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ARTICLES

PREVENTING INDUSTRIAL CRISES: THE CHALLENGES OF BHOPAL

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This article analyses the larger policy issues raised by the Bhopal disaster. The concept of industrial crisis is used as the analytical tool for understanding Bhopal type events. Industrial crisis refers to dysfunctional effects of industrial activities that cause large scale damage (or perception of large scale damage) to human life and the natural environment. They also put public at risk of large damage and lead to major social and economic disruptions. Bhopal was the quintessential industrial crisis of this century. Industrial crises involve three primary stakeholders -- governments, corporations and communities. It is argued that joint actions by stakeholders are necessary to prevent industrial crises. Policy issues that each stakeholder must address are examined.

The worst industrial accident in history occurred in Bhopal, India, on December 3, 1984. The terms 'accident' and 'disaster' which have been used to describe Bhopal are descriptively incomplete and analytically inadequate for comprehending its implications. Events in Bhopal represented a technologically complex, socially disruptive, politically sensitive, organizationally threatening, and publicly controversial crisis that continues to unfold even today, eighteen months after the triggering accident. Bhopal is symptomatic of a larger problem facing rapidly industrializing and highly industrialized societies. The concept of 'industrial crisis' is proposed here as an analytical tool for understanding Bhopal type situations.

fects. Because of the global interdependence of economic and political systems, it is very difficult to localize the effects of industrial crises to their source of origin. Crises spawn conflicts between corporations and victims, between corporations and government agencies, and inter-governmental conflicts that proliferate easily (Barton 1978).

Resolution of crises takes the form of mitigational responses and recovering from its effects. It often does not involve eliminating causes of triggering events, because causes are engulfed in technological uncertainty. Industrial crisis processes are constituted of parallel chains of events in the technical, social, economic and political spheres, that are loosely coupled with each other. Technical recovery involves technological damage control and preventive actions. Social institutions respond to crises in order to normalize disrupted populations. Eventually existing and new social institutions jointly assimilate all aspects of crises leading to social recovery. Economic recovery involves compensating victims and market/financial recovery of corporations. Finally political recovery involves reestablishment of order and legitimacy of political agencies on a routine basis. Since causes of crisis are not eliminated, events similar to the triggering event occur again and deepen and extend the crisis.

Crises caused by negative side effects of industrial activities are becoming more frequent and more bizarre. In the 20th century there have been 6,936 deaths caused by 28 major industrial accidents in fixed facilities, each claiming at least 50 lives. The first 50% of these accidents occurred in the first 77 years and accounted for 35% of deaths caused by major industrial accidents. The remaining 50% occurred in the past 8 years, and accounted for 65% of total deaths in such accidents. Similarly, large scale evacuations mandated by accidents and pollution incidents have increased dramatically in the past two decades. Since 1967, 27 major evacuations involving at least 2,000 people each have been recorded. Total number of people evacuated in these instances was 959,300, nearly 95% of which were evacuated in the past 7 years (Smets 1985). Data on product injuries is not available on a world wide basis. However, in the U.S.A. alone, the number of product injury compensation awards of more than 1 million dollars each, have risen exponentially in the past decade. In 1975 there were less than 50 such awards, in 1985 there were more than 400 of them. Similarly product liability suits went up from under 2,000 in 1974 to over 10,000 in 1984.[1]

Moreover, for each type of crisis we are now experiencing the worst possible cases. Since Bhopal, which was the world's worst chemical disaster, we have experienced the worst nuclear disaster in history at the Chernobyl Nuclear Power Plant in the Soviet Union. We have seen the worst space disaster in history in the explosion of the space shuttle Challenger. Finally, the worst product sabotage in history occurred with the second round of poisoning of Tylenol capsules in the U.S.A. All these events subsumed under our notion of industrial crises, illustrate the wide scope of the problem that industrializing societies must learn to cope with.

