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Crisis communication: learning from the 1998 LPG near miss in Stockholm

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Abstract

The authors examine current trends in urban risks and resilience in relation to hazardous material transports in general, and crisis communication and the Stockholm liquefied petroleum gas (LPG) near miss in 1998 in particular. The article discusses how current dynamics affecting urban areas, such as the decay in terms of increased condensation and limited expansion alternatives combined with industry site contamination and transports of hazardous materials on old worn-out physical infrastructure, work together to produce high-risk factors and increase urban vulnerability in large parts of the world today. Crisis communication takes a particularly pronounced role in the article as challenges in communication and confidence maintenance under conditions of information uncertainty and limited information control are explored. The LPG near miss case illustrates a Swedish case of urban risk and the tight coupling to hazardous material transports. The case also serves as a current example of Swedish resilience and lack of preparedness in urban crises, with particular observations and lessons learned in regards to crisis communication. © 2001 Elsevier Science B.V. All rights reserved.

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1. Urban risks and urban resilience

The basic conceptualization of vulnerability is a function of both risk and resilience. In particular, it assumes that contemplation of urban vulnerability issues in terms of risk should be discussed in accordance with inadequate protection or resilience of the large urban areas. For instance, if safety systems implants (along with those for warning notification, sheltering, etc.) are in poor condition or in shortage, this means increasing the urban communities' vulnerability and in economic terms, growing maintenance expenses thus making such systems increasingly costly.

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The decay that affects urban areas in terms of increased condensation and increased disrepair, together with environmental contamination and old worn-out physical infrastructure, are the high-risk factors, that are seen as pivotal causes of urban vulnerability in the world today [1]. This article will focus on two main characteristics making up urban crises. These are on the one hand, conditions contributing to the increase of urban risk and 'normal' urban accidents [2] and on the other hand, conditions contributing to the loosening of the urban communities' resilience.

1.1. Urban areas and increased risk

Globally, the space between metropolitan areas tends to shorten. European cities have since long been stretching their boundaries to the rims of their natural limitations and any additional horizontal growth is environmentally and economically challenging. Consequently, the pressure on scarce land and other limited resources increase. "Flood plains and unstable hillsides become sites for housing, often informal and low-quality housing, due to the scarcity of land available at reasonable costs and sufficiently close to employment opportunities" [3]. Concentrating industrial activities to flood prone areas can also contribute to increase urban vulnerability. This has been demonstrated in the 1993 American Mississippi River flooding where liquid gas tanks floated down the river, posing a major threat of serious explosion and additional damage [4].

Another factor worthy of consideration concerns the industrial centers in developing countries and countries in transition and settlements in these countries coming increasingly close to, or tied to, hazardous material industries. The Bhopal Union Carbide disaster in 1984 [5] and the Mexico Anaversa disaster in 1991 [6] gave evidence to how so-called 'shanty towns' growing closer to hazardous industries can tremendously increase urban communities' vulnerabilities. In Russia, the so-called 'shadow towns', serve another particularly pronounced example of how increased risk and increased vulnerability have come to interact. These towns, being mono-industrial and engaged in the production of hazardous materials, have tied the lives of whole communities to these highly poisonous industries. A structural dependency has been formed between those who live and work in these cities and the industries that, in the 1990s, had turned these towns into ecological disaster zones [7].

Restricted urban-space availability has also lead to the opening up of existing old, and in many cases, contaminated industry sites for housing and office purposes. As the expansion of available urban areas become more and more attractive for investors, the building of safe infrastructure and transportation routes will, as a consequence of this, require large and costly building projects, putting a heavy burden on the public finances.

Urban structures, being inherently complex, are prone to generate compound failures, regardless of how zealously society tries to predict and prevent them [8]. Perrow, in his theory of normal accidents [2], further argues that the interactive complexity and the tight coupling of systems work to create high-risk systems. The normal accidents, foreseen by Perrow, are normal in the sense of having been built into the system over the course of its development. Social and technical systems, according to Perrow, are currently being designed and utilized in a way that will make the occurrence of accidents inevitable. The tightly coupled systems that Perrow speaks of leave very little room for decision-makers to maneuver in when something goes wrong. The inability to take small or partial measures at an early stage of an impending threatening situation, in turn decreases the range of options at a more acute stage of what soon may turn into a self-fulfilling crisis [9].

Closely interconnected systems, for example, power supply systems, leave insignificant room for flexibility and obstruct, as well, appropriate measures to be taken in urban crisis situations [10]. An example of this is a situation where initial or isolated disruptions cannot be diagnosed and delimited. Single event failures occurring simultaneously might burst out in cascade failures, which in turn will result in a total system collapse or blackout.

Other scholars like Jacobs [11] argue that most of the problems that cause urban vulnerability are accumulative. He characterizes this urban phenomenon as consisting of accumulative problems which threaten policy goals and may create more acute emergency events. Jacobs sees the nature of the accumulative urban problems as something forcing decision-makers to meet challenges on several fronts at the same time and that these problems also tend to create social instability and conflict [12]. The author further argues that "complex urban problems are not always readily identifiable or likely to be solved" [13].

