3 RESULTS FROM DATABASE ANALYSIS

Rational decisions about catastrophe require an inventory of its sources, probabilities, geographic distribution, and trends. An inventory might help to clarify the social costs of disaster including those of prevention, reconstruction, as well as the less easily calculable social-psychological costs. (Orr 1979, quoted in Showalter and Myers 1992).

Thirteen dedicated databases or organizations with specialized databases were contacted including TNO in the Netherlands, BARPI in France, EnvIDAS in the UK, MARS at the Commission of the European Communities Joint Research Centre in Italy and the Fatal Hazardous Materials Accidents Database at Resources for the Future in the USA. Specialist Press databases such as the Oil Spill Intelligence Report were also contacted.

From analysis of their returns it is possible to distinguish several levels of accident reporting:

- full reporting of disasters of international proportions such as Chernobyl, Bhopal and Guadalajara.(See Appendix III).
- limited reporting about nationally important emergencies such as the Bangkok Port Fire(case study no 14, page 35)
- very limited information about the majority of accidents involving hazardous substances.

3.1 Major Disasters

There are some lessons which can be learned from examination of the internationally known accidents that have happened over the last ten years, and which served as catalyst for the development of programmes at both international and national level dealing with all aspects of hazardous substance accident planning, prevention, preparedness, response and recovery.(see section 2.3 on Bhopal. Broad lessons learned from the range of such disasters include:

- The importance of prevention and preparedness in emergency management
- That even with excellent facilities, training and planning serious accidents will happen
- That emergency response plans need to be flexible, yet sufficiently organized that responders know exactly what to do and have the equipment and training to do it
- The need for good quality information about the chemicals involved and the best response methods
- The importance of effective communications at local, national and international level
- The unfortunate truth that it often takes a disaster to improve emergency management and policy

These major emergencies are well known, thoroughly reported and investigated and have served as the catalyst for numerous initiatives around the world. They have been subject to extensive review which will not be repeated here. (for further information see Shrivastava 1987). However, despite such incidents being so well known, there are only limited opportunities to be ready for them when they happen again. Such disasters are characterized by being unexpected, often outside the scope of any existing contingency plan, characterized by a shortage of information at the moments of crucial decision-making and a general inability to cope by the disaster management team. Lagadec notes that even in developed countries *"from a breakdown, we regularly find ourselves slipping rapidly out of control and into crisis - which means, roughly speaking, a situation in which any corrective efforts made are hampered by a sense of confusion, helplessness, and aggravation"*. (Lagadec 1990). Two tentative conclusions follow from this:

- In preparing for major catastrophes of the magnitude of Bhopal and Schweizerhalle, there needs to be a backup to support countries which are faced with this crippling inability to

proceed. If developed countries find it difficult to cope, developing countries will need all the help they can get.

- It is important to prevent situations slipping out of control; this can be improved by strengthening the national capacity to manage smaller emergencies competently.

It is invariably cost effective to concentrate on the improvement of the national response capacity; however, it is difficult to know the full range of problems experienced by developing countries. This requires an assessment of the types of emergencies being faced in developing countries. Currently, such incidents are unknown, the impacts unrecorded and the ability to respond unimproved as a result. The databases were not much help in identifying detail that is required for such analysis.

3.2 Major Emergencies

TNO in the Netherlands and the UK Safety and Reliability Directorate were commissioned to review their databases for accident reports that would fulfill the study requirements. The TNO FACTS database, containing some 15,000 reports, could only identify 75 accidents that could fit the broad requirements of chemical incidents in developing countries. Countries in economic transition were not included in this search because of time and financial constraints. The list was then narrowed down to 37 on the basis of incidents where further information was available. After further research 7 incidents were selected as being neither so significant that they would be well-known, but reported in sufficient detail for lessons to be learned. However, despite the size and coverage of the TNO database, the information available is generally restricted to place, date and a brief indication of the effects and response operation. However, the main lesson from this exercise is that there is insufficient information available about the more common emergencies involving hazardous substances in developing countries. TNO note that *the lack of good accident data is obvious..the accident reports are never complete and are mostly focused on one item of interest.*(TNO 1993). Environmental effects are rarely discussed. (See Appendix IV).

Of the databases consulted only the Environmental Incident Data Service (EnvIDAS) of the UK Safety and Reliability Directorate specifically examines the environmental impact of accidents worldwide. They identified thirty non-marine oil spills and chemical spills in non-OECD countries. However, although a small number had detail of environmental damage, the great majority of reports contained only scant information from which very few lessons could be identified. A sample record is included in Appendix V.