THE CHALLENGES OF BHOPAL

Bhopal is an archetype of industrial crisis. It has all the elements of crisis described above, and in their most convoluted forms. Some of the key features of the Bhopal crisis are summarized in Table 1. The table highlights elements that make it an industrial crisis. A detailed description of the events is not provided here because of space limitation, and because it is well covered by other articles in this special issue. For further details the reader may refer to Shrivastava (1987).

Table 1
The Crisis in Bhopal

Crisis Characteristic	Manifestation in Bhopal
1. Triggering event	– Uncontrolled emission of about 40 tons of Methyl Isocyanate gas into the environment from a Union Carbide (I) Ltd. plant on December 3, 1984.
2. Causes	
Human	– Manning down of plant from 12 to 6 operators – Low worker morale and poor safety training – Operator and managerial errors in pipe washing operations and maintenance decisions.
Organizational	– Facility was strategically unimportant and did not receive adequate managerial attention and resources.

Table 1 continued

Crisis Characteristic	Manifestation in Bhopal
	– Pressures to cut costs created hazardous conditions – Operational Safety Survey did not insist on development of emergency plans. – Failure in Nitrogen pressure system of Tank 610 a week before the accident was ignored.
Technological	– Plant design allowed large scale storage of MIC creating an inherrently hazardous facility. – Plant design modification (connection of Relief Valve Vent Header and Process Vent Header) allowed water to enter the storage tank. – Faculty procedure for maintenance allowed three safety devices to be non-operational. – Plant gauges and equipment were not maintained properly and were unreliable. – Highly contaminated MIC was stored and used in processing.
3. **Environmental**	– Weak physical infrastructure – Unreliable electric supply – Inadequate water supply – Acute housing shortage – 4 Hospitals, 1800 beds, 300 doctors – Unreliable telephone system – Weak social infrastructure – Plant neighbors were unaware – Weak environmental protection laws – Lack communication between company, local authorities on emergency procedures.
4. **Damage to life and environment**	– 3000 people died – 300,000 injured and affected by MIC exposure – 2000 animals died and 7000 were injured – Damage to standing crops, vegetation, soil and water

More Table 1

Table 1 continued

Crisis Characteristic	Manifestation in Bhopal
5. **Socio Economic Disruptions**	– 2 major evacuations of the city involving 200,000 and 400,000 people – Business losses of over $60 million – Costs to Union Carbide of $350 to 1600 million – Prompted a take over attempt by GAF Corporation forcing Carbide to divest 20% of its assets. – Union Carbide and Indian government were sued.
6. **Stakeholders**	– Union Carbide Corporation, Government of India, victims, voluntary organizations, world media
7. **Responses**	– Rescue and relief efforts in Bhopal managed by government and voluntary organizations. – Technological damage control involved neutralization of remaining MIC in the plant. – Conflict resolution efforts in and out of courts. – Internal crisis management by Union Carbide involved public image management, communications, and financial restructuring. – Chemical industry made technical improvements in plant safety and emergency procedures.
8. **Crisis Resolution**	– Crisis considered resolved for UCC with successful defense against GAF takeover attempt and dismissal of cases from U.S. courts. – Government of India considered the crisis resolved with establishment of relief programs.

Bhopal and other industrial crises, are caused by systemic factors that are under control of three key stakeholders. First, private corporations and public sector enterprises own industrial facilities that are the source of hazards that trigger crises. Crisis triggering events such as, accidents, pollution incidents, unsafe products and unsafe working conditions, are a function of

Second, state or government agencies shape the environment for industrial activities by providing physical, administrative and regulatory services to support industrial operations. These infrastructural facilities serve to make industrial products and processes safe for the public. They also enhance public's ability to cope with disasters. Finally, publics participate in industrial activities, as workers, consumers, stockholders, community residents, etc. They provide the resources and motivations for organizations to function. Jointly, these stakeholders control the many variables and their complex interactions that cause industrial crises. Future crises can be prevented only if these stakeholders cooperatively address policy issues dealing with technological hazards. They must simultaneously watch over each others activities to ensure policy implementation.

