foreign ownership. Analogously, the MNC's pursuit of safety facilities may give rise to a strong preference for sole rather than joint ownership of an overseas enterprise.

We further assume that in the course of the facility development, the two sets of values—development and business on the one hand, and environment on the other—may compete or conflict both within and across each set. For example, increased automation, designed to promote safety, may be incompatible with labor-intensive practices designed to promote local employment; location in a densely populated area, designed to improve access by large number of potential workers, may be incompatible with promotion of safety; location in a poorly developed region, mandated by the host country to increase employment and prosperity, may aggravate poor access to the facility and impede response to emergencies; reliance on trained foreign experts, designed to increase safety, may be incompatible with the desire for local control; application of the US exposure standards

¹ Hereafter referred to as "environmental values," "environmental goals," or EH&S.

to dangerous substances, designed to promote safety and equity, may be inconsistent with the standards of safety in the host country and thus be incompatible with host country notions of self-determination.

To explore these value conflicts and tradeoffs, we examine the chronologies of three facilities, one in India and two in Thailand, developed during the 1980s by three US MNCs. We conduct the analysis from the perspective of the key participants: the host countries, the corporations, and, to a limited degree and where applicable, the joint venture partners. Through a detailed examination of the process over time, we explore the *nature of interactions* among the policies of these participants to further their development and EH&S goals, and the *effect of these interactions* on environmental management at the facilities.

The study had two primary objectives: (a) to describe the manner and the extent to which environmental considerations are incorporated into and influence certain outcomes associated with facility siting, and (b) to identify, on an exploratory basis, the variables—and their interactions—that may account for the management and practice of EH&S at the MNC facilities in developing countries. Thus, the distinguishing features of this study include a focus on MNCs with an overt and public commitment to EH&S responsibility; the assumption that all key participants desire environmentally sensitive growth, but must reconcile anticipated and unanticipated conflicts as they arise; and, finally, an assessment of how such reconciliation occurs in the real world of MNC business ventures in developing countries.

Research Context

The extensive literature on the environmental, health, and safety aspects of MNC facilities in developing countries falls into three general categories. The first category includes studies conducted primarily from the corporate perspective. These include analyses of corporate environmental policies and management systems in their international facilities [6], importance of environmental factors in MNC investment decisions [7], organizational behavior of MNCs in the context of various host country regulatory climates [8–10], and implementation of international safety and health guidelines at foreign MNC facilities [11, 12]. A few studies [13] cut across all these themes.

The studies falling into the second category are those conducted primarily from the host country's perspective. Here, the focus has been on the evolution of regulations and policies relative to environment and industrial safety, both in general and in relation to MNC facilities. The work of Bowonder and Arvind [14], Jasanoff [15], Nair [16], Leonard and Morrell [17], Morrell and Poznanski [18], Pimenta [19], Ramakrishna [20], UNCTC [21], Ural [22], and White [23] exemplify this line of inquiry.

The studies in the third category, one that is also the most closely aligned with the subject of our study, explore the dynamics of MNC behavior in relation to developing country regulations. Four general lines of inquiry may be distinguished: (a) the question of “pollution havens,” the flight of hazardous industrial enterprises from industrial to developing countries to avoid more stringent regulations [7, 9, 10, 24–31]; (b) analysis of large-scale technological failures of MNC affiliates in the developing world [18, 32–42]; (c) comparative analysis of EH&S performance of MNC affiliates in industrial vs. developing countries [7, 11, 43, 44]; and (d) comparative analysis of performance of domestically owned vs. MNC-owned facilities in developing countries [16, 19, 43, 45]. To varying degrees, the United Nations had addressed all these issues in a series of recent case studies of MNCs and environmental management in Asia [46, 47].

Collectively, these studies reveal a wide spectrum of MNC approaches to implementing environmental programs in developing countries. Cases of corporate misconduct and "double standards" continue to be documented, though the prominence of the "pollution haven" hypothesis recently declined as a dominant theme in corporate behavior in the developing world. In its place has emerged an alternative perspective that views environmental performance of MNC affiliates as driven principally by the age of the facility than by their developing country location *per se*. In fact, performance at affiliates in many instances exceeds that of domestic enterprises producing the same product line [46-48].

Despite the abundance of inquiries into MNC behavior in the developing world, few explanations are available as to why and how some facilities outperform others, and what changes may be needed to achieve significant improvements in facility performance. In part, this is attributable to a focus on either the earliest (venture conception) and latest (measurement of actual facility performance) stages of a facility life cycle without due consideration to the complexities and interactions during the intermediate stages. Thus, we see an emphasis on corporate expansion strategies and host country policy making prior to negotiation between these two parties and, at the other end of the continuum, retrospective assessments of facility performance within a normal operating context or in times of acute events. Furthermore, one perspective, either the host country's [16] or the corporation's [6], usually dominates the study design. With few exceptions [28, 49-51], little documentation exists of how MNC and host country policies jointly shape actual decisions during negotiations, design, construction, and start-up of a project.

In summary, environmental dimensions of MNC activities in developing countries have been treated as something of a black box. The corporate and host country policies are the inputs into that box, and facility performance are the outcomes. The rich interior, which contains most of the explanations of how policies are transformed into performance, is poorly understood. The present study attempts to close that gap.

Conceptualizing the Facility Siting Process

In its prototype form, establishing overseas affiliates starts with a contact between the MNC and the government of the host country and ends with an on-line facility. The key participants in these events are the host country government, the MNC, and, where applicable, the joint venture partner. Several second-tier participants, such as nongovernmental organizations, trade organizations, trade unions, and lending institutions, also may influence the facility transfer process, but with few exceptions [28] that influence is comparatively minor.

This siting process may be conceptualized as a four-stage chronology of events: negotiations, construction, start-up, and sustained operations (Figure 1). Although the specific events at each stage are unique to each case, certain generic decisions may be expected at each stage.

To begin, *negotiations* occur, the process of initial interactions among corporate representatives, host country officials, and, where applicable, joint venture partners. In cases of joint ventures, two sets of interactions—those between the host country and the corporation (represented by one or all of the venture partners)² and those between the venture partner(s)—proceed in parallel. The arrow leading into the first stage of the model

² In many cases the joint venture is incorporated before an official application for industrial license is submitted to the host country authorities, as was the case with the Indian facility we later discuss. Therefore, the negotiations may include the representatives of both parent corporations as well as those of the new corporate entity.

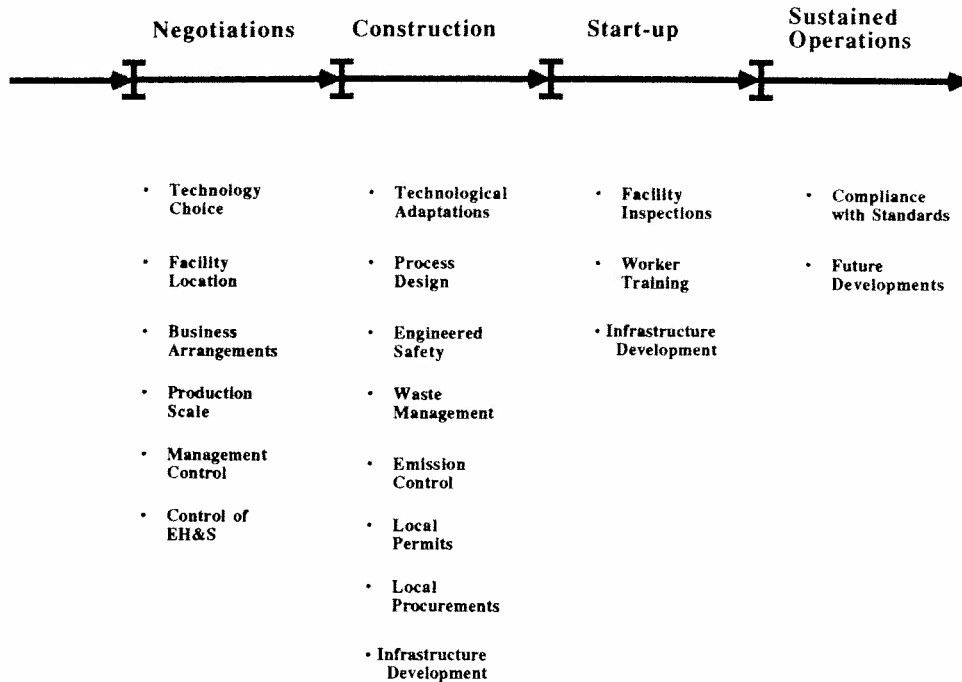


Fig. 1. Stages of facility siting process.

is a reminder that the interactions between the host country and the multinational often resume long before the onset of formal facility negotiations.

Whereas the specific product of the negotiation stage will vary among countries and situations (industrial license, letter of intent, preliminary agreement, or otherwise binding legal document), conceptually its major outcome is one or more explicit working agreements. Such agreements typically specify location, technology and scale of facility, protection of technology, and business arrangements, such as equity participation, management structure, tax rates, and profit remittance. The form of negotiations may range from lengthy, direct interactions among the key participants to routine administrative processes. Their conclusion marks the onset of facility construction.

The *construction* stage includes the design and actual construction (or major modification) of the facility and the associated infrastructure, including engineered safety and pollution controls. Other regulatory activities that precede the start-up also take place during this stage, such as issuance of environmental and occupational permits other than those linked to the industrial license, import of equipment, local procurement, or negotiations between partners over various capital investments.

