Chapter 6

# Future challenges of disaster risk management

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# Introduction

The work of summarizing knowledge in disaster risk management is not only to communicate what we know. It is equally important to recognize what we don't know. Knowledge gaps, once identified, can be addressed by future research and development projects.

We've asked all lead authors and coordinating lead authors to critically look at their fields of expertise and identify the future challenges. Some relate to forming the right partnerships. Other challenges are about creating new knowledge - the classical research projects. A third category of challenges are about applying new knowledge, i.e. innovation. This bottom-up approach brought to light a wide spectrum of future challenges and emerging issues.

This chapter provides a summary of these key messages to various reader communities on the key challenges: all DRM actors, scientific experts, policymakers and practitioners.

# ALL DRM ACTORS

## Partnership

- The Sendai Framework signals a clear mandate to the science, technology, and innovation community to work together with governments in developing and sharing the knowledge and solutions needed to improve the resilience of communities. **Stronger partnerships** among disaster risk science, policy and practice are necessary. The benefits of collaboration are recognized throughout this book by all three communities.

- To tackle **systemic challenges** related to disaster risk reduction, a **transdisciplinary and holistic approach** in is necessary involving science, policy makers and practitioners. Resilience building needs to start at the level of **individual households and communities**. Partnerships are particularly useful for **building awareness** of available knowledge in the communities and build trust to exchange experiences, skills and knowledge.

- Scientists, practitioners and policy makers must work together to create **evidence-based narratives** for reconciling short- and long-term objectives of risk management, such as economic and social benefits, in order to enhance the business case for investment in prevention and mitigation.

- There is a need for **dedicated platforms** at local, regional, national and international level for science-policy-practice interface adapted to the local context. These platforms need to link and cooperate.

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## Knowledge

- Two key challenges in the scientific world are increased complexity and acceleration. Ever more science is produced and is available at a mouse-click. Ever more actors from different disciplines and policy areas are involved. For practitioners, policy makers and even for scientists themselves, the challenge now is to **find the relevant science**, from multiple disciplines, and make sense of it, for multiple policies.

- A fundamental building block is **understanding the risks** being faced; as well as making sense of the relevant science this also requires enhancing the **use of local knowledge**.
- In such a complex policy area, **knowledge management** is essential. Relevant science must be synthesized for different target audiences. Science must be made available in useful format.
- Knowledge is not only the realm of scientists. Evidence in evidence-based policy making is much wider than scientific knowledge only. **Experience of practitioners** must be collected and fed back to scientists (for analysis) and policy makers.

## Innovation

- The main areas for innovation lay in **risk governance**, including better communication among the communities, engagement and clear roles for all actors, and accountability and transparency throughout the system. The **interface between scientific knowledge and pragmatic decision making** must continuously be improved, e.g. through secondments of scientists into government and vice versa.
- Practitioners can benefit from many **unexploited research results**. Hurdles for innovation must be tackled through training, exercises, demonstrations, pilot projects, etc.
- **Vast amounts of data** are being produced from many sources – e.g. earth observation is expected to bring 10TB of free and open data per day. New approaches are needed for data handling and processing. Early warning systems (EWS) play an important role in saving life and property and should benefit from the **data revolution** combined with more robust modelling in order to help reduce the time required for the warning activation and improve the warning information.

## SCIENTIFIC EXPERTS

### Partnership

- **Synthesis of scientific knowledge** across disciplinary boundaries requires the development of networks where mutual learning can happen and trust can be built. It is important to be transparent on context, terminology, assumptions and limitations.

- To tackle **systemic challenges** related to disaster risk reduction, a **transdisciplinary and holistic approach** in science is necessary to integrate natural, social and health sciences with ICT, economics, engineering, legal and policy frameworks and operational practice. A shift from mono-disciplinary silos to transdisciplinary networks is required but challenged by differences in risk frames, objectives, terminology, methods and funding mechanism.

- Science needs to produce **coherent advice**, during emergencies and for long term risk management. **Pre-established mechanisms to access scientific experts** from all disciplines are necessary for effective risk governance. Scientist must be ready to engage with such mechanisms, and translate their expert knowledge for non-technical communities. For emergencies, **impact-based multi-hazard early warning systems** must be developed to assess the likely impact of any hazard on population, economy and society.

- **Partnerships should be effective**. Measuring the effectiveness of partnerships is a scientific challenge in itself. Social network analysis and other techniques should continuously monitor the effectiveness of partnerships, including their depth, reach and growth, connectivity to other networks, scientific innovation and impact on policy and practice.