CORPORATE POLICY ISSUES

There are compelling economic and ethical reasons for corporations to prevent industrial crises. Corporations are legally liable for costly damages caused by crises originating in their facilities. These damages continue to occur for years after the triggering event. There are no reliable means for establishing costs of these damages, hence crises often create open-ended liabilities that can lead to bankruptcy.[2] Moreover, allocating costs for human lives and physical mutilation is highly controversial and requires the resolution of multiple social conflicts.

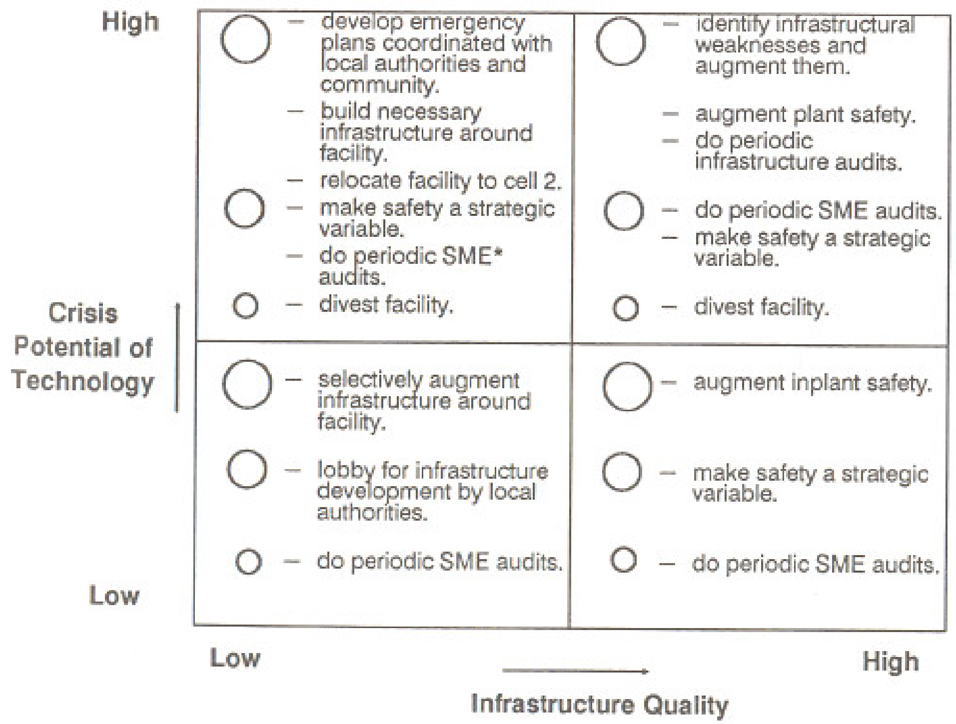
Even in the absence of legal liability, professional managerial responsibility requires preventive and coping measures for dealing with crises. The causes of crisis triggering events invariably include human and organizational factors for which managers hold professional responsibility. Industrial crises also question the legitimacy of corporations in society. To prevent erosion of legitimacy, corporations must attempt to prevent crisis.

Owners of industrial facilities can prevent crises by developing a set of policies dealing with the design of corporate technology portfolio, siting of hazardous facilities, development of safety features around plants, operational safety improvements, and emergency planning.

Corporate Technology Portfolio. One of the most fundamental policy choices that a corporation makes is the choice of product market

domains. Inherent in this are choices of product and process technologies. These choices are based on economic and market considerations. In case of multinational corporations attempting to diversify geographically, choice of technologies is influenced by international product life cycle, foreign market needs, technology transfer arrangements, host country regulations and international competition. In most situations, safety of technologies is a secondary technical consideration. It is not an evaluation criterion in strategic choice of technologies (Bowonder 1985).

Corporate technology portfolios can be made safer by screening technologies on a set of criteria measuring their crisis potential. The screening principle is a simple one-technologies should match the available infrastructure of the place where they are to be located. The framework shown in Figure 1 can be used to assess corporate technology portfolio. The matrix in the figure has two dimensions. The vertical



* SME stands for Safety, Maintainence and Environmental

Figure 1. Technology Portfolio Screen.

axis represents crisis potential of a technology. The horizontal axis represents crisis potential of a technology. The horizontal axis represents the infrastructural capacity of the environment in which the technology is located.