For the purpose of the study, the *start-up* stage is defined as the period during which the facility achieves full, or close to full, design capacity. During that stage the MNC's policies for promoting safety and a sound environmental and occupational facility as well as its approach to "exporting" safety philosophy may become particularly visible through the process of hiring and training the management and workers and through its interactions with the joint venture partner in the day-to-day operations of the facility.

The transition between this setup and the next stage is fluid, but not until *sustained*

TABLE 1
Case Studies

| | Du Pont Agrichemicals (Bangpoo, Thailand, facility) | Occidental Chemical (Bangpoo, Thailand, facility) | Modi Xerox (Rampur, India, facility) |
|-----------------------|--|--|--|
| Year of establishment | 1982 | 1984 ^a | 1986 |
| Principal products | Herbicides Fungicides Insecticides | Chrome compounds for leather tanning | Photocopiers Electronic boards Photoreceptors Developers and toners |
| Marketing | Domestic • Thai farmers | Domestic • Thai leather industry | Domestic and international (>30%) |
| No. of employees | 25 | 42 | 272 ^b |
| Operating schedule | 1 Shift 7 Hours/day 6 Days/week | 3 Shifts 24 Hours/day 7 Days/week | 1 Shift 9 Hours/day 5 Days/week |
| Ownership | Wholly owned | Joint venture | Joint venture |

^a Originally established by Thai-Pakistani interests; restarted in 1986 by Diamond Shamrock and then continued by Oxychem following 1986 acquisition.

^b Of these, 96 are former landowners who are employed primarily as groundskeepers.

operations are the effects of the first three stages on environmental management practices and performance fully visible. It is at this juncture that earlier negotiations, construction, and start-up merge into the real world of plant operations, with outcomes subject to a mix of management and labor relations as well as regulatory oversight from outside the firm. The scope of our study is primarily confined to the first two stages of siting, with only passing reference as necessary to start-up and sustained operations.

Methods and Data Base

The strength of the case study is the ability to explore in depth the anatomy of the facility transfer process, the roles of participants, and the entry points of environmental concerns [52]. Its limitations include the narrow and possibly idiosyncratic data base, which severely limits our ability to generalize our findings. Therefore, we view the study as *hypothesis generating* rather than hypothesis testing.

Of approximately 50 major multinationals that were approached, whose product lines ranged from batteries to food processing, three US corporations agreed to participate in the study: Du Pont, Xerox, and Occidental Chemical (Oxychem). Du Pont offered for study a wholly owned agrichemical formulating and repackaging plant constructed in Thailand by the company's Agricultural Products Department during 1982 and located in Bangpoo Industrial Estate, 20 miles southwest of Bangkok. Occidental Chemical (subsidiary of Occidental Petroleum) offered for study a jointly owned chromium compounds manufacturing plant that was constructed in Thailand in the same industrial estate as the Du Pont facility. This facility had originally been constructed and operated by a Pakistani company during the early 1980s, was subsequently acquired and operated as a joint venture of another US company and a Thai industrialist, and was finally acquired by Occidental Chemical in 1986 while maintaining the same joint venture partner. In the late 1980s the facility underwent substantial reconstruction which doubled its capacity. Xerox offered for study a jointly owned xerography plant built in 1988 in Rampur, India, located in a rural area approximately 120 miles east of Delhi. Key characteristics of each plant are summarized in Table 1. All are less than decade old, modest in size, and use or manufacture hazardous chemicals. In addition, all are successful business ventures.

TABLE 2
Vital Statistics of the Corporations

| | Du Pont | Occidental Chemical (Subsidiary of Occidental Petroleum) | Xerox (Parent co. to Rank Xerox and Modi Xerox) |
|--|--|--|---|
| Year of establishment | 1802 | 1968 ^a | 1906 |
| Unit under study | Division of agrichemical products department | Company | Company |
| Principal product | | | |
| • Company studied | Agrichemicals, coal, fibers, construction, electronics, health care, petroleum | Industrial chemicals | Photocopiers, electronics |
| • Division studied | Agrichemicals | — | — |
| • Plant studied | Crop protection chemicals | Leather tanning chemicals | Photocopying machines and chemicals |
| Number of corporate employees worldwide (1990) | 144,000 | 12000 | 111,000 |
| Total corporate revenues (1990) | \$40,000,000 (44% foreign) | \$2,800,000 ^c (?% foreign) ^d | \$19,200,00 (42% foreign) |
| No. of plants (1989) | | | |
| • U.S. | 5 ^b | 42 | 9 |
| • Other industrial countries | 3 ^b | 1 | 7 |
| • Nonindustrial countries | 8 ^b | 14 | 8 |
| Mode of facility growth during past 15 years | 30% acquired ^b (20% of manufacturing capacity) | Primarily via acquisitions | None have been acquired |

^a Previously Hooker Chemical Corporation.

^b Only for agricultural products.

^c Assuming that Occidental has 15% of \$20 billion parent company assets.

^d Foreign sales of parent company are approximately 8% of total sales.

The three cases have been primarily reconstructed through interviews, site visits, and analysis of key documents such as industrial licenses, joint venture agreements, technical agreements, letters of intent, internal memoranda and policy statements, and quantitative performance indicators. The corporations themselves were the richest data source. In the United States and overseas, we conducted interviews with company managers and executives who had personally participated in key stages of the implementation process. During the site visits at the facilities, we also talked with employees, though these discussions were dominated by management with virtually no input from workers.

Discussions with host country officials possessing either firsthand or indirect knowledge of the three cases were modest. Only in the Indian case were we able to interview a high-level official who had participated in reviewing the company's application for a license. Furthermore, in Thailand, both facilities were developed through routine administrative procedures, without extensive involvement by any one individual government employee. Finally, in the absence of access to the two joint venture partners involved, their perspective has been reconstructed primarily from written documents and the accounts of the US partners.

Corporate Profiles

The vital statistics for Du Pont, Occidental Chemical, and Xerox are shown in Table 2. These are large corporations with multiple overseas facilities, although Occidental Chemical is significantly smaller than the other two. Du Pont, founded in 1802, is one

TABLE 3
Percent Ownership and Origins at Foreign Manufacturing Affiliates of the Companies Studied

| | Percent ownership of foreign affiliates by facility | | | | | |
|--------------------------|---|------------------------|---------------------|----------------------------|--------------------|--|
| | Du Pont Agrichemicals | | Occidental Chemical | | Xerox ^c | |
| Thailand ^b | 100 | Thailand ^c | 49 | Rampur, India ^b | 40 | |
| Mexico ^b | 100 | Thailand ^c | 49 | Bombay, India ^b | 40 | |
| Mexico ^b | 100 | Singapore ^b | 50 | Brazil ^b | 100 | |
| Colombia ^b | 100 | Chile ^c | 100 | Brazil ^b | 100 | |
| Brazil ^b | 100 | Brazil ^c | 50 | Brazil ^b | 100 | |
| Puerto Rico ^b | 100 | Brazil ^c | 50 | Mexico ^b | 100 | |
| Taiwan ^b | 100 | Brazil ^c | 50 | Egypt ^b | 49.99 | |
| Philippines ^b | 100 | Brazil ^c | 100 | China ^b | 100 | |
| Argentina ^b | 45 | Brazil ^c | 100 | Canada ^b | 100 | |
| China ^b | 80 | Brazil ^c | 100 | Canada ^b | 100 | |
| Australia ^b | 100 | Brazil ^c | 100 | UK ^b | 100 | |
| France ^c | 100 | Mexico ^b | 49 | UK ^b | 100 | |
| Italy ^c | 100 | Mexico ^c | 49 | France ^b | <100 | |
| | | Mexico ^c | 49 | Netherlands ^b | 100 | |
| | | Mexico ^c | 49 | Spain ^b | 100 | |
| | | Belgium ^b | 100 | | | |
| Percent wholly owned | 85 | | 38 | | 73 | |
| Percent built | 85 | | 20 | | 100 | |
| Percent acquired | 15 | | 80 | | 0 | |

^a Includes only Xerox AMERICAS and Rank Xerox operations.

^b Built by the company.

^c Acquired by the company (complete or partial equity acquisitions are combined).

of the oldest chemical companies in the United States, with a long tradition of stability and organizational coherence. Its steady growth has been achieved primarily through internal expansion, although the company has made important acquisitions during the past two decades.

Occidental Chemical and Xerox are relatively young companies with histories of rapid growth. The growth of the Xerox photocopier business, which uses a strictly proprietary process, has occurred through expansion, whereas the growth of Occidental Chemical has been primarily through acquisitions. Oxychem's growth strategy suggests that the company may have had less opportunity to develop a distinct corporate identity than the other two. It also suggests that Oxychem is repeatedly confronted with a task of transferring its safety practices to workers and managers inherited through its acquisitions. Furthermore, unlike Xerox and Du Pont, Oxychem must be prepared to assess and, if necessary, correct the environmental offenses created by previous owners.

The three MNCs manufacture chemicals with hazardous properties, although the main product lines and the populations at risk differ considerably. Chemicals manufactured by Du Pont Agrichemicals and Xerox are used by individual small consumers, whereas Occidental produces chemicals exclusively for industrial consumption. Thus, at Du Pont and Xerox hazardous exposures to workers and consumers are of concern, whereas at Oxychem worker exposure is the dominant hazard. At all facilities, hazards in the form of transport accidents and discharges to air, water, and land are present. The companies also differ in the prevailing ownership arrangements at their foreign affiliates (Table 3). Oxychem enters into joint venture partnerships more often than Xerox and Du Pont Agrichemicals. Partly, this can be attributed to the highly proprietary technologies of the latter two, but corporate traditions and reluctance to dilute management control also create a disinclination to joint ventures.

