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Managing disasters involving hazardous substances in Canada: technical and sociopolitical issues

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Abstract

This article focuses on the management lessons learned from disasters involving hazardous materials, which occurred in Quebec, Canada, between 1988 and 1995. The findings of the previous case studies of Canadian and some other disasters are considered as well. Both technical and sociopolitical issues on the disaster management are contemplated from the viewpoint of complexity and uncertainty. A distinction is made between the two concepts through specific examples. In addition, two types of uncertainty, first and second-level, are differentiated. The relationship between technical and sociopolitical issues of such management are then illustrated, and the salience of efficient disaster risk communication between technical specialists and the public for bridging the gap existing between these two types of issues is shown. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

What is a disaster? As one of the recent and most comprehensive studies shows [1], neither a unique and/or universal conceptualization nor a common definition exists in the social science literature. In our previous research and in this study, we consider a disaster as “a sudden, low-probability event, with such important consequences for the surrounding community that it gives rise to tensions in the social fabric of that community” [2]. By this we mean that, when a disaster strikes, the normal functioning of a community is jeopardized in the sense that unusual action must be taken to cope with the disruption. In the research, the operational definition of such a disruption was an evacuation. Thus, even though train derailments are sometimes called accidents, when they entail evacuation, we call them disasters.

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Disaster managers face two important types of issues, technical and sociopolitical [3]. An issue is a broad grouping of activities surrounding questions to be solved. Technical issues deal with the threat, and include search-and-rescue, meteorological forecasts, firefighting techniques, site safety, environmental considerations, etc. Sociopolitical issues are related to the needs of the affected community: evacuation (or confinement), shelter, health care, etc. This category also includes relations with elected representatives, because in Canada the mayor is the person ultimately responsible in such a case, and because every disaster has an important political dimension [4]. The two types of issues are interdependent in the sense that, for example, an evacuation can be influenced by the techniques adopted for coping with the danger, and these in turn by the possible consequences for health – or vice versa. This is why coordination and communication are essential if these issues are to be managed effectively.

In the literature, the management of disasters involving hazardous substances has been found to be particularly complex [5]. One of the reasons for this is the fact that the management of technical issues is itself complex and requires specific expertise, relatively inaccessible to the layperson. When, in addition, there is uncertainty associated with the issues, it becomes even more important to explain the technical decisions, both to those coordinating the sociopolitical issues and to the public at large. Indeed, more and more, the community's representatives and the general public want to understand the technical part of disaster management. Furthermore, it must be remembered that it is a layperson, the mayor, who is ultimately responsible for the response in his or her community (at least in Canada, as seen below).

The discussion that follows is based on the results of research on disasters in Canada, and will focus on the case studies of a few disasters which have occurred in Quebec, Canada, since 1988, and which involve hazardous substances: a PCB fire, a tire-dump fire and two train derailments, one involving sodium hydroxide and chlorine, and the other propane. Although it is always difficult to make comparisons — because no two disasters are alike — the article illustrates the importance of looking at these technical and sociopolitical issues from viewpoint of complexity and uncertainty. A distinction will be made between the two concepts, through specific examples. Before going further, however, a summary of the Canadian disaster management system would appear to be necessary.

2. The Canadian disaster management system: an overview

The activation of the Canadian disaster management system (CDMS) rests with the municipality when the consequences of a disaster affect a community. Officials at the municipal level will ask for help from the provincial level if more resources are needed than the municipality can mobilize to cope with the disaster. The relationship is the same between the provincial and federal authorities. There are a few exceptions to this model, however, which apply when the disaster occurs on federal property: in such a case, federal authorities are in sole charge of the response. In all the provinces of Canada, unlike other countries, there seems to be a reluctance to call in the army.

The pattern of lateral coordination varies. At the federal level, coordination is the responsibility of what is known as the "lead department". This means that federal coordination will vary, depending on the type of disaster and the main specialty involved. This model is based on the premise that those services will have to be paid for following the disaster, and it is the lead department that will do so. Civil protection, called Emergency Preparedness Canada, headed by the Minister of National Defense, tends to act as an administrative coordinator of the required federal resources.

In Quebec, the provincial government has adopted a different model of coordination. The civil protection authority, called Civil Security, headed by the Minister of Public Security (also responsible for the police), acts as the formal coordinator, whatever the type of disaster. In a municipality, the coordinator is formally designated in advance by the municipal council: this individual could be the City Manager, or it could be the fire chief or police chief (or both, when the two belong to the same service). This theoretical model is, in reality, much more informal, because these officials come to know one other through contact prior to the disaster. This helps to develop cooperative interjurisdictional relationships [6].

In the case of hazardous substances, the risk generator, i.e. company management or the individual owner, is supposed to be in charge of disaster management. This means that (s)he will take care of the technical side of the disaster, with the help of experts if necessary (private or public), while the municipality will take care of members of the public who are affected (evacuation, etc.). In the end, the risk generator will be held financially responsible for the expenses incurred. However, the pattern is different for small businesses, where the owner tends to leave the responsibility for the response to the municipality, i.e. technically, to the firefighters. Most of the time, as it does not have sufficient financial resources to pay for the costs of the disaster, the municipality will take charge directly and, in more dangerous situations, the province will be called in.