However, the gradual deterioration of the urban conditions may, eventually, lead to a state of decline where they become so seriously deficient and precarious that broader social goals are threatened. Jacobs further argues that accumulative urban problems therefore provide conditions for a development of generalized and sectoral emergencies. City decision-makers may then have to deal with "a multiplicity of urgent and threatening situations either together or in a narrow time-span" [14].

This potential situation links up to another problem identified in crisis management in general, and urban crisis management in particular, the management of scarce resources. 'tHart has underlined some of the problems becoming evident in urban crises associated with the allocation of rescue service resources. In cases where reinforcements are claimed, he argues, prioritization issues may become crucial, particularly when resource-consuming events occur simultaneously [15], as was the case for instance in the 1992 Bijlmer air disaster [16] and the 1998 Gothenburg fire disaster [17].

1.2. Urban infrastructure and increased risk

Expanding urban areas are characterized by an increasing degree of complex and condensed infrastructure. Especially metropolitan infrastructure is shaped in an intricate and not always easily over-viewable way and may resemble "a bowl of spaghetti" [18], at least to the less technically familiar person. In connection to this, the problem with embedded infrastructural networks should be mentioned. For cost-effective reasons, owners of infrastructural networks prefer to embed new cables aimed to fill new technical functions in pre-existing networks, instead of creating new costly ones [19].

The physical concentration of cables together with the growing centralization of systems for remote control and supervision in urban areas, undoubtedly increase the vulnerability of the entire infrastructural system [20]. Dealing with an increasingly complex infrastructure may expose actors and decision-makers to situations where neither system vulnerabilities are known, nor how the interdependencies will play out in a single accident or a major breakdown. In other cases, decision-makers may be aware of a system's vulnerability for various reasons but may at the same time find that they need to stretch the limits of the system.

As infrastructural systems in large urban areas become more complex, they also become more vulnerable and prone to disruptions and with increasing vulnerability, the infrastructural systems also become all the more costly to repair and replace [21].

> Rapid urban development makes it difficult to keep pace with the development of infrastructure and the provision of basic services. Funds tend to be committed to the extension of services, with less funding or attention given to maintaining existing ones. Poor maintenance further increases the vulnerability of infrastructure [22].

Consequently, actors facing infrastructural disturbances starting simultaneously or in close connection to each other, have to handle a bundle of acute problems that put heavy demands on their decision-making. One illustrative example of this is the massive disruption of the power supply system in Auckland, New Zealand in 1998 [23]. In this case, the quadruple failure of the main power cables, feeding the heart of the Auckland area with power, presented the decision-makers with a very wide range of problems. For example, decision-makers faced the imminent failure of fresh water supply as well as the rapid warming up of chilled and frozen foods, potentially threatening public health and, in the long run, an impending economic disaster caused by massive business flight from the area [24].

In society of today, the provision of infrastructural support is taken for granted [25], a fact that has considerable implications for the recovery from complex urban failures. Some general causes of urban vulnerability are generated by the specific urban design. During the Auckland power-outage in 1998 [26], modern multi-story buildings were subject to huge water supply problems, automated door lock and elevator systems failure. Tower blocks with glass facades turned out to be uninhabitable due to an unimaginable heat production when air-condition systems ceased to function [27].

The United Nations International Decade for Natural Disaster Reduction (IDNDR) also identifies a number of factors explaining why city areas are particularly vulnerable to disasters [28]. One of these factors is the rapid propagation of settlements, posing strains on local authorities to provide, e.g. adequate security and safety. “Rapid growth also means that mechanisms to carry out disaster preparedness and emergency operations become increasingly complex, posing additional strains” [29].

This issue notwithstanding, increased urban condensation and increased complex structures in metropolitan areas demand for extensive logistics including heavy goods transports and hazardous material transports. These transports, going through densely populated urban areas, represent a type of threat picture that has been carried into effect, among others in the Stockholm metropolitan area, causing much national debate about future urban planning, logistics systems and risk management in the aftermath of the incident [30].

1.3. Hazardous material transports as an urban high-risk factor

Old urban areas in different phases of expansion are particularly vulnerable to the type of risks inherent in modern logistics, particularly that of hazardous material transports. Urban areas, through which transports of hazardous material pass daily, presently transform from industrial grounds to residential areas or intersect with residential areas. The rapid growth of urban regions has in many cases caused considerable problems due to the risks presented by pre-existing industrial sites or transport infrastructure where dangerous goods are handled.

Port areas, railway marshaling yards, major roads, etc. are very often surrounded by residential areas, even if they, at the time of their construction were located at a safe distance from populated areas. The ambitions to decrease risks by keeping hazardous industries apart from housing areas and workplaces have so far been moderately successful.

Today, relocation of industries further out from the European city cores and laying out new roads in the periphery of the cities to create 'special safe routes', is restricted for environmental and economic reasons. The use of special routing systems (designated or prohibited routes) in existing infrastructure for vehicles carrying dangerous goods has been introduced in many countries as an alternative measure to decrease the risks associated with the handling of hazardous materials. By diverting the traffic to special routes, such systems aim to protect sensitive areas or objects where a dangerous goods accident could have especially serious effects, e.g. in city centers, tunnels and water reservoirs.

