Policy recommendations

Based on the risk assessments, MSP evaluation and the stress test during the 2013 event, several recommendations for further improvement and expansion of the current MSP for non-structural risk reduction are provided. Parts of these recommendations/improvements are currently already implemented by the ÖBB.

Within the ENHANCE project, the so-called 'capital approach' has been introduced to assess the healthiness of MSPs addressing the risk from natural hazards (McLean et al. 2013). This concept was also the basis for the evaluation provided in terms of MSP development for the ENHANCE case studies (Thieken et al. 2013, Otto et al. 2014). According to this approach, the following five capitals provide partnerships with the capacity of being able to react to natural hazards: social capital, human capital, political capital, financial capital and environmental capital. A more detailed explanation of the five capitals is given in McLean et al. (2013).

The recommendations provided in the following sections will be discussed against the background of the five capitals.

Improving internal risk and crisis management

While the extreme event in 2013 generally demonstrated that Infra:Wetter worked well, it also revealed potential for improving internal risk and crisis management. One aspect that was identified was the need for clearly defined responsibilities during such a long-term event. Being an infrastructure manager with a complex organisational structure, it is important for the ÖBB to have a clear picture of the persons in charge at different levels of the organisation. At the beginning of an event, this is usually the head of the organisational unit responsible for taking decisions at the respective level. However, in case of a longer-lasting crisis, as it was the case in 2013, it is important to share responsibilities and to appoint and communicate deputies that are available in times when the head of the division is not available. In order to strengthen the social capital internally, strategic plans were developed that shall further improve the effectiveness of the crisis management and the preparedness of the responsible staff. For instance, it was decided to appoint an officer in charge on the spot during future events of such a magnitude.

An organised and structured hazard management depends on regular training and continuous education of personnel. For instance, the ÖBB has its own avalanche warning service and commissions that consist of trained avalanche specialists. These experts evaluate the avalanche risk and give advice to decision makers. They have instruction-freedom and receive training and equipment to examine the in-situ conditions of the snow cover in the avalanche starting zones. Based on their advice, the track managers then decide whether the railway service will continue operation, or, if there will be restrictions or even track closures. The avalanche commissions work in cooperation with the ministries, the national disaster management, the avalanche warning services of the federal states, the district administrations and the municipalities. Against the background of the good experiences made with this system and to strengthen the social and human capital, the Natural Hazard Management section of the ÖBB started a project to set up similar institutions for water-related hazards, such as floods and torrential processes. These commissions shall ensure an effective and regulated workflow during crisis situations and a legal basis for imposing safety measures, which is immensely important for the field staff as well as for the decision-makers. If critical decisions are taken by commissions, this would also mean an improvement for ÖBB staff members in terms of liabilities for these decisions. Clear regulations regarding the legal liability of these commissions for certain decisions, such as false alarms, would further improve legal certainty. Although the field personnel showed an enormous work effort to bring the situation under control during the event in 2013, such structured operating instructions help to further optimise and accelerate decision-making processes for an even quicker response during extreme weather events.

To enhance the ability of the ÖBB to implement (temporary) speed limits or stop trains also as far as small-scale convective weather events are concerned, it was furthermore proposed that each train should be equipped with a GPS system so that it can be readily and exactly located.

Enhancing the management of CMCs through enlarging the MSP

In addition to internal improvements of the risk and crisis management, the flood event of 2013 was also a trigger for the ÖBB to further enhance risk management by building up and enhancing cooperation with additional external partners from the public sector, university and industry, improving the social and human capital of the MSP.

For instance, the hydrographic services of the federal states maintain a dense hydrographic monitoring system in Austria and are also responsible for issuing regional flood warnings.[26] To make best use of this information resource, specific thresholds for inundation levels posing a risk to railway infrastructure, for instance in the Salzburg region, were recently defined and integrated into Infra:Wetter. Based on these thresholds, the hydrographic services can provide railway-specific flood warnings to the ÖBB.

[26] http://ehyd.gv.at/

Photo by Dr Madra/Shutterstock.