When hazardous materials are involved, the CDMS response is based on the knowledge of the product at the site of the disaster, i.e. on risk communication prior to the disaster. Canadian law is fairly silent on this subject, with the exception of a recent environmental law. There is, however, no law in Canada comparable to the Seveso Directive or the Right-to-Know Act in the US (although it should be noted that, in this last case, the application may vary widely from one community to another [7]). This silence represents a potential danger to firefighters, among others, and is the reason why a new civil security bill is now being proposed by the Government of Quebec. This bill will force risk generators to declare the risks of disaster posed by their operations. Following that, the municipality and the region will be forced, in turn, to develop disaster management plans and to communicate those risks to the public. However, the bill is not clear on who is to be held responsible, i.e. the owner, company management or the operators.

Even though it has not adopted coercive measures, Canada nevertheless can boast quite a few examples of successful voluntary processes of risk communication in communities with hazardous substances. In Montreal East, for example, representatives from industry and from the three levels of government are currently working with local citizens and with experts to develop an understanding of the risks posed in that area. This is a good example of what can be done. The same applies to the success achieved by some US communities in disaster preparedness surrounding the Right-to-Know Act [8].

3. A summary of the case studies

3.1. A PCB warehouse fire in St-Basile-le-Grand

On 23 August 1988, a warehouse containing approximately 3800 barrels of PCBs caught fire in St-Basile-le-Grand, a community of about 9000 people, 35 km southeast of Montreal [9]. The plume of smoke necessitated the evacuation of a total of 3500 people in St-Basile and in the neighboring towns of St-Bruno-de-Montarville and Ste-Julie.

The event had been a disaster waiting to happen for many years, since the security measures that residents around the warehouse had been asking for had not been taken. Furthermore, because the owner of the warehouse had left for the US, management of the disaster was left to the three municipalities. While there was provincial emergency planning in place in Quebec, few people seemed to know about it at the time. This lack of awareness resulted in a situation of convergence, and organizational chaos ensued. All these elements made the community quite angry with the government. As a consequence, they would form citizens' committees in the three municipalities in order to check on what was being done — or not done — and would themselves coordinate any action they took.

As will be detailed below, there was much technical uncertainty associated with this disaster, the most important being the level of toxicity: PCBs are not supposed to catch fire, so what dangers to health does this product pose? At what critical level does it become dangerous? In order to answer these questions, a special committee composed of international experts was called in by the Government of Quebec and, while it was deliberating, the evacuees were not permitted to go back to their homes.

Added to the technical and organizational uncertainties, there was uncertainty surrounding communication, as seen below. Overall, it was an 18-day crisis, with major consequences: it has taken 10 years to dispose of the remaining barrels of PCBs, and a seemingly unending saga — more uncertainty — surrounded their disposal; even now, the firefighters involved at the time do not know whether or not they are at risk of developing cancer, as the tests were never completed.

3.2. A fire in a tire dump in St-Amable

On 16 May 1990, a tire dump in St-Amable, a town of approximately 5300 people southeast of Montreal — and east of St-Basile — caught fire. The dump was close to a trailer park, and, as in St-Basile, the residents had asked that measures be taken to protect them — like piling the tires in small "islands", for example. They became even more disposed to be cautious when a tire dump in Hagersville, Ontario, caught fire (this had occurred 3 months before). But the provincial Ministry of the Environment had issued a permit for shredding and recycling the tires, so Ministry officials saw these protective measures as unnecessary. Two islands had been created at the entrance to the site, made up of tires for shredding, but the rest of the tires formed a single pile about 15 m high and covering an area of about 45,000 m^2.

This refusal by Quebec's Ministry of the Environment to take protective security measures before the fire was based on the fact that the tires were expected to be recycled within a certain period of time. However, technical problems with the shredder developed, because some of the tires were steel-belted, and because there was only one machine working at full capacity and it broke down easily. This meant that, at the time of the fire, only about 800,000 of the 3,500,000 officially declared tires had been shredded.

In charge of the dump was a small-business owner who was convinced that he was rendering a vital service to the community. When the fire broke out, he declared bankruptcy and left management of the disaster to the municipality, which asked the Government of Quebec for help. At first, management of the disaster was chaotic, as reflected in the uncertainty concerning firefighting techniques (see below). After a few hours, coordination and communication improved considerably, owing to the clear mandate given by the Government of Quebec to Civil Security officials. The decision to extinguish the fire with sand was taken — after consultation with experts — and this was agreed to.

Contrary to the situation in St-Basile, the work was coordinated and there was communication between the government's scientific and technical officials, i.e. the Ministries of Environment, Agriculture and Health. In fact, government coordination of communication was so good that it generated a feeling of mistrust: both in the community and in the media, some had the impression that the presentation had been "packaged" in advance.