The first step is to perform 'environmental impact assessment' and 'worst-case scenario' analysis, to assess the crisis potential of each technology in the portfolio. Each product or facility may be classified as having high or low crisis potential. In addition, an 'infrastructure capability audit' must be conducted. This audit should examine the availability of basic facilities such as, water, electricity, transportation, communication, public health services, emergency services, and legal and administrative services. Quality of infrastructure can be evaluated as high or low based on the quality of services. Based on these analyses each technology in the corporate portfolio can be placed on the matrix shown in the figure. Depending on the location and strategicness of each technology different policies shown in the cells of the matrix may be adopted.

Locating Hazardous Facilities

Businesses traditionally use economic and technical criteria for locating facilities. These include, minimization of costs of transporting raw materials to the facility and finished goods to markets, availability of labor and labor relations climate, availability and price of infrastructural services (water, electricity, land rents, etc), quality of life for employees, and state and local tax incentives. Siting decisions are made at the project design stage by corporate engineers and managers. These traditional criteria and siting decision processes are inadequate for dealing with the problem of locating hazardous facilities.

Hazardous facility location policies need to be modified to incorporate social and environmental considerations, in addition to the traditional economic and technical considerations. Instead of being made by corporate engineers and managers, siting decisions should involve participation by external stakeholders likely to be affected by crises that may be caused by the facility. At the least government and community representatives should be consulted on these decisions.

An example where this has been done successfully is the state of New Jersey in the U.S.A. In 1981, the state passed the Major Hazardous Waste Siting Act (N.J.S.A. 13:IE-49), which established a Siting Commission constituted of representatives of different perspectives (industry, government, environmental groups, and communities). Working together through extensive public hearings, this commission developed several new criteria for siting hazardous waste facilities. These include, protection of the site vicinity population by providing for buffer zones, ensuring structural stability of facility, and protecting ground water, surface water, wetlands, and air quality around the site. Both the process of developing these criteria, and the criteria themselves, offer one model for tackling the hazardous facility siting problem. Similar criteria need to be developed for chemical plants, nuclear plants, and other hazardous facilities. If criteria are developed jointly by corporations and communities, they are more likely to be implemented by corporations, and resulting hazard sites are more likely to be publicly acceptable.

Development of Safety Features Around Plants

While the main responsibility for providing infrastructural services lies with government, corporations have an important role to play in ensuring adequate infrastructure around their own facilities. This is particularly relevant in the case of industrial facilities in developing countries, where governments either do not possess the resources or technologies to build adequate infrastructure, or do not build it because of their own economic and political priorities.

Corporations have in the past participated in a variety of infrastructure development tasks. Infact, entire townships have been developed by corporations in conjunction with local authorities. These are exemplified by company towns in the U.S.A., and housing colonies owned by public and private sector corporations in India. Corporations may selectively develop services that are needed for safe operations, and are inadequately supplied by government. Such services may be restricted to the immediate proximity of corporate facilities, and be planned in such a way as to primarily benefit the company's employees and associates.

For example, companies can fence hazardous facilities to prevent unauthorized persons from getting close to them. They can build sewage extensions to connect facility effluent outlets to the town's sewage system. They can provide safe housing to employees near the plant, but with sufficient buffer zones, thereby preventing unauthorized settlements in the immediate vicinity of the plant. Such unauthorized settlement are endemic to industrial plants in developing countries. The suitability of these and other recommendations to particular companies are of course contingent on particular circumstances. The essential idea here is to develop surroundings of plants/facilities on a selective basis to make their environment safer.

