Contradictions Inherent in the Management of Natural and Industrial Disasters

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ABSTRACT: These days people keep wondering whether the world is more dangerous now than it was before. Do natural disasters really happen more frequently or is it just that the damage they cause that has become greater? The situation is not quite clear. As a result of the globalizing world and advanced communication infrastructure, the number of known / reported catastrophes is relatively high, but that does not necessarily mean there has been an actual increase in frequency. The red mud spill in Hungary was a special combination of industrial and natural disasters. This is one of the reasons why it is very hard to pinpoint who is responsible for the event. Natural disasters tend to raise questions about responsibility that are different from those concerning industrial catastrophes. Interestingly enough, however, nature often plays an important role in industrial disasters. The present article is concerned with how the issues of responsibility are handled in the case of industrial disasters.

KEYWORDS
environmental risks, managerial responsibility, industrial accidents

JEL-codes: P48, R11, H23, O13, Q16, Q5, Q50

I. INTRODUCTION

Tom Massey, director of RWE Power, admitted in reply to a question that "*Fifteen years ago, companies were saying that climate change was not relevant to business. You could not measure it, companies had no individual responsibility for it and there were no global regulations to control it. Many companies argued it was not happening at all. Scientific evidence and government action have fundamentally changed this scenario.*"

Yet this is just the usual way in environmental protection. The carcinogenicity of asbestos had long been proven by science when large building material producers still insisted that slates and asbestos-cement pipes were harmless. It also took a long time to convince economic actors that halogenated hydrocarbons damage the ozone layer and to achieve limitation or prohibition of their production and use.

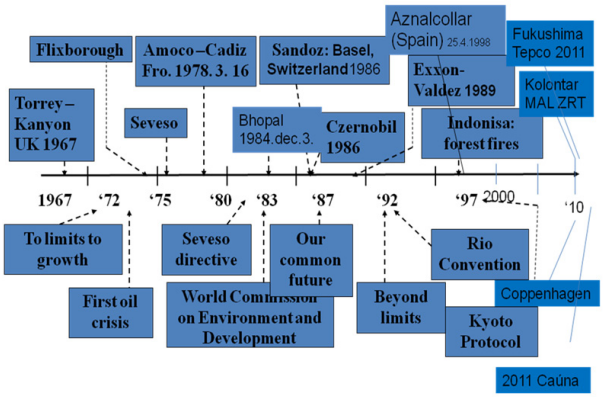

Figure 1: Historical overview of accidents

The front page of the world-renowned economics periodical *The Economist* has hardly featured anything but climate-change-related news for the last couple of years. Still, I am rather certain that it is not these articles but rather extreme weather events (like the 2005 Hurricane Katrina that killed more than 1800 people and flooded the city of New Orleans) that will call the attention of the public to the potentially disastrous impacts of climate change. The tsunami following the Great Sumatra-Andaman earthquake which killed 225,000 people has had a more significant effect on humanity than all the UN development summits that have been held for years. These phenomena made the public realize that, in spite of all our ingenuity, humanity does not "rule over" nature. It took more than 225,000 lives to make us consider that all we have "achieved" so far is to create a weapons stockpile which, even in case of an accidental misunderstanding, is powerful enough to destroy the entire Earth. We do not, however, have anything to protect us from drought-triggered famines, or AIDS, and even less from earthquakes, the latter of which we cannot even forecast. Even the most sophisticated models fail at coping with nature's "inventiveness."

We are surrounded by natural and industrial disasters. The threat is growing continuously despite humanity's enormous efforts to avoid risks. The figure below makes it obvious that even though international efforts have increased in number, industrial disasters have not become any less frequent. The waves stirred by Hungary's 2010 red mud catastrophe have not even settled yet, and still we are already in the middle of a nuclear crisis at Japan's tsunami-stricken power plant.