However, at the same time as the need to decrease the risks associated with the transport of hazardous material has been readily acknowledged by some, the juxtaposed need to restrict the expansion of peripheral motorways or other types of transit routes has been voiced by others. The latter need is often advocated for political, economic and paradoxically enough, environmental reasons, as mentioned earlier. Political arguments stating that 'safer' roads would invite more and heavier traffic and transportation are often heard. In the face of this value conflict, heavy transports and hazardous material transports have come to overstrain already existing vulnerable urban infrastructure as low capacity roads going through densely populated city areas are instead being used for these transports.

Dangerous goods are classified into nine United Nations Hazard Classes. Explosives are found in Class 1. Flammable gases are found in Class 2 [31]. In Sweden, transports of flammable substances are regulated by domestic regulation 1988:1145 [32]. In addition, the handling of flammable substances, exceeding a defined quantity, has to be commissioned by the regional and local authorities concerned. The Stockholm County Council has restricted dangerous goods transition through the Stockholm city area with the exception of a number of specified transit routes.

At the European Union level, current European Union legislation, such as the SEVESO II directive (which replaced the SEVESO on 3 February 1999 directive) [33] aimed at preventing and limiting the consequences of serious accidents involving dangerous substances, also applies to the management of hazardous materials in Sweden [34]. The directive requires member states to report to the Commission triennially on the application of the directive. In any large accident, manufacturers of dangerous substances are required to report on substance facilities and sustentions, through specific safety reports and rescue plans, to the relevant national authorities [35]. If a major accident occurs, the relevant national authorities in turn have to inform the Commission and proceed to file a report on the incident based on the manufacturer's information. The involved national authorities are on their part responsible to establish rescue plans for the surrounding areas [36]. Those persons who may be affected by a major accident should, according to the EU directive, be informed about the safety measures taken and about what should be done in the case of an accident [37]. The authorities concerned are also responsible for controlling that manufacturers follow the directive [38].

Through the Stockholm metropolitan area, approximately 119 vehicles, together carrying 6000 m^3 of different flammable Class 2 substances, transit daily on such specified transit routes, going through densely populated residential areas. These vehicles transport principally petrol and aviation kerosene but also liquefied petroleum gas (LPG).

As to dangerous goods transport through the area where the LPG near miss took place, the Stockholm municipal authority commissioned in 1980 the Stockholm Power Supply Company (Stockholm Energy) to transport propane, classified as an LPG, to and from the Stockholm harbor. In 1990, this authorization was extended to comprise a number of petroleum companies without additional conditions being further specified. In 1980, the office building concerned in the LPG case was not yet constructed. Before the LPG near miss, propane was transited as well by road as by rail through the Stockholm metropolitan area on parallel courses, passing the actual office building 10 times a week. According to the Commission report that came after the incident, this transport procedure was associated with double risks [39].

Propane is currently transported through the Stockholm metropolitan areas 10 times a week. The notation propane comprises a number of hydrocarbons which, at normal room temperature and under absolute atmospheric pressure, are in the form of gas. Propane liquefies under proportionately low pressure. Generally, propane is a compound made up of propane, propene and butane. Liquefied propane is contained in pressurized tanks during transport. When liquefied propane is brought in contact with air, it vaporizes and expands into a gas volume that, under absolute atmospheric pressure, will exceed its liquefied volume by 200–250 times. However, during expansion, the vaporized gas has to be sufficiently diluted with air, around 10 times its volume, to be transformed into a highly explosive substance. Propane is heavier than air and tends to spread close to the ground level. Vaporized propane may travel a considerable distance [39].

In the case study, it becomes apparent that expanding urban areas are associated with a number of vulnerabilities. It further becomes apparent that in the process of transformation and expansion, the permits for hazardous material transitions have not been updated and adjusted to the demands of these new demographic conditions.

1.4. The public and private intersection as an urban risk factor

One factor creating particular problems for crisis managers today is the relation between public and private actors. Market policies, as Jacobs [40] has noted, are becoming increasingly crucial in overcoming urban problems. This international feature, he states, illustrates how state-based economic initiatives loose ground “in favor of a privatization, contracted local services and the establishment of public/private relations” [41]. These market arrangements, today influence local and regional arrangements that are designed to deal with sectoral and localized problems [42].

Today, in many western societies, an increasing part of vital societal functions are being contracted out. Government agencies often choose to, or have to, buy preparedness and crisis management capacity within their respective sectors. Levels of emergency preparedness are to a great extent regulated by detailed contracts between supervising agencies and major private actors in the field [43]. The agencies still carry the formal responsibility for crisis preparedness within these vital societal areas but in reality they are loosing influence and control over the activities in their own sector. Due to the fact that management of an increasing number of vital societal functions is envisioned to be profit generating, or at least self-sustainable, economical factors weigh into risk prognoses and the settings of preparedness levels [44].

Some agencies see this development as a positive one, arguing that it is an efficient way to deal with the costs of bunkering resources for emergency situations. At the same time they realize that the bill may be very high, once these resources are used. Others argue that contract-based preparedness only works to decrease the level of influence held by agencies. Essential parts of crisis management, such as being able to prioritize scarce resources in crisis, can no longer be controlled by the agencies formally responsible. It is apparent that different sectors present different conditions and possibilities for control, even in a contract-based preparedness system.

The electricity sector has been highlighted in this respect, as it constitutes a central part of virtually all other vital social systems. The large amount of small to medium power supply companies makes it difficult for the authorities to maintain a comprehensive overview of the sector [45]. State initiatives to encourage system redundancy and sectoral preparedness standards have to compete with the different economic considerations of a wide array of private companies. Finding a viable balance between public and private interests in these situations, especially when something goes wrong, becomes a crucial balancing act [46].