Operational Safety Improvements

The chemical industry in the United States and elsewhere have developed detailed manuals on industrial safety that can serve as the technical basis for safety improvements. New safety technologies using computer aided detection and control of hazards are also emerging rapidly. Several routine decisions related to production scheduling, inventory management, materials control, and operating procedures can also contribute to safety (Bowonder et al. 1985). These technical solutions are not adopted because of a lack of clear policy guidelines. They are also perceived to be too expensive to be justified in a cost-benefit sense. However, there are many safety improvements that are relatively simple and inexpensive, for which cost is not a legitimate concern. These include, providing public information on hazards to relevant community and government authorities to prepare them for emergencies, and making procedural changes in safety alert systems that warn the community of hazard as soon as a potential emergency is suspected.

Technical solutions to safety problems should be mandated by clear and uniform international standards and explicit corporate policies. Such policies can establish managerial accountability for implementing technical solutions, and performance evaluation and reward systems to help monitor implementation. Clear policies can also help in establishing liability for damages caused by crises.

Emergency Planning

Clear corporate policies are needed for the design and maintainance of emergency plans in case of accidents. Plant level emergency planning depends on local conditions but it can be enhanced in several ways. Normal emergency procedures usually focus on "most likely" emergencies, on protecting workers in the plant, and personnel in the immediate vicinity. These procedures should be augmented with emergency procedures for worst case scenarios, or low probability catastrophic events. Environmental impact analysis under worst case scenario should be the basis for determining the Emergency Planning Zone (EPZ). Any emergency plan should include the functions of (a) technical and medical assessment of accidents, (b) notification and communication with plant management, local authorities and neighboring communities, (c) establishment of command and coordination structure and allocation of responsibility for tasks, (d) delineation of protective actions such as, sheltering, evacuation, control of access to contaminated areas, and control of contaminated substances, and (e) support actions to mitigate impacts of the accident such as, firefighting, medical treatment, crime prevention, etc. (Michael 1986).

The process of developing emergency plans should include participation and training of communities and local authorities to understand and deal with hazard represented by facilities. This should begin by broadly disseminating already public information on hazardous materials, systems and processes, to community members and local authorities.

GOVERNMENT POLICY ISSUES

Government as the protector of public interest has primary and diverse responsibilities in preventing industrial crises. As the primary orchestrator of national policies and financial resources, the government also possesses the power to implement solutions. It can take preventive actions, by adopting economic and industrial policies that explicitly attempt to overcome negative effects of industrial activities, and by ensuring that policies are implemented scrupulously.

State agencies can aid in preventing crises by creating conditions for safe industrialization. The key policy questions they need to address include, design of strategies for sustainable industrialization, development of hazard management policies, development of physical infrastructure to support hazardous technologies, and ensuring policy implementation.

Sustainable Industrialization. Economic development and growth strategies pursued by nation states set up the preconditions for industrial crises, because they involve choice of technologies that possess crisis potential. These strategies are normally driven by considerations of national resource endowments, market opportunities and threats, and the availability of technology, in virtually total disregard of their negative effects or crisis potential. This leads to adoption of hazardous technologies in some sectors of the economy. For example in the energy generating sector some developing countries have adopted nuclear power generation. India, South Korea and Taiwan have six or more nuclear power plants each, generating about 2% to 35% of total energy of their respective countries. Nuclear plants impose immense risks that could be avoided by alternative energy generation technologies, such as, solar power or wind power.

In principle, there is a need to incorporate hazardousness or crisis potential as a criteria in choosing technologies by appropriately modifying industrial licensing procedures. Environmental impact and social impact assessment of industrial projects could be made a part of the licensing process.

Failure to do such screening can be expensive, as the nuclear energy industry in the U.S.A. is now realizing. After billions of dollars worth of research, development, and manufacturing expenditures, it had to withdraw from this technology. If the criteria of crisis potential is not used, the same fate could befall other emerging technologies, such as, biogenetics, lasers, and space travel. The strategic error is in launching off into commercial use of technologies before fully understanding their crisis potential and preparing to deal with it. There are short-term financial pressures from business firms to quickly make use of investments in technological developments. Government policies should provide a mechanism for restraining private firms till the technology and its supporting infrastructure are developed enough to avoid crisis.