Once an MNC decides to enter into a joint venture arrangement, sharing of management responsibilities and adoption of health and safety policies are among the key determinants of EH&S performance at the facility. All three corporations strongly emphasize maintaining control over the daily management of foreign operations, including personnel, training, and financial decisions, and on the adoption of their internal EH&S policies and standards.

The three corporations have extensive internal structures and well-articulated philosophies for dealing with EH&S. However, underlying these apparent similarities are very different histories. Du Pont's concern with safety has its origins in the early 19th century, when gunpowder was its first and only product. Since then, the corporation developed a highly sophisticated safety culture and is now widely recognized as one of the world leaders in that area. Occupational and product safety and, much more recently, responsible environmental management are key ingredients to Du Pont's self-image, both within the industrial community and before the public at large. Safety culture permeates all facets of the company. Commitment to safety is a prerequisite for professional success from the entry-level staff to the top corporate management, as well as a source of pride and professional identity among its employees. The employees are conditioned to a safety culture over the course of several years, and those who do not ultimately embrace it do not survive within the corporation.

The Du Pont safety philosophy is built on the premise that safety can be achieved under all circumstances through a right mix of technology, human behavior, and financial resources. Changes in circumstances may require adjustments of these variables, but such adjustments do not affect the fundamental assumption that the company is capable of determining the safety performance of its facilities and its products through effective "stewardship" measures. Du Pont believes it commands the necessary tools for achieving safety through engineering and intelligent management regardless of where its facilities happen to be located. This premise implies a belief that there are no inherently safe or unsafe technologies, only those where achieving safety is economically or practically feasible or infeasible. Given this deep confidence in technological solutions, the power of tradition, and ability to shape human behavior through persistent and long-term conditioning, the company has a strong reference for wholly owned foreign affiliates, especially those where the hazards are substantial. Du Pont's overseas facilities are, to the extent it is practical, replicas of the equivalent facilities in the United States in both design and management style.

In comparison with Du Pont, Occidental Chemical and Xerox were relatively late embracing the concept of high-level corporate involvement in environment, health, and safety. Both were shaken in the late 1970s by specific incidents that became turning points in corporate policy. For Occidental, the impetus for change was largely provided by inheritance (through acquisition) of Love Canal, the discovery of which galvanized American public opinion around chemical hazards. For Xerox, it was the discovery that one of the toners used in its photocopiers tested positively in a bacterial mutation test, a problem that was promptly corrected. Since the early 1980s, both companies have developed strong safety and environmental policies and procedures. Their occupational injury rates are significantly lower than the US average, especially for Oxychem, which is rapidly approaching the enviable Du Pont performance level (Figure 2).

The key principles for managing the overseas facilities of the three corporations are that the same safety and environmental standards are applied worldwide, and that of maintaining "functional equivalency" with the domestic plants. As defined by Friedman [53], the equivalence means maintaining the same level of protection of human health and

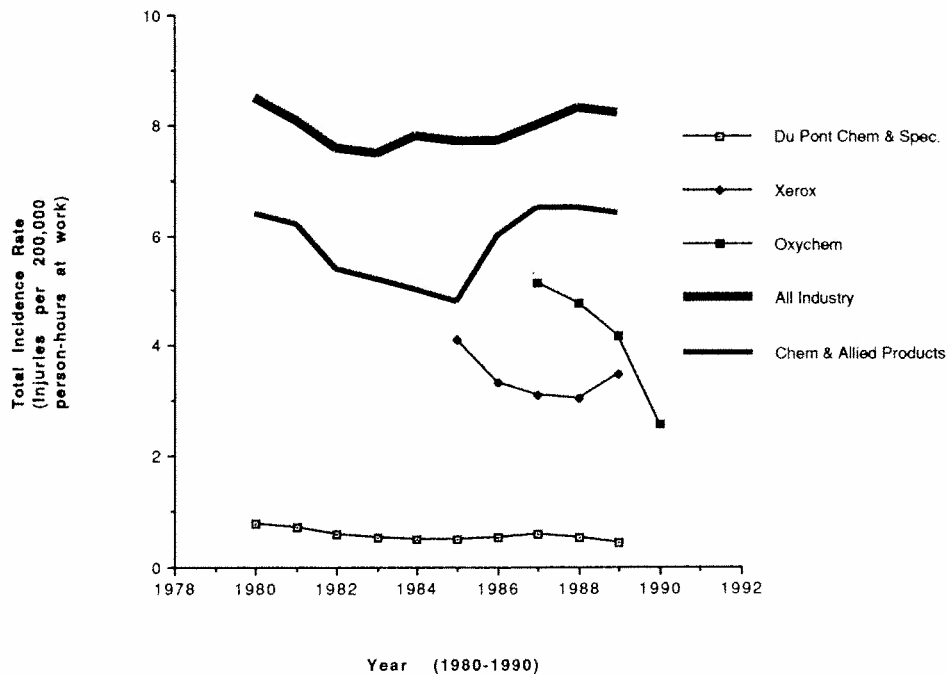


Fig. 2. Total occupational injury incidence rates for Xerox, Du Pont, and Oxychem.

environment across all facilities, regardless of location, while allowing for site-specific methods for achieving such levels. For example, different technologies may be employed among facilities to achieve compliance with a uniform worldwide occupational standard. Or a company may replace a best available technology method, legally mandated in the United States, with an environmental standard in order to protect the natural resources from effects of pollutants.

So defined, functional equivalency is distinct from replication of an equivalent facility elsewhere, both in terms of hardware and management. Based on interviews with the officers and managers of the three corporations, three arguments in favor of functional equivalency emerge: (a) flexibility is necessary and desirable in adapting imported manufacturing technology to local conditions, and may actually improve ultimate performance of the facility; (b) certain parent country requirements based on social or legal motives not directly related to performance may not merit replication; and (c) facility design, engineering, and management practices in the United States embody US-style management, labor, and regulatory conditions which do not necessarily yield maximum performance in a developing country context. In short, functional equivalency in principle allows flexibility in means while preserving ends. At the same time, flexibility may be accompanied by corporate actions that result in circumvention of the principle through substandard investment, operating, and maintenance practices. The flexibility of Oxychem and Xerox in interpreting this principle, in comparison to Du Pont's more rigid approach to replicating its home country EH&S systems, is a theme that runs throughout much of the following analysis.

Host Country Profiles

In many ways, India and Thailand represent the extremes of the spectrum that Kirkpatrick et al. [54] calibrated with "interventionist" and "noninterventionist" models

of development, ranging from far-reaching host country involvement in all aspects of MNC activities, and harsh conditions, to an "investor-friendly," open business climate.

The development philosophy in India has been a simultaneous pursuit of multiple economic, social, and technological objectives. The concepts of self-reliance, equitable growth, prevention of concentration of economic power, and social justice permeate the Indian policy statements and national development plans. Whereas at the conceptual level the government has recognized the need to import foreign technology, India's past four decades of national development reveals an ambiguity toward foreign enterprises and a strong preference for fostering industrialization through the efforts of its own people.

India interprets self-reliance to mean technological independence, promotion of indigenous industries, and, where necessary, import, absorption, and adaptation of foreign technology [55]. Accordingly, multinational direct investors are required, through a phased manufacturing program (PMP), to install highly integrated technologies, as opposed to simple assembly of imported components, and through an indigenization program to rely primarily on locally manufactured parts and materials.

The Indian government has also emphasized the need for balanced regional development through the dispersion of industries. Since its inception in 1951, the industrial licensing process, implemented by the Ministry of Industrial Development, has served as the major instrument for steering investors to the less developed geographical areas, classified as C and D, in preference to the industrialized A and B locations.

India's development philosophy is conducive to active and far-reaching governmental involvement in industrial development, and has given rise to a proliferation of policies and public institutions empowered to implement these policies [16, 56]. The Industrial (Development and Regulation) Act of 1951 gives the central government broad authority to implement several key policies related to planned and carefully controlled industrialization, such as the promotion of certain industries, their location, public ownership, or export promotion. In relation to MNC facilities, this authority translates into close scrutiny and extensive restrictions on the business and technical decisions of prospective investors. All proposals for foreign facilities are carefully screened by several layers of central authorities to determine their necessity to the economy and how the proposal may contribute to indigenous technological and social development. Preference is given to "technical collaborations" (sale or licensing of technology) over equity collaborations (joint ventures), and substantial foreign ownership is highly restricted. Furthermore, production ceilings may also be imposed to prevent monopolistic control of the domestic market. In summary, close government scrutiny, multiple policies, numerous restrictions, and a slow approval schedule characterize the Indian business climate. This active government involvement also extends to the EH&S arena, where central and state authorities influence the multinationals' activities through a two-tiered federal (policy and standard setting) and state (permitting and enforcement) organizational structure.

