4 Seveso: A paradoxical classic disaster

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Introduction

For some people the name Seveso is tied to the experience of a seriously mismanaged toxic chemical release (Conti 1977; Hay 1982; Pocchiari, Silano, and Zapponi 1987); for others it is firmly and positively linked with a set of innovative public policies for managing industrial disasters. These contradictory characterizations make the interpretation of this industrial disaster both paradoxical and ambiguous. The Seveso experience illustrates many different types of uncertainty that are mobilized by industrial disasters and suggests a new interpretive model.

Overview

The chemical release

Dioxin

The Seveso Directive
Seveso: A paradoxical classic disaster

The chemical release

Around midday on Saturday 10 July 1976, an explosion occurred in a TCP (2,4,5-trichlorophenol) reactor of the ICMESA chemical plant on the outskirts of Meda, a small town about 20 kilometres north of Milan, Italy. A toxic cloud containing TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), then widely believed to be one of the most toxic man-made chemicals (Mocarelli et al. 1991), was accidentally released into the atmosphere. The dioxin cloud contaminated a densely populated area about six kilometres long and one kilometre wide, lying downwind from the site (fig. 4.1). This event became internationally known as the Seveso disaster, after the name of a neighbouring municipality that was most severely affected (Hay 1982; Pocchiari, Silano, and Zapponi 1987).

Fig. 4.1 Area affected by the Seveso dioxin release (Source: Roche Magazin 1986)

Eleven communities in the rolling countryside between Milan and Lake Como were directly involved in the toxic release and its aftermath. The four most impacted municipalities included Seveso (1976 population 17,000), Meda (19,000), Desio (33,000), and Cesano Maderno (34,000). Two other municipalities were subject to postaccident restrictions: Barlassina (6,000) and Bovisio Masciago (11,000). Health monitoring was extended to a further five municipalities. The entire affected area is part of the Brianza, a prosperous district of Lombardy, itself one of the wealthiest and most industrialized regions of Italy (fig. 4.2). Though originally agricultural, the economy of this area depended on a cluster of small workshops and industries, mainly engaged in manufacturing furniture.

The Seveso disaster had a particularly traumatic effect on exposed local populations because its seriousness was recognized only gradually. The community was divided by rancorous conflicts. People in other countries also experienced much heightened concern about industrial risks and the need for tighter regulation of hazardous chemical installations. In these respects Seveso resembled Bhopal (1984) and Chernobyl (1986), which have both come to be regarded as international symbols of industrial pathology.

Fig. 4.2 Location of Seveso

But as we shall see, Seveso is a paradoxical symbol, because human health effects of the disaster have been obscure and the process of recovery has been unusual. Victims have been compensated, workers have been redeployed, a substantial programme of long-term health monitoring is in operation, and the site itself has been made into a park. Though initially slow and conflicted, responses to the accident may eventually have showed high-technology society working at its best. Recovery was therefore a process of overcoming initial traumas (e.g. chloracne, fear of genetic impairments, evacuation, animal deaths) and re-establishing customary patterns of societal, economic, and institutional life.
For some, the main lesson of Seveso might be that a reasonably prompt, effective, and generous response by public and private agencies is the key to community recovery. But, to a significant degree, local recovery was achieved by exporting parts of the problem. Seriously contaminated materials were disposed of abroad in an atmosphere of confusion and scandal; their ultimate fate is still unravelling (Gambino, Gumpel, and Novelli 1993; see also Chronology items December 1992 and November 1993). This, too, is part of the style of high-technology industry: consumer satisfaction is often sustained by "externalizing" environmental costs and attendant social problems. In other words, the burdens of technology are often transferred away from producers and immediate consumers into a universally shared but unprotected natural environment or into specific poor communities (local or overseas) that are treated as sweatshops and dumps.2

Dioxin

The Seveso experience was essentially about dread - an emotion mobilized by involvement of the chemical dioxin. Dioxin first came to widespread public notice during the Viet Nam War, when it was identified as a component of the defoliant Agent Orange (Hay 1982). Previously, campaigns on behalf of agricultural and forestry workers had been mounted to have TCP banned because of its alleged toxic effects on humans. These frequently met with scientific disapproval, partly because the evidence was only "anecdotal." The United Kingdom's regulatory system was particularly unsympathetic to such claims (Wynne 1989).