Technologies must foster sustainable economic development. A development that stresses the **sustained** production of goods and services, rational use of human capital, with simultaneous preservation of

natural and technological assets. Production is not endlessly sustainable without such preservation. While the idea of sustainable development applies to all countries, it has more immediate application to developing countries. They have ample supply of labor and rampant unemployment, acute infrastructural shortcomings, ubiquitous pollution problems, and limited resources for procuring or developing technologies. Choice of sustainable technologies will require a significant shift away from the existing development approaches of indiscriminate, urban biased industrialization which simply bypasses more than 70% of the population living in rural areas. It requires choice of technologies that can make use of available human resources, and exploit natural resources less rapaciously.

This does not mean deindustrialization and regression but rather a creative search for safer, environmentally less stressful, infrastructurally less demanding, labor intensive, (more 'appropriate', perhaps) technologies, that can be operated on a decentralized scale to fuel more balanced economic and social development (Schumacher 1973). Such technologies are available, and in many sectors are more advanced than the currently used ones. For example, in the energy generation sector, nonconventional energy sources, such as, biogas, wind power, and solar power using photo-voltaic technology, are less polluting, use less non-renewable resources, are capable of being developed in a decentralized manner, on a more human scale, than thermal and nuclear power plants. They can be made economically feasible through sustained research and development. Similarly, the technology of pest control, which has degenerated to the brute-force overuse of pesticides can be made safer through rational programs of integrated pest management (Norris 1981; Weir and Shapiro 1981).

Hazard Management Policies

Even the most carefully selected portfolio of safe technologies, in a well designed sustainable development strategy, will include some hazardous facilities. These could be nuclear facilities, chemical plants, toxic waste sites, missile bases etc. Comprehensive national hazard management policies are needed to ensure that such unavoidable hazards are adequately protected against. This is an important element of sustainable industrialization.

The Seveso Directive adopted by the Council of the Organization for Economic Cooperation and Development (OECD) is an example of a governmental policy framework established to deal with major technological hazards. The directive establishes an obligation on manufacturers to take all necessary measures to prevent accidents at the stages of plant design, construction and operation. It requires them to anticipate possible causes of accidents, monitor critical points in production processes, introduce stringent safety measures, and adopt emergency plans for limiting the impact of accidents. OECD member governments are required to reciprocate to manufacturer obligations by establishing competent authorities to receive, evaluate, monitor, and act upon information received from manufacturers, and establish emergency plans for off-site use.

The Seveso directive also ensures the communication of relevant information to government and the public. Manufacturers must provide government information on certain hazardous substances which exceed certain amounts in storage, number of person working on-site, description of technological processes, description of safety measures, arrangements for dealing with malfunctions and emergencies, details of emergency plans and equipment available for on-site use, information necessary for preparing off-site emergency plans, and arrangements for initiating action in emergencies. The public must be provided information about safety measures and emergency procedures. Neighboring member states, must be provided the same information given to national citizens (Lykke 1986).

While the Seveso approach has some shortcomings, such as, limited citizen participation, it could serve as a model for national policies on hazard management. The alternative is to establish a network of agencies that jointly cover all aspects of hazard management. In the U.S.A., hazard policies and programs implemented by agencies such as, Environmental Protection Agency, Occupational Safety and Health Administration. Federal Emergency Management Agency, Consumer Products Safety Commission, etc. provide public protection from technological hazards. Although the mere establishment of such agencies

does not ensure prevention of industrial crises, it provides public policy vehicles for addressing root causes of crises.

Infrastructure Development

The state has an unassailable responsibility for providing adequate infrastructural services such as, adequate water supply, electricity, transportation and communications services, sewage etc. these services help in dealing with externalities of industrial production. These services are public goods and some of them (e.g. regulatory controls, law and order services, public health standards, etc.) can be provided only by the state. Preventing industrial crisis requires certain fixed investments in physical and social infrastructure. Building such infrastructure must be made a part of national economic and industrial policies. In the past the focus of these policies has been on building productive capacity and enhancing the employment potential of the economy. This focus has lead to the neglect of infrastructural development that is commensurate with the pace of industrialization (Bowonder et al. 1985).