In contrast to India, Thailand has proceeded along a laissez-faire development path, positioning government institutions as facilitators of foreign investment through various incentive programs. Questions of national identity, self-reliance, indigenization, and protection of domestic markets have, for the most part, played little role in shaping Thailand's relationship with multinationals. Instead, economic growth itself is viewed as the engine of social change which in the long run is the surest way of achieving self-reliance, international recognition, and, ultimately, social equity. The government's self-proclaimed role since the 1960s has been as a provider of infrastructure and coordinator of incentive programs for multinationals seeking to establish facilities. The Industrial Estate Authority

of Thailand (IEAT), which manages the industrial estates where most multinational facilities locate, and the Board of Investment (BOI), which administers various economic incentives, are among Thailand's most visible institutions in implementing this development strategy. Both institutions approach their missions in partnerships with multinationals, under the presumption that national interests will be best served by flexibility and accommodation in siting a new facility. For example, in addition to managing the estates, IEAT serves as an advocate for the multinationals by helping them obtain necessary permits and licenses from the appropriate Thai authorities. This stands in contrast to India, where negotiations of the terms and conditions for multinational facilities are conducted by and large in an adversarial mode with compromises reflecting minimum acceptable outcomes rather than jointly agreed-upon optimization.

Established in 1960 as the first such institution in Southeast Asia, BOI's mission is to guide the country's development through participation in formulating the five-year development plans; to formulate an investment promotion program, including selective encouragement of certain economic sectors; to promote actively, though selectively, foreign investment by helping investors identify investment opportunities, overcome operational problems, and obtain governmental clearances. Despite the lack of authority to issue licenses or attach conditions to such licenses, which lies with the Ministry of Industry, BOI enjoys high status because of its direct link with the Cabinet (with the National Economic and Social Development Board, it is one of the two offices within the Office of the Prime Minister) and because of its role in allocating substantial investment incentives.

Similarly to India, the central government in Thailand has actively influenced the location of MNC facilities; however, that involvement has significantly different philosophical roots. Whereas in India reducing regional inequities has been the primary goal, the objectives of the Thai locational policies have been to facilitate foreign investment by provision of infrastructure, and to relieve urban congestion in Bangkok. Accordingly, while India enforces locational restrictions without major regard for the adequacy of infrastructure and other effects of business, the Thai government has invested in a network of well-serviced industrial estates located in regions relatively attractive to prospective investors.

Thailand's National Environmental Board (NEB), an advisory and planning body whose ability to influence multinationals at the licensing stage occurs only indirectly, through other members of the Cabinet, stands in contrast to the high status of the BOI and to the autonomous state Pollution Control Boards in India [57, 58]. Once a facility is licensed in Thailand, NEB's role is further diminished since the enforcement of environmental and occupational standards is largely assumed by IEAT, an entity which first and foremost is oriented toward an economic development mission. In short, once permitted to enter Thailand, the multinational itself is the dominant force in most, if not all, key decisions: location, sophistication of technology, size and design of technology, safety systems, and environmental management.

The Negotiation Stage

Against this backdrop of distinctive development philosophies and administrative systems (summarized in Table 4), Du Pont and Occidental Chemical initiated business ventures in Thailand, and Xerox in India, in the early and mid-1980s. From first negotiations, into design and construction, and proceeding to start-up, corporate and host country philosophies interacted to shape key locational, scale, design, and environmental and safety features of the facilities. In each case, the structure, form, and agendas for the negotiations between the host country and the corporation were significantly influenced

TABLE 4
Characteristics of the Host Countries Relevant to the Siting of Manufacturing Facilities by Multinationals

| Characteristics | Thailand | India |
|--|--|--|
| Development philosophy | Economic growth as the means to prosperity and social change | Simultaneous social and economic change |
| Policies toward location of facilities by MNCs | | |
| • Key expected benefits to the country | Economic growth, export earnings | Technologic self-sufficiency, satisfying domestic demand |
| • Main purpose of government intervention | To facilitate | To regulate |
| • Extent of government intervention | Low initially, minimal after licensing | High initially, continuous throughout facility life |
| • Instruments of government intervention | Operating license, incentives | Operating license, permits, quotas |
| • Objectives of locational policy | Relieve urban congestion, provide infrastructure | Promotion of regional development |
| Issues in negotiating MNC facilities | | |
| • Direct negotiations | Minimal | Intense |
| • Duration of licensing | Months | Approximately 2 years |
| • Location | Industrial estates are encouraged | "Backward" areas are encouraged |
| • Infrastructure | Provided by government | Companies are on their own |
| • Joint ventures | Required in some cases; otherwise encouraged | Required; exceptions exist |
| • Minimum employment quotas | Not an issue | Not an issue |
| • Sophistication of technology | Encouraged through incentives | Required; phased manufacturing plan |
| • Domestic production quotas | Not an issue | Imposed if monopoly possible |
| Environmental/occupational protection | | |
| • Laws | In place | In place |
| • Role of central authority | Prominent | Prominent |
| • Role of regional/local authority | Minimal | Prominent |
| • Agency with regulatory authority | Ministry of Industry; Industrial Estate Authority | State Pollution Control Boards |
| • Power of environmental agency | National Environmental Board | Ministry of Environment and Forest |
| | • Advisory | • Advisors |
| | • Coordinating | State Pollution Control Boards |
| | | • Regulators and enforcers |
| • Instruments of environmental and occupational regulation of facilities | Industrial license | Environmental emission and discharge permits |

by the host countries' development philosophies. The marked differences between Indian and Thai policies relative to development and MNC facilities are especially evident during this initial stage.

Negotiations between the Indian government and Xerox involved approximately two years of intense interactions between the parties. In accordance with its policies toward MNCs, the Indian government directly specified the location of the proposed facility in a "backward" area of the country, classified as C (on a scale of A to D, with D equated to remote regions and minimal infrastructure), despite the company's reluctance to do so. The chosen site for the facility was in Rampur, 120 miles east of Delhi. Although located on National Highway 24 and on a railroad connection, the area is poorly developed. During construction, the company had no telephones and an inadequate power supply.

The government also limited ownership to 40% and required phased-in procurement of indigenously manufactured parts, toward a goal of 80% over five years. The government also sought to assure effective transfer of sophisticated technology by mandating that Modi Xerox construct an integrated manufacturing facility with a full cycle of photocopying technology under one roof: electronic boards, machine assembly, toner, and photoreceptor (as shown in Table 3, this is not a usual practice of the corporation). It made this requirement while also limiting annual production for the domestic market to 9500 machines, a move designed to limit the potential monopoly Xerox might otherwise acquire over India's domestic copier market. In short, the Indian government succeeded in ensuring that the negotiated working agreement for the proposed facility would conform to the country's core development objectives—technological self-reliance, equitable regional growth, and prevention of concentration of economic power.

Negotiations between the Thai government and Occidental and Du Pont were relatively expeditious (two to three months) and essentially indirect, an experience entirely consistent with the government's role as business facilitator rather than strict regulator. In both cases, the management of the Bangpoo Industrial Estate, where the facilities were located, helped each company by acting as an intermediary between the applicants and the appropriate government agencies. Occidental Chemical applied for, and received, the BOI privileges accorded to foreign investors who own less than 50% of their Thai subsidiaries and who locate in the government-promoted industrial estates. Du Pont, which chose a wholly owned facility, simple technology, and small employment prospects, did not qualify for the privileged status. In both cases, negotiations consisted of routine administrative procedures without significant direct contact between the participants or the need for major adjustments by either party.

Notably, in the three cases the issues of environment, health, and safety were not explicitly incorporated into the negotiations between the host countries and the MNCs. In the Indian case, it can be attributed to the administrative system environmental regulations, whereby the permits are issued by state authorities during the later stages of facility development. Indeed, the industrial license issued to Modi Xerox by the Ministry of Industry after two years of negotiations was conditioned upon compliance with all applicable state environmental regulations.

In the two Thai cases, the central authorities similarly delegated this matter to another administrative body, IEAT. The relatively small size and low projected environmental impacts of the two facilities undoubtedly contributed to that decision. However, the fundamentally different mission and authority of IEAT in Thailand, as compared with the Indian state environmental agencies, suggests that EH&S issues received significantly less attention in the Thai process.

Both Du Pont and Occidental Chemical licenses, signed by IEAT, have environmental and occupational conditions specified, but these are rather minimal constraints: medical checkups for workers, keeping the factories clean, the need for protective clothing and personal protective devices for workers, alarm sound systems, and other "fundamental" requirements among them. The only reference to environmental or occupational standards was the requirement to comply with IEAT wastewater standards.

NEB became briefly involved in the Occidental case regarding the on-site storage of chemicals and the need for a scrubber. Notably, however, satisfactory attention to these matters by the corporation did not appear in the industrial license as a condition for industrial approval. In the Du Pont case, a permit for production of toxic substances was required from the Ministry of Agriculture and issued without delay. Finally, the central authorities did not take up the consideration of the potential effects of concentrating a

large number of hazardous facilities in a confined geographic effects of concentrating a large number of hazardous facilities in a confined geographic area (approximately 70% of facilities in the Bangpoo Industrial Estate are engaged in the manufacture of chemicals, plastics, or pharmaceuticals). Facility acceptance or rejection, and its location within the industrial park, was clearly assigned to the purview of IEAT.

In short, the absence of environmental and occupational issues in the initial interactions between the central government agencies and the three MNCs appears to reflect the host countries' policies of delegating these matters to the appropriate local authorities and, at least in India, to the later stage of the facility siting process.