### Knowledge

- This report shows that a wealth of knowledge exists, but each discipline still has its own scientific challenges. For instance, **natural sciences** seek to improve modelling of bio-physical processes of the Earth and atmosphere to anticipate extreme events for early warning and under climate change. **Engineers** must keep improving standards, cost-benefit methods, green and gray prevention solutions, retrofitting and other engineering challenges. **Social scientists** should better understand decision making under uncertainty, improve risk communication theory, harness social networks and include ethical and legal issues. Measuring effective risk governance (including ethical and legal issues) is an outstanding challenge, as are assessing science-policy interfaces and metrics for the impact of science on DRR. **The information communication technology** (ICT) community must harness rapidly developing technology, including big data, artificial intelligence, and augmented reality for better human-machine interaction. **Economists** see further challenges in disaster financing, including loss estimations, cost-benefit methods and understanding economic recovery, given the diverse scales at which impacts are felt and potential problems created by external intervention for local economies post-disaster. **Health sciences** should be more involved in the DRM community, advancing their understanding of outbreaks and pandemics, health impacts of all hazards, but also advances in data collection.

- **Transdisciplinary research** is in its infancy and should be encouraged. The most difficult challenges in disaster risk management cannot be solved by a single discipline. Specific challenges identified in this report include better handling of **uncertainty**, a more coherent approach to **data** across disciplines (open data, big data, social data) balancing openness with privacy, development of science-based **standards and guidelines**, and development of **methodologies** for all-risk mapping and management.

- There is a clear need for more **systematic knowledge management**. Access to synthesised knowledge of other disciplines is important for scientists, practitioners and policy makers.

## Innovation

- More innovation is needed in in-situ, sea-borne, air-borne and satellite sensors to increase the completeness and timeliness of **earth observation**. Scientists help develop better, cheaper and robust instrumentation, allowing pervasive deployment also in poorly monitored areas, which should yield the necessary data to drive new scientific developments. Similarly, scientists must develop and exploit social networks to gather **fine-grained**

**socio-economic data** on vulnerability and resilience of people, communities, economies and societies. More **technological innovation** is necessary to enable "total conversation" among citizens and authorities.

- A comprehensive strategy for **disaster financing** can not only moderate the impacts of natural hazard risks, it can speed up recovery and reconstruction, and harness knowledge and incentives for risk reduction. More research is needed on how these incentives could work more effectively.

- To foster adoption by public authorities, technological innovations must be **tested and demonstrated** to end-users with clear criteria for evaluation. The policy-impact of innovations need to measured and, if relevant, mechanisms for **institutionalizing innovations** are necessary. It is challenging to make **global solutions available at local level**.

- **Fostering innovation** involves all actors, including funding agencies, researchers, practitioners and policy makers.

## POLICYMAKERS

### Partnership

- **Continuity of partnerships** is particularly challenging. As interlocutors both on policy maker side (rotation) and scientific side (projects end, new projects start over) change often, there is a continuous learning curve. Establishing well-funded, long term partnerships may be beneficial.

- A partnership should first agree on the **principles of risk governance**. If risk tolerance and risk ownership are clear, science can contribute more easily with appropriate methods and appropriate thresholds for acceptable risks.

- There are two key challenges for the public sector: (1) obtaining timely advice during emergency management and (2) obtaining reliable advice for policy making. Both rely on **well-defined and sustainable science-policy interfaces** drawing from the best expertise available. Communication among the communities is particularly challenging, and should not be biased by skewed power relations.

- Participation of policy makers in existing partnerships should be encouraged. These include knowledge centres, alliances of research institutes, national DRR platforms, Community of Users, etc.

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## Knowledge

- More knowledge is needed on **integrated policy making** in the area of disaster risk reduction. A clear understanding of related policies, but also of legal, scientific and ethical aspects is required. Policy makers must both implement and shape regional and global frameworks (Sendai).

- The scientific community must **summarize and translate science** into policy language. The policy community must formulate long-term research challenges for the R&D community. This can help prioritize research funding.

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## Innovation

- **New approaches to risk governance must be tested**, including early warning and emergency management. The balance between national and European/regional systems must be optimized continuously, seeking to optimize cost-benefit, quality and effectiveness.

- A key challenge is to evaluate the (long-term) impact of science-based policies. There is a need for **quantifying the economic, social and humanitarian gains** of better incorporating science.

- New ways of **prioritizing research funding** should be sought based on proven needs of policy makers.

# PRACTITIONERS

## Partnership

- A key challenge for disaster risk reduction is to apply **global solutions to local problems**. Partnerships between scientists and practitioners can enable transfer of knowledge and practice necessary to implement available solutions. Scientists should be aware of the wide variety of social, legal, linguistic, physical and political contexts in which disaster risk management is practiced.

- Where possible, **trans-border agreements** should be put in place in advance, to foster joint exercise and prepare to face the real events. Such mechanisms can lead to harmonisation in preparedness and response planning.

