Perspectives in Disaster Risk Information Management
- RIMMA 2014 Berlin International Workshop Report and Recommendations -

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The second Risk Management International Workshop, "Risk Information Management, Risk Models and Applications, 2014," with special emphasis on risk information management, was held in Berlin November 17–18, 2014. The workshop facilitated an extensive discussion on sharing best practices in multidisciplinary risk modeling, risk information management, risk model applications, implementation, integration on an interdisciplinary level, and harmonization of interdisciplinary risk information. These applications covered a wide diversity of fields ranging from natural hazards like flood and climate risks, technical risks, aviation risks with drones, health risks, costs of natural hazards, social vulnerability, cloud computing and social media, to financial risk management applications. A special session offered expertise in Business Process Modeling, a substantial extension to currently widespread service structure implementation and use.

Keywords: risk information management, disaster risk management, risk models, data science, data gathering, data quality for risk analysis, early warning, risk response, information infrastructure for risk management, costs of hazards, BPML, business process risks, techno criticism

Overview

The workshop was organized by CODATA-Germany in cooperation with the Commission on "Risk, Disaster, Security" of the German Society for Cartography. It was endorsed by the International Cartographic Association Commission on GIS and Sustainable Development as well as by the Technical Committee on Environmental Informatics of the German Informatics Society. The workshop covered a broad spectrum of issues, including application methods from environmental perspectives, social vulnerability of populations exposed to natural and technical hazards (NaTec), technical risks linked to transportation issues and drones, methods and tools used by financial institutions to improve data quality and integrity, applied information science, and use of cost models throughout the phases of risk analysis.

In their introductory remarks, Horst Kremers and Manfred Buchroithner emphasized a significant progress in information management for the risk domain, and the importance of the establishment of key cross-cutting solutions development in early warning, risk response, and security. The efforts of DGfK (German Society for Cartography), ICSU, and of CODATA (ICSU Committee on Data for Science and Technology) demonstrate the great motivation for further research in risk information science and operational applications.

Historically, applied science has operated in a very complex niche, integrating many disciplines and innovative research which requires extensive global risk information. In recent years, there has been a major shift from primary aspects of first aid provision in disaster areas towards an international effort. This has resulted in joint task forces focusing on information provision, data gathering, analysis, and the improved availability of information in all phases (especially in the preparedness phase) of disaster risk management. Particularly important is the complexity of the actors involved in decision making. Thus, it is critical to be able to review data flows, and to provide analysis, data communication, and documentation in a timely manner.

An important issue of inclusion is to investigate information flow for societal groups with special demands in risk situations (those with disabilities, the handicapped, the elderly, and migrants/foreigners who are not fluent in the native language of the region where a disaster occurs).

The workshop focused on decision support for all actors at all stages of the disaster cycle, on prevention, and especially on discovering new approaches and new fields of research.

Non-natural/anthropogenic disaster issues to be addressed in this regard are security of infrastructure, cases of war, and risk to cultural heritage.

The decision makers should define policy as it relates to freedom of information, and determine whether permanent access to disaster data should be granted to a broader community.

The increasing need for preparedness to disaster risks and development of policy response on a regional, national and international levels calls for development and analysis of information in risk domain. Information science is becoming more and more crucial, and should be a focal point for discussion at the international level.

It is equally important to address both expected and unexpected risk. Natural disasters similar to those which have occurred in the past should be anticipated, simulated, and given optimal response. Is the infrastructure prepared for unexpected risk, and how will the infrastructure's vulnerability be estimated? How do we evaluate and integrate costs estimations and price of damages associated with economic development and anthropogenic risk? Is there new risk awareness? What is the interaction with the insurance industry in governance of information on post-disaster data management processes, and on freedom of access to these kinds of sensitive data?

The workshop represented a unique venue for experts in multi-disciplinary domains of risk management to discuss alternative models and applications holistically, and provide alternative views and approaches to risk analysis, with the potential of transferability of methodologies and research tools. The workshop explicitly welcomed contributions in all areas of risk management, and was attended by experts in multi-disciplinary domains related to risk management; such as, disaster risk, cartography, geology, information science, ecology and urban development, climate and earth science, aviation technology, finance, insurance, and business process planning. A significant number of presentations were given in the following areas: pricing natural risk, quantitative prediction of soil erosion risks along oil and gas pipelines, modeling accidents in power supply infrastructure, risk analysis framework and modeling issues of the accidental crash of drones, modeling of tsunami impacts, multi-dimensional approaches in tsunami vulnerability, flood modeling and risk management, using Bayesian networks for uncertainty communication in natural hazard and risk assessments, portfolio screening and integrated quality assessment of key portfolio information, credit rating modeling, remote sensing, disaster cycle and the participatory aspect of risk information management, perception of environmental risk in different countries, assessment of social vulnerability, cloud-based map services, business process management, risk information management challenges, risk assessment, and data gathering challenges.