In the Auckland power-outage in 1998, a number of prioritizations and policies were subject to hard negotiations and compromises between the primary private actor, Mercury Energy, and the authorities in Auckland. One of the issues on the table concerned which actors were going to get the dire reserve power available. Because the power-outage was not declared a formal state of emergency, the Auckland authorities could not force the company to do the prioritizations among its customers, that the authorities deemed necessary for the protection of vital functions. In time, Mercury Energy voluntarily decided to supply many "vital functions" with reserve power, but not all services were immediately placed on-line, including the District Courts and the High Court. Mercury Energy also faced the problem of privatization as it had to contract coping capacity, in the form of generators, freight planes and expertise at market prices at a point in time when these commodities were in high demand [47].

1.5. Urban crises

Urban crises are often tied to the hazardous conditions and routines represented by the urban infrastructural complexity. Major technical failures and disasters often occur at the horizon of scientific knowledge and may well be the result of complex systemic effects and interdependencies poorly understood by those in the charge of large scale socio-technical systems [48].

An inability to handle first-order causes of urban crises easily leads to additional risks of secondary disasters. The problems of second-order causes in crises often have a strong man-made component, as shown by for instance by van Duin [49] and Hasper [50]. Therefore it is becoming increasingly difficult to make a useful distinction between natural and man-made disasters.

Urban centers and mega-cities are crises generating foci especially in the sense that they represent a maze-like web of integrated and complex systems hiding as well their starting point as their end point. These integrated systems, however, are not only infrastructural and technological systems. They also include ‘soft’ systems such as integrated social networks and relations that community resilience partly depends on [51]. Urban crises tend to affect a large number of social strata and groups like rings on water and may in its effect restrain whole societal structures from returning to their normal positions. In the Gothenburg fire disaster in 1998, for instance, the Gothenburg City Director noted that the management of the disaster and the prolonged uncertainty of its origin shook the foundations of the social bond that tied together Gothenburg as a civic community. The very basic notion of trust and belonging in the community was put into question as the community threatened to turn on itself and divide along lines of ethnicity and age [52].

Another problem associated with and particularly prominent in urban crises is so-called “disaster tourism” [53]. This phenomenon is especially pronounced in cases where fatal events occur in densely populated areas attracting large crowds of bystanders and rubbernecks, as well as VIP visitors. This has turned out to be a serious obstacle for rescue service personnel in dealing effectively with urban disaster situations. The Bijlmer air crash in the Netherlands in 1992 and the Gothenburg fire disaster in Sweden in 1998 serve as illustrative examples where bystanders have become a clear obstruction to rescue operations [54].

2. Management of urban crises and the role of the media

Nohrstedt and Nordlund [55] argue that it is not necessarily the direct and tangible effects of a disaster that may determine if a serious situation will develop into a crisis. Instead, a number of other factors or aspects of a disaster situation may turn out to be more significant. Quick, unbiased and trustworthy information to the public is one of these factors that are of outmost importance in major societal disruptions or crises. Government authorities and the media primarily hold the responsibility of informing the public.

The public in crisis situations needs trustworthy information in order to help facilitate and contribute to rescue operations, to protect itself, or simply to avoid unnecessary fear and anxiety. In some cases this has, however, proved difficult, in part because the public has not sought information through the expected information channels. This has particularly been the case in complex urban environment disasters such as the 1998 Gothenburg fire disaster. The urban complexity in this case consisted to a great part of the ethnic and linguistic diversity of the affected families. Unforeseen particulars in the media habits of these receivers of information meant that many of the victims’ families and other affected people got their first information through international media rather than from Swedish authorities engaged in the disaster response [56].

’tHart [57] maintains that crisis communication probably is the most important factor in successful crisis management. He also argues that crisis communication can no longer be a strictly hierarchical and functional gathering and dissemination of information. Instead it needs to be seen as a non-hierarchical process subject to strong political competition. Nohrstedt and Tassew [58] maintain that in a crisis situation, it is of outmost importance that the public has access to unbiased and trustworthy information. Trustworthiness, however, presupposes openness.

In practice, government authorities and the media have quite different, distinct tasks and goals in crisis as well as in normal situations. On the one hand, authorities in crises have an interest in getting particular information out quickly and effectively to the public. The media, on the other hand, must satisfy the public's increased demand for crisis information at all levels. In addition to this, the media has the role of a critical observer — they must not simply serve as a megaphone for the authorities. Instead, they need to function as a control or check on authorities as information disseminators [59].

The media act as an intervening variable in the decision-makers equation in terms of how to get the intended message across to the public. Media's endeavor is to report what is happening as quickly as possible. Those handling the crisis know the media reporting is initiated even before all the facts are known and most likely before any decision-maker has had the time to form an eloquent public statement.

The media looks for information where it can be found and tend to fill information voids with their own analysis. In most cases journalists do not sit and wait to be informed by public officials, especially not in dynamic situations or if a lot is at stake as it is in crisis situations. Thus, in crises, a window of opportunity presents itself to the decision-makers. Here, decision-makers can make use of the media for providing specific information to the public and at the same time get feed back on how the projection of the events unfold in the eye of the public.

