Recommendations

The last few years have seen a number of natural disasters that have been accompanied by major damage to industrial facilities. These events have demonstrated the potential for natural hazards, such as earthquakes, floods, storms, etc., to trigger fires, explosions and toxic or radioactive releases at hazardous installations that use or store hazardous substances. These so-called Natech accidents are a recurring but often overlooked feature of many natural-disaster situations. In addition, chemical and nuclear activities are an increasingly important source or risk of such accidents owing to increased industrialisation and urbanisation.

Unfortunately, disaster risk-reduction frameworks have not commonly addressed technological risks. The Sendai Framework for Action recognises the importance of technological hazards and promotes an all-hazards approach to disaster risk reduction. This includes hazardous situations arising from man-made activities due to human error, mechanical failure and natural hazards.

Chemical risk

Chemical accidents continue to occur relatively frequently in industrialised and developing countries alike, which raises questions about the adequacy of current risk-reduction efforts. The causes underlying chemical accidents are largely assumed to be systemic. Most chemical accidents today are caused by violations of well-known principles for chemicals risk management, which have led to insufficient control measures.

From the forensic analysis of chemical accident reports, a number of underlying causes have emerged, one or several of which can affect a chemical installation to create conditions conducive to disaster. These causes include:

- A lack of visibility due to a lack of published statistics on accident frequency and a reporting bias towards high-consequence accidents, which are a mere fraction of the many smaller chemical accidents that occur each week.
- The challenge to manage across boundaries, when chemical and mechanical engineers commonly assigned to chemicals risk management have little training in human or organisational factors.
- A failure to learn lessons from past accidents and near misses.
- Economic pressure and a trend towards optimisation, which can undermine risk management when decisions are made without due consideration of their impacts on safety risks.
- Failure to apply risk-management knowledge by both individuals and organisations due to a lack of awareness and education, or inattention to inherent safety.
- Insufficient risk communication and disconnection from risk management due to the globalisation of hazardous industries, which places a distance between corporate leaders and the sites they manage.

- Outsourcing of critical expertise or distribution of limited expertise over many sites, making it less accessible when needed.
- Governments do commonly not proactively engage in managing chemical-accident risks until after a serious accident, and accident management is focused on emergency preparedness and response rather than prevention.
- Complacency in government and industry due to the incorrect perception that chemical accidents are no longer a threat, thereby causing a decrease in resources for enforcement and risk management.
- Based on the identified accident causes, a number of areas for further study and experimentation to reduce chemical accident risks should be explored, and it is recommended that the following occur:
- Motivation of corporate and government leadership by exploring new models for risk governance, and promotion of a positive safety culture by fostering risk awareness. Enforcement will need a new strategy to drive industrial safety practice.
- Promotion of systematic accident reporting, data collection and exchange to raise awareness of the potential consequences of chemical accidents. These data should be used to learn lessons from accidents and near misses.
- Development of strategies to combat labour market deficiencies related to process-safety expertise.
- Creation of cheap and easy access to risk-management knowledge and tools, including to risk-assessment competence urgently needed in all areas of the world.
- Building of awareness of chemical risks and how to manage them in developing countries.
- Fostering of regional and international networks and collaboration on chemical accident risk management to create pressure and give developing countries easy access to expertise and technical support.

Nuclear risk

Accidents at nuclear facilities, regardless of the accident trigger, have the potential to cause a disaster. In the EU, a nuclear safety framework aims to ensure that people and the environment are protected from the harmful effects of ionising radiation. The basis of this framework is the defence-in-depth approach, a key concept by which to reach an appropriate level of protection from nuclear risks, and an adequate safety culture.

After several major nuclear accidents, safety assessment methodologies have been continuously improved, and the design of a NPP follows a set of rules and practices that ensure a high safety level. At the design stage, a set of accident conditions is identified that can result from different initiating events, and this set is examined using a conservative, deterministic safety assessment. This is complemented by a PSA, which provides a methodological approach to identifying accident sequences that can follow from a wide range of initiating events, as well as to determining accident frequencies and consequences. The challenge is to make certain that the list of considered initiating events is complete.