Risk, by definition, is the product of two factors, the amount of damage expected to be done by an event that threatens people's lives and valuables and the probability of that event occurring. Given the continuous growth in the population of the Earth (and in the wealth it possesses), environmental risks are obviously increasing as well, no matter whether disasters are becoming more frequent or not.

Image 1: Aznalcollar (Spain). Failure of tailings dam retaining wall, 25 April, 1998.

Image 2:Kolontar (Hungary). Failure of the 'red mud' dam retaining wall, 12 October, 2010. .

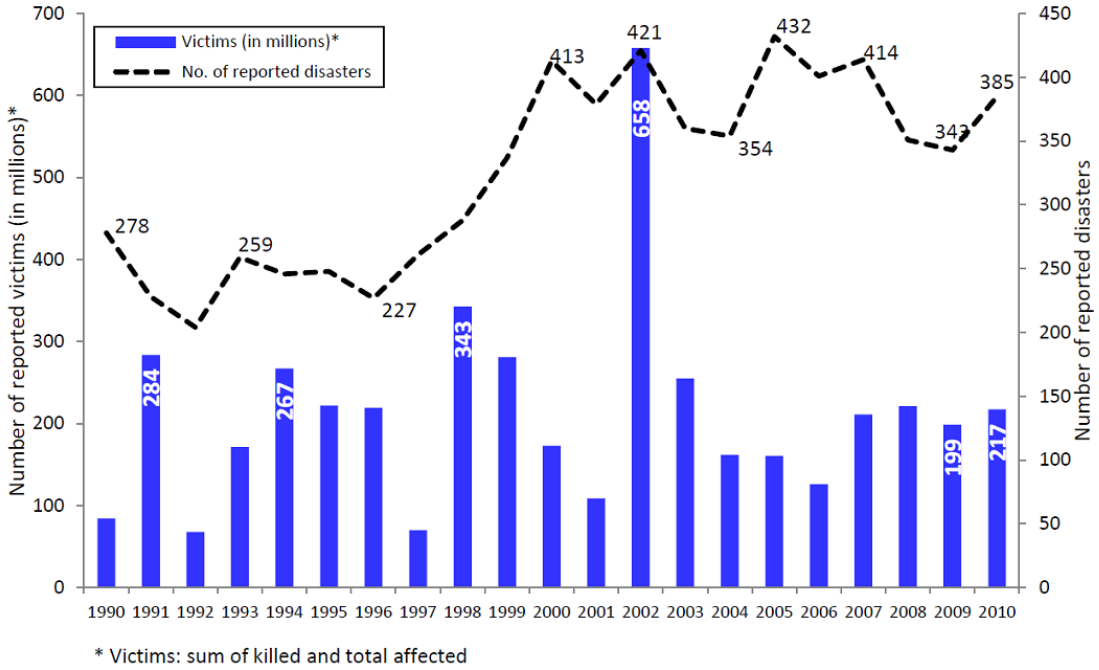

Figure 2. Columns show the numbers of victims in millions, while the dashed line represents the number of reported events. ("Guha-Sapir D, Vos F, Below R, with Ponserre S. Annual Disaster Statistical Review 2010: The Numbers and Trends. Brussels: CRED; 2011. p.3. http://www.cred.be/sites/default/files/ADSR_2010.pdf.)

Still, the answer to the popular question whether today's world is more dangerous or not is rather unclear. Have natural disasters really become more common, or is it just the damage done that has grown? There is no definite answer. As a result of a globalizing world and advanced communication infrastructure, the number of known / reported catastrophes is relatively high but that does not necessarily mean there has been an actual increase in their frequency. The total number of victims also is not above the average of many years.

Considering per capita damage, the picture is even more confusing. The population of the Earth continues to grow exponentially, thus the denominator also grows rapidly. Yet while the number and severity of disasters is fluctuating, there is no clearly visible upward trend. This would suggest a *drop* in relative risk. The *increase* in risk, consequently, is instead caused by rapid growth in accumulated wealth, which also is responsible for the increasing value of insured damage (see figure 3).