If the media is not able to get information from the responsible authorities, they will seek it out from others, for instance, through informal channels, from passers-by or from the victims themselves. Such information can then be used to put pressure on official channels by inviting them to either confirm or deny the assertions made. If both authorities and the media are subjected to extraordinary pressure, as is often the case in crises, this can trigger reactions in which the parties involved begin to accuse and blame one another and may eventually end up seeing one another as adversaries.

van Oostveen [60] maintains that uncertainty leads to an inclination "to say nothing at all". But silence breeds speculation. Under these circumstances, "no news" is seen as "good news", and rightly so. People want to know and to understand. With these things in mind, van Oostveen further argues that it is during the first hours after a disaster, when the media are most hungry for stories and pictures that things tend to go wrong. If something important does go wrong during this critical time period, it is very difficult to set it right later on. This means that it is extremely important that the media, guided by well-informed on-site staff are able to work on or work as close to the scene as possible. The sooner the unavoidable, initial confusion can be replaced by trustworthy information, provided through direct quotes and pictures, the sooner speculations and rumors may be curtailed. If the media, in a reliable manner, can explain how both rescue personnel and the public are acting and reacting in a crisis, the more likely it is that the receivers of this information will be able to understand the crisis in its larger context.

3. The case of liquefied gas near miss in Stockholm in 1998

Around 06.25 a.m. on 13 February 1998, a tank lorry with a trailer containing some 14 t of liquefied propane sprang a leak when passing by the entrance of an office block in a densely populated Stockholm area. The road passing through the area is one of the specified transit routes connecting the Stockholm harbor and the European highways.

The office block, also including a postal distribution center, serves more than 300 people. The residential area is situated 20–30 m from the office block entrance. The office and the residential areas are in close vicinity to one of the Stockholm oil terminals. The morning in question, the tank lorry had left this oil terminal shortly before 06.30 a.m. At that time, 63 people were working in the office building, 60 of them mailmen and sorting clerks working mainly in the basement area and on the ground floor.

According to an eyewitness, as the tank lorry drove by the office block, it was trailing a hose behind. This type of tank lorry is equipped with a hose connecting the lorry to an evacuation valve on the trailer. The hose had come loose and was run over by the lorry, which in turn caused the evacuation valve to come loose from its holding. This allowed for gas to evacuate through a hole about 15 cm in diameter. The lorry wrenched when running over its own hose and the driver noticed gas rapidly evaporating from the trailer. The driver stopped the lorry and when inspecting the trailer, he noticed the demolished valve, realizing it was irreparable. The driver called the Emergency Center (SOS Alarm) at 06.28 a.m. and reported the event. Immediately after noticing the leakage, the driver stopped the traffic coming from behind. An approaching tank lorry then parked crosswise over the road, preventing other vehicles from driving into the gas cloud. The traffic in the opposite direction was stopped by a taxi-driver who had observed the expanding gas cloud.

As a consequence of the valve demolition, the trailer-tank discharged its content of some 7 t of propane in a jet directed towards the lorry tank. During this phase, the energy needed to prime an ignition was insignificant. If the gas cloud surrounding the jet had been ignited during this critical diluting phase, the jet would also have ignited, striking the lorry tank with its content of another 7 t of propane. The first commander of the rescue team stated, when later interviewed, that the worst case scenario had occurred if the gas had ignited during this highly explosive phase. The discharge continued for 1.5 h.

The kind of explosion that occurs when propane burns during expansion produces both a shock-wave and a heat wave resulting in an enormous burning cloud that ignites all inflammable matter within a radius of 200–300 m. In this context, it should be mentioned that the lorry was parked just in front of the mail distribution and sorting rooms in the office block where air-condition and elevator systems as well as electric mail trucks were used. When considering the insignificant quantity of energy sufficient to ignite the gas cloud, that of a “mosquito kick” as the first rescue commander later put it, these circumstances created a high-risk situation in the site during a considerable time period.

If the discharge of the 7 t of propane from the lorry trailer had combusted, individuals outside the buildings within the radius mentioned, would have perished, when exposed to a heat generation of this kind. Under these circumstances, even individuals dwelling inside the neighboring residences and offices would have suffered from this primary heat generation as well as from the effects of secondary fires caused by the heat wave. This first combustion could in turn have caused a secondary one, had the main lorry tank ignited. In the worst case, the second combustion would have occurred when people in the neighboring buildings had started to escape from the site.

Around 06.33 a.m. the first fire-fighting squad arrived at the site. Blocking the risk area from road traffic and trespassing were the first actions taken by the rescue service. However, the subway traffic control did not stop the subway traffic in the area until 07.15 a.m. At the same time the neighboring stations were evacuated.

Between 06.33 and 06.52 a.m. another two fire-fighting squads arrived. The decontamination operation started immediately after the arrival of the first squad and was aimed at directing the gas cloud away from the office block and the residential area by spraying water. Shortly before 08.00 a.m., the most serious threat was eliminated.