Many different protective activities form the basis of ensuring the safety of nuclear facilities, both during normal operation and in the case of accidents. However, the nuclear industry still faces a number of challenges that need to be addressed. The following are therefore recommended:

- Further assess the impacts on the safety of nuclear activities of human and organisational factors (e.g. training, management of change, evolution of regulations and associated requirements), of ageing effects on nuclear facilities and of financial concerns.
- Improve knowledge of the identification and modelling of natural hazards to support safety studies for nuclear facilities.
- Share good practice on emergency responses at local, national and international levels between nuclear and non-nuclear industrial activities to increase the efficiency of emergency-response plans.
- Promote research on the resilience of human organisations in the face of complex situations in nuclear industries and other areas with similar requirements.

Natech risk

Natech accidents are a technological 'secondary effect' of natural hazards and have caused many major and long-term social, environmental and economic impacts. National and international initiatives have been launched to examine the specific aspects of Natech risk and to support its reduction.

The forensic analysis of Natech accident records has allowed the preparation of lessons learned across different triggering natural hazards that support the reduction of Natech risks. This includes the setting up of a dedicated Natech accident database to foster the easy and free sharing of accident data. Accident analyses also show that there is an increased risk of cascading effects during Natech accidents. In general, Natech risk reduction pays off, and several structural, as well as organisational, accident prevention and consequence mitigation measures are available.

Studies on the status of Natech risk management in EU Member States and OECD Member Countries have highlighted deficiencies in existing safety legislation and the need to consider this risk more explicitly. Conventional technological risk-assessment methodologies need to be expanded to be applicable to Natech risk assessment and only a very few methodologies and tools are available for this purpose.

With respect to the effective reduction of Natech risks, several research and policy gaps still need to be closed in a collaborative effort between regulators, industry and academia. Public–private partnerships could be helpful in this context. More specifically, it is recommended that:

- Existing legislation that regulates hazardous industrial activities should be enforced. Where missing, legislation for reducing Natech risks should be developed and implemented.
- Risk communication on Natech risks should be improved between industry

and all levels of government to ensure a free and effective flow of information that enables a realistic assessment of the associated risk.

- Government should promote and facilitate the sharing of Natech accident data for future Natech risk reduction.
- An inventory of best practices for Natech risk reduction should be set up and disseminated to all stakeholders.
- Research should focus on the development of Natech risk assessment methodologies and tools, as well as guidance on Natech risk management for industry and at the community level.
- Competent authorities and workers at hazardous installations should receive targeted training to be able to handle the challenges associated with Natech accidents.
- Additional awareness-raising efforts are needed to help stakeholders recognise the vulnerability of hazardous industry to natural-hazard impact. In this context, the effects of climate change on natural-hazard frequencies and/or severities need to be factored in.

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Chapter 4

Communicating disaster risk

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4 Communicating disaster risk

CONTENTS

Introduction

The communication of disaster risk is inherently a social process. It aims to prevent and mitigate harm caused by disasters, prepare the population for a disaster, disseminate information during disasters and nurture the recovery. Disaster risk communication plays a vital role during all four stages of the disaster cycle: mitigation and prevention, preparedness, response and recovery. This chapter aims at translating scientific insights in disaster risk communication to decision-makers to eventually enable communities to respond effectively to damaging events. It builds on the idea that using insights from (communication) science is essential for effective decision-making to improve lives, livelihoods and health (Aitsi-Selmi et al., 2016; Dickinson et al., 2016).

Risk communication in disasters has traditionally been a one-way, unilinear and top-down transfer of information from authorities to the public (Krimsky, 2009). The current literature on disaster risk communication, in contrast, sees communication between authorities and the public about disasters as an outcome of interactions. Although there is no closure on the effectiveness of new communication strategies due to the lack of systematic studies (Bradley et al., 2014), there is growing empirical evidence that a two-way dialogue between the public and professionals is more effective than the traditional unidirectional model of disaster risk communication (Treurniet et al., 2015). The non-linear, multi-directional approach to risk communication is consistent with a political landscape where the legitimation is gained through negotiation and deliberation.