Even conservative professionals have no doubt that the risks related to climate change have actually increased. Among other phenomena, floods are often associated with climate change and are apparently becoming more and more common in Europe as well. As evidenced by the two tables below, European statistics about the frequency of and the damage caused by floods do not fully support the former assumption though floods have indeed become more frequent, both the numbers of people affected and the amount of damage caused has fallen during the last ten years. The improvement indicated by these figures is, of course, a consequence of efficient flood control measures. As we can see, appropriate protection might offset or even reduce the growth in risk induced by accumulation of

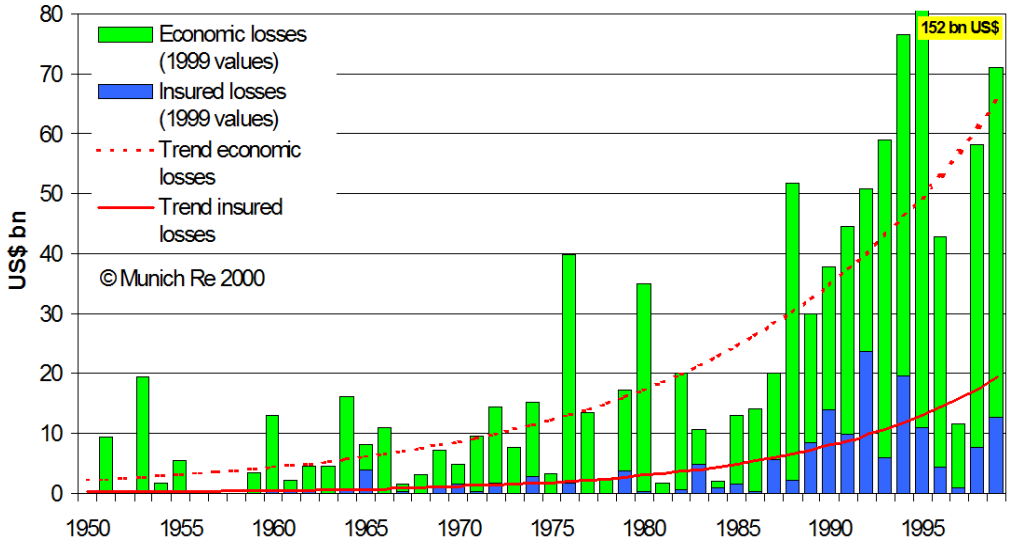

Figure 3: Changes in Economic Losses (green columns) and Insured Damage (blue columns), 1950 to 2000. (Source: Munich Re: 2000 http://www.munichre-foundation.org/NR/rdonlyres/E7ED6B1D-2D9F-4E64-9FB3-5C8A4539AD9B/0/20051116_Hoeppe_Hohenkammer_short_WEB.pdf)

	1980-2009	*2000-2009*
Number of floods	*239*	*147*
Number of countries affected	*22*	*19*
Number of people killed	*1309*	*511*
Number of people affected (millions)	*3.0*	*1.3*
Economic losses (billion USD)	*92.3*	*45.0*

Table 1: Floods and their Impacts (total) in European Countries. Source: EM-DAT The OFDA/ CRED International Disaster Database

wealth.

Nevertheless, the costs of protective measures are very high. Rich European countries already have appropriate flood protection systems in place, yet efforts still continue. In economically underdeveloped regions like Bangladesh, floods still cause incredible devastation. The 1970 storm took more than half a million lives; the storm in 1991 killed "only" 138,000, while the 2007 flood caused 1,042 deaths. Although flood control protection systems are being built in these regions, too, the poor are more severely hit by natural disasters. Some storms and floods can at least be forecast in advance. There are, however, natural disasters that cannot be predicted, and there is no suitable way of ensuring protection against them. Earthquakes or tsunamis will follow some of them.