Before the Seveso release, several industrial accidents involving TCP were known to have occurred. Among others, these affected the following firms and countries:

- 1949 Monsanto (USA);
- 1953 BASF (Germany);
- 1960 Dow Chemical (USA);
- 1963 Phillips Duphar (Netherlands);
- 1968 Coalite Chemical Productions (UK).

These accidents precipitated acute illness among affected workers and added to the burden of existing chronic sickness caused by prolonged exposure to the same chemicals under unsanitary conditions (Hay 1982: 138140). After the BASF accident, production of TCP was stopped at that site. The same occurred at Phillips Duphar, where the plant was closed and subsequently dismantled; its pieces were swathed in concrete and dumped in the Atlantic Ocean. Similar procedures were adopted at the Coalite site near Bolsover. After the Dow Chemical accident, new installations were constructed there. The reactor was enclosed by a supplemental safety vessel, whose purpose was to collect and cool any toxic material that might leak if reactor valves ruptured (Otway and Amendola 1989). Similar "containment vessels" have been widely employed in nuclear power stations that house pressurized water-cooled reactors. Had there been such a vessel at ICMESA, there would probably have been no Seveso disaster.

Dioxin was known to be an extremely dangerous substance, partly because of these industrial
experiences and partly because experimental evidence indicated that it was unprecedentedly toxic to some species of laboratory animals. In many ways the image of dioxin was similar to that of radioactivity: it was invisible, it poisoned at microscopic dose levels, and it was implicated in war. Moreover, because dioxin was carried by people and things, it took on the appearance of a dread disease - a plague. In particular, it was the sense of being gravely contaminated that increased personal, social, and economic distress among the affected population. Products of dioxin-impacted areas were rejected because of feared contamination, thus imposing a stigma on whole communities.

The Seveso Directive

The best-known consequence of the Seveso disaster was the impulse that it gave to the creation of the European Community's Seveso Directive, a new system of industrial regulation. Within the EC, each country previously followed its own rules for managing industrial safety. Urgent discussions about a new EC-wide regulatory framework for ensuring the safety of hazardous installations started after an explosion of cyclohexane in the Nypro Ltd. plant at Flixborough (United Kingdom, 1974). During the next two years, three additional serious chemical accidents occurred within the European Community: these were at Beek (the Netherlands 1975), Manfredonia (Italy 1976), and finally Seveso (Otway and Amendola 1989; Drogaris 1991).

One of the most remarkable features of the Seveso experience was that neither the residents nor the local and regional authorities suspected that the ICMESA plant was a source of risk. They did not even know much about the type of production processes and chemical substances that occurred there. As the Mayor reported (Rocca 1992, personal communication), the factory had been in existence for 30 years and the only occasional complaints from nearby residents concerned some unpleasant smells. Moreover, at Seveso as well as Flixborough, "changes had been made in plant or processes which compromised the safety of the facilities but were not communicated to authorities responsible for public health and safety" (Otway and Amendola 1989: 507).

In light of these disastrous accidents it was clear that new legislation was needed to improve the safety of industrial sites, to plan for off-site emergencies, and to cope with broader regional and transboundary aspects of industrial safety. The Seveso Directive, adopted by the Council of Ministers of the European Communities in June 1982 (Directive 82/501/EEC), is the result of those efforts. A central part of the Directive is a requirement for public information about major industrial hazards and appropriate safety measures in the event of an accident. It is based on recognition that industrial workers and the general public need to know about hazards that threaten them and about safety procedures. This is the first time that the principle of "need to know" has been enshrined in European Community legislation. The "need to know" principle is not as strong as the "right to know" principle that is widely applied in the United States. The status of "need" is determined by the authorities; it is not a right of citizens (Baram 1991; Royal Society Study Group 1992).