- Preparedness planning should be comprehensive and involve multi-agency partnerships in order to make the transition from disaster management to risk management. The process should involve **collective action** by scientists, government, essential services, businesses, the media, other public, private and voluntary organisations and communities to help mitigate potential impacts. **Effective communication of risk**, considering power relations among actors, is an important challenge for scientists.

- **Existing Public Private Partnerships** and **Public Public Partnerships** show clear benefits in terms of efficient risk-sharing. Virtuous feedback loops lead to increased insurance coverage and penetration, investments in disaster risk reduction and innovative risk financing.

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## Knowledge

- Further research in **crisis management** is essential for practitioners. Developing new technology and infrastructure and improved models for **sense-making** of chaotic situations is necessary to allocate scarce resources more effectively during a crisis.

- Development or implementation of **standards** (e.g. on data formats or protocols, such as the CAP protocol, but also on hazard and risk assessment methods) can improve interoperability of the crisis management actors. Scientists, practitioners and policy makers must collaborate to develop practical standards.

- Understanding of **direct and indirect costs** is crucial to selecting and investing in preventive measures, as well the stakeholders to be involved, their roles and responsibilities. The private financial sector plays an important role, along with governments and civil society organizations, in designing innovative financial protection goals and sharing knowledge and capacity.

- The opportunities and challenges that the crisis information systems and social media brings to development of disaster risk management foster a process that builds principles for action for communities of practice, creating a '**space of meaning**' with theories for action, social change and instruments for implementation.

## Innovation

- **Training, exercises and education** are essential to transfer scientific knowledge to practitioners.

- The **Internet of Things** is expected to provide citizens and emergency authorities with information and knowledge in real time. This will allow for new tools to be developed for a more resilient society. A balance needs to be struck between surveillance and privacy concerns.

- It is necessary to develop well-trained **downstream components** in early warning systems, incorporate volunteered geographical information.

- Rather than generating innovative approaches, **embedding and diffusion of innovations** is the key area that both policy and practice must address. Strong bonds and trust within and between communities favours a more effective response in emergencies and can be harnessed by authorities. Social media can also be used to enhance self-organised mobilisation and coordination of local resources, knowledge, and efforts for disaster preparedness and response.

# Conclusions for European research

The EU and in particular its successive Research Framework Programmes (FPs) have actively supported various scientific research projects that, step by step, have contributed to a better understanding of risks in all their dimensions. Multinational and interdisciplinary research in the field of natural and technological disasters has led to the development of innovative tools and methodologies to forecast and monitor natural and human-induced hazards. In addition, research efforts in support of risk and crisis management have largely contributed to the preparedness for, and the response to, major crises and therefore helped reduce the toll on human lives and economic assets.

Since the 7th Framework Programme and now Horizon 2020, the EU research has become more multidisciplinary and has promoted a systemic-risk approach. The report highlights how research projects have been instrumental in delivering a deeper insight into the complex interactions between the hazard element and the natural and the built environment. New research avenues will further address the multi-risk impacts of physical hazards (floods, droughts, forest fires, etc) and the cascading effects of those hazards in order to integrate this information into the overall assessments.

EU-funded demonstration projects and other instruments (e.g., Public-Private Partnerships) are supporting the development and the awareness of risk mitigation and adaptation approaches (e.g. ecosystem-based Disaster Risk Reduction), as well as demonstrating their added value in terms of co-benefits for local economies, social cohesion and the broader environment. One of the priorities of the EU Action Plan for Disaster Risk Reduction is to foster green growth through promoting risk-proofed investments and building the capacity of local and national authorities and communities. Solution-driven research should help to explore how best to transform evolving challenges and problems into new opportunities and potential markets. Climate services, nature-based solutions for more resilient cities or territories and dynamic Earth observation are examples of promising sectors. A strong evidence base on the damage caused by disasters, the benefits of adaptation and mitigation measures, and the costs of inaction constitute key information that supports the science-policy interface and provides planners, designers, engineers and decision makers with appropriate tools for risk management.

# Conclusions for UNISDR Science and Technology Roadmap

In response to a strong call in the Sendai Framework to "enhance the scientific and technical work on disaster risk reduction" (25(g)), the science and technology community, as well as other stakeholders, came together at the UN Office for Disaster Risk Reduction (UNISDR) Science and Technology Conference held 27- 29 January 2016 in Geneva. The conference produced a "Science and Technology Roadmap to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030", which includes expected scientific outcomes, actions, and deliverables under each of the four priority of actions of the Sendai Framework.

This report is a contribution to the Science and Technology Roadmap, and specifically addresses, from a European perspective, topic 1.1 "Assess and update the current state of data, scientific and local and indigenous knowledge and technical expertise availability on disaster risks reduction and fill the gaps with new knowledge."