II. COMBINATIONS OF NATURAL AND INDUSTRIAL DISASTERS

The red mud spill in Hungary was a special combination of an industrial and a natural disaster. This is one of the reasons it is difficult to pinpoint who is responsible for the event. Natural disasters

Countries	*Number of floods*	*Number of people killed*	*Number of people affected*	*Economic losses (billion USD)*
Romania	*25*	*169*	*1187,400*	*1.7*
France	*14*	*34*	*22,500*	*1.6*
Greece	*14*	*15*	*12,200*	*0.7*
Italy	*13*	*72*	*20,000*	*2.1*
UK	*12*	*26*	*379,500*	*16.6*
Bulgaria	*11*	*52*	*13,300*	*0.5*
Austria	*8*	*1*	*45,800*	*0.2*
Hungary	*6*	*14*	*61,400*	*3.8*
Czech Republic	*6*	*38*	*218,800*	*3.1*
Germany	*6*	*29*	*331,600*	*14.1*

Table 2: European Countries most Severely Hit by Floods (2000-2009) Source: EM-DAT The OFDA/ CRED International Disaster Database

tend to raise questions about responsibility that are different from those of an industrial catastrophe. Interestingly, however, nature often plays an important role in industrial disasters. Extreme weather played a role in both the Exxon Valdez incident and the accident in the Gulf of Mexico. The role of exceptional weather conditions—rainfall amounting to ten times the average and a severe windstorm—was also mentioned in connection with the accident in Hungary. Yet do extreme rains and winds, as extraordinary natural phenomena, relieve corporate managers from their responsibilities or limit their extent thereof? How should the important principles of environmental protection, such as the "principle of due diligence" or the "precautionary principle," be interpreted in the context of industrial disasters or activities associated with high ecological risks?

The Harvard case study treated the Exxon Valdez incident as a human resource issue. According to the study written by the world's leading business school, the problem was that the tanker's captain was an alcoholic. Leaving the crew and the cargo to be transported by an alcoholic was no doubt an HR mistake as well.

It is surprising, however, that the case study did not mention the continuous environmental catastrophe many huge oil tankers had been causing. They regularly pumped sea water into their tanks on the way back from port and then pumped the oil-contaminated water back into the sea near the oil port. No one intended to call to account the owners for this "slow catastrophe." Also, the case study never mentioned that the size of the tankers represented an unjustifiable magnitude of risk. Those enormous tankers were only built to economize on oil transportation costs. Accordingly, fuel became a bit cheaper in the US, while corporations' profits grew still larger. Whether the saving of a few cents per liter is worth the increased risk of a potential environmental disaster has, "naturally enough," never been investigated.

Morelli (1999) argue that business and industry are preparing for dramatic shift in responsibility. Recent decades have showed that trust has become a fundamental issue for both governments and economic actors. According to Eurobarometer surveys, politicians and corporate managers are no longer trusted by European citizens and neither are scientists. One could make the rather cynical argument that the public does not greatly trust NGOs

either, even though the public establishes them.

It was an apparent sign of mistrust that, besides Hungarian green organizations, two international NGOs – Greenpeace and Robin des Bois from France – also decided to have an on-the-ground presence at the site of the red mud catastrophe.

Based on the work of respectable scientists and a number of studies, a significant number of Hungarian institutions concluded that neither drinking water sources nor the soil were endangered by the spilt material; nevertheless the two NGOs flooded the media with statements claiming quite the opposite.

"*Robin des Bois can not really give credence to the statements of those Hungarian professors and scientists who claim that there is no risk of radioactivity, nor of heavy metal migration into the deep soil layers*" (36). This is despite the fact that they only sent two experts to the affected area who reported that "*The area flooded by the red mud spill in Hungary directly affects the lives of some 8,500 inhabitants. Only to mention a couple of examples: approximately 70 tons of arsenic, 70 t lead, 130 t nickel, 650 t chromium, 700 t vanadium, 1 600 t sulfur and 114 000 tons of aluminum were released into nature. Arsenic, nickel and chromium 6 have carcinogenic effects*" (3).