Although the Seveso Directive grew out of deficiencies in the existing system of industrial regulation, it is not simply intended to provide protection against hazards: it is also designed to equalize the burden of
regulation on industry. The creation of a single hazardous industry code ensures a "level playing field" for trade within the European Community by depriving unscrupulous industrial operators of competitive advantages that might flow from exploiting differences among varied national regulations. Moreover, adoption of the "need to know" principle increases the political equity of decision-making and adds a valuable new tool to the regulatory process. The next section examines this institutional response in greater detail.

The European Community's institutional response to Seveso

The Directive and its annexes

Other institutional effects of the Seveso Directive

Directives are one type of legislation issued by the European Community. Others include regulations, decisions, recommendations, and opinions. Some of these are binding on the 12 European states that make up the Community, while others are not. Several different units of the Community are involved in the process of legislating a directive (table 4.1).

Table 4.1 Units of the European Community involved in legislating a directive

<table>
<thead>
<tr>
<th>European Community Unit</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Commission</td>
<td>Seventeen members appointed by 12 Member State governments for four years.</td>
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<tr>
<td>Council</td>
<td>Twelve representatives, one from each Member State government; presidency rotates among countries every six months.</td>
</tr>
<tr>
<td>European Parliament</td>
<td>Elected by peoples of the EC for five-year term according to each Member State's electoral system (518 members in 1992).</td>
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The path for adopting a directive is as follows. The Commission presents a proposal to the Council. After consultation with the European Parliament and the Economic and Social Committee (whose opinions must be heard even if they are not strictly binding), the Council may formally adopt the proposal. After adoption, an EC directive is not immediately applicable to a Member State. Individual states must incorporate the directive into national legislation and take all the necessary measures for compliance within a specified period. Such a procedure allows for effective implementation, while respecting different juridical and administrative traditions. If a Member State fails to comply, the Commission may bring a case before the European Court of Justice.

In practice, the process of arriving at the directive on major accident hazards was long and complex. Technical and political problems required extended consultations among different parties and institutions. A proposal was finally presented by the Commission to the Council in July 1979. The required opinions of the European Parliament and the Economic and Social Committee were expressed in 1980 and it took two more years of further consulting and discussion before a directive was finally adopted, on 24 June 1982, 8 January 1984 being the anticipated deadline for implementation by the 10 EC Member States of that time. Directive 82/501/EEC soon became known as the Seveso Directive, despite opposition from Seveso residents, who formally complained to EC authorities in Brussels about what they perceived as an implied insult.

Before the Seveso Directive, manufacturers in different Member States were subject to obligations of varying stringency. For example, the submission of a safety report by the manufacturer responsible for a hazardous installation was not mandatory in all countries. Therefore, the Directive's main purpose was to ensure harmonization of regulations among different countries. This was achieved by establishing minimal EC requirements and permitting Member States to enforce stricter regulations. Such a general purpose is consistent with the overall EC policy on environmental health and safety matters. It is instructive to review the Directive's major components.

The Directive and its annexes

| European Court of Justice | Thirteen judges appointed by agreement among Member State governments for six-year terms. Assisted by six advocates-general. |
| Economic and Social Committee | Assists the Council and the Commission with European Economic Community and European Atomic Energy Community matters; 189 members from various economic and social sectors. |
The Seveso Directive is addressed to EC Member States, and holds them responsible for ensuring that the relevant national institutions accomplish what is required for adequate risk management. The entire Directive is also shaped by a concern for prevention, even those parts that relate to post-accident activities. The first article defines relevant terms such as "industrial activity, manufacturer, major accident, and dangerous substances." It also makes reference to four annexes that identify types of production, operations, and storage activities that are subject to regulation, and dangers that are anticipated.