This seems a strange reaction. Following the St-Basile recommendations, the St-Amable disaster managers wanted to avoid any charges of communication chaos, but their improved coordination was not perceived in a positive light. The same applied to the role of the political representatives. Wanting to avoid the chaotic convergence phenomenon that occurred in St-Basile, they now kept such a low profile that people felt that the politicians did not care. What can be concluded from this is not that recommendations should not be followed, but that they must be applied with care.

3.3. A cargo train derailment in St-Leonard-d'Aston

On 12 December 1989, a 91-car Canadian National Railways (CN) cargo train was traveling from Charny (near Quebec City) to Montreal when 33 cars carrying sodium hydroxide and chlorine derailed in St-Leonard-d'Aston (SLA), a rural municipality of about 2000 people. Nearby, there were approximately 10 houses, among them the city hall, the health services and fire departments. Damage was spectacular, one of the cars ramming through the bedroom — luckily empty — of a house, and the initial evaluation of the situation was difficult.

CN took charge of the technical issues, with the collaboration of experts from the Federal and Provincial governments [10]. Eight cars of sodium hydroxide (caustic soda) were perforated, and 48,000 tonnes of the product spilled onto the ground and into a nearby river which was connected to a water treatment plant in the city of Nicolet, 25 km away.

There were also four derailed chlorine cars being monitored. When these were lifted back onto the track, a second evacuation was needed (600 people), followed by a third (200 people), this time because of a change in wind direction. These evacuations would last for 2 days.

Overall, communication between those responsible for the technical issues and the community was easy. The major problems were telephone line overload and the time required by the local telephone company to install additional lines. There was also a lack of cell phones, and overloading of these circuits as well.

In the end, CN compensated the evacuees for their losses, and, at the beginning of 1990, there was even a special party, organized by the municipality, for all those who contributed to the management of the disaster.

3.4. A cargo train derailment in Lennoxville

On the morning of 24 June 1995, Fête Nationale in Quebec, a convoy of the Canadian and American Railway Co. (CARC), an American company recently acquired from Canadian Pacific Railways (CP), was traveling towards Cornwall (Ontario) from Brownsville (Maine). In Lennoxville, a town of 4,200 people, six of the 60 cars derailed, among them two containing propane residue, both of which capsized. There were also five cars filled with propane which stayed on the track and would later be towed.

When CARC learned about the accident, the company delegated the response to CP. There was no spill, but, due to the weather — this time intense heat instead of the cold encountered in SLA — the firefighters had to continuously water the cars in order to avoid explosion. There was concern about one of the derailed propane cars when it was discovered that its body was badly damaged. Due to the risks associated with moving the car, it had to be left in place and emptied (as seen below).

The municipality activated its emergency plan. The City Manager, acting as coordinator, liaised with the CP officials in charge at the site. Communication with the townspeople and the media was excellent. Unlike the on-site fires, but similar to the SLA situation, it was clear from the beginning that the company would absorb all reasonable expenses related to the accident. Contrary to the other cases, it was a disaster where the leadership was clearly local, even though the technical issues were managed by the rail company.

The first evacuation was complex, and, when one of the propane cars was found to pose a danger, a second evacuation was required. All together, these evacuations would last for 30 hours. Even though this seems a relatively short time, there were nevertheless severe consequences in terms of transportation, because security for the site necessitated closure of a major highway — and the rail line — to the United States and eastern Quebec. Finally, on 27 June, the rail line was reopened, but another technical problem emerged: when the first train went through, it also derailed, this time due to the effect of water on the rails. The problem would be solved quickly, but it does show that technical issues are sometimes complex.

4. Complexity and uncertainty

Apart from certain specialists, the responders for a community are generally relatively powerless to deal with the complexity of the technical issues involved in cases of disasters like the four studied here. This means that we must look at the concepts of complexity and uncertainty in order to really understand what a disaster is.

4.1. Complexity

In a disaster, the event itself — or the response — always presents certain difficulties which have to be overcome. These difficulties are complex in and of themselves when the sheer number of elements contained in them, or the relationships among these elements [11], moves the event out of the realm of a routine response. Because of its non-routine nature, the complex problem is difficult for a human being to grasp, i.e. difficult to understand in terms of pre-established responses or patterns of responses. Of course, such a definition implies that complexity is subjective.

In technical issues, one of the major sources of complexity is the question of the knowledge of the product involved. This is often the case with hazardous materials and can, in turn, influence firefighting and other coping techniques. Even in St-Amable, where it was obvious that the material in question was tires, its composition needed specific evaluation in order for officials to arrive at the right solution. In a train derailment, when the cars are piled on top of one another, as in SLA, gaining any insight into what is on fire can be a complex activity.