And: "*On 4 October 2010, at 1:30pm, the western wall of one of a chain of red mud reservoirs operated by Magyar Alumínium ZRt—MAL collapsed, freeing about 600 to 1,000 thousand cubic meters of red mud, a waste product of the bauxite refining process*" (4).

I did not actually check whether these numbers are correct, but they do sound rather frightening. What I do know, however, is that those elements were not added to the mud during the process, but they were there originally, and their concentration could have doubled at most, and even then only if the bauxite had been of very good quality. (In this case sodium hydroxide would have dissolved at almost half of the bauxite ore—only the aluminum oxide part—thereby increasing the concentration of various other elements in the remaining mud.). Of course, that does not make those elements "free" either, as they are present in the mud in the form of insoluble compounds.

A long citation such as the following may not be exactly appropriate, yet in this very case, it might be worth knowing what the "official" statement (not really read by anyone outside Hungary) reports:

"*Based on the independent examinations of the National Institute of Environmental Health and the experts of HAS, there are no significant amounts of metal contaminants in the red sludge and the concentrations of toxic metals do not exceed the standard limits in the soil, but the pH measured from an aqueous extract of the industrial waste is 11.8, which indicates a strong base. According to the analysis of the samples taken by the Institute of Materials and Environmental Chemistry of the Hungarian Academy of Sciences on October 5th, the red sludge contained cadmium, chrome, mercury, nickel, lead and zinc in concentrations smaller (in some cases considerably smaller) than the values allowed for waste mud. The arsenic content of the samples taken from the area of Kolontár and analyzed by the Institute of Materials and Environmental Chemistry was also less than the values allowed. The laboratory analysis of the soil samples taken on October 8, 2010 conducted by HAS' Research Institute for Soil Science and Agricultural Chemistry has shown that heavy metals from the red sludge did not reach deeper than 10 centimeters into the soil, and even there their level did not exceed the values permitted for contaminants. Based on these results, it is safe to conclude that the deeper layers of the soil and the first water-table are not in immediate danger.*

Based on laboratory analyses, the Office of the Chief Medical Officer has issued a statement to the effect that the red sludge waste matter is dangerous to human health, living organisms, and the environment because of its highly basic effect.
Experts of the National Service for Radiation Health

Emergency Preparedness examined the radiation levels of the affected area, mainly in Kolontár and Devecser. The spilled red sludge is not radioactive. The so-called activity-concentration of the samples gathered is close to natural values of soil, so it is safe to say that they do not pose health risks. According to the official statement of the National Service for Radiation Health Emergency Preparedness, the red sludge does not pose any health risk for those living in the area as far as radioactivity is concerned.

After the analysis of the samples taken according to strict regulations, The University of Pannonia and the National Public Health and Medical Officer Service announced that the amount of airborne dust in the affected areas has not exceeded the levels allowed since October 17, and the level of air pollution has decreased in every settlement examined. In order to continuously monitor the level of airborne dust in the affected areas, the National Service for Public Health and the Middle-Danube-Valley Inspectorate for Environmental Protection, Nature Conservation and Water Management have been operating an integrated monitoring system since October 11.

There is on-going quality control of drinking water in the area stricken by the disaster. Water can be safely consumed over the whole area. The Middle Transdanubian Regional Institute of the National Public Health and Medical Officer Service has conducted more than 120 examinations so far to monitor the quality of water, and all results are negative." (http://mta.hu/mta_hirei/osszefoglalo-a-vorosiszap-katasztrofa-elharitasarol-a-karmentesitesrol-es-a-hosszu-tavu-teendokrol-125859/)

An international NGO, some easy-to-deceive Hungarians might think surely the government wants to do us some good. It is no wonder that society's trust has faded, a finding which is worsened by news broadcasts that reveal serious defects in our institutions, indicating, for example, that we could not even pinpoint the authorities responsible for licensing or operational supervision.