4. Learning from the crisis: lessons and recommendations

In Sweden, it is the Strategic Rescue Command's task to inform the mass media when a hazardous material accident has occurred [61]. The mass media in turn should release information to the public about the event and about precautions and actions taken by the rescue service. In Sweden, in cases where an incident involves hazardous material, it is the first rescue commanders task to contact the Swedish Broadcasting Corporation through the Emergency Center (so-called SOS Alarm). The commander can request an emergency public announcement to be transmitted, which the Broadcasting Corporation is obliged to do. When a first commander requests such an announcement, it is automatically forwarded to the Swedish National Radio and Television Companies. The content of the announcement is communicated through the so-called safe channels between the first commander and the transmission control. Through this procedure the message is automatically checked and confirmed [73].

In the LPG accident case, it is worth noticing that the intention of the first commander of the rescue team was to inform the public to take the proper precautions that he assessed as adequate under the actual circumstances, however, avoiding to specify the risks of an explosion or to aggravate the risk by giving details about the type of explosives involved.

According to the Inquiry Report [62], the first information about the accident was brought to the television media at 07.25 a.m. and to the broadcasting media at 07.30 a.m. by the Strategic Rescue Command. This information aimed at keeping the public indoors due the considerable risk of explosion. The event report from the Emergency Center (SOS Alarm) contradicts the Inquiry Report in stating that the first contact taken between the Emergency Center (SOS Alarm) and the mass media was taken as early as 06.43 a.m.

In a report made by the National Defence Research Establishment [63], it is stated that as early as 06.38 a.m., a local radio station transmitted a short news flash about a tank lorry that had sprung a leak somewhere in the eastern part of Stockholm. A reporter from the local radio station had overheard what was going on through the radio communication between two rescue units and did immediately broadcast this information. Shortly afterwards, a taxi-driver reported to the local radio station that a tank lorry was leaking propane. This information was confirmed by the Emergency Center and was in turn broadcast at 06.46 a.m. The fact that news about the incident had already reached the broadcasting media then came to the knowledge of the first commander of the operative rescue service. Realizing that information about the accident was already on the air at an early stage of the operation, the rescue commander regarded another announcement as unnecessary.

The outdoor warning system (sirens) was not used. The reason for this was, according to the Commission of Inquiry [64], that the outdoor warning system was not adjusted to selective warning, for example, alerting the public in a delimited geographic area. If used, the available outdoor warning system would have alerted not only the inhabitants in the area surrounding the site but also the inhabitants in the entire Stockholm metropolitan area.

The question that naturally arises is the following: is there anything we can call adequate information dissemination in such situations? In the following, this question is tentatively answered. One of the key components in this answer is the subordinate question of who speaks? Three generic models of crisis communication are based on different ways of viewing the speaker and the recipient of the message. Nohrstedt and Tassew [65] direct their attention to the expectations that the public has concerning authorities, their competence, responsibility, openness and capacity to take the initiative. Also of importance is the authorities' image of how these expectations in turn influence the public. The authors propose three perspectives concerning how these qualities can be communicated during a crisis.

1. The sender perspective: this form of crisis communication is "one-way", in that communication is only directed from the sender to the receiver. This is the classical mode of communication, in which the sender's intentions, the content of the message and the communication channel's appropriateness for reaching the target group is deemed the most important feature of communication.
2. The volume perspective: in this case, a "softer", socially-based form of communication is taken into consideration. The receiver is put into a psychological and sociological context with reference to the importance that attitudes and group attachments have for the individual's capacity to accept and adjust to recommendations given by the sender.
3. The dialogue perspective: this perspective takes consideration of the process of interaction between the sender, the channel used to send the information and the receiver. Communication is seen as two-way, and the activities that follow from communication depend on contributions from all involved parties.

That information dissemination during the LPG near miss incident was communicated in a sender perspective manner is evident. Especially during conditions where information is not co-ordinated, which was the case during the Stockholm incident, this communication mode fully exposes its weaknesses. None the less, to co-ordinate information is one of the most crucial and pivotal factors in crisis communication in as much as the public, being in acute need for information, looks for it wherever it is accessible.

Ironically, at the first instance of a crisis situation, the information is often erroneous or vague. This, in turn, puts the trustworthiness of the information provider in a dubious light. This, the second component of the adequate information problem, has the potential of becoming a major crisis in itself [66]. For these reasons, Borodzicz [67] stresses the importance of an information strategy where all information emanates from a single crisis management center.

A third key component to the adequate information problem is the substance of information in terms of the manner in which it is presented by the speaker. Technically complex information and jargon heavy information, that in itself may be accurate, may in turn pose serious problems to the public when trying to interpret the information under stress. The inherent uncertainties and the stress that this type of information dissemination generate in individuals also makes people less likely to pay attention to details, such as special conditions or reservations in a statement. In these situations, the receivers instead tend to focus on anything in a message that increases their sense of security and certainty. The energy company, Mercury Energy, one of the main players in the Auckland power-outage in New Zealand in 1998, became painfully aware of these crisis communication problems when they continuously had to go out and revise their prognoses for the restoration of the power supply [68].

'tHart [69] states that the interpretation and dissemination of information during crises should be done quickly and on a large scale. The media play a crucial role in this procedure. It is by no means certain that the dispositions of the authorities involved and the resources that they place at the media's disposal are in tune with the circumstances at hand. Media strategies in order to handle this problem vary from attempting to oppose or beat the media at their own game, to adapting and learning how to co-operate with the media before, during and after a crisis. What is of outmost importance is that all media operations are designed to meet the needs of the receiver, not only those of the sender.