The other databases contacted suffer from the problems identified with TNO and SRD. Therefore the only information available is a list of incidents with scant information. The accidents reported are not listed here because they are so readily available through other sources. However, the following trends could be identified:

- there are very few relevant accidents listed that specifically detail environmental damage
- the accidents that are listed suffer from inadequate detail
- accidents described as being of "environmental" significance often only list human impacts

The Center for Risk Management in Washington notes *"serious shortcomings exist in the way that natural disaster and major industrial accident data are generally reported. Until these are remedied, further research will be hampered by omissions, errors and ambiguities in the data. We found that none of the sources had a complete record of reports, and that there were often gaps in the reports that were given. Reports of the same event often differed significantly from one source to another and sometimes it was difficult to to determine whether two sources were reporting the same event."(Glickman, Golding and Silverman 1992).*

Similar findings were noted by the New York University International Environmental Law Clinic in their UNCUEA-commissioned report "Environmental Emergencies in Developed and Developing Countries". Press reports from around the world were examined to complement information available from formal databases. They found that "*comprehensive, consistent information about such accidents - including not only their rate of occurrence but also their causes, effects, and implications - is difficult, if not impossible to obtain...in developing countries, it appears as though many environmental accidents or disasters which do not rise to the level of a Bhopal chemical accident are grossly under-reported. Furthermore, the details for accidents that are in fact reported are scarce at best.*"(Rodgers and Rubino 1993).

Such findings are endorsed by the Commission of the European Communities Review of Environmental Accidents and Incidents. The study examined more than one thousand references to chemical accidents occurring between 1975-1990. They found 50% percentage mentioned the term "environment", but less than 5% (49 incidents) described any ecological consequence; of those only four incidents were from the developing world, and two of those were marine accidents.

Even in OECD countries ecological consequences were described in general terms such as "all the fish in the lake were dead". Most of the accidents affected river ecosystems, followed by marine and terrestrial ecosystems. Oil products and pesticides of various types predominated the available reports, probably because these substances were transported in such large amounts. One of the conclusions of the report is that *the low number of accidents reported is remarkable. Probably the number of real accidents is much higher.* (Community Documentation Centre on Industrial Risk 1992).

Therefore a general inadequacy in useful information can be seen at all levels; such poor quality data means that potentially valuable lessons are not being incorporated into the risk assessment process. The specific subset of accidents examined in this report, i.e. "accidents occurring in developing countries over the last ten years where environmental damage was threatened and for which international assistance would have improved response" needs to be seen in this context. The following list of datasets is ordered on the basis of apparently declining level of information availability and reliability:

1. accidents in general in developed countries with statutory notification requirements in place
2. chemical accidents that cause environmental damage in developed countries
3. accidents in general in developing countries
4. chemical accidents in general in developing countries
5. chemical accidents that threatened environmental damage in developing countries
6. chemical accidents that threatened environmental damage in developing countries for which international assistance would have improved response

It can be appreciated that if the first dataset is far from adequate for detailed analysis, the last is particularly difficult to analyze effectively!

3.3 Analysis of Database Results

There are several factors that can help explain the problems encountered in finding adequate information from databases; firstly the series of filters through which any accident information must pass. This would affect the quality of information about any chemical or industrial accident. To make matters even more complex, the identification of environmentally significant accidents suffer from the lack of agreed definitions of environmental damage and accident severity

Data Filters

Most databases rely on a combination of press reports, government and corporate information releases and formal or informal contacts in countries affected. Because many databases rely on similar sources there appears to be considerable overlap of information. This means that although some accidents are recorded (mainly the biggest in terms of news), it is inevitable that many more accidents do not find their way onto the international databases.

The breadth of coverage of accidents improves with the number of sources consulted. However, coverage in more than one source can also mean that inconsistencies appear in the data. One report examining the reliability of accident data found that 41% of the accidents they investigated showed discrepancies in terms of disagreements in the number of fatalities. (Haastrup and Brockhoff 1991). They also found that discrepancies increase with the number of sources describing the incident and that discrepancies were found, surprisingly, for larger accidents where a better reporting system could be expected. They also noted that while most sources managed to describe the data and place of the event with a "high" quality of agreement, the number of fatalities with a "medium" level of agreement, the type and quantity of the chemical involved was often missing altogether or the discrepancies were often factors of 2 or 3 in terms of spill size. If discrepancies in the number of fatalities and chemical type can occur in supposedly well reported, large scale accidents in developed countries then the quality of data for environmental damage in developing countries with poor recording can only be imagined.