Articles 3 and 4 require Member States to ensure that manufacturers identify existing major accident hazards and adopt all appropriate safety measures, including information, training, and equipment for workers. They must also provide competent authorities with a notification containing detailed and updated information on safety precautions and other matters (Article 5). Moreover, Member States must set up competent authorities that will take responsibility for receiving such a notification, examining the information provided, organizing inspections or other measures of control, and ensuring that off-site emergency plans are prepared (Article 7). Furthermore, Member States are held responsible for assuring that "persons liable to be affected by a major accident... are informed in an appropriate manner of the safety measures and of the correct behaviour to adopt in the event of an accident" (Article 8).

Article 8 is a very innovative feature in safety legislation. For the first time in Europe, the safety of people outside hazardous installations is taken into account; previously, only workers might have the right to be informed. The public's right to know was recognized on both pragmatic and ethical grounds. Not surprisingly, this article met with strong resistance and was subject to long delays in implementation (Wynne 1987; De Marchi 1991a, 1991b). Despite these initial difficulties, the Directive proved to be a watershed event. Matters that had previously been considered suitable "for experts alone" were now opened to inspection by - and input from - the general public.

Article 10 requires that Member States shall take the necessary measures to ensure that the manufacturer immediately provides full and detailed information about an accident to the competent authorities; they must in turn ensure that all necessary measures are taken and that full analysis of the accident is accomplished whenever possible. It is a specific obligation of Member States, to report any accident to the EC Commission (Article 11). The Commission is in charge of setting up a register containing a summary of major accidents that occur within the EC, including an analysis of causes, experience gained, and measures taken to enable Member States to use this information for prevention purposes (Article 12). Annex VI to the Directive lists the items of information that the Member States must report to the Commission in the event of a major accident.

The Directive includes provisions for ensuring effective implementation and for updating in light of technological change. Article 15 provides for the creation of a committee composed of representatives of the Member States and chaired by a representative of the Commission. The Member States and the Commission are expected to exchange information about the experiences acquired regarding the prevention of major accidents and the limitation of their consequences. Such information covers the operation of measures stipulated in the Directive (Article 18). Moreover, the Commission is required to
make proposals for revising the technical annexes as new technologies are adopted.

Procedures for updating and revision include regular meetings of the Committee of Competent Authorities. Such meetings have produced two amendments to the original Directive that grew out of experience with major industrial disasters in Bhopal, Mexico City, and Basle during the early 1980s. The first amendment, Directive 87/216/EEC, adopted by the Council on 19 March 1987, modifies Annexes I, II, and III by lowering the threshold quantities of certain substances and including additional industrial activities in the category that requires notification under Article 5.

During the revision process, between 1979 and 1987, there was a continuous exchange of correspondence between the Special Bureau for Seveso (Ufficio Speciale), which had been set up by the Lombardy Region in June 1977 (see Chronology), and various institutions of the EC (Regione Lombardia 1992). In 1984, a report was prepared by the Ufficio Speciale for a meeting of a committee of the European Parliament which was held in Seveso (Meazza 1992, personal communication). The second amendment, Directive 88/610/EEC issued by the Council on 24 November 1988, further revised Annex II to include more types of storage activities. It also substantially revised Article 8, stating that information shall be made publicly available as well as actively provided in an appropriate manner. Such information shall be periodically repeated and updated as necessary. A new annex, Annex VII, was added, which specifies the information that shall be provided to the public.

The official deadline for compliance of Member States with Directive 88/610/EEC was 1 June 1990. Meetings of the Competent Authorities have continued after the adoption of the second amendment, and further revision of the Seveso Directive is being discussed.