For Occidental and Rank Xerox, the fundamental concerns about environmental and occupational health at the prospective facilities were an important element in their negotiations with the respective joint venture partners. The companies were confronted with three tasks: (a) to explicitly specify their own standards as prevailing at the facilities; (b) to assure that the joint management arrangements would allow them to maintain control over the aspects most relevant to EH&S; and (c) to extend their own safety culture on the joint venture partner. In both cases, the imposition of the corporate occupational and environmental standards was a nonnegotiable condition for the successful completion of joint venture agreements; in the Modi Xerox case a verbal understanding was attained with the partner, whereas in the Occidental case conditions were explicitly specified in the joint venture agreement:

The parties agree to cause the Company to bring the project up to environmental health and safety standards prescribed by Occidental Chemical and thereafter to maintain the project in accordance with said standards and all applicable Thai environmental health and safety laws and regulations. If the Company has insufficient funds or cannot borrow the funds needed to achieve the standards prescribed by Occidental Chemical, then the parties will contribute such funds to the working capital of the company in proportion to their respective shareholdings.

It also appears that in both cases the business partners were eager to let the MNC assume the leadership, their motive ranging from simple delegation of unwanted responsibility to viewing the adoption of MNC standards as one of the elements of technology transfer. The attributes of the management system that were to give the two corporations major influence over EH&S would include designation of top management officials. Although this was the general tone of both joint venture agreements, the documents also stipulated gradual transition over time of management to the host country partner.

Less clear is the process of transfer of corporate safety philosophies from the MNCs to the joint venture partners. Chronologies of the two jointly owned cases indicate early and systematic attempts to accomplish such transfer through lengthy personal meetings between senior management of the two enterprises. Occidental Chemical was even willing to forgo the business deal in the event of poor prospects of success in this area. In both cases it appears that the joint venture partners were very receptive to the idea that safety is a good business investment or, as an Occidental Chemical executive phrased it after a popular commercial, "pay me now or pay me later." However, beyond that fundamental agreement, several questions remained unanswered: the depth of the long-term commitment by the host country venture partner to investing into engineered safety infrastructure; the depth of the long-term commitment by the MNC to continuous reinforcement of its safety philosophy and, if necessary, to overriding the partner's preferences; the long-term effect of the physical distance between the home and host countries; the future effects of shifts in top management toward the host country partner; and the long-term effects of the unique local conditions on the MNC's success in maintaining the safety culture at its foreign outpost. Although further analysis of the three cases brings into focus some

specific challenges the MNC faced in this area, these questions remain essentially unanswered by our study.

In summary, the three case studies indicate that the form and scope of negotiations between the host country and MNC are largely influenced by the host country and that development priorities of the host country play a major role in determining the agenda, complexity, and duration of these negotiations. Furthermore, the absence of explicit considerations of environmental and occupational health and safety during the negotiations between the host country central authorities and MNCs is a logical outcome of such negotiations. In contrast to the host country authorities, the two MNCs which entered into joint venture partnerships brought the issues of environment and occupational health and safety to the negotiating table in the context of questions such as whose standards prevail and how management of the operations—including personnel—was to be structured. Finally, the cases suggest that adoption of the MNC safety philosophy by the joint venture partner is a variable whose importance is clearly recognized by the MNC.

The Construction Stage

During the construction stage, the MNC, as the technology owner, is expected to assume a leading role. However, that leadership is constrained in at least three ways: (a) each MNC has to act within the context determined during the negotiations; (b) each needs to respond to the host country's environmental and occupational regulations; (c) those in joint venture arrangements need to account for the partner's views.

The three case studies show that the MNCs responded to these constraints in a manner consistent with the management styles and past experience with foreign affiliates. Du Pont, which commanded the greatest flexibility of the three, owing to whole ownership and restrained role of the Thai government, proceeded to design a facility practically identical to an equivalent facility anywhere in the world. Blueprints for facility design and construction were developed at the US headquarters and consisted of extremely detailed construction specifications: from installation of the fill to achieve appropriate grade, to building of the structures, tie-ins with the electric, water, and sewage companies, to installation of all manufacturing equipment, including selection of the screws and bolts. The specifications left nothing to chance and nothing to the imagination. This was to be another Du Pont facility that happened to be in Thailand.

The entire construction process, from the initial description of the technology which preceded the decision to build, through contract specifications, permit procurement, and supervision of the local construction contractors, was executed by six individuals, four in the United States and two in Thailand. The Thai team members were the future plant manager and production supervisor who would be primarily responsible for local procurement, hiring of workers, and field engineering and production supervision. Site engineering and technology design, two key elements of the Du Pont safety system, were executed by the US members of the team. Site-specific modifications of the facility included the installation of a vacuum system to eliminate any airborne mobilization of particles. This alleviated the need for worker face masks, a particularly cumbersome requirement in the hot climate of Thailand. The building was also constructed to withstand major earthquakes. This significant initial investment is rather typical for Du Pont and is consistent with the corporation's view of safety as good business. After visiting the plant, a manager of another US company with a subsidiary in Thailand remarked, "If our facilities are compared to Jeeps, the Du Pont facilities are Cadillacs."

Occidental's flexibility during design and construction, both in terms of physical design of the facility and management system (there were no personnel changes upon

Occidental Chemical's acquisition of the facility), was limited primarily by two factors: the presence of the joint venture partner and the legacy of the previous owner. In relation to EH&S, the existing infrastructure, the management system, and facility performance lagged behind other Occidental facilities. The primary task for the company in relation to EH&S was therefore to transplant its EH&S procedures and practices to Bangpoo and to install additional safety equipment in the existing facility. These tasks were implemented gradually by the company over the course of several years.

Two years after acquisition, a major expansion of the plant was initiated which doubled its capacity and introduced significant changes in the manufacturing technology. Key changes in the technology included a shift from dry chromate to wet chromate feedstock and increased automation of all transfers, which, in turn, increased efficiency, reduced workers' exposure to chromium, and eliminated waste generation. Design and construction of the expanded facility was a joint project between the Thai professionals employed at the facility and the US-based experts. The project represented a significant technology transfer: the design was "started from a blank piece of paper," with the Thai team playing a significant part in all decisions. This substantial degree of technology transfer is in contrast to the experience at the neighboring Du Pont facility, and can be attributed to several factors: the simplicity of the technology; the absence of proprietary elements beyond what one may describe as the "art of getting a high-quality product" by finding just the right combination of the ingredients (the temperature and the duration of the chemical reaction); and the absence of an equivalent Occidental facility in the United States which would provide the blueprints for the Thai facility. It is also consistent with Oxychem's corporate experience with its other domestic and international facilities, which are often acquired and subsequently modified as needed.

Facility reconstruction also afforded Oxychem the opportunity to introduce a number of safety systems that would be expected at equivalent US facilities. In particular, spill control was stressed, including paving and trenching of critical areas, thus enabling recycling of spills. Another consequence of changing the manufacturing process was the requirement of obtaining a permit to import. Although such permits do not routinely involve environmental considerations, the Thai government (NEB) insisted on receiving assurances from the company that the transfers and transport of the chromate liquid would be conducted in a safe manner. This prompted the company to develop its own transportation capability rather than hire a local trucking enterprise.

The flexibility of Modi Xerox concerning facility design and construction was the most limited of the three. In addition to having to share ownership, the company had to account for conditions imposed by the Indian government during the negotiations: remote location and the need to cope with insufficient infrastructure, a ceiling on domestic production, and extensive integration of technology.

The production ceiling imposed on the facility, in combination with extensive technological integration, created a substantial challenge for the company. One option that was considered involved building a large facility, similar to its other worldwide plants but more integrated, and running it well below capacity for an unknown period of time into the future. An alternative option involved scaling down the plant. The major advantage of the first option was having extensive and well-tested experience in designing the plant and procuring the necessary equipment; its main disadvantage was low cost-effectiveness.

The choice made by Modi Xerox, to build a scaled-down plant, generated a different set of challenges. The significant reduction in size, to approximately one-third of the smallest similar facility in the world of Xerox, also necessitated significant changes in the basic design and the choice of equipment, with two potentially adverse consequences:

additional design costs and, more importantly, altered product quality. The corporation's approach to these challenges is particularly illuminating in this case.

Key steps in the manufacture of carbon-based toner generate fine dust that may at high concentrations present an occupational health hazard and pose a threat of explosions and fires. Automation and infrequent changes in product lines (which requires reassembly of equipment) are the most effective methods of dust control employed in other Xerox toner facilities. However, the relatively small size of the Rampur facility, and the modest initial scale of production, did not justify extensive automation on economic grounds. Thus several manual operations were initially implemented, including hoisting of bags of the starting materials to a mixer located on the upper level (automated since then by an elevator), transfers between manufacturing steps, and bottling the finished product.

At the outset, the management was concerned that the manual operations would generate more airborne dust than the automated operation, but the lack of prior experience with a small-size operation did not allow for accurate predictions of the magnitude of increase. An interim solution was to use individual personal respiratory protection (disposable dust masks) once the facility went into operation. The measure was accompanied by the installation of an extensive personal monitoring system.

The employment of personal protective devices instead of engineered controls was clearly a temporary solution that would be effective only for a modest production scale at the plant. The system was not designed, according to the initial predictions, to meet the demands of a two- or three-shift production schedule. (These predictions were later confirmed during a brief acceleration of production.) As the system was being put in place, plans for future modifications of the key sources of emissions were under development by the corporate EH&S personnel. By 1990, some of the manual steps had been automated, but full automation was not imminent. The possible effects of these changes in facility design on the sustained management of safety at the Xerox facility are discussed in the next section.