The event had also revealed that a good knowledge of the situation on the ground is very important. While the state of flood protection measures and embankments is usually well known due to their good visibility, the situation for torrents is different: catchment areas are difficult to monitor, because the amount of debris is constantly changing. Moreover, there is also the risk of drift-wood blockage. To improve also this aspect of risk management, a pilot project that is concerned with the optimisation of the current observation of torrential catchments, for example, with drones was set up by the ÖBB in collaboration with the University of Natural Resources and Life Sciences (BOKU) in Vienna.

Also the EU Floods Directive provided impetus to the ÖBB to develop additional and more context-specific flood risk maps, which identify and visualise track sections prone to flooding. The maps that were produced for the Floods Directive are usually not of sufficient detail as far as rail infrastructure is concerned. For instance, tunnels under the railway tracks or bridges are not reflected correctly at the tracks, suggesting inundation of railway infrastructure while it is not, in fact. Moreover, to reflect the exact height of the railway tracks, a very detailed digital elevation model (DEM) is needed giving their linear feature. To better account for the specific features of the railway network and to improve the level of detail, the maps of the Floods Directive are currently being enhanced by the ÖBB in collaboration with the engineering company riocom[27] by using e.g. a detailed DEM. The resulting maps illustrate the flood plains with a return period of 30, 100 and 300 years and take the specific details of the railway network into account. They thus help to create specific flood risk management plans and monitoring as well as early warning systems where they are useful and needed.

Enhancing the MSP

After the large-scale flood in 2005, the ÖBB considerably built up its human and social capital in terms of knowledge on hazard occurrence as well as its monitoring and early warning capacity. Following the event in 2005, Infra:Wetter was initiated and implemented; it provides weather warnings on the basis of meteorological parameters. This system is currently being enhanced by adding rail-specific flood warnings that are provided by the hydrographical services of the federal states. Moreover, existing flood hazard maps that were developed in the framework of the EU Floods Directive are further enhanced to comprise the required level of detail for the railway sector. Also knowledge on other hazards such as information on torrential process has been improved through cooperation between the ÖBB and the BOKU in Vienna.

To enhance risk management and strategic planning, this knowledge on the hazard side could be complemented by further strengthening the social and human capital of the partnership in terms of impact assessments (e.g. in terms of direct damage) and finally risk (i.e. probability times damage). Insights into damage and the expected annual damage (EAD) of different natural hazards such as flood and debris flow events would also help to prioritise different risk mitigation measures. For this, models that capture the damaging processes of natural hazards to railway infrastructure would be needed. Damage models that are specifically developed for the infrastructure sector in general and the railway sector in particular, are still scarce (Kellermann et al., 2015c). A few established flood damage models, e.g. the Rhine Atlas damage model (RAM) or the Damage Scanner model (DSM), actually do also consider direct damage to infrastructure by use of depth-damage curves. However, only aggregated CORINE land-use data containing a large variety of urban infrastructure and lifeline elements are used therein (Bubeck et al., 2011). Hence, within the present ENHANCE case study, a railway-specific damage model was empirically derived by Kellermann et al. (2015c) on the basis of the March flood event in 2006 at the Austrian Northern Railway. Its application to a wider railway network was investigated by Kellermann et al. (2016a) and demonstrates its usefulness in a risk management context.

Enhancing the MSP through improved damage data collection

At present, the damage reporting and documentation system comprises three steps. All incidents that occur during railway operations are reported directly by the train conductor and recorded in the internal database on Railway Emergency Management (REM). This includes incidents caused by natural hazards but also other events such as, for instance, deer crossing. As incidents are also recorded from moving trains, identifying the exact reason for an incidence is not always an easy task. Therefore, incidents are examined further by the ÖBB and are then included in the damage database of the ÖBB. Those events that are considered as serious and are thus worth being registered

[27] http://www.riocom.at/_english/about_us.htm

are further examined and verified by ÖBB staff and then included in the ÖBB accident statistics. In this data base, it is also classified whether the incident was caused by a natural hazard and what type of natural hazard.

However, in the current classification scheme, several natural hazards that are characterised by different damaging processes to rail infrastructure are integrated into a single category. For instance, one category comprised the alpine hazards debris flow, landslide and rock fall. This makes the database use difficult in order to gain insights into the specific damaging processes of these individual hazards. A good understanding would be needed, though, to develop impact and risk models that can support risk-based decision making.