Other institutional effects of the Seveso Directive

In order to meet the Seveso Directive's requirements, the Major Accident Reporting System (MARS) data bank has been established to store and retrieve accident information reported by the Member States (Drogaris 1993). It is located at the Commission's Joint Research Centre, Institute of Systems Engineering and Informatics in Ispra, Italy. To promote safety-related knowledge further, a Community Documentation Centre on Industrial Risk (CDCIR) has also been established at the same site. This Centre collects, classifies, and reviews materials relevant to industrial risks and safety.

The effects of the Seveso Directive were not confined to improvements in the management of industrial accidents. The Directive also opened the floodgates for similar initiatives on a variety of other issues, particularly in the fields of environmental management and public health. Among these are the following: Directive 89/391/EEC, which mandates the introduction of measures to encourage improvements in occupational safety and health; Directive 89/654/EEC, which addresses minimum safety and health requirements for the workplace; Directive 90/219/EEC, which relates to biotechnology; Directive 90/313/EEC, on the freedom of access to environmental information; and Directive 89/618/Euratom, which concerns public information about radioactive emergencies. The European Single Act and the Maastricht Treaty also call for greater participation of citizens in EC
decision-making and this has expanded the scope of public information programmes. Indeed, recent reluctance by Danish voters and others to approve the Maastricht Treaty has led to further broadening of the commitment to provide information in support of public policy within the EC.

Beyond the European Community, the Directive has relevance for many international organizations. Those that are concerned with industrial hazards include the World Bank, the United Nations Environment Programme, the Council of Europe, the International Atomic Energy Agency (IAEA), the Office of the UN Disaster Relief Co-ordinator (UNDRO), the World Health Organization (WHO), and the International Labour Organization (ILO). In particular, the OECD (Organisation for Economic Co-operation and Development) has devoted much attention to accident prevention and response and has published a number of recommendations, some of which are specifically addressed to public information and public participation in decision-making (OECD 1989, 1990, 1992).

The lessons of Seveso

A model for managing uncertainty
Modelling the Seveso disaster
Modelling the Seveso Directive
Modelling the Karin B incident
A moral paradox
A scientific paradox
Industrial accidents, industrial society, and recovery

A model for managing uncertainty

Many students of disaster have concluded that uncertainty and communication are key factors in the management of emergencies. During emergencies, uncertainty increases and formerly dominant consensual views of problems and solutions often break down; different parties tend to evaluate the same evidence differently and, at times, tend to perceive different sorts of evidence. Such divergent interpretations create antagonisms and mistrust, which persist after the acute phase of an emergency has ended and complicate the tasks of recovery (Quarantelli 1988; Otway and Wynne 1989).

Our study of Seveso and other disasters (De Marchi, Funtowicz, and Ravetz 1993) suggests that there are six basic types of uncertainty (table 4.2) and eight distinctive strategies for managing the communication of uncertainty (table 4.3). Together, these two sets of variables provide the basis for a model of uncertainty management that has broad applicability.
### Table 4.2 Types of uncertainty

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Situational</td>
<td>Inadequacy of available information in relation to necessary decisions</td>
</tr>
<tr>
<td>Legal/moral</td>
<td>Possibility of future liability or guilt for actions or inactions</td>
</tr>
<tr>
<td>Societal</td>
<td>Absence or scarcity of integration of publics and institutions</td>
</tr>
<tr>
<td>Institutional</td>
<td>Withholding of information by agencies for bureaucratic reasons</td>
</tr>
<tr>
<td>Proprietary</td>
<td>Contested rights to know, to warn, or to conceal</td>
</tr>
<tr>
<td>Scientific</td>
<td>Difficulty of risk assessment or of forecasts of emergencies</td>
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### Table 4.3 Strategies for communication of uncertainty

<table>
<thead>
<tr>
<th>Interpretations</th>
<th>Policies</th>
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<tr>
<td>Suppression</td>
<td>Secrecy</td>
</tr>
<tr>
<td>Discounting</td>
<td>Confidentiality</td>
</tr>
<tr>
<td>Recognition</td>
<td>Publicity</td>
</tr>
<tr>
<td>Amplification</td>
<td>Sharing</td>
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**Situational** uncertainty involves a poor match between the decisions that must be taken and the information at hand. It is normally the most salient type of uncertainty because information is central to decision-making. It is also a very common type of uncertainty because complete high-quality information about major hazards is usually lacking. Moreover, interagency collaboration in decision-making is usually required and knowledge about the capabilities of such agencies is often incomplete.