In describing the design of the three technologies, of note is hazardous waste management in each case. In Thailand, where neither the central nor local authorities imposed any requirements on the companies relative to waste management, the companies were free to follow their own respective policies on that matter. Du Pont's original plan for hazardous waste disposal was to use local landfills, provided that appropriately constructed ones could be located. When that effort failed to produce satisfactory results, the company installed an on-site incinerator. Occidental redesigned its process during the facility expansion to eliminate waste generation altogether. In contrast to Thailand, Indian state and local authorities actively participated in the waste management issues by imposing stiff restrictions on the company's ability to dispose of any hazardous waste off-site. The company's response was to install innovative technologies for on-site treatment, such as a solar evaporator for reducing the volume of liquid wastes and a solar cooker for solidifying the fine dusts.

In summary, the events that took place during the construction stage of the three facilities were the product of interaction of two sets of major factors: the host country constraints, previously solidified through negotiations and exerted indirectly during this stage through the conditions of industrial license, and the corporate policies and past experiences regarding construction of foreign affiliates. The two sets existed in an equilibrium with each other, with the corporate side clearly pressing for a larger territory. When counterpressure from the host country was low, as was the case with the two Thai facilities, the corporate presence dominated, reflecting in the process individual corporate styles of establishing foreign affiliates. These unique styles were particularly visible in the design

of the two Thai facilities and in hazardous waste management; whereas Du Pont characteristically applied a safe, detailed, and time-tested formula for facility design and site-specific modifications, Oxychem, not unexpectedly, experimented with the design as well as with the designers. With regard to hazardous waste management, on the other hand, both companies demonstrated similar policies of cradle-to-grave responsibility for its fate.

When the host country's presence was relatively strong, as in India, the resulting decisions regarding the technology, including the safety systems and hazardous waste management, became a product of corporate adjustments to the host country pressures.

Finally, in our cases, the participation by the joint venture partners at this stage appears to have been low, although the limited analytical power of the study design relative to that issue necessitates careful qualification of that observation.

Facility Start-up and Sustained Operations

The Modi Xerox facility manufactures half a dozen different models of photocopiers, electronic boards, as well as photoreceptor, toner, and developer. It also has a modest R&D unit directed primarily toward improving the existing processes and materials. Manufacturing activities at the Rampur facility are associated with multiple occupational hazards. Chronic health impairment may occur from prolonged inhalation of carbon particles in the toner plant, from inhalation of selenium and arsenic in the photoreceptor plant, and from exposure to vapors in the paint shop. Several materials generate toxic fumes when ignited. There are substantial risks of fire and explosion in the toner plant because of the presence of fine airborne carbon particles. Finally, there are the usual hazards associated with operating a variety of mechanical equipment in the toner plant, the photoreceptor plant, and the machine assembly plant: accidental damage to the limbs, eyes, and body. When the facility first opened, safety training was conducted by a consultant engaged for that purpose. In addition, the safety manager received one month of training in the United Kingdom.

The facility is well within the compliance range of the corporate airborne standards for arsenic, selenium, tellurium, and respirable particles, as well as the reportable incidence rate (for the latter, see Figure 2). Furthermore, its averages for these variables are easily comparable to other US Xerox facilities. However, because of the significant reliance on personal protective devices, achieving and maintaining behavior among workers that is consistent with meeting these standards requires continuous monitoring and feedback. The obviously dangerous violations, such as smoking or using spark-prone instruments in the toner plant, simply do not happen. Other less obviously hazardous activities take time to eliminate. The workers' acceptance of the uncomfortable face masks did not happen overnight. During our brief tour of the facility we saw some workers without protective glasses and we observed fire doors being left open.

Like all systems that rely on modification of human behavior, this one is vulnerable to unusual circumstances. In fact, the Rampur facility may be uniquely vulnerable because first, the average workers in India is entitled to 30% of the workdays off each year because of numerous holidays, requiring frequent shifts of workers among jobs; second, the toner facility is more dependent on worker compliance than other similar Xerox facilities because of less automation; and third, a rapid increase in demand might increase the production level severalfold with the result that the manual step would become a bottleneck.

The Du Pont facility repackages herbicides, and formulates and packages liquid insecticides. Some of these materials are acutely toxic, irritating, and allergenic. Other hazards include the potential explosion of airborne particles, fires, and the generation of

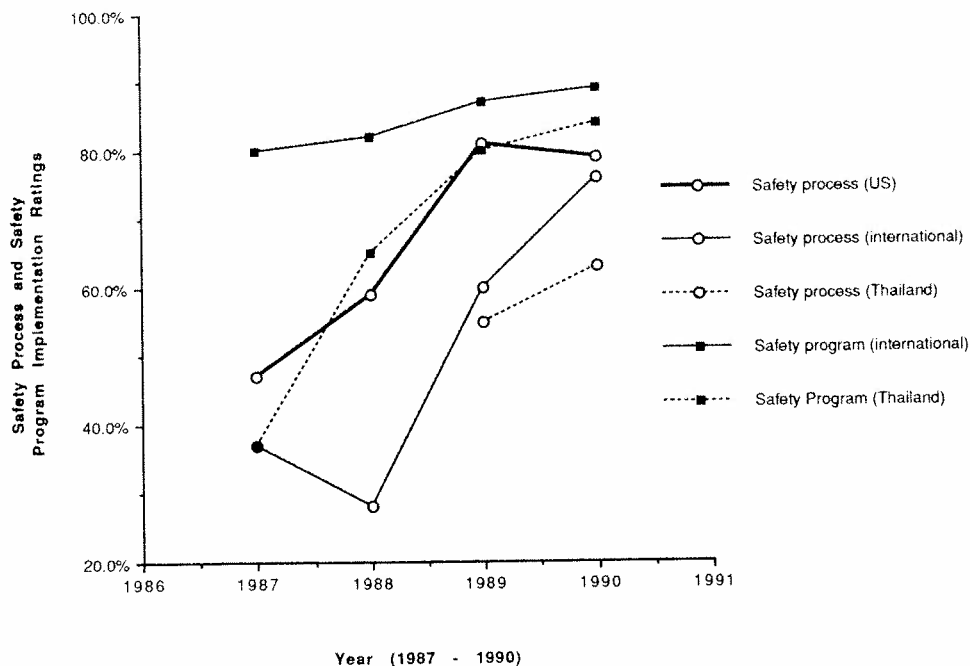


Fig. 3. Safety process and safety program implementation at Occidental Chemical facilities.

highly toxic by-products of combustion. The facility is small and clean, and bears the signs of a safety-conscious management: mandatory use of glasses and hard hats, extensive building reinforcements, doors with outlines on the floor indicating in which direction they open, emergency equipment for chlorine releases in case there is an accident in the facility next door, and a large-capacity water pump to augment the fire-fighting capabilities provided by the industrial estate. In short, this is unmistakably a Du Pont facility.

At the time of its opening, the Thai manager of the facility had been a long-time employee of Du Pont and had participated in all stages of the plant construction. Both the manager and production supervisor received six weeks of training in the United States.

The Occidental Chemical facility manufactures trivalent chrome from two major starting materials more toxic than the product: sulfuric acid and sodium bichromate. The toxic properties of the chemicals used at the plant are quite well established: sulfuric acid is corrosive to biological tissues upon contact; chromium compounds are also irritating and may cause allergic reactions; chronic inhalation of sodium bichromate has been associated with respiratory damage and lung cancer.

Systematic education of employees in Occidental safety practices was introduced approximately a year after the acquisition and proceeded in parallel with the physical upgrading of the plant. The steady improvement in the facility's EH&S record over several years, as indicated by the results of EH&S audits shown in Figure 3, is quite typical among acquired Occidental facilities, and indicates that the process is gradual.

In short, these are well-conceived and well-managed facilities that reflect the policies, past experience, and personalities of the parent US corporations. The three corporations were successful in transferring the essential features of their safety and environmental policies and procedures to the foreign affiliates. Currently, the corporate oversight of the

EH&S at the three facilities continues to be strong, including formal audits approximately every two years, visits by EH&S specialists from the home country several times per year, and a tight reporting network.

The three corporations also applied uniform worldwide performance standards at the facilities for occupational accidents and exposures, and showed a consistent downward trend over the past decade in accident rates. Although limited, the data made available to us demonstrated complete compliance with applicable corporate exposure standards which, in some cases, exceed host country as well as home country requirements. Moreover, occupational injury rates indicated no significant departures from each company's averages.

Preserving EH&S Responsibilities

Throughout the project development process, the three corporations displayed leadership in most matters related to EH&S. They entered the process with well-articulated policies, explicit occupational standards, and time-tested procedures for achieving a high level of performance in the overseas affiliates which they often implemented in advance of, or in place of, host country enforcement actions. For example, the corporations chose to rely on their own occupational standards rather than those of the host countries, and for products with significant downstream hazards (pesticides and leather tanning agents), they took an active interest in managing those hazards. In the absence of adequate local regulations regarding hazardous waste disposal, the corporations also assumed primary responsibility for management of that hazard. Furthermore, the two companies engaged in joint ventures placed significant emphasis on maintaining control over the management of EH&S and in transferring their philosophy and know-how to their partners.

The corporate initiative in the EH&S area can be attributed to several factors. First is the fundamental commitment to establishing environmentally sound and safe facilities, regardless of location and local regulations. Such a commitment would motivate a company to retain control of EH&S responsibilities, a position made more likely by the size and talent available to large firms with a major, global stake in the performance of any one of its facilities.

Another factor that explains the corporate initiative in the EH&S matters derives from their self-image as leaders in manufacturing technology, product design, and quality control. The corporate representatives interviewed believe that they are the best equipped to operate their type of facility and that their procedures are the best assurance of both superior products and minimum hazard. Furthermore, they believe that the most cost-effective method of assuring quality equal to that of a parent country facility is the faithful replication of existing – and proven – facility design, management systems, and training practices, while maintaining flexibility to adapt to local conditions.