Key to the workshop was having multidisciplinary experts together to provide and argue for alternative views and approaches to risk analysis, information quality assessment, and information management. The discussions and presentations provided an overview of risk assessment and disaster management and tools. In the general multidisciplinary sense, the workshop covered presentations on risk models applied in the financial domain. These risk models and their applications stimulated further mathematical/statistical research agenda of NaTec risk situation management.

Strategic Aspects of R&D Demand in Risk Information Management, Risk Models and Applications.

The workshop covered cutting edge technology in the providing and utilization of disaster risk data at all stages of the disaster cycle. Listed below are topics brought forward in the sequence of the discussion. A set of recommendations derived from this discussion is presented in the following section of this report.

The discussion in the "Open Forum" special session launched a dialogue on an extensive range of topics, including real time decision support provided at the level of actors/management and operational forces which have significant impact on society at large.

The leitmotif of establishing a direct link between scientists, decision makers (actors, managers, governments, regulators), and other key stakeholders was consistently raised by various participants. For regulators, it is the ability to determine how much risk is acceptable and what response is suitable for society. This is particularly

critical for extractive industries, where environmental risks are high. For example, the extraction and transportation issues of oil and gas pipelines.

The transferability of research, technology, and risk management models used in various industries and sciences is very important. Joint efforts on a global level in both harmonization and standardization of risk management tools, models, terminology, communications, and links to business process management are required to achieve success in this area. This includes the definition and identification of Process Risk Information Models and Analysis, and identification and evaluation of the most important data needs.

Information Flow Processes and Event Processing for operational risk management in the context of delivery and transportation were also addressed and are seen as important issues opening new opportunities for event processing in risk management in real time.

Freedom of information and permanent access of the scientific community to massive disaster data are to be addressed by regulators, obviously taking into account any safety and privacy requirements linked to ethical issues. Social inclusion and related ethical concerns should also be taken into account when we globally analyze current demographical changes and related accountability. Uncertainty issues in communication in natural hazards can also be addressed using Bayesian networks. Research of perception of natural disasters in various countries is important to establish a clear link between risk, vulnerability, and resilience.

Taking into account the socioeconomic importance of risks, institutional mechanisms for hazard mitigation are to be enhanced with pioneering research and best practices shared across the globe. Discussions at the semantic, syntactic, and pragmatic levels, and establishing risk disaster management information infrastructure should be an important step in the risk management process.

The hazard disaster schema reflects the complexity of the situation on a project level, and should be globally linked to alternative coexisting projects. Standard access to meta-information should be available and set up for practitioners. Risk information processing and evaluation of disaster parameters is important for multidisciplinary experts.

Natural hazards pricing—a new trend in natural hazards research—was presented with illustration of estimation of potential damage costs for buildings in a combination hazard situation. [Neubert]. The link between heat-related health risks involving thermal stress development and prediction of spatial distribution of future heat stress is also based on building data availability. The vulnerability assessment, with the use of several methodologies produced for Tsunami risks, also uses the structural vulnerability of potentially affected buildings as an input. A necessary step in the respective model is ascribing values to buildings, a significant difficulty. This application shows the importance of reliable and standardized data availability on buildings in community or national registers. Presently, such reference data on buildings (type, construction characteristics, and many more attributes) are missing in Germany and are being compiled in Switzerland at the Swiss federal office of statistics. Cooperation with institutions in Civil Engineering, especially in the domain of Building Information Modeling and Documentation, is urgently needed.

Further research will improve diagnostics, models, and risk-aware business processes for decision support. Technocritical risk perception linked to the introduction of new aviation technology like drones was also addressed. Estimating the cost of natural hazards is a new promising field because costs arise in all phases of the risk management cycle.

Assessment of social vulnerability to flooding in an estuarial context shows the importance of quantification with the use and access of fine and accurate socio-economic data which is not always readily available. In all these examples, risk research standardization, access, and data quality improvement is of particular importance. Presently, an important part of project costs in risk research is devoted to search and improve data quality; solving this problem in the future will also help improve risk research.