In this area, legislation can help — if applied. Thus, since the Mississauga event, it has become mandatory for rail transportation companies in Canada to specifically identify and prominently display the contents of a car if they are hazardous. This means that, for example, even though the SLA accident was a spectacular one, it was possible to quickly identify the products involved. In Lennoxville, this identification was even more rapid due to the fact that — luckily — a CP employee from the neighboring city of Sherbooke was having lunch close to the site of the accident. He was able to easily identify the content numbers and to reach the CP offices in Montreal to obtain the necessary information. He was then able to communicate the contents of the cars to firefighters quickly.

Another example of technical complexity in the Lennoxville incident was the fact that one of the two derailed cars contained propane residue. This car was first thought to be safe, but, when it was discovered that it had a large crack in its body and that only a 0.125 in. thickness remained, something had to be done. To pull the car under such conditions could have proved dangerous, because of the possibility of a propane leak — probably followed by a fire. The first technical solution would have been to take the contents away by truck, but this, too, was considered to be too risky. The other solution, one agreed to by experts, was to burn the propane residue. In order to do this, a local company was called in, but this company did not have equipment powerful enough to complete the job in a reasonable length of time, hence the need to call in another company, from further away. During all this time, it was crucial to water the ditches around the accident site, due to the hot, dry weather. This approach was clearly far from routine, even for technical specialists.

The St-Amable and SLA cases provide other examples of complexity in technical issues. In the first case, there was no road around the site, and one had to be opened up urgently. The second involved the complex job of cleaning up the caustic soda before it soaked into the ground, which can be done by neutralization on the site. This was found to be extremely costly, and was the reason why the company, after consulting with experts from the departments of Environment — Federal and Provincial — chose to transport the contaminated soil to a triage center for subsequent purification.

It is also important to take into account sociopolitical complexity. In Lennoxville, we can find examples of this type of complexity surrounding the question of evacuation. First, defining the area to evacuate is itself complex: if the mayor had followed instructions for dealing with the propane issued by Canutec (Federal Ministry of Transport data bank), the whole town would have had to be evacuated. After consulting with various technical experts from CP and the Transport and Environment departments — again, Federal and Provincial — it was decided that an evacuation of about 300 people would be reasonable. Ultimately, the evacuation would only involve 150 people, as the disaster occurred during a vacation period.

A second aspect of the complexity of evacuation concerns who has to be evacuated. In this case, the area included a home for retired nuns and a monastery, not to mention a residence — really a kind of retreat as well — housing a group of motorcyclists with international connections. Added to this was the fact that there were many groups preparing to celebrate St-Jean-Baptiste Day with campfires.

Another source of complexity which we have often come across in our research on disasters — among them the ice storm/power failure of 1998 in Quebec — is the refusal to evacuate. In Lennoxville, the police discussed evacuation with the community — under Canadian law, they do not have the power to force a person to evacuate — and made certain that those who refused were well aware of the risk of explosion or fire.

The final illustration of complexity related to this last evacuation was the problem of evacuee registration, and with it the question of shelter: many people were away on vacation, others were coming back from vacation and wanted to go home, and still others wanted to leave for vacation and needed to go home first.

Sociopolitical complexity was also evident in the evacuation means employed. In the PCB fire, one municipality offered hotel accommodation to its evacuees, while another provided accommodation in community centers. Comparisons were inevitable and questions were asked as to whether or not these solutions corresponded to the socioeconomic levels of the three groups of evacuees, which were different. In St-Amable, the firefighting was almost finished when the specialists began to fear a change in wind direction during the night. Because of this, Civil Security proposed what they called a "voluntary evacuation". By this was meant that the choice of evacuating in the evening, as a preventive measure, or of staying on and, if the wind did change direction, evacuating during the night would be left to the people. Slightly more than half of these potential evacuees chose to stay on. In the end, what was thought by government officials to be a positive measure, i.e. giving the people themselves the responsibility for making the decision, was, in fact, perceived by the community as a failure of leadership on the part of Civil Security because they did not tell people what to do.

4.2. Uncertainty

We have now illustrated what everyone knows intuitively, that a disaster means complexity. Uncertainty, as opposed to complexity, stems from a serious incapacity for disaster responders to solve a problem or deal with a question related to an issue. With complexity, the problem can be solved within a reasonable length of time, although perhaps with some difficulty. With uncertainty, if the problem can be solved — sometimes it will never be — much more time and much greater resources will be required in order to do so. The product on fire, its quantity, its toxicity and the danger of explosion all constitute possible uncertainties in the technical issues of a disaster involving hazardous substances, "possible" because sometimes there is only complexity, as seen above.

We found two types of uncertainty in the research. One is first-level uncertainty, which stems from the perception, individual or organizational, of a relative incapacity to respond appropriately to a given situation [12–14]. Although at this level uncertainty may be subjective, this does not mean that it does not reflect reality. For example, in the Mississauga derailment [15], there was uncertainty as to the contents of the cars because of the fire, and thus, it was not only because of the responders' perceptions that they were unable to find out what was in the cars.