In an ideal world, **legal/moral** uncertainty would not be salient because decisions would always be made in the public interest with due consideration of social justice; decision makers would be held free of liability. But few public decisions about industrial hazards meet these exacting criteria, so decision makers cannot ignore the possibility that they will be subject to legal action or moral censure. Concern about legal/moral uncertainty often leads to indecisiveness and defensiveness about the release of information.

**Societal** uncertainty occurs when institutions and the publics that they are intended to serve are not well integrated. Decisions that are subject to high degrees of legal/moral uncertainty also tend to be affected by societal uncertainty. Such uncertainty is most marked where every action is scrutinized by lawyers who represent other stakeholders. But societal uncertainty can be manifested in other ways. For example, respect for government agencies may be low, or individualism may be carried to extremes,
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either among the public or among leaders in major institutions.

_Institutional_ uncertainty is brought about when agencies withhold information for bureaucratic reasons. It is most likely to be high in circumstances where there are difficulties about informal communication, acquaintance, and trust among personnel of agencies with different traditions and missions. This ensures that the necessary channels of understanding and confidence are absent during a crisis. Institutional uncertainty can be high even in relatively consensual societies, if there happens to be a tradition of bureaucratic secrecy.

When the parameters of confidentiality are strained, _proprietary_ uncertainty becomes salient. Thus, in the midst of an emergency there may be a debate about the rights of persons to know, to warn, or to conceal.

_Scientific_ uncertainty is the last (but by no means the least important) type of uncertainty. It is mobilized at various phases of hazard including before, during, and after emergencies. For example, (scientific) risk assessments that are undertaken well in advance of a crisis may employ long-established techniques to evaluate industrial plants and equipment but may have to depend on less-seasoned methodologies to analyse the transport of environmental pollutants (Funtowicz and Ravetz 1990). When a hazard is in the acute (emergency) phase, the possibility of effective forecasting may be either good or poor, depending on the circumstances (which themselves cannot always be predicted). Thus, scientific uncertainty can vary from low to very high.

Two sets of strategies (table 4.3) are available for communication of uncertainty, one of which is an attribute of people or agencies that make decisions; the other refers to the way in which communication is accomplished. Some people may decide to _suppress_ information about uncertainty entirely, even from themselves. This may translate into a refusal to admit that uncertainty exists or a failure to notice it. It is an extreme form of _discounting_. Ordinary discounting will recognize a possibility but (as with many events in the distant future) will assign such a low value to its salience that it can be neglected for policy purposes. _Recognition_ of an uncertain contingency is a balanced appreciation. By contrast, _amplification_ is an emphasis - perhaps even an overemphasis - of the significance of uncertainty.

Corresponding to the interpretations are the policies concerning communication of uncertainties. At one extreme lies _secrecy_, the extreme case of _confidentiality_; then comes _publicity_, with its own extreme form - _sharing_. There are many variations and nuances in any practical policy of communication. The utility of these classification schema can be illustrated with reference to the Seveso disaster, the Seveso Directive, and the _Karin B_ incident.