There is a gap between scientists and the general public in the area of disaster communication. An extensive effort was undertaken in multiple venues; many experts convened at the open table, and significant progress was achieved. The general public reveals a surprisingly short memory when it comes to the history of natural hazards and resultant loss of human life. Instead of learning from the past and using the existing experience, former incidents and lessons are often forgotten or ignored. In this regard, one cannot underestimate the importance of historical accounts in natural disasters. The problem in risk communication is not the models, the data or the stakeholders, but a call to prevent societal aspects from going forward.

The following steps are proposed to increase awareness: a) compile witness accounts of natural hazards, even if the event occurred more than 1000 years ago; b) quantify the hazard parameters where possible. For example, for a tsunami the parameters would be the initial response, travel times, number of waves, duration of sea level perturbation, maximum water level, and inundated areas; c) quantify the exposed elements where possible (a

good example is cost analysis of loss and damage). Although communities have developed over time, historical reports are important for cultural, heritage, and risk assessment to future generations.

Risk documentation and information archiving and retrieval efforts need to be coordinated. Global classification of risk data at the regional, sectorial, and municipal level may bring a significant contribution to the process and make research more comprehensive.

Models require both real-time and historic data, and outputs in cartographic representation. Often, decisions are made with a high level of uncertainty, with the past not being a defining factor. The amount of historical information used, and the extent to which it is incorporated to the model, needs to be strategically evaluated. The strategy should be optimal in management terms, not model terms. It is the response to the natural hazard that reduces vulnerability and increases resilience.

There are extensive opportunities for providing local disaster information adoptive applications which can be developed using GIS and neural networks tools, and can support emergency services such as firefighters, police, and regulators. This is another important area for future research. Other examples are spatial modeling of risks utilizing Bayesian networks applied to predict accident risks in the power infrastructure of Ukraine, and soil stability models applied to oil and gas pipelines in Azerbaijan.

Special attention should be given to the role of social media in disaster communication. For information communication, dissemination, and use by citizens, the following mechanisms should be considered: open data, crowdsourcing with the engagement of Facebook, Twitter, and other social networking services. Monika Jarosch explored the participatory aspect and how it can improve risk information management. A concern to be addressed here is quality and reliability of information. Depending on the audience, misuse of data with potential false alarms may occur and may influence broader circles of social behavior in time. The next research step is context management and recommendation of policies regulating who may use the data. Fine-tuned business process implementation may significantly reduce the associated risks.

There is an emerging need to evaluate and address data and model uncertainty. UN research emphasized the need for improvement of disaster risk data quality. Applications similar to portfolio screening can provide a significant contribution in this area.

There is a wealth of applied research and technology from multiple industries which can be used in disaster risk management. There is a need for global standards of using basic technology.

Link, the use and involvement of Big Data issues, the ethical availability and use of private data, and also the involvement of human factors at the man/machine interface in technological risks were not discussed in depth at this workshop, but they will be included in the agenda of future events.

Recommendations

The RIMMA 2014 Workshop represents a unique forum which facilitated a discussion for holistic evaluation of the disaster risk management area and its linkages to the global risk management domain. Many innovative ideas and insights emerged from the many forum debates.

As a result of the round table discussion, the following key areas were identified as a priority to be shared and discussed where appropriate with all actors involved at the local, regional, national and global level, especially within the efforts of implementing the UN ISDR Sendai Framework on Disaster Reduction (2015) [01]:

- Critical technical, business, and social infrastructure
- Risk communication : participation and public investment
- Development of new approaches for risk communication, not only for operations, but also for public involvement
- Data availability, uncertainty, and reliability on a global level
- Data global quality and consistent assessment
- Data systematization and standardization on a global level including regional, sectorial, and local strata
- Risk Management Multidisciplinary Information Infrastructure
- Harmonization of global Risk Management models, terminology, and communications to bring value to disaster risk prevention
- Social inclusion and dissemination of Risk Management best practices to the rest of the world
- International legal framework to address disaster risk management and climate change
- Addressing data and model uncertainty
- Creation of action plan which enhances risk resilience
- Model validation and reliable data (Data/Analysis Testbeds)
- Continuity of disaster projects and related information gathering efforts
- Risk analysis linked to the introduction of new technologies
- Addressing the use and involvement costs at every step of risk analysis
- Standardization of data, improvement and availability of socio-economic data for estimation of social vulnerability
- Enhancement of business risk management and industrial process management in risk analysis

Future research in these areas will bring a significant contribution to all the phases of the disaster management cycle.

Acknowledgements

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