In St-Basile, the toxicity of the smoke and of the ashes emanating from the fire was unknown at the time, but precautions had to be taken nonetheless, particularly since the ashes were escaping through a hole made for firefighting purposes in the roof of the warehouse. In St-Amable, the firefighting techniques were influenced by the uncertainty generated by the danger of explosion, as there were some gas tanks under the tires which were not completely empty. That constituted uncertainty, since nobody knew where they were or could predict whether or not the tanks would explode.

In terms of sociopolitical issues, there was communication uncertainty in St-Basile, due to the phenomenon of convergence [16,17]. In the beginning, information was flying around in all directions, resulting in contradictory verbal messages and rumors. Then, there was a communication blackout, which only served to intensify the rumor and anxiety. Even when information became available, people had no confidence in it because it came from the government. This is the reason why an international committee of experts had to be brought in.

Research also identified a second-level uncertainty — one generated by the existence of two or more conflicting "certainties", in this case, by the lack of consensus among responders that characterized the St-Basile and St-Amable fires. In the St-Basile crisis, there was a question as to the contents of the warehouse: did they only consist of PCBs, as officials maintained, or did they include other contaminated products as well, like used oils, which the owner was not licenced to handle? There was also the question of amounts — another legal question: was the owner handling more PCBs than the law allowed? There seemed to be a discrepancy between the official figures and the factual data. As opposed to the train derailments, this lack of consensus among responders constitutes uncertainty because it took a long time to obtain these data, and ultimately no one would ever be certain of the real figures. It is worth noting here that the media can be helpful in this respect by conducting research of their own.

There was also uncertainty in the St-Basile incident caused by the fact that there was at first no consensus as to the choice of the most appropriate firefighting technique to extinguish the fire: foam or water, a frequent dilemma in chemical accidents [18,19]. In addition to these options, the choice in the St-Amable case would be extended to include sand or "do nothing". Another uncertainty, in this last case, was related to the number of tires: according to government records, that number should have been 3.5 million, but according to the owner the number was closer to 15 or 20 million. Needless to say, the interests of the two parties were divergent. For the owner, the government figures were designed to reassure the public, but at the same time he benefited from a larger number of tires in the evaluation of his losses. Even for the experts, the task of counting the tires seemed to be a difficult one, and in the end it would prove to be impossible to arrive at a precise figure.

Both levels of uncertainty can sometimes be explained by a lack of scientific knowledge per se within the scientific community: in St-Basile in 1988, for example, science did not know the effects of a PCB fire on health. Another, hypothetical, example would be the uncertainty as to the impact on health of the combined effects of two or more chemicals in a fire following a train derailment.

Complexity and uncertainty are useful concepts in that they help us to really understand what a disaster is. In the case where hazardous materials are involved, the probability that they are present is much higher than in a more "routine" disaster like periodical flooding, for example. So, now that we have had a look at the issues and their characteristics, we come to the core of this article.

5. Relationships between the technical and the sociopolitical issues

How closely related technical and sociopolitical issues are will be shown by three topics which emerge from our data. The first deals with evacuation, the second with health and the third with leadership.

5.1. Evacuation

If we leave aside the situation where the threat is so clearly evident that spontaneous evacuation is the only option, technical issues can influence the number of individual evacuations required. In the SLA incident, when the chlorine cars had to be lifted onto the track, two additional evacuations were needed. The same happened in Lennoxville with the propane car. By the same token, a refusal to evacuate will also influence the technical issues, and could well translate into more risk for responders.

Technical issues can influence the length of an evacuation: in St-Basile, the evacuation was originally supposed to be for 1 day, then it was extended to 3 days. As the uncertainty related to the PCBs made it necessary for a committee of experts from all over the world to arrive at an acceptable level of toxicity, the evacuation had to be extended again, ultimately to 18 days. This meant that the initial arrangements, for a few days, had to be changed to more permanent ones, and that communication had to be constant — although in fact it was not — between the technical specialists and the community. Although it did not figure directly in the research, the ice storm/power failure of 1998 exhibited a similar pattern: the technical issues surrounding the rebuilding of parts of the electrical grid infrastructure influenced the length of the evacuation, or, in that specific case, the length of confinement for those who decided to stay at home. At the same time, evacuees ask questions concerning technical decisions, and this can sometimes be troublesome for disaster managers who may view this as a challenge to their technical decisions.

5.2. Health

In every disaster, the effects on health of technical issues constitute the most vital and crucial uncertainty, the one that causes the most anxiety for communities. But we must not forget that the same is true for responders. These effects are summarized in Fig. 1, starting with the four products at stake in the analysis, followed by the source of the threat — fire, derailment, etc. — with its corresponding risks — explosion or fire, for example. Then, there are the techniques for coping with the disaster and the associated problems: ashes, smoke or spills. In the case of a spill, the resulting pollution can affect soil or water, or both. There could also be water pollution originating from the water used to fight the fire.