"*In its ruling, the Budapest Court of Appeal named the Middle-Danube-Valley Inspectorate for Environmental Protection, Nature Conservation and Water Management as the building control and construction supervisory authority responsible for the Ajka mud reservoirs,*" reported daily newspaper *Népszabadság*. This recent final ruling put an end to the legal debate whether it was the local notary or the environmental authority that should have inspected the condition of the walls of the ruptured reservoir. In its decision, the court concluded that the red mud reservoir and similar facilities "*had required and still require special licensing and operational regulations which can not be handled in standard building control proceedings.*" Thus the Ajka alumina plant falls under the scope of authority of the environmental inspectorate. Following the red mud catastrophe, Secretary for Environmental Affairs, Zoltán Illés, declared that it was not the authority under the supervision of his own office but rather the local notary who acted as a building control authority in the case of the reservoirs. After the accident, the regional environmental inspectorate and the Public Administration Office of Veszprém County ordered several building control proceedings to be conducted by the notary of Devecser, who, however, declined to do so "for lack of authority." (http://greenprofit.hu/forum/viewtopic.php?f=34&p=28048)

The debate, of course, is still ongoing. Interestingly, society has begun to pay more attention to the role of authorities and other political aspects, while limiting the responsibility of the company operating the reservoirs to the question of material compensation, just as good taxpayers do. The "big" questions turn out to be,Who issued the permits and who supervised the operation of the reservoirs? In this case, the question of responsibility is a multi-faceted one.

Concerning the responsibility of the local notary or the mayor, one might ask why there were people living near the dam and how and why their permits had been issued, or, if they did not have the necessary permits, why was it not ensured that they were prohibited from actually living there? It is hard to imagine, however, how a local notary could be responsible for the building permits for the reservoir itself. Having some knowledge about how environmental authorities operate, we know that they also do not have the necessary expertise. The Office of the Parliamentary Commissioner for Future Generations suggested that the Hungarian Office for Mining and Geology might be the competent authority. Although we know this now, it was not all that clear up until now. Had we known the competent authority, could we have avoided the disaster? Probably not. Supposedly, satellite measurements might be able to detect whether the soil is moving and how fast. If it is actually moving, this could lead to the failure of the dam. Who should conduct such examinations, the authorities or the company operating the reservoir? Both of them, I guess, but the "principle of due diligence" would rather assign that responsibility to the operating party, especially as the authorities, under the "precautionary principle," hardly have a chance to know all the potential risks, technologies, and sources of human error. The operating company has the necessary means for that, and they, too, earn the profit and not (or just very indirectly) authority employees.

Risk theory distinguishes between fair and unfair risks. A risk is considered fair if the accidental and material damage of the hazardous activity is borne by the same "person" who enjoys its benefits. This is, of course, merely rational (or maybe even emotional) reasoning. Most likely, legislation could never deal in practice with such concepts. International experience and practice, which may serve as a starting point in finding a solution, do, nevertheless, exist in this field.

III. INDUSTRIAL DISASTERS AND HOW THEY ARE TREATED

Recently, the number of cases where managers have been subjected to criminal trial because of their companies' environmentally harmful activities has been growing, primarily in Canada and the US. This is theoretically possible under Hungarian legislation as well. Managers usually react defensively to actual legal practice. First, professional reactions tend to emphasize the need for adjustments in legal practice and for providing improved personal protection to managers.

Corporate managers, apparently, consider complex, bureaucratic, and overdocumented environmental management systems (typically developed by external consultants) to be the best method of defense in civil law proceedings, though it is quite obvious from American examples that this is not a sure-fire method of defense.