In order to be better quantify damaging processes and to enhance the human capital in terms of impact assessments, the Natural Hazards Department of the ÖBB currently works on restructuring the reporting system in such a way that insights into damaging processes from different natural hazards can be drawn. Moreover, it was considered to also include 'near-misses' and their causes in the data base.

Risk absorption by the federal government

As described above, natural hazards can be associated with substantial damage that makes additional funding from the federal government necessary. A review of recent annual reports of the ÖBB reveals that additional funds were provided by the government in 2006 (no amount specified), in 2013 (€18.4 million) and in 2014 (€7.2 million) to cover damage from natural hazards.

With the projected increase in the frequency and intensity of CMCs, also the demand for additional finance from the budget earmarked by the ministry for calamities or extra subsidies according to the Bundesbahngesetz could rise. These dynamics are currently not taken into account by the risk-absorbing mechanism, which builds upon past experiences in terms of costs due to natural hazards.

To better account for the dynamics in CMCs associated with global warming but also changes in exposure and vulnerability could be achieved by a periodic review of the earmarked budget reserved by the responsible ministry. Based on this revision, it could then be decided whether the risk-absorbing finances or procedures in general need to be adjusted. Such a dynamic component was, for instance, integrated in the European Floods Directive in Article 14 No. 1-3. Here, fixed intervals of six years for a revision of preliminary risk assessments, flood hazard and risk maps and risk management plans are prescribed. Such periodic revisions could have positive effects in terms of the financial and political capital of the partnership.

Moreover, also the application of risk analyses (i.e. probability times damage) for the entire rail network for the current situation and future scenarios could inform this process. Such analyses would provide insights into the estimated annual damage (EAD) that can be expected for extreme events and thus the human capital. The RAIL flood damage model developed by Kellermann et al. (2015c) within the ENHANCE project could be one of the building blocks of such a risk-informed decision making as demonstrated for the Mur catchment by Kellermann et al. (2016a).

Recommendations for the European level: European damage database

The present case study of the ENHANCE project demonstrated the importance of damage data for enhancing risk management: for instance, damage data can be used to derive railway-specific damage models (e.g. Kellermann et al. 2015c), which can be used to calculate EAD for floods that support the evaluation of different risk mitigation strategies. Moreover, a detailed and consistent long-term damage database could furthermore be used to assess the adequacy of thresholds defined in an early warning system and to inform risk absorption mechanisms provided by national governments.

While the ÖBB already collects detailed damage data due to natural hazards, and, currently further elaborates this system, no such system exists in many other European member states or at the European level. The existence of a European damage database could, however, significantly contribute to improving the understanding of damaging processes to railway infrastructure, the proportional share of different natural hazards to overall losses and the development of strategic risk management. For instance, a risk assessment of the Trans-European Transport Network (TEN-T) could provide guidance on where to invest European Community funds in risk reduction. This appears especially important given the substantial investments of €26.25 billion into transport infrastructure up to 2020.[28] EU financial support is provided by the Connection Eu-

[28] http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/index_en.htm
[29] http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/project-funding/index_en.htm

rope Facility (CEF), the Cohesion Fund and the European Regional Development Fund.[29]

On a European level, information on railway accidents are currently collected based on Regulation (EC) 91/2003 of the European Parliament and of the Council on rail transport statistics. The statistics on rail safety are required by the Commission 'in order to prepare and monitor Community actions in the field of transport safety' (EC 91/2003). The national statistics are reported by the member states to Eurostat, which is also responsible for their dissemination (Article 7).

According to Article 4 in combination with Annex H, statistics on the type of accident are broken down into the categories collisions, derailments, accidents involving level crossings, accidents to persons caused by rolling stock in motion, fires in rolling stock and 'others'. As can be seen from this list, no information is provided on natural hazards and their impacts, or even on damaging processes. To enhance risk management of railway infrastructure also at the European level, this reporting system could be complemented with information on the impacts of natural hazards. How and what type of information to include could be informed by the experience gathered by national railway operators such as the ÖBB.

Photo by Rechitan Sorin/Shutterstock.