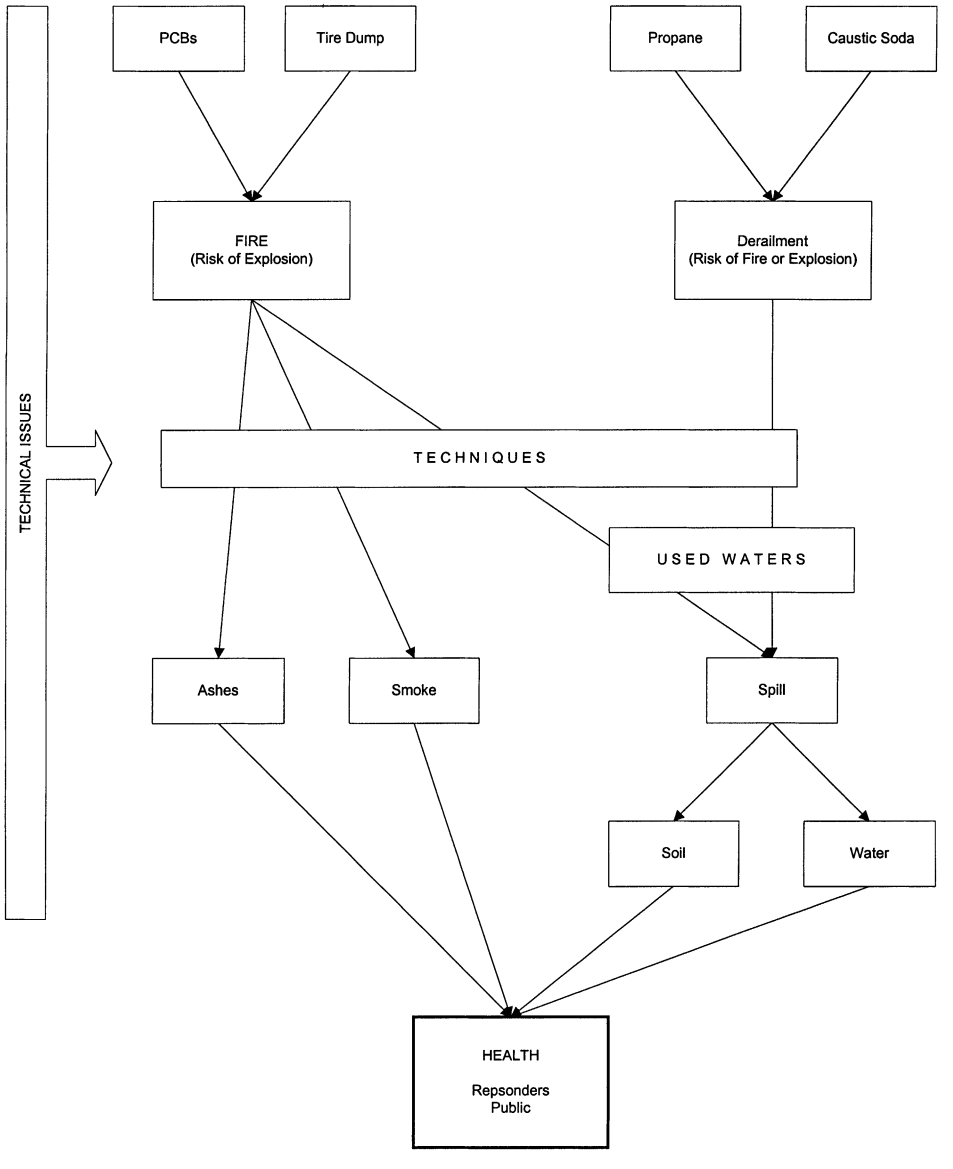

Fig. 1. Relationship between technical issues and health.

Although all these elements may have some influence on health, the St-Amable and SLA accidents demonstrated the importance of water pollution in this respect. In the first case, the contamination of groundwater by water and oil from the fire flowing into two brooks constituted uncertainty. This can be defined as second-level uncertainty, because while Greenpeace regarded it as uncertainty — they knew that these factors had been important in the earlier

Hagersville tire fire — the disaster managers did not. Nevertheless, this uncertainty would last for many months, with analyses being carried out by various laboratories.

In the SLA case, the release of caustic soda into the water would not be detected by the Nicolet water treatment plant until they found an abnormal pH in their analyses. The plant had to be closed for 2 days, which left about 10,000 people without tap water. The issue was well managed, however: information was given out by regional media to the public and an alternate source of water was found. The problem lasted for about 36 h. There are, of course, cases where the lack of tap water affects a much larger area, as was the case during the power failure following the ice storm of 1998: the entire Greater Montreal area was without water.

In this discussion about health, we have looked mainly at the relationships between the technical and sociopolitical issues in a one-directional manner, i.e. the influence of technical issues on health, however it must be remembered that health is one of the first elements that technical responders take into account in their decisions. This means that the techniques selected to cope with the source of the threat will also be greatly influenced by health and safety considerations.