_Modelling the Seveso disaster_

At the time of the Seveso disaster, the complexity of communication problems under conditions of severe uncertainty was recognized, if not fully managed. Before the gas release, no one outside the plant neither residents nor political or health authorities - had any idea that there was a hazard of such
From the very beginning of the disaster, situational uncertainty was salient; decisions had to be taken, sometimes under conditions of great urgency' in the nearly complete absence of information that might guide actions. Scientific uncertainty was salient, as shown by the fact that local investigating magistrates closed off the site within eight days of the accident. Societal uncertainty was severe because there had been no previous institutional preparation or consultation for the accident. Legal/moral uncertainty was also severe. For example, the (Swiss) Technical Director of ICMESA found himself under arrest when he attended a works meeting 12 days after the accident (the Director of Production was also placed under arrest at that time, and was assassinated by terrorists four years later). One of the few relatively straightforward aspects of the accident was the low level of proprietary uncertainty. Although the provision of relevant information did not proceed as quickly or smoothly as desired by all, at least there was no need for the government authorities to use legal means to force the firm to divulge information. The fact that the ICMESA factory was already sequestered would have made it highly imprudent for its owners to withhold information about the contaminants, and it was noted at the time that the dioxin threat had already been publicized by the media before it was officially confirmed. Later, and off the Seveso site, proprietary uncertainty was not as low, particularly in connection with the disposal of barrels containing toxic materials. From 1982 onwards, stories of concealment and blunders began to circulate and these have not yet ended (see Chronology).

Modelling the Seveso Directive

Our model of uncertainty management is also reflected in the regulations of the Seveso Directive. The main concern here is with communication:

> Member States shall ensure that information on safety measures and on the correct behaviour to adopt in the case of an accident is supplied in an appropriate manner, and without their having to request it, to persons liable to be affected by the major accident originating in a notified industrial activity within the meaning of Article 5. The information should be repeated and updated at appropriate intervals. It shall also be made publicly available. Such information shall contain that laid down in Annex VII.  
This portion of the Directive reflects concerns about several sorts of uncertainty. First, there is an attempt to institute progressive reduction of scientific uncertainty via updating requirements. Second, the various phrases that call for effective implementation of the public's right to know show clear awareness of the need to confront problems of institutional uncertainty and proprietary uncertainty. Moreover, the very existence of the Directive, particularly Article 8, underscores heightened awareness of legal/moral uncertainty, for the Seveso event showed that simple "accidents," or "acts of God," are not the most important problems affecting the safety of industrial installations and surrounding communities.

When we consider the implementation of the hazard communication requirements of Article 8, we find that the model illuminates practice. First, actual EC regulations seem to assume that societal and institutional uncertainties are not salient or severe. Nor do they deal with the possibility of situational uncertainty (i.e. less than complete competence of available official expertise for prediction, prevention, or control). The contrast between European and American practice is noteworthy. In the United States, provision is often made for the inclusion of alternative expertise via environmental legislation that permits the use of public funds for the incorporation of local citizens' knowledge into the policy discourse on the grounds of due process or fairness.

Modelling the Karin B incident

Finally, the model can also be applied to the Karin B incident. Some 12 years after the Seveso gas release, a shipload of Italian industrial toxic wastes was first dumped in Nigeria and then reloaded after protests. In the full glare of publicity and widespread public dread, the regions of Emilia-Romagna and Tuscany undertook the final task of disposal, in the process showing how a large quantity of mixed toxic wastes could be managed, with full satisfaction of technical requirements and local concerns.

Between the time that the Karin B was discovered to be carrying a toxic cargo and the eventual agreement on destruction of the wastes, all uncertainties were effectively out of control. Whoever knew about such shipments had previously kept them secret; when they were discovered, therefore, all the issues of knowledge, uncertainty, and responsibility came into play simultaneously. However, when the regional authorities of Emilia-Romagna and Tuscany together with several local authorities - finally took physical possession of the wastes, the change was dramatic. Acting in cooperation with each other and with the media, and creating opportunities for the participation of interested communities, they were able to reduce salient uncertainties, starting with the scientific ones and then proceeding to others, such as institutional uncertainties. The societal uncertainties became less severe and less salient, and the clean-up operation proceeded peacefully to a successful conclusion in all respects (Centro Informativo Karin B 1992; Egidi 1993).