The Occidental and Modi Xerox cases illustrate this perspective. Changes in the process and material changes in Oxychem's Thai facility simultaneously increased cost-effectiveness, improved safety, and improved product quality, the major reason for the business failure of the previous owner. In the Indian case, the corporation introduced numerous modifications in the facility safety and process design in response to host country policies, including some that reduced the degree of automated safety. At the same time, Modi carefully avoided any changes that could have affected the quality of the product.

Lastly, the abiding confidence in the power of technology, good management, and accumulated experience also played a role in corporate insistence of retaining major EH&S responsibility and initiative. This confidence exuded from the corporate representatives

during the interviews. For the three companies, EH&S fell into the same category as the technology they were bringing to the developing countries: both represented a set of skills, knowledge, and hardware that had been previously tested and shown to perform, and which were being transplanted into another country. This was reinforced by the host countries and the joint venture partners who welcomed and encouraged the transfer of EH&S know-how.

The perspective of multinationals as initiators of EH&S, particularly when their proposed facilities are not understood as being pollution intensive, is also reflected in Leonard's study of negotiations undertaken with the national governments of Ireland, Mexico, Spain, and Romania [28]. He suggests that multinationals, faced with volatile public opinion about industrial pollutions and existing regulatory levers for enforcement that can direct legal action with little warning, "tend to construct new plants around the world with enough attention to antipollution technology and procedures to be able to accommodate expected changes in pollution control standards on a wide range of pollutants that all their plants around the world must meet regardless of the current regulatory situation in a particular host country." A similar role for MNCs has been articulated by Knödgen [7], Royston [45], and ILO [11]. The ESCAP/UNCTC host country studies [46, 47] have also described tendencies among MNCs to maintain policies and practices at their foreign subsidiaries that are superior to local MNCs, although inferior to home country products.

Multinationals as Responsible Players

Our analysis has revealed ample evidence of responsible corporate behavior in environmental and occupational management in safety design, occupational standards, downstream hazard management, management arrangements, and training and education. While these findings are partly attributable to the self-selection of participants in this study, we believe they offer a valuable alternative perspective on the inclination of MNC affiliates to perform at standards inferior to those achieved in parent countries [24, 35, 39, 43, 59]. Most of the challenges to that assumption have originated with industry itself, which argues that reputation, liability costs, and morality simply do not permit such practices in today's increasingly global economy. Outside industry circles, other counterarguments suggest a range of technical, economic, and political motives for MNCs to act responsibly in developing country ventures [7, 28, 45, 49, 50].

Managers who collaborated in this study provided support for the notion that liability, reputation, and a sense of moral responsibility are powerful determinants of corporate conduct. In addition, however, the three case studies point to two other factors, as highlighted earlier: pursuit of quality control and pursuit of cost-effectiveness. Both Du Pont and Xerox, for whom the technological processes in their respective facilities were simply repeats of similar ones in the United States, viewed any changes in the basic design and management system not only as a potential threat to the fundamentally important product quality, but also as a potential source of additional costs.

The presence of direct economic and technological components among the factors favoring responsible corporate EH&S conduct is likely to be characteristic of a wide range of technologies and corporations, including those with lesser resources and corporate commitment to the EH&S values than the three participants here. At the same time, an MNC's commitment to responsible behavior should not be equated with long-term guarantees of either strong performance or continuous commitment to excellence. Whether or not these are sustained is closely coupled with corporate EH&S culture, itself a dynamic phenomenon in need of constant reinforcement. As such, it is highly sensitive to changes

of both an internal and external nature which may modify top management priorities, middle management structure, parent company ownership, and parent company oversight.

Downstream Consequences of Upstream Decisions

Our case studies demonstrate that while EH&S matters were prominent during the negotiations between the corporations and their respective joint venture partners, they were strikingly absent from explicit negotiations between the corporations and the host countries. Consistent with Leonard's findings [28], the negotiating agendas between the corporations and the host countries consisted primarily on the economic, technical, locational, and ownership-related aspects of the transactions. In each case, the negotiations represented an opportunity for each host country, which dominated the agenda, to actively pursue its development objectives.

The reticence on the subject of environment and safety during the negotiation stage demonstrated by these two very different host countries suggests that similar attitudes would prevail in other countries, as long as the technology in question was judged to be relatively nonpolluting and not resource intensive. Similarly, the prominence of EH&S considerations during the construction stage is most likely a general phenomenon for multinationals with strong commitments in that area, owing to the importance of facility to design maintenance of corporate EH&S objectives at the affiliate.

The relatively minor role of EH&S matters during negotiations between the host country and the corporation does not mean that the negotiations had no significant effect on EH&S outcomes. To the contrary, a major finding of our analysis is that the decisions jointly made during the negotiations by a host country and a corporation, which appeared remote from the safety matters, had significant downstream effects on the management and practice of safety at the facilities. Moreover, these effects included, in some circumstances, a strain between the development objectives of the host country on the one hand and its EH&S objectives on the other, a tension inadvertently created by the host country's vigorous pursuit of its development agenda.

The specific workings of the Thai industrial estates illustrate this phenomenon. The estates serve as magnets for foreign investors because of their superior infrastructure and therefore facilitate investment and relieve congestion in Bangkok. However, they also allow for the concentration of large numbers of hazardous facilities in close proximity to each other and to the neighboring community.

The multiple functions of IEAT, which manages the industrial estates—to help foreign corporations obtain necessary permits, to manage the infrastructure of the industrial estates, to set and enforce environmental standards, and to oversee the safety of the resident facilities—illustrate even more strikingly the effects of the Thai pursuit of efficiency. They produce a weakened, risk-averse agency with strong preference for negotiated rather than imposed conflict resolution. This gives MNCs substantial flexibility to implement the EH&S systems of their choice, good and bad, without measurable input from the authorities.

Would the safety and environmental outcomes of negotiations be more favorable if efficiency played a secondary role to government-initiated direct influence on the activities of MNCs? The Indian case shows that such a system may create a different set of internal inconsistencies. In this case the combination of the antimonopoly and technology transfer policies of India imposed on the company two contradictory requirements: to "backward integrate" the technology and to keep domestic production low. These requirements led the corporation to choose a scaled-down and highly integrated facility and, in pursuit of

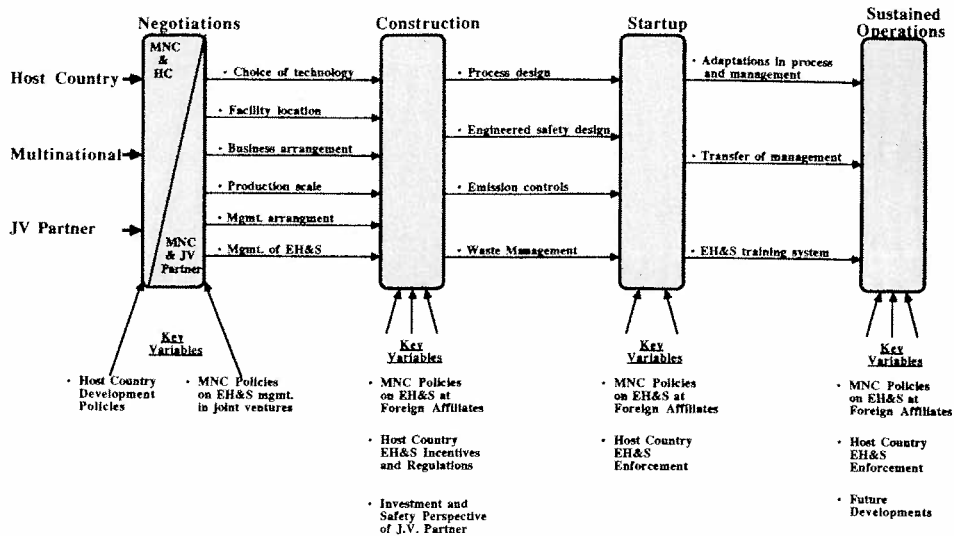


Fig. 4. Input/output model of facility siting.

cost-effective solutions, to opt for a manual rather than an engineered safety system. Although the adjustment was clearly adequate to meet the corporate occupational standard, it nevertheless put to the test the overall corporate safety philosophy of using engineered safety systems as the primary method of controlling employee exposure to hazardous materials.

To assure maintenance of EH&S standards under these conditions would require of Modi Xerox an unwavering corporate commitment to safety on the part of the management in the parent country and at the facility. Its success also will depend on the effectiveness of transfer of corporate philosophy to the joint venture partner and to a work force that will outlast the initial intense oversight by the parent company and be the decisive player in resolving future EH&S challenges. We have observed such an effort in our case study corporation, but clearly its presence cannot be assumed in other cases of MNC affiliates or over the lifetime of the current facility. As the extensive analyses of the Bhopal accident have shown, the cumulative effect of unfavorable external economic, regulatory, locational, and ownership-related circumstances, in conjunction with inadequate corporate commitment to safety, can lead to gradual deterioration of production systems (both human and equipment components) with potentially disastrous consequences [33, 37, 41, 42, 60].

Key Determinants of EH&S Performance

What generalizations are possible regarding the determinants of EH&S performance? Figure 4 attempts to capture the essence of our observations derived from our small sample of companies and countries. The terms input and output are descriptive; they denote the categories of variables that determine the nature of interactions among the principal participants at each stage of facility development and which, directly or indirectly, contribute to the facility-level outcomes. Two types of inputs can be distinguished: those that characterize the principal participants—their values, policies, and implementation systems—and termed key variables and those that represent decisions made during individual stages, and which serve as intermediate variables of sorts.