5.3. Leadership

The third way to look at the relationships between technical and sociopolitical issues is to consider the importance of leadership, i.e. the responsible authority clearly in charge of the technical issues and ready to accept the financial consequences of the disaster. This does not mean that such leadership is not important in the other types of issues as well; on the contrary, but we will concentrate here on leadership in technical issues first.

Before we proceed further, we must point out that there is a difference between coordination [20], i.e. making certain that all the pieces of the puzzle fit together, and leadership, by which we mean that there is a responsible authority in charge. The two are closely related, of course. Where technical issues are concerned, some aspects of the response must be coordinated, whether or not there is leadership: security of the site (various police forces), environmental questions (specialists, both private and governmental), etc. There is also a need to coordinate technical issues globally, if only to fulfil the requirements of communication with the public.

In the train derailments, coordination was clearly the responsibility of the rail companies. At the same time, these companies ensured leadership in that from the beginning they were clearly in charge of the technical issues and of their subsequent effects on the sociopolitical issues as well (these effects mostly concerned indemnities). This is far from being the case in all disasters involving hazardous materials, even though we may like to think that the “polluter pays” principle applies (we will set aside, here, the case where a disaster involving hazardous substances is triggered by an Act of God, even though it must be said that human beings frequently help Him or Her a great deal by exacerbating the consequences of a disaster).

According to the above principle, the owner of the equipment at the center of the incident (or the top management level of a company) should be the authority responsible. This means that (s)he will take charge of the response and of the disaster consequences. However, the law may not always be clear on this point. In the case of oil tanker spills, for example, who is legally responsible is often one of the major questions to be answered, first in disaster management, then in the court of law. In our two on-site disasters, the owner did not want

— or was unable — to assume this responsibility, so the municipalities first, and then the Government of Quebec, had to act as substitutes. In St-Basile, the technical issues were dealt with by firefighters and experts in toxicology, but nobody was in charge of global coordination of these issues and there was no leadership at all. By contrast, in St-Amable, leadership was assumed by Provincial Civil Security officials, and there was technical coordination.

The same reasoning can be applied to sociopolitical issues. In St-Basile, the leadership pattern for this category of issues was chaos, contrary to what occurred in St-Amable. And the sociopolitical response was coordinated as well, more with the help of provincial officials in SLA than in Lennoxville. This latter case was clearly an example of a locally managed disaster, wherein leadership stayed within the municipal authority (in collaboration with the delegates of the railroad companies).

There seems to be a tendency for people to be more positive and cooperative when it is clear to them that there is coordination in the technical issues category. Our research does, in fact, bear this out, although it is always risky to generalize from so few cases. When there is leadership as well, this tendency will be even more pronounced, as this authority is expected to settle, with due diligence and justice, the financial aspects of the losses incurred. Of course, this does not explain everything, and it is important to take into account the risk management of the prodromic phase of a disaster. In that sense, not only were the two on-site fires managed at the end by the Government of Quebec acting as a substitute, but people had no confidence in its willingness to pay for their losses. In addition, they were convinced that it was the same government that was, in fact, largely responsible for the disaster, due to poor risk management prior to the fires.

There is nevertheless a difference between the two cases, with much less resentment in St-Amable, where there was leadership, than in St-Basile, where there was none. It is true that other variables can explain these differences, among them the fact that St-Amable is more rural than St-Basile, Ste-Julie and St-Bruno-de-Montarville. Also, in St-Amable, communication was effective, meaning that people knew what was happening, which was not the case in St-Basile. This brings us to a discussion of the communication between those handling the two types of issues.

6. Communication between those handling the technical and sociopolitical issues

The above discussion has shown how crucial the relationship between technical and sociopolitical issues is in disasters involving hazardous substances. In such a case, a community is dependent on the technical responders, and they in turn must rely on the support of the community. Communication is essential if chaos is to be avoided. What people want to know is:

- Where can I go for information: who has it and how can (s)he be reached?
- What is happening: is there a leak or not?
- What are the risks: explosion, for example?
- What are the risks for health?
- What will be done about the threat, and when (approximately)?
- What do I have to do?
- If there is evacuation, how long will it last?

It is clear that these questions cannot be answered with a precise figure or a yes or no answer if there is uncertainty. This means that the uncertainty itself has to be explained to the community, and this was what happened in all the cases we studied, with the exception of St-Basile. The result was that there was good communication between those handling the technical and sociopolitical aspects of the disaster. There was regular communication between the site, where the technical issues were managed, and the municipality, where the mayor kept both his citizens and the media informed.

In spite of these successes in communication, we cannot assume that explaining uncertainty is easy. The task requires the experts to leave their laboratories to work in the "fish bowl" that is the site of a disaster. They must understand that the rationality valued in science can clash with the emotions brought about by such an event [21]. At the same time, they must understand that while emotions can run high in a community, there is also rationality, and, contrary to the belief of some disaster managers, that the public will not necessarily panic [22].