Crenlinsten [70] points out that the authorities and the media should agree upon a common model or models for information and media contacts during crisis situations. With these preconditions, it is easier to explain to the media why certain information might be sensitive and should be withheld for the time being. By maintaining openness towards the media both during the crisis and after, authorities can maintain trustworthiness even if they are sometimes forced to act covertly.

van Oostveen [71] points out that information disseminators need to learn to master the flow of incoming and outgoing information if they want to avoid contradictory statements and misunderstandings. These kinds of miscommunications, left alone, have a tendency to take on a life of their own. Each individual information provider may only be able to comprehend a part of the total process and there is a constant risk that sources contradict one another. It is therefore of vital importance that all actors in a crisis situation convey their information through one crisis management center or authority.

To ensure that adverse and confusing information does not reach the public in a disaster situation, in Sweden so-called safe channels for information dissemination have been established between the Emergency Center (SOS Alarm) and the television and broadcasting media. Through those channels, the type of information that the Rescue Command and other actors judge as adequate to release to the public is transmitted. During the LPG accident, this was not achieved. The information procedure described earlier would instead have caused serious disadvantages by contradicting the first rescue commanders intentions.

In summing up the information procedure, one can see that the original information was not communicated through the so-called safe channels and consequently not checked and reconfirmed. The message that the first commander actually wanted to communicate was associated with a need to keep the public away from the site but avoiding playing up the threat of an explosion. This is in striking contrast to the message actually broadcasted by the local radio station and this lack of control of emergency information could have resulted in reactions from the public potentially jeopardizing the rescue operation.

When later interviewed, the rescue commander had made himself very clear when discussing the kind of information that should reach the public.

> The main thing is both to prevent people from being at risk and to avoid distress. It is most important that the message that you want to communicate is properly targeted [72].

It is not quite clear whether the rescue commander knew that the news reporter explicitly mentioned propane in her report at 06.46 a.m. The situation was further blurred by the news media that for example, gave unspecified information about the geographical localization of the accident. This was due to the fact that the Emergency Center from the onset was not fully aware of the exact localization of the site and thus provided vague information to the media.

Even if the local radio station was the main source of information during the incident, the television was also an important news supplier. Television networks, however, have a somewhat different news reporting policy than radio, focusing more on flashy pictorial presentations. This gives some food for thought. For instance, if the local radio station had not taken the initiative to broadcast all they knew about the incident, people would certainly have sought information from any available source including TV teams, being able to reach the site on very short notice. In fact, a number of Swedish Radio and Television Companies are located in the vicinity of the accident site. If a television network had been the primary source of information, it may well have been that the TV teams had focused on more spectacular and striking news reporting. Compared with the radio reports, it is very possible that TV reports would have been in even greater opposition to the rescue commander's intentions of keeping a low profile in order to avoid panic.

Concerning the public's need for information, providing the "right" sort of information may be a contradiction in terms. For instance, it is most probable that a first rescue commander or a rescue staff generally sees the publics' need for information based on their own perception of the situation. However, this perception may not at all be the appropriate one [73].

A tentative question to be asked is; were the first commander's intentions achieved after all? The answer is principally yes. Fortunately, one can conclude that the radio stations in general, except for the news flash at 06.46 a.m., produced a balanced picture of the incident even if the rescue commander's intentions about what type of message he wanted convey to the public did not reached them during the acute phase. Can it then be concluded that the rescue commander's intentions were the right ones? In his ambitions to keep the situation under control in this way, did he in fact not run the risk of loosing control by restricting information dissemination?

The reason for posing this question is that the media are constantly hunting for stories and will take every opportunity to increase the news value of an event. While the media may sincerely strive to fill an information void that logically follows in crisis situations it can, at the same time, frustrate a rescue strategy. Fortunately, in this case that did not happen.

According to the Inquiry Report, the public in the vicinity as well as the general public was adequately alerted through the broadcasting media, but due to the lack of outdoor warning systems, only those who happened to listen to the radio or watch TV were informed. According to the commission of inquiry, the warning provided by the media was released too late. The inquiry further states that it cannot be considered satisfactory that the majority of people in the vicinity of the site were not aware of the highly hazardous situation they were exposed to. Therefore, the inquiry highly recommended the introduction of a selective outdoor warning system.

As mentioned previously, propane travels long distances and is heavier than air, accumulating in basements, tunnels and subway stations. If the propane gas had accumulated in the lower parts of the office and housing buildings, the risk for a rise in pressure had been imminent due to the limited gas-expansion space. The risk for the gas reaching and filling the basements of the neighboring buildings and the nearby subway stations and tunnels, where the gas may well have ignited by a formation of sparks from different power devices, was imminent.

Tunnels as well as surface water mains are two-fold high-risk factors as well in their capacity of harboring propane as acting as ignition primers [74]. People exposed to liquefied propane are not immediately alerted by the characteristics of the substance. To the individual, needless to say, standing next to water pipes is not generally associated with high-risk exposure to explosives. Not being aware of such an exposure and not being able to detect it, does not allow people to take precautions.

If the Stockholm LPG accident had happened later that morning, when traffic thorough the area had been more intense and as more people had stayed in the area, the combustion risk had been all the more pronounced. The fact that the subway was not closed before 07.15 a.m. exposed the public to such risks.