During the first stage, host country development policies are listed among the key independent variables. In addition, the company's policies relative to EH&S at international affiliates play an important role by affecting its attitudes toward entering into joint ventures and negotiating with venture partners. The outputs of the first stage, articulated in an industrial license and joint venture agreement, *de facto* represent a comprehensive blueprint of the facility before the engineer's blueprints are drawn.

During the second stage, which is dominated by the technology owner, the MNC policies on EH&S continue playing a major role. The host country presence, secondary to that of MNC, manifests itself during this stage primarily through various EH&S permits. The perspective of the joint venture partner on EH&S matters may also affect the design of the facility, including its environmental and occupational aspects.

During the third and fourth stages, corporate policies relative to their foreign affiliates, including training, enforcement, corporate oversight, reporting, and others, clearly play an important role. Similarly, the host country enforcement plays a significant part at both stages. In addition, the long-term EH&S performance at the MNC facilities will depend on the extent to which the corporate safety philosophy and management systems can be transplanted to the foreign affiliate. This will be partly reflected in the training system implemented during the start-up stage.

The management arrangements in jointly owned ventures are also important in the last two stages, primarily in cases where partners differ in their EH&S objectives and where the joint venture agreement provides for gradual transition of management from the shared arrangement to that dominated by the host country partner. The significance of that factor in maintaining safety at MNC facilities has been raised by several authors (1; 8; 60, p. 21; 61, p. 233]. Finally, a variety of external circumstances have effects on the long-term facility performance, as most dramatically illustrated by the Bhopal case. These are classified as a "future developments" key variable.

In addition to highlighting the importance of corporate policies in determining the facility-level EH&S outcomes, Figure 4 also dramatically illustrates the large array of constraints on the principal participants as they progressively address various issues in the course of the transaction. These constraints rapidly increase in number at the conclusion of negotiations and remain high. Stated differently, once the negotiations are completed, the flexibility of the principal participants, including the corporations, is severely limited.

The assumption underlying the model depicted in Figure 4 is that types and timing of the inputs shown in the conceptual model are common to other cases of facility siting. That is not to say, however, that similar starting ingredients (type of technology, type of corporation, type of host country regulations of MNCs) will yield similar products in the form of facility management and performance. To the contrary, at the heart of this generic model is a complex chemistry of interactions between the environment-, health-, and safety-related policies and development- and business-related policies, whose outcome is difficult to predict. Furthermore, when these interactions lead to tension among mutually desirable but competing objectives, as illustrated by the case studies, corporate culture becomes a crucial determinant in how that tension is resolved. The nature of that response, and therefore the outcome, is also unique for each case.

Functional Equivalency in Practice

Among the dimensions of the debate on the norms of conduct for MNCs in developing countries, two questions have been particularly prominent: Should the MNCs apply uniform worldwide standards, even if that means overriding local regulations (when such are less protective than their own)? Should the MNC objective be installation of identical

systems at foreign and domestic facilities, or is functional equivalency a responsible and practical alternative?

As part of the debate, recurrent accusations that MNCs apply double standards in the operations of their home and developing country facilities [24, 36, 39] have been moderated by those who suggest that developing country affiliate operations of MNCs, while not equal to domestic operation, operate according to better standards than local enterprises [44-47]. In a more normative arena, several governmental and nongovernmental organizations and trade associations, as well as leading multinationals, have become vocal proponents of uniform standards or equivalent safety performance. The Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy by the International Labor Organization [62] called for "the highest standards of safety and health." More recently, the World Commission on Environment and Development [63] called for "highest safety and health protection standards practicable," while the OECD Ministerial Declaration [64] stated that "affiliates of enterprises which are based in OECD countries should operate those facilities at equivalent levels of safety." The UN Commission on Transnational Corporations echoed these sentiments [5] by stressing in its report to the Secretary General the need for uniform worldwide standards.

Our three case studies suggest that the terms of the debate have been generally miscast because either uniform standards or functional equivalency are responsible standards and, equally importantly, are *sensible for a corporation acting in its own self-interest*. We heard, and essentially believe, corporate arguments in support of both functional equivalency and uniform standards which are economic in nature. It is more cost-effective to have a single implementation and enforcement system worldwide. It is also cost-effective to install engineered safety during facility construction instead of retrofitting later as more stringent regulations—the indisputable trend in developing countries—are put in place. All this suggests that the most useful debate is not whether uniform standards and functional equivalency principles meet some ethical standard, but how the principle is actually applied in a process laden with tradeoffs among competing and mutually desirable objectives.

Hidden Tradeoffs

How clearly do the host countries and MNCs perceive the linkages between the initial negotiations and their downstream consequences? How clearly do they perceive the connections between the fundamental values and specific implementation policies? How explicitly are tradeoffs made? The answers will no doubt vary, depending on case-specific circumstances. The limited scope of the present case study research allows for tentative responses at best, based on inferences rather than direct evidence.

In the case of Thailand, the increasingly urgent concerns voiced during the recent years over the environmental and occupational effects of rapid industrialization of the country suggest that the tradeoffs highlighted by two of the case studies are not new discoveries [65-69]. The type of tradeoffs illustrated by the Xerox case, however, was different. They were indirect, incremental, and arose in response to early decisions not apparently related to EH&S matters. Such tradeoffs were less likely to be foreseen during initial negotiations and thus more likely to necessitate accommodative activities during subsequent negotiations. This is for several reasons.

First, a substantial interval (typically several years) usually separates the negotiation stage and the construction and operation phase, during which the outcomes surface. In India, that interval was close to four years. Even in the expedient Thai system of industrial licensing, the interval would have likely approached a year or more.

Second, the indirect and multifactorial nature of the linkages between the independent variables and the EH&S outcomes on a facility level further complicates the matter. It favors making decisions, including any tradeoffs, incrementally and in a fragmented manner. In the Modi Xerox case, for example, the EH&S managers were not included in the decision to implement a fully integrated, small-scale plant. Similarly, the safety technology was chosen incrementally at the facility, partially by trial and error.

Third, the division of responsibilities for regulating MNCs among several host country institutions is a significant obstacle to formulating a comprehensive view of the ongoing interactions. Each institution is committed to its particular mission, which it pursues through narrowly conceived policies and objectives. This is particularly vivid in the Thai system, where the mission of the BOI is distinctly different from that of the NEB, and where the administrative process provides virtually no opportunity for joint consideration of the economic, locational, and EH&S aspects of a proposed facility.

Although in India the process envisions such a common ground in the form of the Technical Committee assembled within the Ministry of Industry, the scope of the committee's deliberations may not be all-inclusive, as in our case. Consequently, the agencies most likely to bring up the matters of EH&S, such as State Pollution Control Boards or the State Inspector of Factories, were excluded from the first stage of the process.

Fourth, it is unlikely that government officials, whose primary responsibilities are to see that the specific development policies are implemented and objectives achieved, would know or want to know about the potential effects of their efforts on the safety systems in the facilities.

Lessons for Corporate Environmentalism

The past decade has witnessed a remarkable reassessment of the perceived relationship between MNCs and developing countries. The largely ideological assumption of fundamental conflict existing between host countries' and corporate goals, which dominated the writings through the mid-1970s, has been increasingly balanced by a recognition of the potentially beneficial contribution of MNCs to the development of countries that host them. Whereas this transition has complex explanations, among the contributing factors are changing attitudes of multinationals themselves, including the growing acceptance by MNCs of the host countries' rights to self-determination and to building their own development path, as well as corporate commitment to occupational safety and environmental protection [48, 61, 63]. More recently, the concept of "corporate environmentalism" has taken root among progressive corporations to give voice to that general philosophy [70].

What is corporate environmentalism in relation to MNC overseas facilities and, more pointedly, how can it be achieved at these facilities? The case studies suggest that the *corporate view* of this concept can be operationally defined through the following principles of conduct.

- The MNC needs to maintain a major influence over the design and management of the facility, regardless of ownership arrangements.
- The MNC needs to assume leadership in many decisions concerned with EH&S, regardless of the degree of host country regulations and enforcement.
- Foreign facilities should be, at a minimum, functionally equivalent to domestic facilities and meet all host country laws and regulations.

- Transfer of parent country EH&S systems to developing countries requires site-specified adaptations to accommodate local natural environmental, infrastructural, and labor conditions, as well as cultural, historical, and religious circumstances. These adaptations determine the ultimate mix of four EH&S implementation tools for achieving functional equivalence: engineering controls, management system, education and training, and personal safety devices.

In sum, our analysis suggests that the corporate concept of environmentalism in overseas facilities is molded by an enduring confidence in the power of technology, along with creative and flexible management, a capacity to innovate, and a growing realization that environmentalism makes good business sense. At the same time, our case studies also show that corporate freedom may be significantly constrained by the host country's pursuit of its development objectives and by the nature of its relationship with a joint venture partner. Whereas it is unlikely that such constraints would result in a major compromise in EH&S performance by a socially responsible corporation, the long process of facility siting presents a multitude of tradeoffs, some foreseeable and some not, which may produce unanticipated downstream repercussions for community and worker protection. These findings suggest that achieving responsible corporate behavior requires vigilance, adaptability, anticipation, and continuous appraisal, even by those corporations most seriously committed to this end.

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