This means that technical responders must accept that their work will be subjected to questions from laypersons with no special training who will want to know the rationale for the decisions being made. If people need to know what is going on, it is because they have decisions of their own to make, such as where to go if they evacuate (e.g. to travel for a week or two or stay with their in-laws for a few days), whether or not to send the children to school, etc. Evacuees are responsible citizens, not cattle to be transported from place to place. It is when they feel that they are being treated in an uncaring way by technical officials that they become angry. They feel they must have the information they need to make decisions.

When they do not have such information, there is the danger that rumors will develop and that the level of anxiety will increase — the two being related. Lack of communication, for example a "no comment" from police, could lead to speculation about hazards which are so dangerous that they have to be hidden. Contradiction in communication is another difficulty, when, as happened in St-Basile, the apparent deployment of the media, politicians or the special clothing that is symbolic of a disaster [23] are at odds with the message that there is no danger.

When the public wants information, they are not asking to be reassured at all costs. They would much prefer a clear message from technical specialists as to the dangers and the uncertainties associated with them — even the experts' differing perspectives — to what they perceive as a "prepackaged" message. They are ready to accept difficult information — as was clear during the power failure following the ice storm — and they adjust accordingly after a difficult moment or two during which they absorb and accept the situation. Nevertheless, this acceptance by the community of the technical decisions accompanying uncertainty requires trust. And trust requires credibility. When the technical experts have credibility, their communication can become one of the most effective ways of lowering the level of anxiety [24].

Credibility is a very capricious notion, however. It can vary, from time to time [25] and from one field to another [26], and it must be built up in advance [27]. Of course, technical-issue responders are probably arriving in a community for the first time, which means they will have had no previous opportunity to develop credibility. As a result, they must show professionalism and a caring attitude towards the community. All the factors considered to be the indicators of good communication [28] must be present if the people are to trust them. An interesting element in the case of the PCB fire was the fact that some experts lived in the area and their own families had been evacuated, which improved their credibility. Of course — fortunately — this is not a necessary condition of credibility.

The risk management of the prodromic phase will, among other factors, influence credibility and acceptance. This applies to companies, like those involved in the cases above, but also to government officials acting as substitute disaster managers. Risk management begins with information. In this respect, there are two possibilities concerning previous knowledge about risks in a community following a disaster. First, such knowledge exists, but nothing has been done to mitigate the risk, as in the two on-site fires. This will leave those in charge of the response with a steep hill to climb in terms of credibility. Second, there was no previous knowledge at all in the community concerning the risks. This means that, when a disaster strikes, the first-responders, like firefighters, do not know how to react to the threat or how to evaluate it, particularly when they have to deal with hard-to-detect hazardous substances.

What all this means is that credibility, trust and acceptance of technical decisions by a community also depend on disaster preparedness. This in turn requires a knowledge of the risks — here, those related to hazardous substances — or at least the capacity to learn about them rapidly in order to know what to do. As mentioned previously, Canadian legislation with respect to train transportation has improved considerably since Mississauga. But there is much to be done in the case of other types of transportation involving hazardous materials, as well as for on-site facilities for dealing with these products. In summary, risk communication between those handling the technical and sociopolitical issues must begin before a disaster occurs, in the form of emergency preparedness. This implies that, subsequently, mitigation measures will be taken — or not — which in turn will influence the response and the relations between those handling the technical and sociopolitical issues.

7. Conclusion

The above discussion provides for a number of conclusions and recommendations for both research and practical fields. Concerning the technical issues, there is, first, for the owners (and the managers as well), the acceptance of their responsibility. As this is sometimes a legally nebulous area, there is a need for clear legislation and, most important, for strict application of the legislation. We can also see the need for expertise on the part of the technical experts and responders: technical training, both in specific fields and in emergency intervention, including the ability to communicate with a community in a stressful situation.

Concerning the sociopolitical issues, there is a need for both first-responders and the public to know the risks present in their community. This in turn requires that mitigation measures be taken, which seems to be a difficult task because it requires laypeople to make decisions concerning these measures in a context of limited resources. One cannot ask the city council of a small town to undertake mitigation if the people living there are not convinced of the need to do so. The first step here must therefore be to ask the risk generators to inform the community about these risks. The process could either be mandatory or voluntary.

In Canada, since Mississauga, information about the contents of rail transporters is mandatory. However, risk information about on-site companies is far less developed, and, while large corporations are usually inclined to give out such information, depending in part on the restrictions due to competition, the major risks in the area involve small or medium-sized businesses and their fear of revealing the risks their operations represent for a community. In addition, the elected representatives may fear a loss of revenue if the plant or equipment is moved away, or they may fear feeling forced to take risk mitigation measures if the risk is known to the community.

In order to avoid such conflicts of interest, a mandatory process is the best option, as long as it is applied — as it is in rail transportation. This will ensure that the relationships between those handling the technical and sociopolitical issues at the time of a disaster may not necessarily be routine, but at least they will present less uncertainty.

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