From the reported accidents in developing countries, many accidents that may well be perceived locally as being of major importance are not recorded. Databases therefore tend to reflect a skewed distribution of accidents, covering many large accidents and very few less significant ones. This reversal of reality can possibly be explained by the series of filters through which information on accidents must pass before finding its way into the annals of emergency management and analysis.

Table 1: Possible filtering of accident information

FILTER	PROBLEMS IDENTIFIED	EFFECT CAUSED
Reporting	• - Government Policy	• -Only 'acceptable' emergencies recorded
	• - Varying Press freedom	• -Coverage varies with Government policy
	• - News Values	• -Only 'big' stories reported
	• - Poor Environmental awareness	• -Environmental effects ignored
	• -Different country approaches to official reporting	• -Little comparability between reports
	• - No standardized notification format	• -Poor quality information
	• -Delay in reporting accidents	• -Data appears years later
Database	• - Quality/Quantity of Press reports	• -Database reflects source material
	• - Overlapping use of Press reports	• -Overlapping coverage of some events, no coverage of others
	• - Corporate confidentiality	• -Restricted access to sensitive incidents
	• - Quality of formal and informal contacts	• -Variability in quality and quantity of national coverage
	• - No standardized reporting	• -Little detail available, also means different databases contain contradictory information about some incidents
	• -Different database designs and parameters	• -Difficulty in comparing data
	• -No agreement on definitions of severity and impact	• -Variability in data, confusion as to exact requirements
	• -Most databases are "extract" databases, i.e. they do not report the full text of the primary source	• -Potential to lose elements from the primary source
Project specification	• -Need to access different databases with different parameters and design	• -Difficulty in ensuring similar coverage of events because of differences in accessing techniques
	• - Project criteria open to interpretation by different database managers caused by no agreed definitions of severity or impact	• -Uncertainty about consistency of coverage

The Press

The press have a particularly important role to play in the recording of chemical accidents; international press and local press are often subject to different pressures from government policy and whereas local journalists might know of particular accidents, being able to record them accurately is often a matter of political sensibility. The international press are generally not so constrained but suffer from the problem of sufficient coverage in depth to notice the smaller emergencies; also what might newsworthy in a local context often will not match the news values of international press. Specialist press have a particularly important role to play; often their specialized focus enables good in-depth coverage of stories that might otherwise be censored or ignored. They also have a role to play in sorting fact from rumour, or even worse, propaganda. For example when a pipeline spill occurred in northwest Equador, initial rumours included blaming a tanker splitting in two off the Equadorian coast. Also estimates of the size of the spill varied widely from 400,000 gallons down to 50,000 gallons. The US based Oil Spill Intelligence Report, with a world-wide network of specialist correspondents, were in a position to cover the story in the depth associated with trade press, with the freedom and objectivity of the international press, thereby dispelling rumours and covering all angles. (Yando 1993). Such specialist journals often maintain their own databases; e.g. the OSIR database identified 277 terrestrial oil spills in non-OECD countries within the last ten years. Again, as with all such databases. the depth of coverage, especially of environmental damage, varies widely from in-depth to very little.

The International Environmental Law Clinic at New York University conducted a survey of press materials on environmental emergencies; they identified 153 incidents that were reported as occurring in developing countries. Of those, 32 involved oil and 106 were chemical or industrial accidents. The report notes that *even fairly thorough reports often target only a subset of the total environmental emergencies which occur. Many reports of oil spills, for example, do not include spills which release a quantity of oil that falls below a certain "de minimis" level. While small spills are less likely than large spills to cause severe environmental damage or to require extensive cleanup efforts, small spills may have cumulative effects on a particular are if they occur with sufficient frequency. (Rodgers and Rubino 1993).*

Basic trends in OECD countries

The track record of chemical accidents in developed countries, as represented by the OECD, shows that the numbers of accidents are generally falling as a result of better prevention and safety management. Their voluntary accident notification scheme, despite the problems of completeness identified earlier, means that accident records are much better compared with developing countries and some tentative conclusions as to environmental impacts of chemical accidents can be arrived at. The EnvIDAS database in the UK found that for transport accidents, impact damage (when the transporter hits either a stationary object or another moving vehicle) as being the most frequent cause of releases in such accidents while mechanical failure and human error are the main causes in fixed sites. Water is overwhelmingly the most likely element of the environment to be affected and that flowing water courses are the most likely medium into which pollutants will be dispersed. (Allen, Fryer and Zahid 1992). The US Fatal Hazardous Materials Accidents Database found that 46% of accidents in their records involved transportation. (Glickman, Golding and Silverman 1992). However, despite the limited quantity of data available, it is likely that non-OECD countries face the greatest challenges.