Chapter 4.1 shows that for disaster risk communication to be successful, public perception should be taken into consideration. This involves both a cognitive and affective dimension (understanding and feeling) and is related to trust in protection measurements and mitigation processes. In the process of communication, policymakers should not underestimate the cognitive paradox: a higher trust in protection hampers the preparedness intentions (Terpstra et al., 2009; Lundgren and McMakin, 2013). This relates to the affective dimension, which is influenced by the way risk is communicated. Presenting the same information about risk in different ways, for example mortality versus survival rates, will influence people's perceptions (Slovic, 1993). Unidirectional ways of risk communication can reinforce negative feelings such as fear and powerlessness. In contrast, a two-way, more inclusive communication mode will give citizens the feeling that self-help and solidarity are indeed appreciated by the formal authorities. This communication strategy opens the possibility to build upon both the cognitive and the affective responses in relation to previous experiences with disastrous situations. However, whilst the literature highlights the importance of the non-linear multi-directional approach of communication, research into actual communication practices indicates that a majority still relies on the one-way form of communication (Höppner et al., 2012).

As Chapter 4.2 on decision-making with uncertainty highlights, disaster risk communication takes place through many different communication channels, including face-to-face conversations, telephone calls, group meetings, mass media such as television, instant messaging and interactive social media, in particular Facebook and Twitter. These communication channels, however, are not considered to be neutral. Today's society's social structure, made up of networks powered by information and communications technologies (ICTs) (Castells, 2009), has shaped and influenced decision-making in disaster risk reduction (DRR) and disaster risk management (DRM). Decision-making under uncertainty starts with the question about what the decision-maker knows and where the gaps in the existing knowledge and information are (Ben-Haim, 2006). Consistent with the multi-directional approach to risk communication, recent studies show that for decision-making at times of uncertainty to be successful, a top-down, command and control approach should be abandoned, and should instead involve the public. Formal authorities, in other words, do not have the monopoly in making decisions about the disaster cycle.

The implementation and use of ICTs including social media provide opportunities for engaging citizens in disaster risk communication by both disseminating information to the public and accessing information from them. ICTs have great potential for enabling effectively communicating community-relevant information, in particular in situations in which people are geographically dispersed (Shklovski et al., 2008; Stal, 2013).

Chapter 4.3 on last mile communication builds upon the recent empirical insights on effective early warning systems. The term 'last mile' is understood as a synonym for the immediate affected area and population (Taubenböck et al., 2009). The chapter shows that the impact of the ICT and social media response are influenced by: 1) large-scale power blackouts and the disabling of information and telecommunications networks and 2) the demographics of the disaster including the willingness of people and their organisations to collaborate in sharing, managing and communicating disaster information and their (dis)ability in accessing resources online. Both the vulnerability of the networks and the particularities of the users require innovative solutions.

Adequately designing, implementing and using ICTs are equally important aspects of innovation to make full use of social and technical capacities to improve actual practices in risk communication. Innovation in disaster risk communication is not neutral, but embedded in social and cultural practices. For example, a recent qualitative study assesses the role of age and ethnic and cultural background in the conceptualisation of colour systems used as part of the Heat Health Watch System and the National Severe Weather Warning Service (Tang and Rundblad, 2015).

The final chapter of this part, on innovation and good practices, builds on these ideas and addresses both the technical and the social/cultural dimension of innovation. Communities and evolving decentralised approaches of disaster risk communication are discussed in the context of ICTs development and use. The chapter takes a people-centred approach by focusing on the challenges of communicating with millennials — technologically sophisticated multitaskers (Hartman and McCambridge, 2011) — as an example of how people with specific backgrounds deal with risk communication technologies at times of uncertainty. Finally, it discusses innovations which allow rich media channels to be utilised, including netcentric operations (Boersma et al., 2012) aiming at delivering better targeted actionable risk information to diverse agents across multi-cultural, multi-disciplinary and multi-jurisdictional boundaries.

This Chapter 4 provides scientists, practitioners and policymakers the state-of-the-art knowledge to improve their understanding on communicating disaster risk. It combines insights from psychological, social and computer sciences and presents good practices for those involved in risk communication practices.