Governments in modern states are in perpetual fiscal deficit. There are always more services being demanded than government can afford. This is true both in developing and industrialized countries. In this environment of resource shortages, the solution is to mobilize private corporations and public sector owners of industrial facilities into developing some parts of the infrastructure needed for safe industrialization. This requires a fundamental reorientation toward dealing with production externalities, that are the causes of crisis triggering events. Dealing with externalities is not simply the responsibility of government, but the joint responsibility of government and plant owners. Corporations possess the know-how and the resources to deal with externalities more effectively than government. In some situations, for example, multinational corporations operating in small new developing nations the corporation may be the **only** party that has the technical and financial resources to build infrastructure for making its plants safe.

In addition to enhancing the physical infrastructure there is need for reinforcing social infrastructure which determines the public's ability to judge the appropriateness of technological risks facing them. This ability is limited by the lack of information and lack of resources to act on it

Government can play a constructive role by empowering communities and workers in industrial facilities through appropriate legislation on public's right to know and right to act on hazards in their vicinity.

Policy Implementation

Government policies and regulations provide a framework for guiding the behavior of business firms. Government often fails to elicit desired behaviors because of loopholes, purposive laxity in implementation, incapacity to monitor performance and punish offenders, differences between policy makers and policy implementors, and inability of the judicial system to prove offenses and enforce deterring punishment (Pressman and Wildavsky 1984). Failures in policy implementation are a characteristic of modern governments.

Such failures cause industrial crises. In Bhopal, the state government failed to implement its own policy with respect to location of noxious industries. It permitted the hazardous UCIL plant to remain in a crowded city neighborhood despite municipal zoning laws prohibiting it. The government also failed to implement the recommendations of its own 1981 Labor Department investigation into safety problems at UCIL.

Policy implementation requires resources, information, and political will. Incremental improvements in policy implementation are possible by, establishing a system of accountability and evaluation, and tying rewards of decision makers with implementation of policies. In addition, community groups should be made in charge of monitoring performance on policies. They can act as independent outside evaluators and a source of public pressure on government and corporations to adhere to policies. Finally, blatant disregard of policies can be controlled by frequently giving exemplary punishment to offenders. The issue of policy implementation is too large to be adequately addressed in this brief article. We have barely raised it here. It is important enough to merit a separate comprehensive analysis.

COMMUNITY ACTION

Regardless of what corporations and governments do, industrial crises cannot be prevented without the active participation of citizen or

community groups. Our economic and social systems neither provide government the power to control corporate behavior with regard to crises, nor provide corporations the necessary economic incentives to voluntarily prevent them. Governments and businesses are crucially dependent on each other for their survival. They collaborate with each other to balance contradictory demands of increasing the productivity of private capital, while simultaneously reducing its negative side effects on the public (Offe 1984). This does not imply that governments are in the pocket of corporations, but only that the logic of free market systems is such that governments and corporations must live in compromise in order to survive. This balance of private and public (represented by government) forces perpetuates status quo. Hence, **direct involvement of the public** in policy making and monitoring implementation of crisis prevention measures, is the only way of structurally changing status quo.

Community Awareness

An aware and alert community can anticipate and prevent industrial crises. Although such crises are low probability events, there are many tell-tale signs and warnings of crisis triggering events that community residents can use to initiate preventive actions. In Bhopal, residents living around the UCIL plant were warned about the hazard potential of the plant by a series of articles in a local newspaper *The Jansatta*. Local authorities and residents ignored these warnings because they were not sensitized to this information. Officials dismissed the warnings as alarmist and sensationalist reporting. Local residents ignored them because they did not know how to react to them.

The ability to recognize the importance of, and to act on, such warnings depends on community awareness of industrial crisis issues. This awareness can be developed by systematic education of members about the nature of technological hazards, and through sustained dialogue between community members, plant personnel, and local emergency management authorities. A permanent dialogue group may be formed for this purpose. The scope, structure and frequency of dialogue would depend on conditions prevailing in the community. Planned and structured information dissemination would avoid alarming residents.