The environmental risk of any activity is inherently uncertain, even theoretically. Wynne makes a convincing point about this with respect to hazardous waste materials, "*Scientific uncertainty is rather high about what is going on inside a waste dump site in chemical, physical and biological terms, while opportunities for examining and reducing this uncertainty are very limited. Therefore we can only make approximations about the impact a dumpsite has on the surrounding area, as the effects are always dependent on how the dumpsite is operated. The conditions under which waste is transferred to a dumpsite and which site it is transferred to is also a function of a number of unknown social factors*" (Wynne).

Considering Wynne's thoughts, one might conclude that corporate managers practice the "art of the impossible" concerning environmental management. Yet we should not forget that the lack

of a theoretical solution does not necessarily imply that there is no practical solution. Concerning the avoidance of environmental risks, scientific accuracy is not a requirement but on the contrary responsible conduct is (usually defined as due diligence in legal terms) (Bartman).

For practical purposes, the environmental risks of any business activity can be analyzed along two dimensions. One of them, in our opinion, is a function of the materials, technologies, and human resources used, since these are the factors determining the company's inputs and outputs and also the frequency and the course of breakdowns. This dimension contains everything that depends on the internal systems of the company.

The other dimension is the company's perception of the ever-changing outside world. We consider this dimension as including the company's geographical location, the ecological characteristics of the surroundings, biodiversity, prevailing winds in addition to demographics (population density, age, and income distribution), and other characteristics such as the existing infrastructure (roads, telecommunication networks, and the presence of hazard intervention systems), the population's educational level, environmental attitudes, employment levels, and political institutions.

Obviously, both dimensions are rather complex, but making a distinction is important as both corporate managers and regulators tend to devote serious attention to the first dimension (environmental risks pertaining to the company's internal matters), while the effects on risk of all the external factors have an inclination to be forgotten by both directors and the authorities. Typically, it is only after a major catastrophe that they realize the existence of these phenomena.

There are many examples that demonstrate the significance of these two dimensions. In Hungary, for instance, a number of chemical factories have found themselves enclosed by ever-expanding cities. Previously, while still located in the outskirts, not even a factory with serious pollution potential had caused a problem, as any pollution releases were diluted before reaching the more densely populated city areas. Later, however, the situation changed. Today, even a company strictly adhering to all pro-environmental requirements might have environment-related conflicts and issues.

IV. CONCLUSIONS

Informing local citizens and preparing them for damage containment is at least as important to the future of the company as reducing the probability of occurrence. In the case of a potential accident, it is critical whether or not local inhabitants and disaster response organizations are prepared to reduce the adverse consequences of any accidents. Both the Bhopal and the Chernobyl disasters, and even this recent red mud catastrophe in Hungary, would have claimed far fewer lives if the authorities and inhabitants had been prepared for the possible occurrence of such an emergency.

We believe that companies should not limit their theoretical and practical environmental risk prevention efforts to their own premises but also should have to take into account the constantly changing natural and social environment. Corporate environmental management, thus, must not be limited to within the company's own four walls.

What we can learn from the red-mud accident in Hungary and from Bhopal and other above mentioned cases, that corporations very often prepared for accidents but even more often they are insured against them. Managers are ready to make any efforts which reduces their personal responsibility. They are often employing external experts preferable very highly respected ones, they are ready to pay for an expensive insurance and they are ready to cooperate with different authorities. All this will not protect them fully against the accidents.

Any company has to meet with the strickest environmental and risk regulation and should have a good environmental performance record, and keep good communications with people living in the surrounding. But they have to understand, that the good communication and the implemented environmental management system, the experts and the advisers even the „working permission" issued by different legal authorities, can not protect them against their moral responsibility for the society and for the local community. Those who are directly gaining the benefit (profit) from an operation, they are and they should be the real experts, so they should take the full responsibility for it, even in a case of natural disaster or terrorist action against them. The moral responsibility of corporate leaders can not be shared with external actors.

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