These facts are in striking contrast to the chief staff officer's opinion, being in the strategic command of the rescue operation. In his opinion, the critical phase, where the risk for combustion was imminent, was of short duration, i.e. the first 10 min from the onset. After the first 10 min, the water supply at the site was sufficient to cool off the lorry tank in case the propane emanating from the trailer-tank would have ignited, according to the chief staff officer [74].

Curiously enough, the decontamination operation per se turned out to be a high-risk factor. The method used for reducing the extension of the gas cloud by jet pipe water spraying was controversial, as later stated by the Commission of Inquiry [74] in as much as the energy released by prompting the water-flux could have ignited the compound. However, an alternative method, i.e. powder extinction is restricted to situations where the propane emission does not exceed a certain critical flow. If the flow is exceeded, this type of extinction fails.

In the aftermath of the accident, the petroleum company responsible for the transportation of propane refrained from their road transportation. Railway tank trucks through the actual metropolitan area still transport propane. Through this arrangement, the risks have decreased considerably, according the Commission of Inquiry. However, the railway transports of propane through the metropolitan area could be avoided, given an alternative route around the lake Mälaren being arranged. To this date, railway transports are considered to be the safest solution compared to road transport.

5. Reflections and comments

The authors have identified some crucial factors in this case study of urban crisis management. First and foremost, the complex of problems with the lorry being parked close to the office block where air-condition and the elevator systems as well as electric mail trucks were used — so that a "mosquito kick" was enough to start a major crisis — may very well illustrate the complexity and tight coupling which favor risk increase in the urban setting. A factor contributing to decreasing the risk, on the other hand, was the favorable social time (early morning) of the near miss that contributed to decreasing the risk, thus providing for its not turning into a real accident and major crisis.

Second, the fact that the subway was not closed until 1 h after the onset of the event, thus exposing the public to considerable risks, clearly illustrates the conditions of inadequate preparedness and crisis training. Also the controversy of the method used for reducing the extension of the gas cloud during the contamination operation illustrates the phenomenon in that the commission of inquiry [74] stated that with today's technical equipment, the rescue services would not have been able to handle this type of situation in the case of an explosion.

Third, factors enhancing the crisis miscommunication can be illustrated by the lack of outdoor systems causing the late notification of many communities in Stockholm. The outdoor warning system available in Sweden is constructed for air raid warnings in warfare situations. These systems are not adapted for the use of selective warning in limited geographical areas. For these reasons, the systems are not well suited for use in, for example, a hazardous material accident, where the proliferation is limited to a certain area. Lacking suitable outdoor warning systems, authorities depend on the media for the dissemination of information in these types of accidents.

Fourth, the Emergency Center not being fully aware of the exact location of the site from the onset, can further be seen as a first-order information consequence of the lacking of outdoor warning systems. The subsequent news media's issuing messages with unspecified data of the location could be interpreted as a second-order consequence of inadequate preparedness which in turn could transform to a real crisis in itself.

Finally, public/private relations in crises today make the dissemination of information complex. Public authorities have discovered that they do not always have control neither over the information flow nor over the content of the type of information that reaches the public, when channeled through the media. Swedish Public Service is the designated medium for the dissemination of public warnings. This service is obliged, through detailed contracts, to forward information from the rescue services to the public. With the increased commercialization of the media and the increasing number of private media channels, the authorities' control of the type of information dissemination in crises runs the risk of being undermined.

Due to this impairment in control over information flows, an additional risk presents itself to the authorities: the competition in news dissemination within the expanding private media sector may jeopardize the Public Service Information dissemination, putting a serious impact on the process of public warning, especially in the absence of alternative early warning systems.

This body of media management problems was exemplified in connection to the turn of the millennium. Authorities and agencies trying to prepare controlled information dissemination concerning this potential crisis event found that media planned to air the turn of the millennium live through television media. The television media saw the event as a first class entertainment, obviously disregarding the risks of causing a world wide panic in case something went seriously wrong along the turn or during the first few minutes of the new year.

The shortcomings of today's information dissemination arrangements are further highlighted when one takes into consideration the particularity of urban populations. As has been shown in previous urban crises, the urban context provides very different types of information receivers, all of whom do not seek information in the same way, using the same language or the same cultural reference frames.

In the current state of affairs, where urban expansion and hazardous material transportation live in an uneasy relationship, the question that naturally arises is: why are transit routes not simply placed outside urban areas? Obviously, in this context, economic and environmental concerns, also placed high up on the urban political agenda, come into play. A lot of incentives also weigh in for local and regional politicians not wanting to deal with the question of safer roads for hazardous material transports. One reason for this is the common fear that, in case “safer roads” are built, these types of transports would increase, causing enduring financial and environmental debate. There is also an implicit risk in discussing hazardous material transports, as such a discussion also would highlight as well the frequency of the transports as the type of goods being transported.

Even if hazardous material accidents primarily are managed at the municipal level, the question arises about whom having the overarching responsibility for hazardous material transports. Is it the local, regional or even the national level of society? A third reason for treating the transportation of hazardous materials as a form of political “poison” is that actors who take charge and show initiative in crises or difficult situations tend to end up in a hot seat. For these kind of reasons, the task of finding a solution to these complex problems might end up in the lap of whoever tries to highlight this urban problem in the first place.

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