Definitions of Environmental Damage and Accident Severity

For most accidents, deaths and injuries are an adequate measure of significance. However, such statistics cannot be seen as an adequate measure of total environmental impact of an accident. While human impacts must be considered, such statistics should simply be seen as another factor in the equation of overall environmental impact.

environmental consequence, areal extent of damage was placed at approximately 5km polluted length of river, 10,000m2 area polluted or approximately 1,000kg of animals involved. (TNO 1988). All such figures can be seen as being somewhat arbitrary, but they present a useful starting point in accident selection.

Other attempts to identify and define severity and damage of industrial accidents have been carried out by the Commission of the European Communities. Their Industrial Accident Scale was devised to allow Member Countries to categorize accidents and hence be able to exchange information on an equivalent and reciprocal basis so that feedback on accidents could be introduced into future prevention and response mechanisms. This scale utilizes a 6-level scale from 0 = worthy of note, to 5 = Catastrophic. Grading an accident depends on parameters characterizing actual or potential danger, consequences and intervention measures. This covers the quantity of a substance released as a percentage of the Seveso threshold, the number of dead and injured and the scale of response required. An attempt is made to include environmental damage by introducing tonnage of wild animal and domestic animals killed, the tonnage of marine and freshwater life killed and areas of contaminated soil.(Community Documentation Centre on Industrial Risk 1990).

However, there are flaws in such an approach. For example, although it is attractive to simply divide the consequences into groups of tonnage killed, such a measure pays no regard to the original biomass of the affected ecosystem and the percentage of that population killed. eg under the present system more than 100 tonnes of fresh water fish killed is described as a "catastrophe" whereas up to 0.5 tonnes is seen as being "worthy of note". This assumes that the lake or river has an unlimited biomass; if the ecosystem only has a total fish biomass of 1 tonne, then 0.5 could be seen as catastrophic. However, despite such problems, the scale was one of the first international attempts to identify significance of environmental damage from accidents. The orginal scale is in the process of being refined to take account of the problems inherent in the approach.

In the UK a *"major accident to the environment"* occurs if *"permanent or long term damage is caused to particular unique, rare or otherwise valued components of the man-made or natural environment, or if there is widespread environmental loss or damage."* (Department of the Environment 1991). The DOE note that *"the time likely to be taken for unassisted recovery to a state close to the original is an important factor. It will depend on the type, susceptibility, diversity, abundance, colonizing ability and population processes of the species involved...for the purposes of the present definition, a projected recovery period longer than about 15 years for terrestrial habitats and about 5 years for aquatic habitats is taken to represent long term damage, although lesser time scales are sometimes appropriate".*

However, it is important to see such attempts to classify accidents in the context of developing countries. Such systems described above may be useful in countries where the expertise, technical resources and institutional framework exist to survey sites, identify significance and estimate recovery time. Unfortunately such facilities are unlikely to be adequate in many developing countries.

The APELL (Awareness and Preparedness at the Local Level) programme of UNEP tries to build national capacity building in developing countries by providing access to training materials on risk and hazard analysis. For the purposes of their work, they identify a five scale measure of environmental consequences arising from industrial accidents. The format is intended to be used in practical hazard assessment in developing countries.

Table 3 Classification of environmental consequences of potential accidents APELL Guidelines

	SEVERITY GRADE	CHARACTERISTICS
1.	Unimportant	no contamination, localized effects
2.	Limited	simple contamination, localized effects
3.	Serious	simple contamination, widespread effects
4.	Very Serious	heavy contamination, localized effects
5.	Catastrophe	very heavy contamination, widespread effects

(UNEP IE/PAC 1992)

While relatively unsophisticated, such a scale can start developing countries on the process of considering hazards, risk and consequence without the requirements of extensive equipment or specialized expertise.

From a governmental perspective it is important that accident impact can be assessed: there appears to be a general view that environmental damage must be great from such chemical accidents but the *lack of information, uncertainty about consequences, and highly subjective perceptions of risks, further enhance perceptions of damage*. (Shrivastava, Mitroff, Miller and Miglani 1988). So increased knowledge of environmental implications can not just help with improving response mechanism, it can also place such accidents firmly into context of seriousness and risk.