Community Empowerment

To be successful, participants in an ongoing dialogue on industrial crisis, requires that community role in the dialogue be legitimized, and that it be given resources to be effective. This requires passage of enabling legislation, such as, 'right to know' laws and 'right to act' laws which allow communities to extract and use information needed for meaningful dialogue. Initiative for such legislation must come from the grass roots. It can not and will not come from the government and private sectors, because decision makers in these sectors do not face the risk of industrial activity and its crisis potential, in the same way as do communities in the proximity of industrial plants.

Community power can also be mobilized through internal organization of the community. Cohesive focused groups can be formed for dealing with industrial crisis problems. Local and national networks of citizens concerned about these problems can be powerful agents of change. The purpose of these networks is to articulate and consolidate an independent community/citizen perspective on the crisis. They reflect the victims' and affected people's view of the causes of and solutions to crisis. They legitimize this view as one that establishment decision makers must seriously consider in making policies with regard to technological hazards. In democratic societies the public's view is supposedly represented by the government, eliminating the need for an independent citizen's perspective. This may be true for non controversial public issues on which there is broad general agreement. But industrial crises are rife with controversy and conflicts in which the government, as a set of organizations, and as a social institution, has vested interests. It cannot be uncritically accepted as unbiased representative of public interests.

Local citizens networks often get established around issues of mitigational responses. Inadequacies in relief, rehabilitation, compensation, medical treatments, and precautionary measures are the nexus for coalescing citizen's interests. Local networks have short lives because they lack resources, focus on immediate local needs, and get overwhelmed by corporate and government agency responses to crises (Gephart 1984). Over time they get branded as radical or marginal, and loose legitimacy with the wider public. To sustain themselves these net-

works must project the implications of local issues for communities around the nation and internationally. They must broaden debate over local problems to include national and international policy questions. A clear opportunity for doing this is linking up with existing public interest groups within the country (consumer groups, environmental groups, labor groups, etc.), and international non-governmental organizations[3].

Citizen networks provide forum for sharing crisis experiences among community members, and among communities. When people share each others' experiences and identify commonalities, they begin to see their own problems as being 'normal' to crisis situations. This facilitates normalization of post-disaster disruptions. They also see how crisis processes evolve toward resolution of some problems, and the need to focus on others. The affected community can regain direction and community spirit by discussing and shaping crisis responses through these networks.

CONCLUSION

Disaster researchers have historically focused their research on natural disasters. Industrial crises represent a new and qualitatively different type of disaster. They are characteristic of industrializing societies caused by human, organizational and technological failures. Bhopal, the quintessential industrial crisis of this century, challenges disaster researchers to broaden their focus and examine ways of preventing and coping with these crises. In delineating preventive policies that need to be developed, we have touched upon variables that **cause** industrial crises. Causes of crises are generally poorly understood and offer a major opportunity for research. The analysis of disaster causes is a theoretically and empirically under developed topic. Disaster studies typically do not focus on causes, because in natural disasters little can be done to affect them. However, in industrial disasters the most critical variables to be understood are its causes. They provide a clue to prevention of future disasters, and serve as a basis for settling questions of liability for damages.

Current efforts at understanding causes of industrial crises focus on technological factors (Perrow 1984). But as we have suggested above these crises are rooted in complex socio-economic causes. Sociological analyses of crises could supplement technical analyses, and serve as the basis for designing technological hazard control policies. Policy issues raised in this paper are merely a convenient beginning for what I hope will become a dominant theme for disaster researchers in the future.

NOTES

1. These figures are exclusive of mass tort cases settled out of court without jury trials. These cases end up costing large sums of money in compensation and lawyers fees, and waste a lot of time.

2. For example, Johns Mansville Company was forced into bankruptcy by liabilities arising from asbestos injury suits. In 1982, A.H. Robins Company filed for bankruptcy to protect itself against Dalkon shield injury suits.

3. A list of international non-governmental organizations (NGOs) concerned about industrial crises is available from the United Nations.

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